



Regional Heterogeneity in the Philippines: A Case of Random Walk and Causality in Wages

Teresita Silma B. Balgos^{1,2}, and Ronaldo R. Cabauatan^{1,3,4}

¹The Graduate School, University of Santo Tomas, Manila, Philippines.

²University of San Agustin, Iloilo City, Philippines.

³College of Commerce of Business Administration, University of Santo Tomas, Manila, Philippines.

⁴Research Center for Social Sciences and Education, University of Santo Tomas, Manila, Philippines.

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ABSTRACT

The intention behind statutory minimum wage is to alleviate poverty, however, variations across regional economies are ubiquitous. This study examines the regional wage distributional pattern, stochastic properties, and whether local economic factors sustain the cyclicity of wage. The distributional regional wage pattern revealed a hierarchical wage structure and disparities in the minimum-to-average wage ratio. The National Capital Region (NCR) reached a maximum minimum wage of PHP570, in contrast to the BARMM's maximum wage of PHP341 over a span of 21 years. Fisher's-combined variance-ratio tests ($p\text{-value}=0.366>0.05$) indicate that wages exhibit a random walk pattern. Granger causality test results showed bidirectional causality between wages and Gross Regional Domestic Product and Employment Rate, while unidirectional causality with Per Capita Gross Regional Domestic Product and Inflation Rate. The results suggest that centralized wage policies will create highly heterogeneous and imbalance effects, as each region has distinct regional economic characteristics. The wage-setting mechanisms sustain the cyclicity of the economy while also being counter-inflationary.

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1. INTRODUCTION

The behavior of wage growth in the Philippines has long been associated with income inequality and its inability to offset consistent annual price increases. In several cases, the demand for higher wage increases overshadows the legislative wage-setting mechanism and regional heterogeneity. The Wage Rationalization Act of 1989 (RA6727) of the Philippines presents criteria for wage determination with the main intention of protecting workers against unduly low pay, promoting the general well-being of workers and higher productivity. Under the wage law, each of the 17 regions in the Philippines has its own Regional Tripartite Wages and Productivity Board who determine and fixed the daily minimum wage rates annually for agricultural and non-agricultural workers in their regions. The minimum wage for non-agricultural workers is further decomposed into establishments with less than ten (10) workers and with ten or more workers.

Over time, the wage-setting process exposed distinct differences in structure, sensitivity, and patterns among various regions. The extent to which wage adjustments are sensitive to

prevailing regional conditions varies. Some regions' wage increases have an overarching focus on the annual food threshold, while others focus on inflation and the economy's robustness. The autonomy of minimum wage determination consequently results in 17 or more different wage rates across the country. There are regions where wages vary by component, city, region, and industry. Region IV-A has six different wage rates, whereas Region 6 has only one. Among the ASEAN member states, only the Philippines has 17 different minimum wages across the country. The behavior pattern of industries in highly urbanized cities has not changed; these regions continue to offer higher wages. In comparison, regions at the periphery offer lower Wages. These behaviors suggest that the local economic landscape of these regions has not changed significantly. According to Balisacan & Hill (2007), the Philippines has an unevenly distributed economic activity, concentrating around the National Capital Region and two adjacent regions, Central Luzon and Southern Luzon, characterized by a fast-growing economy and infrastructure and uneven living standards. These regional disparities have been

*Corresponding author:

E-mail address: Teresita Silma B. Balgos <teresitasilma.balgos.gs@ust.edu.ph>.
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the cause of varied labor market outcome in the Philippines. Further, there is a pending legislation Senate Bill 2534 House Bill No. 7568 of structuring wage increases by granting PHP 100 or PHP750 across the board respectively without considering and correcting the existing wage differences of regions. Despite the popularity and issues surrounding wage determination in the Philippines, most existing wage literature predominantly focuses on regional wage level comparisons and wage-poverty dynamics. However, these do not capture the stochastic behavior of regional wages. The legal framework of the minimum wage often obscures its regional differences. This study addresses these gaps by examining the evolution of regional wage heterogeneity, involving stochastic, wage-setting, and local economic factors, and the pattern of wage movements.

In light of these issues, this study seeks to answer the following questions: (1) Are there relative differences of minimum wage distribution across various regions in the Philippines? (2) Do regional wage settings follow a systematic or a random trend? (3) Are regional wage cyclicality predicted and sustained by local economic factors, which include Gross Regional Domestic Product (GRDP), Per Capita Gross Regional Domestic Product, Labor Productivity, Employment Rate, and Inflation Rate?

2. LITERATURE REVIEW

2.1 Minimum Wage Setting Legal Framework

Every 17 regions in the Philippines have their own Regional Wage Board, mandated by law, to determine and set the minimum wage. The process in the region takes more than one month, as it involves filing and deliberating the petition for a wage increase, conducting public consultations, and holding hearings. The Minimum Wage Fixing process can be initiated either through a *Motu Proprio* by the Regional Board or a petition. The Regional Board acts on the petition within fifteen days from receipt, followed by scheduling, posting, and conducting public hearings in a manner prescribed under Omnibus Rules. The Public Hearing for the petition conducted within forty-five (45) days is attended by the Chairman or any of the Vice Chairmen and members of the Regional Board, employers' and workers' groups, local government unit officials, and other interested parties. The Board resolves the position papers submitted by interested parties within thirty (30) days of the last public hearing. Following this, the Regional Board issues a Wage Order, which the Commission reviews before it is published. The Wage Order takes effect within fifteen (15) days after publication in at least one (1) newspaper of general circulation in the region. (Villanueva, 2010); (Omnibus Rules on Minimum Wage Determination, 1989); (NWMPC Guidelines No. 03). The effectivity period of the new minimum wage order for the agriculture and non-agriculture workers is one year before a new petition for wage increase can be filed or changed.

2.2 Heterogeneity and Predictors

Conceptually, the minimum wage should be determined according to its goals, which include safeguarding workers with a fair wage, reducing income inequality, and alleviating poverty; however, these vary over time and across countries. Most countries have a statutory minimum wage; however, in Asia, only Singapore and Brunei do not have a statutory minimum wage. The Minimum Wage Law of the Philippines,

or the Wage Rationalization Act of 1989 (RA6727), contains several criteria for minimum wage determination. Similar to other countries, regional variation in the economic landscape and wages exists in the Philippines.

Regional Heterogeneity. For example, several studies using a fixed-effects model have demonstrated that endogenous factors, including local economic conditions, often influence the heterogeneity of regions. According to a study by Hou et al. (2025), the heterogeneity across the 31 provinces and cities in China from 2012 to 2022 is influenced by local economies, measured by regional income levels. Goschin's (2014) panel data regression on county-level data from 1995 to 2010 found that regional wage differences in Romania are primarily determined by the region's economic output (GDP per capita) and human capital. In addition, Romania's average wage differences evolve from wage-setting influenced by Gross Regional Domestic Product (GRDP) and institutional forces, such as market and labor competition. In Poland, the minimum wage increases harm regions at the lowest tercile, where the minimum-to-average wage ratio is the highest. A study by Majchrowska and Strawiński (2021), which utilized the minimum-to-average-wage ratio, revealed that a uniformly set minimum wage has a larger impact in low-wage regions than in high-wage regions. The findings suggest that the minimum wage should be differentiated to minimize large disparities in the minimum-to-average wage ratio. Their study implies that national minimum wage policy creates highly heterogeneous effects due to the structure of regional labor markets. According to Xing and Xu (2016), regional variations in minimum wages in China are driven by the Gross Domestic Product Per Capita, employment rate, consumption, GDP growth rate, and local industry and economic structure. The timing and frequency of wage setting in China were flexible and responsive to the needs of the most developed regions, such as Shanghai, which further reinforced its wage dominance.

Gross Regional Domestic Product and Wage Dispersion. Heterogeneity of wages is a consequence of the redistribution of Gross Domestic Product. The connection between output and wages is based on the understanding that output is the source of firms' income, profits, and wages to workers. A long-run cointegrating relationship between output and wage has been established in the study of Bhattacharya and Narayan (2015). Empirical evidence established a long-run cointegrating relationship between output, as represented by Gross Domestic Product (GDP), and wages. Bhattacharya & Narayan (2015) found that real wages and labor productivity in 17 manufacturing firms in India. Similarly, Bersales et al. (2014) found that Gross Regional Domestic Product (GRDP) is a determinant of minimum wage in the Philippines, using a fixed-effects panel data model estimated with two-stage least squares, covering the period from 1980 to 2009. Moreover, according to Bersales, financial shocks are not integrated into the wage-setting in the Philippines. This can be a source of variation in wage responses since wage boards may adopt different measures. In the Processing Industry Sector in the provinces of Java Island (2012-2021), wages, along with inflation, determine the Gross Regional Domestic Product (Rodiya et al., 2024). Sabia (2015), in his literature review, opined that increases in the minimum wage stimulate macroeconomic growth by upskilling low-skilled workers. However, the relationship between minimum wage and GDP remains inconclusive. For example, in the United States, the minimum wage increased during recessions (1990–1991; 2007–2009) but declined during

periods of growth (1996–1997). Moreover, wage disparities persist when compensation fails to match the industrial output due to cyclical changes in labor market power, resulting in low Gross Domestic Product (GDP) (Morin, 2012). According to the literature review and econometric synthesis by Herr & Ruoff (2014), wage dispersion in OECD countries is caused by a range of structural factors, including relative prices, consumption, production, technological choices, wage bargaining units, government policies, labor institutions, minimum wage, and market dynamics.

Wage rates do not incite unemployment. Macroeconomic conditions including employment and inflation illicit varied wage responses from different regions due regional specific and stochastic factors. Recent studies using time-series methods with OLS estimation and the panel fixed effects model have challenged the neoclassical view by pointing out that the minimum wage does not negatively impact employment. The spurious dis-employment effects of wage increases pointed out by neoclassical economists were due to the estimation methods and the sample period chosen, since different periods have varying concentrations of macroeconomic shocks. According to Sumner & Silver (1989), using time-series methods with OLS estimation, different sample periods yield contradicting results in Brazil from 1966 to 1980. This finding aligns with the study by Saltiel & Urzua (2021), which found that wage increases had a negative impact on employment during an impending recessionary period in the formal sector restaurant industry (Saltiel & Urzua, 2021). Fixed-effects panel estimates showed that when time-invariant characteristics of region and labor market heterogeneity are not accounted for, the employment-income relationship is spurious, consistent with the findings of Allegretto et al. (2011), Sugiyarto & Endrigo (2008) for the cross-state variation in the US from 1990 to 2009, and Dube et al. (2010) for the low-wage sector in the US from 1990 to 2006, where local economic conditions and spatial heterogeneity were not considered. The pass-through effect counteracts the effects of wage increases shown in several studies using the Quasi-experimental design employing the Difference-in-Difference (DiD) approach. According to Card & Krueger's (1994), the negative effect of wage increases on employment are counterbalanced by decreases in fringe benefits within the fast-food industry across Pennsylvania and New Jersey in 1992 (see also Wang & Gunderson, 2015) and by transferring workers to other employers in Lithuania (Louzao & Tarasonis, 2023) and by factor substitution and price-pass-through effect (Lemos, 2008). A study conducted by Bocean (2015) for EU countries from 2003 to 2013, using 14 variables related to human resources policy on compensation and employment indicators, showed that wages are not correlated with employment and unemployment rates for the EU-28 and EU-15. The impact of the minimum wage on employment varies according to the market dynamics and exogenous shocks across regions. However, according to Lanzona (2014), using Fixed Effects Panel Data Analysis, the minimum wage increase was catastrophic to small-scale labor-intensive industries in the Philippines with at least ten employees between 1980 and 2008.

Counterbalancing Wage Increase through Price Pass-through Effect. A quasi-experimental Difference-in-Differences (DiD) approach, combined with Propensity Score Matching (PSM), showed that the price pass-through effect of the minimum wage is common, according to Renkin et al. (2020). According to Renkin et al. (2020) a 10% increase in

minimum wage is pass through the prices of grocery products by 0.36% in local grocery stores in the US between 2001 to 2012, while traditional and fast-food restaurants in France between 1994 2003 led to a 2% to 3% increase in restaurant meal prices (Fougere, et al., 2010). Controlling for the region-specific fixed effect also reveals that the wage increase is a pass-through to consumers, according to MacDonald & Nilsson (2016). According to his study, the strength of price increases is evident in months following the enactment of the new wage through a broad range of consumer goods in Australia from 2003 to 2013. Robust time-series models, including ARDL, VAR, and Granger Causality, Were Employed in the studies of Dervishi (2023) for North Macedonia (1995-2022) and Mohammadi et al. (2014) for Iran (1949-2013). These studies revealed bidirectional Granger causality between wage and inflation. An increase in minimum wage contributes to short-term inflation. Both studies find the spiralling effect of wages and prices (see Lorenzoni & Werning, 2023).

3. RESEARCH METHODOLOGY

3.1 Research Design

This study employs a descriptive and quantitative panel-time series design to determine the existence of regional heterogeneity of wages. The descriptives are the mean, minimum, and maximum values, the standard deviation of the minimum wage, and the annual minimum-to-average minimum wage ratio. The quantitative design employs econometric techniques, which consist of the following random properties tests: Variance-Ratio, Chow-Denning Multiple Test, Fisher Type Panel-Joint Tests, Cross-section Joint/Combined, Random-Walk Graphical, and the Dumitrescu-Hurlin Granger Causality test, in panel-time series models. These tests were carried out using the wild bootstrap approach. The predictors (local economic factors) of the minimum wage was examined using the fixed effects model and the Dumitrescu-Hurlin test.

3.2 Data

This study utilizes secondary data sourced from the National Wages and Productivity Commission (NWPC) and Philippine Statistical Authority (PSA). The nominal values were used to maintain consistency, as different base years could lead to discrepancies.

This study focuses on the regional daily minimum wage of non-agricultural workers in establishments with more than ten workers in the Philippines from 2002 to 2022. The focus is the minimum wages of the 17 regions: the National Capital Region (NCR), Cordillera Administrative Region (CAR) Region 1 (Ilocos Region), Region 2 (Cagayan Valley), Region 3 (Central Luzon), Region 4-A (Calabarzon), Region 4-B (MIMAROPA), Region 5 (Bicol Region), Region 6 (Western Visayas), Region 7 (Central Visayas), Region 8 (Eastern Visayas), Region 9 (Zamboanga Peninsula), Region 10 (Northern Mindanao), Region 11 (Davao Region), Region 12 (SOCCSKSARGEN), Region 13 (CARAGA), Bangsamoro Autonomous Region in Muslim Mindanao (BARMM). The daily minimum wage in this study refers to the most recent daily basic pay of non-agricultural workers in an establishment with more than ten workers. The study does not include bonuses, productivity and performance pay, and cost of living allowances and premiums for non-standard work hours or dangerous work.

The study does not include the minimum wage of non-agricultural workers in establishments employing ten workers or fewer, and agricultural workers. Establishments with 10 workers or fewer have lower wage rates than those of establishments with more than 10 workers. Some of these establishments with fewer than 10 workers, classified as Barangay Micro-Business Enterprise (BMBEs), are exempt from minimum wage compliance. In the agriculture sector, formal work arrangements typically do not cover them, as most workers belong to the economy’s informal sector. The wage rates in these two sectors are lower than in establishments with more than 10 workers.

The study covered a twenty-one (21) year period between 2002 and 2022 due to significant changes in 2002 in the geographical reclassification of Region IV into Region IV-A and Region IV-B, the transfer of the province of Aurora was transferred to Region III, and in 2020, the Autonomous Region in Muslim Mindanao (ARMM) replaced by the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM).

3.3 Econometric Approaches

3.3.1 Variance Ratio Test for Random Walk:

To investigate whether regional wage settings follow a systematic or random trend, the study applies variance ratio tests for a random walk. A random walk suggests that changes in wages are unpredictable and not systematically influenced by past wages. In addition, the random walk test is important in determining whether annual wage setting incorporates past spillover effects in the current year. The random walk hypothesis is examined through the Lo-Mackinlay Variance Ratio Test for individual horizons, the Chow-Denning Multiple-VR (Max-z) approach, and Fisher’s Cross-Section Joint Test for multiple horizons.

This study employed the wild-bootstrap approach with a two-point distribution and 1000 replications to provide a robust method for a reliable inference. The wild bootstrap improves small sample properties of the variance ratio tests (Kim, 2006). In a small sample size of 17 cross-sections (regions) and 21 time periods, the heteroskedasticity is amplified, rendering the standard asymptotic distributions invalid and unreliable. The wild bootstrapping involves resampling residuals while preserving the heteroskedasticity structure of the wage data set.

The panel structure is generally composed of $i=1, \dots, N$ as index for regions (cross-sections), while $t=1, \dots, T$ for years (time-series) and $Q = \{2, 4, 8, 16\}$.

3.3.1.1 Individual (Regional) VR test: Lo-Mackinlay Variance Ratio Test

This study employed the Lo-Mackinlay Variance Ratio Test to measure the Variance Ratio (VR) for each horizon (q) or lag (2, 4, 8, 16). It is an individual or regional VR test and serves as the foundation for Chow-Denning and Fisher’s Joint tests. The Lo-Mackinlay Variance Ratio Test (1988) is computed at multiple lags: $q = 2, 4, 8$ and 16 for each region is:

$$VR_i(q) = \frac{\frac{1}{q} Var, (\sum_{j=0}^{q-1} r_{i,t-j})}{Var(r_{i,t})} \tag{1}$$

It is standardized using the heteroskedasticity-robust Lo-Mackinlay standard error, where:

$$z_i(q) = \frac{VR_i(q) - 1}{\hat{\sigma}_i(q)} \tag{2}$$

where q is the aggregation horizon or lag used (2,4,8,16), $VR_i(q)$ is the Variance Ratio statistic for region i at lag q , Var is sample variance operator, $\hat{\sigma}_i(q)$ heteroskedasticity-robust standard error of $VR_i(q)$, $z_i(q)$ standardized z-statistic for testing. Under the martingale difference hypothesis (MDH): The wage growth is $r_{i,t} = y_{i,t} - y_{i,t-1}$. The $y_{i,t}$ is the annual wages for region $i = 1, \dots, N$ and year $t = 1, \dots, T$.

Under the Null Hypothesis (H0) of a Random Walk of $VR(q)$ equal to 1.0. A $VR=1$ signifies random walk or non-systematic properties of wages. However, a $VR < 1$ indicates mean reversion and $VR > 1$ means divergence.

3.3.1.2 Multiple Horizon (lag) Test: Chow-Denning Multiple-VR (Max-z) Test. To test whether each region follows a martingale/ random walk across multiple horizons (lags at 2, 4, 8, and 16), the Chow-Denning test is used. This test stands out since it performs a simultaneous multiple variance ratio test under a null hypothesis of a random walk. It simultaneously verifies if all variance ratios equal one (Cavalheiro et al., 2012). The Chow-Denning (CD) test is based on the principle that any decision regarding the null hypothesis relies on the maximum absolute value of the individual VR statistic, under the MDS assumption proposed by Lo and McKinlay (1988) (see Rufino, 2021). The Chow-Denning Multiple-VR (Max-z) Test across several lags (2,4,8, 16) is computed as:

$$T_{CD,i} = \max_{q \in Q} |z_i(q)| \tag{3}$$

where $T_{CD,i}$ is Chow-denning test statistic for region i , \max is maximum operator, q variance-ratio lag (2,4,8,16), Q refers to the set all of horizon or lag used in the VR test, $z_i(q)$ standardized variance-ratio test statistics for region i at lag q

The **p-value of Chow-Denning Wild Bootstrap** for VR test with multiple lags (2,4,8,16) is computed as:

$$p_i = \frac{1}{B} \sum_{b=1}^B 1(T_{CD,i}^{*b} \geq T_{CD,i}) \tag{4}$$

where B is number of bootstrap replications (1000), $b = 1 \dots, B$ represent the bootstrap iteration index, $T_{CD,i}^{*b}$ bootstrap Chow-Denning max-z statistic, p_i bootstrap p-value for region i .

3.3.1.3 Panel VR Testing: Fisher’s Cross-Section Joint Test

The Fisher’s test was used to test whether all regions follow a martingale/ random walk jointly. This method combines the results of independent tests on the same overall hypothesis (H0) treated as a single large test (Fisher, 1948). Due to sample size, the Asymptotic Chi-Square cannot be used. According to Gonçalves and Kilian (2007), asymptotic distribution of estimated autoregressive parameters does not apply when the errors are conditionally heteroskedastic. Hence the Wild Bootstrap Approach was used. However, the null hypothesis

across all cross-sections can be rejected whenever there are regions with substantial evidence against random walk behavior or the absence of predictability. The formula for Fisher Combined test statistic using region-level bootstrap p-value is:

$$\chi^2_{Fisher} = -2 \sum_{i=1}^k \ln(p_i) \tag{5}$$

where p_i is bootstrap probability from each province's Chow-Denning test, $-2 \ln(p_i)$ is the Fisher transformation term (natural logarithm of the p-value), $2N$ as the degrees of freedom

Where each bootstrap replication is:

$$P^{*(b)} = -2 \sum_{i=1}^N \ln(p_i^{*b}) \tag{6}$$

The panel bootstrap p-value for Fisher's test is the proportion of bootstrap Fisher statistics at least extreme as the observed, thus:

$$p^{bootstrap} = Pr, (\chi^2_{Fisher} \geq \chi^2_{Fisher}) \tag{7a}$$

or

$$\hat{p}_{panel} = \frac{1}{B} \sum_{b=1}^B 1, (P^{*(b)} \geq P^{obs}) \tag{7b}$$

where P^{obs} is observed Fisher combined statistic, $P^{*(b)}$ is bootstrap replication of Fisher statistic, B is the total number of bootstrap replication, b is the iteration index, \hat{p}_{panel} is panel bootstrap p-value. The \hat{p}_{panel} is the significance level derived after comparing the Fisher statistic to its bootstrapped distribution.

If the p-value of the panel is less than 0.05, the null hypothesis that wages behave randomly or without systematic pattern is rejected. However, if the p-value is greater than 0.05, the null hypothesis that wages behave randomly is accepted.

3.3.4 Fixed Effects Econometric model

The POLS (Pooled Ordinary Least Squares), Fixed Effects (FE), and Random Effects (RE) panel regression models were employed to determine the most suitable panel regression model. Model selection test composed of the F-test for the Pooled OLS (POLS) versus Fixed Effects ($F = 230.06, p < 0.01$) and the Hausman test for Random effects (RE) versus Fixed Effects ($\chi^2(4) = 19.15, p < 0.01$) statistically reject the null hypothesis the POLS model and Random Effects Model, respectively and accept the alternative hypothesis, the Fixed Effects. The fixed effects panel regression model controls for unobserved, time-invariant heterogeneity among regions. The model was estimated using GLS Weighing (Generalized Least Squares) Cross-Section SUR (Seemingly Unrelated Regressions) to ensure the lowest standard errors and reliable coefficient estimates (Cadavez & Henningsen, 2012). The fixed effects model provides the independent variables for the Dumitrescu-Hurlin Panel Granger Causality test.

The use of fixed model variables ensures robustness in the findings of the Granger test, thus the equation:

$$\begin{aligned} \log_minwage_{it} = & a_i + \lambda_t - \beta_1 \Delta \log GRDP_{it-1} \\ & + \beta_2 \Delta \log PCGR_{it-1} \\ & + \beta_3 \Delta ER_{it} - \beta_4 IR_{it} + \varepsilon \end{aligned} \tag{8}$$

where $\log_minwage_{it}$ is the logarithm of the minimum wage, a_i is the region-specific fixed effect, λ_t is the time-specific fixed effect, i is region, t is time, ε is error term. $\Delta \log GRDP_{it-1}$ is the 1st difference of the logarithm of Gross Regional Domestic Product (lagged by one period), $\Delta \log PCGR_{it-1}$ is the 1st difference of the logarithm of Per Capita Gross Regional Domestic Product (lagged by one period), ΔER_{it} is the 1st difference Employment Rate and IR_{it} is the Inflation Rate

3.3.5 Dumitrescu-Hurlin Panel Granger Causality: Model and Test Statistics

The Pairwise Granger Dumitrescu-Hurlin (2012) Panel Causality Test was used to determine whether Gross Regional Domestic Product (GRDP), Per Capita Gross Regional Domestic Product, Labor Productivity, Employment Rate and Inflation Rate predict and sustain the cyclicity of minimum wages. The Granger statistics for each region are averaged to form a panel statistic. Moreover, the Pairwise Dumitrescu-Hurlin (DH) Test is more appropriate than the traditional Granger test for examining predictive relationship between wages and local economic factors, primarily because the data set is heterogeneous panel data and the time series is relatively short, spanning only 21 years. The approach is powerful because it examines causality in both time series and cross-sections (Dumitrescu and Hurlin, 2012).

The General Granger Dumitrescu-Hurlin Panel Formula is specified as the following:

$$\begin{aligned} Y_{i,t} = & a_i + \sum_{k=1}^k \gamma_{ik} Y_{i,t-k} + \sum_{k=1}^k \beta_{ik} X_{i,t-k} \\ & + \varepsilon_{i,t} \end{aligned} \tag{9}$$

with $i = 1, \dots, N$ and $t = 1, \dots, T$

$$\begin{aligned} \log_minwage_{i,t} = & a_i + \sum_{k=1}^k \gamma_{ik} \log_minwage_{i,t-k} \\ & - k + \sum_{k=1}^k \beta_{ik} X_{i,t-k} + \varepsilon_{i,t} \end{aligned} \tag{10}$$

where x (independent variables) i,t and y (dependent variable: $\log_minwage$) i,t are the observations of two stationary variables for region i in period t ; $\beta_{i,k}$ represents the Granger-causality coefficients, K for the number of lags, a_i is individual fixed effects, $\gamma_{i,k}$, $\beta_{i,k}$ allowed to differ across regions. Coefficients are allowed to differ across individuals but are assumed to be time invariant (Lopez & Weber, 2017).

3.3.6 Statistical Data Treatment

Data were statistically treated and evaluated using EViews at 0.05 level of significance. To ensure that results obtained are reliable, the model was statistically examined for: (1) Panel Unit Root/Stationarity Test. The Levin, Lin & Chu Test utilized the bandwidth selection, the Newey-West method, and spectral estimation kernel, Bartlett for variables employment rate and inflation rate, except the lagged variables the Gross Regional Domestic Product ($\Delta \log GRDP_{it-1}$) and Per Capita Gross

Regional Domestic Product ($\Delta \log PCGR_{it-1}$), which utilized quadratic spectral kernel. Based on the results of the Levin, Lin & Chu panel data set unit root test, each panel data set has no unit root and is stationary; (2) Cointegration Tests. The Kao Residual Cointegration Test results, along with the significant coefficient on the lagged residual in the ADF test, provide strong statistical evidence of a long-run cointegrating relationship between the dependent variable (Minimum Wage) and independent (predictor) variables in the panel data; (3) Multicollinearity Test. All the centered VIF values of the predictors were below the common thresholds of 5 or 10 which implies that the independent variables the model are not highly linearly correlated with each other. (4) Autocorrelation Test. The Durbin-Watson (DW) test, which detects the absence (or presence) of a first-order autoregressive serial correlation, showed statistic of 1.82 for the fixed effects model is closest to the ideal value 2.0, indicating minimal serial correlation.

4. RESULTS AND DISCUSSION

4.1 Descriptives

Table 1. Statistical Summary of the Minimum Wage in the Philippines

REGION	Mean	Max	Min.	Range	Std. Dev.
NCR	416.14	570	250	320	104.8
CAR	261.52	380	174	206	66.49
1	259.76	400	185	215	57.88
2	262.14	400	185	215	70.65
3	326.07	450	228.5	221.5	69.54
4A	335.86	470	237	233	60.67
4B	263.81	355	182	173	48.11
5	254	365	182	183	48.37
6	285.64	450	180	270	76.44
7	310.81	435	200	235	73.49
8	244.52	350	177	173	52.05
9	257.43	351	165	186	55.66
10	282.19	405	180	225	68.56
11	290	427	170	257	77.92
12	257.48	368	170	198	56.7
13	240.67	350	167	183	49.71
BARMM	234.71	341	140	201	55.87
All	281.34	570	140	430	77.86

Table 1 shows that the National Capital Region (NCR) posted the highest minimum wage (maximum PHP570) across all regions in the Philippines and the highest standard deviation (σ) or wage variability of 104.8, spanning a total range of PHP320 over 21 years from 2002 to 2022. The National Capital Region is the center for government, politics, business, and the economy of the Philippines. In contrast, BARMM has the lowest maximum wage of PHP 341 and a lower wage variability of PHP 55.87. However, BARMM's range of wage adjustments, at PHP 201, is higher compared to other regions with similar economic conditions, largely due to significant increases in recent years. The varied minimum and maximum wages indicate the extent of wage adjustment over 21 years in

every region. In a quintile distribution, NCR has the highest maximum minimum wage. Regions that have a robust economy supported by numerous economic zones and are top contributors to the Philippines' Gross Domestic Product have consistently posted higher wages close to NCR, which includes CALABARZON and Central Luzon. Regions 4A and 3, along with 6 (Western Visayas) and 7 (Central Visayas), have middle-range maximum wages. Region 7 (Central Visayas) has a robust and highly diversified economy, making it more urbanized than Region 6 (Western Visayas). However, Regions 6 and 7 have complementary industries. Region 6's Gross Regional Domestic Product (GRDP) growth rate has been catching up with that of Region 7, and its wage landscape underwent a significant shift in 2022, driven by substantial wage increases. The lower-middle maximum wage regions are Regions 2, 1, 10, and 11. These four regions have an agro-industrial economy. Davao region has a more robust economy, being the economic hub of Mindanao, and offers higher wages than the other three regions. In contrast, CAR, Regions 12, 5, 4B, 9, 8, 13, and BARMM, which are mainly characterized by an agricultural-based economy, have the lowest maximum wages.

The difference between the highest maximum wage value of the National Capital Region and the lowest maximum wage value of BARMM represents a considerable minimum wage gap. The wage variability (σ) of the entire country from 2002 to 2022 is high at 77.86, and the differences in average/mean wages of each region are significant. The wage variability of each region is considerably varied. These differences in wage distribution also reveal the hierarchical wage structure in the Philippines and the heterogeneous economic landscape of the regions.

4.1.2 Minimum-to- Average Wage Ratio (MAW)

The minimum-to-average wage ratio, which is computed by dividing the annual minimum wage of each region by the Philippines' annual Average of the minimum Wage (PAW) from 2002 to 2022, demonstrates a cross-regional variation of wages in the Philippines. The Minimum-to-Average Ratio (MAR) is an indicator of the relative wage level of each region. A minimum-to-average wage ratio of 100% indicates relative wage parity across regions. However, a Ratio above and below 100% represents relatively higher wages and lower wages, respectively, than the average. Variations in the minimum-to-average wage ratio of 100% indicate cross-regional heterogeneity of relative wages.

Table 2. Minimum-to- Average Wage (MAW) trends within Luzon

	NCR	CAR	R1	R2	R3	R4A	R4B	R5
2002	134	93	99	99	122	127	98	98
2003	133	93	98	98	121	126	97	97
2004	127	88	96	94	116	129	100	99
2005	133	84	97	90	120	128	100	94
2006	131	103	99	85	107	126	101	96
2007	152	99	97	84	117	126	100	95
2008	153	94	92	88	117	128	99	90
2009	153	94	92	88	117	128	99	93
2010	154	89	87	84	115	122	98	94
2011	150	87	92	85	112	125	96	91

2012	152	87	90	91	120	120	93	90
2013	153	85	89	89	118	118	95	88
2014	154	89	87	87	120	115	92	89
2015	157	91	85	86	118	113	96	89
2016	154	91	90	96	117	121	91	85
2017	155	88	86	105	117	117	90	90
2018	155	92	89	101	115	115	92	88
2019	150	95	95	98	112	112	90	87
2020	146	104	93	98	114	109	87	84
2021	146	104	93	98	114	109	87	84
2022	141	94	99	99	111	116	88	90

Table 2 presents the minimum-to-average wage ratio for the National Capital Region (NCR), which consistently posted a ratio higher than the national average, ranging from 127% to 157%. The robust economy, numerous and active labor unions and federations, and a higher cost of living and economic activity explain the NCR's high ratio. Regions 4A (CALABARZON) and 3 (Central Luzon) rank 3rd and 4th contributors to the Philippines' Gross Domestic Product and likewise exhibit above-minimum-to-average wage ratios over the years, although these are slightly lower than the NCR. Regions 1 (Ilocos), 2 (Cagayan Valley), 4B (MIMAROPA), and 5 (Bicol) invariably maintain ratios below the national minimum wage average. Region 5 (Bicol) shares a similar trend with Regions 8 (Eastern Visayas), 13 (CARAGA), and BARMM, which have ratios below 100% for twenty-one (21) years. From 2020 to 2021, the pandemic years, wage growth in the Luzon regions was stagnant. Most regions experienced weaker wage growth relative to the annual wage average between 2019 and 2020. There are no regions in Luzon during any observed period that show their relative wage level to be in parity with the national level. The relative wages of regions in Luzon are highly divergent from the average of all regions, revealing significant regional differences in Luzon and higher wage level concentration, particularly in the NCR, Regions 3, and 4A.

Table 3. Minimum-to- Average Wage (MAW) trends within Visayas

	PAW	R6	R7	R8
2002	187	96	107	95
2003	188	96	106	94
2004	197	96	106	90
2005	207	99	108	91
2006	228	97	106	96
2007	237	99	105	93
2008	250	100	107	88
2009	250	100	107	88
2010	263	101	108	84
2011	270	98	113	84
2012	280	99	117	85
2013	285	101	115	84
2014	292	98	116	82
2015	297	101	119	80
2016	312	96	113	76
2017	324	100	113	86
2018	347	101	111	88
2019	357	111	108	88

2020	367	108	110	89
2021	367	108	110	89
2022	404	111	108	87

Table 3 shows the relative standing of minimum wages in the Visayas regions with the Philippines. Region 7 (Central Visayas) consistently shows the highest minimum-to-average wage ratio compared to Region 6 (Western Visayas) and Region 8 (Eastern Visayas). Additionally, the minimum-to-average wage ratios in Region 6 exceed the national average of 101 to 111 during eight specific years: 2010, 2013, 2015, and from 2017 to 2022. Region 6 was at par with the national average in 2008, 2009 and 2011. In contrast, Region 8 generally has the lowest minimum-to-average wage ratio among the three regions. In the earlier years of 2002 and 2003, the ratios for the three Visayas regions were relatively similar, ranging from 95 to 107 in 2002 and 94 to 106 in 2003. However, starting in 2011, the ratios for the three regions began to diverge more sharply, with Region 7 consistently displaying values higher than the annual regional wage average. In the post-pandemic period of 2022, Western Visayas (Region 6) posted a significant increase of PHP 55. The substantial increase in the minimum wage in Western Visayas in 2022 significantly altered the wage landscape in the Visayas. Overall, the Visayas region's relative wage levels are divergent from the regional average.

Table 4. Minimum-to- Average Wage (MAW) trends within Mindanao

	R9	R10	R11	R12	R13	BARMM
2002	88	96	91	91	89	75
2003	88	96	90	90	89	88
2004	91	103	99	91	90	84
2005	87	98	101	97	91	82
2006	94	95	98	94	88	83
2007	91	92	94	90	85	80
2008	90	98	100	90	84	84
2009	90	98	100	90	84	84
2010	97	102	103	93	87	84
2011	99	100	100	94	89	82
2012	95	96	102	93	86	83
2013	98	104	100	91	89	81
2014	96	101	107	92	87	86
2015	94	107	105	91	85	84
2016	95	102	107	95	83	85
2017	91	104	105	91	80	82
2018	91	105	107	90	79	81
2019	89	102	111	87	85	78
2020	86	99	108	92	83	89
2021	86	99	108	92	83	89
2022	87	100	106	91	87	84

Table 4 shows that the wage trend in Mindanao is less dynamic, characterized by fewer and narrower fluctuations over the years. The minimum-to-average wage behavior remained unaltered even by the pandemic. However, this does not guarantee significant increases for each region. Region 9 (Zamboanga Peninsula) has a ratio of 86 to 98, while Region 10

(Northern Mindanao) falls between 92 and 107. The significant ratio started in 2008 for Region 11 (Davao Region) and ranged from 100 to 108% from 2002 to 2022. Moreover, Region 12 (SOCCSKSARGEN) and Region 13 (CARAGA) showed some variability but were below the national average. A significant gap and disparity exist in BARMM, which consistently had the lowest Minimum-to-Average Wage Ratio, ranging from 75 to 89, over a 21-year period. In 2008, 2009, 2011, and 2013, Region 11 was at par with the national average. In general, there is cross-regional heterogeneity in Mindanao intensified by its modest increases in all regions.

4.2 Econometric Tests and Empirical Analysis

4.2.1 Variance Ratio Test for the Regional Minimum Wage from 2002 to 2022

Table 5. Fisher’s Cross-section Joint Tests Null Hypothesis: MINWAGE is a martingale (2002-2022)
Cross-sections included: 17; Total panel observations: 340 (after adjustments)

Summary Statistics			
Statistics	Max z	Prob.	df
Fisher Combined	36.203	0.3661	34
Cross-section	Max z	Prob.*	Wage Trend
NCR	0.9255	0.8160	Random
CAR	0.1772	0.9160	Random
1	1.5669	0.5670	Random
2	0.7778	0.9470	Random
3	2.4879	0.1540	Random
4A	2.6836	0.4820	Random
4B	2.2134	0.4100	Random
5	2.8030	0.3120	Random
6	1.0354	0.7900	Random
7	2.3370	0.1600	Random
8	1.1389	0.5320	Random
9	2.5922	0.2090	Random
10	3.0047	0.1260	Random
11	2.6210	0.1210	Random
12	3.0449	0.1870	Random
13	2.1110	0.3480	Random
BARMM	2.8285	0.2590	Random

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The Wild Bootstrap Fisher Joint Test reveals the panel-level Fisher combined statistics (Max |z| = 36.203) fail to reject the null hypothesis of a random walk, since the p-value (0.3661) is greater than the level of significance (0.05) (Table 5). These results indicate that, overall, wages across all regions in the Philippines are random and do not exhibit a consistent national trend. Furthermore, it means that changes in wage levels are unpredictable. The Fisher Joint Test statistics of each region in Luzon, which include NCR, CAR, Ilocos (Region 1), Cagayan Valley (Region 2), Central Luzon (Region 3), Regions 4A (CALABARZON), 4B (MIMAROPA), and 5 (Bicol), have p-values higher than the 0.05 level of significance. Hence, a random walk (null hypothesis) cannot be rejected. A small Max |z| statistic is associated with a large p-value, indicating the series is random or behaves unpredictably (Lo & MacKinlay, 1988). The National Capital Region (NCR), CAR, Regions 2

and 1 have a lower Max |z| statistic compared with other regions in Luzon. Similarly, in the Visayas, the Fisher’s statistic is lower in Region 6, followed by Region 8 and Region 7. However, regions in Mindanao, which include Regions 9, 10, 11, 12, 13, and BARMM, have a higher Max |z|; however, they reject the null hypothesis. The Fisher’s statistics for the Visayas and Mindanao regions have p-values higher than the 0.05 level of significance, hence the random walk cannot be rejected. All regional minimum wages are randomly determined. The findings imply that regional wages do not exhibit similar patterns to those of the previous year and vary from year to year.

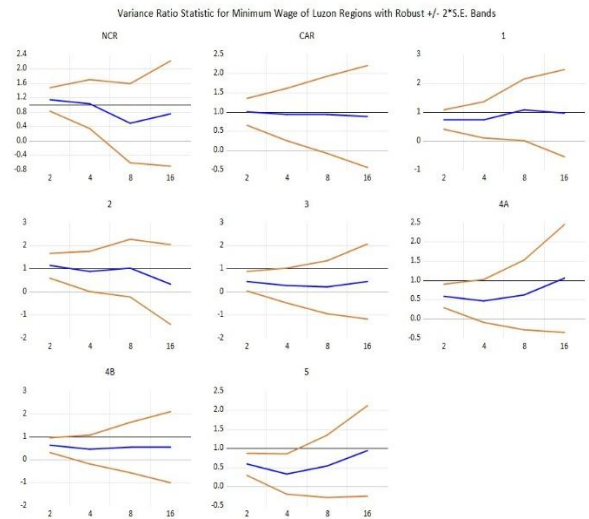


Fig. 1. Random Walk Pattern : Minimum Wage of Luzon Regions at lags 2,4,8 and 16 with 95% confidence bands

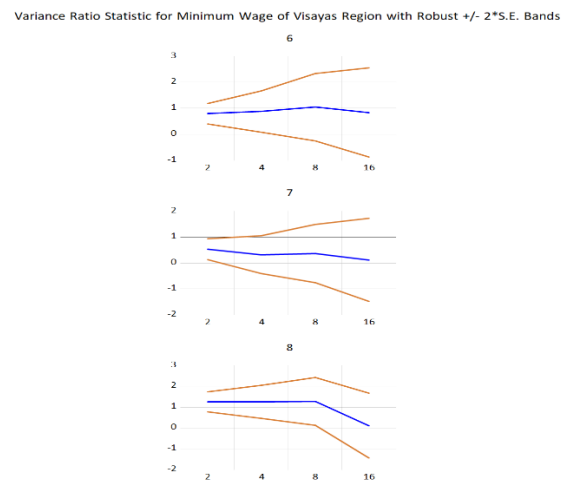


Fig.2. Random Walk Pattern: Minimum Wage of Visayas Regions at lags 2,4,8 and 16 with 95% confidence bands

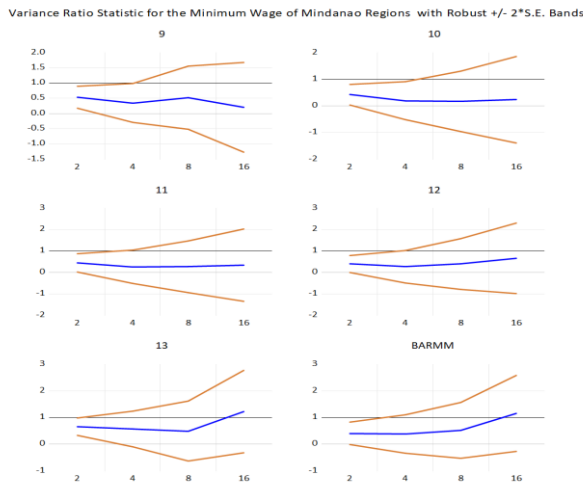


Fig. 3. Random Walk Pattern : Minimum Wage of Mindanao Regions at lags 2,4,8 and 16 with 95% confidence bands

Figures 1-3 Legend (lines): VR line: blue color, ± 2 S.E. confidence bands: orange color, random walk line: black color. Note: A departure of the variance ratio from unity, beyond the confidence bands is evidence against the random walk hypothesis.

Figures 1, 2 and 3 demonstrates the random-walk line for all regions. Regions 5, 10, 12, and BARM confidence bands ± 2 S.E. lie slightly below the random-walk line. Region 5 has longer dips in its confidence bands than its comparable regions, which signals wage rigidity. The Cordillera Administrative Region (CAR) and Region 6 have VR lines that are very close to or nearly align with the random-walk line (VR = 1), indicating that wage settings are unpredictable and do not follow a trend over the years. In contrast, Regions 3, 4B, 7, 9, 10, 11, and 12 had their VR lines below the random-walk line, which persisted for a longer period (lag 16). This condition is typical in wage settings that utilize a wage reversion or offsetting mechanism. The VR line of NCR, Regions 2 and 8, initially started above the random-walk line (VR = 1) but shifted below at lag 16. Meanwhile, Regions 1, 4A, 5, 13, and BARM have VR lines that rise below the random-walk line but shift upwards toward the upper confidence band at lag 16. Overall, the variance-ratio (VR) line for all regions is within ± 2 S.E. confidence bands, indicating that wages exhibit random-walk behavior.

Results of the variance-ratio graph and trajectories are consistent with wild-bootstrap Fisher joint test results, which jointly indicate that the minimum wages of all regions from 2002 to 2022 behave randomly and are dominated by idiosyncratic shocks. Specifically, most of the region’s random walk movements show minor reversals or corrections, usually from lag 2 to 4, but eventually settle on a random walk pattern at lag 16.

4.2.2 Fixed Effects Model

Table 6 confirms that using the FE model confirms that the 1st difference of the logarithm of Gross Regional Domestic Product (lagged by one period) (D_LOG_GRDP_1), the 1st difference of the logarithm of Per Capita Gross Regional Domestic Product (lagged by one period) (D_LOG_PCGR_1), Employment Rate at the first difference (D_ER) and Inflation Rate (IR) are predictors of logarithm of Minimum Wage. The

Durbin-Watson statistic of the fixed effects model (DW = 1.82) is closest to the ideal value 2.0 indicates the absence of autocorrelation.

Table 6. Fixed Effects (FE) Panel Regression Model
Dependent Variable: LOG_MINWAGE, Method: Panel EGLS
(Cross-section SUR): Linear estimation after one-step weighting matrix

Variable	Coeff	SE	t-Stat	Prob.
D_LOG_GRDP_1	-2.863***	0.11	-25.6	0.0000
D_PCGR_1	0.020***	0.00	20.9	0.0000
D_ER	0.007***	0.00	6.3	0.0000
IR	-0.015***	0.00	-12.2	0.0000
C	5.829***	0.01	363	0.0000
Effects Specification				
Cross-section fixed (dummy variables): Weighted Statistics				
R-squared	0.94			
Adjusted R-squared	0.937			
F-statistics	244.1020			
Prob (F-statistics)	0.00000			
Durbin-Watson statistics	1.82			

Additionally, the R-squared is higher with a statistical value of 0.94 for the Fixed Effects confirm the suitability of the Fixed Effects model. These variables in the FE model ensure the robustness of the Granger Causality results.

4.2.3 Granger Causality Test

Table 7. Pairwise Dumitrescu Hurlin Panel Causality Tests (2002-2022) Lags: 2

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
D_LOG_GRDP_1 does not homogeneously cause LOG_MINWAGE	4.439	2.859	0.0042***
LOG_MINWAGE does not homogeneously cause D_LOG_GRDP_1	5.891	4.897	0.000 ***
LOG_MINWAGE does not homogeneously cause D_PCGR_1	2.245	-0.217	0.8279
D_ER does not homogeneously cause LOG_MINWAGE	4.694	3.372	0.0007***
LOG_MINWAGE does not homogeneously cause D_ER	7.221	7.032	0.000***
IR does not homogeneously cause LOG_MINWAGE	1.160	-1.752	0.0797

LOG_MINWAGE	5.406	4.589	0.000***
does not homogeneously cause IR			

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The Pairwise Dumitrescu Hurlin Panel Causality Tests in Table 7 showed that the null hypothesis that the first difference of the logarithm of Gross Regional Domestic Product lagged by one period (D_LOG_GRDP_1) and the first difference (D_ER) does not homogeneously Granger-cause the logarithm of Minimum Wage (LOG_MINWAGE) and vice versa is rejected. Their Zbar-statistic has p-values less than the 0.05 level of significance. The results imply that there is a bidirectional relationship between Gross Regional Domestic Product and the Minimum Wage, as well as between the Employment Rate and the Minimum Wage.

Moreover, the null hypothesis of the first difference of the logarithm of Per Capita Gross Regional Domestic Product lagged by one period (D_PCGR_1) that it does not homogeneously Granger-cause the logarithm of Minimum Wage (LOG_MINWAGE) is not rejected. However, the p-value was insignificant for the Granger-causality of the logarithm of Minimum Wage (LOG_MINWAGE) toward Per Capita Gross Regional Domestic Product lagged by one period (D_PCGR_1). Inflation Rate (IR) does not Granger-cause the logarithm of Minimum Wage (LOG_MINWAGE); the null hypothesis is rejected since its p-value is higher than the 0.05 level of significance—conversely, the logarithm of Minimum Wage (LOG_MINWAGE) homogeneously Granger-cause Inflation Rate (IR). A unidirectional relationship exists between Per Capita Gross Regional Domestic Product (PCGR to Minimum Wage), Inflation Rate (Minimum Wage to Inflation), and Minimum Wage.

4.3 Discussion

Preliminary evidence of regional heterogeneity showed a consistent regional wage gap in the Philippines from 2002 to 2022. Although highly developed regions show comparable average wages, most regions differ significantly in their wage levels. A wider variability of wages arises from the wage-setting mechanism in highly developed regions, characterized by higher average wage rates, except for Regions 2 and 6. Similarly, the regions which posted higher wage rates closer to the National Capital Region since 2002 are regions which consistently have higher minimum-to-average wage ratio across the country. These regions include the NCR, Regions 3 and 4A in Luzon, Region 7 in Visayas and Region 11 in Mindanao. Regions in Luzon with a robust economy typically have wages higher than the national average. Moreover, these regions have a higher number of labor unions and federations, and a higher cost of living. Regions vary not only in wage levels and dispersions but also in the temporal behavior of wages across the country.

The major consequence when wages follow a random-walk process is regional heterogeneity and income inequality. The spillover of randomness in wages causes wages to diverge over time, further widening the gap between regions. These geographical patterns and distribution of wages remain largely unchanged during or even after the pandemic years. Regions that initially experience slightly higher wage increases continue to shift upward due to stochastic variations such as NCR, Regions 3, 4A, 7, and 12. However, several regions with lower

wages, including Regions 8, 4B, 6, and 13, tend to offset these increases by slowing down wage adjustments. The persistence of regional wage variations stem from structural differences in region-specific economic factors and conditions, labor market institutions, wage-setting mechanisms, and divergent policy targets. These factors weaken the predictability of wages and the systematic nature of wage setting. Since the enactment of the first minimum wage law, regional wage patterns in the Philippines have remained consistent. Generally, more developed regions offer higher wages, while less developed regions tend to provide lower wages. These differences in wage distribution highlight the hierarchical nature of wages in the Philippines. Typically, the petition for a wage increase is initiated by the workers' group through a federation or a union. The presence of these organizations strengthens the position of workers in appealing for higher wages. Notably, in the Philippines, regions with a greater number of federations and unions—mostly found in developed areas—tend to have higher wage rates compared to regions with fewer such organizations. While there are uniform criteria in place, wage variations exist due to differing priorities of stakeholders, and wage setting mechanism. Under RA 6727 (Wage Rationalization Act), each region in the Philippines has its own regional wage board. The board has the authority to determine wage rates, accept, reject, or defer petitions for wage increases. Furthermore, the nature of wage consultation necessitates tripartism. However, the outcome of tripartite dialogues depends on the bargaining strength of the worker and employer sectors, while the government prioritizes the national interest. These conditions contribute to unpredictable wage levels. With these, along with the autonomy of wage setting, results in wage rates of 17 or more every year. There are regions, such as the NCR and Region 4A, that have more than six different wage rates; their wages vary by component city, province, and industry. In contrast, there are regions, such as Region 6, that have only one wage rate covering all provinces. These structural disparities have compounding effects on cross-regional random wage adjustments.

Given the random walk pattern of wages, the addition of PHP750 under House Bill 7568 or PHP200 under Senate Bill 2534 across the board will exacerbate wage disparities, as the baseline wage characterized by disparities remains uncorrected. A uniform wage increase exacerbates regional wage inequalities and has serious consequences for the sustainability of regional economies. Although a uniform wage increase improves nominal wage values, it violates the 8th criterion of wage determination under Section 2 of Chapter 3 of RA 6727, which emphasizes the fair return on the capital invested and the capacity to pay of employers. It assumes that all regions and industries are developed and have the capacity to pay, when actually they are not. Each region in the Philippines has a unique economic template. According to Sicat (2024), it is a hefty rise, arbitrary and politically calculated, and the financial capacity of the enterprises was not considered by the legislature. This move could have various consequences, including price hikes (Employers Confederation of the Philippines (ECOP, 2024) and disenfranchisement of other members of the labor force (Philippine Chamber of Commerce and Industry (PCCI, 2024).

The bidirectional predictive relationship shows driving forces that sustain the cycle of wages. The GRDP and GRDP per capita, or Regional Productivity, are considered indicators of the general standard criteria in minimum wage

determination, as enshrined in RA 6727, under the criteria of a fair return on the capital invested and the capacity to pay of employers, and the need to induce industries to invest in the countryside. The key drivers of wage growth are output, productivity, and aggregate demand. According to Keynes (1936), an increase in aggregate demand stimulates production and expands the economy. Under favourable conditions, it leads firms to redistribute their earnings toward workers' wages. Moreover, higher wages result in improved workers' performance, which is translated into higher production. However, when time-invariant heterogeneity is accounted for, within-region GRDP growth is associated with a lower level of wage growth. This represents the output wage gap, rather than a causal relationship. The negative coefficient of the GRDP (-2.86), indicate that the previous years' output is linked to a 2.86-unit lower average wage level, respectively. This means that the regional output, is not fully translated into minimum wage growth. This condition highlights the wage-output gap brought by structural misalignment between GRDP expansion and wage and the rigidity of the minimum wage. Several factors explain this inverse relationship. First, as competition intensifies and the drive for higher productivity and profit persists, many industries—particularly in the industrial and economic hubs of the NCR, Regions 3, and 4—have turned to mechanization and automation and cost cutting measures. Several regions have experienced periods of 0.0% minimum wage growth, particularly in the earlier years despite robust output growth. According to Marquetti (2004), firms often prioritize cost efficiency through labor-saving innovations and productivity gains without equivalent wage increases. Similarly, the large share of informal and part-time employment in the service sector—often flexible, temporary, or reduced-hour—dampens pressure for minimum wages to rise accordingly. Second, the minimum wage exemption granted to Barangay Micro Business Enterprises (BMBEs) despite its value-added contributions to the economy. Third, sluggish wage adjustments, particularly during short-term robust regional output growth and labor market rigidities, hinder timely and proportionate wage responses. Fourth, wage-setting mechanisms in the Philippines, which involve tripartism and regulatory lags of one year, may not respond immediately to changes in sectoral economic performance. Finally, regional competition to attract investment exerts downward pressure on labor costs, sometimes resulting in a “race to the bottom” (Cueto, 2017). The negative contemporaneous relationship in the fixed effects model does not diminish the predictive capacity of the GRDP to the Minimum Wage and vice versa. Similarly, expansion in regional output stimulates demand for labor. The competition among employers for workers consequently increases employment, subsequently strengthening the bargaining position of workers in pushing wages up. Higher wages have a positive impact on aggregate supply and demand for goods and services. This boosts the production cycle, which results in firms hiring more workers.

The Granger test result implies that wages evolve in response to regional output and the labor market. The unidirectional relationship between Per Capita GRDP and wages in the subsequent period. Regional productivity and wealth stem from a robust economy. A higher per capita GDP provides firms with a stronger financial position to increase wages. The association of regional productivity with wages finds support in several labor theory, which includes the marginal productivity theory asserts that the price of labor is

according to their capacity to deliver output. According to Shapiro and Stiglitz, firms should not lower wages or pay lower than the equilibrium so that workers do not shirk. The coefficient of first difference of Per Capita GRDP (regional productivity), lagged by one period, indicates that a one percent increase in labor productivity in the previous period is associated with a negligible 0.02 percent increase in minimum wage. Minimum wage growth in regions with high productivity has been modest since 2002, except for regions with greater wage variability. The one-period lag indicates that expansion in regional productivity takes time to result in wage adjustments due to annual wage-setting cycles and the gradual wage review process conducted by regional wage boards. This positive lagged effect supports the theory that gains in productivity enhance firms' ability to pay higher wages. Conversely, wages do not have a predictive effect on the regional productivity of the region or Per Capita GRDP. Wage growth is sluggish and low, which impedes the growth of Per Capita GDP to be translated to wages, either due to wage-setting behavior or the cost-effect of wages. In the long run after controlling for the region-specific effects, inflation is a predictor of wage. The negative association between inflation and the minimum wage suggests that the minimum wage is not fully adjusted to nominal inflation and the consumer price index. A coefficient of -0.015 for the inflation rate indicates that inflation and wage growth tend to move in opposite directions. This can also mean that a higher inflation growth rate correlates with lower wage growth rates. The timing mismatch between the regional wage board's annual review and adjustment of minimum wage and the monthly inflation changes leads to a lag in wage increases. This results in the inability of the wage increases to offset spillovers of past inflation. Furthermore, the lag in adjustments significantly reduces the purchasing power of wages, making the restoration of real value difficult and worsening over time due to the persistence of inflation. These conditions align with the inflation rate, which does not Granger-cause wage. The Granger result suggests that the minimum wage is not indexed to inflation, contrary to the argument that wage increases arise due to the inflation rate. The cost-push theory explains the wage-setting behavior. The relationship is attributed to timing mismatches between monthly inflation changes and annual wage adjustments, and the inability to offset spillovers of past inflation. The significant predictive relationship of wage on inflation rate suggests that the wage-setting behavior of steady but modest increases in wages across regions has tempered their inflationary effects.

5. CONCLUSION

The combined descriptive statistics and econometric analysis empirically showed that wages are structurally embedded in the regional heterogeneity in the Philippines. The minimum-to-average wage ratio confirms the initial findings in the descriptive statistics, which indicate a wider wage dispersion. Most regions have experienced modest wage increases over the span of 21 years, while regions that have offered higher wages since 2002, including the NCR, Regions 3, 4A, 7, and 11, continue to widen the gap in wage distribution. These regional disparities are amplified in the minimum-to-average wage ratio, where most regions remain below the most developed regions and the national average. Given these conditions, wage convergence is not possible in the Philippines.

The regional wages in the Philippines do not follow a systematic pattern or a uniform stochastic process. Variance-ratio estimates, along with Fisher's combined statistics, suggest that regional wages in the Philippines do not follow a systematic pattern, indicating that the level of wage adjustment is unpredictable. Wage adjustments are independent of previous wage adjustments. These statistics are reinforced by the random-walk graphical diagnostics, where the variance path of all regions shows random-walk properties. All regions cross the random walk line at some point, especially at lag 16, despite the existence of a mean-reverting process of wage determination. These results reaffirm cross-regional heterogeneity of wages.

Granger causality tests revealed that local economic factors, composed of GRDP, Per Capita GRDP, Employment rate, and Inflation Rate, influence and sustain wages. These factors influence the trajectories of regional wage setting. The bidirectional predictive relationship between GRDP and the Employment Rate, with wage, is suggestive of a mutually reinforcing cycle between the labor market and the economy. The inflation rate and per capita GRDP have a unidirectional predictive relationship, with wages reflecting the sensitivity to inflation. It can be inferred from these Granger results that wage-setting behavior is protective of the market and economic conditions. The indexation of wages to inflation indicates that wage adjustments are counter inflationary. This results in a very modest wage increase. In the wage-setting process, a balancing mechanism exists that considers various criteria based on their potential impact on the economy. Since each region adjusts wages at different times, this leads to the use of varied and partial economic performance and industry-specific conditions. Consequently, heterogeneity arises despite the overall performance of most regions in the Philippines being relatively stable at the end of each year. Establishing a national minimum wage or a uniform wage rate, such as across-the-board increases, is risky for a very heterogeneous regional economy with diverse wage behavior. This approach could exacerbate the gap between developed and less developed regions; predominantly agricultural regions may suffer from the closure of industries. Additionally, it could lead to spiralling inflation and create an overall economic imbalance.

6. RECOMMENDATION

These recommendations below seek to guide wage-setting bodies (NWPC and Regional Wage Boards), legislative, the labor and employers' group, and future researchers in addressing interregional wage disparities and the spatial spillovers identified in the analysis.

1) A uniform wage rate is not feasible in the Philippines. The effect on the nominal wage is only temporary, but its effect on developing and less developed regions is disastrous. It will amplify disparities on a national scale.

2) Reduce differences in wage setting goals by designing a baseline formula that establishes the minimum and maximum wage increases for Luzon, Visayas, and Mindanao.

3) Address the output gap by (a) Adopting Sectoral-Wage Fixing System. The gap between the output growth and the minimum wage can be addressed by establishing different wage rates for the three sectors: Agriculture, Industry, and Service in Luzon, Visayas, and Mindanao. The Sector-Specific Wage Ladders of Singapore can serve as a model, and (b) Institutionalizing Wage linked Productivity Programs. The

productivity-based incentive scheme is voluntary under Tier 2 of the Two-Tiered Wage System. Results of this study show that a percentage increase in Gross Regional Domestic Product per Capita is compensated by a negligible increase in wage growth.

4) Review and update the minimum wage setting implementing rules by (a) using robust data and uniform statistical data (current rather than real prices) for consistency and reliability in the wage setting of the Regional Boards, and (b) upskilling and professionalization of the Regional Wage Boards in handling statistical data objectively and accurately. The findings of this study indicate that Regional Wage Boards play a crucial role in maintaining the sustainability of the wage cycle and the economy, even during times of economic distress.

5) Review the Legal Framework by (a) Amending the Wage Rationalization Act (RA6727). This requires the national government and legislature to review the wage-setting mechanism and standard criteria for determining the minimum wage. These criteria should be measurable, specific, and relevant to employers and the labor sector. The cycle or period of wage setting needs to be addressed to have timely and relevant wage adjustments in reference to inflation. (b) Amending the Republic Act 9178 or Barangay Micro Business Enterprises (BMBE) Law. The minimum wage must be established for all Barangay Micro Business Enterprises (BMBEs) workers.

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