Adapting the Herfindahl-Hirschman Index to Measure National Economic Power and Structural Vulnerability: A Case Study of Mongolia

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R.Amarjargal, UFE, Ulaanbaatar, Mongolia
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ABSTRACT

Originally developed in mid-twentieth-century economics to measure trade asymmetry and industrial market concentration (Hirschman, 1945; Herfindahl, 1950), the Herfindahl-Hirschman Index (HHI) offers a mathematically rigorous yet underutilized framework for comparative macroeconomics and international political economy. By substituting corporate market shares with national Gross Domestic Product (GDP), sectoral value added, and bilateral trade shares, the HHI quantifies both systemic power asymmetry across geopolitical blocs and internal structural vulnerability within individual states. Using 2025–2026 macroeconomic and trade datasets from the International Monetary Fund (IMF) and the National Statistics Office of Mongolia (NSO), this paper applies the HHI across three analytical dimensions to evaluate Mongolia's economic standing. The empirical results demonstrate that while Mongolia occupies a modest, middle-ranking position among landlocked (HHI = 1,070.19) and post-socialist economies (HHI = 1,897.22), its immediate regional neighborhood in Northeast Asia exhibits extreme hegemonic concentration (HHI = 5,743.17 nominal; 6,115.45 PPP). Internally, Mongolia displays high sectoral concentration (4-sector HHI = 3,686.79) and acute external trade vulnerability driven by a near-monopsony export partner structure (Partner HHI = 8,041.82). Finally, the paper proposes future methodological refinements—including sub-sectoral decomposition, composite vulnerability indices, and dynamic longitudinal tracking—to establish the HHI as a standard diagnostic tool for small, open, resource-dependent economies.

1. Theoretical Justification: From Market Concentration to National Economic Power

In microeconomic theory, the Herfindahl-Hirschman Index measures the size of firms relative to the industry in which they operate and serves as a primary indicator of horizontal market competition (Rhoades, 1993). Historically, the index emerged from two independent traditions: Albert O. Hirschman (1945) first introduced a square-root concentration index ($\sqrt{\Sigma s_i^2}$) in *National Power and the Structure of Foreign Trade* specifically to measure sovereign trade dependence, while Orris C. Herfindahl (1950) subsequently formulated the unsquared sum-of-squares version (Σs_i^2) to analyze concentration in the U.S. steel industry. In modern usage, the index is expressed as the sum of the squared percentage shares (s_i) of all N entities within a bounded system:

$$\mathbf{HHI} = \Sigma_{i=1}^{N} s_i^2 = s_1^2 + s_2^2 + \ldots + s_N^2$$

Where s_i represents an entity's percentage share of the total system (ranging from 0 to 100), yielding an index bounded between near 0 (perfect dispersion) and 10,000 (pure monopoly, where $100^2 = 10{,}000$). In antitrust enforcement, the U.S. Department of Justice and Federal Trade Commission (2010) categorized markets below 1,500 as unconcentrated, 1,500–2,500 as moderately concentrated, and above 2,500 as highly concentrated—benchmarks later tightened in the 2023 Merger Guidelines to 1,000 and 1,800, respectively.

Extending the HHI to sovereign states is grounded in three core principles of international political economy:

1. **Systemic Polarity and Power Asymmetry:** In structural realist international relations theory, the distribution of material capabilities—chief among them aggregate economic output—determines whether an international or regional system is multipolar, bipolar, or unipolar (Waltz, 1979; Mearsheimer, 2001). As Mansfield (1993) demonstrates, standard polarity counts fail to capture power inequalities among major states, whereas concentration indices capture the *structural geometry* of a geopolitical bloc. Squaring national GDP shares weights large economies disproportionately, reflecting the non-linear nature of geopolitical leverage and standard-setting capacity. Under the 1,500/2,500 benchmark scale, a regional bloc with an HHI above 5,000 operates under effective economic hegemony, whereas a bloc below 1,500 exhibits balanced multipolar interdependence.
2. **Individual Relational Weight (s_i^2):** Within any defined peer group, an individual country's squared share (s_i^2) represents its direct contribution to the bloc's aggregate concentration. Comparing a state's s_i^2 across different geopolitical groupings reveals where it possesses meaningful relative agency versus where it functions as a structural price-taker.
3. **Internal Diversification and External Resilience:** Just as a firm reliant on a single product or buyer faces existential commercial risk, a sovereign state whose Gross Value Added (GVA) or export revenue is concentrated in narrow sectors or bilateral corridors faces acute macroeconomic volatility (Auty, 1993; Frankel, 2010). Applying HHI internally to sectoral output and externally to trade partners transforms a static concentration metric into an early-warning indicator for terms-of-trade shocks, Dutch disease, and asymmetric trade coercion (Hirschman, 1945).

2. Empirical Application: Mongolia's Economic Power and Structural Profile

To demonstrate the analytical versatility of the HHI, Mongolia serves as an instructive case study. As a small, landlocked, post-socialist economy situated between two major Eurasian powers, Mongolia's economic security is shaped simultaneously by its external geopolitical groupings and its internal resource dependence (Pomfret, 2010; World Bank, 2025).

2.1 External Geopolitical Power Across Three Peer Groups

Using 2026 nominal GDP projections and Purchasing Power Parity (PPP) world-share estimates from the International Monetary Fund (2026) World Economic Outlook—where Mongolia's nominal GDP is $31.13 billion and its PPP-adjusted output reaches $81.47 billion (0.04% of global PPP output)—Mongolia's economic power was evaluated across three distinct peer groups:

- **Group A: Former Socialist Countries (*N* = 30):** Encompassing post-communist transition economies across Central and Eastern Europe, the Baltics, the Balkans, the Caucasus, Central Asia, and Mongolia, this bloc exhibits **moderate concentration** with a nominal Group HHI of **1,897.22** (total GDP: $7,376.23B). Economic weight is anchored by Russia ($2,861.16B; s_i = 38.79%; s_i^2 = 1,504.58), followed by Poland ($1,133.09B; s_i = 15.36%; s_i^2 = 235.97) and Romania ($470.09B; s_i = 6.37%; s_i^2 = 40.62). Mongolia holds a **0.42%** nominal share (**0.18** HHI points), ranking **24th** (IMF, 2026). Under PPP valuation, Russia's bloc share expands to 44.04% (1,939.23 points), pushing the Group HHI to **2,237.51**. Mongolia's lower domestic price level lifts its PPP share to **0.52%** (**0.27** points), elevating its rank to **22nd**.
- **Group B: Landlocked Countries (*N* = 43 nominal; 42 PPP):** Across UN-recognized landlocked states with reported IMF data (total nominal GDP: $4,574.20B), economic power is **unconcentrated**, yielding a nominal Group HHI of **1,070.19**. High-income European economies lead the group—specifically Switzerland ($1,135.74B; s_i = 24.83%; s_i^2 = 616.49), Austria ($616.90B; s_i = 13.49%; s_i^2 = 181.89), and Czechia ($427.95B; s_i = 9.36%; s_i^2 = 87.53). Mongolia achieves its strongest relative standing in this peer group, capturing **0.68%** of nominal output (**0.46** points) and ranking **23rd** (IMF, 2026). When adjusted for PPP, high-price European states lose their exchange-rate premium (Switzerland drops to 11.70%, matching Kazakhstan), cutting the Group HHI nearly in half to **618.12** and lifting Mongolia's share past the one-percent threshold to **1.06%** (**1.13** HHI points).
- **Group C: Northeast Asia (*N* = 5):** Evaluating China, Japan, South Korea, Taiwan, and Mongolia (total nominal GDP: $29,185.07B) reveals **extreme hegemonic concentration**, with a nominal Group HHI of **5,743.17**—more than double the 2,500 threshold for high concentration. China ($21,546.40B) commands **73.83%** of regional output (**5,450.39** points), towering over Japan ($4,341.99B; 14.88%; 221.34 points), South Korea ($2,245.85B; 7.70%; 59.22 points), and Taiwan ($1,019.70B; 3.49%; 12.21 points). Mongolia accounts for **0.11%** of regional nominal GDP (**0.01** points), ranking **5th** (IMF, 2026). Under PPP valuation, China's share rises to 76.81% (5,899.33 points), driving the regional HHI to **6,115.45**, while Mongolia registers **0.15%** (**0.02** points). *(Even if Russia's entire $2,861.16B economy is added to form a 6-nation Northeast Eurasian group, the nominal HHI remains heavily concentrated at **4,859.02**, with Mongolia at **0.10%**).*

Table 1. Comparative Geopolitical HHI and Mongolia's Relative Economic Power Score (2026)

Peer Group	Nominal HHI	PPP HHI	Mongolia Nominal Share (s_i)	Mongolia Nominal Score (s_i^2)	Mongolia PPP Share (s_i)	Mongolia PPP Score (s_i^2)
a) Former Socialist	1,897.22	2,237.51	0.42%	0.18	0.52%	0.27
b) Landlocked	1,070.19	618.12	0.68%	0.46	1.06%	1.13
c) Northeast Asia	5,743.17	6,115.45	0.11%	0.01	0.15%	0.02

Source: Author's calculations based on IMF (2026) World Economic Outlook database.

2.2 Internal Sectoral Concentration and Comparative Paradoxes

Applying the HHI to normalized Gross Value Added (GVA) data from the National Statistics Office of Mongolia (NSO, 2026) evaluates domestic economic diversification. Under a standard 3-sector macroeconomic division—Services (49.00%; s_i^2 = 2,401.36), Industry (41.15%; s_i^2 = 1,693.36), and Agriculture (9.85%; s_i^2 = 96.99)—Mongolia registers a high internal HHI of **4,191.72**. However, isolating **Mining & Quarrying** from non-extractive industry provides a sharper diagnostic:

- **Services:** 51.62% (s_i^2 = 2,664.66)
- **Mining & Quarrying:** 28.83% (s_i^2 = 831.02)
- **Agriculture:** 9.83% (s_i^2 = 96.68)
- **Manufacturing & Construction:** 9.72% (s_i^2 = 94.43)
- **Total 4-Sector Internal HHI: 3,686.79** *(High Concentration)* (NSO, 2026)

Comparing Mongolia against **Kazakhstan** (a resource-rich landlocked peer) and **Poland** (an industrialized post-socialist peer) uncovers an important structural nuance—the **Service-Economy Paradox**, consistent with the U-shaped stages of diversification identified by Imbs and Wacziarg (2003) and classical structural growth theory (Kuznets, 1966). On a broad 3-sector basis, Poland exhibits a higher HHI (**5,433.14**, driven by a 67.42% service sector) than Kazakhstan (**4,995.93**, with 61.58% services) and Mongolia (**4,191.35**) (World Bank, 2026; Bureau of National Statistics of Kazakhstan, 2026). Similarly, on a 4-sector basis, Kazakhstan scores **4,415.33** due to its larger service share (61.40%). Yet structural vulnerability lies in the *ratio of extractive to non-extractive industry*: whereas Kazakhstan's

manufacturing, construction, and utilities sector (21.08%) comfortably exceeds its mining sector (13.66%) (Bureau of National Statistics of Kazakhstan, 2026), Mongolia's mining sector (28.83%) is nearly three times the size of its manufacturing and construction base (9.72%) (NSO, 2026).

2.3 External Trade Vulnerability (Partner and Commodity HHI)

The most pronounced concentration appears in Mongolia's external trade sector. Using 2025 full-year export data ($15.7 billion total exports) from the NSO (2026), Mongolia's **Commodity HHI** is **3,450.88**, reflecting a two-mineral duopoly where **copper ore and concentrates (41.4%; 1,713.96 points)** and **coal (40.9%; 1,672.81 points)** generate 82.3% of all export receipts, followed distantly by gold (6.9%), iron ore (2.5%), crude oil (2.0%), cashmere (2.0%), and meat/agricultural goods (1.5%).

More critically, Mongolia's **Export Partner HHI** reaches **8,041.82**—approaching the theoretical ceiling of 10,000. Despite trading with 163 countries, **China** absorbs **89.4%** of Mongolian exports (**7,992.36** HHI points), followed by Switzerland (6.9%; 47.61 points, exclusively gold), South Korea (1.0%; 1.00 point), Russia (0.7%; 0.49 points), and Italy (0.6%; 0.36 points) (NSO, 2026). Mongolia's Partner HHI is more than double its Commodity HHI, empirically confirming Hirschman's (1945) thesis that geographic and logistical dependence on a single bordering monopsony buyer creates profound structural vulnerability.

3. Future Methodological Development of the National HHI

While the calculations above establish the baseline utility of the HHI in macroeconomics, four methodological advancements can elevate it into a premier analytical instrument for economists, central banks, and policymakers:

1. **Multi-Digit Sub-Sectoral Decomposition (Resolving the Service Paradox):** As demonstrated in the comparison with Poland, broad 3- or 4-sector HHI scores penalize post-industrial economies whose service sectors naturally exceed 65% of GDP (Imbs & Wacziarg, 2003). Future applications should standardize calculations at the 2-digit or 3-digit International Standard Industrial Classification (ISIC Rev. 4) level—disaggregating wholesale trade, transport, finance, information technology, and distinct manufacturing sub-industries (United Nations, 2008). At granular levels, genuinely diversified economies will display low HHI scores (<1,000), while resource-dependent economies will remain visibly concentrated.

2. **Composite Sovereign Vulnerability Indices:** Rather than evaluating domestic production, export commodities, and trade partners in isolation, researchers can construct a weighted **Composite Macroeconomic HHI**—combining Internal Sectoral HHI, Export Commodity HHI, Export Partner HHI, and Fiscal Revenue HHI (concentration of state tax receipts). Adapting normalized concentration frameworks such as UNCTAD's (2024) 0-to-1 Hirschman export concentration index onto a unified 0–10,000 dashboard would allow sovereign wealth funds and central banks to calibrate counter-cyclical fiscal buffers directly to structural concentration levels.
3. **Supply-Chain and Critical Mineral Chokepoint Mapping:** In an era of geopolitical fragmentation and green-energy transitions, HHI can be applied to global supply chains for critical minerals (such as copper, rare earth elements, lithium, and coking coal) across both *extraction* and *refining* stages (International Energy Agency [IEA], 2024). Measuring the HHI of global refining capacity reveals strategic bottlenecks and helps resource-exporting nations identify downstream processing investments that reduce bilateral monopsony exposure.
4. **Dynamic Longitudinal Tracking (ΔHHI):** Just as antitrust authorities evaluate horizontal mergers by measuring the *change* in concentration (ΔHHI) before and after a transaction (U.S. DOJ & FTC, 2023), development economists can track annual ΔHHI to audit national industrial policies. If a government implements a multi-year economic diversification strategy or opens a new cross-border rail corridor, a sustained negative ΔHHI in export partners and non-mining value added provides objective, quantitative proof of structural transformation.

Conclusion

Adapting the Herfindahl-Hirschman Index from industrial antitrust enforcement back to its roots in international political economy bridges the gap between descriptive macroeconomic statistics and structural power theory (Hirschman, 1945; Waltz, 1979; Mansfield, 1993). As illustrated through the case of Mongolia, the HHI distills complex geopolitical asymmetries and domestic structural imbalances into transparent, comparable metrics. It confirms that while Mongolia holds a stable middle position among landlocked and post-socialist states, its immediate regional environment is defined by extreme economic unipolarity, and its domestic stability remains tethered to a highly concentrated extractive and bilateral trade structure. With further refinement into granular sub-sectoral and longitudinal frameworks, the national HHI offers policymakers an indispensable compass for navigating geopolitical power dynamics and guiding long-term economic diversification.

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