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# **FUTURE DEMAND FOR NEW CARS IN DEVELOPING COUNTRIES: GOING BEYOND GDP AND POPULATION SIZE**

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**MICHAEL SIVAK  
OMER TSIMHONI**



FUTURE DEMAND FOR NEW CARS IN DEVELOPING COUNTRIES:  
GOING BEYOND GDP AND POPULATION SIZE

Michael Sivak  
Omer Tsimhoni

The University of Michigan  
Transportation Research Institute  
Ann Arbor, Michigan 48109-2150  
U.S.A.

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16. Abstract <p>In this study we first modeled the effects of GDP and population size on sales of new cars in 2006 for the following 25 developing countries: Algeria, Argentina, Brazil, China, Chile, Columbia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, Ukraine, Venezuela, and Vietnam. The main results are that while both GDP and population have significant effects on sales of new cars, substantial deviations between projected and actual sales still remain. The countries that exceeded the projected sales include Iran, Russia, Brazil, Malaysia, Romania, India, Pakistan, Venezuela, and South Africa. In other words, for these countries, reliance only on GDP and population size underestimates the actual sales. Using the relationship that was derived from the 2006 data, projected future GDPs and populations, and assuming that the deviations from the 2006 model are systematic and will remain proportionally constant in the medium term, illustrative calculations were then made for sales of new cars in 2014 and 2020. According to these calculations, the countries with the greatest absolute increases in projected sales from 2006 to both 2014 and 2020 are likely to be China, India, Russia, Brazil, Iran, Malaysia, Mexico, Pakistan, South Africa, and Turkey.</p>			
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## **Introduction**

Two fundamental variables that influence the demand for personal vehicles in a country are the size and wealth of the population. Larger countries, with all other factors being equal, have greater sales of new cars than smaller countries. Analogously, richer countries, with all other factors being equal, have greater sales than poorer countries. This report is designed to evaluate how well these two variables predict the current sales of new cars in 25 developing countries. Of interest are both the fit of a predictive model using these two variables as well as the deviations from the model. The deviations are then used as corrective factors that planners could utilize (in addition to projected future size and wealth of the population) in projecting future vehicle demand. Illustrative calculations for 2014 and 2020 are provided.

## Method

### Countries examined

The following 25 developing countries were analyzed: Algeria, Argentina, Brazil, China, Chile, Columbia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, Ukraine, Venezuela, and Vietnam.

The examined 25 countries met the following criteria in 2006: (1) were not among the 60 high-income countries (World Bank, 2007), and (2) were the next 25 largest economies in terms of GDP purchasing power parity that had GDP per capita of at least \$2,500 (World Bank, 2007). Thus, we used the same criteria as Grant Thornton in a recent general examination of emerging markets (Grant Thornton, 2008), except that we also added the minimum GDP per capita criterion.

The selected countries include the four BRIC countries of Brazil, Russia, India, and China (Wilson and Purushothaman, 2003), as well as nine out the Next Eleven (N-11) countries (O'Neill, Wilson, Purushothaman, and Stupnytska, 2005). (The remaining two Next Eleven countries, Bangladesh and Nigeria, did not meet the minimum GDP per capita criterion.)

### Variables considered

- *Sales of new cars in 2006* (Automotive News, 2007).
- *Population in 2006* (Grant Thornton, 2008), and *projected population in 2014 and 2020* (U.S. Census Bureau, 2008).
- *Wealth as measured by GDP purchasing power parity*. The 2006 values were from the World Bank, as cited in Grant Thornton (2008). The 2014 and 2020 values were derived from the 2006 values by applying the average growth rate forecasted by Grant Thornton (2008) for 2006 through 2014.

## **Approach**

In the first step, we used a multiple regression to model the influences of the current GDP and population on current sales of new cars. In the second step, the deviations of the actual sales from projected sales were quantified. In the third step, the equation derived in the first step using the current values, along with the correction factors from the second step, were applied to the projected 2014 and 2020 values of GDP and population to provide illustrative calculations of future sales of new cars.



## Results

### **Multiple regression of current sales of new cars on current GDP and population**

A multiple regression of the current (2006) sales of new cars on the current (2006) GDP and population was highly significant,  $F(2, 22) = 141.3$ ,  $p < .001$ , with both predictor variables being significant in the model. The model accounted for 93% of the variance in sales of new cars ( $r^2 = .93$ ). The equation of the model is as follows:

$$\text{sales of new cars} = 80980 + (712 * \text{GDP}) - (1799 * \text{population}) \quad (1)$$

where GDP is in billions of US\$ purchasing power parity and population is in millions.

It is interesting to note in Equation (1) that population has a negative coefficient. The implication is that for a given value of GDP (country wealth), a larger population results in smaller car sales. This is the case because in such a situation, GDP per person (individual wealth) is reduced.

### **Deviations of the actual sales from the projected sales of new cars**

Figure 1 shows a scatter plot of the actual versus projected sales of new cars for 2006. If the actual sales were the same as the projected sales, the points would fall on the diagonal line.

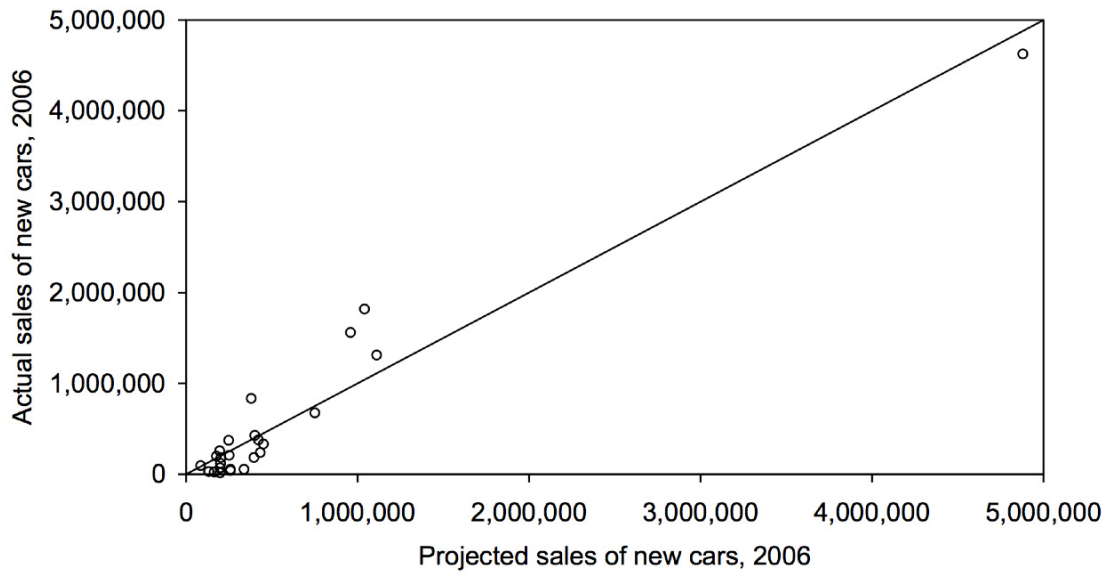


Figure 1. A scatter plot of the actual versus projected sales of new cars for 2006.

The extent of the deviations in Figure 1 from the diagonal is quantified in Table 1 by presenting the ratios of the actual-to-projected sales. A ratio greater than 1 indicates that the actual sales of new cars in that particular country were greater than the projected sales, and vice versa. The countries with a ratio greater than 1 included, in descending order of the ratio, Iran, Russia, Brazil, Malaysia, Romania, India, Pakistan, Venezuela, and South Africa. For these countries, reliance only on population size and GDP underestimates the actual sales.

Table 1  
Ratio of the actual versus projected sales of new cars for 2006.

Country	Ratio
Iran	2.21
Russia	1.75
Brazil	1.63
Malaysia	1.51
Romania	1.31
India	1.18
Pakistan	1.13
Venezuela	1.12
South Africa	1.07
China	0.95
Hungary	0.90
Mexico	0.90
Turkey	0.89
Ukraine	0.84
Argentina	0.74
Chile	0.58
Poland	0.55
Thailand	0.46
Egypt	0.36
Vietnam	0.23
Colombia	0.22
Indonesia	0.16
Philippines	0.15
Peru	0.14
Algeria	0.08

The deviations of the ratios in Table 1 from 1 reflect the contributions of factors other than GDP and population size to the demand for personal vehicles. These factors (see, for example, Dargay and Gately, 1999) include the cost and availability of gasoline, availability and cost of public transportation, road density, country geography, income homogeneity, population-age distribution, population density, etc.

A critical assumption that we made in this study is that the influence of these factors in a given country will remain relatively stable through 2020. We also made the assumption that the influence of these factors on future sales of new cars will be multiplicative. (For example, if in 2006 a country had 120% of the predicted sales, it would continue through 2020 to have 120% of the value derived from the regression Equation (1).) Consequently, in the next analysis we used the ratios in Table 1 as corrections to provide illustrative calculations of 2014 and 2020 sales of new cars based on projected 2014 and 2020 GDPs and populations.

### **Illustrative calculations for 2014 and 2020**

We used the following information in these calculations:

- GDP projections for 2014 and 2020, derived from the actual 2006 values by applying the average annual growth rate forecasted by Grant Thornton (2008) for 2006 through 2014.
- Population projections for 2014 and 2020 by the U.S. Census Bureau (2008).
- Equation (1) derived from the 2006 relationship.
- The correction factors from Table 1.

The results for 2014 and 2020 are shown in Table 2 in terms of the calculated increases in sales of new cars relative to 2006 sales. For both 2014 and 2020, the ten countries with the greatest absolute increases in sales over 2006 are China, India, Russia, Brazil, Iran, Malaysia, Mexico, Pakistan, South Africa, and Turkey.

Table 2  
 Illustrative calculations of increases in sales of new cars from 2006 to 2014 and 2020, respectively. The entries are ranked in decreasing order of the difference between the 2020 and 2006 sales. (See text for critical assumptions.)

Country	GDP, average annual growth (%)	2006 sales (millions)	2014 sales - 2006 sales (millions)	2020 sales - 2006 sales (millions)
China	9	4.6	6.6	15.7
India	8	1.3	2.7	6.4
Russia	5	1.8	1.0	2.1
Brazil	4	1.6	0.7	1.3
Iran	5	0.8	0.4	0.9
Malaysia	6	0.4	0.2	0.4
Mexico	3	0.7	0.2	0.4
Pakistan	7	0.1	0.2	0.4
South Africa	5	0.4	0.2	0.4
Turkey	5	0.4	0.2	0.4
Ukraine	6	0.2	0.1	0.3
Argentina	4	0.3	0.1	0.2
Poland	4	0.2	0.1	0.2
Thailand	5	0.2	0.1	0.2
Venezuela	6	0.2	0.1	0.2
Chile	5	0.1	< 0.1	0.1
Colombia	5	0.1	< 0.1	0.1
Egypt	5	0.1	< 0.1	0.1
Hungary	4	0.2	< 0.1	0.1
Indonesia	5	0.1	< 0.1	0.1
Philippines	6	< 0.1	< 0.1	0.1
Romania	4	0.3	0.1	0.1
Vietnam	8	< 0.1	< 0.1	0.1
Algeria	5	< 0.1	< 0.1	< 0.1
Peru	6	< 0.1	< 0.1	< 0.1

## Discussion

This study was based on the following critical assumptions:

- *The deviations of the actual from the projected sales in the 2006 model are reflections of systematic differences across different countries, and these deviations will remain proportionally the same throughout the time period examined.* Future studies would need to be performed to address the validity of these two assumptions, especially in view of the recent upheavals in the oil and financial markets.
- *Projected increases in population are valid.* It is likely that these U.S. Census Bureau projections, especially for 2014, are reasonably accurate.
- *Projected increases in GDP are valid.* The average annual increases in GDP that were used in the analysis (see Table 2) were projections developed by Grant Thornton (2008) for a time period from 2006 through 2014. Thus, we extrapolated the Grant Thornton projections beyond the time frame originally intended. Furthermore, it is unclear whether major upheavals would influence future growth in GDP in ways not envisioned in Grant Thornton projections, and whether such upheavals would also have psychological effects not captured by GDP.

## Summary

In this study we examined the relationship between both the wealth and size of the population and sales of new cars in 25 developing countries. The main results are that while both GDP and population have significant effects on sales of new cars, substantial deviations between projected and actual sales still remain. The countries that exceeded the projected sales include Iran, Russia, Brazil, Malaysia, Romania, India, Pakistan, Venezuela, and South Africa. In other words, for these countries, reliance only on GDP and population size underestimates the actual sales.

We argued that the deviations of the actual from the projected sales likely reflect the effects of other factors, such as the cost and availability of gasoline, availability and cost of public transportation, road density, country geography, income homogeneity, population-age distribution, and population density. Furthermore, we argued that the contribution of these factors in the medium term is likely to remain proportionally the same. Consequently, we used these deviations, along with projected GDP and population size, to provide illustrative calculations for sales of new cars in 2014 and 2020. The results indicate that the ten countries with the greatest absolute increases in sales over 2006 are likely to be China, India, Russia, Brazil, Iran, Malaysia, Mexico, Pakistan, South Africa, and Turkey.

The calculated sales of new cars in this report should be taken with a substantial grain of salt. Importantly, these are not forecasts, but calculations given certain assumptions whose validity is uncertain. The user of the calculated values should evaluate for himself or herself the likelihood that the assumptions will hold for the time period in question. In other words, this study provides a potentially powerful tool for planners who are willing and able to independently assess the approach and the underlying assumptions. Thus, use at your own risk (and rewards).

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