

Twentieth Century Urbanization in Bangladesh and a Spell of High and Unsustainable Urban Growth

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ABSTRACT: Bangladesh is still a low urbanized country although it experienced a rising trend in the level of urbanization throughout the twentieth century and had a remarkably high urban growth immediately after its independence in 1971. The country recorded the highest ever annual average growth rate (9.04) and percentage of interval variation (137.57%) in an urban population in 1974; thereafter, growth rates of these two parameters went on falling and reached 5.19 and 65.89% respectively in 1991. As a result, urbanization during the tail end of the twentieth century increased but at a decreasing rate leading to an unsustainable urban growth trend. This study, however, examines the factors that contributed to urbanizing Bangladesh during the unsustainable growth period particularly in the last decades of the twentieth century. To this end, a multivariate regression model is developed and analyzed using the ordinary least square method involving stepwise-regression procedure. Primarily ten potential factors are taken into consideration and seven of them emerged as significant in explaining the process of urbanization in Bangladesh. Of these seven factors, the level of industrialization appears as the most influential factor with a coefficient of 1.34, which is followed by the share of urban area, initial level of urbanization and migration with coefficients of 1.13, 0.86 and 0.49 respectively; while the econometric model came up with an adjusted R^2 of 0.95 and the Durbin-Watson Statistic of 1.98. Results of this study provide with better understanding towards guiding the urbanization process, particularly in the developing countries.

Keywords: *Urban growth, Trend analysis, Multivariate regression analysis.*

INTRODUCTION

Throughout the twentieth century, Bangladesh experienced diverse socio-economic and political changes and these changes contributed to mold the pace and pattern of its urbanization. The pace of urbanization up to the middle of the twentieth century was very slow although a rising trend was maintained up to the end of the twentieth century. Meanwhile, the country recorded remarkable growth rates for some of the parameters of urbanization immediately after its independence in 1971. As for example, in 1974 the country experienced the highest ever annual average growth rate (AAGR) of 9.04 accompanied by 137.57% interval variation in an urban population. Thereafter, growth rates of these parameters went on falling but maintained considerable high rates. For example, the annual average growth rates (AAGR) were 7.99, 5.19 and 3.30 in the years of 1981, 1991 and 2001. As a result, the level

of urbanization increased but at a decreasing rate leading to an unsustainable urban growth process. For instance, level of urbanization increased by 6.76% between 1974 & 1981; while it increased by 4.61% and 3.66% between 1981 to 1991 and 1991 to 2001 (Table 1 and Fig. 1 & Fig. 2).

On the other hand, in the interval of 17 years (1974-91) the level of urbanization became more than doubled (Table 1). Naturally, there arise several questions—why did Bangladesh experience such a rapid growth in urbanization? What are the factors behind the unsustainable but high urban growth rates and to what extent these factors contributed to the process of urbanization? The research problems require to carry out a quantitative analysis of the urbanization process involving a number of factors that are assumed to have an influence on the urbanization process.

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Literature Review

Urbanization is a complex phenomenon where a good number of factors from diverse fields uphold the process either independently and/or collectively. So assessment of the extent of influence of these factors is immensely important for sustainable as well as guided urban and regional development. However, the research questions ask for an econometric analysis of the factors behind the urbanization process; unfortunately, the econometric analysis of urbanization is very rare in the literature of urbanization. In Bangladesh, several studies attempted to evaluate the factors involved in urbanization process but none of them carried out quantitative/econometric analysis of urbanization. For instance, Chaudhury (1980) investigated the complex process of urbanization and its impact on lifestyle and national economy. The author described the factors behind the regional variations in urbanization and then associated these variations with economic characteristics of the regions. Laskar (1983) analyzed some important aspects of urbanization dividing Bangladesh into four regions as Central, Eastern, Southern, and Northern. The urban centers were categorized into several size classes based on population, and the shift of the centers from one category to another was depicted over the course of time. The study also investigated the reasons behind the growth and expansion of some important urban centers and thereby provided some key issues for further research. Meanwhile, Rouf & Jahan (2007) analyzed the spatial and temporal patterns of urbanization in Bangladesh with greater emphasis on the post-liberation period. The authors presented the spatial and temporal pattern and a process of urbanization for different forms of urban agglomerations. There is a notion that rural-urban migration has contributed substantially to the process of urbanization in Bangladesh. Mohit (1990) studied the relationships between migration and city-size and found that big cities are more attractive for

migrants in Bangladesh.

Quantitative analyses of urbanization often apply econometric model(s) to explain the factors involved. Becker & Morrison (1988) applied an econometric model that put more emphasis on labor demand in the modern urban sector. The model considered a good number of exogenous variables including urban sector wage rate, gross domestic product, level of government expenditures, capital stock in urban traditional sector etc. 'International labor migration' is an important factor as far as the context of the investigation is concerned, but it is not included in the model. However, the study concluded that government policies do matter in the process of urbanization. For example, policies towards rural development significantly weakened rural push factors. Bairoch & Goertz (1986) made an econometric analysis including 14 factors to explain the urbanization in the nineteenth century developed countries. In this study, the economic factors (e.g., gross national product per capita, agricultural productivity, industrialization, export, etc.) explained the major share of the variation in the level of urbanization compared to the demographic factors (e.g., urban population, total population, migration etc.). The study also revealed that in Europe, urbanization was pulled by industrialization and in the non-European developed countries it was more pushed by agricultural productivity.

Urbanization is associated predominantly with industrialization; however, there are cases where urbanization had taken place without industrialization. For example, resource exporter countries are urbanized although their level of urbanization is very low. Gollin, Jedwab & Vollrath (2013) constructed a model which accounts urbanization with industrialization and without industrialization. This model explains urbanization in two broad paths in terms of structural changes. In the first path, labor moves from agriculture to the industry that leads to creating 'production cities' of tradable goods while in the

Table 1: Trend of the level of urbanization and urban growth of Bangladesh (1891-2011) (Source: BBS, 1984, 1994a, 2004 and 2014)

Census years	Total population	Total urban population	Level of urbanization	Interval variation	Percent of variation	Annual Avr. growth rate
1891	24665000	537000	2.18	--	--	--
1901	28927786	702035	2.43	165035	30.73	2.72
1911	55056315	807024	2.56	104989	14.95	1.40
1921	33254096	878480	2.64	71456	8.85	0.85
1931	35604170	1073489	3.02	195009	22.20	2.02
1941	41997297	1537244	3.66	463755	43.20	3.66
1951	42062610	1819773	4.33	282529	18.38	1.70
1961	50840235	2640726	5.19	820953	45.11	3.79
1974	71479071	6273602	8.78	3632876	137.57	9.04
1981	87120119	13535963	15.54	7262361	115.76	7.99
1991	111455185	22455174	20.15	8919211	65.89	5.19
2001	130522598	31077952	23.81	8622778	38.40	3.30

second path urbanization occurs through 'consumption cities', where labor force are engaged in producing non-tradable goods. Besides, there are studies that investigated the causes of urbanization from different perspectives e.g., political change (Anthony, 2014), the volume of trading in cities (Gollin, Jedwab & Vollrath, 2013), rural-urban migration (Mohit, 1990). However, a well representative model for analyzing urbanization should consider at least socio-economic, demographic and administrative/political factors.

MATERIALS AND METHODS

Salient Features of the Twentieth Century Urbanization in Bangladesh

The process of modern urbanization in Bangladesh had begun at the tail end of British colonial period which continued over the period of East Pakistan and gained momentum in independent Bangladesh. However, the trend of urban growth was not smooth over the time due to the ever-changing socio-political and economic phases as well as administrative policies and reforms. As a result, some of the parameters of urbanization had discontinued growth records although the level of urbanization maintained an upward trend. Table 1 provides the changing patterns of various parameters associated with the level of urbanization from 1901 to 2001. These parameters indicate that the level of urbanization was on the rise throughout the twentieth century through the growth rates of urban population varied significantly over time (Fig.1). Considering the contrasting variations, Rouf & Jahan (2007) split the time span of the twentieth century into three categories—the period of sluggish growth (1901 to 1921), moderate growth (1931-1961) and rapid growth (1971- 1991); while, during the last decade, the level of urbanization had increased but relatively at a slower rate. It is worth mentioning that the urban population of Bangladesh at various census years up to 1941 would be estimated from the undivided Indian census counts by adjusting for territorial changes at the time of partition. In independent Bangladesh, the first census took place in 1974 (BBS, 1987). The level of urbanization was 2.43 % in 1901, which increased to 2.64 % in 1921. The relatively low levels of urbanization during the period may be attributed to the profit motive strategies of the British Colonial Government. Historically, the colonial rulers adopted strategies to destroy indigenous industries of East Bengal of British India (today Bangladesh) with a view to building up industrial-commercial agglomeration around Calcutta (now Kolkata in the Indian state of West Bengal), and that virtually turned the area, which is today Bangladesh, into its rural hinterland. Meanwhile, slow increasing trends were recorded for both of the levels of urbanization and annual average growth rate (AAGR) during the period of 1921-1941. Between 1941 and 1951 the annual average growth rate decreased from 3.66 to 1.70 although the proportion of urban population increased in absolute term. A relatively lower growth rate of urban population during 1941-1951 might be due to the effects of devastating Bengal Famine,

the Second World War and the partition of British India (in 1947). However, a remarkable upward trend in the growth of total urban population was recorded between 1961 and 1991; while, the country witnessed the highest-ever growth rates in terms of intercensal variation and annual average growth rate over the period of 1961-1974. This sharp acceleration in urban population growth during the span of 13 years may be attributed to some industrial development in the 1960s and the emergence of Bangladesh as a sovereign nation. In 1981 the country had over 13.5 million urban populations with a 15.05% level of urbanization accompanied by 115.76% intercensal variation and an annual average growth rate of 7.99 (BBS, 1984). It is noticeable that the rate of change of these two parameters is decreasing since 1974, i.e., it is less than that of the previous census year. For example, in 1991 the above parameters (interval variation and AAGR) became respectively 65.89% and 5.19 which are also less than those of 1981. At the end of the twentieth century, these two rates reduced to 38.40% and 3.30 in order and the level of urbanization increased only by 3.66% to reach 23.81% in 2001. These imply that urbanization over the period of 1974-2001 had increased but at a decreasing rate (Table 1); in other words, this period experienced unsustainable urban growth rates.

Therefore, the trend and pattern of the twentieth-century urbanization in Bangladesh can be summarised as:

A consistent rising trend in the growth rate of the urban population was observed throughout the twentieth century with an exception to the decade 1911-21.

The level of urbanization was very low during the British colonial rule and it continued till the middle of the twentieth century. The low rate of urbanization is primarily attributed to the exploitive policy of the colonial rulers.

The pace of the level of urbanization got momentum from the 1960s and maintained an upward trend up to the end of the twentieth century.

Industrial development paved the way for urbanization in Bangladesh.

The Spell of High but Unsustainable Urban Growth

This section examines the factors that contributed to the level of urbanization and the extent of their contribution to the high but unsustainable urban growth during the period of 1974-1991. Since the population census in the year of 1991 records the culmination of the level of urbanization in the twentieth century, this study takes the year 1991 as the basis of developing an econometric model for this analysis.

Urbanization is a complex process which depends on a variety of factors having socio-economic, demographic and physical characteristics. Besides, there are some factors relating to administrative and even cultural issues that often influence urbanization process significantly. According to R.P. Misra (1978, p. 16);

“Urbanisation is a process which reveals itself through temporal, spatial, and sectoral changes in the demographic,



Fig. 1: Trend of urbanization in Bangladesh (1891-2001) (Source: Table 1)

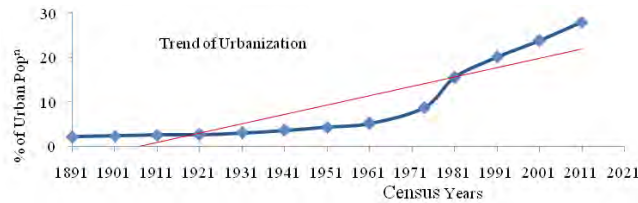


Fig. 2: Urban growth trend in the twentieth century and beyond (Source: Table 1)

social, economic, technological and environmental aspect of life in a given society”.

The present study, however, considers 10 factors, some of which are economic such as level of industrialisation (LI), concentration ratio (CR) and agricultural productivity (AP), some that are demographic such as rural-urban migration (RUM) and population density (PD), some that are administrative/political such as public administration (PA) and share of urban area (SUA) and some that are general such as literacy rate (LR) and gross domestic product (GDP) per capita and initial level of urbanization (ILU). Obviously, not all the variables are of equal importance but these are the factors that are believed to be worthy of explaining the urbanizing process in Bangladesh. However, cross-sectional data against 64 districts of Bangladesh are taken into consideration and the data are collected from various census reports/statistical yearbook of Bangladesh published by Bangladesh Bureau of Statistics².

Empirical Model and Analytical Techniques

The regression model takes the following form:

$$U_n = \alpha_0 + \beta_1 (LI)_i + \beta_2 (CR)_i + \beta_3 (RUM)_i + \beta_4 (LR)_i + \beta_5 (PA)_i + \beta_6 (AP)_i + \beta_7 (GDP)_i + \beta_8 (PD)_i + \beta_9 (ILU)_i + \beta_{10} (SUA)_i + \gamma_i \quad (1)$$

where, U_n refers to level of urbanisation and $n = 1, 2, 3 \dots 64$. α_0 is the intercept, and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9$, and β_{10} are the coefficients, and γ_i is the stochastic disturbance term.

The ordinary least squares method with stepwise-regression procedure is employed explain the factors behind the level of urbanization. In the estimation process adjustment for multi-

collinearity was made to the regression model³. As part of the remedial measure of multicollinearity problem, one of the variables is dropped from a total of 10 variables while seven of the remaining variables came out as significant (Table 3) in explaining the urbanization process in Bangladesh.

Towards the Adjusted Empirical Model

The Problem of Multicollinearity

A high correlation was detected between two explanatory variables, the level of industrialization (LI) and the concentration ratio (CR). A remedial measure(s) to get rid the multicollinearity problem vary depending on the severity of multicollinearity, importance of factors which are multicollinear etc. (Koutsoyiannis, 1996). However, we felt that removal of one of the collinear variables is an effective way to get rid of the multicollinearity problem. So LI and CR are regressed with different adjustments in order to eliminate either of them. After a series of operation it was observed that CR to be dropped from the model³ thus we obtained the following adjusted model:

$$\hat{U}_n = 12.03 + 1.34 (LI)_i + 0.49 (RUM)_i - 0.07 (AP)_i + 0.001(GDP)_i - 0.003 (PD)_i + 0.86 (ILU)_i + 1.13 (SUA)_i \quad (2)$$

It should be noted here that pair-wise correlations may be a sufficient but not a necessary condition for the existence of multicollinearity (Gujarati & Sangeetha, 2007, p. 380). It is evident from the Table 2 that most of the correlation coefficients between the exogenous variables are relatively modest indicating nonexistence of collinearity problem. However, after the adjustment, R^2 has increased slightly and all other estimates are statistically significant with expected signs.

Table 2: Correlation matrix for the endogenous and the exogenous variables (Source: own estimation)

Variables	LI	RUM	AP	GDP	PD	ILU	SUA	LU
LI	1							
RUM	0.49	1						
AP	0.17	0.29	1					
GDP	0.08	-0.02	-0.31	1				
PD	0.62	0.55	0.39	-0.25	1			
ILU	0.7	0.57	0.09	0.08	0.61	1		
SUA	0.69	0.57	0.13	0.16	0.73	0.7	1	
LU	0.74	0.58	-0.05	0.37	0.56	0.81	0.9	1

(Number of observation: 64)

Moreover, the econometric model was checked whether it has been affected by other problems including serial correlation and Heteroscedasticity.

The Durbin-Watson d statistic is used to check whether the serial correlation is present in the model. 'If d is found to be 2 or less, it is assumed that there is no first-order autocorrelation in the application' (Gujarati & Sangeeta, 2007, p. 479). The d-statistic is 1.98, which indicates this model is free from the influences of serial correlation. Turning to the problem of heteroscedasticity which is more common in cross-sectional data than in the time-series data (Gujarati & Sangeetha, 2007). So, it was surmised that there may have heteroscedastic variance, σ_i^2 , which is positively related to one of the explanatory variables, a share of an urban area (SUA) i.e., $\sigma_i^2 = \sigma^2 (\text{SUA})^2$, (where σ^2 is a constant). The reason behind this notion is the rate of population growth in urban areas not always matches the rate of area expansion. However, the Goldfeld-Quandt test is applied to detect if heteroscedasticity is present in the model⁴ and the test result provided no trace of heteroscedasticity in the adjusted model.

The Case of Lagged Endogenous Variable and Autocorrelation

The initial level of urbanization i.e., the substratum of urbanization is introduced in the model as a lagged endogenous variable. It is customary that when the endogenous variables are included as independent variables, the ordinary least squares (OLS) is not a valid procedure because of correlation of independent variables with the residual (Bairoch & Goertz, 1986; Gujarati & Sangeetha 2007, p. 753). Both of the fixed and random effects estimators become biased if a lagged endogenous variable is used as a regressor (Kennedy, 2003, p. 313). However, our model is not of the form:

$$Y_t = \beta_x + Y_{t-1} \quad (3)$$

$$\text{Rather, it looks like } Y = \beta_x + Y_1 \quad (4)$$

Therefore, the lagged endogenous variable assumes such a form that is similar to other exogenous variables and does not lead the model to be biased.

RESULTS AND DISCUSSIONS

Industrialization is believed to be the most influential determinants in the process of urbanization both in the developed and developing countries. It actually paved the way for urbanization in most of the countries throughout the world. Bangladesh is no exception to this; although the extent of its contribution is not as much as it is in the Western countries. However, industrialization emerged with the highest coefficient [$\beta = 1.34$, $p < 0.01$] among the explanatory variables. Actually, the pace of urbanization in Bangladesh began with industrialization inasmuch as the regions with strong industrial background are highly urbanized. For example, Dhaka, Narayanganj, Khulna, Kushtia, and Chittagong districts have a long history of industrial heritage, and consequently, these districts are leading in the arena of urbanization.

Contrary to the common belief, 'rural urban-migration' (RUM) emerged as a mediocre factor in terms of its contribution to urbanization. It secured the fourth position [$\beta = 0.49$, $p < 0.01$] among the explanatory variables. As a matter of fact, the impact of RUM was not distributed evenly over the urban system of the country rather it was concentrated on some specific large urban agglomerations. So comments on rural-urban migration relating to its contribution to be made with caution. A priori, agricultural productivity (AP) records a negative effect with urbanisation [$\beta = -0.07$, $p < 0.001$]. In fact, an inverse relationship between agricultural productivity and urbanization, particularly in developing countries, is more tenable; since gainful agriculture retains people in rural areas. This justifies the presumption that in the developing countries the failure of agriculture is one of the factors that accelerate urbanization through the push mechanism, more specifically the rural-urban migration (RUM). The coefficients of 'population density' and 'gross domestic product' per capita take relatively small values indicating that they were relatively less influential in urbanizing Bangladesh. In general, gross national product (GDP) per capita is much higher in a highly urbanized country than

Table 3 : Statistics for explanatory variables in the econometric model5

Variable	Estimated coefficient	Standard error	t-statistic
Level of Industrialisation	1.34	0.451	**2.97
Rural-urban Migration	0.49	0.173	**2.83
Agricultural Productivity	-0.07	0.017	***-3.76
GDP per capita	0.001	0.000	***5.09
Population Density	-0.003	0.001	*-2.48
Initial Level of Urbanisation	0.86	0.122	***7.00
Share of urban area	1.13	0.095	***11.82

$R^2 = 0.96;$ $\bar{R}^2 = 0.95$

Number of observations 64

Durbin-Watson statistic 1.98

* $p < 0.05$ (i.e., significant at 5%); ** $p < 0.01$ (i.e., significant at 1%) and

*** $P < 0.001$ (i.e., significant at 0.1%)

- i) 'P<0.05' indicates that the probability of getting this value if there is no relationship between the variable and the level of urbanisation is less than 5 in 100.
- ii) The signs of the estimated coefficients are in accordance with prior expectations while the R^2 value is reasonably high.

that in a less urbanized country—which furnishes the rationale to accept that GDP per capita plays a notable role in making a country urbanized. However, GDP has a nominal contribution to urbanisation in Bangladesh [$\beta = 0.001, p < 0.05$]. This is perhaps due to the dominance of the agrarian sector in the economy of Bangladesh where lion's share of the GDP would come from the primary sector.

On the other hand, the share of the urban area came out as an outstanding influential factor [$\beta = 1.13, p < 0.001$] of urbanization. It is obvious that the share of an urban area is highly correlated with the level of urbanization. In practice, many areas were annexed with the adjacent urban agglomerations and/or some areas were reclassified as urban through relaxing the existing definition of an urban area (BBS, 1997a), and these were implemented as part of administrative decentralization and/or achievement of development goals. As for example, between 1981 and 1991 urban area under Dhaka district increased by 90.02% making the share more than half of the total area. Over the same time period, the increment of the urban area for the other most urbanized districts namely, Khulna, Chittagong, and Rajshahi were respectively 145.19%, 247.30%, and 39.39%. Likewise, other urban areas were also expanded considerably. Finally, the adjusted R^2 (0.95) is quite high, the Durbin-Watson Statistic (1.98) is below the autocorrelation margin, and more importantly, the signs of the estimated coefficients are in accordance with prior expectations.

CONCLUSION

Despite the long history of urbanizing Bangladesh entered into the twenty-first century with a low level of urbanization

through the country experienced a phenomenal urban growth in the last three decades of the twentieth century. Up to the middle of the twentieth century, the level of urbanization was very low because of the exploitive attitude of the colonial power; little or no attempts were undertaken toward industrial development in the present Bangladesh part of British India. After the partition of India in 1947, the urbanization process slowed down initially due to the migration of people to India. However, urbanization gained some momentum in the late 1960's which could be linked to some industrial development in and around some major cities, particularly, Dhaka, Chittagong, and Khulna. After independence in 1971, the level of urbanization increased quite rapidly due partly to enhanced administrative and development activities and to the flexibility in defining an urban area. High but unsustainable urban growth in the post-liberation period could be attributed to the above reasons.

Agricultural productivity (AP) and rural-urban migration (RUM) emerged as significant explanatory variables in the process of urbanization while the latter is highly influenced by the former. These interrelationships provide us with noteworthy indications for guiding urbanization through agricultural/rural development. Urbanization in developing countries takes place predominantly due to pushing factor without the full extent of labor absorption. However, it can be recommended that the extent of imbalances in terms of employment opportunities and wage rates between urban and rural areas need to be reduced. When urban wage level grows at a faster rate than the rural wage level, this stimulates further rural-urban migration in spite of rising levels of urban unemployment. At the same time,

the creation of more jobs in an urban sector without simultaneous measures to enhance income and employment opportunities in rural areas is a false solution to the urban unemployment problem. Because more urban employment opportunities again lead to more rural-urban migration as well as an increased level of urban unemployment. Thus employment opportunities in the rural areas could be used as an effective instrument in regulating rural-urban migration as well as urban growth particularly in the developing countries

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ENDNOTES

¹1971 was a census year but census was not carried out due to the war of independence. December 16, 1971, Bangladesh emerged as an independent country and its first census took place in 1974.

²Factors behind Urbanization in Bangladesh: A brief description

Level of Industrialisation (LI)

Historically, all industrialized countries are highly urbanized. Level of industrialization is recognized as a powerful determinant of urbanization across the globe. According to Todaro & Smith (2012, p. 337), urbanization and industrialization could be used synonymously. The magnitude of employment in the industrial sector is seen as an index of the state of industrialization of a region (BBS, 1997b).

Concentration Ratio (CR)

It reflects a region's relative strength in terms of employment opportunities in the industrial sector. Concentration ratio is measured as—the percentage share of a region in the total (nationwide) industrial employment divided by percentage share of the region in the total economically active population for the corresponding year i.e.,

$$\text{Concentration Ratio} = \frac{\% \text{ share of the region in the total industrial employment}}{\% \text{ share of the region in the total economic active population}}$$

Level of industrialization and concentration ratio are calculated from the data published in the Report on Bangladesh Census of Manufacturing Industries (CMI) 1991-1992 (BBS, 1997b).

Rural-Urban Migration (RUM)

People are defined as migrant when they change their place of residence or intend to settle in the place of an enumeration area which is different from the previous place of residence. The time period here is at least 6 (six) months but there is no time

limit for the migrants who change their place of residence for marriage (BBS, 1994a). Rural-Urban Migration is believed to be one of the most contributive factors of urbanization in many developing countries (Brueckner, 1990; Todaro & Smith, 2012, p. 316- 317).

Literacy Rate (LR)

In general literacy rates in urban areas are higher than that in rural areas. Actually, the level of urbanization and literacy rate are directly related; so, literacy rate can be taken as an explanatory variable in the analysis of urbanization.

Public Administration (PA)

The employees of government establishments and other organizations usually live in urban areas and thereby contribute to increasing the proportion of urban population. So, the number of total employment in various establishments and organizations is such a factor that deserves to be included in the model for explaining the urbanization process of a country.

Population Density (PD)

Population density (or land-man ratio) is an important factor in the analysis of urbanization. It is measured simply by dividing the total population a region with its total area.

A share of an urban area (SUA)

A share of an urban area (SUA) directly relates to the level of urbanization as far as urbanization of Bangladesh is concerned. It is measured as the percentage share of an urban area of a specific region. Thus,

$$\text{A share of urban area} = \frac{\text{Urban Area}}{\text{Total Area}} \times 100$$

Initial Level of Urbanization (ILU)

Among the explanatory variables, one lagged dependent variable—the level of urbanization in 1961— is included as a regressor. Influence of this initial level of urbanization (ILU) is obvious in the process of urbanization. It actually contributes to the urbanization process in several ways including demographic and socio-economic expansion. However, data on rural-urban migration (RUM), literacy rate (LR), population density (PD), Share of urban area (SUA) and initial level of urbanization (ILU) are taken/calculated from Bangladesh Population Census 1991, Vol. 3 (Urban Area Report) (BBS, 1997a).

Agricultural Productivity (AP)

Agricultural productivity plays a significant role in the process of urbanization in an agrarian economy like Bangladesh. Demand for labor in the rural areas goes on falling with decreasing agricultural productivity; as a result, the rural poor migrate to the urban areas in search of work, while a considerable por-

tion of them do not go back. The reverse is true for increasing agricultural productivity. Thus, agricultural productivity exerts its effect on the level of urbanization directly. Considering the reality in Bangladesh agriculture, an intensity of cropping (IC) is used as a surrogate for agricultural productivity and is measured as

$$\text{Intensity of cropping} = \frac{\text{Total cropped area}}{\text{Net cropped area}} \times 100$$

Gross Domestic Product (GDP) per capita

Most of the highly urbanized countries have a high rate of gross domestic product per capita (Todaro & Smith, 2012, p. 312); at the same time, no country has ever achieved a middle-income status without a considerable share of the population into urban areas (Annez & Buckley, 2009). So, it is argued that urbanization and economic growth go together. Again, GDP per capita is a good indicator of a region's position in terms of its employment opportunities, a standard of living which in turn relate to the level of urbanization. Agricultural Productivity (AP) and Gross Domestic Product (GDP) per capita are calculated/taken from Statistical Yearbook of Bangladesh-1993 (BBS, 1994b).

3Multicollinearity Problem and the Remedial Measures

The level of industrialization (LI) and the concentration ratio (CR) are regressed with different adjustments in order to single out the less important one to drop from the model. The stages of operations are presented hereunder. Firstly, level of urbanization, U_n , is regressed on LI and CR to obtain the following regression equation.

$$\hat{U}_n = 11.32 + 34.28 (LI)_i - 34.93 (CR)_i \quad (B1)$$

$$t = \begin{matrix} (1.090) & (3.962) & (5.160) \\ (10.387)^{***} & (8.653)^{***} & (-6.768)^{***} \end{matrix}$$

$$R^2 = 0.74 \quad \bar{R}^2 = 0.73 \quad df = 2$$

Equation (B1) shows that LI and CR together explain about 0.74% of the variation in the level of urbanization but both of the variables have large standard errors which give rise to

wider confidence interval indicating $\hat{\beta}$'s are not statistically significant. Moreover, the concentration ratio was found inversely related to urbanization which is quite unusual. A priori, one would expect a positive relationship between urbanization and concentration ratio. However, in the presence of multicollinearity, it is impossible to isolate the individual impact of either LI or CR on urbanization. Therefore, CR is regressed on LI to get

$$\hat{CR} = 0.04 + 0.76 (LI)_i \quad (B2)$$

$$(0.026) \quad (0.017)$$

$$t = (1.504)^* \quad (43.632)^{***} \quad R^2 = 0.97$$

Equation (B2) clearly indicates almost perfect collinearity between CR and LI. Again, U_n is regressed on LI to have

$$\hat{U}_n = 9.94 + 7.89 (LI)_i \quad (B3)$$

$$(1.405) \quad (0.923)$$

$$t = (7.072)^{***} \quad (8.546)^{***} \quad R^2 = 0.54$$

The coefficient of LI in equation (B1) is excessively high (34.28) which is absurd; while it is reasonable in equation (B3). Now, U_n is regressed on CR and we have

$$\hat{U}_n = 10.46 + 9.02 (CR)_i \quad (B4)$$

$$(1.607) \quad (1.357)$$

$$t = (6.509)^{***} \quad (6.645)^{***} \quad R^2 = 0.42$$

Comparing regression equations (B1) and (B4), it can be realized that something is wrong with the regression equation (B1), as the coefficient of concentration ratio is pathologically high, and also inversely related to urbanization violating the established belief. The reason behind these unusual results seems to be the presence of multicollinearity in the model. When faced with severe multicollinearity, usually one or more of the collinear variable(s) is/are dropped to get rid of the multicollinearity problem (Gujarati & Sangeetha, 2007, p. 366- 373). Comparing regression equations (B3) and (B4) it can be noticed that as an independent variable CR gives a lower level of R^2 than that with the LI. Therefore, CR is dropped and LI is retained in the model; thus we obtain the following adjusted model:

$$\hat{U}_n = 12.03 + 1.34 (LI)_i + 0.49 (RUM)_i - 0.07 (AP)_i + 0.001(GDP)_i - 0.003 (PD)_i + 0.86 (ILU)_i + 1.13 (SUA)_i \quad (B5)$$

4Heteroscedasticity and its Detection

The number of observations with the econometric model is several times greater than the parameters and the sample size is large enough which made it (the model) compatible with the Goldfeld-Quandt test. However, the null and alternative hypotheses of the test are the null hypothesis, H_0 : disturbance terms (V 's) are a homoscedastic alternative hypothesis, H_a : disturbance terms (V 's) are heteroscedastic

As per the suggested steps of Goldfeld and Quandt test (Greene, 2003, p. 223; Gujarati & Sangeetha, 2007, p. 417),

the estimates obtained are

Regression based on the first 24 observations:

$$\hat{U}_n = -1.20 + 4.71 (SUA)_i \quad (C1)$$

(10.144) (3.168)

$r^2 = 0.091$; $RSS_1 = 1806.003$ and $df = 22$

Regression based on the second 24 observations:

$$\hat{U}_n = 5.28 + 1.19 (SUA)_i \quad (C2)$$

(4.522) (0.283)

$r^2 = 0.4434$; $RSS_2 = 4666.0116$ $df = 22$

From the above results we have, $F^* = 2.58$, and the critical F-value is 2.83 ($p < 0.001$) against 22 numerator and 20 denominator degrees of freedom. Since the observed F (F^*) is less than the critical F (i.e., $F^* < F$), the null hypothesis cannot be rejected. Therefore, the disturbance term V_i in the model is homoscedastic and it justifies the application of OLS method in the analysis.

⁵Technical Aspects of the Econometric Analysis

In the estimation process, some inconveniences were confronted particularly with the multicollinearity problem. However, in order to alleviate the problem of multicollinearity, the variable 'concentration ratio' (CR) was eliminated from the model which may have a specification error in the outcomes. The combination of cross-sectional and time-series data is an effective remedial measure of multicollinearity problem but it is not possible as the study deals with only cross-sectional data.

In the econometric model, the level of urbanization is the dependent variable which assumes values between zero and one; this is because of the fact that the level is measured as a percentage. Accordingly, a growth model of urbanization would take logistic (S-shaped) curve rather than linear growth (or straight line) (Davis, 1965). Hence, a logistic or normal transformation needs to be made to the dependent variable to comply with the shape of the curve. However, such a transformation was not made considering the range of data which fall between nine to 52 percent with few cases at the lower extreme while only one case in the upper extreme. Since almost all the values of the dependent variable fall in the lower-middle range, the logistic curve can be approximated quite well by a straight line (see Bairoch & Goetz, 1986).

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