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A COMPARATIVE APPRAISAL OF TRANSPORT AND POVERTY PATTERNS FOR AFRICAN CITIES

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Abstract
The last fifty years upsurge of urban motorization has been accompanied by social inequalities, traffic congestion, inefficacious public transport, and detrimental impacts on community health due to environmental pollutions. In all this change, the urban poor often have been most adversely affected. Poverty mitigation is an imperative facet of urban sustainable development. The objective of the study reported herein was to shed some light on transport and poverty patterns for some selected African urban areas, 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 African 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 half 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, elasticities of urban poverty with respect to urban transport were developed. The elasticities provided further clues into urban transport and urban poverty trends, and were used in taxonomy of the African urban areas. The appraisal of developed elasticities 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.

Introduction

The United Nations Millennium Declaration of year 2000 encompasses the eight goals; eradication extreme poverty and hunger, achieve universal primary education, promote gender equality and empower women, reduce child mortality, improve material health, combat HIV/AIDS, malaria and other diseases, ensure environmental sustainability and a global partnership for development. 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. Nevertheless, 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. Transport 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 and Zhi, 1997; UNESCAP and AITD, 1999). Nevertheless, the existing level of understanding of the relationships between poverty and transport is very limited.

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 transport. The intensive proximity of activities makes non-motorized transport occasionally an optimal and viable alternative for urban short trips. Inadequacy and inability to access urban jobs and services are imperative ingredients of the social exclusion that define urban poverty (Peng, 2005). Due to improve the social dimension in sustainable development, transport plays a pivotal role in rural vivacity, welfare; areas are economic and social isolation. The rural poor often have extremely limited mobility beyond their immediate settlement due to geographical isolation and the high cost of motorized transport. 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 transport. 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 transport systems (Vaziri, 1986). In many Asian cities, urban poor cannot afford private cars or motorcycles; on the other hand, they bear unfair shares of motorized urban transport 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 transport in African cities. The objective of the study reported herein was to shed some light on transport and poverty patterns for African urban areas, during the last decade. The study provided some clues and empirical evidences of the possible interrelationships between urban transport and urban poverty. The study time-series database consisted of 10 variables, covering a 6 year period of 1993 to 1998. For African urban areas, pertinent aggregate urban statistics were extracted from centralized data sources of international agencies (UN-Habitat, 2004). After database preliminary statistical analysis, due to data inaccessibility, incompleteness and missing values, 36 urban areas were selected for detailed analysis. Transport 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 transport to facilitate poverty reduction via better transport decision-making.

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 transport and poverty were collected for 96 cities throughout the world (UN-Habitat, 2004). For the years 1993 and 1998, information for 80 and 52 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 36 urban areas, which are listed in table1, with their pertinent country. They were the intersection of the 80 and 52 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 transport, and specifically, to urban work trips. Urban travel demand is structured for different trip purposes separately. In transport analysis, the demand variables describe the social and economic activities that give rise to transport 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 ΔDUPOP presents the change in total population from 1993 to 1998. For each variable, the table shows number of valid cases from the 36 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 23.34, presenting 35% missing information. More than 86% missing information for the ΔSPPWH 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 0.36 to 3.47, and average value of 0.92. 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 0.65 to 24.36, and average value of 4.50. 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, EPEIE, TPUPM, TPUTT and TPUBM, reflecting growths in urban population, informal employment, 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, TTTWT and TPUNM, reflecting reductions in percent households below poverty line, percent women headed households below poverty line, city production per capita, 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 36 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.

Correlation analysis

To develop an understanding of the interrelationship among the database variables, as a first step, pair-wise correlation analysis was performed. The results of correlation analysis are summarized in Tables 4 & 5. The Table 4's second column shows the results for year 1993 when the original 80 urban areas were used. The table's third column shows the results for year 1998 when the original 52 urban areas were used. The Table 5, shows the results when the finally selected 36 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 80 urban areas were used, DUPOP, total population, was significantly and positively correlated with TTTWT, average travel time for work trips, TPUTT, percent work trips using train or tramway and TPUBM, percent work trips using bus or minibus; and negatively correlated with TPUNM, percent work trips using non-motorized modes. For 1993 and the original 80 urban areas, the 10x10 correlation matrix showed that, on the average, a variable was 24.45% significantly correlated with other variables, as reflected by the second column. For 1998 and the original 52 urban areas, the 10x10 correlation matrix showed that, on the average, a variable was 15.56% significantly correlated with other variables, as reflected by the third column. In Table5 For 1993 and 1998, for the finally selected 36 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 a level of significance 0.05. Based on the 20x20 correlation matrix, on the average, a variable was 17.36% 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 1998 and the original 52 urban areas, SPPHH, percent households below poverty line, was positively correlated with SPPWH, percent women headed households below poverty line. For the finally selected 36 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, TPUTT93, percent work trips using train and tramway in year 1993 and SPPWH98, percent women headed households below poverty line in year 1998. For the finally selected 36 urban areas, SPPHH98, percent households below poverty line in year 1998, was positively correlated with SPPWH98, percent women headed households below poverty line in year 1998 and TPUBM98, percent work trips with bus or minibus in year 1998.

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 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.

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. Again a multivariable model for each of the SPPHH and SPPWH, with independent variables pertinent to transport, which are, TTTWT, TPUPM, TPUTT, TPUBM and TPUNM, was 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 transport 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 transport variables. Multivariable model, presented at the last row of Table 6, suggested the coexistence of larger percent of households below poverty line for year 1998, as the dependent variable, with larger travel time for work trips and larger percent work trips using bus or minibus, as independent variables in year 1998. Moreover, univariate models, listed in table 6, suggested the relationships such as linear, logarithmic, inverse and compound functions, between SPPHH, percent households below poverty line and SPPWH, percent women headed households below poverty line, as dependent variables, with TPUTT, percent work trips with train and tramway, TPUPM, percent work trips using private vehicle and TPUBM, percent work trips using bus or minibus as independent variables, for years 1993 and 1998.

Elasticity Analysis

To further characterize poverty and transport time-series patterns during the period 1993 to 1998, elasticities 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):

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

Where $E_{Y/X,t1\text{-}t2}$ 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 elasticities were computed.

The results of descriptive analysis for the developed elasticities 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 elasticities showed large variations, from 0.74 to 6.78. The large variations are also reflected by minimum negative values and maximum positive values of the developed elasticities. The mean values for elasticities of SPPHH, percent households below poverty line, with respect to all variables except ECPPC, EPEIE and TPUPM were positive. The relative large number of missing cases, more than 80%, for elasticities of SPPHH with respect to DUPOP, SPPWH, ECPPC and TPUTT made their pertinent descriptive analysis less reliable. The $E_{SPPHH/ECPPC}$ mean value of -1.54 suggested that, on the average, a 1.54 percent time-series decrease of percent households below poverty line coexisted with one percent time-series increase of average city product per capita.

Of more relevance to the objective of this study were the SPPHH elasticities with respect to transport variables. The $E_{SPPHH/TTTWT}$ mean value of 0.9 suggested that, on the average, a 0.9 percent time-series decrease 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 -0.29 suggested that, on the average, a 0.29 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 0.07 suggested that, on the average, a 0.07 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 1.96 suggested that, on the average, a 1.96 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 42.76 suggested that, on the average, a 42.76 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 elasticities 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 elasticities also were influenced by a third variable, the time variable.

To clarify time-series variation, based on developed elasticities of SPPHH with respect to transport variables, taxonomy of the study urban areas was developed. Table 8 portrays these variations. For the selected 36 urban areas, after excluding 20 for 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, transport elasticities 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 elasticities could be used for urban areas comparative assessment.

Conclusions

The study offers the methodology and conclusions of a comparative macroscopic study in connection with urban poverty and transport. 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 transport patterns for a selected number of African urban areas 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 96 urban areas, 36 were selected for detailed analysis. The study time-series database consisted of 10 variables, covering 1993 to 1998. The poverty variables were the percent of total and women headed households below poverty line. The transport 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 average travel time of work trips and the percent work trips using non-motorized private vehicles showed negative mean values. The 1993 to 1998 changes for total population, the percent employment in informal sector, the percent work trips using train and tramway and the percent work trips using bus or minibus showed positive mean values. 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. A multivariable linear model was found significant for cross-sectional relationship between percent households below poverty line and average travel time for work trips and percent work trips using bus or minibus. 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 .The elasticity analysis shed further light on the variable changes and trends during the period of 6 years. The interpretations for the mean values of developed elasticities of the percent households below poverty line with respect to transport 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 elasticities were suggested for comparative assessment of urban areas with respect to poverty and transport. The large variations of elasticities suggested the possibility of complex time-series relations between poverty and transport 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 transport showed several significant correlations. They also showed large cross-sectional and time-series variations. 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 transport issues.

LIST OF TABLES

TABLE 1. The Study Selected Urban Areas

Country	City	Country	City
Cote d'Ivoire	Abidjan	Ghana	Kumasi
Ghana	Accra	Nigeria	Lagos
Madagascar	Antananarivo	Gabon	Libreville
Mali	Bamako	Malawi	Lilongwe
Central African Republic	Bangui	Togo	Lome
Congo	Brazzaville	Mozambique	Maputo
Zimbabwe	Bulawayo	Kenya	Mombasa
Guinea	Conakry	Liberia	Monrovia
Benin	Cotonou	Chad	N'Djamena
Senegal	Dakar	Kenya	Nairobi
Cameron	Douala	Niger	Niamey
Zimbabwe	Harare	Mauritania	Nouakchott
Nigeria	Ibadan	Burkina Faso	Ouagadougou
Uganda	Jinja	Benin	Porto Novo
Rwanda	Kigali	Maroc	Rabat
Dem. Republic of Congo	Kinshasa	Tunisia	Tunis
Kenya	Kisumu	Namibia	Windhoek
Burkina Faso	Koudougou	Cameron	Yaounde

TABLE 2. Description of the Database Variables

Variable	Category	Description	Dimension
DUPOP	Demographic	Total population of the urban area	1000 persons
SPPHH	Social	Percent households below the locally defined poverty line	Percent in decimal
SPPWH	Social	Percent women headed households below the locally defined poverty line	Percent in decimal
ECPPC	Economic	City product per capita	US dollar
EPEIE	Economic	Percent population employed in informal sector	Percent in decimal
TTTWT	Transport	Average travel time for work trips	Minutes
TPUPM	Transport	Percent work trips using motorized private vehicle	Percent in decimal
TPUTT	Transport	Percent work trips using train or tramway	Percent in decimal
TPUBM	Transport	Percent work trips using bus or minibus	Percent in decimal
TPUNM	Transport	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	30	58.8	5968.3	1114.9	1296.5	1.16
DUPOP98	22	63.9	10726.7	1426.33	2230.01	1.56
ΔDUPOP	19	-699.3	6160.7	404.41	1419.94	3.51
SPPHH93	28	0.06	0.7	0.3472	0.1869	0.5358
SPPHH98	25	0.09	0.65	0.3239	0.1616	0.491
ΔSPPHH	20	-0.47	0.25	-0.0292	0.1872	6.406
SPPWH93	12	0.11	0.95	0.5007	0.2484	0.4961
SPPWH98	16	0.03	0.7	0.2598	0.2084	0.8019
ΔSPPWH	5	-0.55	-0.08	-0.3042	0.2002	0.6581
ECPPC93	27	12	5705	989.38	1160.84	1.17
ECPPC98	8	180	1044	632.48	280.84	0.44
ΔECPPC	5	-2116	223	-398.75	978.56	2.45
EPEIE93	33	0.06	0.89	0.5443	0.2189	0.4022
EPEIE98	14	0.288	0.92	5581	0.199	0.3566
ΔEPEIE	14	-0.35	0.33	0.0034	0.1844	54.8178
TTTWT93	30	20	120	46.15	22.6	0.48
TTTWT98	31	5	60	37.16	16.72	0.45
ΔTTTWT	26	-63	15	-9.87	18.12	1.83
TPUPM93	28	0.03	0.77	0.2431	0.1711	0.7039
TPUPM98	30	0	0.9	0.2527	0.2275	0.9003
ΔTPUPM	26	-0.01	0.55	0.04	0.1314	24.3604
TPUTT93	29	0	0.01	0.001	0.0028	2.6992
TPUTT98	30	0	0.55	0.0356	0.1236	3.47
ΔTPUTT	26	-0.01	0.55	0.04	0.1314	3.2877
TPUBM93	29	0	0.075	0.3159	0.2185	0.6916
TPUBM98	30	0	0.8	0.4272	0.2235	0.5231
ΔTPUBM	26	-0.3	0.67	0.1119	0.2141	1.9138
TPUNM93	28	0.13	0.91	0.4399	0.2061	0.4686
TPUNM98	29	0.02	0.67	0.294	0.1763	0.5997
ΔTPUNM	24	-0.69	0.2	-0.1608	0.1971	1.2259

TABLE 4. Results of cross-sectional correlation analysis

Variable	(93), 80 Urban areas	(98), 52 urban areas
DUPOP	(+) TTTWT , (+) TPUBM (+) TPUTT , (−) TPUNM	
SPPHH		(+) SPPWH
SPPWH	(+) EPEIE , (+) TTTWT	(+) SPPHH
ECPPC	(−) EPEIE	(+) TTTWT
EPEIE	(+) SPPWH , (−) ECPPC	(+) TPUPM , (−) TPUBM
TTTWT	(+) DUPOP , (+) TPUBM (+) SPPWH	(+) ECPPC
TPUPM	(−) TPUBM , (−) TPUNM	(+) EPEIE , (−) TPUNM (−) TPUBM ,
TPUTT	(+) DUPOP	
TPUBM	(+) DUPOP , (−) TPUPM (+) TTTWT , (−) TPUNM	(−) EPEIE , (−) TPUNM (−) TPUPM
TPUNM	(−) DUPOP , (−) TPUBM (−) TPUPM	(−) TPUPM , (−) TPUBM

TABLE 5. Results of time-series Correlation Analysis

Variable	(93),(93,98), 36 urban areas	(98),(93,98), 36 urban areas
DUPOP	(+) TTTWT 93 , (+) DUPOP 98 (+) TPUTT 93 , (−) EPEIE 98 (+) TPUBM 93 , (+) TTTWT 98	(+) DUPOP 93 , (+) TTTWT 98 (+) TTTWT 93 , (+) TPUTT 98 (+) TPUTT 93
SPPHH	(+) SPPWH 93 , (+) TPUTT 93 (+) EPEIE 93 , (+) SPPWH 98	(+) SPPWH 98 , (+) TPUBM 98
SPPWH	(+) SPPHH 93 , (−) ECPPC 98	(+) SPPHH 93 , (+) SPPHH 98
ECPPC	(−) EPEIE 93 , (−) TTTWT 98	(−) SPPWH 93
EPEIE	(+) SPPHH 93 , (−) ECPPC 93 (+) EPEIE 98	(+) EPEIE 93 , (−) DUPOP 93 (+) TPUPM 93 , (−) TPUBM 93 (+) TPUPM 98
TTTWT	(+) DUPOP 93 , (+) TTTWT 98 (+) TPUTT 93 , (+) TPUTT 98 (+) DUPOP 98	(+) DUPOP 93 (+) DUPOP 98 (+) TTTWT 93 (−) ECPPC 93
TPUPM	(+) EPEIE 98 , (−) TPUBM 93 (+) TPUPM 98 , (−) TPUBM 98	(+) TPUPM 93 , (−) TPUBM 98 (+) EPEIE 98
TPUTT	(+) DUPOP 93 , (+) TTTWT 93 (+) SPPHH 93 , (+) DUPOP 98	(+) TTTWT 93 , (+) DUPOP 98
TPUBM	(+) DUPOP 93 , (−) TPUNM 93 (+) TPUBM 98 , (−) EPEIE 98 (−) TPUPM 93	(+) TPUBM 93 , (−) TPUPM 93 (+) SPPHH 98 , (−) TPUPM 98
TPUNM	(+) TPUNM 98 , (−) TPUBM 93	(+) TPUNM 93

TABLE 6. The Study Developed Models

Dependent variable	Independent variable	Model	R^2	Parameters	
				C	B_1
SPPHH93	TPUTT93	Linear	0.176	35.441	30.366
SPPWH93	TPUPM93	Logarithmic	0.431	105.024	-17.426
		Inverse	0.437	43.464	141.843
SPPHH98	TPUBM98	Linear	0.221	0.201	0.34
		Compound	0.248	0.181	3.367
SPPHH98	TTTWT98	Linear	0.318	0.054	0.004
	TPUBM98				0.33

TABLE 7. Descriptive Analysis of Elasticities

Elasticity	Number of cases	Minimum	Maximum	Mean	Standard deviation	Coefficient of variation
$E_{SPPHH/DUPOP}$	3	-1.26	12.29	4.24	7.12	1.68
$E_{SPPHH/SPPWH}$	5	-0.15	1.71	0.89	0.82	0.91
$E_{SPPHH/ECPPC}$	4	-3.07	-0.42	-1.54	1.14	0.74
$E_{SPPHH/EPEIE}$	9	-34.58	6.85	-4.37	12.24	2.8
$E_{SPPHH/TTTWT}$	13	-3.6	6.4	0.9	2.88	3.18
$E_{SPPHH/TPUPM}$	13	-4.81	2.91	-0.29	1.97	6.78
$E_{SPPHH/TPUTT}$	6	-0.53	0.77	0.07	0.48	6.77
$E_{SPPHH/TPUBM}$	10	-1.34	11.87	1.96	3.7	1.88
$E_{SPPHH/TPUNM}$	12	-1.22	477.55	42.76	137.24	3.2

TABL

E 8. Taxonomy Based on Elasticities

Elasticity Range	Poverty Trend	
	$\Delta SPPHH<0$	$\Delta SPPHH>0$
$E_{SPPHH/TTTWT}<-1$	Ibadan, Kumasi, Porto novo	Dakar, Younde
$E_{SPPHH/TPUPM}<-1$	Porto novo	Yaounde
$E_{SPPHH/TPUTT}<-1$		
$E_{SPPHH/TPUBM}<-1$	Ibadan	
$E_{SPPHH/TPUNM}<-1$		Antananarivo
$-1<E_{SPPHH/TTTWT}<0$		
$-1<E_{SPPHH/TPUPM}<0$	Ibadan, Kinshasa, Kumasi, Lagos	Antananarivo, Dakar,

		Nairobi
$-1< E_{SPPHH/TPUTT}<0$	Ibadan, Kinshasa, Kumasi, Lagos	
$-1< E_{SPPHH/TPUBM}<0$	Brazzavile	
$-1< E_{SPPHH/TPUNM}<0$		Cotonou, Lome, Yaounde
$0<E_{SPPHH/TTTWT}<1$	Lagos	Bangui
$0<E_{SPPHH/TPUPM} <1$		
$0< E_{SPPHH/TPUTT}<1$		Dakar, Nairobi
$0< E_{SPPHH/TPUBM}<1$		Antananarivo, Yaounde
$0< E_{SPPHH/TPUNM}<1$	Ibadan	
$1<E_{SPPHH/TTTWT}$	Bamako, Brazzavile, Conkary, Douala, Kinshsa	Nairobi
$1<E_{SPPHH/TPUPM}$	Brazzavile	Cotonou, Lome
$1<E_{SPPHH/TPUTT}$		
$1<E_{SPPHH/TPUBM}$	Kinshasa, Kumasi, Lagos	Dakar, Lome, Nairobi
$1<E_{SPPHH/TPUNM}$	Bamako, Brazzavile, Kinshasa, Porto novo	Dakar, Nairobi

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