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Inflation, GRDP Growth, and Open Unemployment in Pangkalpinang City: An Okun's Law Approach

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ABSTRACT

This study examines how real Gross Regional Domestic Product (GRDP) growth and inflation relate to changes in Open Unemployment Rate (OUR) of Pangkalpinang City, Indonesia, a small urban economy whose output is tied to tin smelting, trade, and services. Using official annual data from Statistics Indonesia (BPS) for 2010–2024, the study estimates difference version of Okun's law augmented with inflation by ordinary least squares with Newey–West standard errors. Unit-root tests (ADF, Phillips–Perron, and KPSS) indicate that all regression variables are stationary, which rules out spurious regression, while an Engle–Granger test combined with an error-correction check gives no reliable evidence of a long-run equilibrium in levels. In baseline model, a one-percentage-point increase in real GRDP growth is associated with a 0.32 percentage-point smaller change in OUR ($p = 0.086$; HAC $p = 0.071$). The sign of the growth coefficient in each of the eight models, which included those that used a dummy variable for COVID-19, national growth as a control, and lagged growth, was always negative. The sign of the growth coefficient in each of the 12 models run after removing an observation from the sample (the "leave-one-out" models) was also always negative. However, when 2020 was removed from the sample, the growth coefficient became statistically insignificant. The sign of the inflation coefficient was generally positive, but in almost all cases was not statistically significant. Therefore, there is no evidence of a short-run Phillips curve trade-off. We only have 12 observations for our analysis; thus, we can state only that our findings suggest how output growth affects local unemployment rates rather than providing definitive proof. Our findings also suggest that output growth does not translate well into employment. This is because we work with a capital-intensive smelting base and a large informal economy. Finally, our findings indicate that inflation control and job creation should be pursued as distinct policy objectives.

Keywords: *Okun's law; Phillip's curve; open unemployment rate; regional labor market; Pangkalpinang*

INTRODUCTION

Pangkalpinang, the capital of Kepulauan Bangka Belitung Province, is a small urban economy that depends on a narrow set of activities. Tin ore is mined in the surrounding regencies, but much of it is smelted inside the city, so the tin industry reaches the city's accounts through the Basic Metals manufacturing sub-sector rather than through mining. This sub-sector produced 18.16 percent of the city's GRDP at current prices in 2010 (Badan Pusat Statistik Kota Pangkalpinang [BPS Kota Pangkalpinang], 2015–2025), yet it employed only 859 workers in eight large and medium establishments in 2023. Most residents work in trade, transport, accommodation, and other services.

The city's labor market has been volatile. The Open Unemployment Rate (OUR) reached 10.64 percent in 2015, fell below 5 percent in 2018–2019, and rose to 6.93 percent in 2020, when real GRDP

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contracted by 3.0 percent during the COVID-19 pandemic. Real GRDP contracted again by 2.3 percent in 2024, mainly because manufacturing output fell, yet unemployment rose by only 0.22 percentage points that year. Episodes like these raise a simple question for local policy: how closely does unemployment in the city follow output and prices?

Two macroeconomic regularities frame the question. Okun's law predicts that faster output growth reduces unemployment because firms need more workers to produce more (Okun, 1962), and Phillip's curve predicts a short-run trade-off in which higher inflation accompanies lower unemployment (Phillips, 1958). Evidence for both in Indonesia is mixed. Darman (2013) significant district-level evidence emerges only when endogeneity is taken into consideration, with observed relationship concentrated in more industrialized western regions, despite negative *Okun's law* coefficient identified at national level (Aginta et al., 2025). Using a data-driven classification of districts, Siregar et al. (2026) find that the relationship is strong in diversified, labor-absorbing centers, weak or reversed in capital-intensive hubs, and close to flat in commodity-based enclaves. Syachbudy et al. (2023) show that there has been no stable trade-off in the Phillips Curve for Indonesia between 1985 and 2021.

The majority of the research cited in support of the link between unemployment rates and crime rates is derived from national surveys or large panels. Time-series analyses based upon single cities are rare, as city-level data is typically available only annually and has many missing values. Consequently, there is a risk of relying on data that cannot be verified through official sources, especially if researchers require more frequent or longer series than what is readily available. In contrast, the current study utilizes solely published annual BPS data, clearly identifies the number of observations included in the study, and selects estimation techniques and statistical tests which can still be validly applied when there are relatively few observations.

Okun (1962) provided two variations of the relationship between unemployment and production: a gap form and a difference form. A gap version uses an unemployment rate and an output gap to relate them, while a difference version uses changes in unemployment and growth of production to relate them. Since the difference version does not require estimating potential output, it is generally used when there are only short-term data available for regions. A review of 25 years of empirical research has found that the majority of studies have adopted the difference version (Boďa & Považanová, 2025). This coefficient cannot be considered as a structural constant. Ball et al. (2017) stated that Okun's law works relatively well in most developed economies; however, there can be significant differences in the coefficients of the law among countries due to differences in labor market structures. On the other hand, the relationship is usually weaker in developing economies since many workers who lose their job in the formal sector will become either self-employed or do casual labor instead of becoming unemployed (La Porta & Shleifer, 2014). For the ASEAN-10 economies over 1991–2022, Boďa et al. (2026) showed Okun's law holds in both its difference and gap versions only for Malaysia and Thailand, and that where it is valid it is weaker than in advanced Western economies.

Regional evidence for Indonesia points to strong heterogeneity. Aginta et al. (2025) estimate regional Okun's law for 514 districts over 2011–2020 and find that the coefficient becomes significant only once growth is instrumented, and only in the western regions. In Central Europe, regional Okun coefficients also differ widely, with economic prosperity and human capital among their main drivers (Boďa et al., 2024). For Indonesia, Siregar et al. (2026) find opposing directions of growth–unemployment relationships across different regimes are obscured when represented by a single national coefficient, while shocks to economic growth can also extend beyond district boundaries to neighboring areas. Spatial interdependence also appears in the link between industrial agglomeration and unemployment in Java (Prastiwi & Khoirunurrofik, 2025). At the provincial level, Wulandari and Astuti (2023) use an error-correction model for Central Java over 2003–2020 and find that economic growth lowers unemployment rate in both long and short run. At level of a single regency, Rafli et al. (2024) estimate a negative but insignificant Okun coefficient for Kabupaten Banjar and conclude that the law does not hold there. Taken together, these studies suggest size of Okun coefficient depends on how labor-intensive local growth is, which motivates testing it for a city whose largest industrial activity is capital-intensive smelting.

In United Kingdom, the *Phillips curve* was initially identified through an observed association linking unemployment with changes in wage inflation (Phillips, 1958). Friedman (1968) argued that any

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trade-off is temporary, because unemployment returns to its natural rate once expectations adjust. A further reason to expect a weak trade-off at the city level is that local prices are largely set outside the city. In times of inflation due to increased costs of food, energy, and transportation as opposed to increased domestic demand, there is no necessary correlation between price increases and employment increases. While the results from Indonesia are inconsistent, they appear to support this concept. For example, Syachbudy et al. (2023) reported that inflation and unemployment were not negatively correlated during the period 1985-2021; Nasution et al. (2025) found that inflation had no statistically significant effect on unemployment in Central Java; and a panel study conducted at the provincial level for the period 2010-2021 indicated that GRDP growth and the COVID-19 shock, however not inflation, had a statistically significant effect on the open unemployment rate (Mifrahi & Darmawan, 2022). Conversely, Wulandari and Astuti (2023) discovered a negative effect of inflation on employment in the short-term which vanished in the long-term. A review of Indonesian policy notes that inflation is shaped largely by global price pressures, distribution disruptions, and subsidy adjustments, and that government addresses it with instruments different from those used against unemployment (Septiyanti et al., 2025).

Two hypotheses follow. H1: real GRDP growth is negatively associated with the change in the OUR, as predicted by Okun's law. H2: inflation is negatively associated with the change in the OUR, as implied by a short-run Phillips trade-off. This research has three main goals: (1) To determine the relationship between actual GRDP growth and changes in the OUR in Pangkalpinang during the period of 2010 through 2024. (2) To determine if inflation exhibits the inverse relationship predicted by a short-term Phillips curve. (3) To determine if the relationships found in objectives one and two will continue after the effects of the COVID-19 pandemic have been taken into consideration, as well as the inclusion of other relevant variables, and the elimination of those years that significantly affected the overall results. This study is contributing a clearly documented and replicable estimation for a commodity-based economy, as well as providing an explicit explanation of what can and cannot be shown within the context of a relatively small data set.

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METHODS

Data

The study uses annual time-series data for Pangkalpinang City over 2010–2024, compiled from the 2015–2025 editions of *Kota Pangkalpinang Dalam Angka* (BPS Kota Pangkalpinang, 2015–2025), using the most recent published vintage for each year. The OUR is taken from August round of National Labor Force Survey (Sakernas), only round that produces city-level estimates. Real GRDP is measured at constant 2010 prices, and inflation is December year-on-year change in Consumer Price Index, which BPS compiles for Pangkalpinang as one of Indonesia's CPI cities. National real GDP growth (2010-base series), used as a control, is taken from BPS national accounts (Badan Pusat Statistik, 2025). The sample starts in 2010, the first year of the constant-2010-price series. BPS did not publish a city-level OUR for 2016 because Sakernas did not produce city-level estimates that year; this observation is left missing rather than imputed.

Annual frequency is a deliberate choice. The city-level OUR is published only once a year, and quarterly city-level GRDP is not available for most of the sample period. Interpolating annual figures to quarters would add observations without adding information and would produce artificially smooth series whose induced serial correlation invalidates standard unit-root and cointegration inference. An earlier version of this study used a quarterly series; because that series could not be traced to official city-level publications, it has been replaced entirely by the official annual data described here. Table 1 summarizes the variables.

Table 1. Variable Definitions and Data Sources

Variable	Definition	Unit	Source
ΔOUR	Annual change in the Open Unemployment Rate (August Sakernas)	Percentage points	BPS Kota Pangkalpinang (2015–2025)
g	Growth of real GRDP at constant 2010 prices, 100 × Δln GRDP	Percent	BPS Kota Pangkalpinang (2015–2025)
INF	December year-on-year change in the CPI	Percent	BPS Kota Pangkalpinang (2015–2025)
ΔINF	Annual change in inflation (robustness)	Percentage points	Computed from INF
g_{nat}	Real GDP growth of Indonesia (control)	Percent	Badan Pusat Statistik (2025)
COVID	Dummy equal to 1 in 2020 and 2021	—	Author

Note. Growth is computed as the log difference of real GRDP multiplied by 100. The 2024 GRDP figure is preliminary.

Model Specification

Following Okun (1962) and Darman (2013), the relationship is specified in first differences and augmented with inflation:

$$\Delta OUR_t = \beta_0 + \beta_1 g_t + \beta_2 INF_t + \varepsilon_t \qquad (1)$$

where $\Delta OUR_t = OUR_t - OUR_{t-1}$, g_t is real GRDP growth, and INF_t is inflation. H1 implies $\beta_1 < 0$ and H2 implies $\beta_2 < 0$. The expression $-(\beta_0 + \beta_2 \cdot INF)/\beta_1$ gives the growth rate at which the OUR remains unchanged for a given inflation rate. Because ΔOUR cannot be computed for 2016 and 2017, the estimation sample consists of 12 observations (2011–2015 and 2018–2024). Specifying the model in differences has an important econometric advantage: if, as the tests below show, all regressors and the dependent variable are stationary, the regression is balanced and the risk of spurious correlation between trending series does not arise.

Estimation Procedure

Three methodological stages are used to obtain empirical estimates. Initially, stationarity properties and integration orders of variables are established through three complementary procedures: ADF (Dickey & Fuller, 1979), PP (Phillips & Perron, 1988), and KPSS (Kwiatkowski et al., 1992). The first two tests take a unit root as null, whereas KPSS test assumes stationarity under its null. Because OUR and ln GRDP display trends in levels, their specifications include both an intercept and a linear trend; after differencing, only an intercept is retained. One lag at most is permitted in the ADF specification, with lag selection based on Bayesian information criterion, while KPSS test is implemented with one lag. The next stage evaluates whether variables share a long-run relationship in levels. For this purpose, Engle–Granger residual-based test (Engle & Granger, 1987) is applied, followed by inclusion of lagged levels-regression residual in Equation (1) to represent error-correction mechanism. Finally, Equation (1) is estimated using Ordinary Least Squares. Inference is presented using conventional standard errors alongside Newey–West heteroskedasticity and autocorrelation consistent (HAC) standard errors, the latter calculated with one lag and a small-sample correction (Newey & West, 1987). The corresponding p-values are evaluated using t distribution.

Fourth, the residuals are checked for normality (Jarque–Bera), first-order serial correlation (Breusch–Godfrey LM), heteroskedasticity (Breusch–Pagan), functional form (Ramsey RESET), and multicollinearity (variance inflation factors). Fifth, robustness is assessed by (i) adding a COVID-19 dummy for 2020–2021; (ii) excluding 2011, which records an unusually large fall in the OUR; (iii) excluding the pandemic year 2020; (iv) replacing inflation with its first difference; (v) adding national GDP growth to separate the local association from the national business cycle; (vi) adding lagged growth to allow for delayed labor market adjustment; and (vii) re-estimating the baseline model twelve times, each time leaving out one year.

The "autoregressive distributed lag" (ARDL) bounds-testing method (Pesaran et al., 2001) was not employed. The ARDL bounds-testing method is only appropriate when there is an un-interrupted time-series data set that can be used to create the required lags, and when there is a sufficiently large

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number of observations available to allow for the identification of the optimal number of lags, as well as to ensure that the bounds critical values provided by the bounds testing methodology are statistically significant. Although the bounds-testing methodology provides critical values based on small-sample sizes, those critical values are only provided for samples with 30 or more observations (Narayan, 2005). Because of the limited number of observations (12) that could be analyzed in this study, and due to the fact that there was a missing observation in 2016, an ARDL model would require lag selections that were not supported by the available data. As a result of the small sample size used in this study, all statistical analyses conducted in this study reported exact p-values, considered the 10% level as "weak evidence," and assigned equal weight to the consistency of sign and magnitude among alternative specifications as they did to each test of statistical significance.

RESULT AND DISCUSSION

Descriptive Overview

Table 2 and Figure 1 present the data. The OUR was high in 2014–2015 (8.84 and 10.64 percent), fell to 4.70 percent in 2018, rose to 6.93 percent in 2020, and has stayed between 5.76 and 5.98 percent since 2022. Real GRDP grew by 4.38 percent per year on average but contracted in 2020 (−3.0 percent) and 2024 (−2.3 percent), with a strong rebound of 9.3 percent in 2021. Inflation drifted down from 9.36 percent in 2010 to 0.76 percent in 2024, with peaks in 2013, 2016, and 2022. Both contraction years coincided with a rise in unemployment.

Table 2. Official Annual Data for Pangkalpinang City, 2010–2024

Year	OUR (%)	Real GRDP (billion Rp, 2010 prices)	GRDP growth (%)	Inflation (%)
2010	9.37	5,799.5	–	9.36
2011	5.63	6,193.0	6.79	5.00
2012	5.25	6,571.3	6.11	6.57
2013	6.66	6,951.0	5.78	8.71
2014	8.84	7,247.5	4.27	6.81
2015	10.64	7,555.0	4.24	4.66
2016	n.a.	7,946.0	5.17	7.78
2017	5.80	8,358.5	5.19	2.66
2018	4.70	8,782.8	5.08	3.45
2019	4.97	9,069.3	3.26	2.31
2020	6.93	8,797.1	−3.00	0.52
2021	6.81	9,611.4	9.26	3.60
2022	5.90	10,208.0	6.21	6.07
2023	5.76	10,750.8	5.32	2.01
2024	5.98	10,503.9	−2.30	0.76

Note. BPS Kota Pangkalpinang, *Kota Pangkalpinang Dalam Angka* 2015–2025 editions (most recent vintage for each year); GRDP growth computed by the author. n.a. = not published at the city level. The 2024 GRDP figure is preliminary.

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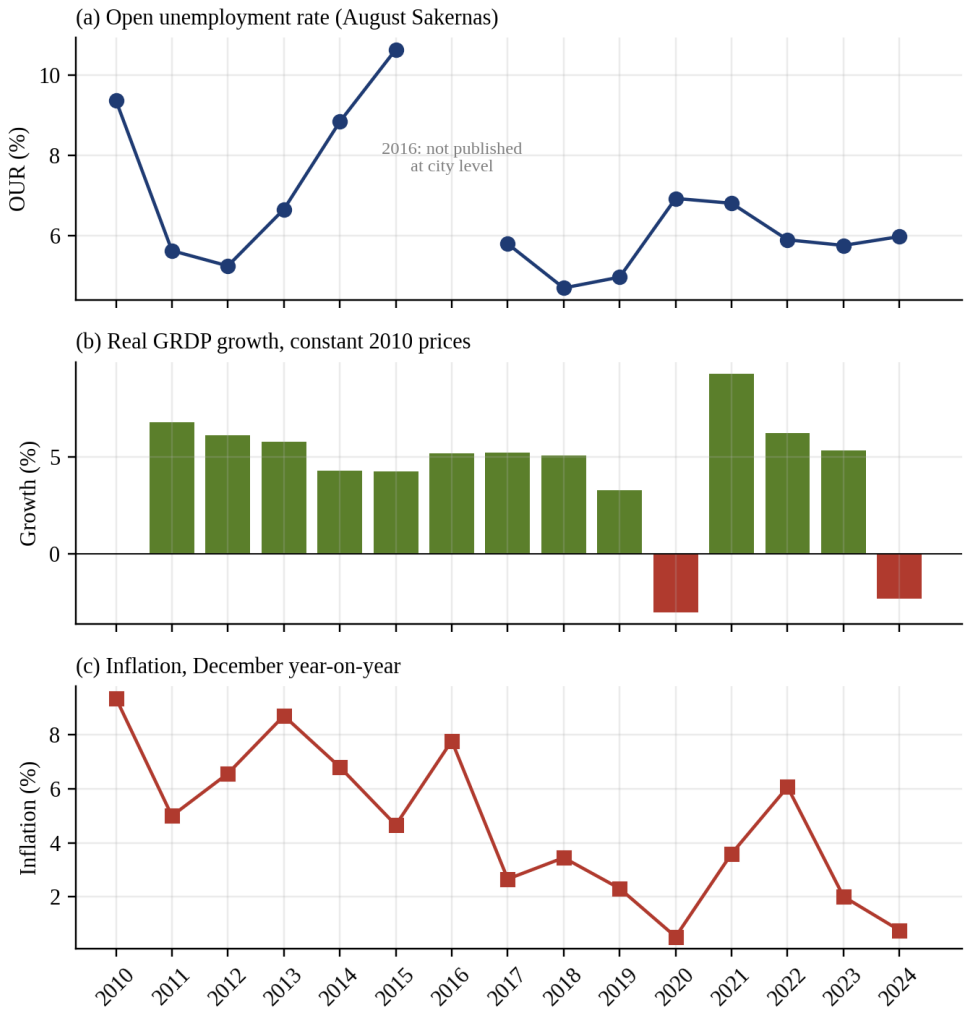

Figure 1. OUR, Real GRDP Growth, and Inflation in Pangkalpinang City, 2010–2024

Source: BPS Kota Pangkalpinang (2015–2025), processed by the author.

Stationarity and Cointegration Tests

In table 3, I report on the means, standard deviations, and results of the unit-root testing for each of the variables used in my study. Both of the unit-root tests (ADF and PP) failed to find evidence against a unit root in log real GRDP; additionally, KPSS test showed that log real GRDP was non-stationary in levels. However, when I first-differenced log real GRDP to produce real GRDP growth, both of the unit-root tests (ADF and PP) found evidence against a unit root; also, KPSS test showed that real GRDP growth was stationary. My analysis indicated that although the OUR was found to be stationary in levels according to the ADF test, it was not stationary according to the PP test. Additionally, the KPSS test showed that the OUR was stationary in levels. Therefore, my findings suggest that the OUR was stationary in levels or near-stationary during my relatively brief sample period. My analysis further indicated that although inflation in levels had a constant, it appeared to be ambiguous with regard to whether it was stationary or not because both the ADF and PP tests did not find evidence against a unit root, whereas the KPSS test did find evidence that inflation in levels was non-stationary. This ambiguous result was likely due to the fact that inflation was generally declining. On the other hand, my analysis also indicated that inflation was stationary about a linear trend, and its first difference was clearly stationary. Most importantly for equation (1), all of the variables that were included in equation (1) were stationary (i.e., ΔOUR, g, INF (trend-stationary), and ΔINF). Since all of these variables were stationary, equation (1) was balanced.

Table 3. Descriptive Statistics and Unit-Root Tests

Variable	Det.	Obs.	Mean	Std. dev.	ADF t (p)	PP t (p)	KPSS (p)	Conclusion
OUR (level)	c, t	14	6.66	1.76	−4.015 (0.008)	−2.889 (0.166)	0.049 (>0.10)	Mixed; near I(0)
ln GRDP (level)	c, t	15	9.01	0.19	−2.426 (0.366)	−1.990 (0.607)	0.137 (0.067)	I(1)
INF (level)	c	15	4.68	2.80	−2.351 (0.156)	−2.269 (0.182)	0.639 (0.019)	Ambiguous
INF (level)	c, t	15	4.68	2.80	−3.588 (0.031)	−5.095 (0.000)	0.064 (>0.10)	Trend-stationary
ΔOUR	c	12	0.12	1.65	−3.474 (0.009)	−4.302 (0.000)	0.115 (>0.10)	I(0)
g (Δln GRDP × 100)	c	14	4.38	3.29	−3.242 (0.018)	−3.095 (0.027)	0.222 (>0.10)	I(0)
ΔINF	c	14	−0.61	2.82	−4.374 (0.000)	−10.152 (0.000)	0.061 (>0.10)	I(0)

Note. Det. = deterministic terms (c = constant, t = linear trend). ADF lag length selected by Bayesian information criterion (maximum one lag); KPSS with one lag. H_0 of ADF and PP: unit root; H_0 of KPSS: stationarity. KPSS p-values are interpolated from tabulated critical values and are bounded at 0.10. The level OUR series and ΔOUR omit 2016 (and ΔOUR also 2017), so these tests treat the remaining observations as consecutive.

Because log GRDP is I (1) while the OUR is close to stationery, the conditions for a conventional cointegrating relationship between them are not clearly met. The Engle–Granger test was nevertheless run on the level's regression of OUR on ln GRDP and inflation. That regression explains only 18 percent of the variation in the OUR level. Its residual-based statistic (−4.80) lies below the 5 percent critical value (−4.45), but the result is fragile: when the OUR is regressed on ln GRDP alone with a constant and trend, the statistic (−3.85) does not reach even the 10 percent critical value (−4.08). More decisively, when the lagged residual from the level's regression is added to Equation (1) as an error-correction term, its coeff. is −0.258 with p = 0.565 (Table 4, Model 8), so there is no evidence that the OUR adjusts toward a long-run level determined by output and prices. The analysis therefore proceeds with the difference specification and makes no claim of a long-run equilibrium.

Estimation Results

Table 4 reports estimates. In baseline model (Model 1), coefficient on real GRDP growth is −0.320 (standard error 0.166; p = 0.086; HAC p = 0.071): A 0.32 percentage-point reduction in change of OUR is associated with each one-percentage-point increase in growth. The coefficient on inflation is positive (0.277) and insignificant (p = 0.262). At the sample-mean inflation rate of 4.21 percent, the estimates imply that growth of about 4.6 percent per year is needed to keep the OUR stable, slightly above the average growth actually achieved over the estimation sample, which is consistent with the small average increase in the OUR. The model explains 29 percent of the variation in ΔOUR, and F-test does not reject joint null (p = 0.211). The modest R^2 is what one would expect for an equation in differences and contrasts with the very high fit typically obtained when trending series are regressed on each other in levels.

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Table 4. OLS Estimates of the Inflation-Augmented Okun Equation (dependent variable: ΔOUR)

Variable	(1) Baseline	(2) + COVID	(3) Excl. 2011	(4) Excl. 2020	(5) ΔINF	(6) + g_{nat}	(7) + g_{t-1}	(8) ECM check
Constant	0.316 (0.887) [0.730; 0.543]	−0.293 (1.014) [0.780; 0.599]	0.405 (0.610) [0.526; 0.424]	−0.016 (1.176) [0.990; 0.972]	1.246 (0.798) [0.153; 0.093]	1.148 (1.084) [0.321; 0.061]	1.237 (0.649) [0.098; 0.022]	0.265 (0.925) [0.782; 0.595]
GRDP growth (g_t)	−0.320 (0.166) [0.086; 0.071]	−0.346 (0.164) [0.069; 0.037]	−0.239 (0.117) [0.075; 0.024]	−0.272 (0.203) [0.217; 0.185]	−0.241 (0.143) [0.126; 0.124]	−0.231 (0.175) [0.224; 0.094]	−0.341 (0.110) [0.017; 0.026]	−0.271 (0.191) [0.193; 0.181]
Inflation (INF_t)	0.277 (0.231) [0.262; 0.191]	0.388 (0.246) [0.153; 0.071]	0.248 (0.159) [0.158; 0.116]	0.287 (0.243) [0.272; 0.176]		0.354 (0.232) [0.166; 0.089]	0.418 (0.156) [0.032; 0.031]	0.218 (0.259) [0.424; 0.425]
ΔINF_t					0.183 (0.202) [0.390; 0.485]			
COVID dummy		1.493 (1.279) [0.277; 0.062]						
National growth (g_{nat})						−0.335 (0.266) [0.243; 0.061]		
Lagged growth (g_{t-1})							−0.227 (0.109) [0.075; 0.013]	
ECT_{t-1}								−0.258 (0.429) [0.565; 0.636]
Observations	12	12	11	11	12	12	11	12
R^2 / Adj. R^2	0.292 / 0.135	0.395 / 0.168	0.351 / 0.189	0.213 / 0.017	0.248 / 0.080	0.409 / 0.188	0.600 / 0.428	0.323 / 0.069
F-statistic (p)	1.857 (0.211)	1.742 (0.236)	2.162 (0.178)	1.085 (0.383)	1.481 (0.278)	1.847 (0.217)	3.496 (0.078)	1.270 (0.348)

Note. Coefficients with conventional standard errors in parentheses and p-values in brackets [conventional; Newey–West HAC with one lag and small-sample correction, t distribution]. ECT_{t-1} = lagged residual of the level's regression of OUR on ln GRDP and INF. Leave-one-out range of the GRDP growth coefficient across twelve re-estimations of Model 1: −0.498 to −0.239.

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The results of the robustness checks show that the growth coefficient remains negative regardless of what other variables are included in the model. In addition, the size of this coefficient varies slightly across all models. Specifically, the growth coefficient ranged from −0.231 to −0.346. When we added a COVID-19 dummy for 2020-2021 (Model 2), the growth coefficient did not change significantly from its value in Model 1; it remained at −0.346 (HAC p = 0.037). The dummy was positive; however, it was also very imprecise, which suggests that the unemployment changes experienced during the pandemic years were higher than those that could be explained by growth alone. When we removed 2011 from the sample (Model 3), the growth coefficient was reduced to −0.239 (HAC p = 0.024). Removing 2020 from the sample (Model 4) led to a smaller growth coefficient of −0.272, however, the estimate was no longer statistically significant (p = 0.217). This indicates that much of the identifying variation used to estimate the relationship between growth and unemployment is provided by the economic downturn associated with the pandemic. Finally, when we substituted inflation with its first difference (Model 5), the growth coefficient became −0.241 (p = 0.126).

Model 6 also includes National GDP Growth. Both growth variables have negative coefficients; however, the Local Growth Coefficient decreases to -0.231 and loses its usual significance level. This decrease suggests that some portion of the city's Okun Relationship can be attributed to the national business cycle. The Local Growth is closely related to the national business cycle. Model 7 provides for an option for Delayed Adjustment: Current Growth (-0.341; p = 0.017) and Lagged Growth (-0.227; p = 0.075) are both negative; therefore, there would be a Cumulative Association of approximately -0.57 over a two-year period. Since Model 7 is based on only eleven observations and four parameters, it

should be considered a suggestion of gradual adjustment as opposed to strong evidence of such. The Growth Coefficient is negative in all twelve Re-estimations in the Leave-One-Out Analysis (Figure 3). These coefficients range from -0.498 (without 2021) to -0.239 (without 2011).

Inflation, in levels or in differences, is positive in every specification and insignificant in all but Model 7, where it is positive and significant (0.418; p = 0.032). No specification yields the negative sign implied by a short-run Phillips trade-off. H1 is therefore supported in direction, with weak statistical evidence, and H2 is not supported.

Diagnostic Tests

The diagnostic tests in Table 5 do not indicate violations of the classical assumptions for Model 1. The residuals are consistent with normality, there is no evidence of serial correlations or heteroskedasticity, the RESET test does not suggest functional-form misspecification, and the variance inflation factors are low. Because these tests also have limited power with 12 observations, they support, but do not guarantee, the validity of the estimates. Figure 2 plots the data underlying the Okun relationship, and Figure 3 shows the leave-one-out estimates.

Table 5. Diagnostic Tests for Model 1

Test	Statistic	p-value	Conclusion
Jarque–Bera (normality)	1.968	0.374	Normality not rejected
Breusch–Godfrey LM, 1 lag (serial correlation)	0.040	0.842	No serial correlation detected
Breusch–Pagan (heteroskedasticity)	1.072	0.585	No heteroskedasticity detected
Ramsey RESET, F (functional form)	1.294	0.288	No misspecification detected
Variance inflation factor (g, INF)	1.63	–	No multicollinearity

Note. n = 12. Tests have limited power in small samples.

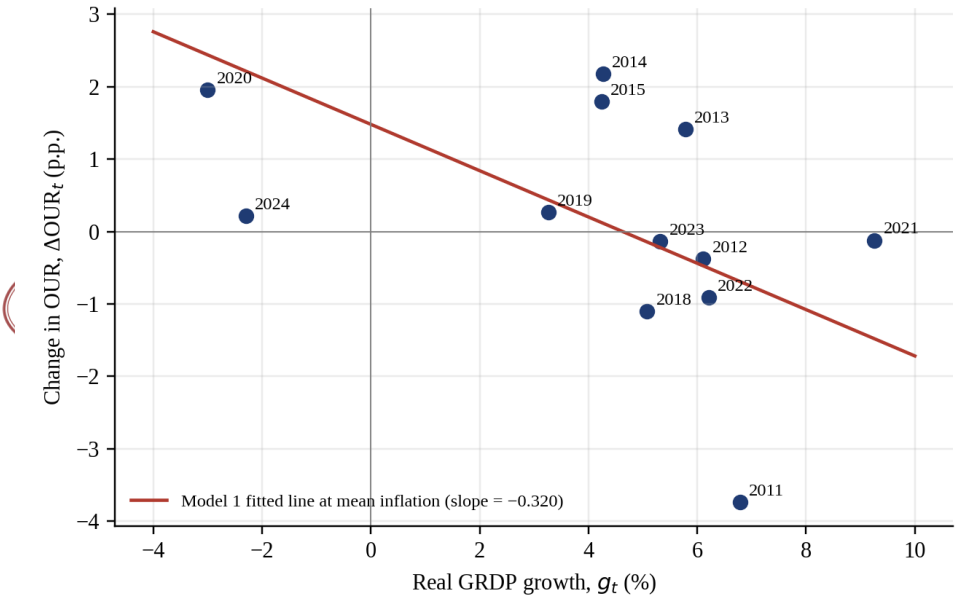

Figure 2. Real GRDP Growth and the Annual Change in the OUR, Pangkalpinang City, 2011–2024

Note. The line shows Model 1 fitted values evaluated at the sample-mean inflation rate. *Source:* BPS Kota Pangkalpinang (2015–2025), processed by the author.

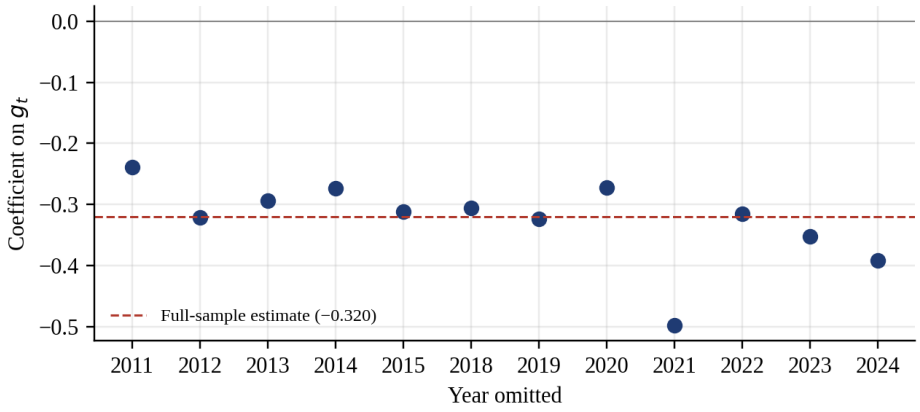

Figure 3. Leave-One-Out Estimates of the GRDP Growth Coefficient (Model 1)

Source: Author's estimation.

Discussion

The negative growth coefficient is consistent with Okun's law and with Darman's (2013) national estimate, and its imprecision is consistent with district-level evidence that simple Okun regressions in Indonesia often yield weak or insignificant coefficients (Aginta et al., 2025; Rafli et al., 2024). Its size is also in line with finding, where Okun's law holds in ASEAN economies, it is weaker than in advanced economies (Bod'a et al., 2026). Its modest size fits the regime pattern described by Siregar et al. (2026), in which capital-intensive and commodity-linked places show weaker growth–unemployment associations than diversified, labor-absorbing centers. The clearest evidence in the Pangkalpinang data comes from the two contraction years. In 2020, output fell by 3.0 percent and the OUR rose by 1.96 percentage points; in 2024, output fell by 2.3 percent but the OUR rose by only 0.22 percentage points. The smaller drop in 2024 is also revealed since it was largely due to the decrease in production of the manufacturing sector. Production of the manufacturing sector decreased from approximately Rp1.98 trillion to Rp1.38 trillion (BPS Pangkalpinang City, 2015–2025). Although there was a significant loss of production within a capital-intensive sector, this only led to a slight change in the rate of unemployment.

The coefficient is small due to two factors related to the local labor market. The first factor relates to how the informal sector absorbs some of the shock. In 2024, the BPS classified 37.7 percent of the total workforce in the city as informal workers. These workers included own-account workers, employers who used the services of temporary or unpaid workers, casual workers, and unpaid family workers. As formal sector jobs disappear, many workers will take up positions within this group instead of becoming unemployed; therefore, output shocks can be reflected in changes in the type of employment (La Porta & Shleifer, 2014). Second, the labor force has grown: the labor force participation rate rose from 62.37 percent in 2020 to 66.99 percent in 2024, so part of the recovery in output was absorbed by new entrants rather than by a fall in unemployment. The finding that national growth absorbs part of the local coefficient (Model 6) also suggests that the city's labor market responds to the national cycle, in line with evidence of spatial spillovers in Indonesian regional labor markets (Prastiwi & Khoirunurrofik, 2025; Siregar et al., 2026).

The non-existence of a Phillips curve trade-off is consistent with Syachbudy et al. (2023), Nasution et al. (2025), and Mifrahi and Darmawan (2022) as well as the long-term findings of Wulandari and Astuti (2023). From 2010 to 2024, Pangkalpinang's inflation dropped from over 9 percent to under 1 percent, yet there was no subsequent increase in unemployment. Furthermore, the two highest peaks in inflation in Pangkalpinang occurred in 2013 and 2022, which were both times when the federal government increased subsidized fuel prices. Therefore, the pattern described above combined with the fact that global prices, distribution costs, and federal government subsidies influence Indonesian inflation (Septiyanti et al., 2025), indicates that the majority of price changes in Pangkalpinang are caused by supply side influences and imported cost influences. Model 7 has a positive coefficient;

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however, this should not be given too much weight. However, it does indicate that there are cost push episodes that occur when inflation increases and there is lower demand for labor.

The policy implications of the results of this study are very clear. The growth rate of output is important for increasing the number of jobs available in Pangkalpinang. However, according to the results of this study, Pangkalpinang must grow at a minimum of 4.6% per year just to maintain the current level of unemployment. Furthermore, the growth rates experienced by Pangkalpinang due to the growth of the smelting industry have produced minimal job opportunities. Therefore, any policy measures designed to increase labor absorption such as supporting MSMEs (micro, small, and medium enterprises), trade, transportation, and tourism related services will likely lead to lower levels of unemployment as opposed to relying on increased levels of output from the smelting industry. Inflation control is also an essential element in protecting the purchasing power of low-income and informal household's real incomes. However, inflation control cannot be relied upon to create new employment opportunities. Instead, price stability and job creation are best seen as complementary objectives that can be achieved through the use of separate instruments as opposed to being viewed as competing objectives that must be traded off against each other.

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CONCLUSION

Using official annual BPS data for 2010–2024, this study finds that real GRDP growth is negatively associated with changes in the Open Unemployment Rate in Pangkalpinang City, consistent with Okun's law: a one-percentage-point increase in growth is associated with a 0.32 percentage-point smaller change in OUR. The sign was consistent with the eight specifications used for analysis, and with the twelve leave-one-out estimates. However, the statistical significance of the results is quite limited and may be partially attributable to the negative impact of the 2020 pandemic. Inflation has a positive effect; however, it is largely non-significant, therefore, the results of this study do not provide evidence of a short-run Phillips curve trade-off. Each variable included in the regression is stationary and we could not find any consistent relationship between variables in the long run.

There were several limitations to the current study. First, there was a maximum of 12 years of data used (and 1 year was missing), which limits the statistical analyses in terms of power and can be affected greatly by single years such as 2020. Second, in general, when testing unit roots and/or cointegration in small sample sizes, there is little power, thus any findings made based upon such tests would simply indicate associations. Third, the associations between the variables indicated by the estimated coefficients do not imply causal relationships since growth, inflation, and unemployment are all determined simultaneously and no instrumental variable is utilized. Lastly, additional control variables cannot be added because of limitations related to degrees of freedom and other possible variables such as labor force participation, investment and/or minimum wages rates were omitted from the model.

Future research may (i) examine the Okun relationship using a panel of all seven regencies and cities of Kepulauan Bangka Belitung, which would allow for more observations and comparisons between Pangkalpinang and mining regencies; (ii) use sector level growth data to directly assess the employment intensity of smelting, trade and services; (iii) use other determinants of growth such as investment, minimum wage and labor force participation rate; (iv) use the most recent data when they are released after 2024; and (v) use alternative estimation methods, such as Instrumental Variable (IV) method to deal with potential endogeneity of growth or Sakernas microdata to determine who bears the burden of unemployment changes.

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