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Regional remuneration divergence in Slovakia: The role of FDI as a conditioning factor

Regionálna divergencia odmeňovania na Slovensku: úloha PZI ako podmieňujúceho faktora

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Abstract: The study examines regional disparities at the NUTS 3 level in Slovakia over the period 1996–2022 through real convergence in remuneration per capita. Building on the theoretical framework of regional convergence, the analysis assumes that less developed regions should exhibit faster growth, allowing observed trends to be evaluated in the context of expected convergence or divergence. The aim is to quantify disparities and examine the relationship between foreign direct investment and remuneration dynamics. Conditional β-convergence and robustness-based σ-convergence are applied, complemented by the Lorenz curve and the Gini coefficient. The estimates indicate β-divergence: regions with higher initial remuneration experienced larger absolute increases, leading to widening differences. The relationship between FDI and remuneration growth is positive but only marginally significant. The results also confirm σ-divergence and a rise in inequality as measured by the Gini coefficient. The findings clearly show that regional disparities in remuneration continue to widen, while the link between foreign direct investment and wage growth remains weak. These results highlight the need for a deeper examination of the mechanisms shaping regional wage formation and the factors driving persistent divergence across Slovak regions.

Key words: *Remuneration. Beta-divergence. Sigma-divergence. Regional disparities.*

JEL Classification: R12. J31. O47.

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Introduction

Regional disparities in labour income represent a persistent feature of the Slovak economy and remain central to debates on territorial cohesion. Although Slovakia has experienced strong economic growth and increasing integration into international production networks, wage differences between regions continue to reflect significant structural imbalances.

Despite the extensive literature on regional development in Slovakia, most empirical studies focus on output-based indicators such as GDP per capita or labour productivity. Considerably less attention has been devoted to remuneration per capita, which more directly captures labour-market outcomes and household income conditions. At the same time, foreign direct investment, a fundamental driver of industrial transformation in Slovakia, has been analysed largely in relation to productivity, while its association with regional remuneration dynamics remains insufficiently explored.

This study addresses these gaps by examining whether Slovak regions experienced real convergence or divergence in remuneration per capita over the period 1996 to 2022 and by assessing whether FDI acts as a conditioning factor in this process. Using annual data for NUTS 3 regions, we apply a panel β-convergence framework complemented by σ-convergence and inequality measures such as the Lorenz curve and the Gini coefficient. The contribution of the study lies in applying convergence methods directly to labour income, incorporating FDI into the analysis, and providing long-term evidence on the evolution of regional wage disparities in Slovakia.

Persistent regional disparities in remuneration represent not only an economic imbalance but also a structural phenomenon rooted in long-standing differences in industrial composition, labour-market segmentation, innovation capacity, and the spatial concentration of capital. While performance-based indicators often capture convergence driven by cyclical growth or external shocks, wage indicators reflect deeper and more rigid processes linked to productivity differentials, institutional wage-setting mechanisms, and regional variations in the quality of human capital. These processes adjust more slowly, making remuneration a more sensitive indicator of deeply embedded structural inequalities rather than short-term fluctuations.

The Slovak economy has undergone several profound transformations, including the transition to a market economy, accession to the European Union, technological change, and shifts in global value chains, each of which has had uneven regional effects. Such shocks may reinforce the existing advantages of core regions while reducing the absorption capacity of

peripheral areas. In this context, analysing the dynamics of remuneration is crucial for identifying whether economic integration supports territorial equalisation or, conversely, strengthens spatial divergence.

The relevance of examining regional disparities in remuneration remains high because widening wage differences have implications that extend beyond the labour market itself, as they influence internal migration, the spatial distribution of skilled labour, the fiscal capacity of regions, and long-term socio-economic cohesion. If disparities persist or intensify despite sustained economic growth, this indicates that market mechanisms alone may be insufficient to correct structural imbalances. A deeper analytical focus is therefore required to identify the forces driving persistent divergence and to assess how structural factors, including but not exclusively foreign direct investment, shape regional wage development over time.

1 Theoretical framework and literature review

Regional convergence remains one of the central topics in growth and spatial economics. According to neoclassical growth theory, economies tend to approach a steady-state level of output and income, implying that less developed regions should grow faster than more advanced ones. Empirically, this process is typically analysed by means of β-convergence, which examines the relationship between initial income levels and subsequent growth, and σ-convergence, which tracks the evolution of dispersion across regions (Solow, 1956; Monfort, 2008; Barro, Sala-i-Martin, 1992).

Despite these theoretical expectations, empirical evidence for Europe reveals that regional convergence is far from uniform. Several studies document substantial differences in regional growth trajectories shaped by factors such as industrial structure, agglomeration forces, and the spatial concentration of economic activity. In many EU member states, national-level income convergence has coincided with persistent or even widening regional disparities (Fingleton, 1999; Geppert, Stephan, 2008; Goecke, Hüther, 2016; Ezcurra, 2019).

The experience of Central and Eastern Europe illustrates this divergence particularly clearly. The transition to a market economy and subsequent EU integration fundamentally reshaped regional economic dynamics. Although CEE countries generally converged towards EU income levels, regional inequalities within countries often increased. Slovakia represents a notable example, as despite recording one of the fastest GDP growth rates in the EU during the 2000s, its regional disparities remained persistent or intensified (Cuaresma et al., 2012; Tvrdoň, Skokan, 2011; Klamár, 2008).

Foreign direct investment is frequently highlighted as an important factor influencing these patterns. On the one hand, FDI may promote convergence through technology transfer and productivity growth. On the other hand, when FDI inflows are spatially concentrated in economically stronger regions, they may reinforce existing disparities and contribute to regional divergence (Borensztein et al., 1998; Kolasa, Bijsterbosch, 2009; Crescenzi, Iammarino, 2018).

Most empirical studies on convergence in Central and Eastern Europe, including Slovakia, use GDP per capita or labour productivity as primary indicators of regional development (Jarmużek, Banerjee, 2009; Tvrdoň, Skokan, 2011). Comparatively little attention has been given to regional wage convergence, despite the fact that remuneration per capita provides a more direct measure of labour-market performance and household living standards.

This gap motivates the present study, which examines real convergence in remuneration per capita across Slovak regions and explores the role of FDI as a conditioning factor. By combining β- and σ-convergence frameworks with region-level data, the analysis contributes to understanding whether foreign investment acts as a mechanism of regional equalisation or, conversely, amplifies wage inequality across space. These theoretical considerations form the basis for the empirical approach outlined in the following sections..

2 Material and methods

In this study, regional disparities are measured through real convergence in remuneration per capita. The primary objective is to quantify regional disparities in remuneration per capita at the NUTS 3 level in the Slovak Republic. Building on this framework, a secondary objective is to assess the relationship between foreign direct investment and the dynamics of remuneration through conditional β-convergence. The analysis does not aim to identify causal effects of FDI on remuneration. Instead, FDI is included solely as a conditioning factor within the β-convergence framework, capturing associations rather than causal relationships.

We address the following research questions:

1. RQ1: Do the regions of the Slovak Republic exhibit real convergence in remuneration per capita over the period 1996 to 2022, in the sense of β-convergence and σ-convergence?
2. RQ2: What is the relationship between foreign direct investment and remuneration per capita across Slovak regions?

Convergence is assessed using two complementary approaches:

- Conditional β-convergence: We test whether regions with a lower initial level of remuneration per capita exhibit faster growth, conditional on their exposure to foreign direct

investment. This specification captures statistical associations rather than causal mechanisms. A positive coefficient indicates β-divergence, while a negative coefficient indicates β-convergence (Barro and Sala-i-Martin, 1992).

- σ-convergence (robustness check): To assess robustness, we examine whether cross-regional dispersion in remuneration levels declines over time, measured by the sample standard deviation and sample variance. A downward trend in these dispersion measures indicates narrowing regional disparities (Muchová and Chrenková, 2008).

The convergence approaches applied in this study, namely β-convergence and σ-convergence, are general methods for assessing the narrowing or widening of levels across units such as regions, countries, or other groupings. Beyond measuring regional disparities in remuneration, these methods are commonly applied to other economic variables, for example inflation when comparing EU countries or other aggregates (see, for example, Budová, 2024).

The literature on regional convergence predominantly relies on indicators such as GDP per capita (Lalinský, 2015) or labour productivity, while regional disparities in the Slovak Republic are rarely examined through remuneration per capita. An even more pronounced gap concerns the direct assessment of the relationship between foreign direct investment and remuneration at the regional level. This study addresses these gaps by, first, evaluating convergence directly using remuneration per capita as the market price of labour and an immediate source of household income and, second, explicitly examining the relationship between FDI and remuneration dynamics within a NUTS 3 panel framework.

Building on this identified gap, we also provide an economic rationale for the chosen measure and the mechanisms through which FDI may affect remuneration. Remuneration per capita captures regional labour-market conditions and labour income directly and is therefore sensitive to changes in labour demand, skill composition, and institutional settings. Foreign direct investment may influence remuneration through several channels, including capital accumulation and job creation, technological and managerial spillovers to domestic firms, supply-chain linkages, and shifts in bargaining power and skill demand. However, when FDI is spatially concentrated in core regions, its effects may be associated with deeper regional disparities if diffusion to peripheral areas is limited. Analysing convergence through remuneration per capita and examining the relationship between FDI and remuneration therefore provides an economically relevant and still underutilised perspective on regional disparities in Slovakia.

Data

The analysis covers the eight NUTS 3 regions of Slovakia: Bratislava, Trnava, Trenčín, Nitra, Žilina, Banská Bystrica, Prešov, and Košice. The observation period spans 1996 to 2022 at an annual frequency. The dataset constitutes an unbalanced panel, and missing observations were not imputed.

The variables used in the model are as follows:

- Remuneration of employees: originally reported in current prices in million euros by region and converted to per capita values expressed in euros per person.
- Foreign direct investment, annual inflow: originally reported in thousand euros by region and converted to per capita values expressed in euros per person.
- Population: used exclusively for per capita conversions.

Regional FDI data were obtained from the National Bank of Slovakia, while data on remuneration and population were sourced from the Statistical Office of the Slovak Republic.

Model specification:

$$Remuneration\ growth_{it} = \beta_0 + \beta_1 initial\ level\ of\ remuneration\ per\ capita_{i,t-1} + \beta_2 FDI_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (1)$$

where μ_i denote region fixed effects, absorbing time-invariant regional differences, and τ_t denote year fixed effects, capturing common annual shocks. A negative estimate of β_1 indicates β-convergence, whereas a positive estimate indicates β-divergence. The parameter β_2 captures the statistical association between foreign direct investment per capita and the growth of remuneration.

As a robustness component of the analysis, we also report σ-convergence by tracking the time path of the cross-sectional standard deviation and variance of remuneration levels across regions.

To complement the β- and σ-convergence analysis, we plot the Lorenz curve for the regional distribution of remuneration per capita for selected years, specifically 1996 and 2022. For each year, regions are ordered in ascending order according to remuneration per capita in real euros per person. We then compute the cumulative share of regions on the horizontal axis and the cumulative share of remuneration on the vertical axis, and plot these points against the line of equality (Gastwirth, 1972). Inequality is summarised using the Gini coefficient, which measures the distance of the Lorenz curve from the diagonal, where zero indicates perfect equality and one indicates maximal inequality. A more pronounced curvature of the Lorenz

curve and a higher Gini coefficient in the later year indicate greater interregional disparities in remuneration.

3 Results

Empirical estimates indicate a systematic association between the initial level of remuneration and the subsequent dynamics of remuneration growth across regions, while foreign direct investment is included as a conditioning factor rather than a causal determinant.

Table 1 reports estimates of the relationship between the initial level of remuneration per capita and subsequent remuneration growth, controlling for FDI per capita. The coefficient on Initial level of remuneration is positive and statistically significant (estimate = 0.00887, p = 0.00006), indicating that regions with higher initial remuneration per capita experience larger subsequent increases in remuneration measured in absolute euros per capita. This result points to β-divergence, as differences in remuneration levels widen under this definition of growth.

The coefficient on FDI per capita is positive and marginally significant (p = 0.079), suggesting a weak positive association between per-capita FDI inflows and subsequent remuneration growth. Given the borderline level of statistical significance, this relationship should be interpreted with caution.

From the perspective of regional disparities, these estimates imply that higher-remuneration regions add larger absolute amounts to remuneration levels than lower-remuneration regions, thereby increasing gaps in final remuneration per capita. Substantively, this pattern is consistent with the β-divergence plots, which exhibit an upward-sloping relationship, the evidence of σ-divergence reflected in rising dispersion, and the Lorenz curve and Gini coefficient results, which together indicate increasing interregional inequality.

Table 1 Conditional β-convergence of remuneration

Remuneration growth	**Independent variables**			
	Initial level of remuneration		**FDI per capita**	
	Estimate	p-value	Estimate	p-value
	0.00887	0.00006 ***	0.00001	0.07934 .

Note: ***; . denote statistical significance at the 0.1%, and 10% levels.
Source: own calculations based on data from the NBS and the Statistical Office of the Slovak Republic

Figure 1 depicts the relationship between the initial level of remuneration per capita on the horizontal axis and subsequent remuneration growth on the vertical axis, with each dot representing a region–year observation. The blue line shows the estimated linear trend. The positive slope of this regression line provides visual evidence of β-divergence, indicating that

regions with higher initial levels of remuneration subsequently record larger increases in euros per capita. This pattern implies that regional differences in remuneration levels persist and tend to widen over time.

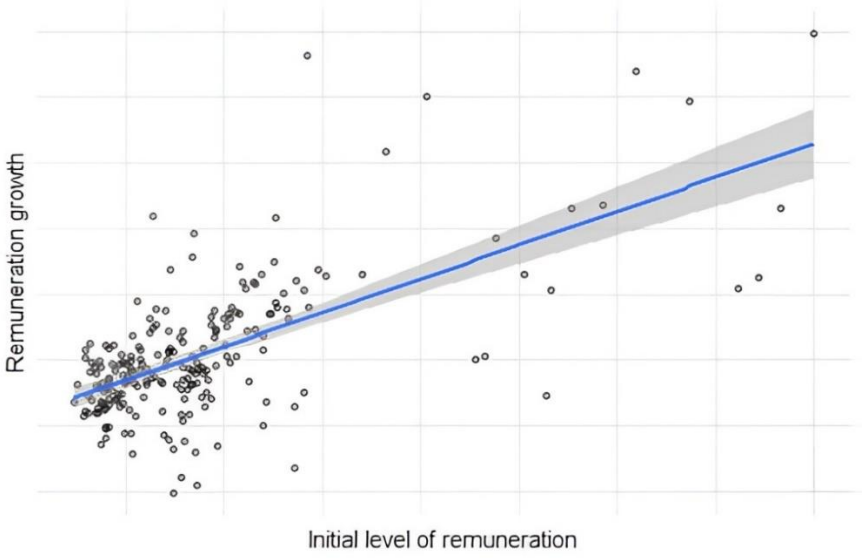

Figure 1 Beta-divergence
Source: own processing

Figure 2 illustrates the evolution of interregional dispersion in remuneration per capita over time. Comparing the first and last years of the sample, the variance increased from 0.226 to 26.483 and the standard deviation rose from 0.476 to 5.146, indicating σ-divergence. In other words, regional differences in remuneration per capita have deepened over time, with gaps between regions being substantially larger at the end of the period.

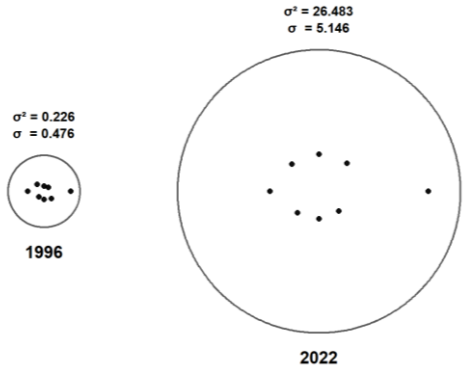

Figure 2 Sigma-divergence
Source: own processing

Figure 3 compares remuneration per capita in the initial and final years for each region and illustrates their net change over the period 1996 to 2022. Although all regions experienced growth in remuneration per capita, the magnitude of this growth varies markedly, with a substantial gap between the smallest and the largest increase. From a disparities perspective,

this implies that final remuneration levels are more dispersed than at the beginning of the period. Regional differences in remuneration have therefore widened, and the gaps between regions have deepened. This pattern of divergence is consistent with the increase in interregional dispersion identified in the σ-convergence analysis.

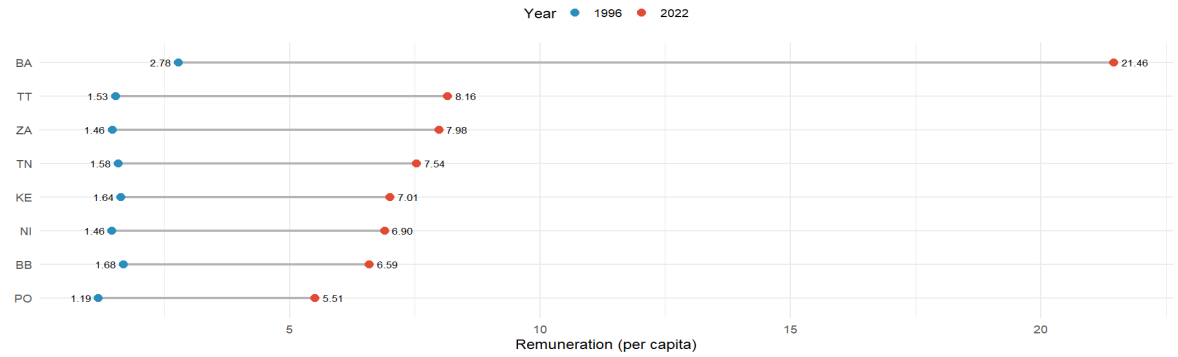

Figure 3 Change in remuneration by region (1996 → 2022)
Source: own processing

Figure 4 presents the Lorenz curves for the distribution of remuneration per capita across regions in the initial and final years of the sample. The curve for 2022 lies further from the line of absolute equality and is accompanied by a higher Gini coefficient. This indicates that a larger share of total remuneration is concentrated in a smaller number of regions than at the beginning of the period. In other words, inequality in the regional distribution of remuneration has increased over time, corroborating the evidence from the σ-divergence analysis and the comparison of cumulative changes across individual regions.

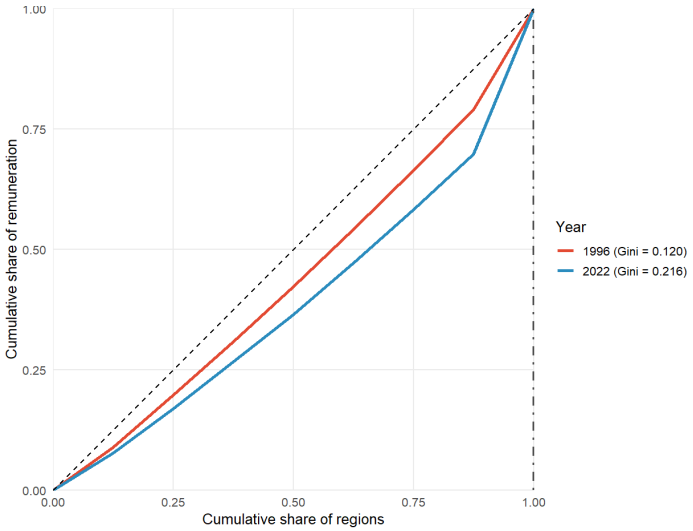

Figure 4 Lorenz curves of remuneration by region
Source: own processing

4 Discussion

Comparison with the literature indicates consistency with the conclusions of Banerjee and Jarmużek (2010), who assess regional disparities using β- and σ-convergence analyses based on GDP per capita and labour productivity and conclude that regional differences persist or deepen over time. Although the present study uses remuneration per capita, understood as the market price of labour and a direct source of labour income, rather than output-based indicators, the direction of the findings is comparable. Regional disparities persist and tend to widen whether measured on the income side, through remuneration, or on the output side, through GDP or productivity. From a methodological perspective, the overlap is also clear, as both approaches combine β- and σ-convergence frameworks, with σ-based measures providing a robust picture of the widening or narrowing of cross-regional dispersion. This suggests that the divergence observed in Slovakia is not specific to a particular indicator, but rather reflects deeper structural mechanisms that operate similarly across both production-based and income-based measures.

Since remuneration per capita captures labour-market outcomes more directly, the alignment of our findings with GDP-based studies indicates that regional disparities are embedded in long-term differences in economic structure, labour-market composition, and regional development capacity. The consistency of convergence results across different types of indicators reinforces the interpretation that regional divergence in Slovakia represents a persistent and systemic feature, rather than a cyclical or short-term fluctuation.

The findings of this study are also consistent with those reported by Klamár (2016). His analysis, based on the Gini coefficient and the coefficient of variation across a range of socio-economic indicators, documents a deepening of regional disparities in Slovakia, with only temporary stabilisation after 2008. Our results for remuneration per capita confirm this conclusion. The Gini coefficient for remuneration is higher in the final year than in the initial year, the Lorenz curve lies further from the line of equality, and σ-dispersion of remuneration levels across regions has increased. Taken together, these results indicate that interregional inequality in remuneration rose over the period considered, in line with the development described by Klamár (2016).

By complementing Klamár's findings with income-based evidence, the present study demonstrates that the widening of regional disparities is visible not only in broader socio-economic aggregates, but also in the primary distribution of labour income. This adds an important dimension to the understanding of regional inequality. While composite socio-

economic indicators reflect a wide set of conditions, remuneration per capita directly captures the economic position of households. The increasing curvature of the Lorenz curve and the rise in inequality measures therefore point to a deepening divergence in living standards and labour-market opportunities across regions. The alignment of patterns across different inequality metrics strengthens the conclusion that regional gaps have widened simultaneously along multiple dimensions.

The findings of this study also build on the work of Habaník, Hošťák and Kutík (2013), who emphasise the importance of foreign direct investment as one of the key determinants of regional differences in Slovakia. In the context of our results, regional disparities have widened, while foreign direct investment appears to be a potential rather than a clearly identified driver of these differences. The positive but only marginally significant association between FDI per capita and remuneration growth suggests that although foreign investment may contribute to wage increases, its effect is not sufficiently strong to offset broader divergence forces.

This pattern may indicate that regional capacities to absorb and transform investment inflows into higher labour income differ substantially, which is consistent with the literature highlighting the role of structural conditions, human capital, and regional economic profiles in mediating the effects of foreign direct investment (Borensztein et al., 1998; Crespo and Fontoura, 2007). In this sense, FDI functions more as a complementary factor, with its impact depending on pre-existing regional characteristics, rather than as a uniform mechanism capable of driving convergence. Overall, the results suggest that widening regional disparities in Slovakia are shaped by a combination of structural, institutional, and investment-related factors, with foreign direct investment playing a conditional and region-specific role rather than a dominant or decisive one.

Conclusion

The results of the analysis indicate that the regions of the Slovak Republic did not exhibit real convergence in remuneration per capita over the period 1996 to 2022. On the contrary, β-divergence was identified, meaning that regions with higher initial levels of remuneration recorded larger absolute increases, thereby widening interregional disparities. The answer to research question RQ1 is therefore that regional differences in remuneration increased over the examined period. This conclusion is further supported by evidence of σ-divergence and a rising Gini coefficient, both of which clearly point to growing wage inequality across regions.

With respect to research question RQ2, the relationship between foreign direct investment and remuneration growth is positive but only weakly supported by statistical evidence. This

suggests that although foreign direct investment may contribute to increases in remuneration, the association is not sufficiently strong to promote real convergence across regions. The spatial concentration of investment in economically more developed areas is therefore likely to reinforce existing disparities rather than mitigate them.

From a methodological perspective, this study contributes to the literature by applying convergence approaches directly to remuneration per capita, understood as the market price of labour and a direct source of household income. In doing so, it complements existing analyses that focus predominantly on output-based indicators such as GDP or labour productivity and provides additional insight into the income dimension of regional disparities.

From a policy perspective, the findings point to the need to strengthen the territorial balance of foreign direct investment and to encourage its greater dispersion beyond economically core regions. At the same time, regional policy should focus on upgrading workforce skills and improving the investment environment in peripheral areas in order to enhance their capacity to attract and absorb higher value-added investment. Such measures could help mitigate divergence in remuneration and contribute to more balanced regional development.

The limitations of the study relate primarily to the scope of the empirical model, which does not incorporate additional variables that may influence regional differences in remuneration. Future research could extend the analysis by including supplementary explanatory factors, which would allow for a more detailed examination of the mechanisms shaping regional disparities in remuneration.

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