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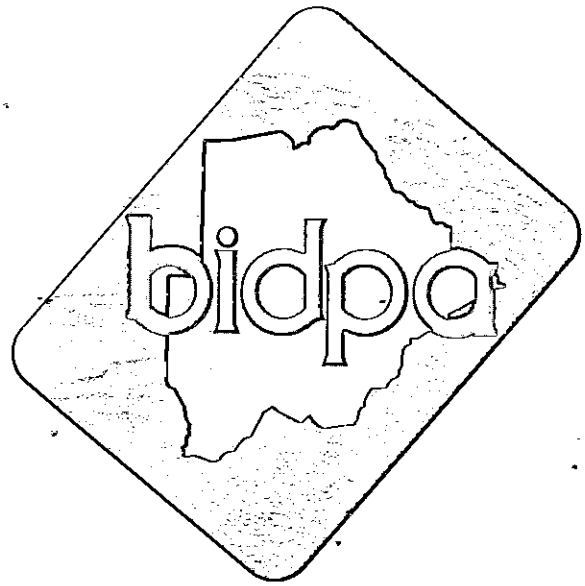

BOTSWANA INSTITUTE FOR DEVELOPMENT POLICY ANALYSIS

A SIMPLE FORMULA FOR FORECASTING THE BOTSWANA URBAN POPULATION TOTAL

By : Per Granberg

BIDPA Working Paper No. 15

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civil society is increasingly becoming a significant actor in determining and driving the course of government policies, yet despite this phenomenon, *civil society* as a term remains a nebulous and varied description of a number of parts which never quite add up to a coherent whole. In many instances, analysts who examine in depth the emergence and significance of groups and organizations within societies, and how these groups impact on the priorities of government and state institutions, omit a proper examination of civil society as a concept within their context. As Peter Lewis observes:

Abstract

The aim of the present paper is to establish a simple functional relationship linking urbanisation and economic growth. The paper consequently focuses on the interplay between developments in urban population and basic economic variables, with the latter seen as representative of important forces driving the urbanisation process.

The purpose for establishing such a relationship is to produce a short and simple "annexe" to the revised MEMBOT model (forthcoming), capable of providing quantitative estimates illustrating the likely nature of urban population changes under alternative economic scenarios.

Keywords

Population
Urbanization
Economic models
Botswana

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Introduction

1. Botswana has experienced a rapidly growing population during the last few decades, and in particular, a rapidly growing *urban* population. Data from the Population Census for 1971 and 1991 show that the nation's total population increased from 0.57 mill. in 1971 to 1,33 mill. in 1991, i.e. it more than doubled in twenty years, while the urban population grew from 0.05 mill. in 1971 to 0.61 mill in 19991, i.e. it increased more than tenfold during the two decades.

2. The rapid urban expansion has meant that a steadily increasing share of the nation's population has converged upon the urban centres, while a steadily decreasing share has remained in the rural areas. During the period 1981-91 the "urban drift" was in fact so pronounced that even the absolute number of rural dwellers decreased, despite the underlying rapid growth of the nation's total population. Thus, the total rural population stood at 0.79 mill. in 1981, but had fallen to 0.72 mill. in 1991. The corresponding rural share of the total population fell from 82% in 1981 to 54% in 1991.

3. Population movements on such a scale have important implications for how and where the nation should use its development resources. Unless the urban infrastructure in the form of housing and building land, water and sewerage, roads and transport, schools and hospitals etc. is expanded in response to the urban influx, it may soon become severely over-stretched. If this happens, serious losses in overall production efficiency and social welfare may result.

4. The nation's total supply of resources is limited, while the total demand put upon them is virtually *un*limited. Decisions about how to utilise limited available resources, in the face of essentially unlimited demands, are among the important responsibilities that local and central government have to face. A realistic picture of the urban/rural population distribution, and how it may develop over time in reaction to various other developments, is therefore of considerable importance to these authorities (as is, of course, a host of other factors not touched upon in the present paper).

5. Urban population growth may be analysed in different ways. From a purely demographic point of view, population growth may for instance be analysed in terms of variabies such as age distribution, fertility and mortality rates, migration rates etc. In a different type of analysis, one may try to identify the way and extent to which some of these factors, for instance migration, relate to "non-demographic" factors, representing for instance economic opportunities.

6. In the present analysis we are not concerned with demography as such. Instead our focus is on the second type of relationship, i.e. between developments in urban population on the one hand, and in basic economic factors on the other, the latter being seen as representative of important forces driving the urban growth process.

7. Consequently, it should be understood from the outset that the aim of the present effort is limited. It is not to undertake a broad study of the urbanisation process. Rather, it is to establish a simple functional relationship linking urbanisation and economic factors, for the purpose of producing estimates of the former that are logically consistent with the latter.

8. In more concrete terms, the aim is to produce an "annexe" to the revised MEMBOT model (forthcoming).[1] This "annexe" should be kept "short and simple", yet capable of providing quantitative estimates illustrating the likely nature of urban population changes under alternative economic scenarios.

9. Estimates produced from such a "short and simple" MEMBOT-annexe will be highly tentative in nature. They should not be taken as "gospel truth". Nevertheless, they may prove of interest to government planners etc. This is because they will carry the advantage of being consistent with the economic magnitudes describing the scenarios investigated. Consistency, moreover, will be achieved via a simple and easily understood set of estimation-functions and -assumptions, factors that the planners may easily change, should the need arise.

10. The tentative nature of the results is not only a reflection of the fact that we have chosen to rely on a simple, even simplistic, relationship. Even if we were to adopt a more complex and all-encompassing functional relationship, the results would still be tentative in nature. In fact, we can hardly expect to prove statistically that any given relationship exists between for instance urban population and employment.

11. This follows from the simple fact that actual time-series' population data are extremely scarce; essentially we have only one set of observations available for each of the years in which population censuses were carried out, i.e. in this case for: 1971, 1981 and 1991. Three observations are hardly sufficient to allow for proper econometric treatment, statistical operations or similar. The proposed link between annual population movements and annual economic changes must therefore remain of a hypothetical nature, unsubstantiated by actual annual observations.

12. Finally, it may be mentioned that although the primary purpose of this paper is to prepare the above mentioned MEMBOT-annexe, numerical results derived from the present exercise are also included (see table A1[2]). These are based on official statistics covering the period up to the mid-90s, and on typical NDP8 assumptions for later years. As such they should be illustrative of the real situation. They are therefore presented to the public, not with the claim of perfection, but in the hope that they may be of interest to the students of urban developments, despite their shortcomings.

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[1] The Macro Economic Model for Botswana (MEMBOT) has been used by the Ministry of Finance and Development Planning for planning and forecasting purposes since the late 1970s. It is now due for a major revision.

[2] Tables A1, A2 etc. are found in the table annexe at the back of the paper.

Urbanisation

13. Few people are born to a life of "ease and fortune". Most have to *earn* a living in order to secure the means of existence for themselves and their dependants. Under most realistic circumstances, therefore, significant changes in the average standard of living etc. will result unless population and production "grow hand in hand".

14. In the traditional (and largely non-urban) society all but a few depended on agriculture for their survival. Today's urban population, in contrast, typically has to make their living outside the traditional sector; the option of "living off the land" is almost by definition denied them. People in urban areas consequently have to earn their livelihood in the "modern and monetary" sector of the economy.[3]

15. The above simple "truism" lies at the root of the present effort to link the growth of urban population to the corresponding growth in "modern sector" production and employment. As seen from an economic point of view, growth in urban population is to a large extent assumed to reflect a corresponding growth in urban employment. Without growing urban employment opportunities, the scope for urban population growth is largely restricted to the "demographic potential" of the existing urban population, i.e. to the growth of for instance average family (or household) size that follows from inherent fertility rates etc.

16. It may be noted that the above statement implies that we have made a definite choice with respect to the way in which we regard the underlying factors driving the urbanisation process. This approach seems a natural choice in Botswana's case, but it does not by any mean represent the only approach possible. In other parts of the world, rapid urban growth without a corresponding employment increase has been observed. Such urban growth, which tends to result in increasing urban poverty, consequently must be driven by underlying factors different from those proposed for Botswana.

17. To illustrate that urban population growth may spring from alternative sources, we shall shortly describe two different urbanisation scenarios. Urban population is affected by economic factors in both cases, but the ways in which these occur are rather different, as are the resulting effects upon the social fabric of urban society. For this purpose we distinguish between the following two types of "engines" driving the urbanisation process: the push and the pull factor.

a. The push factor:

18. People may be said to be pushed into urban areas, or rather out of the rural ones, if they are severely marginalised in their (original) rural setting, i.e. if they have to leave their original rural home because they can no longer make a living there. People thus "forced off the land" are however not ensured an adequate "escape" from poverty by moving to town. Urban employment opportunities may be scarce, and many of them may end up as unemployed slum-dwellers. The spread of such social evils as urban slums, poverty and crime will consequently tend to result when the push factor is at work.

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[3] This will in many, perhaps most, cases mean that they have to earn a living as wage employees. But *all* need not be so engaged; some may be self-employed. Thus, a trend observed in many urban areas around the world is the growth of various types of small scale, informal economic activities, often in response to a lack of formal employment opportunities.

19. The push factor may reflect a variety of underlying evils: the marginalised persons may have lost their access to land or other farming requirements, their earnings from agriculture may have dropped close to zero due to natural disasters, war and insecurity may have made the countryside unsafe, etc.

20. Such evils have been observed in many parts of the world, but they hardly apply in Botswana's case. Drought may seem a possible exception to this rule, given that it has made Botswana agriculture a precarious undertaking in most years. This, however, has been mitigated by the introduction of drought relief measures, making it possible to survive in the countryside even in the face of insufficient agricultural production volumes.

21. Neither do the expected manifestations of these evils, in the form of widespread and rapid "slumification" of the urban areas, appear to be particularly prevalent in Botswana's case. This is not to argue that urban poverty is non-existent. Extensive urban poverty and slums do exist in Botswana, and have done so for many years. The prevalence of these ills does not, however, appear to have increased markedly despite the extremely rapid growth of urban population recorded since 1981.

22. A recently published study of poverty in Botswana[4] indicates that the rate of urban poverty remained fairly stable, and comparatively low, during the period 1985/86 to 1993/94. Thus, as seen from table 1, the rate of severe urban poverty dropped from 10% in 1985/86 to 9% in 1993/94, both far below the parallel rural rates. The rate of moderate poverty was about twice as high, but also this was significantly below the parallel rural rates, and decreasing somewhat during the period.[5]

Table 1: Estimated national poverty rates (number of persons), 1993/94 & 1985/86

Degree of poverty	1993/94			1985/86		
	Urban	Urban Village	Rural	Urban	Urban Village	Rural
I : Severe	9%	29%	40%	10%	38%	51%
II : Moderate	19%	17%	16%	20%	20%	17%
III : Sum of above	29%	48%	55%	30%	58%	68%

Source: Study of Poverty and Poverty Alleviation in Botswana, table 3.4

23. These urban rates refer exclusively to the towns of Botswana. As will be pointed out later, the current definition of Botswana's urban population is inclusive of the population of these towns *as well as* of a number of the major villages. The poverty rates given for urban villages in table 1 may therefore also be of some interest.

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[4] Study of Poverty and Poverty Alleviation in Botswana. Ministry of Finance and Development Planning. February 1997.

[5] Poverty is here measured against a Poverty Datum Line (PDL), which represents a prescribed minimum standard of living. If the income of a given household is below its PDL, the household is said to be poor. Poor households with income below the food-component of the PDL are classified as severely poor. Other poor households are here referred to as moderately poor. For a further presentation of the PDL etc., see the above referred Study of Poverty and Poverty Alleviation in Botswana.

24. The degree of moderate poverty in urban villages is seen to be roughly similar to that found in towns (and in rural areas). Severe poverty, on the other hand, is quite widespread in the villages, much more so than in towns, although not so much as in the rural areas. Significant reductions in the rates of severe poverty were experienced during the period for both urban villages and rural areas.

25. All told, these data are not suggestive of a rapidly increasing "slumification" of the urban population. Instead they appear to suggest a sort of status quo situation, with urban slums and "non-slums" growing largely in tune. This relative stability seems suggestive of a situation in which the urban poor act as a sort of "urban-migration-buffer". The function of this buffer is discussed in the below.

b. The pull factor:

26. People are "pulled into" urban centres if they are "lured" by the prospects of a better life in these areas. The urban attraction may typically be based on the expectation that they will find work in the urban areas, and that this will earn them a better income than they can expect if they remain in the rural areas.

27. This does not necessarily imply that all urban migrants do in fact find work. Some will fail to do so, and may eventually have to return to their rural homestead. But a significant number of them will sooner or later succeed in finding work, and this will act as a beacon of hope to the many who share their dream of a better life.[6]

28. The fact that work is not assured, i.e. that it is the hope rather than the certainty of earning a better income that attracts people into towns, is reflected in the already stated fact that Botswana does have considerable urban slums, unemployment and poverty. But the fact that the relative degree of urban poverty has remained fairly constant during the last decade suggests that this pocket of poverty and unemployment serves as a kind of buffer between, on the one hand, the relatively well off urban employees, and on the other, the mass of migrant job-seekers.

29. To clarify the function of the buffer, let us for instance assume that its magnitude suddenly decreases while other factors remain unchanged. The prospect for actually obtaining work (among those seeking it) will then improve, as fewer people compete for the same number of jobs. In reaction, more job-seekers will flow into town, hoping for the easier-to-obtain jobs. This will again increase the size of the buffer until a balance between hope and discouragement is re-established.

30. Similarly if the buffer of job-seekers suddenly increases, while other factors remain unchanged. The chance of obtaining work will then decrease, as more people compete for the same number of available jobs. In consequence, fewer hopeful migrants will flow into town,

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[6] Ideas of this nature are well established in development economics. They were first introduced in the late 1960s and early 1970s, and are often referred to as the Harris-Todaro hypothesis. Thus, according to The New Palgrave Dictionary of Economics (Macmillan, 1994): "The motivation for the Harris-Todaro hypothesis lies in an attempt to explain the persistence of rural to urban migration in the presence of widespread urban unemployment, a pervasive phenomenon in many less developed countries. It is natural to ask why such unemployment does not act as a deterrent to further migration. According to the Harris-Todaro hypothesis, the answer lies in the migrant leaving a secure rural wage for a higher expected urban wage even though the latter carried with it the possibility of urban unemployment."

and more discouraged will leave town, thus reducing the size of the buffer until a balance between hope and discouragement is again re-established.[7] [8]

c. *Push contra pull*

31. In most realistic cases, the push and pull factors are not mutually exclusive. The push factor will often be associated with a certain degree of pull, and the pull factor with a degree of push. Alternatively, the one may be interpreted as an excessive form of the other. The two are therefore not altogether clear-cut alternatives to each other. Their intrinsic difference is more one of relative degree than of absolute nature, and it may be difficult to decide just how much push or pull is exercised in any given case. Nevertheless, the distinction between them serves a useful purpose, in so far as it clarifies some "archetype" forces driving the urbanisation process.

32. Consequently, one may argue that even in Botswana's case some degree of push is at work, for instance as a result of the drought conditions that have persistently troubled agriculture. However, drought relief programmes *have* been put in place, making it possible to survive in the countryside even in the face of insufficient agricultural yields. We therefore feel justified in concluding that the pull factor has by far been the most important driving force behind the rapid urbanisation process seen during later decades. Our present simple attempt to analyse this process is therefore based on this factor alone.

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[7] In the above we have, for the sake of simplicity of argument, discussed the urban unemployment buffer solely in terms of migration from rural areas. This is not, of course, to suggest that already established urban residents are immune against unemployment. Quite obviously they are not. However, even though established urban residents are subject to unemployment, this does hardly rule out migration. Rather, it will probable leave relatively less room for it.

Neither, of course, does the above arguments imply that migration is the only factor behind urban population growth, or that the internal growth-rate of the urban population can not in itself be an important factor. However, unless the net natural rates of increase is significantly different in urban and rural areas, they will not in themselves have much impact upon the overall urbanisation rate, i.e. upon the urban share of the nation's total population. Furthermore, even if the two rates of net natural increase should be different enough to significantly affect the urbanisation rate, this may be assumed to have no more than a modifying impact upon migration, allowing it a little less (or more) scope, in much the same way as already described above.

[8] Note that if the above description provides a correct interpretation of the process involved, unemployment will persist even if *all* of the currently unemployed persons should find work. The ranks of the unemployed would in this case be filled by an influx of fresh recruits, attracted by the prospect of finding employment. As seen in this perspective, unemployment is not merely a sign of a temporary lack of jobs for today's unemployed, but also the manifestation of an underlying, long-term structural imbalance between the income potentials offered in various sectors of the economy. Consequently, focusing on the urban/rural dimension, we may regard much of the rural work force, engaged in traditional low-income activities, as a long term pool of "reserve labour" for the urban and modern sectors of the economy. Migration and unemployment will continue to persist until this pool has been depleted. The latter may occur because the store of traditionally engaged workers has been depleted, or because income opportunities have been evened out between urban and rural activities.

A closer look at the growth of urban and rural population during recent decades

33. As already noted, the population of Botswana, especially the urban population, grew rapidly during the 1970s and 1980s. According to the published statistics (summarised in table 2) the nation's total de facto[9] population increased from 574,100 in 1971 to 941,000 in 1981 and to 1,326,800 in 1991, corresponding to an average (geometric) growth-rate of 5.1 % pa during 1971-81 and 3.5 % pa during 1981-91. Urban population grew much quicker, from 54,400 in 1971 to 150,000 in 1981 and to 606,200 in 19991, corresponding to average annual growth-rates of 10.7 % pa during 1971-81 and 15.0 % pa during 1981-91.

Table 2: Urban and rural population (de facto), 1971, 1981 & 1991

	Population number ('000)			Percentage distribution			Average % pa growth-rates	
	1971	1981	1991	1971	1981	1991	1971-81	1981-91
Gaborone	17.7	59.7	133.5	3%	6%	10%	12.9%	8.4%
Francistown	18.6	31.1	65.2	3%	3%	5%	5.3%	7.7%
Lobatse	11.9	19.0	26.1	2%	2%	2%	4.8%	3.2%
S-Phikwe	4.9	29.5	39.8	1%	3%	3%	19.6%	3.0%
Orapa	1.2	5.2	8.8	0%	1%	1%	15.8%	5.4%
Jwaneng	na	5.6	11.2	0%	1%	1%	na	7.2%
Sowa Town	na	na	2.2	0%	0%	0%	na	na
Total - towns	54.4	150.0	286.8	9%	16%	22%	10.7%	6.7%
Urban villages	na	na	319.5	0%	0%	24%	na	na
Total urban	54.4	150.0	606.2	9%	16%	46%	10.7%	15.0%
Total rural	519.7	791.0	720.6	91%	84%	54%	4.3%	-0.9%
Total national	574.1	941.0	1,326.8	100%	100%	100%	5.1%	3.5%

Source: CSO, Statistical Bulletin, June & Sept. 1996, Vol. 21 Nos. 2 & 3. Table 1.1.1

34. According to these statistics Botswana's urban population consequently grew at an average rate of 12.8 % pa during the period 1971-91, a very high rate of growth by any standard. However, inspecting the data of table 2 it is seen that the large majority of the people joining the rank of the urban dwellers during 1981-91 were living in villages rather than in towns. Thus, out of the total urban population increase from 150,000 in 1981 to 606,200 in 1991, villagers accounted for 70% (i.e. for some 319,500 out of the total increase in new urban dwellers of 456,000). In contrast, the population living in towns grew by 136,800, (i.e. from 150,000 in 1981 to 286,800 in 1991), corresponding to an average growth-rate of 6.7 % pa. This is still a very high rate of growth, but far below the 15.0 % rate recorded above.

[9] Botswana's de facto population includes all persons who were residents of Botswana at the time of the census. It includes non-citizen residents, and excludes citizens living abroad.

35. The inclusion of Botswana's major villages among the urban centres follows from the definition of urban areas adopted by the Central Statistics Office (CSO). According to the definition quoted in one of its recent Statistical Bulletin[10] a village is classified as urban provided it has a population of 5,000 or more, and less than 25% of its work-force is engaged in traditional agriculture. Following this definition nineteen villages were classified as urban subsequent to the 1991 census.[11]

36. According to the same source: "In 1971 the urban areas were the first five towns listed in the table. After the 1981 census, Jwaneng was also classified as urban, together with the villages of Tlokweng and Palapye." The last part of this statement is seen to be at variance with the estimates of table 2; it is readily seen from the table that Tlokweng and Palapye are excluded from the urban total reported. The inclusion of the urban villages into the urban category in 1991 may therefore be seen as a reclassification of these villages, a reclassification brought about by the rapid growth of Botswana's major villages, and the increasingly non-agricultural character of their economic base.

37. Although the recent CSO estimates of urban population reported in table 2 exclude all urban villagers for years before 1991, CSO estimates published in earlier years did in fact include Tlokweng and Palapye in the urban group. Thus, data published during the 1980s classified the population of these villages as urban both for 1971 and 1981 (see table 3). This, however, is incorrect according to the above referred definition, which states that the urban areas of 1971 should only include the five towns then existing in Botswana.

Table 3: Population estimates for 1971 & 1981

	Population number ('000)	
	1971	1981
Gaborone	17.7	59.7
Francistown	18.6	31.1
Lobatse	11.9	19.0
S-Phikwe	4.9	29.5
Orapa	1.2	5.2
Jwaneng	na	5.6
Tlokweng	3.9	6.7
Palapye	5.2	9.6
Total urban	63.5	166.3
Total rural	510.6	774.8
Total national	574.1	941.0

Source: CSO, Statistical Bulletin, June 1987, Vol. 12 Nos. 2. Table 1

38. The inconsistencies pointed out above are in most respects marginal and unimportant. Nevertheless, they do represent a source of confusion. As such it may be useful to put on

[10] See table 1.1.1, Statistical Bulletin, June 1996 & Sept. 1996, Vol. 21 Nos. 2 & 3. Published Feb. 1997.

[11] The nineteen villages classified as urban were: Bobonong, Gabane, Ghanzi, Kanye, Kasane, Letlhakane, Mahalapye, Maun, Mochudi, Mogoditshane, Molepolole, Moshupa, Palapye, Ramotswa, Serowe, Thamaga, Thlokweng, Tonota and Tutume.

record the correct set of population estimates, derived by faithfully adhering to the earlier cited CSO definition.

39. Table 4 presents the revised set of population estimates for 1971, 1981 and 1991. These are largely the same as given in table 2; essentially only the 1981 urban population total differs. Thus, as in table 2, Botswana's total (de facto) population is seen to have increased from 574,100 in 1971 to 941,000 in 1981 and to 1,326,800 in 1991, implying average growth-rates of 5.1 % pa for 1971-81 and 3.5 % pa for 1981-91.

40. The revised urban estimates show that total urban population grew from 54,400 in 1971 to 166,300 in 1981 and to 606,200 in 1991, corresponding to average annual growth-rates of 10.8 % pa during 1971-81 and 13.8 % pa during 1981-91. Population growth in towns accounted for nearly all urban increase during 1971-81, while the reclassification (and growth) of major villages accounted for the lions share of the urban population growth during 1981-91.

41. But even disregarding this reclassification effect, urban population grew quickly, suggesting the existence of significant net migration from the countryside towards the towns. Thus, population in towns grew by 6.7% pa on average during 1981-91. Although a far cry from the 13.8% pa estimated for towns and major villages combined, this is in itself an impressive figure.

Table 4: Revised population estimates, 1971, 1981 & 1991

	Population number ('000)			Percentage distribution			Average % pa growth-rates	
	1971	1981	1991	1971	1981	1991	1971-81	1981-91
Towns	54.4	150.0	286.8	9%	16%	22%	10.7%	6.7%
Urban villages	na	16.3	319.5	0%	2%	24%	na	34.7%
Total urban	54.4	166.3	606.2	9%	18%	46%	11.8%	13.8%
Total rural	519.7	774.8	720.6	91%	82%	54%	4.1%	-0.7%
Total national	574.1	941.0	1,326.8	100%	100%	100%	5.1%	3.5%
Memo: Urban villages + Total rural	519.7	791.1	1,040.1	91%	84%	78%	4.3%	2.8%

Source: table 2 and 3 above.

42. The revised rural estimates "mirror" the urban ones. They show that the rural population grew from 519,700 in 1971 to 774,800 in 1981, but dropped to 720,600 in 1991. This corresponds to average annual growth-rates of 4.1 % pa during 1971-81 and -0.7 % pa during 1981-91. The reclassification of urban villages is the major factor explaining the rural population decrease during 1981-91, but regular migration-to-town must also have played a significant role. This is indicated by the last line of table 4, which shows that even if the urban villages had retained their rural classification, total rural population would only have grown by 2.8% pa during 1981-91. This rate is significantly below the overall national average of 3.5% pa and far below the 6.7% pa rate in towns.

Implications of the definition of urban areas

43. The adopted definition of urban population seems quite reasonable, given that a fairly large share of the Botswana population has tended to congregate in villages, that quite of few of these villages has tended to have fairly large populations, and that they have grown increasingly urban and non-agricultural in character over the years.

44. However, the adopted definition presents our current attempt (at forecasting the post-1991 urban population) with a significant problem. This is because the definition makes for sudden, significant shifts in the urban population estimates. Thus, a given village, and all its inhabitants, will be classified as rural "no matter what" until the critical limits (of 5,000 inhabitants, and 75% non-agricultural work-force) are reached. Thereafter, a marginal increase of a single inhabitant or employee will cause the village and all its inhabitants to be reclassified as an urban area.[12]

45. For prediction purposes such sudden, large shifts are problematic to handle. Ideally we would prefer to deal with smooth and continuous relationships, i.e. relationships in which a marginal development in the independent variable results in a marginal response in the dependent variable. Such simple relationships can clearly not handle discrete events like urban population changes brought about by reclassification of whole groups of people; a much more complex model will be required to capture the nature of these developments.

A simple "urbanisation model"

46. In the following we shall present an extremely simple "urbanisation model", or rather: a simple framework for estimating the urban population totals of Botswana. It is recalled from the above discussion of push and pull factors that the latter is held to be the dominant force behind Botswana's present "urban drift". Essentially, therefore, the model treats the "internal growth" of the urban population as a dependent variable, "driven" by the growth in a few central economic variables, which represent the employment and income opportunities on offer in urban centres.

47. The term "internal growth" as used above refers to population growth within already *existing* urban areas. As already explained, this is not the only determinant of urban population growth. Total urban population may also increase as a result of "external shift", i.e. as a result of reclassification of major villages. During the period 1981-91 this was in fact the major factor behind the rapid urban growth then recorded. The "internal growth" and the "external shift" are discussed in further detail below.

48. The manifestations of the urban population growth process, which we occasionally will call the urbanisation process for ease of reference, are illustrated in tables A1 and A2.

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[12] The 75% non-agricultural work-force criterion may, at least in theory, be a source of classification instability in its own right. Some village dwellers will presumably refrain from engaging in agriculture during drought years, thus effectively reducing agriculture's share of the total work-force. In good rain-years, on the other hand, they may again turn to agriculture, thus increasing agriculture's share of the total work-force. It is therefore theoretic possible that villages bordering on the "25% agriculture" limit may be urban in drought years, and rural in rain years.

Table A1 gives numerical results illustrating the outcome of the process for a given economic growth scenario, while table A2 details the calculation formulas producing the numerical results.[13]

49. Table A1 is seen to give estimates for the entire period 1971 - 2001; i.e. it covers not only the "prediction period" following the 1991 Population Census, but also the two decades prior to 1991. The inclusion of the latter may seem superfluous, there being little apparent need to "forecast the past". However, the urban population total is an unknown quantity also for most years before 1991, the only solid evidence at hand being the population data referring to the census years 1971, 1981 and 1991. By including the whole period in our analysis we therefore obtain a series of annual estimates covering the urban (and rural) population of these years.[14] These may be interesting in themselves, but perhaps more important for the present purpose is the fact that we use these years to "calibrate" and test the model.

a. External shift

50. Trying to forecast the number and magnitude of future reclassification shifts with any degree of confidence would in principle be difficult, requiring a much more extensive model than the simple framework described in the present paper. Fortunately, the problem faced may not in practise be too big, as long as we limit our effort to the task of making a rough guess about how many village-dwellers will be reclassified following the 2001 Population Census.

51. This is because the larger part of the rural-to-urban reclassifications that can realistically be expected to materialise before year 2001 has already been effected. In other words: the very extensive number of reclassifications made as a result of the 1991 census appears to leave us with relatively few "promising" reclassification- candidates for the decade following 1991.[15]

52. To illustrate this point, table A3 summarises some pertinent data for all Botswana villages with 3,000 inhabitants or more in 1991. The minimum of 3,000 inhabitants was chosen because a village of this magnitude appears to have a realistic chance of reaching a population-total of 5,000 by year 2001, i.e. of meeting the urban classification criterion.

53. A total of 362,000 people lived in these villages in 1991, out of which 320,000 have already been classified as urban, while 42,000 remain in the rural category. Unless we are willing to assume annual population growth-rates in excess of 5% pa throughout the whole period 1991-2001, the potential for reclassification shifts in year 2001 is therefore limited to a 1991 population-base of only 42,000. This is considerably less than for the reallocation shifts of 1991, which had a 1981 population-base of approx. 185,000.

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[13] Note that the model is constructed in a Lotus 123 spreadsheet, and that the formulas are presented in terms of Lotus 123 spreadsheet syntax.

[14] Strictly speaking, even the nation's *total* population is unknown for years between censuses. But these totals will show a relatively "stable" growth pattern, and can as such be estimated on an annual basis directly from the census data with considerable confidence. In the present paper we use the annual population estimates and projections prepared and published by the CSO.

[15] This is not, of course, to imply that the general drift towards more concentrated and urban types of settlements will come to a halt, only that the number of villages that will actually pass into the urban category during the period 1991-2001 seems likely to be rather lower that was the case for the period 1981-1991.

54. Table A3 also provides an attempt to forecast developments in the villages making up the 1991-base. In so doing we have attempted to take into account both population size and employment structure. This is of course a rather complicated task, and the resulting estimates are necessarily quite rough. Such as they are, however, they seem to indicate a possible overall reclassification shift of some 33,600 people in 2001.

55. Consequently, whereas the 1991 Population Census saw a total of 286,800 persons being reclassified from rural to urban, we will assume that only 33,600 persons will be reclassified as a result of the 2001 census. Admittedly, this is no more than a rough guestimate, and at less than 12% of the 1991 figure it may seem unduly low. However, although our analysis is both uncertain and rough, it does seem to indicate fairly conclusively that the potential for reclassifications in year 2001 will be rather limited. Due to the relatively small size of the above discussed 1991-base, the absolute magnitude of these reclassifications seems unlikely to be very different from what we have guestimated.

56. Above we have discussed the magnitude of reclassification shifts, i.e. the magnitude of discrete shifts in the urban population-total. By nature these shifts refer to given census years only, and we may for many purposes leave it at that. If so, however, we may have to accept that any annual time-series' estimates covering the urban population may take on a distinctly jumpy appearance, looking a bit like a staircase: rising abruptly in census years and remaining comparatively flat between census years. This may make the data unsuitable for various analytical purposes. Table A1 therefore also presents the data in a smoothened form. The smoothing has been done using the simplest of formulas: each discrete shift is distributed evenly (in absolute terms) over the whole preceding period.[16]

b. Internal growth

57. The adopted assumption about the pull factor having been the dominant force behind the "urban drift" observed in recent decades implies that the urban growth process has been driven by growing urban employment and income opportunities, perhaps especially for low or non-skilled workers. The former variable is consequently seen as a function of the latter. In mathematical form we may express the relationship between the two as follows:

Internal growth = F(employment and income opportunities)

where: Internal growth refers to population growth within already existing urban areas.
F(.....) symbolises the functional relationship between the two variables.

58. The above formula is of a general and unspecified form, merely indicating that a structural relationship exists between variables expressing developments in urban population, and employment and income opportunities in urban areas. In order to advance beyond this general statement, we must provide concrete specification of the F(.....)-function, and of the types of variables in question. This is the topic of the next chapters.

i. Inputs data

59. Time series data for Formal Employment and Compensation of Employees are available from various CSO publications. Intuitively, either would appear well suited to represent

[16] Note that in so doing we wilfully militate against the provision that the minimum number of villagers that can actually be reclassified in "one go" is 5,000.

the input variable of our urbanisation-function, i.e. the urban employment and income opportunities. However, none of these data are ideal for our current purpose. Firstly, because they refer to the country as a whole, not only to the urban areas. Secondly, because they include agriculture, an economic activity few urban residents engage in.

60. They also exclude some incomes and activities relevant to the current purpose. Thus, the data on formal employment are exclusive of employment in non-formal activities, while the data on compensation of employees are exclusive of incomes from other sources than employment.

61. Ideally, of course, we ought to use data that accurately measure the relevant employment and income opportunities in urban areas. Such data, however, are not readily available. We therefore have to rely on the available CSO statistics, but will nevertheless try to exclude the most obvious "irrelevancies" from them. The agricultural element has therefore been excluded from both series of data.

62. This leaves us with two alternative sets of input estimates. None is ideal for our present purpose, but both are presumably quite useful substitutes for the data that we would ideally have desired. Both may however have suffered from occasional "lapses" with respect to their internal accuracy and consistency over time. Thus, National Accounts statistics, including Compensation of Employees statistics, are only available on a provisional basis for some years, and their internal consistency over time is adversely affected by the fact that estimates have been revised, but for later years only.

63. The employment statistics are also subject to a degree of uncertainty; data coverage has undoubtedly varied over the years. Neither do they always correspond too convincingly to National Accounts statistics, in respect of annual growth rates and similar. This, however, may equally well be due to weaknesses in the National Accounts statistics. It is not a priori obvious which of these series is the more reliable and representative in each particular incidence. This being the case, we have chosen to combine the two in the form of an average, the magnitude of which we use to represent the level of urban employment and income opportunities.

64. The two types of data, however, can not be averaged directly. This follows from the simple fact that they have different denominations: one is measuring "Pulas earned" and the other "persons employed". The averaging of the two is therefore not based on absolute data, but on the corresponding annual growth rates. It follows that the resulting estimates, used as input into our urbanisation formula, are also expressed as % pa growth-rates.

ii. Output data

65. The output variable resulting from the urbanisation formula has hitherto been referred to as the internal growth. This is short for: the growth in Botswana's total urban population that occur within the existing set of urban localities, i.e. exclusive of any population changes due to reclassification of villages. The output variable is expressed in the same way as the input variable, i.e. it is expressed in terms of a % pa growth-rate.

iii. Functional form

66. The functional form adopted in the current paper is extremely simple: the output variable is the product of the input variable multiplied by a coefficient (C). Hence:

Input variable = C * Output variable[17]

where: Output variable = growth-rate representing internal urban population change;
Input variable = growth rate representing the underlying economic variables, i.e. employment and income opportunities;
Ç = coefficient representing the ratio by which annual percentage changes in the underlying economic variables "translates" into corresponding annual percentage changes in the urban population.

67. The magnitude of the coefficient C, which we will call the urban growth coefficient, can be estimated for the period 1971-91, using urban population totals and available statistics in respect of the economic variables chosen to represent the "driving" forces behind the urbanisation process. In doing so, however, a problem arises; population estimates are only available for the three years when Population Censuses were held, i.e. for the years 1971, 1981 and 1991. The implied equation system is therefore under-determined, meaning that a unique set of C-estimates can not be identified. To overcome this problem we have to put restrictions on the permissible value of C. This is achieved by specifying a time-series profile to which all annual C-values have to adhere.

68. In the present case, the adopted time profile prescribes that the C-values within each of the two ten-year periods (1971-81 and 1981-91) remain constant. The C-estimates thus calculated are given in table A1, where it is seen that both sets of estimates turn out at approximately 0.6. In other words: each percentage increase in the underlying employment and income variables has on average translated into 0.6 % increase in urban population during the period 1971-91.[18]

69. No growth coefficient estimates may be calculated for years subsequent to the latest census year (1991). For these years the value of the growth coefficient must be given exogenously. The values thus specified represent important fundamentals for the urbanisation estimates and forecasts produced for these years.

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[17] This great simplicity of approach is necessitated by the fact that we have extremely few actual observations of the urban population total.

[18] This result may perhaps on first impression seem unacceptably low. Assume, for instance, that employment and incomes move "in step", so that we can depict the "underlying driving factor" in terms of the employment variable alone. If so, we have found that the urban population growth is little more than half of the corresponding employment growth. "But surely", one may protest, "population growth must exceed employment growth, since the average employee tend to support a number of dependants". However, it is recalled that the above result refers to *growth-rates*, i.e. to relative, not absolute changes. There is a significant difference of scale between population and employment totals, with the former typically being much larger than the latter. A 0.6% increase in population may therefore easily translate into more persons than a 1.0% increase in employment.

When evaluating the above result it should also be noted that the urban population totals used to estimate the C-values are exclusive of the village reclassifications made subsequent to the 1991 Population Census. It should furthermore be noted that the employment and income data used are not restricted to urban activities, but cover all relevant (non-agricultural) activities throughout the whole country. Quite a lot of these activities was located outside the pre-1991 urban areas. For instance, table A4 shows that about half of all formal (non-agricultural) employment was located outside these areas in 1991.

70. Specifying the appropriate C-values would appear quite a difficult task, given that we essentially have to make guesses about peoples' future expectations and perceptions. To simplify matters, however, we may be guided by the coefficient values already estimated for earlier years. In the absence of any evidence to the contrary, we may often allow ourselves the luxury of assuming that the immediate future will be much like the recent past, i.e. in this case that the growth coefficients of years after 1991 will be largely in line with those already calculated for the years before 1991.

71. In the present case, however, this comforting "rule of thumb" should not be adopted out of hands, because we know that something fairly dramatic happened to the urban population total in 1991. In earlier years these totals included almost exclusively town dwellers, but following the 1991 Population Census this changed significantly. Thereafter, the term urban population referred to towns and village dwellers alike, approximately on a 50/50 basis. As seen from table A4 such factors as the average number of people "supported" by each person employed varies greatly between towns and villages. The question consequently arises whether the 1991 reallocation of major villages into the urban category may not have substantially changed the value of the growth coefficient.

72. To study this question, table A5 provides a rough one-factor analysis of the likely reclassification effects. The analysis is based on a simple and partial approach, linking urban population solely to employment, i.e. ignoring the income variable. This simplification allows us to "compare like with like", i.e. to compare the number of urban dwellers to the number of persons employed. The analysis suggests that the growth coefficient may not have changed dramatically as a result of the inclusion of major villages into the urban category. Nevertheless, it does suggest a minor increased. An urban growth coefficient of 0.65, i.e. slightly higher than the coefficient of 0.60 estimated for earlier years, was therefore adopted for the period 1991-2001.

c. Estimation results

73. Our calculations suggest that slightly less than half of all Botswana residents will live in urban areas in the year 2001. Thus, the results given in table A1 indicate that some 46.5% of the nation's total (de facto) population will by then live in the country's currently existing urban areas. In addition, villages containing some 2.0% of the nation's population seem likely to grow into urban-type settlements. A majority of urban residents will live in urban villages, not in towns.

74. The 48.5% urban population share projected for year 2001 is higher than the parallel share of 45.7% recorded for 1991, but it is not much higher. The days of extremely rapid urbanisation of Botswana's population therefore appear to be all but over; henceforth we may expect to see urbanisation proceeding at a more moderate pace, i.e. a more moderate pace than during the years leading up to 1991.

75. A slower rate of urbanisation does not, of course, imply that the corresponding absolute population numbers are negligible. On the contrary; as long as the nation's overall population continues to grow quickly, the number of urban residents will do the same, otherwise the urban share of the total population will decrease. For many purposes, it is these absolute population estimates, rather than the urbanisation rates, that are of importance.

76. Inspecting table A1 we find that the total urban population is expected to grow from 606,200 in 1991 to approx. 821,600, i.e. by around 215,000. Some of this increase will be due to reclassification of villages, but even if we disallow for these reclassifications we are left with a net increase of some 182,000. This is in itself a very substantial number, corresponding to nearly 2/3 of the total 1991-population in all Botswana towns. The implications in terms of additional urban housing, water, schools requirements etc. may therefore be quite substantial, even though the rate of urbanisation remains fairly constant.

77. Table A1 also indicates that the rural population total may be expected to grow from some 720,600 in 1991 to approx. 872,000 in 2001, i.e. by around 151,000 over the period. Although this figure in absolute, and especially in relative, term is smaller than its urban counterpart, it nevertheless implies that the rural areas will have to accommodate a significantly higher number of people than ever before.

78. A pertinent question is therefore if and how the additional people may be accommodated within the rural economy. Can or will these people become productively engage in agriculture or other rural activities? Or will a general rise in people's expectations mean that the rural population increase coincides with a decreasing willingness to engage in low-income activities such as agriculture? And if so, will not this make them even more eager to migrate to urban areas in search of wage employment than here allowed for?

79. The answer to these questions will have obvious implications for the validity of our estimates. For instance: if increased rural population pressure results in increased migration towards urban centres, the likely implication is that the magnitude of the urban growth coefficient (C) will *ceteris paribus* increase over time. The obvious manifestations of such an increase will *(ceteris paribus)* be a reduction in the rural population and an increased in the urban, but also an increase in urban poverty and unemployment.

d. Sensitivity analysis

i. Sensitivity analysis wrt the urban growth coefficient

80. In the above section we have suggested that the magnitude of the C-values used in table A1 for years after 1991 may be open to discussion. By doing so we have merely stated the obvious; i.e. that forecasting is an inherently risky business. By its very nature it is based on uncertain assumptions, and especially so in the present case, which reflects fairly subconscious mechanisms of expectations and perceptions. The possibility that a different set of growth coefficient values ought to have been chosen is therefore very real.

81. In general terms the effect of adopting a different coefficient value is obvious. A higher growth coefficient will give a larger urban population, and a lower coefficient a smaller population, provided that the growth coefficient itself is positive. But how much larger or smaller? In the following we shall try to illustrate the magnitudes involved.

82. Section A of table A6 contains estimates relating to a number of alternative growth coefficient values. Only the growth coefficients differ between the various alternatives, all other magnitudes are kept constant, and equal to their magnitude in table A1, throughout the whole exercise. Table A6 also gives the absolute and relative deviation from the central value

of each of the alternatives estimated. The central value is the estimate calculated in table A1, i.e. using a growth coefficient of 0.65.

83. The table shows that an increase from 0.65 to 0.72 in the growth coefficient, i.e. a 10% increase from the central value, will result in 20.600 additional urban inhabitants by year 2001.[19] This causes the urban population ratio to grow from 46.5% to 47.7%, i.e. by 1.2% in absolute terms. The corresponding relative increase in the urban population itself, and in the urban share of the total population, is 2.6%.

84. A 10% decrease from the central C-value is seen to give fairly similar negative effects. A 10% change in the magnitude of the growth coefficient (C) consequently gives rise to a mere 2.6% change in the urban population. It might therefore appear that our estimates are fairly robust, i.e. that they are relatively unaffected by variations and mis-spesification of the growth coefficient.

85. However, before drawing any conclusion to this effect we should first address the question of whether or not a 10% change in the growth coefficient is in itself a noticeable change when compared to the C-value's own internal field of variation. Assume for instance that the growth coefficient can realistically be expected to vary widely, and that we do not really know if the C-value ought to be 0.65 or 0.30 or 1.00. The above sensitivity analysis has then obviously covered no more than a narrow band of C's inherent variation potential.

86. Rather than conclude that our results are fairly robust with respect to variations in C, we may then be forced to draw the opposite conclusion. Because, if the above described scenario applies, we have only learned that a fairly insignificant change in the adopted C-value produces a minor change in the urbanisation estimates. But this does not really allow us to conclude that the latter is non-sensitive to changes in the former. Non-sensitivity ought to imply that a significant change in the C-value results in an insignificant change in the urbanisation estimate.

87. We may try to provide a tentative illustration of the likely range of possible C-values. To do so we make a rough and simple calculation, based on the same idea as presented in table A5. Hence, we simplify the adopted estimation formula, by permitting the input variable to be represented by the employment data alone. This allows us to compare the formula's inputs and outputs directly (in terms of employed and urban persons). The data used in the below refer to 1991, and are taken from various tables previously introduced.

88. The total number of urban residents in 1991 was approx. 606,200, and the total number of formally employed persons outside agriculture 219,200.[20] The latter figure refers to the

[19] Note that the urbanisation estimates quoted for year 2001 are exclusive of possible reclassification effects throughout the whole sensitivity analysis exercise.

[20] It may be noted that the non-agricultural employment total given by the 1991 Population Census is 282,300 (see table A4), i.e. significantly higher than the figure of 219,200 used here. The latter is copied from the formal employment data attached to table A1. It is not immediately clear how much of this difference is due to informal employment, and how much to other factors. Even so, however, we have allowed ourselves to adopt the urban employment ratio of the census data, there being little or no alternative data available.

The fact that our adopted employment data may quite possibly be excluding a very substantial source of employment is of course unfortunate. Nevertheless, we have, as earlier explained, to use them, since more appropriate time series data are not available. Luckily, this may not be as much of a problem as it may appear at first glance. Thus, it is recalled that the input-data required for our calculations reflect the growth-rate, not the absolute level, of the employment variable.

whole country; formal employment is of course not restricted to urban areas only. According to the 1991 census some 70.8% of all non-agricultural employees were working, and presumably living, in urban areas. Applying this percentage to the above total, we get an urban total of 155,200 formal sector employees.

89. The 606,200 urban residents were consequently supported by 155,200 formal sector employees. Therefore:

- Each percentage increase in total urban formal employment implies an absolute increase of 1,552 persons.
- The average ratio between population and formal employment is approx. 3.9.[21]

90. In the above we have established the magnitude of the *average* ratio between population and formal employment. For our current purpose, however, we need the corresponding *marginal* ratio. The two types of ratios can not in general be assumed of equal magnitude.

91. The question therefore has to be addressed: how many *additional* urban residents will each *additional* urban employee on average bring. Or, expressed differently: how much will the urban population on average tend to grow as a result of a growing number of urban employment opportunities.

92. Ignoring the unlikely case of a negative population reaction to employment growth, the minimum ratio between population and employment increases is in theory nil. This, however, would imply that all new employees are recruited from formerly unemployed urban residents, that they do not bring their family or relatives "to town" to join them in their newfound fortune, and that no new entrants fill their former place in the rank of the urban unemployed.

93. This seems a rather unlikely scenario. We have previously argued the case for the pull-hypothesis, which implies that any increase in urban employment opportunities will tend to attract fresh migrants in search of employment, thus maintaining an "unemployment buffer". Neither is it supported by the statistical evidence at hand. Scant though it is, it still seems to suggest that urban unemployment has remained high despite a steady growth of employment opportunities. In all probability therefore, each new urban employment opportunity will on average tend to create *at least* a similar number of urban residents.

94. Let us assume that each new urban job does on average create for instance two additional urban residents. We may then calculate the corresponding growth coefficient (C) value as follows:

- A 1 % increase in the urban employment total gives an absolute increase of 1,552 persons employed.
- With a population/employment-ratio of 2.0 this translates into a total of 3,104 additional urban residents.
- The latter amounts to 0.51% of the urban population total of 606,200.
- The urban growth coefficient (C) value is consequently: 0.51.

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[21] It may be noted that in table A4 the average 1991 number of urban residents per non-agricultural employee is gives as 3.0 (for the aggregate of all areas classified as urban following the 1991 census). This, however, refers to *total* (non-agricultural) employment, while the employment estimate adopted above refers to *formal* employment only.

95. We may calculate the C-values for other population/employment-ratios in the same way. Table 5 gives C-values corresponding to population/employment-ratios varying from 1.0 to 4.0, i.e. from a "minimum" implying that each new urban employment opportunity brings one new urban resident, to a "maximum" a little in excess of the above calculated average population/employment-ratio.

Table 5: Alternative population/employment-ratios and their urban growth coefficients, 1991

Urban population/ employment-ratio	Urban growth coefficient (C)	Deviation (%) from central C-value
1.00	0.26	-60%
1.50	0.38	-41%
2.00	0.51	-21%
2.50	0.64	-2%
3.00	0.77	+18%
3.50	0.90	+38%
4.00	1.02	+58%

96. Although all of the above alternatives (and more) are theoretically possible, they are not equally likely. To pinpoint the most feasible range would however be a difficult task, given the complex underlying mechanisms of expectations and perceptions at work. Setting feasible limits for the growth coefficient will therefore have to be a matter of conjecture. All told, it seems to the present author that the most likely range of population/employment-ratios may be: 2.0 - 3.0, but also that the possibility that it may extend to: 1.5 - 3.5 should not rule out.

97. It is recalled that our above discussed sensitivity estimates reflected a 10% change in the C-value, i.e. on a change from 0.65 to 0.72 or 0.59. In view of the above argument, we may therefore infer that these changes only cover part of the C-value's likely area of variation. Although no firm evidence is at hand to support such a conclusion, it does nevertheless seem likely that variations of 20% around the central value are quite probable, and variation of 40% quite possible.

98. All told, we therefore end up with the tentative conclusion that the magnitude of the C-value is in itself rather uncertain, and that we must expect urbanisation estimates derived from it to be relatively sensitive to variations in it, i.e. sensitive to *a priori* likely variations in the C-value within the range of uncertainty affecting these coefficient values.

ii. Sensitivity analysis wrt the underlying growth factors

99. We may also investigate the effect of altering the magnitude of the input variable, i.e. of the "underlying growth factor". Section B,I of table A6 provides some pertinent estimates. The central values are in this case calculated using an underlying economic growth factor of 5.5% pa for the whole period 1991-2001. Only the magnitude of this input variable is allowed to change throughout our analysis; all other data etc. are the same as in table A1, including the growth coefficient, which is kept constant at 0.65.

100. The table shows that if the magnitude of the input variable is increased by 0.5 percentage point from the adopted central value, i.e. from 5.5% pa to 6.0% pa, the result is a total of 27.400 additional urban residents in year 2001. Such an increase will cause the urban population ratio to grow from 50.9% to 52.5%, i.e. by 1.6% in absolute terms. The corresponding relative increase in the urban population itself is 3.2%. A similar decrease in the magnitude of the input variable, i.e. from 5.5% pa to 5.0% pa, is seen to result in fairly similar negative effects.

101. A 0.5 percentage point change in the input value corresponds roughly to a 10% change in the adopted central value of this variable. Given that the resulting percentage changes in the urbanisation variables are much smaller, it may appear that our estimates are fairly robust with respect to variations in the underlying growth factor. However, before drawing any conclusion to this effect, we must, as in the above discussed case, ask ourselves if a 0.5 percentage-point change in the central growth rate is in itself a large or a small change.

102. Historically, Botswana's growth-rates with respect to employment and compensation of employees have tended to be comparatively high, but they have also varied considerably from year to year. Significant variations must be expected to affect also the years ahead. As judged against these potential variations, a 0.5 percentage point change seems small. Economic forecasts will in general be subject to a much larger degree of uncertainty.

103. The lower and upper alternatives inspected in table A6 (i.e. 3.5% pa and 7.5% pa) may perhaps serve to provide a more realistic impression of what the future may possibly bring. As seen from table A6 (section B,I) a 2.0 percentage point decrease in the input variable, i.e. from 5.5% pa to 3.5% pa, implies a reduction of more than 100,000 urban inhabitants, and a decrease of 6.0% in the direct urbanisation ratio. A 2.0 percentage point increase in the input value from 5.5% pa to 7.3% will bring even larger changes.

104. All told, we therefore feel impelled to conclude as we did in the above chapter. The adopted input estimate is in itself rather questionable, and the urbanisation estimates derived from it are quite sensitive to realistic variations in it.

105. Above we have studied the effect of altering the growth coefficients for the whole period: 1991-2001. This may be seen as a "theoretical inspection" of the model as concerns its inherent sensitivity with respect to the input variable. For actual forecasting purposes, however, the fact has to be taken into account that the earlier part of this period is today already history, covered by actual statistics. Realistically speaking, therefore, we are only at liberty to introduce our alternative input assumptions for the later part of the period, i.e. the years for which no official statistics are at hand, if our aim is to predict urbanisation ratios towards year 2001. In section B,II of table A6 we have done so.

106. The estimates are again compared to a set of central values, which also in this case are calculated from an input growth-rate of 5.5% pa. This rate, however, is only introduced for the last half of the period: 1991-2001. The same is true for each of the alternative growth-rates introduced. In all other respects the results reflect the data of table A1, including the input data for the first half of the period.

107. Our sensitivity analysis consequently only covers the growth rates for the prediction period proper. Since this is only 5 years, and since we use 2 year moving averages, we must

expect relatively minor effects to emerge from our analysis, as compared to the effects found in section B,I.

108. The data given in section B,II bear this out. Thus, a 2.0 percentage point decrease in the input variable, i.e. from 5.5% pa to 3.5% pa, is now seen to produces a reduction of less than 50,000 urban inhabitants (compared to more than 100,000 urban inhabitants in the above case), and a decrease of 2.8% (rather than 6.0%) in the direct urbanisation ratio.

109. Consequently, the effect of changing the input variable is more than 50% reduced as compared to the above scenario, but they still remain quite substantial. Also from a practical forecasting point of view, the estimates derived are therefore quite sensitive to possible variations in the input variable.

110. Summing up, therefore, the urbanisation estimates etc. calculated illustrate the likely developments in these variables under given scenarios, but the should not be taken as gospel truth. In an overall assessment they are not too robust, not because they are particularly sensitive to *given* variations in the growth coefficient or input variable, but because both the latter are subject to considerable uncertainty and a fairly wide margin of error.