

Urban transport and poverty patterns in selected Islamic countries

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Abstract

The objective of the study reported herein was to shed some light on transport and poverty patterns for some selected urban areas, in Islamic countries, during the last decade. In order to facilitate the urban poverty eradication, the study is an attempt to provide clues and empirical evidences of the possible interrelationships between urban transport and urban poverty. Using centralized databases of international agencies, for the period of 1993 to 1998, for a set of Islamic cities, urban information pertinent to transport and poverty was collected. The study database consisted of information regarding population, poverty, travel behaviour and other pertinent social, environmental and economic attributes of the selected urban areas. The database univariate statistical analysis provided clues on data validation and completeness. Due to data inaccessibility, incompleteness and missing, around one-third of the original set of cities were screened and selected for final detailed analysis. The multivariable statistical analyses for the finally selected cities showed interesting results and relations in connection with urban transport and urban poor, and facilitated mathematical modelling. For the period of 1993 to 1998, elasticity's of urban poverty with respect to urban transport were developed. The elasticity's provided further clues into urban transport and urban poverty trends, and were used in taxonomy of the Islamic urban areas. The appraisal of developed elasticity's reflected considerable time-series variations during the 6-year period of 1993 to 1998. To support urban sustainable development, the study corroborated the significance of urban transport intervention challenges if they are expected to play proactive roles in urban poverty reduction and alleviation.

Keys-words: *transportation, urban sustainable development, poverty eradication, and Islamic countries.*

1. Introduction

Urban transportation sustainable development entails distributional and social equity. Social and distributional needs are met by ensuring a fair distribution of resources and poverty reduction. The United Nations Millennium Declaration of year 2000 encompasses several goals including eradication of extreme poverty and hunger. The Millennium Declaration Goals pledge especial attention for poverty alleviation in development policies and projects. Poverty is a multidimensional and fuzzy concept, portraying the lack of the economic, social and cultural means necessary to procure acceptable levels of living and liveliness. Locally defined poverty line or low-income line, often have been deployed to ascertain population breakdown of the poor. Transportation is a key sector for economic and social development, providing mobility and accessibility. Transportation should provide services for all social groups. Transportation projects in general affect various income groups differently; nonetheless, they should accomplish a balance between economic growth and social justice, especially in reduction of the number of poor households. Inadequacy of access and mobility is a signifying attribute of the poor, penalizing them from economic and social opportunities (Gannon & Zhi 1997; UNESCAP 1999). The existing level of understanding of the relationships between poverty and transportation is very limited and the methods for addressing transportation problems of the poor are severely underdeveloped.

In urban areas, economic and social activities are to a large extent more spatially concentrated than in rural areas. The intense time and location proximity of interactions require more distinctive cyclic behaviors, often on daily basis, and entailing efficacious urban transportation. The intensive proximity of activities makes non-motorized transportation occasionally an optimal and viable alternative for urban short trip. Inadequacy and inability to access urban jobs and services are imperative ingredients of the social exclusion that define urban poverty (Peng 2005). Transportation plays a pivotal role in rural vivacity and welfare. The rural poor often have extremely limited mobility beyond their immediate settlement due to geographical isolation and the high cost of motorized transportation. Indeed, in many rural communities, lack of access or feeder roads has often been recognized as the main cause of inadequate and scarce earnings (Cook 2005). The last five decades of population, urbanization and economic growths have resulted in unprecedented motorization of transportation. Many harmful effects including social inequalities, congestion, safety, pollution and non-renewable resource depletion, have accompanied the extraordinary rise of motorization. Several studies have concluded that special user groups of the poor, the young, the elderly, the careless and the handicapped suffer serious accessibility and mobility disadvantages from not being adequately served by the vast automobile-based urban transportation systems (Vaziri 1986). In many cities, urban poor cannot afford private cars or motorcycles; on the other hand, they bear unfair shares of motorized urban transportation adverse effects (Barter 1998).

This paper describes an attempt to use time-series information for a comparative macroscopic urban study to establish possible relationships between poverty and transportation in Islamic countries. The objective of the study reported herein was to shed some light on transportation and poverty patterns for urban areas, during the last decade. The study provided some clues and empirical evidences of the possible interrelationships between urban transportation and urban poverty. The study time-series database consisted of 10 variables, covering a 6-year period of 1993 to 1998. For the Islamic country's urban areas, pertinent aggregate urban statistics were extracted from centralized data sources of international agencies (UNHabitat 2004). After database preliminary statistical analysis, due to data inaccessibility, incompleteness and missing values, 33 urban areas were selected for detailed analysis. Transportation projects typically affect various income groups differently; nonetheless, they should accomplish a balance between economic growth and social justice, especially in reduction of the number of poor households. This study is a small step toward grasping the possible relationships between poverty and transportation to facilitate poverty reduction via better transportation decision-making.

2. Database

The limited study resources confined the data collection to information gathering from the international databanks. The data reliability bore the assumption that for the accessible databases, definitions were similar and comparable through time and among urban areas. For the period of 1993 to 1998, urban information pertinent to transportation and poverty were collected for 86 cities throughout the world (UNHabitat 2004). For the years 1993 and 1998, information for 61 and 58 urban areas were accessible and extracted, respectively. The process of data refinement and screening included several stages of statistical analyses, and showed many missing values. The final study database consisted of 10 aggregate variables for 33 urban areas, which are listed in table1, with their pertinent country. They were the intersection of the 61 and 58 urban areas having information for 1993 and 1998, respectively. The study database variables are described in Table 2. Five variables are pertinent to urban poverty and the other five are pertinent to transportation, and specifically, to urban work trips. Urban travel demand is structured for different trip purposes separately. In transportation analysis, the demand variables describe the social and economic activities that give rise to transportation needs; the supply variables describe different aspects of the cost and level of service by which such need might be met.

The univariate statistical analysis of the database shed light on the database cross-sectional and time-series variability. The analysis covered computation of statistics such as minimum, maximum, mean, standard deviation and coefficient of variation, as summarized in Table 3. For example, DUPOP93 presents the urban area total population in 1000 persons for year 1993, and Δ DUPOP presents the

change in total population from 1993 to 1998. For each variable, the table shows number of valid cases from the 33 urban areas and their statistics for 1993 and 1998. It also shows the number of cases and statistics for variable changes during the 6 years. For Table 3, the average number of valid cases was 20.14, presenting 39% missing information. More than 86% missing information for the Δ SPPWH, the change in percent women headed households below poverty line from year 1993 to 1998, was extensive, and curtailed its pertinent statistical analysis. The study database showed significant cross-sectional variability as reflected by the coefficients of variation in range 0.33 to 3.12, and average value of 0.95. For 1993 and 1998, TPUTT, percent work trips with train or tramway, showed largest coefficient and EPEIE, percent population employed in informal sector, showed smallest coefficients of variation among urban areas.

The variables changes designated by “ Δ ”, showed higher time-series variability as reflected by the coefficients of variation in range 0.81 to 20.46, and average value of 4.5. For each variable, Table 3 reflects mixed variation among urban areas, growths for some and reductions for others, confirmed by negative minimum values and positive maximum values, respectively. The variables that on the average showed growth were DUPOP, TPUPM, TPUTT and TPUBM, reflecting growths in urban population, percent work trips with motorized private vehicle, percent work trips using train or tramway and percent work trips using bus or minibus respectively. The variables that on the average showed reduction were SPPHH, SPPWH, ECPPC, EPEIE, TTTWT and TPUNM, reflecting reductions in percent households below poverty line, percent women headed households below poverty line, city production per capita, informal employment, work trip duration and percent work trips using non-motorized modes, respectively. The coefficient of variations reflected high cross-sectional and time-series variability among the 33 urban areas, reflecting undesirable trends for some.

The study database univariate analysis showed significant cross-sectional and time-series variability, as was reflected by the coefficients of variation. The missing information was significant for some variables, especially for variable reflecting percent women headed households below poverty line. The interpretations of the univariate statistical analysis were encouraging for several variables. Growths for percent work trips with bus or minibus and train or tramway has been accompanied with reduction in percent women headed and total households below poverty line and average work trip travel time.

3. Correlation analysis

To develop an understanding of the interrelationship among the database variables, pair-wise correlation analysis was performed. The results of correlation analysis are summarized in Tables 4 and 5. The second column of Table 4 shows the results for year 1993 when the original 61 urban areas were used. The table's third column shows the results for year 1998 when the original 58 urban areas were used. Table 5 summarizes the results when the finally selected 33 urban areas were used. For example, the cell belonging to the first row and the second column of Table 4 shows that for year 1993, when the original 61 urban areas were used, DUPOP, total population, was significantly and positively correlated with TTTWT, average travel time for work trips and TPUBM, percent work trips using bus or minibus. For 1993 and the original 61 urban areas, the 10x10 correlation matrix showed that, on the average and at the level of significance 0.05, a variable was 24.45% significantly correlated with other variables, as reflected by the second column. For 1998 and the original 58 urban areas, the 10x10 correlation matrix showed that, on the average and at the level of significance 0.05, a variable was 15.56% significantly correlated with other variables, as reflected by the third column. In Table 5 For 1993 and 1998, for the finally selected 33 urban areas, the size of the 20x20 correlation matrix again prevented their display herein. The matrix revealed a number of interesting patterns. Several pairs of variables were found correlated at the level of significance 0.05. Based on the 20x20 correlation matrix, on the average and at the level of significance 0.05, a variable was 18.94% significantly correlated with the other variables, as can be confirmed by number of entries for the second and third columns.

The second row of Table 4 shows significant correlations for SPPHH, percent households below poverty line. For 1993 and the original 61 urban areas, SPPHH, percent households below poverty line, was positively correlated with SPPWH, percent women headed households below poverty line and TPUTT, percent work trips using train and tramway; and negatively correlated with ECPPC, city product per capita and TPUPM, percent work trips using motorized private vehicle. For 1998 and the original 58 urban areas, SPPHH, percent households below poverty line, was positively correlated with SPPWH, percent women headed households below poverty line and negatively correlated with TPUPM, percent work trips using motorized private vehicle. For the finally selected 33 urban areas, SPPHH93, percent households below poverty line in year 1993, was positively correlated with SPPWH93, percent women headed households below poverty line in year 1993, EPEIE93, informal employment in year 1993, SPPHH98, percent households below poverty line in year 1998, SPPWH98, percent women headed households below poverty line in year 1998 and TPUNM98, percent work trips using non-motorized mode in 1998; and negatively correlated with ECPPC93, city production per capita in 1993. For the finally selected 33 urban areas, SPPHH98, percent households below poverty line in year 1998, was positively correlated with SPPHH93, percent households below poverty line in year 1993, SPPWH93, percent women headed households below poverty line in year 1993, SPPWH98, percent women headed households below poverty line in year 1998 and TPUBM98, percent work trips with bus or minibus in year 1998; and negatively correlated with ECPPC93, city production per capita in 1993.

The correlation analysis reflected several significant linear correlations among 10 variables, and the results were in line with findings of the previous studies. The percent women headed and total households below poverty line, as expected, were positively correlated with the percent work trips using bus or minibus, percent work trips with train or tramway and informal employment; and negatively correlated with city product per capita. The correlation analysis confirmed the previous findings for urban areas that economically lower income cities with lower average city product per capita coexisted with more poor. It also confirmed that in urban areas with more poor, higher percent of work trips are made by public or non-motorized modes, and lower percent of work trips are made with motorized private vehicle.

The correlation analysis suggested the possibility of developing simple models for urban poverty and transport. For year 1993 and 1998, eleven typical mathematical relationships between SPPHH, percent households below poverty line, and SPPWH, percent women headed households below poverty line as dependent variables, and five transport variables, as independent variables, were evaluated. The transport variables were TTTWT, average travel time for work trips, TPUPM, percent work trips using motorized private vehicle, TPUTT, percent work trips using train or tramway, TPUBM, percent work trips using bus or minibus, and TPUNM, percent work trips using non-motorized modes, respectively. The functional forms were linear, growth, compound, quadratic, logarithmic, cubic, S shape, exponential, inverse, power and logistic. Consequently, for 1993 and 1998, total of 220 univariable models were evaluated. Furthermore, multivariable models for SPPHH and SPPWH with transportation variables of TTTWT, TPUPM, TPUTT, TPUBM and TPUNM were also developed and evaluated.

The statistically significant models, based on f-test for the model and t-test for coefficients, and at a level of 0.05, with largest coefficients of determination, R squares, were identified, which are listed in Table 6. Assuming that the transportation variables could explain poverty variables in urban areas, the models derived, provided some clues for possible cross-sectional relationships between percent households below poverty line and the database transportation variables. Univariate models, listed in Table 6, suggested the domination of linear relationships between SPPHH, percent households below poverty line and SPPWH, percent women headed households below poverty line, as dependent variables, with TPUPM, percent work trips using private vehicle and TPUBM, percent work trips using bus or minibus as independent variables, for years 1993 and 1998. These models imply the coexistence of larger percents of households below poverty line with larger percents of work trips using bus or minibus and smaller percents of work trips using private vehicles. Moreover, multivariable models presented in Table 6, suggested the coexistence of larger percent of households

below poverty line, as the dependent variable, with larger travel time for work trips and larger percent work trips using bus or minibus, as independent variables.

4. Elasticity analysis

To further characterize poverty and transport time-series patterns during the period 1993 to 1998, elasticity's of SPPHH, percent households below poverty line with respects to other nine variables were developed. The arc elasticity E of a variable Y with respect to a variable X for the period $t1-t2$ reflects the percent variable Y changes with respect to one percent change of the variable X during period $t1-t2$, as is shown by Equation 1 (Kanafani 1983):

$$E_{Y/X,t1-t2} = \frac{(Y_{t2} - Y_{t1})/(Y_{t2} + Y_{t1})}{(X_{t2} - X_{t1})/(X_{t2} + X_{t1})} \quad (1)$$

Where $E_{Y/X,t1-t2}$ is the arc elasticity of variable Y with respect to variable X during the period $t1$ to $t2$. When the difference between $t1$ to $t2$ gets very small, the arc elasticity converges to point elasticity. If the absolute value of elasticity is greater than one, then the behaviour of Y respect to the X is elastic. If the absolute value of elasticity is smaller than one, then the behaviour of Y respect to the X is inelastic. Unit elasticity occurs when the elasticity is equal to one. The elasticity of SPPHH with respect to any other variable reflects its percent change with respect to one percent change of the other variable during the period of 1993 to 1998. Using Equation 1, nine arc elasticity's were computed.

The results of descriptive analysis for the developed elasticity's are summarized in Table 7. The relative large number of missing cases of Table 7 made the results less statistically representative for all urban areas. Nevertheless, as the table shows, the coefficients of variation of elasticity's showed large variations, from 1.23 to 9.43. The large variations are also reflected by minimum negative values and maximum positive values of the developed elasticity's. The mean values for elasticity's of SPPHH, percent households below poverty line, with respect to all variables except EPEIE, TTTWT and TPUPM were positive. The relative large number of missing cases, more than 80%, for elasticity's of SPPHH with respect to DUPOP, SPPWH, EPEIE and TPUTT made their pertinent descriptive analysis less reliable.

The $E_{SPPHH/TTTWT}$ mean value of -3.2 suggested that, on the average, a 3.2 percent time-series increase of percent households below poverty line coexisted with one percent time-series decrease of average travel time of work trips. The $E_{SPPHH/TPUPM}$ mean value of -0.77 suggested that, on the average, a 0.77 percent time-series decrease of percent households below poverty line coexisted with one percent time-series increase of percent work trips using motorized private vehicle. The $E_{SPPHH/TPUTT}$ mean value of 0.09 suggested that, on the average, a 0.09 percent time-series decrease of percent households below poverty line coexisted with one percent time-series decrease of percent of work trips using train and tramway. The $E_{SPPHH/TPUBM}$ mean value of 1.43 suggested that, on the average, a 1.43 percent time-series decrease of percent households below poverty line coexisted with one percent time-series decrease of work trips using bus and minibus. $E_{SPPHH/TPUNM}$ mean value of 51.08 suggested that, on the average, a 51.08 percent time-series decrease of percent households below poverty line coexisted with one percent time-series decrease of percent work trips using non-motorized modes. The interpretations of elasticity's mean values, as they reflected mean values of time-series changes, were not always parallel with the results of correlation analysis. Furthermore, the analyses were not based on the same number of cases. Indeed, the developed arc elasticity's also were influenced by a third variable, the time variable.

To clarify time-series variation, based on developed elasticity's of SPPHH with respect to transportation variables, taxonomy of the study urban areas was developed. Table 8 portrays these variations. For the selected 33 urban areas, after excluding 17 for time-series missing information, half showed increase for SPPHH, the percent households below poverty line. For either group of urban areas, with increase or decrease of percent households below poverty line, transportation elasticity's showed large variations, from negative to positive, and from inelastic to elastic. These

variations suggest the possibility of significant complex time-series direct and indirect relations between poverty and transport that could not be quantitatively captured due to limited sample points. Nevertheless, developed elasticity's could be used for urban areas comparative assessment.

5. Conclusions

The study offers the methodology and conclusions of a comparative macroscopic study in connection with urban poverty and transportation. In order to facilitate eradication of urban poverty, which is an imperative facet of sustainable development, the paper describes an attempt to shed some light on urban poverty and transportation patterns for a selected number of urban areas in Islamic countries, during last decade. The accessible databases were overwhelmed by data incompleteness and missing values. This significantly curtailed the reliability of the results and quantitative interpretations. After preliminary evaluation of 86 urban areas, 33 were selected for detailed analysis. The study time-series database consisted of 10 variables, covering time period 1993 to 1998. The poverty variables were the percent of total and women headed households below poverty line. The transportation variables were work trips average travel time and percents of modal splits. The study results could have been enhanced if further information regarding urban poverty and urban transport demand and supply had been available.

The univariate and multivariate statistical analyses for the selected urban areas showed interesting results and relations for the selected variables. The study database univariate analysis showed significant cross-sectional and time-series variability for urban poverty and urban transport. The 1993 to 1998 changes for percent households below poverty line, percent women headed households below poverty line, the average city production per capita, the percent employment in informal sector, the average travel time of work trips and the percent work trips using non-motorized private vehicles showed negative mean values or negative growths. The 1993 to 1998 changes for total population, the percent work trips using private vehicle, percent work trips with train and tramway and the percent work trips using bus or minibus showed positive mean value or positive growths. The percent households below poverty line was found positively correlated with percent women headed households below poverty line and percent work trips using public or non-motorized transport modes, and negatively correlated with average city product per capita and percent work trips using motorized private vehicle. The correlation analysis confirmed the previous findings for urban areas that economically lower income cities with lower average city product per capita coexisted with more poor. It also confirmed that in urban areas with more poor, higher percent of work trips are made by public or non-motorized modes. This reflects the importance of public and non-motorized transportation development as a key factor in achieving urban social sustainability for Islamic countries. Several univariable models were found significant for cross-sectional relationship, as linear, logarithmic, inverse and compound functions, between percent women headed and total households below poverty line, as the dependent variables, and variables pertinent to transport, as independent variables in years 1993 and 1998. Nevertheless, linear relations dominated the calibrated models. Four multivariable linear models were found significant for cross-sectional relationship between percent women headed and total households below poverty line with transportation variables. The elasticity analysis shed further light on the variable changes and trends during the study period of 6 years. The interpretations for the mean values of developed elasticity's of the percent households below poverty line with respect to transportation variables, as they reflected mean values of time-series changes, were not always parallel with the results of correlation analysis, as they were not based on the same number of cases. The developed elasticity's were suggested for comparative assessment of urban areas with respect to poverty and transportation. Significant variations in developed elasticity's suggested the possibility of complex time-series relations between poverty and transportation for the selected urban areas.

Due to study limited resources, the study database was overwhelmed by data incompleteness and missing values. This significantly curtailed the reliability of the results and quantitative interpretations. The study confirmed the need for more relevant and complete centralized databases. Nevertheless, for the selected urban areas and the 6-year period of 1993-98, urban poverty and urban transportation showed several significant correlations. They also showed large cross-sectional and

time-series variations. The study confirmed the importance of public and non-motorized transportation as the key factor in achieving social sustainability for urban areas of Islamic countries. Although the study findings are based on a very limited database, the methodology can be applied to other periods or geographical scopes for addressing pertinent poverty and transportation issues.

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Table 1: The study urban areas

No.	City	Country	Continent
1	Abidjan	Cote d'Ivoire	Africa
2	Amman	Jordan	Asia
3	Bamako	Mali	Africa
4	Bandung	Indonesia	Asia
5	Bishkek	Kyrgyzstan	Asia
6	Chittagong	Bangladesh	Asia
7	Conakry	Guinea	Africa
8	Cotonou	Benin	Africa
9	Dakar	Senegal	Africa
10	Dhaka	Bangladesh	Asia
11	Douala	Cameron	Africa
12	Ibadan	Nigeria	Africa
13	Jakarta	Indonesia	Asia
14	Jinja	Uganda	Africa
15	Koudougou	Burkina Faso	Africa
16	Lagos	Nigeria	Africa
17	Lahore	Pakistan	Asia
18	Libreville	Gabon	Africa
19	Lome	Togo	Africa
20	Maputo	Mozambique	Africa
21	N'Djamena	Chad	Africa
22	Niamey	Niger	Africa
23	Nouakchott	Mauritania	Africa
24	Ouagadougou	Burkina Faso	Africa
25	Porto Novo	Benin	Africa
26	Rabat	Morocco	Africa
27	Sana'a	Yemen	Asia
28	Semarang	Indonesia	Asia
29	Surabaya	Indonesia	Asia
30	Tallin	Estonia	Europe
31	Tangail	Bangladesh	Asia
32	Tunis	Tunisia	Africa
33	Yaounde	Cameron	Africa

Table 2 : Description of the database variables

No.	Variable	Category	Description	Dimension
1	DUPOP	Demographic	Total population of the urban area	1000 persons
2	SPPHH	Social	Percent households below the locally defined poverty line	Percent in decimal
3	SPPWH	Social	Percent women headed households below the locally defined poverty line	Percent in decimal
4	ECPPC	Economic	City product per capita	US dollar
5	EPEIE	Economic	Percent population employed in informal sector	Percent in decimal
6	TTTWT	Transportation	Average travel time for work trips	Minutes
7	TPUPM	Transportation	Percent work trips using motorized private vehicle	Percent in decimal
8	TPUTT	Transportation	Percent work trips using train or tramway	Percent in decimal
9	TPUBM	Transportation	Percent work trips using bus or minibus	Percent in decimal
10	TPUNM	Transportation	Percent work trips using non-motorized mode, such as bicycle, walking or other	Percent in decimal

Table 3 : Descriptive analysis of the database variables

Variable	Number of cases	Minimum	Maximum	Mean	Standard deviation	Coefficient of variation
DUPOP93	27	58.8	13047.7	1948.4	2876.68	1.48
DUPOP98	20	30.1	10000	1745.4	2359.61	1.35
ΔDUPOP	18	-699.3	2500	184	662.9	3.61
SPPHH93	28	0.05	0.78	0.288	0.21	0.73
SPPHH98	26	0.09	0.53	0.259	0.17	0.64
ΔSPPHH	22	-0.32	0.26	-0.02	0.13	6.23
SPPWH93	16	0.02	0.95	0.356	0.3	0.85
SPPWH98	14	0.018	0.585	0.22	0.19	0.86
ΔSPPWH	5	-0.4	-0.06	-0.204	0.16	0.81
ECPPC93	29	0.124	2843	804.3	702.91	0.87
ECPPC98	10	180	1932	964.9	556.62	0.58
ΔECPPC	8	-911	306	-32.6	402.37	12.33
EPEIE93	26	0.27	0.9	0.536	0.18	0.35
EPEIE98	18	0.275	0.928	0.544	0.2	0.37
ΔEPEIE	17	-0.38	0.44	-0.011	0.22	20.46
TTTWT93	28	15	90	41.5	20.29	0.49
TTTWT98	25	12	60	37	12.06	0.33
ΔTTTWT	21	-45	15	-3.4	13.37	3.9
TPUPM93	23	0.05	0.77	0.3	0.19	0.77
TPUPM98	23	0	0.9	0.351	0.29	0.82
ΔTPUPM	17	-0.26	0.32	0.037	0.15	4.14
TPUTT93	22	0	0.01	0.001	0	2.83
TPUTT98	22	0	0.55	0.043	0.14	3.12
ΔTPUTT	16	0	0.55	0.037	0.14	3.73
TPUBM93	23	0	0.6	0.244	0.19	0.77
TPUBM98	22	0	0.8	0.352	0.24	0.69
ΔTPUBM	17	-0.13	0.68	0.119	0.22	1.83
TPUNM93	24	0.13	0.92	0.44	0.2	0.46
TPUNM98	21	0	0.862	0.288	0.24	0.82
ΔTPUNM	16	-0.7	0	-0.212	0.2	0.94

Table 4 : Results of cross sectional correlation analysis

Variable	1993, 61 urban areas	1998, 58 urban areas
DUPOP	(+) TTTWT , (+) TPUBM	
SPPHH	(+) SPPWH , (-) TPUPM (-) ECPPC , (+) TPUTT	(+) SPPWH , (-) TPUPM
SPPWH	(+) SPPHH	(+) SPPHH
ECPPC	(-) SPPHH (-) EPEIE	
EPEIE	(-) ECPPC , (+) TPUNM (-) TPUBM	(+) TPUPM , (-) TPUBM
TTTWT	(+) DUPOP	
TPUPM	(-) SPPHH , (-) TPUNM	(-) SPPHH , (-) TPUBM (+) EPEIE , (-) TPUNM
TPUTT	(+) SPPHH	
TPUBM	(+) DUPOP , (-) TPUNM (-) EPEIE ,	(-) EPEIE , (-) TPUNM (-) TPUPM
TPUNM	(+) EPEIE , (-) TPUBM (-) TPUPM	(-) TPUPM , (-) TPUBM

Table 5: Results of time-series correlation analysis

Variable	1993, 33 urban areas	1998, 33 urban areas
DUPOP	(+) TTTWT 93 , (+) TTTWT 98 (+) TPUTT 93 , (+) TPUNM 98 (+) DUPOP 98	(+) DUPOP 93 (+) TPUTT 93 (+) TPUNM 98
SPPHH	(+) SPPWH 93 , (+) SPPHH 98 (-) ECPPC 93 , (+) SPPWH 98 (+) EPEIE 93 , (+) TPUNM 98	(+) SPPWH 93 , (+) SPPWH 98 (+) SPPWH 93 , (+) TPUBM 98 (-) ECPPC 93
SPPWH	(+) SPPHH 93 , (+) SPPHH 98 (+) EPEIE 93 , (-) TPUPM 98 (-) TPUPM 93 , (+) TPUBM 98	(+) SPPHH 93 , (+) TPUBM 93 (-) ECPPC 93 , (+) SPPHH 98 (-) TPUPM 93
ECPPC	(-) SPPHH 93 , (-) SPPWH 98 (-) EPEIE 93 , (+) ECPPC 98 (-) SPPHH 98	(+) ECPPC 93
EPEIE	(+) SPPHH 93 , (-) ECPPC 93 (+) SPPWH 93	(+) TPUPM 93 (-) TPUBM 98
TTTWT	(+) DUPOP 93 , (+) TTTWT 98	(+) DUPOP 93 , (+) TTTWT 93
TPUPM	(-) SPPWH 93 , (+) EPEIE 98 (-) TPUNM 93 , (+) TPUPM 98 (-) SPPWH 98 , (-) TPUBM 98	(-) SPPWH 93 (+) TPUPM 93 (-) TPUBM 98
TPUTT	(+) DUPOP 93 , (+) DUPOP 98	
TPUBM	(-) TPUNM 93 (+) SPPWH 98 (+) TPUBM 98	(+) SPPWH 93 , (+) SPPHH 98 (-) TPUPM 93 , (-) EPEIE 98 (+) TPUBM 93 , (-) TPUPM 98
TPUNM	(-) TPUPM 93 , (+) TPUNM 98 (-) TPUBM 93	(+) DUPOP 93 , (+) TPUNM 93 (+) SPPHH 93 , (+) DUPOP 98

Table 6 : The developed models

Dependent variable	Independent variable	Model	R ²	Parameters	
				Constant	Coefficient
SPPWH93	TPUPM93	Linear	0.456	78.7199	-1.4733
		Logarithmic	0.438	122.085	-27.132
		Inverse	0.374	20.0672	289.859
		Compound	0.366	103.742	0.9436
SPPHH98	TPUPM98	Compound	0.272	0.4095	0.1479
	TPUBM98	Linear	0.25	0.1777	0.3356
SPPWH93	TPUPM93	Linear	0.482	65.67	-1.392
	TPUNM93				0.224
SPPWH93	TPUPM93	Linear	0.538	92.407	-1.758
	TPUTT93				-37.228
SPPHH98	TTTWT98	Linear	0.56	-0.063	0.007
	TPUPM98				-0.099
	TPUTT98				0.27
	TPUBM98				0.265
SPPWH98	TTTWT98	Linear	0.681	-0.493	0.011
	TPUPM98				0.111
	TPUBM98				0.645

Table 7: Descriptive analysis of elasticity's

Elasticity	Number of cases	Minimum	Maximum	Mean	Standard deviation	Coefficient of variation
E _{SPPHH/DUPOP}	1	12.29	12.29	12.29	–	–
E _{SPPHH/SPPWH}	5	-0.15	1.71	0.73	0.9	1.23
E _{SPPHH/ECPPC}	7	-11	17.84	0.9	8.52	9.43
E _{SPPHH/EPEIE}	12	-34.58	6.85	-3.21	10.7	3.34
E _{SPPHH/TTTWT}	13	-40.79	6.4	-3.2	11.68	3.66
E _{SPPHH/TPUPM}	9	-4.82	2.91	-0.77	2.26	2.95
E _{SPPHH/TPUTT}	3	-0.16	0.51	0.09	0.36	4.11
E _{SPPHH/TPUBM}	7	-1.34	5.23	1.43	2.13	1.49
E _{SPPHH/TPUNM}	10	-0.68	477.55	51.08	150.2	2.94

Table 8: Taxonomy of urban areas

Elasticity Range	Poverty Trend	
	$\Delta SPPHH < 0$	$\Delta SPPHH > 0$
$E_{SPPHH/TTTWT} < -1$	Bandung, Ibadan, Porto Novo, Surabaya, Tallin	Dakar, Yaounde
$E_{SPPHH/TPUPM} < -1$	Porto Novo, Surabaya	Yaounde
$E_{SPPHH/TPUTT} < -1$		
$E_{SPPHH/TPUBM} < -1$	Ibadan	
$E_{SPPHH/TPUNM} < -1$		
$-1 < E_{SPPHH/TTTWT} < 0$		Amman
$-1 < E_{SPPHH/TPUPM} < 0$	Ibadan, Lagos	Dakar
$-1 < E_{SPPHH/TPUTT} < 0$	Ibadan, Lagos	
$-1 < E_{SPPHH/TPUBM} < 0$		
$-1 < E_{SPPHH/TPUNM} < 0$		Amman, Contonou, lome, Yaounde
$0 < E_{SPPHH/TTTWT} < 1$	Lagos, Tangil	
$0 < E_{SPPHH/TPUPM} < 1$		
$0 < E_{SPPHH/TPUTT} < 1$		Dakar
$0 < E_{SPPHH/TPUBM} < 1$		Amman, Yaounde
$0 < E_{SPPHH/TPUNM} < 1$	Ibadan, surbaya	
$1 < E_{SPPHH/TTTWT}$	Bamako, Conkary, Douala	
$1 < E_{SPPHH/TPUPM}$		Cotonou, Lome
$1 < E_{SPPHH/TPUTT}$		
$1 < E_{SPPHH/TPUBM}$	Lagos, Surabaya	Dakar, Lome
$1 < E_{SPPHH/TPUNM}$	Bamako, Porto Novo	Dakar