Research Article

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MULTIPLICATIVE ANALYSIS OF THE FISCAL AND INVESTMENT DETERMINANTS OF PROCESSING INDUSTRY MODERNISATION

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Background. The technical re-equipment of industry requires effective support levers, among which a multiplicative model for assessing the impact of fiscal regulation of equipment imports on the modernisation of the processing industry is of special importance.

Purpose. The study aims to implement a multiplicative model to assess the impact of instruments for the fiscal regulation of equipment imports on the efficiency of industrial development, the compensatory potential of reverse tax revenues, and the socio-economic multiplier of employment.

Findings. The study employs a multiplicative model to derive an aggregate indicator of industrial development efficiency and to conduct an analysis based on data from 2022 to 2025 in Ukraine, with forecasts through 2030 obtained via extrapolation. The effects indicate a structural shift in Ukraine's imports by 2030, with the share of the investment-technology group exceeding 27%. The aggregate efficiency indicator shows steady growth, rising from a low level in 2022–2023 ($E_{\text{dev}} = 0.200\text{-}0.262$) to a moderate level in 2025 ($E_{\text{dev}} = 0.376$) and reaching a stable level of 0.396 by 2030 under the baseline fiscal regime. It was determined that the complete abolition of duties would lead to a fiscal gap of USD 5.9 billion in 2025, while in 2030, budget losses exceeding USD 10 billion may be partially compensated by reverse tax revenues. The socio-economic multiplier confirmed that reinvestment of the released funds would ensure the annual creation of jobs amounting to 10.3–15.5% of actual employment in 2025 over 2026–2030, with the projected employment capacity of the total industrial potential reaching 3.41 million workers, compared with 1.34 million employees in 2025.

Implications. The feasibility of introducing preferential customs and tax regimes is supported by the reverse fiscal multiplier effect, which, through job creation, may partially offset the primary budget losses in the medium term. The abolition of import duties on equipment has the potential to become budget-neutral due to reverse tax revenues, which provides grounds for revising customs and tariff policies. The proposed multiplicative model can be expanded to account for regional labour market disparities and the effects of labour reallocation between industries.

Keywords: Fiscal Regulation, Industrial Development, Manufacturing Industry, Multiplicative Model, Multiplier.

1. Introduction.

Profound structural shifts characterise the current state and dynamics of Ukraine's economic development. Transformation processes, adaptation to new macroeconomic conditions, and significant changes in the structure of domestic demand require accelerated technological modernisation of domestic enterprises. The total volume of Ukraine's taxable imports shows a steady upward trend. It increased by 46.6% from 2022 to 2025 and, according to forecasts, will increase to 3.2 times the baseline level by 2030 (State Customs Service of Ukraine, n.d.).

The key driver of these dynamics is the priority investment and technological group "Machinery, Equipment, and Transport" (Verkhovna Rada of Ukraine, 2022). Its purchasing volumes have almost doubled over the period studied (an increase of 93.2%), and they will have steadily consolidated to account for 27% of the state's forecast imports by 2030 (State Customs Service of Ukraine, n.d.). Since fiscal pressure on this group of goods in 2025 has already become a significant burden, with a projected increase of 74.8% by 2030, the development and justification of flexible instruments to stimulate customs and tax policy is becoming a strategic goal to ensure the technical reindustrialisation of the processing industry.

The lack of comprehensive macroeconomic instruments that directly link the level of customs and tax burdens on capital goods imports to long-term structural changes in the labour market makes it urgent to develop and test a multiplicative model to assess the impact of fiscal regulation on equipment imports. Most existing approaches are either limited to a purely fiscal analysis of direct budget losses or rely on microeconomic models to assess enterprise efficiency, which require cumbersome, often inaccessible internal commercial reporting from business entities.

A key foundation for modelling these macroeconomic mechanisms is the evaluation of the multiplicative effects of fiscal policy, particularly in light of trade flows, production structure, and economic openness.

When analysing the relationship between trade dynamics and policy tools, Cacciatore and Traum (2022) revealed that external trade openness and net trade flows significantly moderate the scale of fiscal multipliers. Complementing this structural view, Crespo Cuaresma and Glocker (2023) highlighted the critical role of production composition and product tradability, emphasising that government spending multipliers heavily depend on sectoral characteristics and product-level trade dynamics. The micro-to-macro production functions are integrated to estimate the fiscal multiplier of infrastructure investment, thereby bridging the gap between microeconomic fundamentals and aggregate dynamics and illustrating the linkages from direct capital expenditures to macroeconomic expansion (Chang & Lee, 2026). The framework is complemented by Mazier et al. (2025), who provided a rigorous assessment of the state intervention in open systems. Their research offers a strong conceptual framework for designing targeted fiscal and trade interventions by assessing policy performance and recovery trajectories in open economies.

This relationship is studied to overcome the outlined limitation by developing simplified yet highly accurate macroeconomic instruments. This is critically important for public administration, since the absence of such models makes it impossible to objectively predict when the reverse fiscal multiplier will fully offset the initial budget losses from granting import privileges. Hence, there is a real risk of adopting ineffective regulatory decisions, either due to the premature abolition of fees, which leads to an uncontrolled budget deficit, or due to excessive fiscal withdrawal of working capital, which blocks modernisation of the processing sector even before the start of the production cycle. The presence of a reasonable efficiency threshold allows the state to flexibly balance fiscal stability and the industry's technological renewal.

The purpose of the study is to develop and test a multiplicative model to assess the impact of instruments of fiscal regulation on equipment imports on the efficiency of industrial development and the labour market in the processing industry.

To achieve the set aim, the following research questions (RQs) were identified:

RQ 1. What are the actual (2022–2025) and forecast (2026–2030) dynamics of the sectoral structure of Ukraine's taxable imports, and how does the current level of fiscal burden affect it?

RQ 2. How can a transparent multiplicative model for assessing the efficiency of industrial development be built based on the macroeconomic parameters of investment imports, fiscal withdrawal of working capital, and dynamics of labour remuneration?

RQ 3. What are the values of the integral efficiency index for the current (2025) and prospective (2030) periods within a reasonable scale of threshold points, and what specific mechanisms of customs and tax regulation correspond to these levels?

RQ 4. How can the reinvestment of resources released as a result of fiscal divergence into the domestic processing industry be transformed into the creation of new, highly productive jobs and a qualitative renewal of the labour market?

2. Literature Review.

2.1. Green and Decarbonised Industrial Development.

A contemporary paradigm of industrial modernisation amid global transformations requires a radical rethinking of the role of fiscal instruments, which should act not just as regulators of budget flows but as catalysts for deep technological renewal. While investigating the mechanisms by which the industrial sector adapts to the strict requirements of carbon neutrality, Mani et al. (2024) emphasise that, for emission-intensive industries most vulnerable to international competition, technological innovations and balanced climate policy instruments are the only effective means of achieving zero emissions by 2050.

Okonkwo (2026) indicates that public policy should take into account not only internal production factors and geopolitical realities but also the substantiation of geopolitical strategies to ensure access to renewable energy, thereby stimulating overall economic growth through the diversification of technological flows.

Recently, the conceptualisation of the circular economy and the assessment of the agricultural sector's bioenergy potential have become a focus, with a primary interest in the potential of using agricultural waste as a strategic resource to produce biofuels and strengthen regional energy autonomy. At the same time, scientists emphasise the need to adhere to environmental and technological limits when extracting plant residues to avoid harming soil fertility. While deepening the engineering and technological dimensions of this problem, researchers propose an architecture of decentralised "energy islands" based on circular bioenergy models, which is critically important for the energy sustainability of local territories amid high infrastructure risks. An important basis for bioenergy is also the agrotechnical basis, in particular, effective crop rotation systems and the rational use of organic residues as a factor of resource-saving agricultural management.

On the other hand, sustainable industrial development and the capitalisation of domestic production are impossible without a stable supply of resources and the formation of a new legal framework for management (Devlin and Yang, 2022). Analysing the raw material base as a primary element of industrial chains, Peng et al. (2025) provide a detailed overview of the state of mineral resources and recent advances in metallogenic models, using manganese as an example, emphasising that effective management of basic industrial resources determines the potential for further high-tech redistribution.

However, the transition to higher levels of capitalisation should occur within the framework of modern environmental jurisprudence (Lesniewska & Steenmans, 2023), and the transformation of the legal field in the circular economy is intended to integrate the principles of justice and the rational use of nature directly into enterprises' production cycles.

Despite the in-depth conceptualisation of decarbonisation processes, global environmental law, and circular resource management in the research mentioned above, no tools have been developed to assess the effectiveness of such environmental policies at the macro level.

Most existing approaches are purely theoretical or rely on cumbersome econometric systems that do not enable state institutions to quickly digitise the reverse macroeconomic effects of providing fiscal preferences (Cacciatore & Traum, 2022; Crespo Cuaresma & Glocker, 2023).

In particular, researchers have not paid attention to the mathematical justification for how preferential imports of high-technology equipment and equipment for "green" production accelerate the processing sector's capitalisation rate and overall macroeconomic growth.

2.2. Sectoral Adaptation and Digitalisation for Sustainable Development.

Strategic and marketing guidelines for industry development are crucial to successful sector transformation. Comparing domestic and foreign experience, the authors demonstrate the need to develop a holistic system for the marketing and promotion of biofuels in both domestic and foreign markets. In addition, the circulation of processing by-products is an integral part of the closed cycle.

Analysis of the digestate market indicates its high potential as an environmentally safe alternative to mineral fertilisers (Lohosha et al., 2025b). Along with bioenergy, the trend toward the greening of production and the introduction of smart technology is rapidly developing. A comparative analysis of agricultural technologies based on environmental indicators confirms the feasibility of optimising their resource intensity in the context of a smart economy, which is harmoniously complemented by economic and mathematical modelling of investment programs for environmental management within agricultural clusters (Zos-Kior et al., 2021).

Current requirements for transparency of business processes encourage the end-to-end digitalisation of value chains (Lutsiak et al., 2020). The digital control model proposed by scientists, based on the Farm-to-Fork principle, enables optimisation of capital investments and guarantees high product quality.

At the same time, the features of the transformation of such chains in traditional segments of the agri-food market, in particular in the vegetable oil market, have also received detailed justification (Lutsiak et al., 2020). Undoubtedly, the stability of enterprise operations depends on the effectiveness of financial management tools and the level of information transparency. A comprehensive assessment of transformations in the renewable energy market influenced by financial and economic factors has been provided (Hnatenko et al., 2024), and methodological approaches to assessing the quality of financial reporting to reduce information asymmetry for investors have been systematised (Pravdiuk et al., 2021). The issues of financial stability analysis and simulation modelling of enterprise bankruptcy risks under macroeconomic turbulence have been clarified (Mayovets et al., 2021).

Finally, the successful integration of business into the global space requires the application of adapted sustainable marketing concepts and an appropriate regulatory framework. Methodological principles for sustainable marketing to enhance the competitiveness of enterprises in global markets have been substantiated (Belkin et al., 2025), and priorities for harmonising Ukrainian legislation on organic production with international and European standards have been identified (Lohosha, 2025a).

Despite a thorough analysis of digital chains, financial sustainability, and marketing strategies, previous studies have considered these problems in isolation and in an autonomous manner at the micro- or meso-levels. Until now, no interdisciplinary approach has been developed to assess the relationship between state fiscal pressure and qualitative shifts in the labour market and in capitalisation. Existing methodological approaches primarily focus on assessing the internal reporting of individual enterprises and are unsuitable for rapid macroeconomic monitoring using open data. This creates an urgent need for an integrated tool that combines the investment, tax, and social components of processing industry development into a single mathematical model adapted to the constraints of a limited information space.

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3. Materials and Methods.

3.1. Multiplicative Assessment of Fiscal Stimulation Efficiency in Industrial Development.

To implement applied economic analysis at the macro level, a simplified methodology for assessing the overall efficiency of fiscal incentives of industrial development is developed exclusively using statistical and forecast data provided in the study. This approach enables the obtaining of a single, consolidated coefficient based on aggregated macro-level parameters, such as import volumes, fiscal load, and labour market indicators, without requiring proprietary internal reporting from individual enterprises. A multiplicative specification was selected for the function ($E_{\text{dev}} = I_{\text{imp}} \cdot K_{\text{fisc}} \cdot I_{\text{wage}}$) instead of a conventional additive (linear) model. A more complex model is used due to the economic interdependence and systemic synergy of these macroeconomic variables.

In the analysis of complex systems, the additive form assumes full or partial interchangeability of factors (substitution effect), whereby a high value of one factor can artificially compensate for a low value of another indicator. For this study, such logic is unacceptable since high volumes of capital imports (I_{imp}) will not ensure a real industrial breakthrough if the country experiences degradation of human capital and stagnation of wages (I_{wage}). The multiplicative form implements the principle of nonlinear synergy, in which a zero or critically low value of any component reduces the final efficiency.

Differentiating the multiplicative model allows estimation of the elasticity of the integral index, i.e., determining by how many percentage points the overall efficiency of industrial development will change when investment imports or the fiscal burden changes by 1%. This provides flexibility when modelling alternative scenarios of tax and customs policies. Sustainable industrial development and capitalisation of domestic production are impossible without stable resource provision and the formation of a new legal framework for management.

Analysing the raw material base as a primary element of industrial chains, Peng et al. (2025) provide a detailed overview of the state of mineral resources and recent advances in metallogenic models, using manganese as an example, and emphasise that the effective management of basic industrial resources determines the potential for further high-tech redistribution. Therefore, fiscal incentives for the import of capital technologies should align with these global imperatives for raw material sustainability and environmental law.

This study fully covers the entire information base for mathematical calculations and includes three basic components.

The investment orientation index of import (I_{inv}) reflecting the level of capitalisation of external purchases. It is defined as the share of the high-tech group “Machinery, Equipment, and Transport" (groups 84–90) in the overall structure of taxable imports of the country (Verkhovna Rada of Ukraine, 2022):

$$I_{inv} = \frac{\text{Imp}_{84-90}}{\text{Imp}_{tot}} \quad (1)$$

where: Imp_{84-90} – the volume of imports of equipment and transport, Imp_{tot} – the total volume of taxable imports of the country.

The fiscal capital retention coefficient (K_{fisc}) reflects the proportion of working capital retained by enterprises after import duties and tax payments, serving as a key tax incentive index:

$$K_{fisc} = 1\text{-St}_{ser} \quad (2)$$

where: St_{ser} – the effective aggregate tax and duty burden rate for the analysed enlarged group of goods.

The index of relative wage growth (I_{wage}) assesses the qualitative change in the level of wages in the industry compared to the base period, which serves as the main socio-economic indicator of development efficiency:

$$I_{wage} = \frac{\text{ZP}_t}{\text{ZP}_{2022}} \quad (3)$$

where: ZP_t –the average wage of an employee in the analysed (or forecast) year, ZP_{2022} – the value of wages in the base year (2022).

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A multiplicative model is used to combine macroeconomic indicators into integrated indicator of industrial development efficiency:

$$E_{dev} = I_{inv} \times K_{fisc} \times I_{wage} \quad (4)$$

This formula allows the quantification of economic policy effectiveness. To evaluate dynamic policy changes over time relative to the base year (2022), the dynamic fiscal incentive index can be expressed as:

$$K_{fisc,t}^{dyn} = \frac{1-S_{tser,t}}{1-S_{tser,2022}} \quad (5)$$

Under the baseline scenario ($S_{tser} = 0.26$), the retention coefficient is fixed at $K_{fisc} = 1 - 0.26 = 0.74$. If preferential tariff regimes or full duty exemptions are implemented ($S_{tser} \to 0$), K_{fisc} approaches 1.0, thereby directly increasing the overall industrial development efficiency index E_{dev}. Conversely, any increase in fiscal pressure reduces K_{fisc} and suppresses E_{dev}, which fully conforms to economic logic. For example, based on data for 2025, where imports of machinery amounted to USD 22,858.78 million with a total volume of USD 64,257.67 million ($I_{inv} = 0.3557$), the retention coefficient was 0.74 ($K_{fisc} = 0.74$), and wages increased from USD 447.46 to 638.47 ($I_{wage} = 1.4269$), the value of the integral index is as follows:

$$E_{dev2025}=0.3557\times0.74\times1.4269 = 0.376 \quad (6)$$

In the long-term forecast period (2030), incorporating a realistic moderate currency devaluation scenario (projected average exchange rate of 51.00 UAH/USD), equipment imports will reach USD 39,962.10 million out of USD 143,431.80 million total imports ($I_{inv} = 0.2786$). The fiscal retention coefficient remains at 0.74 ($K_{fisc} = 0.74$), while the adjusted average wage reaches USD 860.60 ($I_{wage} = 1.9233$). This yields an updated integral index value of:

$$E_{dev2030}=0.2786\times0.74\times1.9233\approx0.396 \quad (7)$$

This confirms stable high-efficiency dynamics while accounting for macroeconomic currency risks. The model operates with large-scale government-level flows, and the normal limits of the integral index E_{dev} range from 0.20 to 0.50.

The value was assessed on the following scale:

a) $E_{dev} > 0.42$ – a high level of efficiency, indicating an advanced pace of technological modernisation and a rapid increase in the household incomes. Under such conditions, the abolition of customs duties on the means of production is economically feasible, since higher budget revenues from higher salaries and enterprise profits will quickly offset the losses from the abolition.

b) $0.31 \leq E_{dev} \leq 0.42$ – moderate (stable) threshold, indicating stable industrial expansion, represented by the benchmark of 2025 of 0.376. A sudden and complete removal of import duties in such circumstances risks a fiscal deficit. Hence, state intervention should be based on flexible regulatory structures such as granting specific exemptions from import duties while maintaining VAT or tax deferrals through promissory notes.

c) $E_{dev} < 0.31$ – a low level of efficiency, indicating degradation of the industrial structure, with equipment purchased and labour remuneration stagnating. In this case, abolition of customs barriers will not have a multiplicative effect, since the problem lies in institutional risks or a drop in domestic demand.

Threshold values of the integral index are based on a detailed analysis of the structural and logical limits of Ukraine's key macroeconomic parameters. Since the share of investment engineering in the total imports of the state is objectively constrained within the range of 0.25-0.40 due to a significant volume of critical purchases of energy and raw materials, while the basic fiscal coefficient is fixed at 0.26 with the projected wage index ranging from 1.0 to 2.18, the final indicator mathematically fluctuates within the range of 0.10-0.20.

An index value below 0.10 serves as a critical threshold for industrial degradation, indicating a contraction in equipment imports to less than 20% and a complete stagnation of incomes; any fiscal preferences lose their stimulating potential. The accelerated renewal of capital assets and wage growth make it possible to eliminate customs barriers on means of production, because increased fiscal revenues from domestic taxation offset the initial revenue losses.

Thus, the proposed methodology is a complete, objective, and mathematically grounded toolkit for assessing the overall effectiveness of tax incentives for industrial development at the macro level.

The use of the multiplicative model I_{eff}, which aggregates key parameters of the investment orientation of imports (I_{inv}), fiscal burden (K_{fisc}), and qualitative changes in the labor market (I_{wage}), enables an accurate quantitative assessment of the effectiveness of fiscal mechanisms without requiring cumbersome intra-corporate reporting by individual enterprises.

In modern macroeconomic research, parametric (e.g., stochastic frontier analysis, SFA) and nonparametric methods are often used to assess efficiency. Data Envelopment Analysis (DEA) is the leader among them. Despite their mathematical appeal, the DEA method and similar approaches have several significant limitations, making the proposed multiplicative model more appropriate (Table 1). Thus, while DEA has focused on micro- or meso-level comparison of the relative efficiency of numerous homogeneous systems, the proposed multiplicative model is a flexible and targeted tool for strategic macro-planning.

Table 1. Comparison of the Macroeconomic Model and the DEA Method for Assessing Industrial Development Efficiency.

Comparison Criterion	Developed Multiplicative Model	Assessment	Method of DEA / SFA	Assessment
Requirements for the sample size	The model operates reliably with limited time series and forecasting macromodels.	Low	DEA requires a large number of homogeneous decision-making units, e.g., entities, industries, and regions.	High
Extrapolation and predictive potential	The model is easily integrated with trend-based forecasting models and allows the effectiveness of policies to be assessed until 2030.	High	DEA is a static tool focused on assessing the *past* relative efficiency of entities within the existing sample; it cannot forecast the overall effect in future periods.	Low
Sensitivity to statistical anomalies	Sensitivity is manifested only at the level of individual distorted commodity items, which can be easily corrected by experts.	Moderate	Any random error or outlier in the output data can radically shift the entire efficiency frontier for other entities.	High
Interpretability of results (economic content)	Each element of the model has a clear macroeconomic and social interpretation that is understandable to policymakers.	High	The "black box" effect. DEA provides an efficiency coefficient (ranging from 0 to 1) but does not explain the reasons for a parameter's changes.	Low
Dependence on internal monitoring	Completely absent. The model is deliberately adapted to aggregate open data from customs and tax statistics.	Low	Requires detailed, homogeneous datasets of input and output resources, which are often considered trade secrets by enterprises.	High

It uniquely combines investment, fiscal, and social components into a single monitoring indicator adapted to the realities of a limited information space. Therefore, the developed approach provides a reliable basis for further analysis and substantiation of the optimal model of tax and customs incentives to accelerate technological modernisation in the domestic processing sector and improve socio-economic indicators.

3.2. Limitations.

The design and implementation of practical tests for the proposed macroeconomic multiplicative model, aimed at assessing the overall efficiency of industrial development, enabled us to establish clear quantitative guidelines. However, the methodological framework of this study has several limitations that should be considered when interpreting the results.

First of all, the developed toolkit deliberately operates exclusively with aggregated national parameters, such as total import volumes, average sectoral fiscal burden rates, and average labour market indicators, to avoid the need to analyse cumbersome enterprise-level internal reporting. As a result, the macroeconomic nature of the data obscures the microeconomic specificity of individual business entities.

This means that it does not consider sector-specific differences in capital intensity, financial resilience, the physical depreciation of fixed assets, and the varying capacity of individual manufacturing subsectors to reinvest liberated capital.

Moreover, the model's fiscal coefficient is based on a simplified architecture that assumes a constant average tax rate of 26% over the 2022–2030 time horizon. This baseline scenario neglects potential changes in customs and tax policies, the development of preferential regimes for product lines, and the internal structure of fiscal pressure, in which import VAT is the main burden. At the same time, tariff rates vary depending on international trade agreements. Finally, long-term projections for the 2026–2030 horizon carry inherent extrapolation risks, relying solely on extensions of historical trends and deterministic mathematical calculations.

Consequently, the model is unable to fully predict or account for the sudden volatility in global and domestic commodity markets, exchange rate fluctuations, the risk of devaluation of the national currency, and unpredictable institutional and geopolitical factors that can radically transform market capacity and the configuration of logistics chains.

The baseline forecasting for 2026–2030 was performed using a logarithmic/linear trend extrapolation model, based on empirical data of 2022–2025 ($R^2 > 0.89$). Foreign currency conversions (USD) for macroeconomic indicators and average wages up to 2030 were calculated by assuming a gradual exchange rate adjustment from UAH/USD 32.2 in 2022 to an estimated average of UAH/USD 51.0 by 2030, in line with official medium-term macroeconomic projections.

The socio-economic indicator of the labour market is also characterised by a degree of conventionality, since the calculation of the potential to create new jobs uses a fixed average cost of organising one job of USD 50,000 (World Bank, 2023; UNIDO, 2022). In the real conditions of the structural transformation of the industrial sector, this indicator differs significantly depending on the level of knowledge-intensiveness and digitalisation of the technologies being implemented, which directly adjusts the actual rates of attracting workers to the processing industry, and the assessment of changes in wages exclusively in dollar terms relative to the base year 2022 partially masks internal inflationary processes and real purchasing power in the national market.

Finally, the identified statistical deformations and anomalies in individual product groups, manifested in the emergence of negative forecast values for customs duties for railway and tram rolling stock by 2030, indicate the excessive sensitivity of the algorithms to sharp historical declines in supplies in past periods.

This highlights the model's limited ability to fully capture highly specialised market segments subject to severe structural disruptions without expert adjustments or explicit mathematical constraints. To eliminate these mathematical artifacts resulting from unconstrained linear trend extrapolation, a logical non-negativity constraint $f(x) = \max(0, \text{trend})$ was applied to the predictive model, guaranteeing that projected trade volumes and fiscal revenues remain non-negative ($R_t \geq 0$).

4. Results.

An analysis of the sectoral composition of taxable imports for 2022–2025 shows significant structural changes in the national economy, driven by adaptation to macroeconomic conditions and shifts in demand. The total volume of taxable imports showed a steady upward trend, rising from USD 43,824.24 million in 2022 to USD 64,257.67 million in 2025, an increase of USD 20,433.43 million (State Customs Service of Ukraine, n.d.).

This reflects a recovery in residents' purchasing power, infrastructure reconstruction, and the effectiveness of measures to de-shadow foreign economic operations (State Customs Service of Ukraine, n.d.). The key driver of the growth in import revenues was the enlarged commodity group "Machinery, Equipment, and Transport".

Its purchasing volume nearly doubled over the period, reaching USD 22,858.78 million in 2025 (State Customs Service of Ukraine, n.d.). An increase in imports of industrial reactors, boilers, and electrical equipment contributes to the dynamics of the mechanical engineering sector. This is due to the need to modernise production capacities and stabilise the energy sector. To ensure the vital activity of the state and support basic industries, it was important to expand imports of chemical products and rubber.

This increased by USD 3,601.83 million, as did food and agricultural products, which increased by USD 3,393.88 million (State Customs Service of Ukraine, n.d.). A significant reduction in fuel and energy product imports was recorded.

After the peak indicators in 2022, driven by the acute supply crisis in the domestic market, the figure decreased by USD 2,231.15 million due to the diversification of logistics routes and the stabilisation of global energy prices. Small volume declines were seen in the mineral products and railroad rolling stock segments.

Thus, structural analysis reveals a clear shift of priorities in import financing from the emergency procurement of energy in 2022 to capital investments in high-technology machinery and transport equipment by the end of the period under review (Table 2).

Table 2. Taxable Imports by Industrial Structure in 2022-2025, USD million.

Indicator	2022	2023	2024	2025	Deviation 2025/2022 (+/-)
1-24 Food and Agricultural Products	5,264.80	6,861.96	7,586.10	8,658.68	+3,393.88
25-26 Mineral Products	234.56	265.86	263.73	212.36	-22.20
27 Fuels and Energy Products	11,895.47	9,569.67	9,394.29	9,664.32	-2,231.15
28-40 Chemical Industry Products and Rubber	8,571.95	10,480.86	11,400.15	12,173.78	+3,601.83
41-43 Raw Hides and Skins, Furs, and Products Thereof	101.75	139.20	160.50	164.61	+62.86
44-49 Wood Articles and Pulp-And-Paper Products	825.64	929.14	1,064.15	1,097.72	+272.08
50-67 Textiles, Textile Products, Footwear	1,554.93	2,404.84	2,465.30	2,509.09	+954.16
68-70 Stone, Glass, Ceramic Products	505.05	668.67	677.53	714.48	+209.43
72-83 Metals and Products Thereof	2,290.13	3,146.98	3,606.37	4,203.19	+1,913.06
84-90 Machinery, Equipment, and Transport	11,835.19	16,723.51	19,036.23	22,858.78	+11,023.59
Including:					
– Reactors, Boilers, Machinery, Equipment	3,988.61	5,018.45	5,979.96	6,684.14	+2,695.53
– Electrical Machinery and Equipment; Video and Audio Equipment	3,108.68	3,833.94	4,589.66	5,552.49	+2,443.81
– Aircraft And Spacecraft	22.43	8.66	16.25	28.90	+6.47
– Ships, Boats, and Other Floating Craft	11.59	6.45	11.81	19.33	+7.74
– Optical Instruments and Apparatus	699.05	981.22	1,115.84	1,236.00	+536.95
Other goods	744.79	1412.75	1742.95	2000.66	+1,255.87
Total	43,824.24	52,603.43	57,397.31	64,257.67	+20,433.43

Source: based on State Customs Service of Ukraine (n.d.).

The projected data for 2026–2030 (Fig. 1) confirm these core structural changes and enable an accurate quantitative characterisation of long-term import trajectories. Total taxable imports continue to grow exponentially, from USD 102,361.65 million in 2026 to USD 143,431.80 million in 2030. The positive trend supports the hypothesis of a fast-growing domestic market and macroeconomic activity exceeding 2 times the 2022 baseline. The key growth contributor remains the "Machinery, Equipment and Transport" commodity group (UKTZED groups 84–90). Its import volume is expected to increase from USD 26,459.30 million in 2026 to USD 39,962.10 million in 2030. This will help it retain its top position and cover over 27% of the country's total expected imports.

The second most important group influencing import profiles is the chemical industry and rubber (groups 28-40). The sector is steadily growing, from USD 13,587.80 million in 2026 to USD 17,628.60 million in 2030, highlighting the continuing domestic dependence on foreign inputs for raw materials, pharmaceuticals and agrochemicals. The food and agriculture sector (groups 1–24) shows a parallel upward trajectory, with projections to reach USD 13,866.50 million by 2030, indicating the solid presence of foreign products in the domestic consumer basket.

There was a clear recovery in the metals and metal products segment (groups 72–83). The values of imports in this category have increased almost twofold compared with 2024–2025 levels, amounting to USD 7,187.78 million in 2030. This expansion reflects the expected implementation of large-scale capital construction programs and the structural restoration of damaged infrastructure. Fuels and energy products (group 27) are expected to decline gradually over the forecast horizon, following relative stabilisation in 2024–2025, falling from USD 8,413.73 million in 2026 to USD 7,147.66 million in 2030 (State Customs Service of Ukraine, n.d.). The trajectory reflects progress in energy-efficiency measures, increasing penetration of renewable sources, and increased domestic extraction.

In the analytical structure, particular attention should be paid to the segment of railroad and tram rolling stock, whose forecasted values fall into the negative zone. In economic terms, this anomaly implies acute structural disruptions, a severe technical contraction of trade flows in this niche, or the need to refine the trend extrapolation model to account for historical statistical distortions.

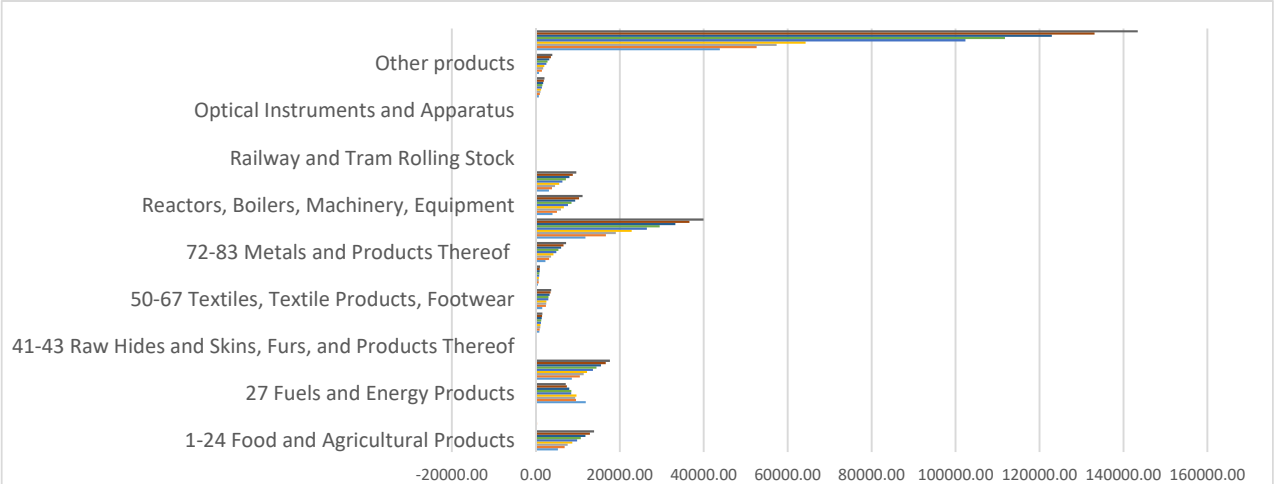
The indicators for other raw materials and consumer goods, such as textiles (USD 3,670.35 million in 2030) and wood (USD 1,559.80 million in 2030), are changing in a stable, moderate manner without triggering radical structural changes. As can be seen in the forecast visualised in Figure 1, there is a clear consolidation of the investment and technological model of imports, in which the vast majority of foreign exchange resources are directed toward the purchase of means of production, transport and components for industrial development, which defines the strategic goal of a country to increase the level of localisation of production to avoid excessive deficit in the trade balance.

An analysis of the current structure of the fiscal burden on imports in the "Machinery, Equipment, and Transport" group indicates significant regulatory potential to stimulate domestic processing.

The basic tax burden on imports of capital goods and components ranges from 20.0% to 32.0% of their customs value. The main fiscal pressure is not at the expense of import duties, which for most categories of goods from WTO and EU countries are already at a minimum or zero level (0%–5% for groups 84, 89, 90, and 0% for groups 86 and 88), but through the collection of a 20% value-added tax.

For such strategic subgroups as reactors, boilers, and industrial equipment (group 84), as well as optical and measuring instruments (group 90), the total load of 20.0%–26.0% creates an additional financial burden for enterprises at the modernisation stage, removing significant amounts of working capital even before the start of the direct production process.

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	1-24 Food and Agricultural Products	25-26 Mineral Products	27 Fuels and Energy Products	28-40 Chemical Industry Products and Rubber	41-43 Raw Hides and Skins, Furs, and Products Thereof	44-49 Wood Articles and Pulp-And-Paper Products	50-67 Textiles, Textile Products, Footwear	68-70 Stone, Glass, Ceramic Products	72-83 Metals and Products Thereof	84-90 Machinery, Equipment, and Transport	Reactors, Boilers, Machinery, Equipment	Electrical Machinery and Equipment; Video and Audio Equipment	Railway and Tram Rolling Stock	Ships, Boats, and Other Floating Craft	Optical Instruments and Apparatus	Other goods	Other products	Total
2030	13866.50	153.15	7147.66	17628.65	259.20	1559.80	3670.35	982.04	7187.78	39962.13	11118.23	9659.26	-44.55	14.12	38.10	2049.79	3904.78	143431.7
2029	12859.57	175.72	7369.14	16658.49	244.47	1479.45	3519.54	939.79	6610.00	36572.55	10276.85	8803.80	-26.79	6.49	32.97	1903.95	3568.61	133139.9
2028	11831.09	181.80	7970.77	15528.21	223.43	1377.68	3265.89	885.22	6016.88	33238.47	9362.59	8003.92	-11.18	45.39	29.69	1736.06	3172.09	122949.6
2027	10715.53	200.20	8461.05	14434.34	206.69	1301.26	3016.40	823.63	5389.41	29526.94	8512.66	7152.26	-1.15	-6.91	25.88	1571.79	2793.70	111741.1
2026	9817.23	226.95	8413.73	13587.88	193.99	1216.98	2964.28	800.72	4861.31	26459.30	7679.81	6292.98	24.33	25.81	19.44	1444.40	2499.74	102361.7
2025	8658.58	212.36	9664.32	12173.78	164.61	1097.72	2509.09	714.48	4203.19	22858.78	6684.14	5552.49	30.07	28.90	19.33	1236.00	2000.66	64257.67
2024	7586.10	263.73	9394.29	11400.15	160.50	1064.15	2465.30	677.53	3606.37	19036.23	5979.96	4589.66	44.39	16.25	11.81	1115.84	1742.95	57397.31
2023	6861.98	265.86	9569.67	10480.86	139.20	929.14	2404.84	668.67	3146.98	16723.51	5018.45	3833.94	81.03	8.66	6.45	981.22	1412.75	52603.43
2022	5268.80	234.56	11895.47	8571.95	101.75	825.64	1554.93	505.05	2290.13	11835.19	3988.61	3108.68	55.87	22.43	11.59	699.05	744.79	43824.24

Fig. 1. Forecast of Taxable Imports by the Industry Structure for 2026-2030, USD million.
Source: based on State Customs Service of Ukraine (n.d.)

The most capital-intensive category is group 85 (Electrical Machinery), where the fiscal load may reach 32.0% of the customs value. For vehicles, this burden is additionally increased by specific excise duty rates, significantly increasing the cost of upgrading the logistics and industrial parks of processing enterprises (Table 3).

In the context of intensified industrial development, the full or partial abolition of customs duties on imports of capital goods and high technology represents a powerful instrument of indirect government support, capable of radically accelerating the country's reindustrialisation. Elimination or temporary freezing of import duties at 0% for all subgroups of investment imports without exception (in particular for groups 84, 85, and 90) will reduce the initial cost of equipment.

However, a key stimulating effect can be achieved only if the mechanism for collecting import VAT is transformed. The introduction of the tax bill institute, deferral of payment, or complete exemption from VAT on imports of equipment, the analogues of which are not produced in the territory of the state, can free up billions of financial resources of processing enterprises and direct them to expanding operational activities and increasing the share of added value of finished products. Such a step will lower the entry threshold for new industrial projects, increase the investment attractiveness of the processing sector for foreign capital, and accelerate the technological renewal of fixed assets, which will compensate for losses of the state budget by expanding the tax base with direct taxes and increasing foreign exchange earnings from exports of finished goods.

Table 3. Customs Duty Rates and Total Burden by Group "Machinery, Equipment, and Transport".

Group of Ukrainian Classification of Goods for Foreign Economic Activity (UKTZED)	Category of Goods	Preferential Import Duty (WTO / EU Countries)	Full VAT	Excise Tax	Total Basic Percentage of Payments (of customs value)
84	Reactors, Boilers, Machinery, Equipment	0% – 5%	20%	None	20.0% – 26.0%
85	Electrical Machinery and Equipment; Video and Audio Equipment	0% – 10%	20%	None	20.0% – 32.0%
86	Railway and Tram Rolling Stock	0%	20%	None	20.0%
88	Aircraft and Spacecraft	0%	20%	None	20.0%
89	Ships, Boats and Other Floating Craft	0% – 5%	20%	None	20.0% – 26.0%
90	Optical and Measuring Instruments	0% – 5%	20%	None	20.0% – 26.0%
Total	Base Load Range	0% – 10%	20%	-	20.0% – 32.0%

Source: based on Verkhovna Rada of Ukraine (2024a; 2024b).

The analysis of fiscal revenues presented in Table 4 enables an assessment of the budgetary effectiveness of import taxation for the enlarged commodity group "Machinery, Equipment, and Transport" (groups 84–90) over the long term.

During 2022–2025, actual customs duty revenues in this sector grew rapidly, increasing from USD 3,077.149 million to USD 5,943.283 million, reflecting an expanded tax base due to intensified equipment imports.

Table 4. Fiscal Revenues from Imports of the Group "Machinery, Equipment, and Transport" and Forecast Changes, USD billion.

Indicator	2022	2023	2024	2025	Forecast					Average Tax and Duty Ratio
					2026	2027	2028	2029	2030	
84-90 Machinery, Equipment, and Transport	3.077	4.348	4.949	5.944	6.879	7.677	8.642	9.509	10.390	0.26
Including										
Reactors, Boilers, Machinery, Equipment	0.917	1.154	1.375	1.537	1.766	1.958	2.153	2.364	2.557	0.23
Electrical Machinery and Equipment; Video and Audio Equipment	0.808	0.997	1.193	1.444	1.636	1.860	2.081	2.289	2.511	0.26
-Railway and Tramway Rolling Stock	0.011	0.016	0.009	0.006	0.005	0.000	0.000	0.000	0.000	0.2
Aircraft and Spacecraft	0.004	0.002	0.003	0.006	0.005	0.000	0.009	0.001	0.003	0.2
Ships, Boats, and Floating Craft	0.003	0.001	0.003	0.004	0.004	0.006	0.007	0.008	0.009	0.23
Optical Instruments and Apparatus	0.161	0.226	0.257	0.284	0.332	0.362	0.399	0.438	0.471	0.23

Note: Forecasted values for specialised subcategories (such as railway rolling stock) incorporate a non-negativity boundary constraint $\max(0, trend)$ to prevent mathematical extrapolation artefacts and accurately reflect structural import displacement without generating negative fiscal balances.

Source: based on State Customs Service of Ukraine (n.d.).

According to the forecast calculations, this trend of fiscal expansion will continue in 2026–2030, with the total amount of fees for this group increasing from USD 6,879.418 million to USD 10,390.15 million, at a stable average taxation and payment rate of 26%. From a financial analysis perspective, the subgroup of railway and tram rolling stock warrants particular attention. It is projected that by 2030, revenue from the fiscal levies will drop to near-zero levels due to the complete displacement of imports by domestic manufacturers of these products. The result in public budget planning is significant state budget compensation, the introduction of targeted tax incentives or the need to correct the structural mathematical distortions of the predictive model.

The wider implications of scrapping import tariffs to encourage domestic manufacturing suggest an inherent tension between short-term fiscal prudence and long-term strategic industrial policy. For critical investment subcategories such as industrial equipment, vessels and precision instruments (groups 84, 89, 90), the average tax and payment rate is 23%. For electrical machinery (group 85), the load is 26%.

The full exemption from fiscal duties on these capital goods in 2026 would result in an immediate loss of annual budget revenue exceeding USD 3.7 billion. This annual amount of uncollected tax will exceed USD 5.5 billion by 2030. Such a large-scale fiscal gap poses a critical threat to the financing of current state expenditures in the short term, making the total cancellation of payments unlikely. However, the taxation system must be reformed to provide targeted preferences for processing industry enterprises.

For example, abolishing import duties and introducing import VAT bills payable directly on production equipment, without the right to resell it, is an economically justified step. Leaving these billions of working capital at the disposal of processing enterprises will give a powerful impetus to the creation of new factories and plants, which in 2-3 years will fully compensate for the initial budget losses due to revenues from profit tax, personal income tax from newly created jobs, and will also ensure the inflow of hard currency from the export of finished products with a high share of added value instead of exporting raw materials. Despite a significant devaluation of the national currency (the exchange rate increased from UAH/USD 32 to 45), the rate of nominal wage increases in production outpaced the hryvnia's depreciation.

As a result, the average salary in dollar terms showed stable growth, from USD 477 in the most difficult 2022 to almost USD 638 by the end of 2025. This confirms that the industrial sector actively adapted and fought to maintain its human resources potential (Table 5).

Over the first two years, the sector lost approximately 170 thousand officially employed specialists (a drop of almost 11%). This is due to both the physical shutdown of factories and the transition of part of the business to the "shadow" economy or a reduced work schedule.

The initial drop in the workforce size stems from wartime demographic shifts, migration, and capital-intensive automation. However, qualitative efficiency increases due to higher labour productivity, greater capital capacity, and wage appreciation.

Table 5. Complex Dynamics of Personnel and Wages in the Industry of Ukraine.

Year	Number of Employees (thousands of people)	Average Wages (UAH)	Average Annual Exchange rate of the NBU (UAH/USD)	Average Wages, USD
2022	1,580	15,441	32.34	447.46
2023	1,410	18,200	36.57	497.68
2024	1,365	23,167	39.38	588.29
2025	1,340	28,731	45.00	638.47

Source: based on the Ministry of Finance of Ukraine (2026).

The demographic losses and the outflow of more than 7 million citizens (State Customs Service of Ukraine, n.d.) have created long-term supply-side labour constraints, which require a shift toward capital-intensive, high-value technological re-equipment rather than workforce expansion.

The quantified impact of reinvesting the released fiscal resources (Table 6) shows the potential of job creation and the expansion of industrial employment through the targeted elimination of import duties.

The basic mathematical logic is that all tax-free fiscal resources on equipment imports are completely absorbed by the corporate sector and invested directly in capital and capacity expansion. Labour market capacity is clearly expanding in line with projected import volumes, with a benchmark creation cost of USD 50.0 thousand per workplace. The theoretical volume of capital released in 2022 was enough to support 61,542.98 new positions, but this potential increased to 118,865.66 jobs by 2025.

Table 6. Potential Employment Growth after Customs Duty Abolition.

Indicator	2022	2023	2024	2025	Forecast				
					2026	2027	2028	2029	2030
Customs revenues, USD bn.	3.077	4.348	4.949	5.943	6.879	7.677	8.642	9.509	10.390
Average industrial wage, USD	447.46	497.68	588.29	638.47	708.89	779.28	789.34	804.47	860.60
Potential employment, million	2.20	2.80	2.70	2.98	3.11	3.16	3.30	3.35	3.41
Cost per job, USD th.					50.0				
Potential jobs created	61,540	86,960	98,980	118,860	137,580	153,540	172,840	190,180	207,800

Source: based on the Ministry of Finance of Ukraine (2026).

This multiplier effect continues to scale over the 2026-2030 forecast horizons, creating between 137,580 and 207,800 prospective new positions annually. Such a continuous flow of capital investments can significantly change the employment landscape by bringing segments of the workforce into the manufacturing sector.

The industrial employment capacity is expected to grow steadily from 3.11 million workers in 2026 to 3.41 million by 2030, reflecting this structural shift. The model captures qualitative changes in wages, as the average monthly wage of a processing industry worker shows a steady upward trend, increasing from USD 447.46 in 2022 to USD 638.47 in 2025, with a further forecast to reach USD 860.60 by 2030 (adjusted for currency devaluation). This growth in nominal income reflects higher labour productivity due to the introduction of new imported equipment and increased competition for skilled labour in the labour market.

From the point of view of state regulation, the abolition of customs duties for USD 10,390.15 million in 2030, although it removes primary revenues from the budget, launches a powerful multiplier effect: the creation of more than 207 thousand high-paying jobs provides a large-scale return of financial resources to the state system (Ministry of Finance of Ukraine, 2026).

Thus, reorienting customs policy from a fiscal function to a stimulating one serves as a driver of industrialisation and creates a sustainable, long-term platform for minimising unemployment, improving population well-being, and transforming the processing industry into a high-tech sector with high wages. The above dynamics of large-scale labour involvement and nominal wage growth confirm that the renewal of fixed assets in processing enterprises is a key catalyst for increasing labour productivity and socio-economic development.

However, to provide an objective macroeconomic basis for decision-making in fiscal regulation, it is necessary to formalise the relationships among investment import parameters, fiscal pressure levels, and labour market indicators. The developed multiplicative model ($E_{dev} = I_{inv} \times K_{fisc} \times I_{wage}$) enables digitisation of the effectiveness of the implemented customs and tax policy over 2022–2025 and in the long term until 2030.

The generalised results of the calculations of the model components and the final integral coefficient are presented in Table 7.

Analysis of the macroeconomic parameters enables tracing a clear evolution of the efficiency of fiscal regulation and identifying key structural trends in the industrial sector. Period of Low Efficiency (2022–2023): The values of the integral index E_{dev} ranged between 0.200 and 0.262, remaining below the low-efficiency threshold of 0.31. This suppressed performance was driven by the dominance of energy imports, constrained capitalisation rates ($I_{\text{inv}} = 0.2701$-0.3179), and moderate wage dynamics. Starting from 2024 ($E_{dev} = 0.323$), a qualitative break in the development trajectory is observed, reaching $E_{dev} = 0.376$ in 2025.

The growth of the import investment orientation index ($I_{inv} = 0.3557$), combined with an increase in average monthly wages, indicated a transition to planned technological upgrades. The forecast volatility and achievement of high efficiency (2026–2030) show that, in 2026, a corrective decrease in the integral indicator to 0.303 is observed due to total market capacity expansion. However, in the long term, by 2030, the value of E_{dev} reaches 0.396. The stabilisation of investment imports at USD 39,962.10 million ($I_{inv} = 0.2786$), combined with a 1.92-fold increase in the dollar-equivalent wage ($I_{wage} = 1.9233$, reaching USD 860.60 under exchange rate adjustment) demonstrates that by 2030, the integral index E_{dev} reaches 0.396 under the fiscal scenario ($K_{fisc} = 0.74$). This positions the manufacturing sector at the upper limit of the stable efficiency threshold ($0.31 \leq E_{dev} \leq 0.42$). The above calculations fully verify the feasibility of a gradual transition from fiscal exclusion to the stimulation of customs and tax policies to drive technological renewal in the processing industry. Values for alternative scenarios ($K_{fisc} = 0.90$ and 1.00; $E_{dev} = 0.482$ and 0.536) are derived through proportional mathematical scaling relative to the baseline model ($K_{fisc} = 0.74$, $E_{dev} = 0.396$).

Table 7. Dynamics of Macroeconomic Indicators and the Integral Index of Industrial Development Efficiency (E_{dev}) in 2022–2030.

Year	Total Taxable Imports, USD mln	Imports of Machinery, Equipment, and Transport, USD mln	Import Investment Orientation Index, (I_{inv})	Fiscal Withdrawal Ratio for Working Capital, (K_{fisc})	Average Wage (ZP_t), USD	Relative Wage Growth Index, (I_{wage})	Integral Efficiency Index, (E_{dev})	Efficiency Level by Model Scale
2022	43,824.24	11,835.19	0.2701	0.74	447.46	1.0000	0.200	$E_{dev} < 0.31$
2023	52,603.43	16,723.51	0.3179	0.74	497.68	1.1122	0.262	$E_{dev} < 0.31$
2024	57,397.31	19,036.23	0.3317	0.74	588.29	1.3147	0.323	$0.31 \leq E_{dev} \leq 0.42$
2025	64,257.67	22,858.78	0.3557	0.74	638.47	1.4269	0.3760	$0.31 \leq E_{dev} \leq 0.42$
2026 *(forecast)*	102,361.65	26,459.30	0.2585	0.74	708.89	1.5843	0.303	$E_{dev} < 0.31$
2030 *(forecast)*	143,431.80	39,962.10	0.2786	0.74	860.60	1.9233	0.396	$0.31 \leq E_{dev} \leq 0.42$

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5. Discussion.

The reorientation of customs and tax policy from a fiscal function to a stimulating one is a decisive factor in accelerating the technological modernisation and reindustrialisation of the processing industry. An assessment of import flow dynamics indicates deep structural shifts in the national economy, with the commodity group "Machinery, Equipment, and Transport" becoming the leader, with purchasing volumes increasing to USD 22,858.78 million in 2025 and forecast to reach USD 39,962.10 million in 2030. These trends are fully consistent with emphasising the need to introduce capital-intensive technologies and to renew fixed assets as a prerequisite for ensuring sustainable development amid challenges. Unlike works focused exclusively on the agrotechnical and engineering aspects of modernisation, this work demonstrates that the key barrier to deploying investment processes remains fiscal pressure, which removes billions of dollars in working capital from businesses even before the start of the production cycle.

The multiplicative model for assessing integral efficiency E_{dev} enabled the digitisation of the systemic relationship among the parameters of investment imports (I_{inv}), the level of fiscal burden (K_{fisc}), and qualitative shifts in the labor market (I_{wage}).

The calculated values of the integral index for 2022–2025 show a consistent transition from low efficiency ($E_{\text{dev}} = 0.200$ in 2022) to a stable moderate level ($E_{\text{dev}} = 0.376$ in 2025), with the estimated achievement of an upper-baseline efficiency level ($E_{\text{dev}} = 0.396$) in the long term by 2030. These results deepen and methodically complement approaches to economic and mathematical modelling and to the assessment of transformation processes in industrial and agricultural clusters (Mayovets et al., 2021; Zos-Kior et al., 2021), forming a clear gradation scale for regulatory decision-making. Unlike the concepts of autonomous analysis of financial and marketing instruments (Belkin et al., 2025), the developed methodology demonstrates that eliminating customs barriers yields a synergistic effect only with a strong internal multiplier.

An important debatable aspect of the study is the resolution of the fundamental dilemma between the emergence of a short-term fiscal gap and the need to ensure long-term macroeconomic growth.

The direct abolition of customs duties on means of production will result in a budget shortfall of approximately USD 3.7 billion in 2026 and over USD 5.5 billion in 2030, making a one-time, total abolition of taxes risky for the financial system.

However, empirical evidence suggests that the use of flexible regulatory mechanisms, such as exemptions from import duties with the preservation of VAT or the use of promissory notes mitigates the risk of a fiscal deficit while stimulating the annual creation of 207.8 thousand new jobs. This capital optimisation framework also embodies the broader principles of digitisation and value chain integration (Lutsiak et al., 2020) in the context of macroeconomic regulation.

A labour market analysis suggests that the main driver of labour productivity is the reallocation of released fiscal resources to the manufacturing sector, which is expected to boost average monthly wages from USD 447.46 in 2022 to USD 860.60 by 2030.

This generates additional fiscal flow in the form of personal income tax, corporate profit tax and social security contributions, which is consistent with studies on economic transformation and reporting transparency (Hnatenko et al., 2024; Pravdiuk et al., 2021). The preferential circulation of capital is consistent with the basic principles of circular economy systems (Lohosha et al., 2025b), indicating that temporary tariff concessions on capital goods improve long-term fiscal sustainability.

Notwithstanding these macroeconomic insights, the study has several methodological caveats. The framework abstracts away from firm-level microeconomic heterogeneity and specific institutional risks, as it is based on aggregated national parameters. These long-term projections through 2030 are also based on trend extrapolation, making them sensitive to global market volatility and evolving legal standards, thereby necessitating continued legislative alignment (Lohosha, 2025a).

Future research should focus on improving the multiplicative model (E_{dev}) by adding regional parameters, environmental indicators aligned with smart-economy paradigms, and developing sectoral incentive schemes for high-tech manufacturing niches.

The theoretical contribution of this work is to extend the fiscal multiplier framework to open economies subject to shocks by explicitly relating incentives to import capital to structural adjustments in the labour market. The model has a major drawback: it is sensitive to financial turbulence and exchange rate fluctuations. Future research should take into account regional differences in labour and the dynamics of cross-sectoral labour reallocation.

6. Conclusions.

A comprehensive macroeconomic toolkit was developed to assess the impact of fiscal and customs regulations on capital-goods imports. Analysis of the structure of taxable imports in Ukraine demonstrates that total market capacity has tripled, mainly due to the high-tech sector "Machinery, Equipment and Transport", which consistently accounts for more than a quarter of all imports.

However, current fiscal burdens impose severe liquidity constraints, depleting essential working capital for manufacturing enterprises before production begins. To address these problems, a mathematical model was developed to estimate the integrated index of industrial development efficiency, accounting for nonlinear synergies among three macro-variables: the import investment orientation index, the fiscal capital withdrawal coefficient, and the relative USD-denominated wage growth index.

This multiplicative formulation has significant advantages over standard DEA. It does not require proprietary corporate reporting, increases predictive power, and avoids unrealistic assumptions about factor substitution.

The quantitative modelling shows a distinct evolution of industrial development efficiency: low initial values, moderate stabilisation, and then a moderate efficiency level over the long-term forecast horizon.

A complete cessation of payments is premature due to the threat of a fiscal gap, requiring flexible instruments such as import duty exemptions with retention of value-added tax or tax bills. However, the expected transition beyond the known critical threshold is the achievement of the macroeconomic breakeven point, where the total elimination of customs barriers on means of production may be recommended, as the resulting domestic tax revenues have the potential to partially compensate for the initial budget losses.

The long-term socio-economic multiplier effect of the labour market of reinvesting fiscal resources in the domestic processing industry has been digitised. Given a fixed benchmark cost of setting up a modernised workplace, there is potential to create a significant number of high-productivity jobs annually through corporate capital accumulation. This expansion causes a qualitative transformation of the labour market, increasing manufacturing employment and promoting wage growth. This dynamic provides a basis for long-term social stability and expansion of domestic demand.

Conflict of Interest Statement.

The authors declare that there is no conflict of interest.

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REFERENCES

Belkin, I., Trapaidze, S., Bondarenko, V., Omelianenko, O., & Cherniavskyi, I. (2025). Sustainable marketing of Ukrainian agricultural enterprises to enter global grain markets. European Journal of Sustainable Development, 14(2), 490. https://doi.org/10.14207/ejsd.2025.v14n2p490

Cacciatore, M., & Traum, N. (2022). Trade flows and fiscal multipliers. The Review of Economics and Statistics, 104(6), 1206–1223. https://doi.org/10.1162/rest_a_00985

Chang, M., & Lee, H. (2026). Bridging micro and macro production functions: The fiscal multiplier of infrastructure investment. Journal of Monetary Economics, 157, 103873. https://doi.org/10.1016/j.jmoneco.2025.103873

Crespo Cuaresma, J., & Glocker, C. (2023). Production structure, tradability and fiscal spending multipliers. Journal of International Money and Finance, 138, 102921. https://doi.org/10.1016/j.jimonfin.2023.102921

Devlin, A., & Yang, A. (2022). Regional supply chains for decarbonising steel: Energy efficiency and green premium mitigation. Energy Conversion and Management, 254(115268), 115268. https://doi.org/10.1016/j.enconman.2022.115268

Hnatenko, I., Bebko, S., Ievseitseva, O., Shikovets, K., Kvita, H., & Zos-Kior, M. (2024). Market analysis of the renewable energy market of Ukraine in the context of changes in financial and economic processes. Financial and Credit Activity: Problems of Theory and Practice, 5(58), 446–459. https://doi.org/10.55643/fcaptp.5.58.2024.4576

Lesniewska, F., & Steenmans, K. (2023). Circular economy and the law: Bringing justice into the frame (1st ed.). Routledge. https://doi.org/10.4324/9780429355141

Lohosha, R. (2025a). Harmonisation of Ukrainian legislation in the field of organic production with international standards. Baltic Journal of Economic Studies, 11(3), 381–392. https://doi.org/10.30525/2256-0742/2025-11-3-381-392

Lohosha, R., Palamarchuk, V., & Krychkovskyi, V. (2025b). Market circulation of digestate in Ukraine and other countries. Baltic Journal of Economic Studies, 11(5), 196–206. https://doi.org/10.30525/2256-0742/2025-11-5-196-206

Lutsiak, V., Lavrov, R., Furman, I., Smitiukh, A., Mazur, H., & Zahorodnia, N. (2020). Economic aspects and prospects for the development of the market of vegetable oils in a context of formation of its value chain. Montenegrin Journal of Economics, 16, 155–168. https://doi.org/10.14254/1800-5845/2020.16-1.10

Mani, A., Budd, T., & Maine, E. (2024). Emissions-intensive and trade-exposed industries: Technological innovation and climate policy solutions to achieve net-zero emissions by 2050. RSC Sustainability, 2(4), 903–927. https://doi.org/10.1039/d3su00335c

Mayovets, Y., Vdovenko, N., Shevchuk, H., Zos-Kior, M., & Hnatenko, I. (2021). Simulation modeling of the financial risk of bankruptcy of agricultural enterprises in the context of COVID-19. Journal of Hygienic Engineering and Design, 36, 192–198.

Mazier, J., Reyes, L., & Chong, C. Y. (2025). Economic policy efficiency and recovery in an open economy. Review of Political Economy, 1–29. https://doi.org/10.1080/09538259.2025.2462949

Ministry of Finance of Ukraine. (2026). Average monthly salary by economic activity (2020–2026). Minfin Economic Portal. https://index.minfin.com.ua/ua/labour/salary/average/branch

Okonkwo, P. (2026). Geopolitical strategies for renewable energy access, development, and growth. Elsevier. https://doi.org/10.1016/C2024-0-03587-4

Peng, E., Yang, J., Wang, Z., Li, D., Gao, Y., Yan, D., Chen, Y., & Guo, X. (2025). Manganese resources in China: An overview of resource status and recent advances in metallogenic models and exploration. Minerals, 15(8), 859. https://doi.org/10.3390/min15080859

Pravdiuk, N., Bondarenko, V., Pokynchereda, V., & Timchenko, O. (2021). Quality of financial reporting of the enterprise: Evaluation methodology. European Journal of Sustainable Development, 10(2), 113. https://doi.org/10.14207/ejsd.2021.v10n2p113

State Customs Service of Ukraine. (n.d.). Statistics and registers. https://customs.gov.ua/statistika-ta-reiestri

UNIDO. (2022). Industrial Development Report 2022: The future of industrialization in a post-pandemic world. United Nations Industrial Development Organization. https://www.unido.org/idr2022

Verkhovna Rada of Ukraine. (2022). Law of Ukraine No. 2697-IX "On the Customs Tariff of Ukraine". https://zakon.rada.gov.ua/laws/show/2697%D0%B0-20#n2

Verkhovna Rada of Ukraine. (2024a). Law of Ukraine No. 3853-IX. On amendments to Subsection 2 of Section XX "Transitional Provisions" of the Tax Code of Ukraine on exemption from value added tax on imports of goods for the restoration of energy infrastructure. Verkhovna Rada of Ukraine. https://zakon.rada.gov.ua/laws/show/3853-20

Verkhovna Rada of Ukraine. (2024b). Law of Ukraine No. 3854-IX. On amendments to Section XXI "Final and Transitional Provisions" of the Customs Code of Ukraine on exemption from import duty on goods for the restoration of energy infrastructure. https://zakon.rada.gov.ua/laws/show/3854-20

World Bank. (2023). World Development Report 2023: Migrants, refugees, and societies. World Bank Group. https://doi.org/10.1596/978-1-4648-1941-4

Zos-Kior, M., Shkurupii, O., Fedirets, O., Shulzhenko, I., & Rubezhanska, V. (2021). Modeling of the investment program formation process of ecological management of the agrarian cluster. European Journal of Sustainable Development, 10(1), 571–583. https://doi.org/10.14207/ejsd.2021.v10n1p571