

Probabilistic Fiscal Monitoring and Reverse Threshold Analysis of Türkiye's Public Health Administration under High Inflation

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ABSTRACT

Public health administrations are exposed to simultaneous uncertainty in revenue, labour expenditure and supply prices, but consolidated financial statements are usually interpreted through retrospective point estimates. This study develops a probabilistic fiscal-monitoring framework for Türkiye's Ministry of Health without treating accounting outcomes as measures of managerial performance. Comparable consolidated accrual statements for 2024 and 2025 were reconciled into reported, operating and researcher-defined core views. Revenue and expenditure concentration, liquidity, rigidity and the change in core coverage were examined; the latter was decomposed through a two-factor Shapley procedure. Three conditional 2026 scenarios were then evaluated using 100,000 correlated beta-PERT draws per scenario with Latin hypercube sampling. Core coverage increased from 47.75% to 49.49%, although the core financing gap widened from TRY 635.7 billion to TRY 867.0 billion. Revenue growth contributed 18.86 percentage points to coverage, while expenditure growth offset 17.12 points. Labour-related costs represented 67.28% of 2025 core expenditure, and one revenue category generated 83.68% of gross revenue. In the baseline scenario, the median financing gap was TRY 1,205.6 billion and the 95% Fiscal-at-Risk was TRY 1,324.5 billion. Under managed disinflation, coverage improved in most simulations while the nominal gap widened. The framework demonstrates that proportional coverage and absolute financing need can move in opposite directions and converts static accounts into transparent, scenario-conditioned risk measures. For policymakers, the results support combining conventional fiscal indicators with probabilistic early-warning thresholds and closer monitoring of labour, procurement and short-term financing pressures; future research should extend the framework using longer time series and integrate service volume, procurement, supplier-payment and health-service performance indicators. The outputs are not official forecasts, causal estimates, audit findings or performance evaluations.

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1. INTRODUCTION

Fiscal sustainability in a health system cannot be reduced to whether revenue and expenditure balance in a single accounting period. The broader question is whether access, quality, financial protection and continuity of services can be maintained while demographic change, technological development and price pressures reshape resource needs (Kutzin, 2013; Organisation for Economic Co-operation and Development [OECD], 2024; World Health Organization [WHO], 2010). This distinction is especially important for a ministry of health. Unlike a commercial enterprise, it may deliver services without market prices, pursue distributive objectives and depend on general-budget support. An accounting deficit is therefore not evidence of commercial failure. It may nevertheless show a persistent distance between recognized revenue and the resources consumed in service provision, making the monitoring of financing sources, buffers and exposure to shocks necessary. That distance is difficult to interpret with deterministic ratios alone. Wage settlements, imported medicines and devices, energy costs, supply-chain disruptions and capital commitments can all affect health-sector expenditure. These pressures are correlated: inflation may raise nominal revenue while simultaneously increasing labour and input costs. A point estimate cannot show the probability of deterioration, the scale of the financing gap in the upper tail or the combination of drivers that would breach a policy threshold. A conventional break-even value may also be mathematically valid but operationally implausible. High inflation creates an additional accounting problem. Nominal growth can be mistaken for an expansion in real resources, while inflation-adjustment entries may materially change the reported operating result without producing a current inflow for service financing. Türkiye's annual-average consumer inflation was 34.88% in 2025 (Turkish Statistical Institute [TurkStat], 2026). The Central Bank of the Republic of Türkiye (CBRT, 2026) subsequently reported an end-2026 inflation forecast of 26% and emphasized scenario-based uncertainty communication. This environment provides a strong rationale for fiscal stress testing rather than mechanical extrapolation from the latest accounts. Sustainability and resilience are related but distinct. Sustainability concerns whether a financing arrangement can be maintained over time; resilience concerns the capacity to resist, absorb, recover from and adapt to shocks. Rao et al. (2023) describe resistance, recovery and renewal as dimensions of fiscal resilience, while Barbera et al. (2017) show that governmental responses depend on both vulnerability and anticipatory capacity. In health care, maintaining essential services during a crisis may worsen a short-term accounting result while protecting population health and organizational capacity.

The World Bank's Health Financing Sustainability and Resilience Assessment separates sufficiency, sustainability, resilience and efficiency (World Bank, 2024). This prevents expenditure restraint from being treated automatically as resilience. Lower spending is not necessarily desirable if financing is already insufficient for required services. OECD (2024) similarly links fiscal sustainability to adequate financing and the reduction of ineffective spending. The present study therefore treats lower expenditure neither as an automatic sign of efficiency nor as an unconditional policy objective.

Stress testing operationalizes resilience by examining thresholds across several plausible states instead of relying on one central forecast. Rajala and Jalonen (2023) frame this as possible-worlds thinking in public services, and multiple-scenario designs are particularly useful when interacting risks cannot be represented by one adverse path (Aikman et al., 2024). For a health ministry, relevant warning points include declining revenue coverage, worsening negative working capital and a tail financing gap that exceeds ordinary budget flexibility.

Accrual accounting records depreciation, provisions, valuation changes and asset transfers that may not appear in cash budgets in the same period. These entries differ in their implications for near-term service financing. Published operating results and analytically adjusted measures should therefore be reported together rather than one replacing the other. Transparent categories may strengthen anticipatory capacity, whereas valuation-related gains can obscure operational pressure when interpreted as recurring financing (Barbera et al., 2020; Chan, 2003).

Financial ratios can help monitor capacity and exposure in public health agencies (Suarez et al., 2011), but they cannot be interpreted as private-sector bankruptcy tests. A current ratio below one does not establish insolvency for an institution with statutory budget support, although it indicates dependence on the timing of transfers and short-term liability management. Revenue and expenditure composition also matter. A concentrated revenue base and rigid labour expenditure may leave aggregate ratios apparently stable until a dominant component is shocked. Concentration measures are therefore used here descriptively, not as competition-law indicators.

Traditional cost-volume-profit analysis identifies the activity level at which revenue equals fixed and variable costs (Mohd Fadzil et al., 2023; Younis et al., 2010). Consolidated ministerial accounts do not provide unit prices, marginal costs or case-mix-adjusted activity. Patient-volume break-even would consequently be invalid. The relevant concept is fiscal break-even: the revenue required to cover a specified proportion of accrual-based core expenditure. Reverse stress testing then asks what revenue growth is required under each simulated cost path. This is consistent with

probabilistic modelling practice, in which parameter uncertainty is propagated through the model and reported as a distribution (Briggs et al., 2012; O'Hagan et al., 2007; Sullivan et al., 2014).

The literature on health-financing sustainability, public-sector resilience and probabilistic modelling offers useful but separate foundations (Barbera et al., 2017, 2020; Briggs et al., 2012; Liaropoulos & Goranitis, 2015; OECD, 2024; World Bank, 2024). Less developed is an operational connection among these traditions at the level of consolidated public-health accrual accounts. This study addresses that gap by distinguishing official and analytical balances, measuring rigidity and concentration, decomposing coverage change, estimating correlated tail risk and deriving reverse financing thresholds. The term coverage-affordability paradox is used narrowly to describe an improving revenue-to-expenditure ratio accompanied by a widening absolute financing gap; it

is not proposed as a new general economic theory. The methodological contribution does not arise from any single technique in isolation, but from integrating accounting reconciliation, decomposition, correlated probabilistic stress testing and reverse-threshold analysis within a unified fiscal-monitoring framework for public health administration. This integration converts retrospective accrual accounts into forward-looking, scenario-conditioned risk indicators without treating accounting outcomes as measures of managerial performance.

Four questions guide the study: how the Ministry's fiscal structure, concentration and liquidity changed between 2024 and 2025; how revenue and expenditure contributed to the change in core coverage; what deficit and coverage distributions emerge under alternative 2026 scenarios; and which drivers and revenue thresholds dominate fiscal risk.

2. MATERIALS AND METHODS

2.1. Study Design, Perspective and Data Source

This study combined a quantitative financial-statement case study with a one-year prospective fiscal stress test. The analysis was conducted from the perspective of the consolidated public administration of the Turkish Ministry of Health. The data consisted of the Ministry's 2025 consolidated balance sheet and operating results statement, which also reports comparative figures for 2024 under the same consolidation scope (Ministry of Health, Republic of Türkiye, 2026). Earlier statements were not combined with these data because their reporting scopes were not consistently consolidated. The dataset covered the complete set of published top-level accounts rather than a statistical sample. Fifteen expenditure groups under account 630 and eight revenue groups under account 600 were reconstructed. Account 610 deductions and account 698 inflation-adjustment entries were incorporated separately. Balance-sheet data included current assets, cash and cash equivalents, total assets, long-term liabilities and equity. Short-term liabilities were derived as total assets minus equity and long-term liabilities.

All account classifications, analytical exclusions, scenario assumptions and calculation rules were researcher-defined and are described in the present study. The study is an independent academic analysis and does not constitute an audit, an official forecast, a legal-compliance review or an evaluation of institutional or managerial performance. Amounts are reported in nominal Turkish lira unless otherwise stated. For comparisons of annual flows, 2024 values were converted to 2025 prices using the 34.88% annual-average consumer-price change reported by TurkStat (2026). Balance-sheet stocks were not inflation adjusted.

2.2. Accounting Definitions and Deterministic Indicators

Net revenue was calculated as gross revenue under account 600 less deductions under account 610. The reported operating result retained the inflation-adjustment account included in the published statement. The operating result excluding inflation adjustment removed account 698 so that this accounting entry was not interpreted as current service-financing revenue.

Researcher-defined core expenditure excluded valuation changes (630.11), depreciation (630.13), provisions (630.15), receivables written off (630.20) and assets transferred without charge (630.25). Core revenue excluded valuation gains (600.11), reversals of provisions (600.15) and assets received without charge (600.25). Core coverage was calculated by dividing core revenue by core expenditure. The core financing gap was defined as core expenditure minus core revenue; a positive value therefore represents the amount not covered by recognized core revenue. These exclusions were intended to separate recurrent service-financing flows from non-cash, valuation-related or non-recurring accrual items and were applied consistently to both years.

The expenditure blocks used in the simulation were mutually exclusive. Labour expenditure comprised personnel expenditure (630.01) and social-security premiums (630.02). Goods-and-services expenditure corresponded to account 630.03. Other core expenditure comprised the remaining accounts included in core expenditure after labour and goods-and-services expenditure had been deducted.

Narrow expenditure rigidity was defined as labour expenditure divided by core expenditure. Extended rigidity included labour expenditure, depreciation and

interest as a share of total expenditure. Current ratio, cash ratio, debt ratio, equity ratio, fixed-asset intensity and net working capital were calculated using conventional accounting identities. These measures were interpreted as descriptive public-sector financial indicators rather than private-sector insolvency thresholds.

2.3. Concentration and Coverage Decomposition

Revenue and expenditure concentration were evaluated using the Herfindahl–Hirschman Index (HHI) and top-component shares. These measures were used descriptively to assess the extent to which revenue and expenditure were concentrated across account groups. The change in core coverage between 2024 and 2025 was decomposed into revenue and expenditure effects using a two-factor Shapley procedure. Each factor's contribution was averaged across the two possible sequences in which revenue and expenditure could change. The two effects were required to sum exactly to the observed change in coverage, providing an internal consistency check.

Let $C(R,E)=R/E$ denote core coverage, where R is core revenue and E is core expenditure. The Shapley revenue contribution was calculated as the average of $[C(R_{2025},E_{2024})-C(R_{2024},E_{2024})]$ and $[C(R_{2025},E_{2025})-C(R_{2024},E_{2025})]$. The expenditure contribution was defined analogously, ensuring that the two contributions summed exactly to the observed change in core coverage.

2.4. Probabilistic Fiscal Stress Test

The 2026 stress test applied four correlated growth rates to the 2025 base values: core-revenue growth, labour-cost growth, goods-and-services growth and other-core-cost growth. Each input followed a bounded beta-PERT distribution with shape parameter $\lambda = 4$. Beta-PERT distributions were selected because the scenario inputs were expressed through plausible minimum, most likely and maximum values and because unbounded extreme values were not considered appropriate for the one-year model.

Three conditional scenarios were examined: managed disinflation, baseline risk and adverse supply shock. The minimum, most likely and maximum assumptions for all four inputs are reported in Table 1. These values were constructed as scenario-conditioned stress bounds rather than statistically estimated confidence limits. Their calibration combined three sources of information: the 2025 observed expenditure structure and nominal growth pattern, the 2026 inflation outlook reported by the CBRT (2026), and economically plausible differences in the speed with which inflation and supply-price pressures could pass through to labour, procurement and other operating costs. Accordingly, the modal values represent the central assumption within each scenario, whereas the minimum and maximum values define plausible lower

and upper stress boundaries. The adverse scenario deliberately assigns stronger cost-side pressure, particularly to goods and services, to represent exposure to medicine, medical-supply, imported-input and other procurement-price shocks. The scenarios are therefore conditional analytical experiments and should not be interpreted as probability-weighted macroeconomic forecasts.

Dependence among the four inputs was represented through a Gaussian copula. Because only two directly comparable consolidated years were available, the correlation coefficients were not estimated econometrically from the historical financial statements. They were prespecified modelling assumptions designed to represent moderate positive co-movement generated by a common inflationary and policy environment. The assumed correlations were 0.35 between revenue and labour, 0.25 between revenue and goods and services, 0.20 between revenue and other costs, 0.50 between labour and goods and services, 0.40 between labour and other costs, and 0.55 between goods and services and other costs. The assumptions reflect two modelling considerations. First, labour, procurement and other operating costs were expected to exhibit stronger positive co-movement because they are jointly exposed to domestic price dynamics, wage adjustments, exchange-rate-sensitive inputs and common budget conditions. Second, correlations between revenue and expenditure components were specified at lower levels because the timing and magnitude of revenue adjustment need not coincide contemporaneously with cost pass-through.

The coefficients were intentionally kept within a moderate range so that no variable was treated as mechanically determined by another. The resulting correlation matrix was positive definite. Robustness analyses using independent inputs and a prespecified higher-correlation matrix were subsequently used to assess whether the principal findings depended materially on these judgemental dependence assumptions. Thus, the correlation matrix should be interpreted as a transparent structural assumption for stress testing, not as an empirically estimated description of Türkiye's fiscal accounts.

Each scenario was simulated using 100,000 four-dimensional Latin-hypercube draws with the fixed random seed 20260713. FaR95 was defined as the 95th percentile of the simulated financing-gap distribution, whereas expected shortfall was calculated as the mean financing gap among the worst 5% of simulations. Reverse revenue-growth requirements were calculated separately for each simulated expenditure outcome by determining the increase in 2025 core revenue required to achieve coverage levels of 55%, 60% and 100%, with 100% representing full accrual-based coverage. The median and 95th-percentile revenue-growth requirements were subsequently reported.

Table 1. Scenario input assumptions for the 2026 fiscal stress test

Input (% growth)	Managed disinflation	Baseline risk	Adverse supply shock
Core revenue growth	25 / 38 / 55	20 / 35 / 55	10 / 25 / 45
Labour-cost growth	25 / 34 / 42	30 / 41.1 / 52	35 / 46 / 60
Goods-and-services growth	15 / 24 / 35	18 / 30 / 48	30 / 45 / 70
Other-core-cost growth	10 / 22 / 35	10 / 26 / 45	20 / 38 / 65

Note. Values are percentage growth assumptions expressed as minimum / mode / maximum for beta-PERT distributions with $\lambda = 4$. They are scenario-conditioned stress assumptions rather than statistical confidence intervals or official forecasts. The 2025 base values used in the simulation were TRY 849.5 billion for core revenue, TRY 1,154.85 billion for labour expenditure, TRY 451.38 billion for goods-and-services expenditure and TRY 110.37 billion for other core expenditure; the three expenditure blocks sum to the 2025 core expenditure of TRY 1,716.6 billion reported in Table 2.

2.5. Sensitivity, Robustness and Reproducibility

Input importance was assessed using partial rank correlation coefficients (PRCCs) between each simulated growth rate and the financing gap while controlling for the ranked values of the other three inputs. For each scenario, simulated inputs and outcomes were first converted to ranks; the linear effects of the remaining ranked inputs were removed from both the input of interest and the financing-gap outcome, and the correlation between the resulting residuals was calculated. This procedure measures the strength and direction of the monotonic association between an input and the model output conditional on the other simulated inputs. A negative coefficient therefore indicates that larger values of the corresponding input are associated with a smaller

financing gap, whereas a positive coefficient indicates a larger gap. The absolute magnitude provides a comparative measure of global sensitivity within the specified simulation structure. These PRCCs were generated from the simulated distributions and should be distinguished from the prespecified Gaussian-copula correlations used to create dependence among the model inputs. Neither set of coefficients represents a causal estimate. The baseline scenario was repeated under four alternative specifications: independent inputs, a prespecified higher-correlation matrix, triangular distributions using the same minimum, mode and maximum values, and beta-PERT bounds widened symmetrically by five percentage points. Numerical convergence was assessed using 10,000, 50,000 and 100,000 draws.

3. RESULTS

3.1. Observed Balances and Real Change

Total expenditure increased from TRY 1,316.6 billion in 2024 to TRY 1,831.9 billion in 2025, while net revenue rose from TRY 583.2 billion to TRY 853.2 billion. The reported deficit was TRY 628.4 billion in 2024 and TRY 793.1 billion in 2025. Excluding inflation adjustment, the 2025 deficit was TRY 978.6 billion. The TRY 185.5 billion difference between the

reported and operating results shows why both measures should be disclosed.

Core revenue rose from TRY 580.9 billion to TRY 849.5 billion, and core expenditure from TRY 1,216.6 billion to TRY 1,716.6 billion. After CPI adjustment, real growth was 8.42% for core revenue, 4.61% for core expenditure and 1.12% for the core deficit. Core coverage improved by only 1.74 percentage points, from 47.75% to 49.49%. Table 2 presents the reconciled indicators.

Table 2. Observed fiscal indicators, 2024-2025

Indicator	2024	2025	Change / interpretation
Total expense (TRY bn)	1,316.6	1,831.9	39.13% nominal; 3.15% real
Net revenue (TRY bn)	583.2	853.2	46.30% nominal; 8.47% real
Reported result (TRY bn)	-628.4	-793.1	Includes inflation adjustment
Result excluding inflation adjustment (TRY bn)	-733.4	-978.6	Operational financing distance
Core revenue (TRY bn)	580.9	849.5	8.42% real growth
Core expense (TRY bn)	1,216.6	1,716.6	4.61% real growth
Core deficit (TRY bn)	635.7	867.0	1.12% real growth
Core coverage	47.75%	49.49%	+1.74 percentage points

Note. Real change uses the 34.88% annual-average CPI. Core indicators are researcher-defined analytical measures and do not replace the official statements.

3.2. Concentration, Rigidity and Decomposition

Personnel expenditure represented 56.94% of total expenditure in 2025, and personnel plus social-security premiums accounted for 67.28% of core expenditure. Personnel alone explained 58.93% of the expenditure increase, goods and services 21.91%, social-security premiums 7.14% and project current expenditure 3.79%. Extended rigidity, comprising labour, depreciation and interest, was 68.81% of total expenditure.

Expense HHI rose slightly from 0.390 in 2024 to 0.393 in 2025, while the top-three expenditure share declined from 88.90% to 87.68%. Revenue remained substantially more concentrated: revenue HHI declined from 0.735 to 0.714, although one enterprise-and-property revenue category still accounted for 83.68% of gross revenue. The Ministry therefore combined a relatively concentrated revenue structure with a rigid expenditure structure. The Shapley decomposition clarified why strong nominal revenue growth yielded little net coverage improvement. Revenue growth contributed 18.86 percentage points, whereas expenditure growth contributed -17.12 points. Their sum equalled the observed 1.74-point increase. Most of

the potential gain from revenue growth was therefore absorbed by expenditure pressure.

3.3. Balance-Sheet Resilience

Total assets increased from TRY 561.8 billion to TRY 999.5 billion, largely through tangible fixed assets. Fixed-asset intensity rose from 82.16% to 85.10%. The debt ratio fell from 36.03% to 29.02%, and the equity ratio increased from 63.97% to 70.98%, indicating a stronger reported long-run balance-sheet composition. Short-run liquidity moved differently: the current ratio declined from 0.80 to 0.69 and negative net working capital widened from TRY 24.8 billion to TRY 65.4 billion, although the cash ratio improved from 0.22 to 0.30. Infrastructure capacity and short-term buffers therefore require separate monitoring.

3.4. Probabilistic Financing Gap and Coverage

The probability of full one-year fiscal break-even was close to zero in all scenarios because the starting financing distance was too large to be crossed by the bounded growth assumptions. The more informative outputs were partial coverage, tail deficit and reverse thresholds. Table 3 reports the principal scenario results.

Table 3. Monte Carlo fiscal stress-test results (100,000 draws per scenario)

Scenario	Median deficit	FaR95	Expected shortfall	Mean coverage	P(coverage 2025)	< P(deficit widens)
Managed disinflation	1,063.8	1,155.3	1,176.7	52.6%	6.3%	100.0%
Baseline risk	1,205.6	1,324.5	1,351.9	48.9%	60.2%	100.0%
Adverse supply shock	1,437.2	1,574.6	1,606.7	42.6%	100.0%	100.0%

Note. Deficits are TRY billion. Probabilities are conditional on the distributions specified for each scenario. FaR95 = Fiscal-at-Risk at 95%.

Figure 1. Scenario-conditioned 2026 core financing-gap measures

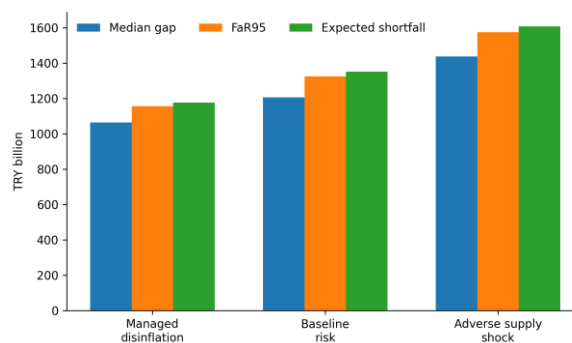


Figure 1 compares the median financing gap with FaR95 and expected shortfall. All three measures increased as assumptions moved from managed disinflation to adverse supply shock. Under managed disinflation, the median gap was TRY 1,063.8 billion and mean coverage was 52.56%. Coverage fell below its 2025 value in only 6.32% of simulations, yet the absolute gap widened in 99.98% of draws. This is the

clearest instance of the coverage-affordability paradox: proportional coverage improves while the nominal financing requirement becomes larger.

Under baseline risk, the median gap was TRY 1,205.6 billion, FaR95 was TRY 1,324.5 billion and expected shortfall was TRY 1,351.9 billion. Mean coverage declined to 48.91%; the probability of falling below the 2025 rate was 60.21%, and the probability of reaching

55% coverage was only 0.40%. Under adverse supply shock, the median gap reached TRY 1,437.2 billion, FaR95 TRY 1,574.6 billion and mean coverage 42.65%. Coverage was below 45% in 85.22% of draws.

3.5. Reverse Thresholds and Global Sensitivity

Table 4 shows that the median revenue growth required for 55% coverage ranged from 45.14% under managed disinflation to 62.22% under adverse supply shock.

Table 4. Reverse revenue-growth requirements

Scenario	Median growth for 55% coverage	Median growth for 60% coverage	Median growth for break-even	P95 growth for break-even
Managed disinflation	45.1%	58.3%	163.9%	173.6%
Baseline risk	52.8%	66.7%	177.8%	191.2%
Adverse supply shock	62.2%	77.0%	194.9%	211.5%

Note. Growth is measured relative to 2025 core revenue. P95 is the revenue growth required to cover 95% of simulated expenditure outcomes

Figure 2. Global sensitivity ranges for the simulated core financing gap

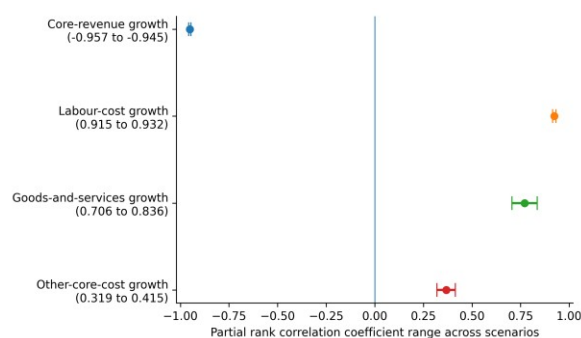


Figure 2 summarizes the PRCC ranges across scenarios. Core-revenue growth was the strongest gap-reducing input (-0.957 to -0.945), while labour-cost growth was the strongest gap-increasing input (0.915 to 0.932). Goods-and-services growth became more influential as conditions worsened (0.706 to 0.836), consistent with supply-price exposure. Other-core-cost growth had a smaller positive relationship with the gap (0.319 to 0.415).

3.6. Robustness

The central conclusions were stable across alternative dependence structures, marginal distributions and bound widths. Median deficit remained between TRY 1,203.6 billion and TRY 1,206.6 billion; mean coverage between 48.89% and 49.12%; and median break-even revenue growth between 177.73% and 178.27%. The probability of coverage deterioration ranged from 56.86% to 63.77%. Baseline FaR95 differed by less than TRY 0.03 billion between 50,000 and 100,000 draws, supporting numerical convergence.

Median full-coverage requirements were 163.89%, 177.75% and 194.94%; the corresponding 95th-percentile requirements were 173.64%, 191.19% and 211.49%. A limited one-year efficiency programme would therefore be insufficient to close the modelled financing gap without material changes in the financing base or accounting perimeter.

4. DISCUSSION

The findings show that Türkiye's public health administration experienced an improvement in proportional revenue coverage between 2024 and 2025, while the absolute financing requirement continued to increase. Core coverage rose from 47.75% to 49.49%, whereas the difference between core revenue and core expenditure increased from TRY 635.7 billion to TRY 867.0 billion. This pattern is especially relevant in a high-inflation environment, where both revenue and expenditure may expand rapidly. The findings therefore indicate that proportional indicators should be interpreted together with absolute financing requirements and inflation-adjusted changes.

These results should not be interpreted as an assessment of government policy, ministerial performance or budget adequacy. The analysis is based on consolidated accrual statements and examines the relationship between recognized accounting revenue and expenditure within the published reporting scope. Importantly, the researcher-defined core financing gap does not represent the total funding requirement of the Ministry or an unfunded government deficit. General-budget appropriations, public transfers and other statutory financing mechanisms extend beyond the operating-revenue accounts included in the analytical core measure. The core financing gap should therefore be interpreted as the portion of core expenditure not covered by recognized core revenue within the defined accounting perimeter, rather than as evidence of an inability to finance public health services.

The Shapley decomposition showed that revenue growth contributed 18.86 percentage points to the improvement in coverage, while expenditure growth offset 17.12 percentage points. The resulting net

increase was therefore limited to 1.74 percentage points. This finding indicates that revenue and expenditure should be evaluated together rather than through separate nominal growth rates. Fiscal sustainability depends not only on expenditure growth but also on the development of the public revenues available to finance health services (Liaropoulos & Goranitis, 2015; Lorenzoni et al., 2023; OECD, 2024). Health-system sustainability also includes service continuity, workforce capacity, quality, access and financial protection rather than financial indicators alone (Kutzin, 2013; Zurynski et al., 2022).

The study describes the simultaneous improvement in coverage and increase in the absolute financing requirement as a coverage–affordability paradox. This term is used only as a descriptive analytical label. It does not imply that the Ministry or the public sector is unable to finance health services. Instead, it demonstrates that an improving revenue-to-expenditure ratio may coexist with a larger nominal financing need. The revenue structure was also highly concentrated, with one revenue category accounting for 83.68% of gross revenue. This finding describes the composition of recognized accounting revenue rather than the Ministry's complete financing structure and should therefore be interpreted together with the wider role of budget appropriations and public transfers.

The expenditure structure was labour intensive. Personnel expenditure and social-security premiums represented 67.28% of core expenditure. This is consistent with the nature of healthcare services, which depend heavily on physicians, nurses and other health professionals; consequently, a high labour share should not be interpreted automatically as inefficiency. However, high expenditure rigidity may have additional management implications under inflationary conditions. When a substantial proportion of expenditure is committed to relatively inflexible labour-related obligations, short-term flexibility in goods-and-services expenditure may become more limited. This category includes medicines, medical supplies and other inputs required for service delivery. Budget-execution evidence has shown that financial rigidities and delays can contribute to difficulties in purchasing necessary drugs and supplies and to the accumulation of supplier arrears (WHO Regional Office for Europe, 2025). In the present study, such outcomes were not directly measured and should therefore be regarded as potential operational risks rather than observed effects. Nevertheless, sustained procurement pressure or longer supplier-payment periods could indirectly threaten service continuity and accessibility if essential inputs cannot be obtained when required. From a public health management perspective, expenditure rigidity should therefore be monitored together with procurement prices, supplier-payment periods and the availability of essential medicines and medical supplies.

The scenario analysis added a prospective dimension to the financial statements. Under the baseline scenario, the median financing requirement was TRY 1,205.6 billion, while the 95th-percentile Fiscal-at-Risk was TRY 1,324.5 billion. These figures are conditional model outputs rather than official forecasts. Under managed disinflation, coverage improved relative to 2025 in most simulations, although the nominal financing requirement increased in almost all draws. This result reflects the large expenditure base and continuing nominal growth assumptions and should not be interpreted as evidence of unsuccessful economic or health policy. Under the adverse scenario, coverage declined and financing requirements increased, particularly when labour and goods-and-services costs increased together. Scenario-based analysis is useful because public-sector financial conditions may be influenced by several related factors at the same time (Aikman et al., 2024; Rajala & Jalonen, 2023; Ranger et al., 2021).

The reverse-threshold analysis showed that full accrual-based coverage would require very high one-year growth in recognized core revenue. These values are mathematical benchmarks rather than recommended policy targets. A public health administration is not expected to operate according to a private-sector commercial break-even model because public services are financed through taxation, budget appropriations and transfers. Intermediate thresholds, such as 55% or 60% coverage, may therefore be more useful for monitoring changes in fiscal pressure as new information becomes available regarding inflation, wages, procurement costs or public transfers.

Sensitivity results identified core-revenue growth as the strongest financing-gap-reducing factor and labour-cost growth as the strongest financing-gap-increasing factor. Goods-and-services expenditure became more influential under adverse assumptions. These findings indicate where detailed monitoring may be most useful but should not be interpreted as causal estimates or evidence of inappropriate management. The balance-sheet findings also require a balanced interpretation. Total assets, equity and fixed-asset intensity increased, while the debt ratio declined. At the same time, the current ratio decreased and negative net working capital widened. Long-term infrastructure capacity and short-term liquidity should therefore be monitored separately, particularly when inflation increases recurrent operating costs.

The probabilistic framework developed in this study could also be integrated into an Early Warning and Decision Support System for the Ministry of Health and, where appropriate, the Ministry of Treasury and Finance. The model could be periodically updated using realized revenue and transfers, wage adjustments, procurement-cost information and short-term liquidity indicators to estimate the probability of predefined coverage or Fiscal-at-Risk thresholds being exceeded.

Such an approach would be consistent with the emphasis placed on stronger budgetary governance and coordination between health and finance authorities under constrained fiscal conditions (OECD, 2024). The system would not replace formal budgeting or managerial judgement; rather, it could provide a complementary forward-looking tool for identifying emerging fiscal pressures before year-end financial statements become available.

The study has several limitations. It is based on only two directly comparable consolidated financial years, and scenario distributions and correlations are therefore transparent modelling assumptions rather than parameters estimated from a long historical series. The available statements also do not allow the increase in personnel expenditure to be decomposed into wage adjustments, changes in workforce size, service-volume growth or inflation-related effects. Accordingly, no specific mechanism can be identified as the principal cause of labour-expenditure growth. Recognized revenue is not equivalent to the complete public financing envelope, and service volume, procurement performance, access, quality and health outcomes were not included. Future studies using longer time series could empirically calibrate the scenario parameters and integrate financial information with procurement, workforce and service-delivery indicators to examine more directly how fiscal pressures interact with health-system performance. Accordingly, the model evaluates internally coherent conditional scenarios rather than estimating the statistical probability that any particular 2026 scenario will occur.

Overall, the framework provides a neutral and transparent method for interpreting public-health financial statements under uncertainty. Its contribution lies in combining accounting reconciliation, concentration measures, decomposition, scenario analysis, sensitivity testing and reverse thresholds. The results are intended to support fiscal monitoring and planning rather than evaluate government policy, ministerial management or individual programmes. For policymakers, the findings support joint monitoring of financing adequacy, expenditure rigidity, procurement conditions and short-term liquidity rather than expenditure reduction as an objective in itself.

5. CONCLUSIONS

The consolidated financial statements of the Turkish Ministry of Health indicate that core revenue coverage improved between 2024 and 2025, reaching 49.49%, while the absolute core financing gap continued to widen. Labour-related expenditure accounted for more than two-thirds of core expenditure, and recognized revenue remained concentrated in a limited number of categories. These findings demonstrate that proportional improvement in fiscal indicators may

coexist with increasing absolute financing needs, particularly in a high-inflation environment.

The probabilistic analysis further showed that this pattern may persist under alternative 2026 scenarios. Even under managed disinflation, improved coverage did not necessarily translate into a smaller nominal financing gap, whereas adverse cost conditions substantially increased tail fiscal risk. The reverse-threshold results also demonstrated that full accrual-based coverage would require very large increases in recognized core revenue and should therefore be interpreted as a mathematical benchmark rather than a policy target.

From a public health management perspective, the high share of relatively rigid labour expenditure highlights the importance of preserving sufficient flexibility for medicines, medical supplies and other essential operating inputs. In an inflationary environment, monitoring procurement costs, supplier-payment periods and short-term liquidity alongside conventional financial indicators may help identify fiscal pressures that could potentially affect service continuity and accessibility. These operational consequences were not directly measured in the present study and should therefore be interpreted as potential risks rather than observed outcomes.

The stochastic framework developed in this study could be used as a complementary Early Warning and Decision Support System by the Ministry of Health and, where appropriate, the Ministry of Treasury and Finance. Periodic updating of revenue, transfer, wage, procurement and liquidity information could allow the probability of predefined coverage and Fiscal-at-Risk thresholds to be monitored before year-end financial statements are available. Such a system would complement, rather than replace, formal budgeting, treasury management and managerial judgement.

The study contributes methodologically by integrating accounting reconciliation, concentration analysis, Shapley decomposition, probabilistic stress testing, sensitivity analysis and reverse thresholds within a single public-health fiscal-monitoring framework. The findings are conditional on the accounting definitions and scenario assumptions used and should not be interpreted as official forecasts, causal estimates or evaluations of institutional performance.

For policymakers, the results support joint monitoring of financing adequacy, expenditure rigidity, procurement conditions and short-term liquidity rather than treating expenditure reduction as an objective in itself. Future research should extend the analysis using longer comparable time series and integrate financial data with workforce, procurement, supplier-payment, service-volume, quality and accessibility indicators to examine more directly how fiscal pressures interact with health-system performance.

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