Forecasting Employment Rate in Service Sectors in Bangladesh: An Application of Autoregressive Integrated Moving Average Model

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Abstract-

- ***Background/ Objectives:***

The employment growth rate reflects the socioeconomic development of a country. The service sector is an integral part of the economy in all countries. Service sectors are the top rising sectors in Bangladesh. Specially provides employments, inputs, and public services for the economy. A forecast of employment rate in service sectors can help the implementation of policies, strategies, and budgets to encourage entrepreneurs of service sectors within the target range. The famous forecasting method namely the ARIMA or autoregressive integrated moving average model applied in this study.

- ***Methods/ Statistical analysis:***

The purpose of the study is to forecast the employment growth rate in the service sectors (2019–2028). Secondary data analysis and forecast model are done for the available year and employment data extracted from WDI, world bank database, and Bangladesh Labor Bureau website and it has been collected over 28 years. We applied ADF, PP, and KPSS tests to investigate the stationary character of the data. Stata and R studio software was applied to build a structure of the ARIMA method to model and forecast the employment growth rates.

- ***Findings:***

In this study, the employment of Bangladesh from 1991 to 2018 is modeled using ARIMA (P, I, Q) methodology. The forecast of the sample period (1991–2018) showed accuracy by the selected the best two ARIMA (0, 2, 0) and ARIMA (1, 1, 0) model. The model and results were validated by the lowest values of AIC and BIC, fewer P-values, graphical arrangements of ACF, and PACF plots. Both of the post sample forecasts with ARIMA (0, 2, and 0) and (1, 1, 0) showed an increasing trend of (2019–2028) employment growth rate in service sectors. If the increasing trend persists, according to ARIMA (0.2.0) the forecast employment rate for 2028 is 43.33% in the service sectors. On the other hand, the employment growth rate in service sectors of Bangladesh would be approximately 47.28% in 2028, based on another ARIMA (1, 1, and 0). Statistical outcomes illustrate that Bangladesh's employment growth rate in service sectors is an increasing trend that will continue growing in the future.

- ***Improvements/Applications:***

These findings will help policymakers, researchers, and academicians to formulate employment-related strategies and policies more precisely.

Indexed Terms- Forecasting, ARIMA, employment growth rate, National Labor Policy

I. INTRODUCTION

The service sectors are important components of any nation's economy. It contributes direct and significant inputs to the national economy and provides crucial job creation for the rest of the economy. Some service sectors such as education, health, ICT, tourism, electricity, water, and sanitation sectors, are also directly relevant to achieving socio-economic development goals. Bangladesh recognizes the importance of promoting growth in services sectors and provides several incentives in wide diversity of sectors such as health care, banking, tourism, communications, transportation, education, health, information technology, share market, finance, engineering, internet, management, among others. Service sector provides micro and macro-finance, marketing, transport, insurance for the development of

the agricultural and industrial sectors. So the growth of service-related sectors activities boosts the other secondary sectors as well. On the other hand, the service sector can play a major role in reducing inequalities in the distribution of income in the economy. At present, there is widespread consensus among academicians, scholars, and policymakers that budgets in human capital confer benefits to citizens. The probability is high if people are better educated and skilled, and receive on average higher income, and are subject to a lesser risk of unemployment (OECD, 1998). Also, other external benefits from education accumulate in the forms of personal growth, monetary issues, social cohesion, consciousness, empowerment, and lower crime. Also skilled and educated laborers are necessary for every country. In the service sectors, skilled labor are very required and optimal. The paper aims to show how much percentage of labor will be required in the upcoming years. That will help to estimate not only forecasting service sectors also other sectors. When we can be able to forecast service sectors we also can assume the growth of other sectors. According to the famous economists like S. Kuznets, C. Clark, and others, the development and growth of any country depend on the progress of service sectors. Service sectors provide a better lifestyle and quality of living when communication, internet, banking, tourism, and other sectors are organized.

II. LITERATURE REVIEW

This paper's literature spotlights on forecasting the growth of employment in various sectors. However, we found fewer efforts to forecast employment in services (% of total employment) in the Bangladesh context in addition to the other countries. Therefore, the authors of the paper reviewed the studies related to employment forecasting in various sectors. Chau (1970) applied an econometric model to create short-run forecasts on Hawaii people's income and employment. He applied popular multiple regression models for forecasting and concluded that the forecasting ability of the model is quite accurate in employment forecasting. Paquet et al (2006) Applied a semi-log model and examined the past and future behavior of the employment rate of both genders in Canada. Vitartas and Ford (2008) forecasted employment demand in the local area, Australia using logistic regression. In their findings, the forecasting capacity of the model was below the expectation. Raoufinia (2016) used VAR models to forecast Swedish employment growth. Up to a certain point, the findings of the study were satisfactory in short-term forecasting. Chang and Sung (2010) forecasted employment in various industries for a resourceful economy in Georgia. They developed the Bayesian vector autoregressive models for their research purpose. Their findings showed that fitted models execute well in the long-run. Barnow (2002) and Sexton (2002) contributions showed that their forecasts have valid, useful, and applicable information on labor market trends.

III. MODEL SPECIFICATION

A stationary time series helps to keep away from unauthentic regression (Yule, 1926; Granger and Newbold, 1974). Numerous tests have been applied for testing stationarity, the most famous one is the unit root test. Unit root test helps to test stationarity or non-stationarity also it has become widely popular over the past several years. In the following regression model, we can run to distinguish a unit root.

$$\Delta Y_t = b_0 + \sum_{j-1}^{k} bj\Delta Yt - j + \beta_t + \gamma Y_{t-1}\, u_t$$

If a time trend is unnecessary this model can run without t. If the unit root is absent, Y does not correlate with Y_{t-1} also differencing Y show a white-noise series in the output. The ADF and PP test of the null hypothesis of no unit root tests. So, H_o: $\beta=\gamma=0$ if the is a trend (we apply F-test) and Ho: $\gamma=0$ if there trend is absent (t-test is utilized). When the null hypothesis is accepted, it is assumed that there is a unit root and we need to one or more differenced data before running a regression. When the null hypothesis is discarded, it is proved that the data are stationary and we do not need differencing (Salvatore & Reagle, 2002).

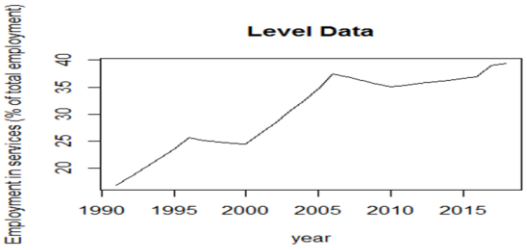
The ARIMA model is a popular model that incorporates the autoregressive and the moving average option (Dobre & Alexandru, 2008). The Box-Jenkins (BJ) methodology is the pioneer in this context, theoretically, it is popular as the ARIMA model (Gujarati, 2003). Unlike the regression models, in which Y_t is explained by several regressors X_1, X_2. . . X_k, the BJ-type time series models allow Y_t to be explained by previous data, or lagged values of Y itself

and stochastic error terms. For this reason, sometimes ARIMA Models are theoretic popular models. Overall, the Box-Jenkins or ARIMA (p,i,q) model is a combination of the AR, differencing, and MA model as follows;

$y_t = a_0 + a_1 y_{t-1} a_2 y_{t-2} + \ldots \ldots + a_p y_{t-p} - b_2 u_{t-2} - \ldots \ldots - b_q u_{t-q} + u_t$

Differencing non-stationary series one or more times to achieve stationary position this process is recommended by Box and Jenkins. So introduces a popular ARIMA model, with the 'I' positioning for 'Integrated'. But its first difference $\Delta Y_t = Y_t - Y_{t-1} = u_t$ is stationary, so y is 'first-order integrated' or y~I(1). Three necessary primary stages are required to construct an ARIMA time series model; they are model identification, estimation, and validation.

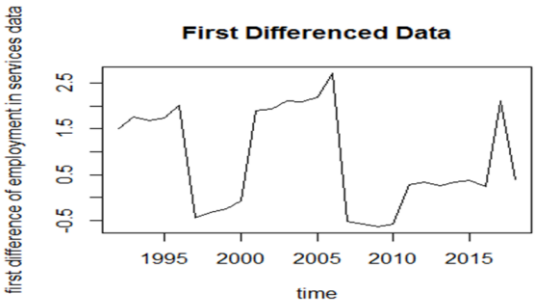
Figure 1. The employment in the service sector in Bangladesh



(Source: Authors' estimation)

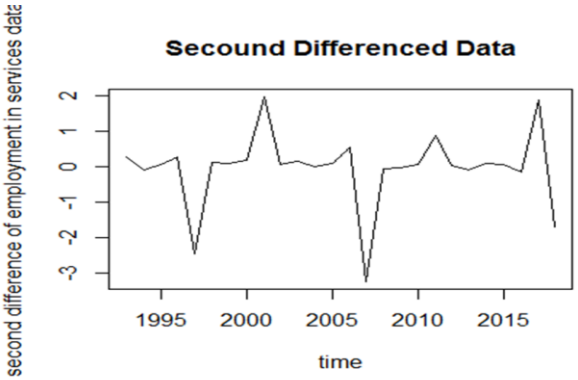
Figure 1 shows the total employment size in Bangladesh over 28 years from 1991 to 2018. The figure was given as the value of the millions of employment.

Figure 2. First Differences Employment Growth Rates in Bangladesh



(Source: Authors' estimation)

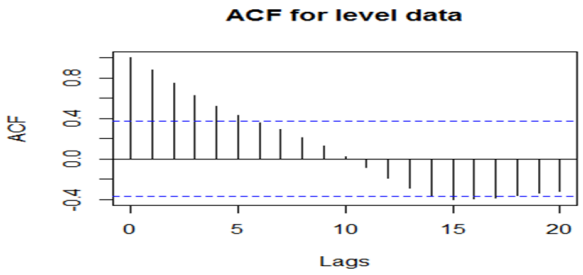
Figure 3. First Differences Employment Growth Rates in Bangladesh



(Source: Authors' estimation)

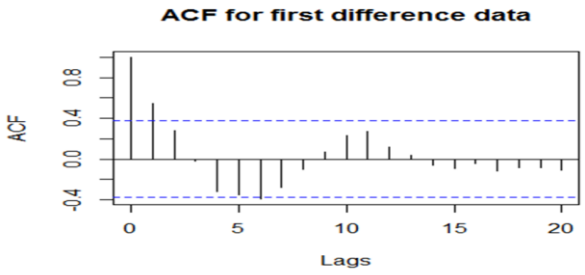
The above figure 1-3 shows that, various presentations of Employment in services (% of total employment) data. Figure 1 shows the level of data. On the other hand, figures 2 and 3 represent the first and second differences of data over time.

Figure 4. First Differences Employment Growth Rates in Bangladesh



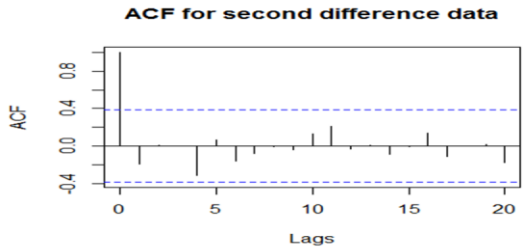
(Source: Authors' estimation)

Figure 5. First Differences Employment Growth Rates in Bangladesh



(Source: Author's estimation)

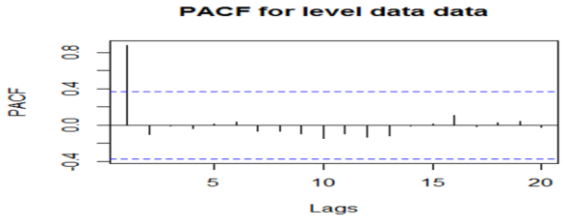
Figure 6. First Differences Employment Growth Rates in Bangladesh



(Source: Author's estimation)

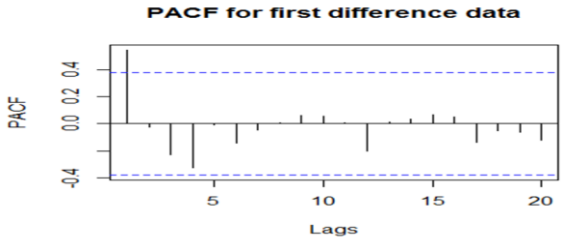
The above figure 4-6 show the autocorrelation function representation of employment in services (% of total employment) data.

Figure 7. First Differences Employment Growth Rates in Bangladesh



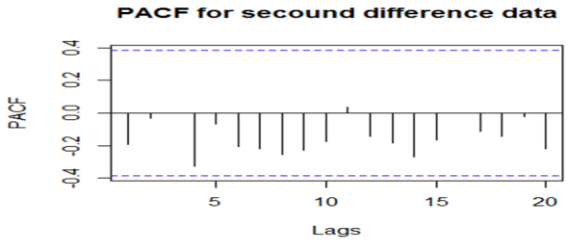
(Source: Author's estimation)

Figure 8. First Differences Employment Growth Rates in Bangladesh



(Source: Author's estimation)

Figure 9. First Differences Employment Growth Rates in Bangladesh



Source: Author's estimation

The above figure 4-6 show the PACF representation of employment in services (% of total employment) data.

Finding the best model applying ADF Test

ARIMA (2, 2, 2) : Inf
ARIMA (0, 2, 0) : 77.88928
ARIMA (1, 2, 0) : 78.83811
ARIMA (0, 2, 1) : 78.82894
ARIMA (1, 2, 1) : Inf

Best model: ARIMA (0, 2, 0)

Series: Employment in services (% of total employment) data
sigma^2 estimated as 1.084: log likelihood=-37.94
AIC=77.89 AICc=78.06 BIC=79.15

Training set error measures:

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	-0.04006289	1.00343	0.5214601	-0.08829744	1.652348	0.4797242	-0.1917889

Finding the best model applying PP Test:

ARIMA (2, 2, 2) : Inf
ARIMA (0, 2, 0) : 77.88928
ARIMA (1, 2, 0) : 78.83811
ARIMA (0, 2, 1) : 78.82894
ARIMA (1, 2, 1) : Inf

Best model: ARIMA (0, 2, 0)

sigma^2 estimated as 1.084: log likelihood=-37.94
AIC=77.89 AICc=78.06 BIC=79.15

Training set error measures:

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	-0.04006289	1.00343	0.5214601	-0.08829744	1.652348	0.4797242	-0.1917889

Jarque Bera Test

data: fit2$residuals
X-squared = 19.921, df = 2, p-value = 4.724e-05

Box-Ljung test

data: fit2$residuals
X-squared = 7.0585, df = 10, p-value = 0.7199

Finding the best model applying KPSS test:

ARIMA (2, 1, 2) with drift : 79.4252
ARIMA (0, 1, 0) with drift : 84.91659
ARIMA (1, 1, 0) with drift : 77.53664
ARIMA (0, 1, 1) with drift : 79.32055
ARIMA (0, 1, 0) : 95.44942
ARIMA (2, 1, 0) with drift : 79.50619
ARIMA (1, 1, 1) with drift : 79.51969
ARIMA (2, 1, 1) with drift : 81.53652
ARIMA (1, 1, 0) : 78.97231

Best model: ARIMA (1, 1, 0) with drift

Series: Employment in services (% of total employment)

Coefficients:

	ar1	drift
	0.5360	0.8415
s.e.	0.1572	0.3601

sigma^2 estimated as 0.8834: log likelihood=-35.77
AIC=77.54 AICc=78.58 BIC=81.42

Training set error measures:

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	-0.01582008	0.8881307	0.6986438	0.07681965	2.313213	0.6427268	0.03267396

Jarque Bera Test

data: fit3$residuals
X-squared = 1.8469, df = 2, p-value = 0.3971

Box-Ljung test

data: fit3$residuals
X-squared = 8.1917, df = 10, p-value = 0.6101

We got the best two ARIMA models from ADF, PP, and KPSS test. The ADF and PP test shows that ARIMA (0, 2, 0) is the best model, on the other hand, the KPSS test shows that ARIMA (1, 1, 0) is the best model. We consider both models in this paper.

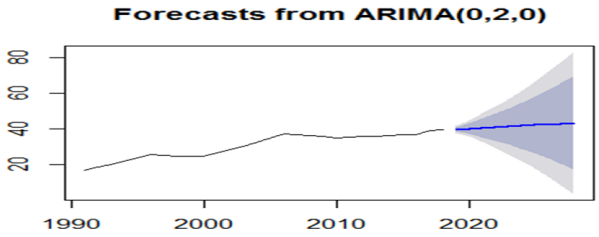
Table 1. Point forecasting for the next 10 years using ARIMA (0, 2, and 0)

Year	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2019	39.77	38.44	41.11	37.73	41.82
2020	40.19	37.18	43.15	35.60	44.73
2021	40.56	35.57	45.56	32.93	48.20
2022	40.96	33.65	48.27	29.78	52.14
2023	41.35	31.46	51.25	26.22	56.49
2024	41.75	29.01	54.48	22.28	61.22
2025	42.14	26.35	57.93	18.00	66.29
2026	42.54	23.48	61.60	13.39	71.69
2027	42.93	20.41	65.46	8.48	77.39
2028	43.33	17.14	69.51	3.28	83.38

Source: Author's estimation

Table 1 shows the point forecasting from ARIMA (0, 2, 0) based on ADF and PP tests.

Figure 10. Employment growth rate forecasting for 10 years



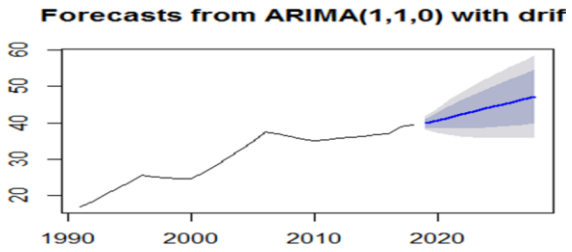
Source: Author's estimation

Table 2. Point forecasting for the next 10 years using ARIMA (1, 1, 0)

Year	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2019	39.98	38.78	41.18	38.14	41.82
2020	40.69	37.48	42.90	37.32	44.06
2021	41.47	38.352	44.58	36.70	46.23
2022	42.27	38.350	46.19	36.27	48.27
2023	43.09	38.453	47.73	35.99	50.19
2024	43.92	38.64	49.21	35.83	52.01
2025	44.76	38.88	50.63	35.77	53.74
2026	45.60	39.18	52.01	35.78	55.41
2027	46.44	39.52	53.35	35.85	57.02
2028	47.28	39.89	54.66	35.98	58.57

Table 2 shows the point forecasting from ARIMA(1,1,0) based on ADF and PP tests.

Figure 11. Employment growth rate forecasting for 10 years



Source: Author's estimation

In figures 10 and 11, forecasted growth lines are illustrated for the next ten years with an ARIMA (0,2,0) and ARIMA (1,1,0) model. The forecasted line illustrated in figure 11 and In figure 12, the upper and lower bound are included. Both figures show that the service sectors' labor growth is an upward trend.

CONCLUSION

In the current study, around three decades of employment in service sector time series data were used to forecast for the next 10 years. The forecasted data, based on ARIMA (0,2,0) showed that the employment rate in service sectors would increase from 39.77% in 2019 to 43.33% in 2028. On the other hand, based on another ARIMA (1,1,0) model, the forecasted data showed that the employment rate in service sectors would increase from 39.98% in 2019 to 47.28% in 2028; unless and until more strict employment control policies and strategies are implemented in Bangladesh. When we will get data for another year (2019), the model can be checked for validity and probably more accurate forecasts can be performed. Overall, in this study, the ARIMA (0,2,0) and ARIMA (1, 1, 1) models are the appropriate and suitable models to forecast the employment growth rate in service sectors for the next decades. Among the several ARIMA models, the AIC and BIC's values for these two models are the minimum. Also, P-value determines the significance of our model. This clearly shows that service sectors should be focused and concentrated on the future of Bangladesh. Bangladesh is currently experiencing high levels of unemployment so it is recommended that government should make them skilled so that they will adjust with service sectors requirements. The declining employment growth rates show that Bangladesh will be able to control employment. These findings are close to the findings reported by all other national and international bureau. These findings are particularly essential for the government of Bangladesh as well as other organizations, particularly when it comes to planning for the upcoming decades. Though we forecasted employment growth rates in service sectors for one decade, it is suggested that researchers should be aware of when forecasting for more than 5 years.

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