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WORLD-SYSTEM GEOECONOMIC STRATIFICATION: THE ROLE OF NON-EQUIVALENT TECHNOLOGICAL EXCHANGE

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Abstract. The *purpose* of the paper is to identify and analytically substantiate the role of technological protectionism in the processes of deepening the geoeconomic stratification of the world-system. *Methodology*. The study employs economic analysis and comparative statistics to examine macroeconomic imbalances; the indicator method is applied for segmentation based on key development indicators; a range of theoretical research methods were employed, with a particular emphasis on abstract, logical, and comparative analysis, abstraction, generalisation, and formalisation. *Results*. The article examines the processes of contemporary global hierarchization triggered by the asymmetry in the distribution of intellectual rent. Stable disparities in global income distribution and technological potential, which preclude egalitarian development of the world-system, are identified and systematized. The role of technological protectionism as a driver of geoeconomic polarization is revealed, wherein the deployment of complex regulatory standards by the Core creates a "regulatory trap" for the lower tiers of the hierarchy. A direct causal link between non-equivalent technological exchange and the institutional shadowization of international economic relations is proven. It is established that high transaction costs associated with legal certification compel economic agents in the Semi-periphery and Periphery to systematically bypass formal barriers. It is substantiated that such adaptation leads to the camouflaging of commodity nomenclature, invoice price manipulation, and the criminalization of logistics chains. It is generalized that the Core's technological dominance acts as the primary cause of both the structural underdevelopment of the Periphery and the institutional degradation of the global trade environment. *Conclusions*. The dominant role of geoeconomic segregation has been substantiated. The main types of risks inherent in this mechanism have been identified. Further steps have been proposed to overcome the negative consequences caused by this phenomenon.

Keywords: geoeconomic stratification, world-system, non-equivalent technological exchange, intellectual rent, non-tariff barriers, regulatory trap, shadow trade.

JEL Classification: F13, F54, O33, O11

1. Introduction

In the contemporary architecture of the world economy, the classical paradigms of trade liberalisation, based on the reduction of tariff barriers, have ultimately given way to strategies of technological protectionism. Today, the key factor of global differentiation is not the volume of nominal GDP, but the ability of a state to monopolise intellectual rent. The countries of the institutional Core, maintaining control over digital platforms, innovation standards, and fundamental R&D, employ them not only as instruments of value capitalisation but also as 'regulatory filters' that restrict the diffusion of knowledge and the technological diversification of developed countries (the institutional Core).

As a result of such non-equivalent technological exchange, a persistent geoeconomic segregation of the world-system is formed, accompanied by destructive macrostructural effects: the 'thin industrialisation' of the Semi-periphery, which falls into the trap of technological dependence on imported components, and the chronic marginalisation of the Periphery. The latter manifests

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itself in the systemic displacement of peripheral agents into the shadow economy, the criminalisation of logistics chains, and entrapment in debt traps, which neutralises the potential of legal integration initiatives. Consequently, there arises a scholarly necessity to reconsider the nature of contemporary global asymmetry, where non-tariff barriers and regulatory restrictions become the primary cause not only of technological lag but also of institutional degradation across entire segments of the world market.

The theoretical foundation of the hierarchical structure of the world economy was laid in the works of I. Wallerstein, whose world-systems approach makes it possible to view the contemporary economy as an integrated structure: Core – Semi-periphery – Periphery (Wallerstein, 2011). The issue of value distribution asymmetry has been thoroughly elaborated by representatives of the global value chain theory (Gereffi et al., 2005; Gereffi, 2018; Kaplinsky & Morris, 2016), who, however, often reduce the technological dependence of the Periphery to institutional immaturity or a lack of investment. The empirical dimension of these processes has been reinforced by studies employing gravity models of trade (Subhan et al., 2021), which confirm the dependence of commodity flows on classical factors – GDP size and geographical distance.

Recent studies demonstrate that technological asymmetry has become an inherent feature of interactions between the Core and the Semi-periphery: Özmerdivanlı and Sönmez (2025) point to significant divergences in financial and environmental development trajectories, while Nasim et al. (2024) confirm the structural heterogeneity of financial sector efficiency across these groups of countries. At the same time, Kozlova and Didenko (2022) focus on the non-equivalence of the impact of technological progress on the quality of life in the Core and the rest of the world.

In our view, such an approach is limited, as it disregards the political factor – the deliberate use of regulatory instruments by the Core as filters for the diffusion of innovations. The widespread thesis of 'global liberalisation' ignores reality: high compliance costs have turned into a rigid equivalent of tariffs, locking peripheral economies into 'regulatory traps'.

Despite the considerable body of research, the profound interrelation between the rigidity of non-tariff barriers imposed by the Core and the scale of institutional degradation of trade flows in developing countries remains overlooked. In particular, the scholarly discourse insufficiently addresses the 'feedback mechanism', whereby regulatory pressure becomes a catalyst for the displacement of national capital into shadow segments, the criminalisation of logistics chains, and the manipulation of invoice values. Most authors examine these phenomena in isolation, without linking them to the technological segregation of the world-system as the root cause. Consequently, existing models fail to provide a comprehensive explanation of how non-equivalent technological exchange transforms into the systemic shadowing of international trade, which determines the necessity of conducting the present study.

Despite the depth of existing research, the problem of conceptualising non-tariff barriers (NTBs) as derivatives of technological protectionism strategies, rather than purely environmental or technical regulation, remains insufficiently addressed. The interpretation of the shadowing of international trade exclusively as a consequence of the internal weakness of Peripheral institutions is flawed. What is overlooked is systemic causality: the Core's rigid regulatory pressure renders legal access to highly profitable markets economically unfeasible for peripheral agents, objectively pushing them towards 'grey' logistics schemes.

The aim of the study is to identify and analytically substantiate the role of technological protectionism in the processes of deepening the geoeconomic stratification of the world-system. The relevance of this task is determined by the need to reveal the economic logic of regulatory asymmetry, which generates the 'premature deindustrialisation trap', restricting outsider countries to raw material specialisation and preventing their integration into the upper tiers of value chains. The author argues that it is precisely non-equivalent technological exchange that serves as the key lever for reproducing inequality within contemporary integration blocs.

2. Macroeconomic Trends in the Positioning of Geoeconomic Actors

The institutional Core of the world economic system is formed by the leading developed countries, represented at the intergovernmental level by the politico-economic club of the 'Group of Seven' (G7) (United States, Japan, Germany, United Kingdom, France, Italy, Canada). At the supranational level, the European Union (EU) functions as an integration core, acting as a consolidated economic bloc (which includes three of the aforementioned European G7 members). It is precisely the synergy of the capital and institutions of the G7 and the EU that defines the rules of the game in the global environment. The scale of this geoeconomic dominance is evidenced by the fact that the Core countries, while comprising only 9.7% of the world's population, accumulate nearly half of global income – 44.5% of global GDP in 2023. The absolute leader of this segment is the United States, with an economy amounting to 25.9% of global GDP. By ensuring an unprecedentedly high level of average GDP per capita – USD 60.4 thousand (4.6 times higher than the global average), the Core countries seek to artificially preserve the existing asymmetric distribution of power. In defending their status as technological leaders, these

actors deploy a system of highly complex technical, digital, and environmental non-tariff barriers, which serve as protective filters against goods from other regions.

This institutional hegemony of the Center is increasingly challenged by the Semi-periphery, where new industrial giants, macroeconomically united in the E7 group (China, India, Brazil, Indonesia, Mexico, russia, Turkey), consolidate their economic and political potential through platforms such as BRICS and the Shanghai Cooperation Organisation (SCO). Contemporary trends indicate the gradual formation of a powerful alternative macroeconomic pole, which, in terms of the overall scale of nominal production, nearly matches the Core's indicators, yet is characterised by significant demographic pressure and a substantially lower level of qualitative income per capita. The strategic objective of these actors is the dismantling of the financial and technological monopoly of the global Center. This vector is particularly evident in 2026 during India's chairmanship of BRICS, whose official agenda unfolds under the slogan 'Building for Resilience, Innovation, Cooperation and Sustainability' (BRICS 2026). Emphasising the development of independent digital public infrastructure, proprietary artificial intelligence ecosystems, and sovereign cross-border payment systems, the member countries seek to establish an alternative international technological environment protected from Western sanctions and non-tariff pressures.

The effectiveness of such processes and the formation of self-sufficient value chains within the Semi-periphery is also vividly illustrated by the development dynamics of the Association of Southeast Asian Nations (ASEAN), which is gradually transforming from a mere production platform into a self-sufficient pole of global innovation-driven growth.

At the same time, the Periphery, which encompasses the rest of the world's countries and concentrates nearly half of humanity (48.1% of the global population), demonstrates a critically low capacity for income accumulation. Certain regional groupings within this broad segment, such as the African Continental Free Trade Area or the Southern Common Market (MERCOSUR), attempt to resist global asymmetry through instruments of internal liberalisation. However, being trapped in chronic debt, infrastructural deficits, and raw material specialisation, the countries of the peripheral segment as a whole prove incapable of overcoming the Core's high-tech regulatory labyrinths and non-tariff barriers. This conserves their structural backwardness (ensuring a cumulative GDP per capita level of only 26.7% of the global average) and stimulates a large-scale drift of national capital into undeclared, shadow segments of world trade. Empirical confirmation of this geoeconomic confrontation and the deep polarisation of global capital is provided by contemporary macroeconomic indicators of world-system development, detailed in Table 1.

The calculations identify a number of stable macroeconomic trends that make it possible to substantiate the specificity of the contemporary positioning of different geoeconomic actors within the global hierarchy.

Table 1

Macroeconomic differentiation of the global system by structural segments of the world hierarchy in 2023

Segment	GDP, trillion USD	GDP per capita, thousand USD	Population, million people	Share in world GDP, %	GDP per capita relative to world average, %	Share in world population, %
World	**105,44**	**13,1**	**8 050,1**	**100,0**	**100,0**	**100,0**
Core (G7 Group)	**46,96**	**60,4**	**777,3**	**44,5**	**461,1**	**9,7**
United States	27,36	81,6	334,9	25,9	622,9	4,2
Germany	4,46	52,7	84,5	4,2	402,3	1,0
Japan	4,21	33,8	124,5	4,0	258,0	1,5
United Kingdom	3,34	49,1	68,0	3,2	374,8	0,8
France	3,03	44,5	68,1	2,9	339,7	0,8
Italy	2,25	38,3	58,9	2,1	292,4	0,7
Canada	2,14	53,4	40,1	2,0	407,6	0,5
Semi-periphery (E7 Group)	**44,88**	**13,2**	**3 398,8**	**42,6**	**100,8**	**42,2**
China	17,79	12,6	1 410,7	16,9	96,2	17,5
India	3,55	2,5	1 428,6	3,4	19,1	17,7
Brazil	2,17	10,1	216,4	2,1	77,1	2,7
Mexico	1,79	13,9	128,5	1,7	106,1	1,6
South Korea	1,71	33,1	51,7	1,6	252,7	0,6
Indonesia	1,37	4,9	277,5	1,3	37,4	3,4
Turkey	1,11	13,1	85,3	1,1	100,0	1,1
Periphery	**13,60**	**3,5**	**3 874,0**	**12,9**	**26,7**	**48,1**

Source: calculations by the authors based on World Bank data

The comparison of the parameters of the first segment demonstrates the monocentric concentration of financial power within the Core. The evident imbalance between accumulated capital and the planet's population confirms the existence of the Center's stable institutional rent. The unprecedentedly high level of GDP per capita is an inherent feature of this group of countries, serving as the fundamental determinant of their global dominance. This large-scale gross surplus materially enables the leaders to construct the rules of the game in international economic relations, while regulatorily restricting the diffusion of material and financial resources beyond their borders.

At the same time, the indicators of the Semi-periphery reflect a tendency towards structural incompleteness and record the deep heterogeneity of this bloc. Although the aggregate production capacity of the E7 group allows it to act as a significant alternative macroeconomic pole, the colossal demographic pressure effectively neutralises the scale of nominal output. This keeps per capita income indicators precisely at the threshold of the global average, forming a stable dichotomy between gross and qualitative development outcomes. A vivid empirical manifestation of this dichotomy is the fact that, despite nearly identical gross shares in the world economy, the systemic gap in GDP per capita between the institutional Core and the Semi-periphery remains critical, reaching 4.6 times.

The most pronounced asymmetry is observed in the parameters of the Periphery, where a causal link emerges between the existing landscape of international economic relations and the chronic marginalisation of the least developed countries. The vast share of the global population concentrated in this segment is effectively excluded from the processes of fair distribution of world income due to inefficient resource allocation within the system of international trade. The calculation results vividly capture this geoeconomic divide: despite encompassing nearly half of humanity, the average per capita income level in the Periphery is critically low, amounting to only about one quarter of the global average, while compared to the institutional Core this qualitative gap exceeds 17 times. Traditional markets of peripheral countries undergo systemic elimination from highly profitable legal flows, which conserves their overall backwardness and nullifies the potential of internal integration initiatives.

Recording only the gross volumes of world production does not fully reveal the deep drivers of global asymmetry, since the nominal scale of an economy often conceals its structural vulnerability. To uncover the qualitative nature of global segregation, it is necessary to analyse the structure of international trade flows in terms of the technological intensity of products (Zubko, 2011) and the information and communication technology (ICT) sector. The degree of countries' involvement in the export and import of high- and medium-technology goods, assessed both relative to trade structures and to the scale of national economies, serves as the key marker of the distribution of intellectual rent within the world-system. The empirical reflection of this technological differentiation and the patterns of intellectual rent distribution is represented by our calculated indicators, structured in Table 2.

The qualitative polarisation of the world-system in the coordinates of the technological dimension of international trade makes it possible to identify the deep trends of contemporary international economic relations.

3. Analysis of the Consequences of Deformations in the Segments of the World Hierarchy

The analysis of the parameters of the first geoeconomic segment confirms that the institutional Core continues to confidently maintain its status as the global coordinator of high-technology development and the principal beneficiary of intellectual rent. The aggregate share of high- and medium-technology exports of the G7 countries has reached 61.8% of total exports, which is an inherent feature of the developed Center. This consolidated technological surplus serves as the fundamental determinant of its financial dominance.

At the same time, a clear differentiation of indicators reveals an important structural feature: the core of the G7 countries' dominance in material flows lies precisely in the medium-technology segment (where the parameters of Japan and Germany exceed the 55–60% mark), which creates a colossal macroeconomic burden on the national product (in Germany, for instance, aggregate industrial exports generate almost one third of GDP). By controlling the rules of global capital allocation and patent rights, the Core leaders minimise their dependence on imports of ICT goods, keeping it at a low level relative to GDP (almost twice below the global average), thereby protecting their domestic markets from technological depreciation.

At the same time, the macrostructural indicators of the Semi-periphery reflect the trend of forming a specific 'production vanguard' of the planet, recording the deep internal heterogeneity of this bloc. The analysis of updated graphs illustrates a stable geoeconomic dichotomy: the group of E7 countries formally surpasses the Core in terms of the share of purely high-technology exports (both in the overall structure of supplies and relative to GDP), with China, South Korea, and Mexico acting as the key drivers. However, this expansive trend is accompanied by a parallel abnormally high level of imports of ICT sector components, which, in relation to GDP, is several times higher than the corresponding parameters of developed states. This empirically proves that the Semi-periphery functions predominantly as a global assembly conveyor, whose high-technology

Table 2

Technological differentiation of trade turnover by segments of the global hierarchy in 2023

Segment	HTE and MTE, % of total exports			HTE and MTE, % o GDP			ICT goods imports, % of total imports	ICT goods imports, % of GDP
	total	incl.		total	incl.			
		HTE	MTE		HTE	MTE		
World	**43,1**	**17,5**	**25,6**	**10,3**	**4,2**	**6,1**	**11,9**	**2,8**
Core (G7 Group)	**61,8**	**18,9**	**42,9**	**10,5**	**3,2**	**7,3**	**9,2**	**1,9**
United States	57,4	16,8	40,6	4,7	1,4	3,3	10,2	1,1
Germany	71,9	15,2	56,7	29,7	6,3	23,4	7,6	2,7
Japan	78,5	17,4	61,1	12,7	2,8	9,9	9,1	1,8
United Kingdom	48,2	19,2	29	7,7	3,1	4,6	8,4	1,7
France	52,1	21,3	30,8	11	4,5	6,5	8,9	2,1
Italy	54,3	10,4	43,9	14,6	2,8	11,8	7,1	1,7
Canada	51,2	11,2	40	12,3	2,7	9,6	8,5	2,1
Semi-periphery (E7 Group)	**45,2**	**22,4**	**22,8**	**11,7**	**5,8**	**5,9**	**16,5**	**4,2**
China	54,6	26,1	28,5	10,6	5,1	5,5	21,5	3,6
India	36,4	6,5	29,9	4,7	0,8	3,9	9,8	1,4
Brazil	34,1	6,2	27,9	5,1	0,9	4,2	10,5	1,7
Mexico	51,8	18,8	33	19,6	7,1	12,5	15,2	6,1
South Korea	72,1	21,2	50,9	27,8	8,2	19,6	14,3	5,1
Indonesia	31,5	8,5	23	5,2	1,4	3,8	11,1	1,9
Turkey	35,9	3,4	32,5	9,8	0,9	8,9	8,3	2,4
Periphery	**18,6**	**4,2**	**14,4**	**2,7**	**0,6**	**2,1**	**5,1**	**0,9**

Notes: HTE – high-technology exports, MTE – medium-technology exports

Source: calculations by the authors based on World Bank data

surplus is critically dependent on the import of Western semiconductors, microchips, and basic innovative solutions.

A vivid manifestation of the internal heterogeneity of the segment is also India, Brazil, and Turkey, where the share of purely high-technology commodity exports in GDP does not even reach the one-percent mark, which indicates their continued raw-material or low-technology specialisation.

The most pronounced critical structural asymmetry is observed in the parameters of the Periphery, where the calculations record manifestations of a direct causal link between the absence of an innovative basis and the chronic marginalisation of economic development. The indicators of both high-technology and medium-technology exports in this segment are negligible, together not even providing 3% of GDP load, while the level of the Periphery's involvement in global high-tech exports is more than four times lower than the world average. Traditional economies undergo systemic elimination from highly profitable legal value-creation chains due to their inability to overcome the strict technical and regulatory filters of the Core. This conserves their technological dependence, forcing them to remain merely suppliers of primary resources for the needs of the Core and Semi-periphery, which significantly nullifies the potential of their internal integration initiatives. The cumulative effect of non-equivalent technological exchange is traced along the retrospective vector of the unfolding of world-system polarisation (Fig. 1).

The process of the chronic elimination of technologically vulnerable actors from the Periphery and Semi-Periphery from markets characterised by high intellectual rent is leading to an unprecedented widening of the economic divide between the poles of the world system. The trajectory of per capita middle-income development empirically confirms that liberalisation models of world trade have not only failed to level out inter-level disparities but have also acted as a catalyst for their deepening.

Between 1960 and 2023, GDP per capita in the G7 countries increased 36.6-fold, reaching an all-time high. The most dramatic divergence in trends occurred between 1980 and 2000, coinciding with the unfolding of the third scientific and technological revolution and the Western countries' monopolisation of the first global digital and financial platforms. Control over the allocation of global innovation resources allowed the Core to maximise its lead over the lower echelons of the hierarchy, recording peak levels of segregation at the turn of the millennium: in 2000, the per capita income gap between the Core and the Semi-Periphery stood at 16.4 times,

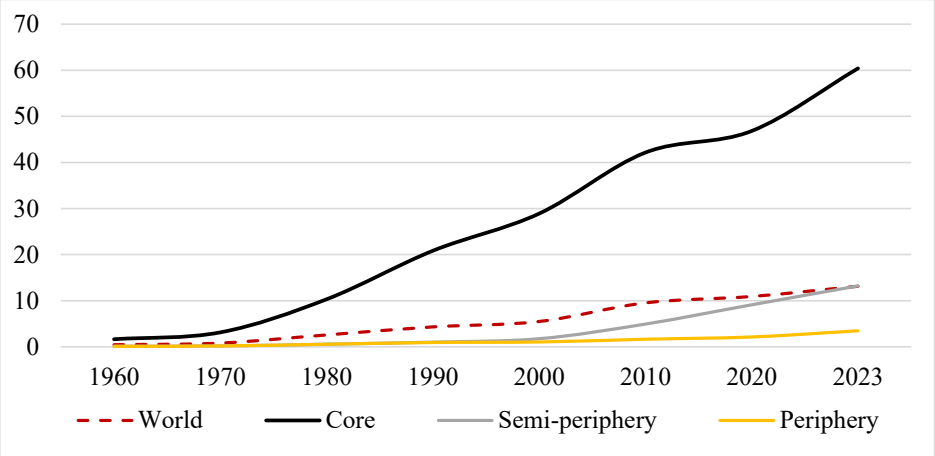

Figure 1 Dynamics of GDP per capita by segments of the world hierarchy, 1960–2023 (thousand USD)

Source: Authors' calculations based on World Bank data

whilst with the countries of the Periphery it reached a critical level of 27.5 times.

The trends in the indicators for the Semi-Periphery (Group E7) show record growth in GDP per capita (93.1-fold between 1960 and 2023) and a steady narrowing of the gap with the Core (from 20.5-fold in 1990 to 4.5-fold in 2023). This indicates the success of catch-up modernisation. However, a comparison of these data with the trade structure analysed earlier (see Table 2) shows that this convergence is primarily the result of a massive industrial surge by certain Asian giants (primarily China and South Korea), which have transformed into the 'world's factory'. Even despite the massive expansion of industrial exports, the semi-periphery only managed to catch up with the global average income level in 2023 ($13,220 compared to $13,142 globally), confirming the persistence of its dependent status due to the need to pay intellectual rent to the Core for basic technologies.

The indicators for the lowest segment, the Periphery, serve as irrefutable proof of a causal link between the lack of a domestic technological base and chronic economic marginalisation. Although in absolute terms the indicator has increased 32.5-fold over the entire sixty-year cycle, in relative terms the Periphery remains trapped in a raw materials trap. A certain formal narrowing of the gap between the Periphery and the Core in the period after 2010 (from 25.5 to 17.3 times in 2023) is not due to a real technological breakthrough by poor countries, but exclusively to a demographic boom in these regions and the inflationary inflation of nominal gross indicators.

An assessment of long-term cumulative effects through the lens of calculated growth indices spanning more than sixty years suggests that technological protectionism acts as a driving force behind the preservation of the global hierarchy. The rapid rise of the Semi-Periphery, which increased its average GDP per capita by a factor of 93.1 (almost three times the growth rates of the Periphery – 32.5 times – and the Core – 36.6 times), vividly illustrates the phenomenon of 'compressed development' in the era of supply chain relocation (Whittaker, 2020).

The essence of this macroeconomic phenomenon lies in a fundamental shift in the temporal parameters of modernisation: unlike the classical stage-based development of the last century, today's developers are forced to roll out industrial capacity and digital infrastructure simultaneously, effectively bypassing the intermediate stages of capitalism's evolution. However, the flip side of such intensification is the effect of 'thin industrialisation', whereby the integration of the E7 countries into global value chains is limited to narrow, predominantly assembly-based operations. Even though the E7 economies are demonstrating rapid growth (around 3.5% annually), this process remains technologically unequal. As Kozlova and Didenko (2022) demonstrate, increased investment in R&D in Core countries yields a significantly higher quality-of-life multiplier (through social benefits and innovation), whereas in the E7 countries, similar investments have limited social impact, highlighting a structural gap between gross output and real well-being.

The consequence of such a distortion is the emergence of chronic vulnerability among new industrial giants: by adopting ready-made foreign technological solutions, they instantly exhaust the scope for internal geo-economic manoeuvre. The rapid rise in the cost of the national labour force, in the absence of sovereign, game-changing innovations, creates a trap of premature deindustrialisation for the Semi-Periphery, as transnational capital easily migrates to cheaper peripheral regions.

This is precisely why this large-scale industrial leap did not lead to the elimination of systemic asymmetry, but merely altered its nature, deepening the original dichotomy between gross output and the quality of life of the population. The institutional Centre's monopolisation of key innovations brings about the regulatory elimination of weaker actors from the processes of distributing pure intellectual rent, transforming the architecture of the international economic system into a closed system where legal channels for levelling out economic well-being remain artificially blocked.

The cumulative effect of unequal technological exchange and regulatory pressure from the Core is not limited to purely macroeconomic imbalances, but manifests itself in profound structural disruption within the Semi-Periphery and Periphery countries themselves. The blocking of legal, high-profit export channels through strict non-tariff restrictions perpetuates the technological backwardness of the Global South and triggers destructive socio-economic processes.

Firstly, there is a proliferation of informal employment. When national capital in the Periphery is unable to certify its products to Core standards, it is forced into the informal sector. This trend is most acute in Sub-Saharan African countries, where the informal economy accounts for 50–75% of the total working-age population, which finds itself completely excluded from the official distribution of GDP (Guha-Khasnobis, 2006). Secondly, this asymmetry exacerbates gender marginalisation: up to 90% of the female population in the poorest regions of the Periphery are pushed into the sphere of undeclared artisanal or domestic labour, which lacks institutional protection. Thirdly, in attempting to offset chronic trade deficits, Periphery countries fall into chronic debt traps. Striking examples include such peripheral entities as Djibouti (external debt – 102.9% of GDP) and Eritrea (248.9% of GDP) (Iloh et, al, 2023). The foreign currency loans they receive are spent not on innovative modernisation, but on servicing interest payments to financial institutions in the Core.

These distortions compel economic agents in the Semi-Periphery and the Periphery to seek ways of adapting to an asymmetrical international environment. As contemporary econometric studies (Oxford Economic Papers, 2024) show, there is a direct correlation between an increase in the density of the Core's non-tariff barriers and a rise in the volume of undeclared trade. The logic of this process is described by transaction cost theory: when the costs of legally overcoming non-tariff barriers become economically unviable, they begin to exceed the cost of the risk of smuggling or artificially undervaluing customs value.

This triggers three fundamental processes of institutional trade degradation:

1. the camouflaging of goods flows (deliberately reclassifying products as simple raw materials with lower certification requirements);
2. the artificial under-declaration of invoice values to offset financial losses incurred from undergoing Core laboratory tests;
3. the criminalisation of logistics chains through the circumvention of digital and technical filters in high-profit markets.

Thus, the non-tariff protectionism of the institutional Core is the root cause of the chronic shadowing of international trade in the lower segments of the world system.

4. Conclusions

An analysis of the dynamics and macrostructural parameters of the world-system allows us to draw the following scientific conclusions.

Technological protectionism acts as the dominant mechanism of geo-economic segregation. The monopolisation of intellectual rent by Core countries and the digitalisation of instruments of influence have replaced traditional tariff-based methods of regulation. This ensures the stable preservation of the world system's hierarchical structure and limits the diffusion of innovations beyond the institutional Centre.

The contemporary division of labour reflects a qualitative transformation of 'dependency traps' for the lower echelons of the global hierarchy. Despite outpacing GDP growth, the Semi-Periphery (the E7 group) demonstrates the effect of 'thin industrialisation', where exports of high-tech goods are derived from critical imports of Western ICT components. Peripheral countries, in turn, remain systematically trapped in the primary raw materials sector due to their inability to integrate into high-profit value chains.

Non-tariff protectionism has created a latent 'regulatory trap' in the global market. The roll-out by Core countries of a system of highly complex technical regulations, sanitary and environmental standards (in particular CBAM) has created a barrier whereby formal trade liberalisation is offset by the excessive cost of certification procedures, which for peripheral producers often exceeds the net cost of production.

Institutional pressure from the Centre is causing profound structural distortions in peripheral economies. Restricted access to legal markets exacerbates three macro-structural anomalies: the excessive expansion of informal employment, widespread gender marginalisation in labour markets, and the formation of chronic debt traps driven by the need to cover persistent trade deficits.

Increased non-tariff pressure acts as a direct catalyst for the informalisation of international trade. In

the context of transaction cost theory, it has been demonstrated that when the cost of legally navigating the Centre's regulatory barriers exceeds the risks of smuggling, economic agents resort to systematically circumventing formal rules. The main tools for such adaptation are the camouflaging of product ranges as raw material groups, the manipulation of invoice values, and the criminalisation of logistics chains, leading to the overall institutional degradation of trade flows.

Future research in this area should focus on the following key areas:

– the creation of 'adaptive regulatory hubs' in semi-peripheral countries, which would enable local producers to minimise transaction costs associated with certification and compliance with environmental standards without losing competitiveness in core markets;

– developing a methodology for transitioning from 'grey' logistics schemes to transparent digital trade tools, involving the implementation of blockchain solutions to track the origin of goods. This will help mitigate the risks of invoice value manipulation and ensure the integration of national agents into legitimate value chains;

– exploring alternative ways out of 'debt traps' through the development of regional technological alliances. The focus should be on creating our own quality standards and digital ecosystems that reduce dependence on the technological dictates of the Centre and promote the diversification of export markets, reorienting them towards partnerships within the group of developing countries.

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