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Employment Volatility and the Sustainability of Payroll-Based Health Insurance Contributions in Indonesia: Evidence from the February 2025 National Labor Survey

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ABSTRACT

This research examines the sustainability of payroll-based health insurance contributions in Indonesia using microdata from the February 2025 National Labor Force Survey (Sakernas). The analysis focuses on wage workers (pekerja penerima upah/PPU) as the main financing base of the National Health Insurance (JKN). The aim of this study is to analyze the sustainability of JKN financing, exploring factors such as income capacity, contribution coverage, job stability, employment contract structure, and job volatility, which affect the continuity of payroll-based contributions. Using cluster analysis and Principal Component Analysis (PCA), the study identifies three major labor-risk segments among PPU workers: formal and stable, semi-formal, and vulnerable or volatile. The findings show that the vulnerable or volatile group constitutes the largest share of the PPU population and exhibits the highest stopwork rate, making it the primary source of national risk to the sustainability of payroll-based contributions. In contrast, the formal and stable group presents the lowest risk, while the semi-formal group represents a smaller transitional segment with relatively high employment disruption. The sustainability of JKN financing depends not only on workers' ability to pay contributions but also on the stability of employment relationships and labor market dynamics. Policies aimed at strengthening employment continuity, reducing contract-related job disruption, and protecting high-risk sectors and regions are essential for maintaining JKN membership and contribution flows.

INTRODUCTION

Indonesia's National Health Insurance (JKN) system is a major pillar in the effort to achieve universal health coverage (Nafiah et al., 2025; Perdana et al., 2022; Sasmita et al., 2025; Susanti et al., 2022; Susilo et al., 2025). One of the main sources of financing in this system comes from wage workers (PPU) through a payroll-based contribution mechanism. Within the framework of social health financing, a payroll-based contribution model is regarded as relatively stable because it relies on formal employment relationships and continuous income flows (Carrin et al., 2005).

However, labor market characteristics in developing countries, including Indonesia, are not entirely stable (Al Ayyubi et al., 2023; Kikkawa & Gaspar, 2023; Ridhwan et al., 2025; Yulianti & Fitriansyah, 2024). High levels of informality, the dominance of short-term employment contracts, and dynamic labor mobility are key features of labor market structure (Fields, 2011). These conditions give rise to the phenomenon of employment volatility, namely changes in employment status over a certain period, which may disrupt workers'

income continuity and ultimately affect the sustainability of contribution payments in social insurance systems

In the health financing literature, the sustainability of an insurance system is determined not only by the ability to pay, but also by the stability of the income sources that support such contributions (Wagstaff, 2009). Workers with unstable employment relationships, such as short-term contracts or seasonal jobs, face a higher risk of experiencing job separation. This condition may lead to interruptions in contribution payments and increase the risk of discontinuity in membership under the payroll-based JKN scheme.

Furthermore, labor market developments indicate the existence of a spectrum of workers positioned between full formality and high vulnerability (Pucheta & Kalil, 2025; Sandhya, 2026; Weller, 2023). Some workers are attached to the formal system, but with lower employment protection, more fragile contract structures, or higher employment volatility. In aggregate, these groups may become an important source of risk to the sustainability of the health financing system, particularly when their population size is large.

Several studies have examined health financing sustainability and labor market dynamics, but mostly in separate contexts. Carrin et al. (2005) highlighted that payroll-based contributions are relatively stable in formal economies, but their study did not account for employment volatility in developing countries. Wagstaff (2009) emphasized that income stability is as important as the ability to pay for sustaining health insurance contributions, yet his analysis focused on tax-financed systems rather than payroll-based mechanisms. Fields (2011) provided a comprehensive overview of labor market volatility in developing countries, including informality and contract instability, but did not link these directly to health insurance contribution continuity. Packard et al. (2019) examined social protection systems in the context of a diversifying world of work, arguing that non-standard employment poses risks to contribution-based social insurance, but their study focused on multiple countries without specific empirical evidence from Indonesia. The World Bank (2010) analyzed Indonesia's labor market, identifying high informality and contract uncertainty, but did not explicitly connect these findings to the JKN financing system. More recently, studies on JKN have focused on membership coverage and financial sustainability from the supply side, with limited attention to the demand-side risks arising from employment volatility among wage workers.

Although various studies have discussed health financing and labor market dynamics separately, studies that explicitly link employment volatility to the sustainability of payroll-based contributions, particularly in the context of wage workers in Indonesia, remain limited. Therefore, this study aims to analyze the level of labor vulnerability among PPU workers and its implications for the sustainability of JKN contributions.

This study offers several novelties. First, it uses the most recent nationally representative microdata from the February 2025 National Labor Force Survey (Sakernas) to provide an up-to-date empirical assessment of labor risk among wage workers in Indonesia. Second, it develops a multidimensional labor risk index using Principal Component Analysis (PCA) that captures not only income and contribution capacity but also employment stability, contract type, seasonal work, and household dependency burden. Third, it employs cluster analysis to identify three distinct labor risk segments among PPU workers—formal and stable, semi-formal, and vulnerable or volatile—which has not been previously mapped in the context of JKN financing. Fourth, it quantifies the contribution of each segment to national risk by combining population share and job separation rates, providing policy-relevant evidence on where systemic risks are concentrated.

Methodologically, this study develops a multidimensional approach encompassing income capacity, contribution payment coverage, job stability, contract structure, and

employment volatility. Furthermore, a clustering method is used to identify labor risk segmentation, while Principal Component Analysis (PCA) is employed to construct a labor risk index representing the main dimensions of vulnerability. This approach is expected to provide a more comprehensive understanding of the sources of risk in the JKN payroll system and to serve as a basis for more targeted policy formulation.

The aim of this study is to analyze the sustainability of JKN financing by exploring factors such as income capacity, contribution coverage, job stability, employment contract structure, and job volatility, which affect the continuity of payroll-based contributions. The theoretical benefit of this research lies in bridging labor economics and health financing literature, demonstrating that employment volatility is a key determinant of contribution sustainability in payroll-based social insurance systems. Practically, the findings are expected to provide evidence-based recommendations for policymakers to design targeted interventions—such as protecting high-risk sectors, reducing contract-related job disruption, and strengthening employment continuity in order to maintain JKN membership and contribution flows, particularly for vulnerable wage workers.

METHOD

Data Source and Study Design

This study employs a quantitative approach using secondary microdata from the February 2025 National Labor Force Survey (Sakernas) conducted by Statistics Indonesia (Badan Pusat Statistik, 2025). Sakernas is a nationally representative survey designed to capture labor force conditions, employment status, and job characteristics of the working-age population. The unit of analysis in this study is wage workers (pekerja penerima upah/PPU), as this group constitutes the primary contributor base to the National Health Insurance (JKN) through payroll-based contributions, and is defined broadly to include employees and paid apprentices. The dataset was constructed through a merging process using the identifiers TAHUN, PSU, SSU, and URUTAN, and the merging process was validated with no loss of observations. After restricting the sample to workers with positive and observed wages, the final analytical sample consists of 51,004 individuals, which were then aggregated to the province-by-industry level, resulting in 620 analytical units.

Operational Definition of Labour Risk Indicators

The main focus of this study is to assess labour vulnerability and its implications for the sustainability of payroll-based contributions in the National Health Insurance (JKN) system. In the context of social health financing, sustainability is not only determined by the ability to pay, but also by the stability of income and employment relationships (Wagstaff, 2009). Payroll-based contribution systems are generally considered stable due to their reliance on formal employment and regular wage flows (Carrin et al., 2005). However, labour market conditions in developing countries are often characterized by job instability, informal arrangements, and contract uncertainty, which may disrupt contribution continuity (Fields, 2011).

In this study, the worker contribution is defined based on a payroll-based scheme, where the contribution is calculated as a proportion of monthly wages with an upper wage limit. Mathematically, the contribution of worker i is defined as:

$$\text{Contribution} = 1\% \times \min(\text{Wage}, 12{,}000{,}000)$$

The ability to pay is then measured as the ratio between contributions and wages:

$$\text{ATP Ratio} = \text{Contribution}/\text{Wage}$$

In addition to financial capacity, labour risk is measured through several indicators, including job separation (proxy for employment volatility), contract status (written vs. no contract), seasonal employment, and household size as a proxy for dependency burden.

Study Variables and Database Structure

To facilitate reproducibility, the variables used in this study are summarized in Table 1. The dataset includes indicators of income capacity, contribution burden, employment stability, and job characteristics. These variables are constructed from Sakernas microdata and aggregated using survey weights to ensure representativeness.

Table 1. Operational Definition of Variables and Database Codes

Variable Concept	Database Code	Operational Definition
Wage Workers (PPU)	MJJ_EMPREL	Wage workers including employees and paid apprentices.
Wage Level	MJJ_UPAH_U	Monthly wage received by workers.
Worker Contribu-tion	Calculated	Contribution defined as 1% of wage with an upper limit of Rp12,000,000.
Ability to Pay	Ratio (Contribu-tion/Wage)	Ratio of contribution to wage as a proxy for financial capacity.
Employer Cove-rage	MIE_SOC_A	Workers whose health insurance contributions are paid by employers.
Self-Payment	MIE_SELF_A	Workers who pay health insurance contributions independently.
Job Separation	MPK_HENTI	Workers who experienced job termination within the last year.
Written Contract	MJC_CONTRA	Workers with formal written employment contracts
No Contract	MJC_CONTRA	Workers without any employment contract
Seasonal Work	MCD_TASKSE	Workers engaged in seasonal employment.
Household Size	JMLART	Number of household members as proxy of dependency burden.
Labour Risk In-dex	PCA (PC1)	Composite index constructed using Principal Component Analysis based on labour vulnerability indicators.

Source: Authors' compilation based on Sakernas February 2025 questionnaire and variable definitions (Badan Pusat Statistik, 2025)

Analytical Strategy

The analysis begins with data preparation, including consistency checks, merging of Sakernas files, and validation to ensure that no observations were lost during the integration process. The analytical sample is then restricted to wage workers (PPU) with positive and observed wages, so that the unit of analysis accurately reflects workers participating in the payroll-based contribution scheme.

All labour risk indicators are subsequently aggregated to the province-by-industry level using survey weights to maintain national representativeness. The resulting dataset captures key dimensions of labour vulnerability, including income capacity, contribution burden, employment stability, contract structure, seasonal work, and household size. In general, weighted averages are calculated as:

$$\overline{x_{ps}^{(w)}} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$$

where wi denotes the survey weight of observation i in province p and sector s.

Prior to modelling, missing values in selected variables are examined. Variables with incomplete observations are imputed using the national median in order to preserve the group structure, while all variables are standardized using z-scores to ensure comparability across different measurement scales.Labour risk segmentation is then conducted using k-means clustering to group province-by-industry units based on similarities in their risk profiles (MacQueen, 1967). The optimal number of clusters is determined using the elbow method and validated through the silhouette index (Rousseeuw, 1987), resulting in three main clusters representing different levels of labour vulnerability.

To capture the multidimensional nature of labour risk, a Labour Risk Index is constructed using Principal Component Analysis (PCA). The index is derived from four key indicators: job separation, absence of contract, seasonal employment, and household size. The first principal component (PC1), which explains the largest proportion of variance, is interpreted as the composite measure of labour vulnerability (Jolliffe, 2002).

The Labour Risk Index is further aggregated to the provincial level using weighted averages across province-by-industry groups, defined as:

$$LRI_p = \frac{\sum_s n_{ps}^{(w)} \cdot PC1_{ps}}{\sum_s n_{ps}^{(w)}}$$

where nps represents the weighted number of workers in province p and sector s.

In addition, the contribution of each labour segment to national risk is assessed by combining the population share of workers and the weighted rate of job separation. The risk contribution is defined as:

$$RC_j = SharePop_j \times Stopwork_j$$

This approach allows the identification of clusters, provinces, and sectors that act as the main drivers of national risk in the continuity of payroll-based JKN contributions.To ensure robustness, correlations among variables are examined prior to clustering to detect potential redundancy. Variables with very high correlation are evaluated conceptually to avoid duplication of information. In this study, the variable representing any contract is excluded from the final model due to its strong complementarity with the no-contract variable. All analyses are conducted using R Statistical Software.

RESULTS AND DISCUSSION

Descriptive Overview of Labour Risk Indicators Before proceeding to clustering and index construction, the distribution of the main labour risk indicators is examined to understand their variability across province-by-industry units. The summary statistics are presented in Table 2.

Overall, the results show substantial heterogeneity, particularly in terms of wages and employment stability. The median wage is around IDR 2.85 million, with a very wide range from IDR 625,000 to over IDR 21 million. The distribution is highly skewed to the right, indicating that a small number of units have very high wages compared to the majority. This pattern confirms the presence of strong income disparities across sectors and regions and justifies the need for standardization before clustering.

In terms of contribution structure, the proportion of workers whose contributions are paid by employers averages around 50%, indicating that payroll-based financing remains the dominant mechanism. However, about 20% of workers still pay contributions themselves, suggesting that not all workers are fully covered by employer-based arrangements. The distribution of self-payment is uneven, meaning this condition is concentrated in certain groups.

Labour stability indicators reveal additional insights. The average job separation rate is relatively low, but the distribution is highly skewed. This indicates that while most groups

experience low employment disruption, some groups face significantly higher job instability. This uneven distribution suggests that employment volatility is concentrated rather than widespread.

Regarding employment contracts, although a large share of workers has some form of contract, a considerable proportion still works without any formal contract. This indicates that formal and informal employment arrangements coexist within the PPU segment. Meanwhile, written contracts are present in more than half of the observations, but not universally, reflecting varying degrees of job formalization.

Seasonal employment also shows a skewed pattern, with most units having low levels but a few exhibiting high dependence on seasonal work. This suggests that certain sectors are more vulnerable to fluctuations in employment continuity.In contrast, household size is relatively stable across units, indicating that dependency burden varies less compared to labour market indicators.

Overall, these descriptive statistics confirm that the selected variables have sufficient variation to distinguish different labour risk profiles. At the same time, the presence of skewed distributions highlights the importance of standardization before clustering. The results also suggest that labour vulnerability is multidimensional, driven not only by income differences but also by employment stability and contract structure.

Table 2. Descriptive Statistics of Labour Risk Variables

Variable	Mean	SD	Median	Min	Max	Skew	Kurtosis
Median Wage	2,838,749	1,406,975	2,850,000	625,000	21,100,000	4.74	50.45
Employer Coverage	0.50	0.33	0.47	0	1	0.12	-1.39
Self Payment	0.20	0.22	0.15	0	1	2.11	4.98
Job separation (1 year)	0.06	0.11	0.03	0	1	5.28	38.28
Any contract	0.74	0.25	0.78	0	1	-0.60	-0.66
Written Contract	0.57	0.34	0.58	0	1	-0.10	-1.52
No. contract	0.25	0.24	0.20	0	1	0.64	-0.57
Seasonal work	0.21	0.28	0.08	0	1	1.39	1.09
Household size	3.90	0.66	4.00	1	7	-0.34	5.54

Source: Authors' calculation using Sakernas February 2025 microdata (processed, 2025)

Determination and Validation of the Number of Clusters

The optimal number of clusters was determined using a combination of the elbow method and silhouette analysis. This approach was used to ensure that the selected number of clusters balances statistical fit and interpretability.

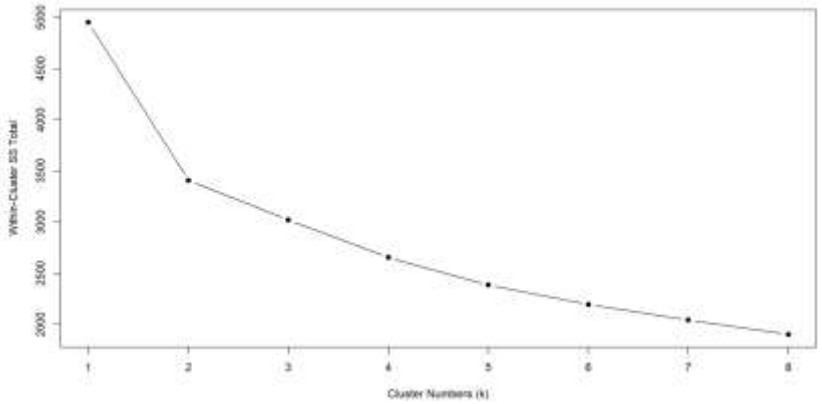

Figure 1. Elbow Method for Determining the Optimal Number of Clusters
Source: Authors' analysis using Sakernas February 2025 data (processed, 2025)

The elbow method evaluates the within-cluster sum of squares (WSS) for different values of k. As shown in Figure 1, the WSS decreases sharply when the number of clusters increases from 1 to 3, and then begins to flatten. This pattern indicates that adding more clusters beyond three provides only limited improvement in explaining the variation within the data. Therefore, the elbow point is identified at k = 3.

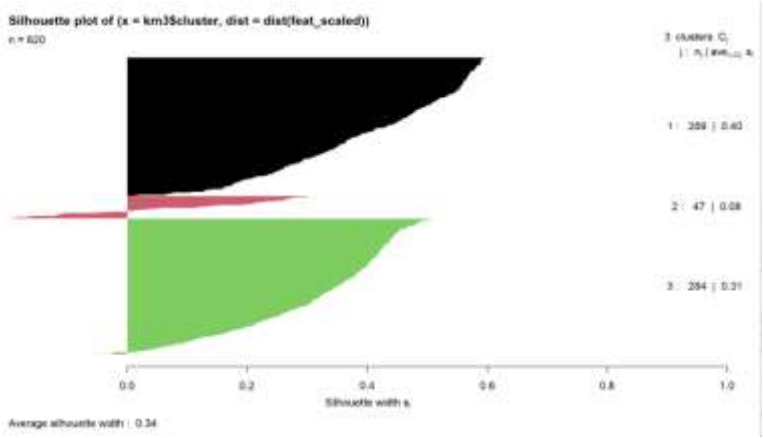

Figure 2. Silhouette Plot for k = 3 Clustering
Source: Authors' analysis using Sakernas February 2025 data (processed, 2025)

To further validate this result, silhouette analysis was conducted. The average silhouette score indicates a moderate level of cluster separation, suggesting that the clustering structure is reasonably well-defined. As illustrated in Figure 2, two clusters exhibit relatively good separation, while one cluster appears less distinct, indicating the presence of a transitional group between segments.

Based on these results, the analysis adopts a three-cluster solution. This specification allows for a meaningful segmentation of labour risk into three groups, capturing differences between stable, transitional, and vulnerable employment conditions. In addition to statistical justification, the three-cluster solution is also more interpretable from a policy perspective compared to a simpler two-cluster structure.

Labour Risk Segmentation: Cluster Profiles

The clustering results identify three distinct labour risk segments among wage workers, reflecting substantial heterogeneity in employment conditions and contribution stability.

The first cluster, labelled Formal and Stable (Low Risk), represents workers with relatively strong employment security. This group is characterized by higher median wages, high employer contribution coverage, and a dominant presence of written contracts. At the same time, indicators of labour instability—such as job separation and seasonal employment—are consistently low. These characteristics suggest that workers in this cluster are firmly embedded in formal employment relationships, ensuring relatively stable and continuous contribution flows within the payroll-based system.

The second cluster, labelled Semi-Formal (Medium Risk), represents a transitional segment between stability and vulnerability. Although this group records relatively high wages and maintains a considerable level of employer coverage, it is distinguished by a substantially higher reliance on self-payment. In addition, the levels of job separation and seasonal employment are higher compared to the formal cluster. This combination indicates that while workers in this group remain partially connected to the formal system, their employment conditions are less stable and more prone to disruption.

The third cluster, labelled Vulnerable or Volatile (High Risk), exhibits the most fragile labour conditions. This group is characterized by lower wages, limited employer coverage, and a high proportion of workers without formal contracts. Moreover, job separation and seasonal employment are significantly higher, indicating unstable and discontinuous employment relationships. These features imply a heightened risk of contribution interruption, making this cluster the most critical segment from the perspective of payroll-based financing sustainability.

Overall, the segmentation demonstrates that labour risk among wage workers is not uniform but distributed along a continuum ranging from stable formal employment to highly vulnerable and volatile work arrangements. This classification provides a meaningful basis for understanding the structural sources of risk within the payroll-based contribution system.

Table 3. Average Characteristics of Labour Risk Clusters

Cluster	Number of units	Median wage (IDR)	Employer coverage (%)	Self-payment (%)	Job separation (%)	Written contract (%)	No contract (%)	Seasonal work (%)	Household size
Formal & Stable (Low Risk)	289	3,200,000	77.32	15.24	3.90	85.81	6.11	6.92	4.01
Semi-Formal (Medium Risk)	47	3,500,000	64.11	80.11	7.53	77.41	10.79	10.91	3.76
Vulnerable / Volatile (High Risk)	284	2,000,000	21.09	15.64	8.80	24.13	46.62	24.00	3.81

Source: Authors' calculation based on cluster analysis of Sakernas February 2025 data (processed, 2025)

Distribution of Population and Risk Contribution Across Clusters

Although the number of analytical units is relatively balanced across clusters, their population sizes differ substantially when weighted by the number of workers. This distinction is critical, as the contribution of each cluster to national risk depends not only on

its characteristics but also on its population share.The Vulnerable or Volatile (High Risk) cluster constitutes the largest segment of wage workers, accounting for the majority of the PPU population. This group is not only large in size but also exhibits the highest job separation rate. As a result, it emerges as the primary contributor to national risk in the continuity of payroll-based contributions.

In contrast, the Formal and Stable (Low Risk) cluster represents a substantial share of workers but contributes significantly less to overall risk due to its much lower level of employment volatility. This indicates that stable employment relationships effectively mitigate the risk of contribution discontinuity.Meanwhile, the Semi-Formal (Medium Risk) cluster accounts for only a small fraction of the total population. Although its job separation rate is relatively high, its limited population size results in a minimal contribution to aggregate national risk.

These findings highlight that systemic risk in payroll-based financing is driven by the interaction between employment instability and population size. In other words, even moderate levels of vulnerability can generate substantial systemic risk when affecting a large segment of workers. This underscores the importance of focusing policy interventions on large and vulnerable groups rather than solely targeting the most extreme cases.

Table 4. Population Distribution and Risk Contribution by Cluster

Cluster	Total workers	Population share (%)	Stopwork rate (%)	Risk contribution (percentage points)	Share of national risk (%)
Formal & Stable (Low Risk)	25,925,636	39.19	3.62	1.42	20.56
Vulnerable / Volatile (High Risk)	38,854,545	58.73	9.05	5.32	77.00
Semi-Formal (Medium Risk)	1,373,539	2.08	8.13	0.17	2.44

Source: Authors' calculation using weighted Sakernas February 2025 data (processed, 2025)

Structure of Job Separations

To better understand the sources of employment volatility, job separation is decomposed into different types of shocks, namely involuntary separation, contract expiry, voluntary exit, and other reasons.

The results indicate that the structure of job separation differs substantially across labour risk clusters. In the Vulnerable or Volatile (High Risk) cluster, contract expiry emerges as the dominant driver of job separation. This suggests that employment instability in this segment is primarily associated with the widespread use of temporary or short-term employment arrangements rather than involuntary job loss. As a result, interruptions in contribution payments are more likely to occur due to structural characteristics of employment rather than unexpected economic shocks.

In contrast, the Formal and Stable (Low Risk) cluster is largely characterized by voluntary job separation. This pattern reflects a more stable labour market environment, where workers transition between jobs by choice, supported by stronger employment protection and more formal contractual arrangements. The relatively small share of involuntary separation further reinforces the stability of this group.

Meanwhile, the Semi-Formal (Medium Risk) cluster shows a mixed pattern, with a dominant share of voluntary exits accompanied by a moderate contribution from contract expiry. This combination indicates that the group occupies a transitional position, where workers are still connected to formal employment but face higher mobility and less stable employment conditions compared to the fully formal cluster.

Table 5. Composition of Job Separation by Cluster (%)

Cluster	Involuntary (%)	Contract expiry (%)	Voluntary (%)	Other (%)
Formal & Stable (Low Risk)	4.84	28.54	50.12	16.49
Vulnerable / Volatile (High Risk)	5.64	41.99	30.50	21.87
Semi-Formal (Medium Risk)	0.78	11.88	65.22	22.12

Source: Authors' calculation based on job separation decomposition from Sakernas February 2025 data (processed, 2025)

The differences in the composition of job separation across clusters highlight that employment volatility is not homogeneous in nature. While some groups experience mobility driven by individual choice, others are structurally exposed to contract-based employment instability.

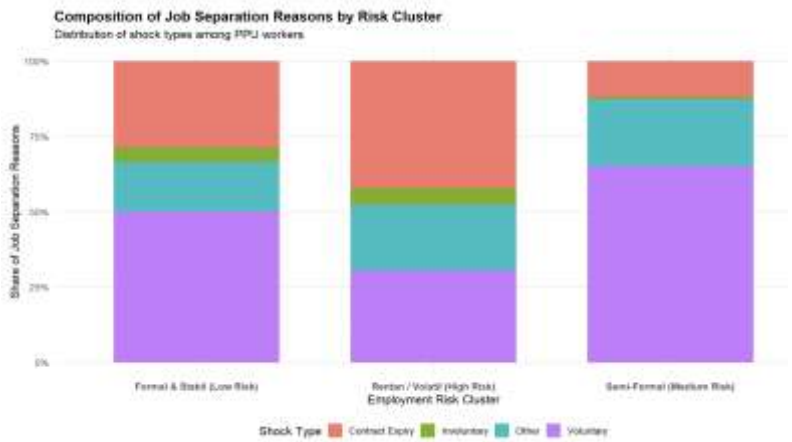

Figure 3. Composition of Job Separation by Cluster
Source: Authors' visualization based on Sakernas February 2025 data (processed, 2025)

The graphical representation further reinforces these differences by clearly illustrating the dominance of contract expiry in the vulnerable cluster and voluntary mobility in the more stable groups. Overall, these findings suggest that the main risk to the sustainability of payroll-based contributions does not stem primarily from involuntary job loss, but rather from the structural prevalence of short-term employment arrangements and labour mobility patterns.

National Composition of Employment Shocks

To complement the cluster-level analysis, this section examines the composition of employment shocks at the national level. This aggregation provides a broader perspective on the dominant sources of job separation among wage workers in Indonesia.

The results show that contract expiry constitutes the largest share of job separation at the national level, followed by voluntary exits. In contrast, involuntary separation accounts

for only a relatively small proportion. This pattern indicates that employment instability within the PPU segment is not primarily driven by layoffs or economic downturns, but rather by the structural characteristics of employment relationships.The dominance of contract-based separation suggests that discontinuity in payroll-based contributions is closely linked to the prevalence of temporary and non-permanent employment arrangements. Even in the absence of major economic shocks, the expiration of contracts can systematically interrupt contribution flows.

Table 6. National Composition of Employment Shocks

Type of shock	Total workers	Share of total shocks (%)
Contract expiry	1,059,337	38.77
Voluntary	956,572	35.01
Other	569,652	20.85
Involuntary	146,979	5.38

Source: Authors' calculation using nationally weighted Sakernas February 2025 data (processed, 2025)

When combined with the national job separation rate, the contribution of each shock type further illustrates its relative importance. Contract expiry contributes the largest portion to overall employment volatility, followed by voluntary mobility, while involuntary separation contributes only marginally.

These findings reinforce the conclusion that the sustainability of payroll-based contributions is more sensitive to contract dynamics than to traditional labour market shocks. In this context, employment volatility should be understood as a structural feature of the labour market rather than a temporary outcome of economic fluctuations.

Labour Risk Index Based on PCA

To complement the clustering analysis, a Labour Risk Index was constructed using Principal Component Analysis (PCA) to capture the multidimensional nature of labour vulnerability.The results show that the first principal component (PC1) represents the main dimension of labour risk, with strong positive loadings on job separation, absence of contract, and seasonal employment (Table 7). These variables reflect unstable employment conditions, indicating that the index effectively captures employment-related vulnerability.PC1 explains approximately 34.8% of the total variance, while the first two components together explain more than 60% (Table 8). Given its dominant explanatory power, PC1 is used as the Labour Risk Index in this study.

Table 7. PCA Loadings of Labour Risk Indicators

Variable	PC1	PC2	PC3	PC4
Job separation	0.442	-0.348	0.814	-0.143
No contract	0.617	0.193	-0.370	-0.667
Seasonal work	0.631	-0.173	-0.294	0.697
Household size	-0.159	-0.901	-0.338	-0.221

Source: Authors' analysis using PCA on Sakernas February 2025 data (processed, 2025)

Table 8. Explained Variance of Principal Components

Component	Standard deviation	Proportion of variance	Cumulative proportion
PC1	1.180	0.348	0.348

PC2	1.011	0.255	0.604
PC3	0.943	0.222	0.826
PC4	0.834	0.174	1.000

Source: Authors' analysis using PCA on Sakernas February 2025 data (processed, 2025)

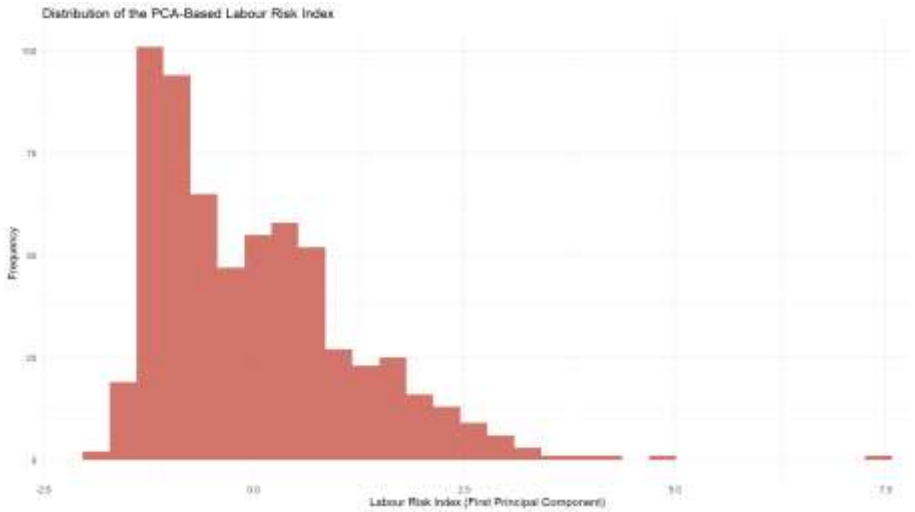

Figure 4. Distribution of Labour Risk Index (PCA-Based)
Source: Authors' calculation based on PCA first principal component from Sakernas February 2025 data (processed, 2025)

Overall, the PCA-based index provides a complementary continuous measure of labour vulnerability, allowing comparison across units beyond discrete cluster classification.

Regional and Sectoral Concentration of Risk

The distribution of labour risk across provinces reveals a clear pattern of concentration rather than uniformity. In labour market analysis, aggregate risk is shaped not only by the average level of vulnerability but also by how that vulnerability is distributed across units. When risk is concentrated in a limited number of regions, the overall system becomes more sensitive to labour market dynamics in those areas. In this context, the sustainability of payroll-based contributions depends on both employment volatility and the spatial distribution of workers.

As shown in Figure 5, a relatively small number of provinces account for a disproportionately large share of national risk contribution. Provinces such as East Java, West Java, and Central Java dominate this distribution. Their role is driven primarily by the size of their labour force rather than by extreme levels of job separation. This indicates that systemic risk is largely a function of scale. Even moderate levels of employment instability can generate substantial national risk when they occur within large labour markets.

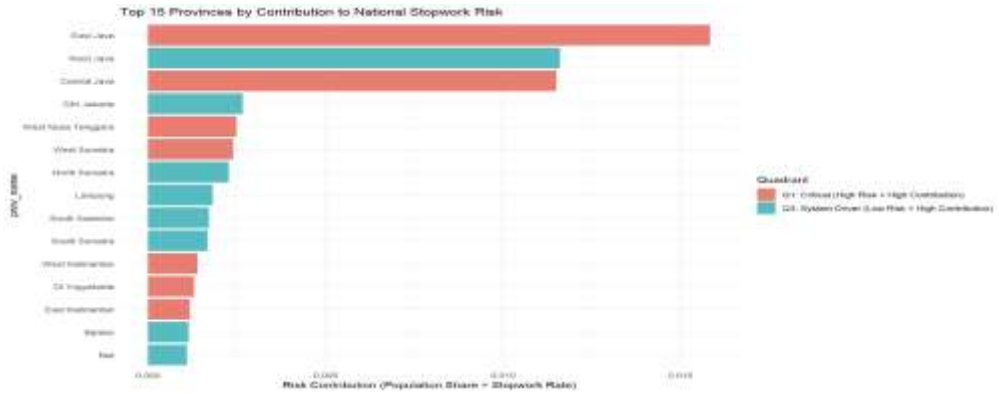

Figure 5. Top Provinces by Risk Contribution
Source: Authors' aggregation of risk contribution using Sakernas February 2025 data (processed, 2025)

This pattern can be further interpreted through a comparison between job separation rates and contribution to national risk. Figure 6 shows that provinces can be grouped into distinct categories, separating those with high systemic importance from those with more localized risk. Some provinces combine both high stopwork rates and high contribution, while others contribute significantly despite only moderate volatility. This distinction highlights that systemic risk cannot be understood solely through the intensity of labour instability, but must also consider the size of the affected population.

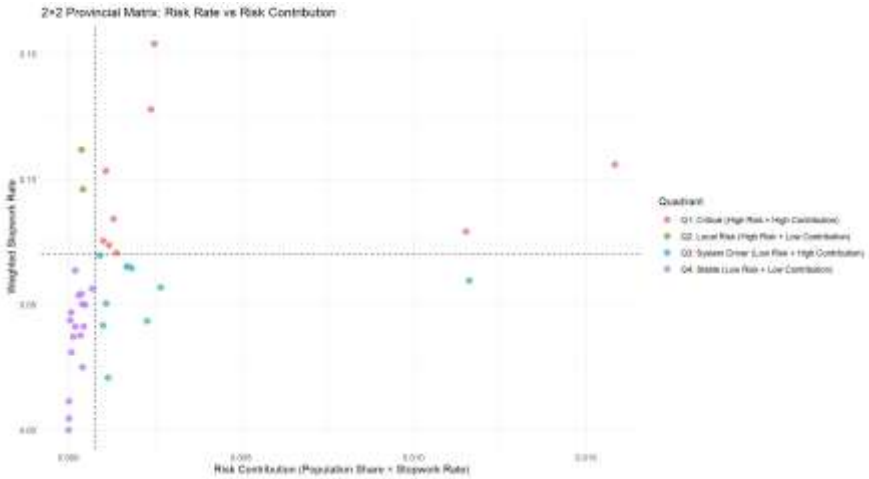

Figure 6. Provincial Risk Matrix (Stopwork vs Contribution)
Source: Authors' analysis based on provincial-level risk indicators from Sakernas February 2025 data (processed, 2025)

The unequal distribution of risk is further confirmed by the Lorenz curve in Figure 7. The curve deviates substantially from the line of equality, indicating that a small number of provinces account for a large share of total national risk. The use of the Lorenz curve in this context follows the approach commonly applied in inequality analysis, where deviations from perfect equality reflect concentration across units (O'Donnell et al., 2007). This result implies that the sustainability of payroll-based contributions is disproportionately influenced by a limited number of high-impact provinces.

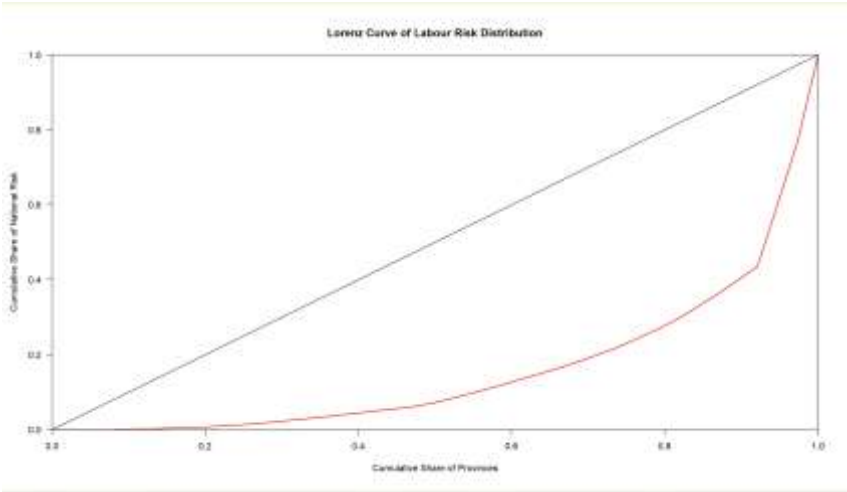

Figure 7. Lorenz Curve of Risk Contribution Across Provinces
Source: Authors' calculation of cumulative risk contribution shares using Sakernas February 2025 data (processed, 2025)

To provide a clearer spatial interpretation, Figure 8 presents a map of risk contribution across provinces. The map shows that risk is geographically clustered, with higher contributions concentrated in densely populated regions, particularly in Java. In contrast, many provinces outside these areas exhibit lower contributions, even when local job separation rates are relatively high. This spatial pattern reinforces the earlier finding that national risk is driven more by the scale of employment than by isolated instances of high volatility. The map also highlights regional disparities in labour market structure, suggesting that employment stability and workforce distribution vary significantly across Indonesia.

Figure 8. Map of Risk Contribution by Province
Source: Authors' mapping using provincial risk contribution estimates from Sakernas February 2025 data (processed, 2025)

At the sectoral level, a similar concentration pattern emerges. Labour-intensive sectors such as construction, agriculture, and trade contribute the most to national risk. These sectors combine relatively high employment volatility with large workforce shares. From a labour market perspective, sectors characterized by seasonal work, informal arrangements, and short-term contracts tend to exhibit greater instability (Fields, 2011). As a result, their contribution to aggregate risk is amplified not only by volatility but also by the number of workers involved.

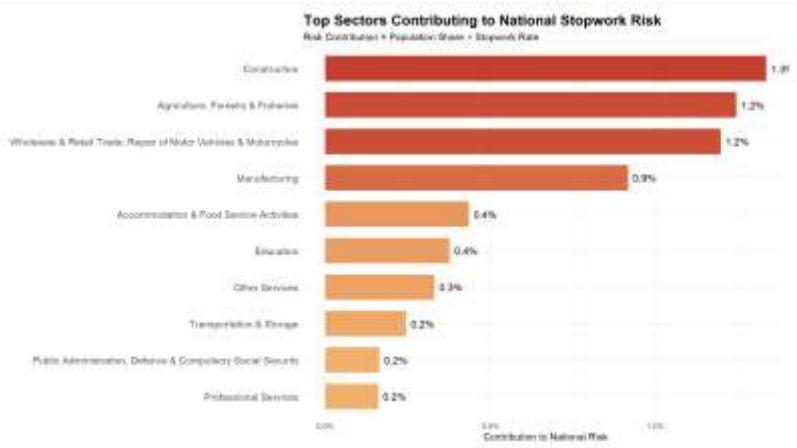

Figure 9. Top Sectors by Risk Contribution
Source: Authors' calculation of sectoral risk contribution using Sakernas February 2025 data (processed, 2025)

Overall, the results indicate that labour risk is concentrated in a relatively small number of provinces and sectors. This concentration implies that the sustainability of payroll-based contributions is particularly sensitive to conditions in these high-impact areas. Targeted policy interventions focusing on key provinces and sectors are therefore likely to be more effective than uniform approaches applied across the entire labour market.

Synthesis of Main Findings

Overall, the findings of this study point to several important insights regarding the structure of labour risk and its implications for the sustainability of payroll-based health insurance contributions.

First, the results demonstrate that wage workers are not a homogeneous group. Instead, they can be clearly segmented into distinct labour risk profiles, ranging from formal and stable employment to highly vulnerable and volatile work arrangements. This segmentation highlights the presence of structural heterogeneity within the PPU population, which has important implications for contribution stability.

Second, employment volatility is shown to be more closely associated with the structure of employment relationships than with income levels alone. While income remains an important dimension, the analysis indicates that factors such as contract status, job continuity, and the prevalence of seasonal work play a more critical role in determining the likelihood of job separation and, consequently, contribution discontinuity.

Third, the largest source of systemic risk originates from the vulnerable or volatile segment, which also represents the majority of the workforce. This finding underscores that systemic risk is driven not only by high individual vulnerability but also by the size of the population exposed to that risk. As a result, even moderate instability can translate into significant aggregate risk when it affects a large group of workers.

Finally, labour risk is found to be highly concentrated across specific regions and sectors. A relatively small number of provinces and labour-intensive sectors account for a disproportionate share of national risk. This concentration suggests that the sustainability of payroll-based contributions is particularly sensitive to conditions in these high-impact areas.

Taken together, these findings indicate that labour risk in the payroll-based system is multidimensional, structurally embedded, and unevenly distributed. Consequently, policies aimed at improving contribution sustainability need to account for heterogeneity across worker segments, employment structures, and regional labour market dynamics, rather than relying on uniform approaches.

CONCLUSION

This study examined the sustainability of payroll-based health insurance contributions in Indonesia using microdata from the February 2025 National Labor Force Survey (Sakernas). Focusing on wage workers (PPU) as the main financing base of the National Health Insurance (JKN), the analysis shows that the continuity of payroll-based contributions is shaped not only by workers' ability to pay, but also by the structure and stability of their employment relationships. The findings indicate that labour risk among PPU workers is multidimensional and unevenly distributed across worker groups, regions, and sectors.

The cluster analysis identified three main labour risk segments: formal and stable, semi-formal, and vulnerable or volatile. Among these, the vulnerable or volatile cluster emerged as the most critical segment because it combines the highest stopwork rate with the largest share of the worker population. This means that the main source of systemic risk in payroll-based financing does not come from a small marginal group, but from a broad segment of workers whose employment relationships are fragile and more likely to be interrupted. By contrast, the formal and stable cluster contributes less to national risk despite its large size, reflecting the protective role of stronger contracts, employer coverage, and lower employment volatility.

The analysis of employment shocks further shows that contract expiry is the dominant source of job separation, both within the vulnerable cluster and at the national level. This finding suggests that contribution discontinuity in the JKN payroll system is driven more by structural features of the labour market, particularly temporary and short-term employment arrangements, than by involuntary separation alone. The PCA-based Labour Risk Index also confirms that labour vulnerability is concentrated in specific province-by-industry units, while the regional and sectoral analysis reveals that national risk is disproportionately shaped by a small number of provinces and labour-intensive sectors, especially those with large worker populations and moderate-to-high stopwork rates.

Taken together, these findings imply that policies aimed at sustaining payroll-based JKN contributions should move beyond a narrow focus on contribution affordability. Interventions need to address employment continuity, contract stability, and the concentration of labour risk in high-impact provinces and sectors. In practice, this means that targeted measures for vulnerable worker segments, labour-intensive sectors, and system-driving regions are likely to be more effective than uniform nationwide approaches. Strengthening the continuity of employment relationships is therefore essential not only for labour market protection, but also for the long-term sustainability of payroll-based health insurance financing in Indonesia.

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