AmericasBarometer Insights: 2009 (No.6)[*]

Methodological Note: Measuring Relative Wealth using Household Asset Indicators

Abby Córdova, Ph.D.
Post Doctorate in Political Science and LAPOP
abby.b.cordova@vanderbilt.edu
Vanderbilt University

The Latin American Public Opinion Project (LAPOP) research program relies heavily on basic measures of individual economic status. For some time we have been attempting to refine those measures, and in this *Insights* study,[1] we focus on measuring relative wealth. In doing so, we focus on a critical issue in the social sciences, namely how to obtain valid and reliable measures of personal economic well-being. Our ultimate goal is to develop solid measures of individual economic status to assess the consequences of poverty and economic inequality for democratic political culture in Latin American and Caribbean countries.

Research has shown that expenditure-based economic status indicators have been found to be more reliable than indices that are income-based (Deaton 1997). A major reason for this is the relatively high non-response rate for income-based measures as well as under or over reporting typically found in income items utilized in standard of living household surveys. In public opinion research, to estimate reliable indicators of individual economic status is even more challenging since often neither income nor consumption data are collected in this type of survey.

The LAPOP questionnaires have always included an income item (Q10) that takes into account the decile distribution of income in each country. Specifically, the LAPOP surveys ask respondents to indicate (by privately picking a number from a card) the income bracket in which their total household income falls, rather than asking them to state a precise monetary amount. By using that procedure, we have been able to minimize non-response and, hopefully, under or over reporting. Unfortunately, without a validation survey, which privacy considerations and ethical norms would prevent us from carrying out, validation of the incomes reported to our interviewers cannot take place.

Nonetheless, the income variable in the LAPOP surveys still shows a relatively high proportion of missing values due to non-response (around 17 percent in the 2008 round of surveys for all 23 countries included in that round),[2] substantially reducing the number of valid cases in multivariate statistical analyses that include the income variable. Such a loss on a key predictor variable is serious as it means that all substantive analysis is deprived of many cases that would otherwise be available for analysis since few (if any) of the other survey items in the questionnaire produce such a high level of non-response.

As a result, the LAPOP surveys have also always collected information on household assets with the aim of obtaining more precise measures of economic well-being on the largest possible proportion of respondents. Indeed, the

---

* The Insights Series is co-edited by Professors Mitchell A. Seligson and Elizabeth Zechmeister with administrative, technical, and intellectual support from the LAPOP group at Vanderbilt.

[1] Prior issues in the *Insights* series can be found at: www.vanderbilt.edu/lapop/studiesandpublications. The data on which they are based can be found at: www.vanderbilt.edu/lapop/datasets.

[2] Funding for the 2008 round mainly came from the United States Agency for International Development (USAID). Significant sources of support were also the Inter-American Development Bank (IADB), the United Nations Development Program (UNDP), the Center for the Americas, and Vanderbilt University.

non-response rate associated with the household asset items in the LAPOP questionnaires is much lower than the one for the income variable (less than one per cent in the 2008 pooled dataset). However, the underreporting or overreporting problem might still be present when household assets are employed, as the study by Martinelli and Parker (2008) suggests, although that evidence came from a special purpose survey, and it is impossible to know how broadly this problem exists in other kinds of surveys and in other settings. Notwithstanding these limitations and concerns, as will be demonstrated in this methodological note, a reliable economic status indicator can be obtained using the household asset items included in the LAPOP surveys. A relative wealth index was computed using the methodology described below based on the following items in the LAPOP surveys:

Could you tell me if you have the following in your house:		
Television	(0) No	(1) Yes
Refrigerator	(0) No	(1) Yes
Conventional telephone	(0) No	(1) Yes
Cellular telephone	(0) No	(1) Yes
Vehicle	(0) No	(1) One (2) Two (3) Three
Washing machine	(0) No	(1) Yes
Microwave oven	(0) No	(1) Yes
Indoor plumbing	(0) No	(1) Yes
Indoor bathroom	(0) No	(1) Yes
Computer	(0) No	(1) Yes

Once this data is obtained in raw form, the key question is how to compute a wealth index based on household assets that enjoys internal validity; in other words, a wealth indicator that is able to effectively discriminate between economically well-off and worse-off individuals. One common choice, frequently used in the analysis of LAPOP surveys in the past, is to create an index based on the "count" of household assets. The rationale has been that since there is no *a priori* way of weighting the various assets, assuming an equal weight of each was a reasonable way to proceed. This approach, however, can lead to inaccurate results since two individuals with very different economic resources and therefore standards of living can be assigned the same wealth score. For example, an individual who has indoor plumbing and who owns a television would be assigned the same score as one with indoor plumbing and who owns a car; obviously, using this methodology could result in large measurement error by underestimating the wealth of the individual with the car. Instead, in this paper we propose a more appropriate methodology as the new LAPOP standard, one in which the distribution of household assets weights more heavily luxury assets. In order to make those weights non-arbitrary and replicable, we calculate them systematically, based on the Principal Component Analysis (PCA) method described below.

Before getting into the PCA details, we wish to note that a further issue is how to compute a wealth index that will work across space. That is, we want to be able to compare individuals who live in rural vs. urban areas, but we know that in many rural areas in Latin America and the Caribbean, public services such as potable water and electricity are not widely available, whereas in cities they are. We do not want to call an individual "poor" if she lives in a rural area, without water or electricity, yet owns a car, a cell phone etc. Thus, our index must be sensitive to contextual variation both in terms of urban/rural differences and in terms of variation across countries since in the AmericasBarometer we include countries as wealthy as Argentina and as poor as Haiti.

Constructing the Wealth Index

In the 2010 country reports, LAPOP will implement a weighting system for constructing wealth indexes based on assets that relies on Principal Component Analysis (PCA). Filmer and Pritchett (2001) popularized the use of PCA for estimating wealth levels using asset indicators to replace income or consumption data. Based on their analysis of household assets for India and the validation of their results using both household assets and consumption data for Indonesia, Pakistan, and Nepal, they concluded that PCA "provides plausible and defensible

weights for an index of assets to serve as a proxy for wealth" (Filmer and Pritchett 2001 128).

Filmer and Pritchett (2001) note that asset-based measures depict an individual or a household's long-run economic status and therefore do not necessarily account for short-term fluctuations in economic well-being or economic shocks. Thus, although we expect the income variable to be correlated with the wealth measure here estimated, we are aware that the two might tap different dimensions of economic well-being, as previous studies have found (Gasparini et al, 2008; Lora 2008).

Following Filmer and Pritchett, many other studies, especially in the fields of economics and public policy, have implemented and recommend the use of PCA for estimating wealth effects (Minujin and Hee Bang 2002; McKenzie 2005; Vyass and Kumaranayake 2006; Labonne, Biller and Chase 2007).

The estimation of relative wealth using PCA is based on the first principal component. Formally, the wealth index for household i is the linear combination,

$$y_i = \alpha_1(\frac{x_1 - \bar{x}_1}{s_1}) + \alpha_2(\frac{x_2 - \bar{x}_2}{s_2}) + ... + \alpha_k(\frac{x_k - \bar{x}_k}{s_k})$$

Where, $\bar{x}_k$ and s_k are the mean and standard deviation of asset x_k, and α represents the weight for each variable x_k for the first principal component.

By definition the first principal component variable across households or individuals has a mean of zero and a variance of λ, which corresponds to the largest eigenvalue of the correlation matrix of x. The first principal component y yields a wealth index that assigns a larger weight to assets that vary the most across households so that an asset found in all households is given a weight of zero (McKenzie 2005). The first principal component or wealth index can take positive as well as negative values.

The wealth index here estimated for twenty one Latin American and Caribbean countries is based on the ten items listed above in the AmericasBarometer 2008 round of surveys carried out by LAPOP. As suggested in the literature, all variables were first dichotomized (1=Yes, 0=No) to indicate the ownership of each household asset (Vyass and Kumaranayake 2006). Weights (effectively defined by factor scores) for each asset were computed separately for urban and rural areas for each country. Then, a "relative wealth" variable was created in the pooled dataset. Thus, the wealth index takes into account the distribution of assets in urban and rural areas within a given country in order to reflect each country's economic conditions across urban and rural areas. As an example, Table 1 summarizes the results of the PCA for urban and rural areas in two countries, Peru and Costa Rica.

From Table 1 it can be observed that even though Peru and Costa Rica show dissimilar levels of economic development, at first glance the application of PCA seems to provide appropriate factor scores or weights using a common list of assets from the LAPOP surveys in both urban and rural areas in these two countries.

In urban areas in both countries, for example, since almost all households have a television set, this asset receives a very low weight. This means that having a TV does little to increase one's wealth index score compared to a respondent who does not have a TV in the household. In sharp contrast, having a microwave, a washing machine, or a computer is weighted more heavily. It is also noteworthy that very few individuals have more than one vehicle in these two countries, and therefore the indicator variables for two and three vehicles are assigned a low weight since these variables correlate weakly with other assets. Also, it can be observed that the factor score for "no vehicle," as expected, has a negative sign, indicating that an individual in a household without a car ranks lower in terms of economic status than one with a vehicle.

Table 1. Results from Principal Components Analysis												
	Peru Urban			Peru Rural			Costa Rica Urban			Costa Rica Rural		
Variable description	Mean	Std. Dev.	Factor Score	Mean	Std. Dev.	Factor Score	Mean	Std. Dev.	Factor Score	Mean	Std. Dev.	Factor Score
Housing Characteristics												
Indoor plumbing (drinkable water)	89.2%	0.009	0.245	71.2%	0.023	0.157	98.5%	0.004	0.194	94.7%	0.010	0.235
Indoor bathroom	87.8%	0.010	0.275	58.7%	0.025	0.186	97.5%	0.005	0.228	93.0%	0.011	0.277
Durable Assets												
Television	96.8%	0.005	0.162	73.3%	0.023	0.256	98.5%	0.004	0.157	97.1%	0.007	0.288
Refrigerator	69.7%	0.014	0.337	24.3%	0.022	0.340	96.6%	0.006	0.283	92.7%	0.011	0.322
Conventional telephone	62.2%	0.014	0.331	9.3%	0.015	0.338	76.4%	0.014	0.318	65.4%	0.020	0.308
Cellular Phone	71.7%	0.013	0.218	32.8%	0.024	0.293	60.2%	0.016	0.287	46.5%	0.021	0.260
No vehicle	86.4%	0.010	-0.301	93.6%	0.013	-0.370	67.3%	0.016	-0.398	70.3%	0.020	-0.337
One vehicle	11.9%	0.010	0.258	6.1%	0.012	0.348	27.6%	0.015	0.348	25.3%	0.019	0.284
Two vehicles	1.2%	0.003	0.125	0.3%	0.003	0.137	4.7%	0.007	0.131	3.8%	0.008	0.139
Three vehicles	0.04%	0.002	0.084	0.0%	0.000	0.000	0.4%	0.002	0.050	0.5%	0.003	0.055
Washing Machine	27.6%	0.013	0.359	2.1%	0.007	0.278	95.0%	0.007	0.301	90.1%	0.013	0.336
Microwave	25.5%	0.013	0.369	4.0%	0.010	0.340	76.3%	0.014	0.366	60.3%	0.021	0.332
Computer	32.8%	0.014	0.350	8.8%	0.015	0.299	38.3%	0.016	0.314	21.8%	0.018	0.282
Largest Eigenvalue, λ	3.414			3.272			3.052			3.426		
Proportion of Variance Explained	0.263			0.273			0.235			0.264		
Source: AmericasBarometer 2008 by LAPOP												

Table 2. Internal Validity of Wealth Index: Results based on the First Principal Component (21 Latin American countries)					
Quintiles of Wealth	1	2	3	4	5
Housing Characteristics					
Indoor plumbing (drinkable water)	49.54%	70.85%	84.95%	88.39%	93.18%
Indoor bathroom	36.02%	61.20%	79.06%	84.70%	92.40%
Durable Assets					
Television	68.93%	88.30%	97.89%	98.29%	99.08%
Refrigerator	40.90%	68.71%	85.98%	91.13%	96.07%
Conventional telephone	8.55%	28.52%	51.22%	62.02%	77.09%
Cellular telephone	42.34%	66.58%	78.51%	82.76%	92.73%
No vehicle	99.48%	98.41%	93.33%	66.92%	18.23%
One vehicle	0.46%	1.50%	6.29%	29.82%	66.13%
Two vehicles	0.04%	0.08%	0.32%	2.93%	12.60%
Three vehicles	0.01%	0.01%	0.06%	0.32%	3.04%
Washing machine	14.08%	33.99%	51.06%	57.92%	74.39%
Microwave oven	1.83%	12.05%	34.10%	42.56%	72.50%
Computer	0.98%	4.18%	20.72%	37.78%	67.77%
Average Wealth (Mean Scores for First Principal Component)	-2.275	-.972	-.053	.996	2.833
Source: AmericasBarometer 2008 by LAPOP					

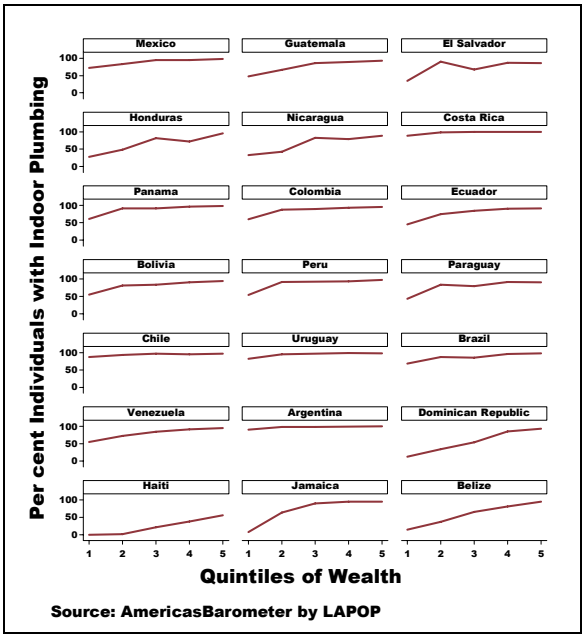
Internal Validity of the Wealth Index

In order to assess the internal validity of the wealth index proposed here, quintiles of wealth were computed based on the index to assess the characteristics of the poor and rich. Table 2 shows the percentage of the population in Latin America and the Caribbean that has access to each asset and the average wealth level across quintiles. Appendix 1 and 2 show the results for urban and rural areas, respectively. As can be observed, the first Principal Component Analysis methodology discriminates well between the rich and poor. Individuals in the fifth quintile unambiguously show much higher levels of wealth than the rest of the population in both urban and rural areas.

Inequality across and within countries

How much inequality is there within and across countries? In order to explore this point, Figure 1 shows the distribution of a single item, indoor plumbing, by country and quintiles of wealth. As expected, there are sharp differences in access to clean water within and across countries. The degree of inequality in access to clean water within countries can be seen by the steepness of the slope in each line graph. For example, the graph for Dominican Republic shows huge inequalities in access to clean water in this country. While only 12.45 percent of those in the first quintile have indoor plumbing, about 93 per cent of individuals in the fifth quintile do. In contrast, the figure below shows that in countries with higher standards of living, like Costa Rica, Uruguay, and Argentina, not only does a much higher proportion of the population have access to clean water, but also this asset is more evenly distributed between the rich and poor (as depicted by the flatter lines).

Figure 1
Inequality in Access to Clean Water across and within Countries



Correlation between the Wealth Index and Other Variables

As can be seen in Figures 2 and 3, economic status as measured here is correlated in the expected direction with other variables in the AmericasBarometer dataset. Individuals in Latin American and Caribbean countries belonging to higher quintiles of wealth show higher levels of income and education. Moreover, as the literature suggests, the poor show lower interest in politics and more limited knowledge of political issues.[3]

[3] The exact wording of the interest in politics item in the LAPOP surveys is the following: How much interest do you have in politics: a lot, some, little or none? The original scale was recoded into a 1-100 scale. The political knowledge index was computed based on five items in the surveys (GI1-GI5); it consists of a count of correct answers to each of the five items.

Figure 2
Correlation between Relative Wealth and Income Level and Years of Schooling

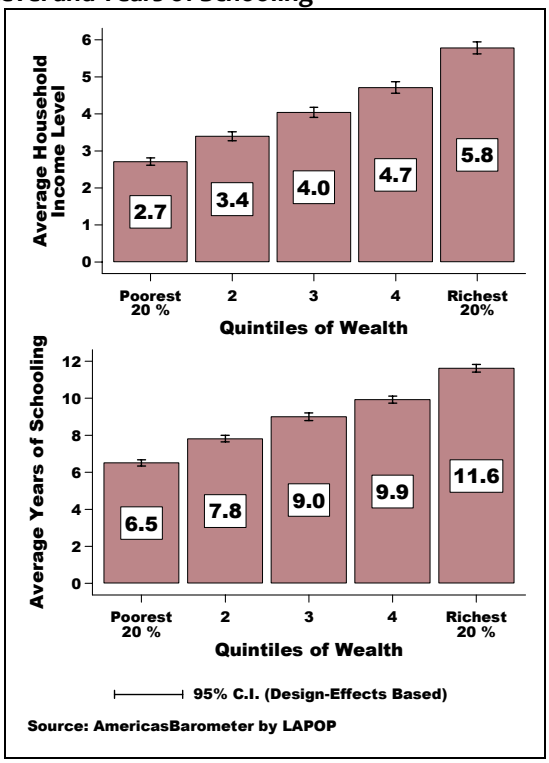
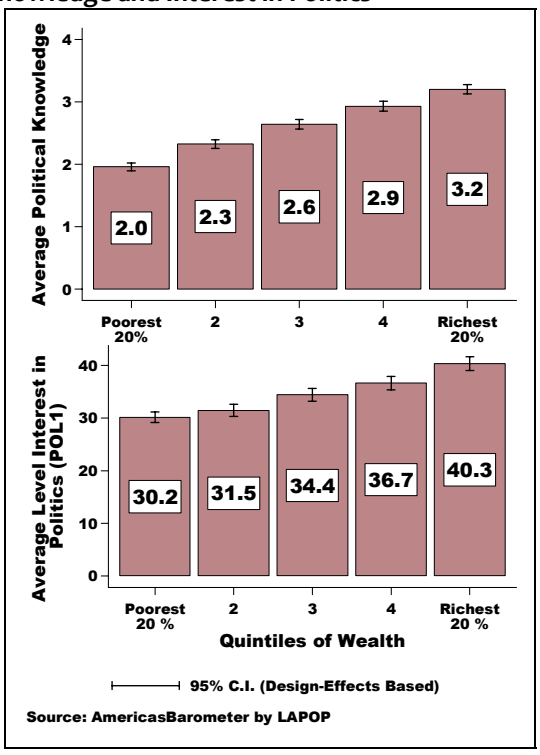
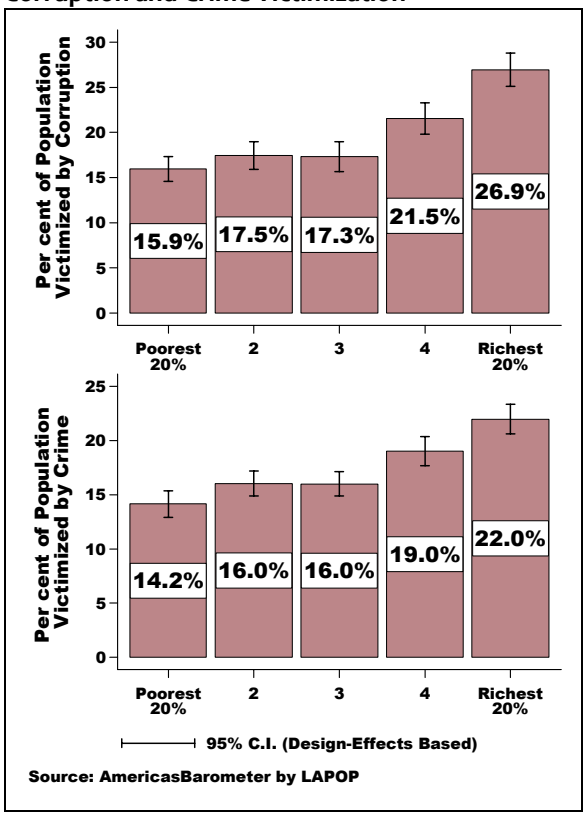


Figure 3
Correlation between Relative Wealth and Political Knowledge and Interest in Politics



As a final validation of the utility of the PCA wealth index, we show in Figure 4 that in terms of corruption and crime victimization, as found in previous research and studies by LAPOP and other studies, the rich are more likely to be victims.

Figure 4
Correlation between Relative Wealth and Corruption and Crime Victimization



Conclusion

We conclude by noting that for the 2010 round of surveys, in which the issue of wealth and poverty will be central, we will utilize this context specific Relative Wealth Index, hereafter RWI, rather than the count-based index used by LAPOP in the past.

Cited Works

Deaton, Angus. *The Analysis of Household Surveys A Microeconometric Approach to Development Policy*. Baltimore, MD: Published for the World Bank [by] Johns Hopkins University Press, 1997.

Gasparini, Leonardo, Walter Sosa Escudero, Mariana Marchionni, and Sergio Olivieri. 2008. Income, Deprivation, and Perceptions in Latin America and the Caribbean: New Evidence from the Gallup World Poll. Latin American Research Network, Inter-American Development Bank, and Center for the Study of Distribution, Labor and Social Affairs (CEDLAS), La Plata, Argentina.

Filmer, D., and LH Pritchett. "Estimating Wealth Effect Without Expenditure Data or Tears: An Application to Educational Enrollments in States of India." *Demography* 38, no. 115-32 (2001).

Labonne, Julien , Dan Biller, and Rob Chase. "Inequality and Relative Wealth: Do They Matter for Trust? Evidence from Poor Communities in the Philippines." In *Social Development Papers, Community Driven Development, The World Bank*, 2007.

Lora, Eduardo, ed. *Beyond Facts: Understanding Quality of Life*. Washington, DC: Inter-American Development Bank, 2008.

Martinelli, Cesar and Susan W. Parker. 2008. "Deception and Misreporting in a Social Program" Journal of the European Economic Association(forthcoming).

McKenzie, David J. "Measuring Inequality with Asset Indicators." *Journal of Population Economics* 18, no. 2 (2005): 229-60.

Minujin, Alberto, and Joon Hee Bang. "Indicadores de inequidad social. Acerca del uso del índice de bienes para la distribución de los hogares."*Desarrollo Económico* 42, no. 165 (2002): 129-46.

Vyass, Seema, and Lilani Kumaranayake. "Constructing Socioeconomic Status Indexes: How to Use Principal Component Analysis." *Health Policy and Planning* 21, no. 6 (2006): 459-68.

Appendix

Appendix 1. Internal Validity of Wealth Index: Results based on the First Principal Component (Urban Areas; 21 Latin American countries)					
Quintiles of Wealth	1 Poorest 20%	2	3	4	5 Richest 20%
Housing Characteristics					
Indoor plumbing (drinkable water)	66.64%	87.79%	90.53%	95.53%	98.14%
Indoor bathroom	51.45%	81.79%	90.67%	94.45%	98.14%
Durable Assets					
Television	84.43%	98.34%	99.22%	99.55%	99.93%
Refrigerator	53.32%	86.68%	94.64%	96.90%	99.20%
Conventional telephone	12.49%	40.53%	67.91%	75.85%	90.62%
Cellular telephone	51.51%	72.23%	84.19%	86.45%	95.37%
No vehicle	99.36%	98.21%	91.63%	56.66%	8.54%
One vehicle	0.58%	1.66%	7.92%	38.95%	72.79%
Two vehicles	0.06%	0.11%	0.39%	4.00%	14.93%
Three vehicles	0.00%	0.02%	0.07%	0.40%	3.74%
Washing machine	19.12%	43.94%	62.73%	70.20%	86.16%
Microwave oven	2.64%	17.02%	43.91%	54.96%	83.72%
Computer	1.45%	6.00%	29.68%	51.34%	82.71%
Average Wealth (Mean Scores for First Principal Component)	-2.41	-0.96	-0.002	1.13	2.73
Source: AmericasBarometer 2008 by LAPOP					

Appendix 2. Internal Validity of Wealth Index: Results based on the First Principal Component (Rural Areas; 21 Latin American countries)					
Quintiles of Wealth	1 Poorest 20%	2	3	4	5 Richest 20%
Housing Characteristics					
Indoor plumbing (drinkable water)	19.0%	39.9%	73.8%	74.8%	84.1%
Indoor bathroom	8.4%	23.6%	55.9%	66.1%	81.9%
Durable Assets					
Television	41.2%	70.0%	95.2%	95.9%	97.5%
Refrigerator	18.7%	35.9%	68.7%	80.2%	90.3%
Conventional telephone	1.5%	6.6%	18.0%	35.7%	52.3%
Cellular telephone	26.0%	56.3%	67.2%	75.7%	87.9%
No vehicle	99.7%	98.8%	96.7%	86.5%	36.0%
One vehicle	0.3%	1.2%	3.0%	12.4%	53.9%
Two vehicles	0.0%	0.0%	0.2%	0.9%	8.3%
Three vehicles	0.0%	0.0%	0.0%	0.2%	1.8%
Washing machine	5.1%	15.8%	27.8%	34.5%	52.8%
Microwave oven	0.4%	3.0%	14.5%	18.9%	51.9%
Computer	0.1%	0.9%	2.9%	12.0%	40.4%
Average Wealth (Mean Scores for First Principal Component)	-2.04	-1.003	-0.16	0.73	3.03
Source: AmericasBarometer 2008 by LAPOP					