Bounded Black-Litterman Allocation for Indonesia's Social Security Fund: A Regulatory Feasibility Study

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Abstract

This study examined whether a Black–Litterman allocation remained feasible for Indonesia's social security fund when the investment limits in Government Regulation No. 99 of 2013, as amended by Government Regulation No. 55 of 2015, were treated as binding constraints. The object was the Old-Age Security (Jaminan Hari Tua, JHT) portfolio managed by BPJS Ketenagakerjaan. Using secondary data from BPJS Ketenagakerjaan reports for 2022–2025, market proxies for six asset classes, and the text of the regulations, the study mapped the reported asset mix against the class-level limits in Article 37 and the minimum holding of government securities required by the Financial Services Authority. It then compared three allocations analytically: the reported mix, an unconstrained mean–variance mix, and an equilibrium-anchored Black–Litterman mix. The mapping showed that the 2025 reported mix lay inside the permitted set. An unconstrained mean–variance solution had no built-in reason to respect the 50 percent aggregate ceilings on equities and corporate bonds or the 50 percent floor on government securities. A Black–Litterman solution could be kept inside the permitted set, provided that the regulation entered the optimizer as inequality constraints rather than as an after-the-fact check. Per-bank, per-issuer, and per-manager limits remained an implementation layer outside a class-level optimizer. The contribution of this paper was a feasibility reading rather than a claim of superior risk-adjusted performance. The practical implication was that any increase in the equity share should be specified as a constrained policy portfolio, not as the output of an unconstrained optimizer.

Keywords: *Black–Litterman, Constrained Optimization, Regulatory Feasibility, Old-Age Security, Social Security Fund.*

A. INTRODUCTION

Old-age protection in Indonesia rests on the National Social Security System established by Law No. 40 of 2004. Within this system, Old-Age Security (Jaminan Hari Tua, JHT) is a defined-contribution programme financed by a contribution of 5.7 percent of wages, of which 3.7 percent is paid by the employer and 2 percent by the worker (Government Regulation No. 46 of 2015). By the end of 2025, the funds managed by BPJS Ketenagakerjaan reached IDR 897.85 trillion, an increase of about 13 percent over the previous year, with investment income of IDR 59.70 trillion (BPJS Ketenagakerjaan, 2026b). The 2025 Integrated Report records the Social Security Fund (Dana Jaminan Sosial, DJS) at IDR 884.06 trillion and the JHT programme at IDR 542.10 trillion, or 60.38 percent of total managed funds (BPJS Ketenagakerjaan, 2026a).

Size, however, does not imply diversification. At the level of total managed funds, debt securities account for 74.18 percent, time deposits 13.01 percent, equities 8.38 percent, mutual funds 4.13 percent, and direct investment and property 0.30 percent (BPJS Ketenagakerjaan, 2026a). This pattern is consistent with the Fiscal Policy

Agency's finding that JHT and Pension Security (Jaminan Pensiun, JP) assets are largely placed in short-tenor instruments, producing an *asset–liability mismatch* (Yusuf et al., 2020). The OECD (2025) likewise identifies the investment of pension assets as one of the main policy challenges facing Indonesia's asset-backed pension system.

This concentration is lawful. The management of employment social security assets is governed by Government Regulation No. 99 of 2013 as amended by Government Regulation No. 55 of 2015. For the Old-Age and Pension Security Funds, Article 37 of that regulation places no upper limit on securities issued by the State or by Bank Indonesia, but it limits deposits per bank, corporate debt securities, equities, mutual funds, asset-backed securities, real estate investment funds (Dana Investasi Real Estat, DIRE), *repurchase agreements*, direct investment, and land and buildings. In addition, the Financial Services Authority (Otoritas Jasa Keuangan, OJK) requires BPJS Ketenagakerjaan to invest at least 50 percent of the Social Security Fund in Government Securities (Surat Berharga Negara, SBN) (Otoritas Jasa Keuangan, 2016, 2017). The permitted set of weights therefore has upper bounds on several asset classes and a lower bound on SBN. On 29 June 2026 the government enacted Government Regulation No. 27 of 2026 as the second amendment. It retains the main ceilings applicable to JHT but raises the limit on direct investment, adds infrastructure investment funds and securities lending as eligible instruments, and requires the fund to rebalance within one year whenever a ceiling is exceeded because of changes in instrument values.

The rules that shield the fund from equity shocks also explain why an optimizer that ignores regulation cannot serve as a policy tool. Markowitz (1952) laid the foundation for the trade-off between expected return and variance. In its raw form, however, the *mean–variance* model is highly sensitive to estimated means: small changes in the estimates produce *corner solutions* and extreme weights (Best & Grauer, 1991; Michaud, 1989). For a social security fund, a corner solution is not only statistically fragile but often unlawful. An equity weight of 60 percent may look efficient on the *frontier* while exceeding the 50 percent aggregate ceiling. Indonesian studies of old-age funds have shown that actual portfolios are not optimal and that regulatory limits narrow the room for optimization (Ilmi, 2024; Krisnawan, 2019). These studies stop at the question of efficiency; they do not translate the *frontier* into the regulatory language with which the fund must comply.

The Black–Litterman model reverses the usual sequence. Market or benchmark weights are combined with a risk-aversion coefficient and a covariance matrix to obtain equilibrium returns, and investor views, if any, then update this *prior* in a Bayesian manner (Black & Litterman, 1992; He & Litterman, 1999). Idzorek (2005) details the calibration of the scalar τ and the uncertainty matrix Ω, while Kolm and Ritter (2017) clarify the duality between Black–Litterman optimization and Bayesian regression. Out-of-sample evidence shows that Black–Litterman portfolios tend to be more stable than *mean–variance* portfolios (Allaj, 2020; Bessler et al., 2017). The framework has been extended to time-varying covariances (Harris et al., 2017), tail dependence through copulas (Sahamkhadam et al., 2022), and the downside risk

measure *Conditional Value-at-Risk* (CVaR) (Kocuk & Cornuéjols, 2020). For pension funds, Sun et al. (2023) and Wu and Sun (2025) adapted the same framework. These works show that the Black–Litterman framework can be modified; they do not show that the modified results automatically comply with social security regulation in an emerging market.

A clear gap therefore remains. Efficiency studies of old-age funds exist, and Black–Litterman studies of pension funds exist. Yet research asking whether a Black–Litterman allocation can be placed inside the legal set that applies to JHT, given the currently reported weights, is limited. Because this study does not fully estimate the weights empirically, the question is framed as three propositions examined through regulatory mapping and analytical argument.

P1. An unconstrained *mean–variance* allocation built on market proxies for JHT asset classes is likely to violate at least one class-level limit, namely the 50 percent aggregate ceiling on equities or corporate debt securities, or the 50 percent floor on SBN.

P2. A Black–Litterman allocation that uses only the equilibrium *prior*, without aggressive active views, can be kept inside the permitted set, provided that the regulatory constraints are embedded in the optimization.

P3. If a constraint binds at the class level, it is more likely to be the SBN floor or the aggregate equity ceiling than the deposit limit, because the deposit limit applies per bank rather than to the asset class as a whole.

The aim of this study is to assess the *regulatory feasibility* of a Black–Litterman allocation for the JHT fund. Its theoretical contribution is to separate two tests that are often conflated, efficiency and legal validity, and to show at which stage regulation must enter the Black–Litterman framework. Its practical contribution is an operational guideline for public fund managers in specifying a constrained policy portfolio.

B. METHOD

This study employs a descriptive quantitative design based on secondary data in the form of a *desk study*. No participant funds were reallocated. The published JHT weights are read against the regulation, and two model-based alternatives are then constructed from market proxies for six asset classes: SBN, corporate debt securities, time deposits, domestic equities, balanced mutual funds, and DIRE. The share of environmental, social, and governance (ESG) equities is recorded only as part of the equity ceiling and is not treated as a separate variable.

Four groups of data sources are used. First, the integrated reports and audited financial statements of BPJS Ketenagakerjaan for 2022–2025, which present managed funds, asset mix, and investment income (BPJS Ketenagakerjaan, 2026a, 2026b). Second, Government Regulation No. 99 of 2013, Government Regulation No. 55 of 2015, and Government Regulation No. 27 of 2026, together with the OJK minimum SBN requirement (Otoritas Jasa Keuangan, 2016, 2017), which define the permitted set of weights. Third, market proxies for asset-class returns: the INDOBeX *Government Total Return* index for SBN, the INDOBeX *Corporate Total Return* index for corporate debt, Bank Indonesia statistics on 12-month deposit rates, the LQ45 index for equities

(with IDX ESG Leaders as the ESG sub-portion), a balanced mutual fund index, and the total return of DIRE listed on the Indonesia Stock Exchange. Fourth, the OECD (2025) and the International Labour Organization (2023) provide international context on investment challenges and the sustainability of pension schemes. No primary survey was conducted.

The analysis proceeds in four steps. The first step rewrites the regulation as class-level inequalities that can be loaded into an optimizer. The permitted set K for the JHT fund is defined as: $w_{SBN} \geq 0.50$; $w_{CORP} \leq 0.50$; $w_{EQ} \leq 0.50$; $w_{MF} \leq 0.50$; $w_{DIRE} \leq 0.20$; with $w \geq 0$ and weights summing to one. Per-bank limits on deposits (at most 25 percent for each state-owned bank and 15 percent for any other bank), per-issuer limits (5 percent), and per-manager limits (15 percent for mutual funds and 10 percent for DIRE) are excluded from the optimizer and recorded as implementation constraints. The second step records the actual weights (w_{actual}) from the latest public mix.

The third step forms an unconstrained *mean–variance* portfolio (w_{MV}) on the proxy covariance matrix with a no-*short-selling* restriction but without regulatory ceilings. The fourth step derives equilibrium returns through reverse optimization (Equation 1), updates them with moderate views (Equation 2), and then re-optimizes the same objective function subject to K (Equation 3) to obtain w_{BL}.

$$\Pi = \delta \, \Sigma \, w_{mkt} \tag{1}$$

$$\mu_{BL} = [(\tau\Sigma)^{-1} + P^{T}\Omega^{-1}P]^{-1} \, [(\tau\Sigma)^{-1}\Pi + P^{T}\Omega^{-1}Q] \tag{2}$$

$$\max_{w} \; w^{T}\mu_{BL} - (\delta/2) \, w^{T}\Sigma w \quad \text{s.t.} \; \mathbf{1}^{T}w = 1; \; w \geq 0; \; Aw \leq b \tag{3}$$

In these equations, Π is the vector of equilibrium returns, δ the risk-aversion coefficient, Σ the covariance matrix of excess returns, w_{mkt} the benchmark weights, τ the scalar of *prior* uncertainty, P the view matrix, Q the vector of view returns, Ω the covariance matrix of view errors, and A and b the matrix and vector of inequalities that translate K. A weight vector is called feasible if it satisfies every row of K. The comparison of the three vectors against K is used to assess P1–P3. The *Sharpe ratio* may be reported only as descriptive context and is not a proposition.

Ethical approval was not required because the study uses only public data. Its main limitation is structural: BPJS Ketenagakerjaan does not publish monthly returns by asset class, so every model weight is a proxy weight. Accordingly, the claim concerns the feasibility of a policy mix, not the list of securities actually held by the fund.

C. RESULTS AND DISCUSSION

1. The Actual Mix against the Permitted Set

Table 1 maps the mix of total managed funds in the 2025 Integrated Report against the class-level limits applicable to the Old-Age Security Fund. Because the report does not disaggregate the mix by programme, the mix mapped here is that of total managed funds. Debt securities dominate the portfolio. SBN and Bank Indonesia securities have no upper limit, but SBN must be at least 50 percent, while corporate debt securities are capped at 50 percent in aggregate. Since the split between SBN and

corporate debt is not reported at this level, compliance with the SBN floor can only be inferred conditionally. Deposits of 13.01 percent face no aggregate ceiling; their limit applies per bank. Equities of 8.38 percent sit well below the 50 percent aggregate ceiling, while mutual funds (4.13 percent) and direct investment and property (0.30 percent) are small. On this mapping, w_{actual} lies inside K. The solvency ratio of the JHT programme was 101.64 percent, which is classified as healthy (BPJS Ketenagakerjaan, 2026a).

Table 1. 2025 Managed-Fund Mix and Class-Level Limits for the JHT Fund

Asset class	Mix (%)	Class-level limit (GR 99/2013 as amended by GR 55/2015, Art. 37; OJK SBN rule)	Status
Debt securities (SBN, SRBI, corporate bonds)	74.18	SBN and BI securities without upper limit; SBN at least 50% of DJS investment; corporate debt ≤ 50% aggregate and ≤ 5% per issuer	Feasible provided SBN ≥ 50%
Time deposits	13.01	No aggregate ceiling; ≤ 25% per state-owned bank and ≤ 15% per other bank (implementation layer)	Feasible; not binding at class level
Listed equities	8.38	≤ 50% aggregate; ≤ 5% per issuer (implementation layer)	Feasible; ample headroom
Mutual funds	4.13	≤ 50% aggregate; ≤ 15% per investment manager	Feasible
Direct investment and property	0.30	Direct investment ≤ 5% (≤ 10% since GR 27/2026); land and buildings ≤ 10%; DIRE ≤ 20%	Feasible
Total	**100.00**		

Source: BPJS Ketenagakerjaan (2026a); Government Regulation No. 55 of 2015; Government Regulation No. 27 of 2026; Otoritas Jasa Keuangan (2016, 2017); processed by the author. The mix is the share of total managed funds, not a JHT-specific mix. Per-bank, per-issuer, and per-manager limits are not loaded into the class-level optimizer.

2. Why Unconstrained Mean–Variance Is Not a Viable Policy Tool

When only sample means and a no-*short-selling* restriction are available, the optimizer places weight on the asset class with the highest return-to-risk ratio in the data window. In Indonesian data, that window often favours equities after market-recovery years and deposits when policy rates are high. The first tendency can breach the 50 percent aggregate equity ceiling. Both tendencies compress the SBN share and can therefore breach the 50 percent SBN floor. By contrast, a concentration in deposits does not breach any class-level limit but burdens the implementation layer: a 40 percent deposit share, for example, requires placement in at least two state-owned banks or three other banks.

P1 is therefore supported analytically, that is, at the level of the model's structural properties rather than by a single point estimate: an unconstrained optimization problem has no reason to comply with K, and in this market it frequently

does not. This is the *error maximization* mechanism described by Michaud (1989), which in the context of a social security fund should be read as a compliance failure rather than a mere statistical anomaly.

3. Black–Litterman and the Permitted Set

The equilibrium *prior* reverses the direction of the analysis. Weights close to the market or to the existing policy mix generate Π, and in the absence of extreme views the Black–Litterman formula returns weights that remain close to that starting point (He & Litterman, 1999; Kolm & Ritter, 2017). Because w_{actual} already lies inside K, a *prior* built from a nearby benchmark will generally also lie inside K. P2 holds when two conditions are met. First, active views must not be calibrated with such high confidence that they overwhelm the *prior*. Second, the regulation must enter the optimizer as inequalities rather than being checked only after the computation is complete. The *posterior* return formula (Equation 2) does not contain K; only the subsequent optimization (Equation 3) does. A feasibility study that stops at the closed-form return is therefore incomplete. The new provision in Government Regulation No. 27 of 2026, which allows one year to rebalance ceiling breaches caused by market value changes, also indicates that tolerance bands and a *rebalancing* schedule should be designed from the outset.

P3 follows from the shape of K. SBN has no upper ceiling and so cannot bind from above, but its floor can bind when the model shifts weight towards equities, deposits, or corporate debt. Deposits have no aggregate ceiling and therefore do not bind at the class level; the per-bank limit binds only at the implementation stage. Equities still have ample headroom in the current portfolio, but they are the class most often exceeded by unconstrained models. In a constrained Black–Litterman optimization, the SBN floor is thus the constraint most likely to bind first if the equity share is raised, whereas the equity ceiling binds only when views or sample moments become aggressive. The ceilings on mutual funds, DIRE, direct investment, and property remain slack at current weights.

4. Comparison with Prior Studies

Krisnawan (2019) and Ilmi (2024) concluded that old-age fund portfolios were not optimal and that regulatory limits narrowed the scope for improvement. Nothing in Table 1 contradicts that conclusion, because inefficiency and invalidity are two different tests. A point on the unconstrained *frontier* may fail to comply with regulation, while a point inside K may fail to lie on the *frontier*. The relevant policy object is their intersection. Sun et al. (2023), Wu and Sun (2025), Harris et al. (2017), and Sahamkhadam et al. (2022) show that the Black–Litterman framework can be adapted to a range of risk characteristics. This study does not transfer the Sharpe ratio or CVaR magnitudes from those works; it borrows only the modelling framework and poses a feasibility question specific to Indonesia's social security fund.

Three caveats keep the claims proportionate. First, proxy returns are not the returns of the fund's actual portfolio. Second, the class-level permitted set is not the

complete compliance set; an equity weight of 40 percent that passes Table 1 may still breach the 5 percent per-issuer limit if implementation is concentrated. Third, the limits in Article 37 apply to the investment of each of the JHT and JP funds separately, whereas the mapped mix aggregates all managed funds, including the Work Accident Security fund, the Death Security fund, and BPJS corporate assets, which are subject to different limits. Feasibility in this study is therefore a necessary, but not sufficient, condition for an implementable investment mandate.

D. CONCLUSION

A social security fund governed by law cannot use a portfolio model that ignores the regulation governing it. For JHT, the set permitted by Government Regulation No. 99 of 2013 as amended by Government Regulation No. 55 of 2015, together with the OJK minimum SBN requirement, already contains the currently reported mix. An unconstrained *mean–variance* model has no inherent reason to stay within that set and, on Indonesian proxies, is likely to exceed the equity ceiling or push the SBN share below its floor. The Black–Litterman model is the more suitable candidate because its *prior* starts from observable weights, but it is feasible only if those weights are re-optimized under the same regulatory constraints.

Theoretically, this study establishes regulatory feasibility as a test distinct from efficiency that must be imposed at the optimization stage rather than at the stage of estimating *posterior* returns. Practically, any diversification of JHT assets should be specified as a constrained policy portfolio, with the SBN floor and the equity ceiling as the principal constraints, and with per-bank, per-issuer, and per-manager limits handled in the implementation layer. Claims about superior risk-adjusted performance and about an ESG tilt require a different research design.

The limitations of this study include annual holdings data, the use of proxy returns, an asset mix reported at the level of total managed funds, and the absence of numerical estimates of w_{MV} and w_{BL}. Future research should replace this analytical comparison with a fully estimated constrained optimizer, use programme-level data, test out of sample, and account for the changes introduced by Government Regulation No. 27 of 2026. Until then, the defensible statement is that the permitted set is known, the current mix lies within it, and a Black–Litterman policy mix can be kept within it, whereas a point on the unconstrained *frontier* cannot be assumed to do the same.

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