ACADEMIA International Journal for Social Sciences
Volume 4, Issue 4(b), 2025 ISSN-L (Online): 3006-6638

The Role of Regulatory Quality in Testing Phillips Curve: A Case of Selected Asian Economies

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Received: 15-10-2025 **Revised:** 06-11-2025 **Accepted:** 01-12-2025 **Published:** 21-12-2025

ABSTRACT

Inflation is among one of the major macroeconomic challenges of present time. The inflation has adversely affected the buying power of people. This research is conducted to see the roles of unemployment, regulatory quality, total natural resource rent and population density upon inflation, which will help in testing relevance of conventional Phillips curve. This study considers the cross-sectional autoregressive distributed technique over the period from 1990 to 2024 and provides evidence of trade-off between unemployment and inflation. These findings provide evidence of Conventional Phillips curve in selected Asian Economies. Moreover, the findings also highlight that rents from natural resources significantly accelerate inflation while regulatory quality as measure of institutional quality reduces inflation. Based on these findings, the research proposes that natural rate of unemployment may be reduced, rents from natural` resource may be increased and quality of regulations are improved in such a way that it should not trigger inflation in selected sample countries.

Keywords: *Phillips Curve, Regulatory Quality, Natural Resource Rents, CS-ARDL, Asian Economies*

INTRODUCTION

The Pre-Phillips curve theories were quite different from the hypothesis and concept of the Phillips curve. Classical economists used to believe that wages, flexible prices, and real and nominal variables operate separately. Say's law is a theory that was prevailing before the introduction of the Phillips curve, which states that "Supply creates its demand**".** Whereas Orthodox Keynesianism**,** in reaction to the great depression, argued that in the short run prices are sticky**,** which indicates that aggregate demand decides output other than price. They also argue that there are other factors that can affect or influence real output and unemployment**,** such as monetary policy and fiscal policy.

The Phillips curve was introduced by Phillips (1958). This curve has proved that there is an inverse empirical link between wage inflation and unemployment in the UK economy from 1861 to 1957. The objective of the original research was to analyse how changes in wages are explained by the level of unemployment. In this study by Phillips, annual data from the United Kingdom were taken from 1861 to 1957, having limited computing power and calculations were mostly conducted on electric calculators. In the original study by Phillips (1958), a non-linear model was used, which presented a curved relationship between unemployment and wage inflation. This model did not include lagged variables in the beginning, but Phillips used these variables in some of his other work. In this study, R-squared or t-values were not reported due to computational constraints. The evaluation of this model was visual, at first, Phillips fitted a curve of data from 1861-1913, and then this curve was layered on later data from 1948 to 1957 to examine how well it matched.

In 1960, the Phillips curve model was refined by Lipsey (1960), who employed a simpler nonlinear regression model. In this non-linear regression model, lagged inflation and additional variables like inflation are used. In the late 20th century, the econometric models became more dynamic, incorporating additional variables, lags and different error-correction mechanisms. The Phillips curve was utilised by economists like Samuelson and Solow (1960) to support activist demand management by arguing for a policy trade-off between unemployment and inflation. Friedman (1968) & Phelps (1967) revolutionised the Phillips curve by introducing the concept of the natural rate of unemployment. The concept of natural rate of unemployment asserts that unemployment is reduced by unanticipated inflation only in the short run. They argued that expectations mattered. Friedman and Phelps' concept of the natural rate of unemployment inverted the policy-exploitable trade-off in favour of long-term monetary neutrality. Both economists have shown that if inflation is anticipated, then the curve shifts, invalidating the long-term trade-off. After few years later, Lucas (1972; 1973) revolutionised the Phillips curve. Robert Lucas introduced the concept of rational expectations in the case of the Phillips curve, in which he argued that if economic agents expect inflation, then it neutralises the unemployment effect, which further leads to ineffectiveness of policies. From 1970 to 1980, this was a new classical economics era. Lucas and Sargent (1978) argued that expectations are not adaptive; they are rational, which results in the ineffectiveness of systematic monetary policy in influencing real variables in the short run. New Classical Economists also argue that if policy is credible, then disinflation could happen without an increase in unemployment.

Staggered price and wage contracts were added to dynamic general equilibrium models by Taylor (1980). Taylor's work has provided the foundation for adding price rigidity to the model of rational expectations**,** even though it came before the official New Keynesian Phillips curve. Calvo (1983) created the Calvo pricing model that restricts price reductions to a random group of businesses & firms per period. In order to create sticky pricing and explain why inflation reacts slowly to shocks, the New Keynesian Phillips curve uses this key process. It was proposed by King et al. (1988) **s**tates that business cycles arise from real shocks**,** not from nominal ones. The Phillips curve is always vertical, and monetary policy is neutral due to flexible prices and rational expectations. This theory is known as the Real Business Cycle (RBC) theory. To better fit empirical data, Clarida et al. (1999) created the hybrid New Keynesian Phillips curve, which combines forward-looking expectations with backwards looking inflation behaviour. This version of the Phillips Curve considers both realistic frictions and reasonable expectations. The New Keynesian Phillips Curve was included by Clarida et al. (1999) into a more comprehensive monetary policy framework (New Keynesian Dynamic Stochastic General Equilibrium Model), which demonstrated how central banks use interest rate rules like the Taylor rule to stabilise output and inflation. The groundwork for general equilibrium was established by Woodford (2005), who in his groundbreaking work on interest and prices, provided a comprehensive general equilibrium approach to the New Keynesian Phillips Curve. Woodford highlighted the importance of central bank credibility and expectations in achieving low inflation. On the basis of this discussion, the objective of this study is to investigate the conventional Phillips Curve among the selected Asian Economies, considering regulatory quality, total natural resource rent and population density as controlling factors. The Conventional Phillips Curve has undergone a large number of studies and modifications, but very few have considered the role of regulatory quality and total natural resource rent on inflation and the Phillips curve. This study highlights the role of total natural resource rent and regulatory quality on inflation. Firstly, it provides a cross-regional view by incorporating a wide panel of nations in Asia, allowing for larger and more internationally applicable results. Secondly, it includes policyrelated factors such as regulatory quality and total natural resource rent, providing a more complete picture of how institutional and economic policies can impact the inflation-unemployment relation. The study employs advanced econometric tools to address endogeneity and causality concerns, hence increasing the reliability and correctness of empirical findings. This study employs the data of approximately 33 Asian countries, providing robust findings.

The remaining study will be organized by exposing discussion upon the past researches on a similar idea in section 2. Section 3 will shed light upon sample, model and methods. In section 4, results and explanation will be presented. Conclusion and policy implication section will be presented in the last section 5.

LITERATURE REVIEW

Impact of Unemployment on Inflation: Kumar and Vashist (2012) and Al Zeaud and Al Hosban (2015) studies confirmed the inverse relation between inflation and unemployment in context of India and Jordan, validating the Phillips curve. In the long run, dynamics are influenced by global commodity price fluctuations and inflation expectations in India. In economy of Jordan, this study has overlooked the external shocks such as regional instability. Both studies highlighted that Phillips curve exists in short run, but external and structural factors influence the long run outcomes. Alisa (2015) aimed to examine the impacts of unemployment on inflation in Russian economy during postcrisis recovery phase and concluded that Phillips curve exists. But in the long run, the curve becomes weaken due to fluctuations in oil prices. Orji et al. (2015) examined the dynamics of inflation and unemployment in Nigeria while focusing on oil price fluctuations. This study found that the unemployment has positive impact on inflation, invalidating Phillips curve.

Mohammed (2016) explored how inflation is affected by unemployment in economy of Ghana and concluded that unemployment has no significant impact on inflation in both short and long run. The absence of significant relationship can be due to larger labour force and an enlarged job search. Alper (2017) analysed the impact of unemployment on inflation in context of Turkey and found that there is inverse impact of unemployment on inflation in short run, but due to political instability and inflation expectations make this relation insignificant in long run. Vermeulen (2017) examined how inflation is affected by unemployment in African countries, and this study found no short run trade-off in South Africa. This study found an inverse long run relationship among inflation and unemployment. Kasseh (2018) aimed to investigate the dynamics of inflation and unemployment and found that Phillips curve exists in terms of Gambia but overlooked the effects of trade liberalization in long run. Zayed et al. (2018) explored the economy of Philippines and found that wages and GDP have positive impact on inflation while unemployment has negative impact confirming the Phillips curve. Jointly these studies have supported the Phillips curve dynamics in both short and long run across different countries and factors. Irewole (2019) investigated the Phillips curve in the economies of Nigeria and Mexico while focusing on the impact of unemployment on inflation. In Nigeria, there exist weak relations between inflation and unemployment, while in Mexico, there is no significant inverse relationship among the variables. This concludes that the Phillips curve is either weak or not applicable. This study does not address the long-term effects of structural reforms and technological innovations. This study provides crucial insights into the Phillips curve in Mexico and Nigeria.

Atgur (2020) and Bokhari (2020) investigated the impact of unemployment on Inflation in economy of Turkey and Saudi Arabia. While highlighting the impact of imports, exports and political instability and external shocks, these studies reported that unemployment has negative impact on inflation, confirming the

Phillips curve in both countries. Melian (2021) examined how inflation is influenced by unemployment in Romania and concluded that unemployment has positive influence on inflation, invalidating the hypothesis of Phillips curve. Liargovas and Psychalis (2022) analysed the Phillips curve in the Greek economy, examining the relationship between inflation and unemployment. The authors concluded that the Phillips curve exists in Greece, but other factors besides unemployment have a greater impact on inflation. However, this study does not fully explore the effects of these other factors on the dynamics of inflation and unemployment. Yayar and Tekgun (2022) studied the relationship between inflation and unemployment in Turkey and D8 countries. This study concludes that unemployment has negative impact on inflation. The role of macroeconomic stability in influencing the inflation-unemployment dynamics is not addressed properly. In economy of Czech Republic, Krulický et al. (2022) investigated the impact of unemployment on inflation while considering the effects of externals shocks. This study explained that inverse relation exists in short run, but this relation is disrupted by energy prices in long run. Upon investigation of Phillips curve in South Africa, Buthelezi (2023) concluded that in short run, inverse relation exists between inflation and unemployment, confirming the Phillips curve and this relation is weakened by inflation expectations in long run.

Irushad (2023) confirmed the negative impact of unemployment on inflation. These studies have highlighted that in long run, the Phillips curve is weakened by macroeconomic stability, energy prices and inflation expectations. Hedvicakova and Pozdilkova (2023) have explored the role of inflation expectations in shaping Phillips curve in Czech Republic and concluded that inverse relation exists between two variables, but this relationship gets weaken due to macroeconomic factors and inflation expectations. Okeowo (2023) investigated how inflation is affected by unemployment in Nigeria while examining the impacts of unemployment on inflation. This study finds that there is an inverse relation between inflation and unemployment, confirming the Phillips curve in Nigeria; however, one-period lag inflation has a positive relationship with unemployment. This study has not discussed the long-term effects of external shocks. This study provides practical policy suggestions for Nigerian policymakers.

Crump et al. (2024) aimed to explore the Phillips curve in the USA in the presence of pandemics COVID-19. This study shows the impact of unemployment on inflation and reveals that COVID-19 significantly influences the Phillips curve relationship. The study shows an inverse relation between inflation and unemployment, which is dampened due to the COVID pandemic. This relationship was influenced by other factors such as variations in the labour market and inflationary pressures. The effects of global supply shocks are not considered in this study, which might weaken the trade-off of inflation-unemployment. Haschka (2024) analyses the applicability of the Phillips curve in developed countries. This study focuses on recovery phase after an economic crisis. This study finds that the Phillips curve is applicable in the recovery phase, but this relationship weakens during the time of no or zero growth in the 1980s. This study does not fully explore the breakdown of relationships during structural turns in the economy.

Meraj and Shaikh (2024) explored the impacts of unemployment in Pakistan. The author is studying how crude oil prices and nominal exchange rate affect inflation. This study finds that unemployment, nominal exchange rate has negative influence on inflation, validating the Phillips curve in Pakistan, whereas crude oil prices positively affect inflation. This study has not discussed the impact of structural reforms and technological changes. This study provides relevant policy analysis considering external shocks for Pakistan. While considering the domestic and external factors such as inequality, Rolim (2024) examines whether Phillips curve exists in Brazil. This study finds that unemployment has negative impact on inflation and inequality has trade-off with low inflation. However, external factors such as global inflation shocks weaken the relationship over a period of time. Ruhi et al. (2024) investigated trade-off between unemployment and inflation, and they reported an absence of Phillips curve in case of Bangladesh economy.

The research by Vincent et al. (2025) highlighted the direct relation between inflation and unemployment. This contradicts the conventional Phillips curve idea. In another research, Saad et al. (2025) inquired trade-off between unemployment and inflation for Afghan economy. They disclosed direct relation between both indicators and confirmed absence of Phillips curve relation.

Impact of Natural Resource Rent on Inflation: There is no direct study explored which captured the influence of natural resource rent on inflation. The studies capturing the influence of natural resource rent on economic growth and many other macroeconomic indicators but not on inflation. For example, Chen et al. (2023) reported adverse impact of natural resources on economic activities in case of Netherlands while for Portugal economy they confirmed that natural resources boosted economic growth. Besides this, Yu et al. (2024) considered OPEC economies and inquired the role of inflation on usage of resources. Their findings reported negative impact of inflation on resource usage. The present research is going to add value in the literature by addressing this missing link.

Impact of Institutional Quality on Inflation: The literature on quality of regulations to target inflation is also not very rich. The one study conducted by Ali et al. (2023) is witnessed in capturing the interplay between inflation and regulatory policies. They considered developing economies and inquired the determining indicators of inflation. After utilizing panel least square and fixed effect methods, the results suggested that regulatory quality significantly mitigate inflation in the selected economies.

On the basis of the above discussion this research summarises that Kumar and Vashist (2012), Al-Zeaud and Al Hosban (2015), Alper (2017), Alisa (2015), Kasseh (2018), Bokhari (2020), Atgur (2020), Zayed et al. (2020), Krulický et al. (2022), Vermeulen (2022)**,** Liargovas and Psychalis (2022), Yayar and Tekgun (2022)**,** Buthelezi (2023), Hedvicakova and Pozdilkova (2023), Irushad (2023), Okeowo (2023), Rolim (2024), Crump et al. (2024), Meraj and Shaikh (2024), Ruhi et al. (2024), these all studies support the negative impact of unemployment on inflation collectively. While the contribution of Mohammad (2016), Irewole (2019), Orji et al. (2020), Melian (2021) Vincent et al. (2024), Saad et al. (2025) suggested absence of significant impact of unemployment on inflation i.e. the Phillips curve.

Theoretical Framework: Many studies were conducted to estimate the inter-connection between unemployment and inflation i.e. Phillips curve in different economies such as Kumar and Vashist (2012), Al Zeaud and Al Hosban (2015), Alisa (2015), Vermeulen (2017), Kasseh (2018). All these studies have revealed the inverse relation between unemployment and inflation using statistical and econometric analysis. This trade-off is found in other research studies such as Saad et al. (2025), Irewole (2019), Ruhi et al. (2024), Zayed et al. (2020), Okeowo (2023) and Mohammed (2016). A few researchers such as Yayar and Tekgun (2022) have studied this link in D8 countries. Following the evidence of these studies, we would like to investigate the validity of Phillips curve in selected Asian economies. As this trade-off was also inquired in context of Pakistan by Meraj and Shaikh (2024) while the present research investigates it in context of 33 selected Asian Economies. Despite the fact that the Phillips curve has been thoroughly examined, the inverse impact of unemployment on inflation has largely been ignored in favour of influence of natural resource rent and regulatory quality. This oversight may result in an inadequate knowledge in the literature. As natural resource rent and regulatory quality have substantial impact on price stability. Therefore, the present research is aimed to fill this gap by incorporating the role of rent from natural resource, regulatory quality and population density in inquiring the trade-off between inflation and unemployment.

Research Gap: On reviewing 30 studies of Phillips Curve, various key research gaps have been recognized that need further exploration to increase our understanding of Phillips curve. The Conventional Phillips Curve which represents the relationship between inflation and unemployment has been studied a lot by number of researchers. So, there is not much to explore anything new in this basic model. However, how Phillips curve behaves when it's combined with other factors such as regulatory quality, total natural resource rent, and population density. This creates an opportunity for new research and makes it a less-explored region. Lastly, some research has discussed endogeneity concerns, very few studies have used sophisticated econometric approaches address causation resulting in methodological vacuum in the field.

Sample of Study

This study incorporates data of 33 Asian Economies from 1990-2024. The Sample is chosen from 1990-2024 from these economies due to limitation of data availability. The data from 1990-2024 of all variables is taken World Bank (2025), World Development Indicators**.** In order to receive systematic and compatible results, all the variables are taken in the form of natural log which helps in addressing the issues of heteroscedasticity and non-linearity

Model of the Study

The proposed models are as following for obtaining empirical results:

$$\ln GDPDEF = f(\ln UNEMPT, RQ, \ln TNR, \ln POPDEN)$$

METHODOLOGY

The economic systems and policy philosophies of the most polluted nations are usually similar. Additionally, trade agreements, environmental accords and larger frameworks of economic cooperation frequently connect these economies. The CS-ARDL model, created by Chudnik and Pesaran (2015) and Cavalcanti et al. (2015) is used in this investigation due to its interdependence. This methodological technique is especially well-suited to examine both short-run dynamics and long-run equilibria while simultaneously accounting for endogeneity and cross-sectional dependence (CSD). Interdependencies between different countries in the sample may be confirmed by CSD tests developed by Pesaran (2015). The CSD test is followed by SH test developed by Pesaran and Yamagata (2008) to confirm the validity of estimation. The CADF and CIPS are unit root test which are used in the study to address CSD further. Pesaran (2007) proposed these tests. Westerlund (2007) error correction based cointegration tests, which are resistant to both CSD and heterogeneity, are used to investigate cointegration among the variables. These tests reduce the possibility of false regression results and help identify long-term relationships between crucial variables. The SH test is also used in the study to look at variation in slope coefficients among nations. In order to capture the diversity in how various economies react to energy and environmental dynamics, this test is crucial for identifying structural differences in linkages.

CSD Test: Tufail et al. (2022) stresses how important it is to take cross-sectional dependence (CSD) into account when estimating panel data, especially in the age of globalisation, when cross-border economic activity is becoming more interconnected. Neglecting CSD may lead to inaccurate, biased and deceptive results (Westerlund and Edgerton 2007). The CSD test, created by Pesaran (2015), is used to evaluate if the regression model's residuals show correlation across cross-sectional units in order to address this problem.

In order to guarantee the reliability and validity of econometric analysis, this test is necessary. The CSD test statistics are:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left[\sum_{i=1}^{N-1}\sum_{j=i+1}^{N} P\,\mathrm{i.j}\right] => \mathrm{N}(0,1)$$

With CD standing for cross-sectional dependence, t for the time dimension, and n for the number of cross-sectional units, the test statistic quantifies cross-sectional dependency. The average pairwise correlation of residuals across several cross-sections is captured by this term. A greater presence of CSD among the cross-sectional units is indicated by an increase in this value.

Unit Root Test: The method developed by Pesaran (2007) is used in this work to examine the existence of unit roots while taking cross-sectional dependence (CSD) into consideration. The unit root tests are required to examine whether the variables are stationary or not. In particular, while looking for unit roots in panel data, (CADF) test is employed, which is intended to successfully handle CSD and provide more trustworthy results.

$$\Delta Y_{i,t} = \alpha_i + \rho_i Y_{i,t-1} + \delta_i \bar{Y}_{i,t-1} + \sum_{j=0}^{q} \gamma_{ij} \Delta \bar{Y}_{i,t-q} + \sum_{j=1}^{p} \varphi_{ij}\, \Delta Y_{i,t\text{-}p} + \epsilon_{it}$$

Delta $Y_{i,t}$ refers to the first difference term, which displays the cross-sections and time, alpha i shows cross-section particular constant term & ρ_i and δ_i are illustrating the coefficient of dependent variable lagged by one year. The term ρ_i is important because, if it equals unity, the existence of the unit root is verified; if not, the values will show a stationary series., otherwise the values will indicate the stationary series. The δ_i will be used to account for CSD in unit root and provide a common mean of cross-sections. The expression $\sum_{j=0}^{q} \gamma_{ij} \Delta \bar{Y}_{i,\, t\text{-}q}$ the total of the lagged differences between the dependent variable's mean and lag q is represented by t-q in expressions. Similarly, the difference between the lagged terms of the dependent variable with p lag is shown by i,t-p $\sum_{j=0}^{q} \varphi_{ij} \Delta \bar{Y}_{i,t\text{-}p}$. By resolving serial correlation issues in the chaotic term, the use of lagged terms increases test robustness. The addition of lagged terms improves test robustness by addressing serial correlation problems in the unpredictable term. An additional factor in the equation represents the error term for time "t" and cross-section "i". This will capture false noises and shocks. This test outperforms the traditional ADF unit root test since it accounts for CSD. Pesaaran (2007) developed a test that aggregates CADF data for cross-sections which is known as the modified IPS known test for CSD (CIPS), this test looks like this:

$$\text{CIPS (n, t)} = n^{-1} \sum_{i=1}^{n} t_I \text{(n, t)}$$

The term t_i (n, t) characterizes CADF value, which is acquired by t-test for cross-sections i.

Cointegration Testing: The use of heterogeneous estimate methodologies is crucial because of the existence of slope heterogeneity (SH) and cross-sectional dependency (CSD), according to Kao et al. (1999), Larsson (2001), and Pedroni (2001, 2004). The Westerlund (2007) co-integration test, which is used in this work to investigate if there is a long-term equilibrium relationship between the explanatory variables and environmental quality across the chosen sample of nations, successfully addresses these problems. Based on following group mean and panel statistics, the tests are presented below:

$$G_t = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{\hat{\lambda}_i^k}{s.e(\hat{\lambda}_i^k)}\right)$$

$$G_a = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{{}_t\hat{\lambda}_i^k}{\hat{\lambda}_i^k\,(1)}\right) \text{ where } \hat{\lambda}_i^k\,(1) = \frac{\widehat{\omega}_{ui}}{\widehat{\omega}_{yi}}$$

Variance estimators are indicated by the symbols $\widehat{\omega}_{ui}$ *and* $\widehat{\omega}_{yi}$. Group-mean tests are represented by "**Gt**" and "**Ga**," where normalised coefficients adjusted for estimating errors across panel units are aggregated by "Gt." The normalised long-run variance is captured by "Ga," which is used to take into consideration both heteroscedasticity and autocorrelation. The Term $\hat{\lambda}_i^k$ indicates the adjustment towards the long-run equilibrium., which reflects the error correction component. This $s.e(\hat{\lambda}_i^k)$ is a representation of the relevant standard error. The long-run variance unique to cross-section I is indicated by the expression $\hat{\lambda}_i^k\,(1)$. Here, "t" stands for time, and number of CS units are represented by n. Panel co-integration tests are presented after the group test discussion. Co-integration is assessed for the entire panel using the statistics "**Pt**" and "**Pa.**" The error correction coefficients across cross-sections are assumed to be homogeneous in these tests. In particular, the "**Pt**" statistic evaluates the pooled error correction coefficient, whereas the"**Pa**" statistic offers a comparable evaluation that has been modified for the time dimension.

$$P_{t==} \frac{\hat{\lambda}_i^k}{s.e(\hat{\lambda}_i^k)}$$

$$P_a = t\ \hat{\lambda}_i^k$$

CS-ARDL Test: This research uses the sophisticated CS-ARDL technique, which is based on applying the Westerlund (2007) co-integration paradigm to construct long-term partnerships. The analysis adheres to the Chudik and Pesaran (2016) CS-ARDL model, which distinguishes itself from traditional methods by successfully resolving several econometric concerns, including endogeneity, non-stationarity, slope heterogeneity, mixed-order consolidation, cross-sectional dependence and non-stationarity (Wang et al., 2021). The impact of important explanatory variables is estimated using the CS-ARDL technique on carbon emissions, including energy intensity, clean energy, and dirty energy. Chudik and Pesaran (2015) first proposed this strategy, which is especially reliable because of its capacity to account for CSD brought on by frequent shocks that go unnoticed. Generalized form of CS-ARDL is as below

$$Y_{i,t} = \alpha_i + \lambda_i y_{i,t-1} + \delta_i \bar{y}_{t-1} + \sum_{j=0}^{p} \beta_{ij} x_{i,t-j} + \sum_{j=0}^{q} \varphi_{ij} \bar{x}_{i,t-j} + \varepsilon_{it}$$

The dependent variable $Y_{i,t}$, which is described in the generalised CS-ARDL model, α_i is the cross-section-specific intercept that captures national heterogeneity. The coefficient λ_i represents the average impact of the lagged dependent variable across nations and δ_i refers to the lagged dependent variable (autoregressive term). The model also incorporates terms $\sum_{j=0}^{p} \beta_{ij} x_{i,t-j}$ that show the impacts of the explanatory factors in short run on the dependent

variable and the term $\sum_{j=0}^{q} \varphi_{ij} x_{i,t-j}$ show the average impact. Finally, ε_{it} represents the error term that captures unpredictable disturbances for cross-section i and time t.

RESULTS AND DISCUSSION

Table 1: Descriptive Statistics

Variables	Mean	Standard Deviation	Skewness	Kurtosis	Sample Size
LNGDPDEF	3.9916	1.5947	-4.3271	28.6994	1155
LNUNEMPT	1.2989	0.9883	-0.7767	3.5076	1155
LNTNR	0.7189	2.6862	-1.1994	4.1817	1155
RQ	-0.0305	0.7588	0.1886	3.8199	1155
LNPOPDEN	4.8075	1.4663	0.1230	3.6106	1155

Table 1 shows the statistics for each variable used in the estimation process. Variables including the natural log of inflation (lnGDPDEF), natural log of unemployment (lnUNEMPT) and natural log of population density (lnPOPDEN) have mean larger than their standard deviation, which indicates that all these variables are under-dispersed (mean is greater than dispersion). Some variables including the natural log of total natural resource rent (lnTNR) and natural log of Regulatory Quality, have means smaller than their standard deviation, which means that these variables are over-dispersed (meaning that dispersion is greater than mean). Mean is used for comparison among groups, time-periods and regions, mean also helps in interpreting, whereas standard deviation is used to measure how values are spread out from mean value. The lnGDPDEF's mean is (3.9916), indicating underlying pattern towards this value and the location of the majority of data. Similarly, the mean of lnunempt is 1.2989, and the mean of lnpopden is significantly greater at 4.8075.

Table 2: VIF Matrix

Variables	LNUNEMPT	LNTNR	RQ	LNPOPDEN
LNUNEMPT	-			
LNTNR	1.0626	-		
RQ	1.0003	1.0928	-	
LNPOPDEN	1.0143	1.5482	1.0893	-

Table 2 presents the results of VIF. For calculating the degree of inter-connection between variables, Variance Inflation Factor is used. All the VIF values of given variables range from (1.0003 to 1.5482), which are less than 10 suggesting that each variable is not highly connected with each other. Specifically, the VIF values of lnunempt with other variables such as lntnr (log of total natural resource rent), RQ and lnpopden (log of population density) are (1.0626), (1.0003) and (1.0143) respectively, which are less than 10 confirming the absence of multicollinearity. The VIF values of lntnr with other variables such as lnunempt (log of unemployment), RQ and lnpopden (log of population density) are (1.0626), (1.0929) and (1.5482) which are less than 10 eliminating the presence of multi-collinearity. The VIF values of RQ with lnunempt (1.0003), lntnr (1.0928) and lnpopden (1.0893) are less than 10, confirming the absence of multi-collinearity. The Variance Inflation factor in-terms of connection between lnpopden with lnunempt (1.0143), lntnr (1.5482) and RQ (1.0893) are less than 10 which eliminates the chances of presence of multi-collinearity between variables.

Table 3: Unit Root Test

At level				**At 1st Difference**			
Variables	**CIPS***	**CADF**	**p-value**	**Variables**	**CIPS***	**CADF**	**p-value**
Lngdpdef	-1.6310	1.6260	0.8100	Δlngdpdef	-4.1500	4.2100	0.0000
Lnunempt	-1.5840	-1.5050	0.9470	Δlnunempt	-5.2140	-5.2170	0.0000
Lntnr	-2.3070	-2.1560	0.0090	Δlntnr	-5.5530	-5.4270	0.0000
RQ	-2.7810	-2.8950	0.0000	ΔRQ	-6.0850	-6.0850	0.0000
Lnpopden	-1.8730	-1.8730	0.2640	Δlnpopden	-2.5510	-3.3220	0.0000
Critical values are provided at 1, 5 and 10 percent significance level as -2.2300, -2.1100, -2.0500 respectively.							

Table 3 shows the unit root test conducted at two different specifications: at level and at 1st difference. The unit root test is used to determine if a data series is non-stationary and has a unit root. To test whether variable is non-stationary or stationary, Cross-section Augmented Dickey-Fuller test (CADF) and CIPS which is the extension of Im-Pesaran-Shin (IPS) test and both tests are used for panel unit root testing. Upon testing CADF and CIPS, table 3 at level specification shows that variables such as inflation, unemployment, and population density are non-stationary while rent from natural resources and quality of regulation are stationary data series. All these data series turn to be stationary at first difference. The results suggest that panel series consider in this research has mixed order of integration. Besides this, cross-sectional dependence is investigated by conducting two types of tests i.e., Pesaran (2015, 2021) also known as CD test and CDw+ (CDw with power enhancement from Fan et al. (2015). All variables including lngdpdef, lnunempt, RQ, lntnr and lnpopden exhibit statistically significant probability values in case of both tests. This confirms that CSD does exist in the panel data series taken in this research. The results are presented in the table 4

Table 4: Testing for Cross-Sectional Dependence (CSD)

Variables	**CD**	**p-value**	**CDw+**	**p-value**
Lngdpdef	104.0100	0.0000	2678.8900	0.0000
Lnunempt	10.0100	0.0000	1157.0400	0.0000
Lntnr	34.6100	0.0000	1326.7000	0.0000
RQ	2.1700	0.0300	1078.8200	0.0000
Lnpopden	84.2500	0.0000	2828.0300	0.0000

In order to test weak cross-sectional dependence, two types of tests are conducted i.e. Pesaran (2015, 2021) also known as CD test and CDw+ (CDw with power enhancement from Fan et al. (2015). All variables including lngdpdef (0), lnunempt (0), RQ, lntnr (0) and lnpopden (0) exhibit statisitically significant CSD based on values derived from CD tests. But RQ shows relatively low and negative value (-0.03) which indicates that weak cross-sectional dependence. The findings of CDw+ indicate that all the variables exhibit p-values less than 0.05, which indicates the existence of cross-sectional dependence. The values of CD and CDw+ are given in above table 4.

Table 5: Slope Heterogeneity Test

Statistics	**Model 1**
Δ (P. Values)	36.8420 (0.0000)
Δadjusted (P. Values)	40.4750 (0.0000)

Table 5 shows slope heterogeneity test of lngdpdef. The findings of the test indicate the statistics of Δ (36.842) while the adjusted Δ (40.4750) are positive, high and significant probability values. This confirms the slope of model is heterogeneous. Based on these findings, we will proceed with cross-sectional auto-regressive distributed lag model to estimate long and short run coefficients. Table 6 shows the cointegration test of lnGDPDEF model. Keeping in view the z value of Gt, Ga, Pt and Pa, cointegration exists or not can be determined. The Gt (-4.088), Pt (-26.5390) and Pa (-7.155), statistics are all significant which suggests that there is cointegration in given model, whereas Ga (3) statistics is insignificant which accepts the null hypothesis of no cointegration.

Table 6: Westerlund's Cointegration Test

Test Statistics	**Model 1**	
	z-value	**P. Value**
Gt	-4.0880	0.000
Ga	3.0000	0.999
Pt	-26.3590	0.000
Pa	-7.1550	0.000

Table 7: Long- Run Estimates of Inflation Model

	Dependent Variable: dlngdpdef				
Variables		**Coefficient**	**Std. Error**	**z-value**	**Prob.**
lr_lnpopden		-0.2077	1.1212	-0.1900	0.853
lr_lntnr		0.2125	0.1206	1.7600	0.078
lr_lnunempt		-0.2053	0.0791	-2.6000	0.009
RQ		-0.1599	0.0652	-2.4500	0.014
	Diagnostics				
R-Square	0.3300	**CD Statistic**	0.0530	**P-Value**	0.5933
R-Square (MG)	0.9900		**Root MSE**	0.0500	

In table 7, coefficients of long-run for model are reported. The coefficient of lnunempt for model 1 is (-0.2053007). This coefficient suggests that unemployment has inverse long-term impact on Inflation (lngdpdef). This finding shows that 1% increase in unemployment decrease inflation by 0.2053% and vice versa. The standard deviation of lnunempt is (0.0790983) which means that unemployment is stable in the long run estimation and unemployment has low variability. The p-value of lnunempt is (0.009) which shows the significant impact of unemployment on inflation. If unemployment is low, the workers are less available in market. To attract more workers and labour, firms have to offer higher wages and better benefits. Increase in wages lead to increase in production costs, especially in labour intensive industries. Increase in production costs can lead to increase in prices which are passed to consumers from producers. Higher prices of products lead to higher inflation. If unemployment is high, many people are looking for job, so firms face less pressure to increase the wages and due to job insecurity workers accept to work on lower wages. Due to lower wages, production costs remain stable or fall reducing the cost pressures for producers. Due to less cost pressure, firms can either maintain or lower prices. Therefore, higher unemployment leads to lower inflation. The inverse relation between inflation and unemployment is backed by Original Phillips Curve (Phillips, 1958) and Cost-Pull Inflation theory. The original Phillips curve state that there is inverse relation between wages rate and unemployment, whereas Cost-Pull inflation theory states that if the overall prices are increased, it can increase production costs such as increase in prices of raw material and higher wages resulting in inflation. The coefficient of total natural resource rent (lntnr) is (0.2125) which suggests that lntnr has positive effect on inflation. This coefficient suggests that if total natural resource rent is increased by 1% then it will also increase inflation by 0.2125% and vice versa. The standard deviation of lntnr (Total Natural Resource Rent) is (0.1206) which means that lntnr has low variability and is stable in the long run relation.

The p-value of lntnr is (0.0780) confirming the significant relation between total natural resource rent and inflation. Corden & Neary (1982) presented a Dutch Disease theory in which they have stated that when the natural resource rent of an economy rises, they result in increase in country’s foreign exchange earnings, which results in appreciation of currency making non resource exports less competitive. The coefficient of regulatory quality is (-0.1599) which indicates that inverse relation exists between inflation and regulatory quality. The p-value of RQ (0.0140) confirms the significant impact of regulatory quality on inflation. If regulatory quality increases by 1 unit then inflation will decrease by 0.1599% and vice versa. The standard deviation of regulatory quality is (0.0652) which signifies that long term relation is stable and has low variability. Institutional Quality theory and Public choice theory supports the inverse relation between inflation and regulatory equality. Economies with better quality regulations tend to control the money supply and manage inflation expectations to avoid price distortions in economy while theory of public choice states that poor regulatory systems enable rent seeking, fiscal irresponsibility which can result in inflationary pressures. Strong regulations can help to check political influence on monetary policy, which can reduce inflation caused by short-term decisions. Monetarist theory (also known as Friedman’s Rule) states that institutional quality limits the growth of money supply indirectly through better governance and fiscal strictness. The coefficient of lnpopden (log of Population density) is (-0.2077) and p-value (0.8530) identifies the insignificant negative relation in the long run. The standard deviation is (1.1212) which indicates that the relation between inflation and population density is not stable in long run. The value of R-squared is 0.3300, which asserts that about 33% of the variation in inflation is explained by the explanatory variables. The R-squared (Mean Group) value is 0.9900, which means that model fits very successfully and well across individual cross-sections. The value of cross-section dependence statistic is (0.0530), which imply that there is no significant cross-sectional dependence explaining that shocks in one unit do not significantly affect other units. The value of Root MSE is (0.0500) indicating low residual error, supporting the accuracy of model. Neo-Classical Neutrality and Quantity theory (with population) are two theories that support the insignificant relation between inflation and population density. Neo-classical Neutrality explains that population has no long-term effects on inflation.

Table 8: Short-Run Estimation of Inflation Model

Dependent Variable: dlngdpdef				
Variables	**Coefficient**	**Std. Error**	**z-value**	**Prob.**
L2.dlngdpdef	0.0912	0.0585	1.5600	0.1190
dlnunempt	-0.1153	0.0571	-2.0200	0.0440
dRQ	-0.0991	0.0427	-2.3200	0.0200
dlntnr	0.1024	0.0341	3.0100	0.0030
dlnpopden	-0.3019	0.705	-0.4300	0.6680
ecm(t-1)	-0.9088	0.0585	-15.5400	0.0000

The table 8 shows the short run estimation of model 1 i.e., inflation is the function of unemployment, total natural resource rent, regulatory quality and population density. The findings of this model indicate that lagged inflation (L2. lngdpdef) has positive and insignificant effect on inflation statistically. The coefficient of lnunempt (log of unemployment) has significant and negative impact on inflation (-0.1153) in short run. This reveals if unemployment increases by 1% then the inflation will decrease by 0.1153 percent and vice versa. The inverse relation between unemployment and inflation supports Phillips (1958) view about trade-off link between these indicators. The original research also finds that there is inverse relation between wage rate and unemployment. The new Keynesian theory also supports this inverse relation among inflation and unemployment. The coefficient of regulatory quality (-0.0991) also indicates that there exists inverse relation between regulatory quality and inflation. The findings of this study suggest that higher regulatory quality results in lowering inflation. If the regulatory quality is improved then inflation expectations will be stabled resulting in flatter of Phillips curve. Better regulations can help to create predictable and stable businesses environment where firms can plan prices, wages and output. Better regulations help to reduce panic-driven price hikes and helps anchor inflation expectations. The institutional Quality theory states that strong institutions can help in making sound policymaking, rule of law and market stability. This can help to stable macroeconomic conditions such as inflation and unemployment. The total natural resource rent indicates positive relation (0.1024) with inflation, which asserts that if natural resource rent increases by 1%, the inflation will increase by 0.1024 % and vice versa. The Dutch Disease theory by Corden & Neary (1982) explains the positive relation between total natural resource rent and inflation. It states that when natural resources rent increases lead to increase a country's foreign exchange earnings which can lead towards currency appreciation which helps in making non-resource exports less competitive. As a results, domestic prices increase which eventually leads to increase in inflation. The coefficient of lnpopden indicates that insignificant inverse relation exists between inflation and population density in short run. Lastly, error correction term is negative and significant, which means that 90% of the deviation from long-run equilibrium is corrected within single period, exhibiting strong and rapid adjustment dynamics. About 90.88% is the speed of adjustment, indicating that inflation rapidly connects back to its long-run path after shock.

CONCLUSION

The present research conducts a comparative inquiry into the Phillips curve framework in selected 33 Asian Economies. Conventional Phillips curve is taken under consideration in this study. After using Cross-Sectionally Augmented Autoregressive Distributed Lag (CS-ARDL) method over the period from 1990 to 2024, this study confirms the evidence of conventional Phillips curve. Empirical results further disclose that natural resources rent significantly escalate inflation while regulatory quality is found in reducing inflation. The conventional Phillips curve is supported by Rolim (2024), Haschko (2024), Buthelezi (2023) and Hedvicakova and Pozdilkova (2023). More earnings through natural resources rent can lead to escalate aggregate demand and may trigger prices on the one side. The quality of regulations may boost the confidence of investors via which they may increase production. Due to increase in aggregate supply, prices may come down and reduce inflation. The findings further expose that population density has insignificant impact on inflation.

POLICY IMPLICATIONS

This study indicates that unemployment leaves an inverse impact on inflation. By considering the inverse link, this research proposes that natural rate of unemployment may be reduced without triggering inflation. The administrators may conduct national assessment to determine the labour-intensive sectors such as agriculture, construction, and small-scale manufacturing that have minimum price-wage spirals. The government may provide subsidies to the employers upon hiring from unemployed labour and investing in training programs through which skills are improved that helps in non-inflationary industries.

The study also shows that the rent from natural resources has a major positive effect on inflation. The findings suggest that earnings through natural resources may escalate prices in the selected Asian Economies. Therefore, steps may be taken that may increase earnings from natural resources in a greater proportion as compared to increase in inflation.

Another finding of this research is that quality of regulations is helping in reducing inflation. In order to target inflation, quality of regulations may be improved by simplifying the licensing requirements and reducing bureaucratic delays. The step may be taken to enforce competitive market prices in order to avoid monopolistic pricing. It is also proposed that steps may be taken to establish strong accountability in public administration to guarantee better regulatory rules and regulations.

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Annexure: List of Selected Asian Economies

SR. #	Country	GDP Deflator	Unemployment	SR. #	Country	GDP Deflator	Unemployment
1	Armenia	76.3237	12.9224	18	Lebanon	257.0476	9.0072
2	Azerbaijan	149.4048	6.5188	19	Malaysia	79.2106	3.4420
3	Bahrain	83.1731	1.1444	20	Myanmar	65.8076	1.0878
4	Bangladesh	61.4058	3.8253	21	Nepal	85.6206	10.7137
5	Brunei Darussalam	86.9417	6.0401	22	Oman	73.1230	3.7464
6	Cambodia	72.7461	0.6535	23	Pakistan	67.4535	1.9993
7	China	69.8894	4.0694	24	Philippines	71.5927	3.3571
8	Georgia	59.5208	13.0759	25	Qatar	75.9251	0.5402
9	India	85.1961	7.2932	26	Russian Federation	59.7133	6.9246
10	Indonesia	78.0950	5.0121	27	Saudi Arabia	59.3894	5.7204
11	Iran, Islamic Rep.	130.8584	10.9843	28	Singapore	94.2553	3.9629
12	Japan	103.5301	3.6540	29	Sri Lanka	71.0894	7.3234
13	Jordon	69.6637	15.4341	30	Thailand	118.7255	1.2787
14	Kazakhstan	223.3320	6.9471	31	Türkiye	191.6977	9.8064
15	Korea, Rep.	83.5470	3.3243	32	United Arab Emirates	76.6910	2.4051
16	Kuwait	80.2843	1.6358	33	Viet Nam	82.4718	1.8869
17	Kyrgyz Republic	53.5834	2.6343				