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Quantifying Hidden Healthcare Externalities- Development and Validation of the Shadow Cost Index

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Abstract: ***Health policy evaluations typically assess healthcare affordability using direct medical expenditure and financial risk protection, implicitly treating non-monetary barriers as secondary. This paper argues that such approaches systematically understate the true welfare cost of healthcare access. In settings characterized by informal labor markets and limited income protection, healthcare utilisation requires substantial investments of time, effort and cognitive resources that generate economically meaningful opportunity costs. We develop and empirically apply the Shadow Cost Index (SCI), a composite measure capturing five non-monetary dimensions of healthcare burden: time burden, opportunity cost, informational barriers, systemic frictions and emotional strain. Using primary survey data from households and reproducible analysis conducted in Python, we show that time burden and opportunity cost are the dominant contributors to overall healthcare burden even when direct medical costs are low. The findings demonstrate that expenditure-based metrics substantially mismeasure healthcare affordability and help explain persistent gaps between nominal coverage and effective access. The Shadow Cost Index provides a welfare-economic framework for evaluating healthcare systems that aligns policy assessment with lived economic constraints.***

Keywords: Shadow Cost Index, opportunity cost, healthcare externalities, indirect costs, health economics, India, non-monetary burdens

1. Introduction

Health systems are commonly evaluated using financial indicators such as out-of-pocket expenditure, ruinous health spending and insurance coverage. These measures play a central role in health policy formation and international development discourse. However, they heavily rest on a narrow conception of affordability that equates access with the absence of only large medical payments, implicitly assuming that non-price barriers to care are negligible.

In practice, accessing healthcare requires households to incur substantial non-monetary costs. Patients and caregivers especially family members spend time travelling to facilities, waiting for services, navigating administrative procedures and making repeated visits chiefly in economies dominated by informal employment and limited income protection. These time investments translate directly into forgone income and disrupted household functioning impacting mental well-being of individuals. As a result, healthcare utilisation frequently imposes immediate welfare losses even when services are subsidized or free at the point of use.

From a welfare-economic perspective, these non-monetary costs function as shadow costs that shape healthcare demand and utilisation. When the opportunity cost of time is high, households may rationally delay or forgo care despite low monetary costs. This helps explain a persistent empirical puzzle in health policy of why expansions in insurance coverage and reductions in user fees do not consistently produce proportional increases in utilisation or improvements in health outcomes.

Despite strong theoretical foundations in time allocation and welfare economics, opportunity costs and related non-monetary burdens remain weakly integrated into empirical healthcare evaluation. Existing metrics focus on realized expenditures and financial risk, systematically overlooking time loss, income displacement, informational frictions, institutional inefficiencies and emotional strain. This omission constitutes a measurement failure.

This paper addresses this gap by developing and empirically validating the Shadow Cost Index (SCI), a composite measure designed to capture the cumulative non-monetary burden associated with healthcare access.

2. Related Literature

Economic analyses have long recognized that healthcare generates costs beyond direct medical expenditure. Early cost-of-illness frameworks distinguished between direct medical, direct non-medical and indirect costs, with indirect costs typically defined as productivity losses due to morbidity or mortality (Rice, 1967). While foundational, these frameworks were designed primarily for macroeconomic accounting rather than household-level welfare analysis.

Subsequent advances in health economics emphasized the role of non-price barriers in healthcare demand. Acton (1975) and Phelps and Newhouse (1974) demonstrated that time costs act as implicit prices that significantly influence utilisation. Becker's (1965) theory of time allocation formalized time as a scarce resource, implying that healthcare-related time losses represent real opportunity costs.

Empirical evidence from low and middle-income countries underscores the importance of these non-price barriers, particularly in informal labor markets. Studies from India document substantial travel, waiting and administrative costs even under publicly financed health systems, helping explain gaps between nominal coverage and effective utilisation.

Parallel research on financial risk protection emphasizes substantial health expenditure and impoverishment (Wagstaff & van Doorslaer, 2003; Xu et al., 2007). These measures are informative but inherently expenditure-based roundly excluding non-monetary costs.

Behavioral and institutional economics highlight the role of informational frictions, administrative complexity and scarcity-induced cognitive load (Banerjee & Duflo, 2011; Mullainathan & Shafir, 2013). However, these insights are rarely operationalized within economic cost measurement.

Taken together, the literature identifies multiple non-monetary dimensions of healthcare burden but treats them in isolation. Opportunity cost, despite its centrality to economic theory remains under-measured. The Shadow Cost Index directly addresses this fragmentation.

3. Methodology

3.1 Conceptual Framework

The Shadow Cost Index is grounded in household welfare theory. Households maximize utility subject to income, time and health constraints. Healthcare access requires monetary expenditure as well as time and cognitive effort. In informal labor markets, the time devoted to healthcare directly reduces contemporaneous consumption.

Conceptually, the effective cost of healthcare equals monetary payments plus the opportunity cost of time and non-pecuniary frictions such as uncertainty and stress. The SCI approximates this effective cost using observable and self-reported indicators. This formulation serves as a welfare representation rather than a structural model.

3.2 Domain Selection and Measurement

Five domains are included:

- **Time Burden**- travel time, waiting time, visit frequency
- **Opportunity Cost**- forgone income, missed workdays, disrupted schooling
- **Informational Burden**- uncertainty about diagnosis, procedures, eligibility
- **Systemic Burden**- bureaucratic complexity, inefficiencies, availability constraints
- **Emotional Burden**- anxiety, fear, psychological stress

Each domain is measured using multiple survey items and normalized for comparability.

3.3 Index Construction and Analytical Strategy

The SCI is constructed as an unweighted sum of normalized domain scores. An unweighted structure avoids imposing normative assumptions and allows empirical patterns to emerge transparently.

All data cleaning and analysis were conducted using Python. The empirical strategy relies on descriptive statistics and correlation analysis, appropriate for index validation rather than causal inference.

4. Empirical Results

Table 1: Descriptive Statistics of Shadow Cost Index Components (N = 50)

Variable	Mean	Std. Dev.	Min	Median	Max
Emotional Burden	3.78	1.39	1.5	3.5	7.5
Time Burden	21	16.38	3.38	17.38	60.98
Informational Burden	0.53	0.28	0.15	0.45	1
Opportunity Cost	0	0.01	0	0	0.03
Systemic Burden	1033.92	1738.97	100.22	109.82	7004
Total SCI	34.01	12.24	8.5	33.38	56.69

Notes: All components are normalized prior to aggregation. Opportunity cost values are conservatively scaled.

Table 2: Correlation Matrix of SCI Components

Variable	Emotional	Time	Informational	Opportunity	Systemic	Total SCI
Emotional	1	0.73	0.35	0.39	0.69	0.62
Time	0.73	1	0.29	0.64	0.54	0.71
Informational	0.35	0.29	1	0.36	0.14	0.63
Opportunity	0.39	0.64	0.36	1	0.21	0.6
Systemic	0.69	0.54	0.14	0.21	1	0.35
Total SCI	0.62	0.71	0.63	0.6	0.35	1

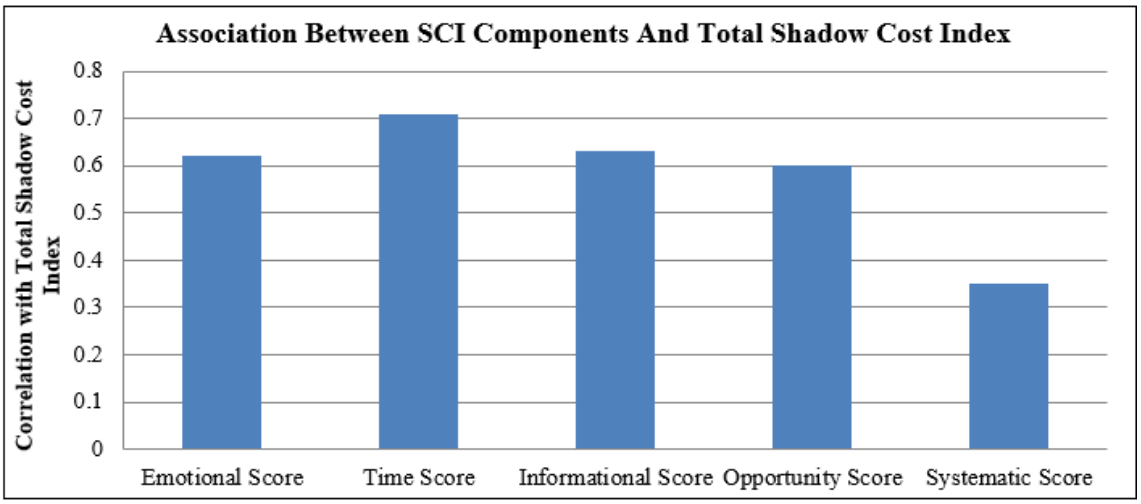

Figure 1: Association Between Shadow Cost Index Components and Total SCI
(Bar chart showing correlations of each SCI component with the Total Shadow Cost Index)

This figure presents Pearson correlation coefficients between each Shadow Cost Index component and the composite SCI score. Time burden exhibits the strongest association with overall healthcare burden, followed closely by opportunity cost. Informational and systematic burdens show moderate associations, while emotional burden appears secondary once economic channels are considered.

5. Interpretation of Results

Time burden exhibits the strongest association with the Total Shadow Cost Index, followed closely by opportunity cost. This confirms that healthcare access imposes its primary welfare costs through time-intensive and income-displacing mechanisms. Informational and systematic burdens act as upstream drivers by increasing time requirements and uncertainty. Emotional burden while substantial appears largely endogenous to economic and institutional stress.

6. Discussion and Policy Solutions

The results demonstrate that healthcare access operates through non-price rationing mechanisms. Even when services are financially subsidized, households face high effective prices in the form of forgone income and time.

Policy-Relevant Solutions

- Reduce time burden through appointment systems, decentralized diagnostics and telemedicine
- Mitigate opportunity costs via income compensation, wage protection or conditional cash transfers
- Simplify administrative processes through digitization and reduced documentation
- Improve information flow with patient navigation and standardized communication
- Address emotional burden structurally by reducing uncertainty and delays

The Shadow Cost Index can be incorporated into program evaluation to identify high-burden populations and assess reforms beyond expenditure-based metrics.

7. Limitations

The study is exploratory and based on a modest sample size. Opportunity cost is self-reported and may be subject to recall bias. However, excluding opportunity cost would introduce a more severe bias by understating burden in informal labor settings.

8. Conclusion

This paper develops and validates the Shadow Cost Index as a unified measure of hidden healthcare burdens. The findings demonstrate that time burden and opportunity cost dominate healthcare burden with institutional and informational frictions amplifying these effects.

The central contribution of this paper is to show that healthcare affordability cannot be assessed through expenditure alone. Reducing shadow costs is essential for achieving genuine accessibility. The Shadow Cost Index provides a welfare-economic framework for evaluating healthcare systems as they are experienced in practice rather than as they appear in financial accounts.

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