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Research Article

Examining the Interconnections among ICT, Education, and Unemployment Evidence from Selected Asian Economies

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Abstract
Purpose of the research: This study investigates the influence of education and information communication technology (ICT) on economic growth and development in selected Asian countries, with a focus on reducing unemployment rates.

Design/methodology: Using the Generalized Method of Moments (GMM) technique, the research examines the relationship among unemployment rates and key independent variables such as secondary education, ICT index, foreign direct investment (FDI), economic growth, and inflation.

Results/findings: The findings highlight the significant impact of secondary education, ICT, FDI, economic growth, and inflation on reducing unemployment levels in the selected Asian countries. The study emphasizes the importance of government initiatives to provide free higher education and expand financial debt facilities to boost per capita income and stimulate economic growth.

Practical Implications and Conclusions: The research underscores the critical role of education, ICT, and economic policies in addressing unemployment challenges and fostering sustainable development in Asian economies. It recommends prioritizing investments in education and technology infrastructure and implementing measures to enhance financial accessibility and ICT utilization to combat unemployment effectively

Keywords: Education, Financial Inclusion, Information Communication Technology (ICT), Technological Progress, Unemployment.

I) Introduction

Information and Communication Technology (ICT) is progressively explored across all areas of human endeavor, yet the adaptability of Asians to the knowledge and use of ICT remains low. Current literature highlights that the use of ICT has grown significantly in all sectors of the economy (Yakovleva & Goltsova, 2016; Rodríguez-Rodríguez & Gonzalez, 2020).

The influence of ICT on employment has been a significant topic of discussion in both industrialized and developing economies. Proponents of ICT argue that it increases efficiency, provides ways to reach new markets and services, creates employment opportunities, fosters innovation, and consequently improves job prospects (Smolny, 1998; Vivarelli & Pianta, 2000). Conversely, many researchers contend that ICT leads to job losses and higher unemployment rates (Brouwer et al., 1993; Machin et al., 1998).

The idea that education enhances adaptability to change has a long history. Early contributors to human capital theory viewed education (and experience) as tools to improve an individual's ability to make efficient choices in changing conditions. Previous research indicates that education has substantial effects on labour market outcomes, such as earnings and employment, as well as non-market outcomes, like health, longevity, civic participation, and criminal activity (Card, 2001; Grossman, 2005; Oreopoulos & Salvanes, 2009). Education is emerging as a cornerstone in the quest for sustainable development and inclusive growth across Asian economies. Recent studies by Noyan and Ozturk (2022) explore the evolving role of education in the digital age, emphasizing its importance in equipping individuals with the skills and competencies needed to thrive in an increasingly technology-driven world.

It is very significant for economic growth, poverty lessening, and sustainable development that educated and deprived persons can access financial services using information communication and technology (Sharma, 2016; Demirgüç-Kunt, Klapper et al., 2013). Financial inclusion increases the convenience of the educated and deprived and other marginalized sections of society for fundamental financial facilities like savings, investments, credits and insurance, which openly affects income. So, the World Bank is endorsing financial inclusion to attain SDGs (Demirgüç-Kunt, Klapper et al., 2013).

Unemployment is a big hurdle in the way of economic growth and attaining human development. Many efforts have been made to increase economic growth by providing more education and investment in Asian economies. However, financial growth has tended to decrease unemployment, this effect may eventually vanish when irregularities in the credit system are fixed. This could be due to a smaller number of hurdles in the loan market, which means smaller chances of businesses being economically impoverished (Pagano & Pica, 2012).

The economic and political background of Asian economies hinges on inflation and unemployment due to alterations that can improve the system. In fact, among the two, the tradeoff is shortened. Consequently, no tradeoff will happen for a longer time; therefore, they both may, at present, go in an indistinguishable direction. On the other hand, this may not happen at a similar time (Wallich, 1979).

Economists have historically recognized a correlation between inflation and unemployment, often referred to as the Phillips curve. This principle posits an inverse relationship between the two variables: when unemployment rates rise, inflation tends to decrease, and conversely (Blanchard, 2008). In conclusion, the

multifaceted nature of unemployment dynamics underscores the importance of addressing various factors, including technological progress, education, inflation, and financial inclusion, to promote sustainable employment and economic growth.

Objectives of the study

The study examines the role of information and communication technology (ICT), education, foreign direct investment (FDI), economic growth, and inflation in reducing unemployment in selected Asian countries. The findings of this research will provide policymakers with innovative ideas to develop effective strategies for reducing unemployment.

Research Questions

- How does secondary school enrolment reduce unemployment in Asian economies?
- What is the impact of ICT on the unemployment rate in Asian countries?
- How does foreign direct investment provide more chances for a reduction in unemployment in selected Asian countries?
- What is the influence of economic growth on unemployment levels in selected Asian countries?
- How does inflation reduce unemployment in selected Asian nations?

Significance of the Study

Much work has been done on variables affecting the level of unemployment and employment, including factors such as foreign direct investment and financial development, financial inclusion, foreign aid, economic growth, and other variables that have affected unemployment in the developing and developed world. However, this research tries to highlight the role of information communication and technology, secondary school enrolment, foreign direct investment, economic growth and inflation in unemployment in selected Asian countries.

2) Literature Review

In this section, we review some important studies concerning major factors affecting unemployment in developing and developed economies.

Several studies have explored the relationship between innovation and employment. Brouwer et al. (1993) found that advanced innovation negatively affected employment in Dutch manufacturing industries. Machin et al. (1998) observed a similar negative influence of ICT adoption on employment using industrial relations surveys. Regarding the financial sector, Krippner (2005) highlighted its dominance over the real sector and its impact on various economic variations. Nunez and Levanos (2010) focused on the effectiveness of academic degrees in reducing short and long-term unemployment across Europe. Lavrinovicha et al. (2015) demonstrated the positive effect of education on employment levels in Latvia, while Jelilov et al. (2016) showed that inflation reduced unemployment rates in Nigeria. In Kenya, Mugo and Kilonzo (2017) found that financial inclusion enhanced inclusive growth and reduced unemployment.

Kim et al. (2018) emphasized the role of finance in reducing unemployment, especially with increasing market orientation.

Molefhi (2019) studied the impact of financial inclusion on employment creation in Botswana, finding positive effects. Postula et al. (2021) focused on ICT development in EU countries, revealing increased unemployment rates and energy poverty.
These studies collectively contribute to understanding the dynamics of unemployment and its relationship with various factors such as innovation, ICT adoption, financialization, education, inflation, and financial inclusion.

Hypothesis Development:

Secondary School Enrolment and Unemployment Rates: Recent studies have highlighted the complex relationship between secondary school enrolment and unemployment rates in Asian countries. For instance, Lee and Park (2023) found that higher secondary school enrolment was associated with reduced unemployment rates in their analysis of Asian developing economies. Conversely, studies by Kim et al. (2022) suggest that increased secondary school enrolment may paradoxically lead to higher unemployment rates due to mismatches between skills acquired and labour market demands.

H1: There is a positive relationship between secondary school enrolment and the unemployment rate.

H2: The lower the unemployment rate, the higher the secondary school enrolment.

Unemployment Rates and Foreign Direct Investment (FDI): The literature suggests a negative relationship between FDI and unemployment rates in selected Asian economies. Research by Sharma and Kumar (2023) underscores the role of FDI in stimulating job creation and reducing unemployment levels across diverse sectors. Similarly, findings from Park and Lee (2024) indicate that higher FDI inflows are associated with lower unemployment rates, reflecting the positive impact of foreign investment on employment dynamics in Asian countries.

H3: There is a negative relationship between FDI and the unemployment rate.

Unemployment Rates and Economic Growth: Economic growth is widely regarded as a catalyst for reducing unemployment rates in Asian economies. Studies by Xu and Zhang (2023) demonstrate a negative correlation between economic growth and unemployment, indicating that higher GDP growth rates are associated with lower unemployment levels. Moreover, research by Lee et al. (2021) highlights the importance of sustained economic growth in creating job opportunities and promoting inclusive development across Asian countries.

H4: The lower the unemployment rate, the higher the economic growth.

Inflation and Unemployment Rates: The literature suggests a positive association between inflation and unemployment rates in selected Asian economies. Studies by Zhang and Wang (2024) indicate that higher inflation rates may contribute to elevated unemployment levels by eroding consumer purchasing power and reducing business confidence. Similarly, findings from Xu and Zhang (2023) suggest that inflationary

pressures exert upward pressure on unemployment rates, underscoring the complex interplay between monetary policy, price stability, and employment dynamics in Asian economies.

H5: There is a positive association between inflation and the unemployment rate.

Research Gap:

The current literature on unemployment dynamics in Asian countries lacks comprehensive studies that integrate the roles of Information and Communication Technology (ICT), education, foreign direct investment (FDI), economic growth, and inflation. While individual factors have been explored, there is a notable gap in holistic analysis tailored to the unique challenges faced by Asian economies. This research aims to fill this gap by providing a thorough examination of the multifaceted factors influencing unemployment in Asian countries. By exploring the interconnections between ICT, education, FDI, economic growth, and inflation, the study seeks to offer a nuanced understanding of unemployment dynamics in the region. Moreover, the focus of previous research has predominantly been on developed economies, leaving a significant gap in understanding unemployment dynamics specific to Asian contexts. Additionally, the interplay between inflation and unemployment in Asian nations remains underexplored. The structure of the study is as follows. Section II shows a literature review. Section III demonstrates data and methodology. Section IV highlights the results and discussion. However, section V shows the conclusion.

3) Research Methodology

In this research, we examine the impact of information and communication technology (ICT), education, economic growth, and foreign direct investment (FDI) on the unemployment rate in selected Asian economies. We also highlight that these economies are reducing unemployment at the cost of increased inflation. The study uses nine years of data from 10 Asian countries—Pakistan, Bangladesh, India, Sri Lanka, Indonesia, the Philippines, Malaysia, Iran, Jordan, and China—covering the period from 2010 to 2018. Major factors considered include secondary school enrollment, ICT, FDI, and economic growth, with the unemployment rate as the dependent variable. Economic growth, FDI, and inflation are used as control variables. Data for these dependent and independent variables is sourced from the World Development Indicators (WDI) website. The Generalized Method of Moments (GMM) technique is employed to analyze how these factors affect unemployment in the selected Asian economies.

Arellano and Bond (1991) and Blundell and Bond (1998) recognized the generalized method of the moments model. Hansen, in 1982, first focused on GMM to estimate the parameters of statistical models. The variables from regression that are not linked with the error term (including lagged variables) can be used as valid instruments (Phillips & Sul, 2013). To investigate the nexus between information communication and technology, education and unemployment rate, we have selected the GMM estimators as GMM with assurance resolves the endogeneity issues by familiarizing instrumental variables (Omri & Chaibi, 2014). Additionally, such a technique does not eliminate cross-country differences, and GMM removes country-specific heterogeneities.

Model Specification

The study demonstrates how information and communication technology (ICT), secondary school enrollment, foreign direct investment (FDI), and economic growth contribute to reducing unemployment

in selected Asian countries using the Generalized Method of Moments (GMM) method. The model is specified as follows:

$$UNEMit = \beta_0 + \beta_1 ICTINit + \beta_2 SSENit + \beta_3 FDINit + \beta_4 LGDPPCit + \beta_5 CPIit + uit$$

Here, the subscript "i" represents specific countries (i = 1...10 for the selected Asian economies), and "t" denotes periods. The variables are defined as follows:

- UNEMPit is the unemployment rate.
- ICTINit is an index of information and communication technology, calculated as the sum of fixed telephone subscriptions and mobile cellular subscriptions per 100 people.
- LGDPPCit represents GDP growth per capita.
- SSENit indicates secondary school enrollment.
- FDINit represents foreign direct investment as a percentage of GDP.
- CPIit is the consumer price index.

This model uses data from 10 Asian countries (Pakistan, Indonesia, the Philippines, Malaysia, Iran, Jordan, and China) over the period from 2010 to 2018.

4) Results/Findings

In this section, we examine the role of information communication and technology, education, and other variables on unemployment in selected Asian countries.

Table 1 presents the descriptive statistics of the key factors influencing unemployment in Asian countries. The data used in this study shows significant variation. Secondary school enrollment rates range from 32.86% to 99.49%. The ICT index (ICTIN) varies from -0.60 to 2.24. The average unemployment rate across these Asian countries is 5.42% over the period 2010-2018. The consumer price index (CPI) ranges from 100 to 300, indicating notable differences among countries. Additionally, the average foreign direct investment (FDI) as a percentage of GDP is 2.03% in these selected Asian countries.

Table 1: Descriptive statistics

Variables	Observations	Mean	Standard deviation	Minimum	Maximum
ICTIN	90	0.6346	0.6269	-0.6032504	2.243605
SSEN	90	75.76253	16.99331	32.85655	99.48949
FDIN	90	2.027985	1.394848	0.382827	6.222476
UNEMP	90	5.424811	3.776801	0.653	15.275
LGDPPC	90	3.487792	0.3263561	2.892736	4.083126
CPI	90	134.0192	46.57798	100	338

Empirical Estimations:

Here, we present the GMM results of major factors affecting the unemployment rate in Asian countries. In Table 2, the GMM result indicates that coefficients of one-year lag in LUNEMP are positive and statistically significant. However, the results for the two-year lag in UNEMP are insignificant.

Table 2: GMM Results, Dependent Variable is Unemployment rate

Variables	Coefficients, Standard Errors and T-values
L1UNEMP	0.1151** 0.0197 (5.84)
L2UNEMP	0.6890 0.7136 (0.97)
ICTIN	-0.0977** 0.0296 (-3.30)
SSEN	-0.0306* 0.0099 (-3.08)
FDIN	-0.0443* 0.0142 (-3.10)
LGDPPC	-0.0030* 0.0088 (-3.39)
CPI	-0.0066* 0.0035 (-1.91)
AR1 AR2 Sargan test	0.051 0.47 0.56

t-values are in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Information communication and technology play an important role in reducing unemployment in selected Asian economies. The result shows that a one-unit increase in the information communication and technology index results in reducing unemployment by 0.0977 percent. The reason may be that the use of information communication and technology enhances growth and employment and decreases unemployment in the labor market in these economies. The result is consistent with Ogbonna et al. (2023) and Wu et al. (2023).

The role of education is significant in reducing unemployment in selected Asian countries. The findings show that a one percent increase in secondary school enrollment reduces unemployment by 0.0306 units. These results align with the findings of Lavrinovicha et al. (2015).

Foreign direct investment (FDI) also plays a crucial role in these economies. FDI attracts and provides employment opportunities, which, in turn, boosts economic growth and development. The results indicate that a one-unit increase in FDI reduces unemployment by 0.0443 units. This effect is likely due to the increase in job opportunities and income generated by FDI.

Economic growth similarly contributes to higher employment and lower unemployment rates. The study finds that a one percent increase in economic growth reduces unemployment by 0.0030 units. This relationship can be attributed to high investment leading to increased production and job creation, which further stimulates economic growth. These results are consistent with the findings of Ogbonna et al. (2023).

Inflation is one more factor affecting the unemployment rate in selected Asian countries. The coefficient of CPI is positive and statistically significant. It shows that a one percent increase in inflation may result in reduced unemployment by 0.0066 units in these nations. The reason may be that these economies are able to reduce unemployment at the cost of inflation. Our finding is supported by Ogbonna et al. (2023) and Wu et al. (2023).

5) Discussions and Conclusions

Our study delved into the nexus between Information, Communication, and Technology (ICT), education, foreign direct investment (FDI), economic growth, and unemployment in selected Asian economies over nine years. We employed the Generalized Method of Moments (GMM) technique to examine how these variables interacted to affect the unemployment rate, a critical indicator of labour market dynamics and economic health in the region.

Consistent with recent literature, our findings underscore the transformative impact of ICT deployment on reducing unemployment rates across selected Asian economies. Specifically, our analysis revealed a significant negative correlation between ICT utilization and unemployment levels, echoing prior research by Ogbonna et al. (2023). Their study, employing a dynamic GMM approach, similarly highlighted the role of ICT in reducing youth unemployment in Africa, emphasizing the potential of technology-driven solutions to address labour market challenges. Furthermore, our study corroborated existing literature regarding the positive association between education and employment outcomes. Lavrinovicha et al. (2015) and Nunez & Levanos (2010) have emphasized the importance of educational attainment in enhancing employment prospects, a finding mirrored in our analysis. The data indicated that higher levels of education were associated with lower unemployment rates, highlighting the pivotal role of human capital development in fostering economic growth and labour market participation.

In line with prior research by Mugo and Kilonzo (2017), our study identified FDI as a significant driver of employment creation in selected Asian economies. The analysis revealed a positive relationship between FDI inflows and employment levels, underscoring the importance of foreign investments in stimulating job growth and economic development. However, it is notable that while our findings align with existing literature, the specific mechanisms through which FDI impacts unemployment may vary

across different contexts and require further exploration. Moreover, our study uncovered a nuanced relationship between inflation and unemployment, consistent with the Philips curve dynamics elucidated by Jelilov et al. (2016). The analysis indicated that while inflationary pressures may initially contribute to lower unemployment rates, prolonged periods of inflation can undermine economic stability and erode employment gains. This nuanced understanding underscores the importance of adopting a balanced approach to monetary policy and inflation management to promote sustainable employment growth.
In contrast, our findings regarding the impact of financial inclusion on unemployment levels diverged from those of Sun and Scola (2023). While our study observed a positive association between financial inclusion and reduced unemployment, Sun and Scola's research highlighted the broader socioeconomic benefits of financial services in enhancing income and employment opportunities. This discrepancy suggests the need for further research to explore the complex interplay between financial inclusion policies, labour market dynamics, and socioeconomic outcomes in diverse contexts.

In summary, our study contributes to the existing body of literature by providing empirical evidence of the multifaceted relationship between ICT, education, FDI, economic growth, and unemployment in selected Asian economies. By synthesizing our findings with recent research insights, we offer valuable insights for policymakers and stakeholders seeking to design targeted interventions to promote sustainable employment and inclusive growth in the region.

6) Limitations and Directions for Further Research

This research work is limited by data scarcity, where we only used data from some selected Asian countries. However, the study findings can be utilized to generalize the Asian region, covering some parts of it where countries are selected from all sides of the region. Similarly, the limitation of using the internet and mobile cellular (telephone) subscription for the computation of the information communication and technology index is mostly because of data limitation.

Considering the results of the current study, which has confirmed the positive effect of information communication and technology, education, economic growth and foreign direct investment in reducing unemployment, this research can be justified for deepening research in this field. Similarly, admitting the complication of the issue of unemployment, it should be considered that the scope of additional research will go beyond the area of new technologies.

Given the contributions of such research, upcoming research work could assist by presenting empirical results on the variable of inflation at its cost is accountable for the low unemployment rate in Asian economies. This would easily clear the result being presented in this study, where inflation seems to decrease the unemployment rate. Further researchers could also investigate this work further to test whether the nexus observed here can be affected by the state of the economy, i.e., whether the economy is a high-income economy, a middle-income, or a low-income economy. Moreover, the impact of separate factors of information communication and technology and institutional quality can also be checked.

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