

# **The Impact of Cell Phones and BAC Laws on Motor Vehicle Fatality Rates**

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## **Abstract**

This paper develops a set of models for the determinants of automobile fatalities with particular attention devoted to the effects of increased cell phone usage. Cell phones have been associated with both life-taking and life-saving properties. However, prior statistical evaluations of the effects of cell phones have led to fragile results. We develop in this paper econometric models using time series data, allowing for polynomial structures of the regressors. The models are evaluated with a set of specification error tests providing reliable estimates of the effects of the various policy and driving related variables evaluated. The statistical results indicate the effect of cell phones is non-monotonic depending on the volume of phones in use, first having a net life-taking effect, then a net life-saving effect, followed finally with a net life-taking effect as the volume of phone use increases.

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## I. INTRODUCTION

The determinants of motor vehicle accidents have been the topic of interest among economists, public policy makers, and health professionals for many years. Studies have been conducted on the determinants of motor vehicle accidents in aggregate, as well as by components, i.e., automobiles, trucks, motorcycles, etc. The interest in transportation accidents also led to studies involving railroads, ships, and aircraft as well as accidents due to the interaction of two or more modes of transportation. In addition to interest in accidents themselves, there has been an interest in the determinants of the outcomes of these accidents, i.e., injuries, fatalities, and property damage.<sup>1</sup> Centering our discussion on motor vehicle accidents, numerous studies have investigated the effect on motor vehicle accidents due to: speed, speed variance, alcohol, speed limits, vehicle miles traveled, measures of income, unemployment rates, technology advances, the age of the fleet, population characteristics, police enforcement, seat belt legislation, and the effects of the deregulatory climate which came about in the 1980's, among others. More generally, these potential determinants of accidents and factors reducing accidents may be placed into three categories: those associated with the vehicles themselves, e.g., technology improvements; those due to the roadways, e.g., speed limits; and those relating to drivers, e.g., alcohol consumption, income, etc. More recently, the question has arisen as to the effect of cell phones on motor vehicle accidents. While it may generally be argued that the probability of a motor vehicle accident increases with the use of cell phones by drivers, it is not necessarily as obvious when considering motor vehicle

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<sup>1</sup> See Loeb, Talley, and Zlatoper (1994) for a detailed discussion of the determinants of transportation accidents.

fatalities. Some analysts claim that fatalities, like accidents increase when drivers use cell phones, due to an inability of at least some drivers to dial and talk while driving (similar to an inability to chew gum and tie one's shoes). In addition, there is evidence that cell phones reduce the driver's attention span and reaction time which in turn increases the probability of an accident. Further, others have argued that the distraction of using a cell phone is not restricted to the time while on the cell phone itself, but may extend for several minutes after the phone conversation has terminated. On the other hand, the opposite argument has been made that cell phones can reduce fatalities, that is, given an accident, cell phones increase the probability of obtaining help promptly which may result in the saving of lives. In any case, cell phone use by the public at large has increased dramatically since 1985. In 1985, there were approximately 340,200 cell phone subscribers. By the year 2004, this number grew to over 182,140,000 subscribers.<sup>2</sup> It probably would be descriptive to say the growth of cell phone subscribers was explosive rather than exponential over time. In addition, Glassbrenner (2005), in a National Traffic and Safety Administration (NHTSA) study, estimates that in 2005, ten percent of all drivers at any moment during daylight hours are using a hand-held or hand-free cell phone. Looking at hand-held phones only, Glassbrenner estimated that driver hand-held use rose from 5 percent in 2004 to 6% in 2005.<sup>3</sup> As such, we see not only tremendous growth in cell phone subscribers but also an increase in usage of these devices over time by drivers.

The question then arises as to the net impact that cell phones have on motor vehicle fatalities. This study provides some econometric insight into the effect of cell

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<sup>2</sup> See Cellular Telecommunications and Internet Association (2005).

<sup>3</sup> See Glassbrenner (2005).

phone use on motor vehicle fatalities. This is accomplished using econometric techniques on a time series data set covering the period 1975 to 2003. The models developed are subjected to a set of specification error tests to assure that the results are statistically viable.<sup>4</sup>

## **II. BACKGROUND**

Between 1975 and 1980 motor vehicle fatalities trended upward (from 44,525 to 51,091) and then trended downward to 42,643 in 2003.<sup>5</sup> The determinants of these fatalities have been the subject of numerous studies in the past. These factors, as mentioned above, include socioeconomic factors such as the unemployment rate, income, and population attributes as well as vehicle and driver related factors. These later factors include, among others, alcohol consumption, speed limit laws, vehicle miles traveled, interstate highway mileage, the mix of rural to interstate highway mileage, the blood alcohol threshold indicative of driving under the influence of alcohol, and a time trend.<sup>6</sup> Recently, the question of the potential effect of cell phones on motor vehicle fatalities has become a significant policy issue such that three states (New Jersey, Connecticut, and New York) as well as Washington D.C. ban the use of hand-held cell phones while driving.<sup>7</sup>

The traditional econometric based literature has examined many of the potential factors effecting motor vehicle accidents and injuries, starting with Peltzman (1975). Obviously, early studies do not consider cell phones, since they were not in use at the

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<sup>4</sup> Cell phones have also been suggested as a potential contributor to disease. This question is not addressed in the present paper. See, for example, Maier, Blakemore, and Koivisto (2000) on this matter.

<sup>5</sup> See Chart A.

<sup>6</sup> See Loeb, Talley, and Zlatoper (1994) on this.

<sup>7</sup> Chart B portrays the growth in cell phone subscriptions.

time of the studies. In these studies, economic factors such as measures of income and the unemployment rate have been examined.<sup>8</sup> Some have argued that higher incomes are associated with more accidents while others have argued that they are associated with fewer accidents. Since the demand for safety and driving intensity are both related to income and may counteract one another, the net effect needs to be determined empirically.<sup>9</sup> Unemployment rates have been used in many studies as a control for economic activity and have been found to be inversely related to motor vehicle accidents.<sup>10</sup> Miles driven is expected to be positively related to motor vehicle accidents as is alcohol consumption by drivers and the public in general.<sup>11</sup> Further, interstate highway mileage and the relationship between rural and urban highway mileage have also been investigated as to their effects on accidents.<sup>12</sup> In addition, studies have suggested that empirical models should be normalized by population or characteristics of the population, such as the proportion of the population aged 65 or older, or the proportion of the population characterized as youthful.<sup>13</sup> The effect of speed and speed variance has been an issue debated at length in the transportation literature.<sup>14</sup> The effect

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<sup>8</sup> A time trend has also been used in some studies as a proxy for permanent income, changes in technology, or other omitted factors. See Loeb (2001,1993) and Peltzman (1975). Concern arises in using both a time trend and measures of income in models due to high correlation between such variables. Loeb and Clarke (forthcoming) found a correlation between real GDP and a time trend to be 0.988 and 0.997 when the variables are measured in natural log form for the time period 1970-2001.

<sup>9</sup> Prior studies have found a positive relationship between accidents and income using time series models and a negative relationship with cross-sectional models. See Loeb, Talley, and Zlatoper (1994).

<sup>10</sup> See, for example, Evans and Graham (1988) and Fowles and Loeb (1995).

<sup>11</sup> See Loeb, Talley, and Zlatoper (1994), Fowles and Loeb (1995), and Loeb and Clarke (forthcoming).

<sup>12</sup> See Loeb, Talley and Zlatoper (1994).

<sup>13</sup> See, for example, Clarke and Loeb (forthcoming), Keeler (1994), Loeb (1988), and Fowles and Loeb (1992). It should be noted further that, as in the case concerning real GDP and a time trend, there is also a strong correlation between real GDP and both population and vehicle miles driven. For the sample period 1975-2003, the correlation between real GDP and a time trend is 0.99 while the correlation between real GDP and population and vehicle miles driven is 0.995 in both cases. As such, most models developed do not include more than one of these variables so as to avoid multicollinearity.

<sup>14</sup> See Loeb, Talley, and Zlatoper (1994), Lave (1985), Fowles and Loeb (1989, 1995), and Levy and Asch (1989).

of speed limits have also been investigated as potential contributors to motor vehicle accidents and have been found in some studies to have some effect on fatalities.<sup>15</sup>

Unlike the above mentioned variables, cell phones have only recently been investigated regarding their influence on motor vehicle related accidents, and then rarely in a traditional regression format. Perhaps the most well-known study to date is that of Redelmeier and Tibshirani (1997). Using cross-over analysis, they analyze 699 drivers involved in property damage only accidents in the Toronto (Canada) area during the period July 1, 1994 to August 31, 1995. They find, among other things, that the risk of being involved in such an accident is four times higher when a cell-phone is being used. In addition, they find that hands-free devices offer no additional safety as compared to the hand-held devices. However, they find that 39 percent of drivers involved in these accidents used cell phones to call for assistance after a crash which suggests that cell phones may be advantageous after a crash. Similarly, McEvoy et al. (2005) using cross-over analysis and Australian data evaluated 456 drivers aged 17 or older who owned cell phones and were involved in crashes which resulted in hospital visits. Interestingly, they found that the use of mobile phones up to ten minutes before a crash was associated with a four fold increased probability of a crash. Hands-free devices again were found no safer than hand-held devices. Laberge-Nadeau et al. (2002), using Canadian survey data (36,078 responses) and logistic-normal regression models found the relative risk of accidents is higher for users of cell phones as compared to non-users by approximately 38 percent. However, the risk diminishes when the models are more extensive. Another survey based study using cross over analysis was conducted by Sullman and Baas (2004). Their survey resulted in approximately a 50 percent response rate and

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<sup>15</sup> See Fowles and Loeb (1995) and Loeb (1993).

investigated all crashes, regardless of severity. Once demographic and other variables were accounted for, they did not find a significant correlation between cell phone use and crash involvement. An alternative technique to examine the effect of cell phones on motor vehicle accidents involves the use of measuring response rates, or reaction time, in a simulated laboratory situation. Consiglio et al. (2002) found that both hand-held and hand-free devices resulted in a reduction in reaction time in a braking situation. They also found that conversation both in-person or via a cell phoned caused reaction time to slow while listening to music did not.

The current paper evaluates the effect of cell phones on motor vehicle fatalities using econometric methods and a time series data set covering the period 1975 to 2003. As such, we are able to diminish statistical problems associated with survey data and provide an analysis while controlling for traditional factors in such models. To reduce the likelihood that the models suffer from omission of variables, misspecification of the structural form, or simultaneous equation bias (which may result in biased estimates) along with non-normality of the error structure and serial correlation, a set of specification error tests are applied to the models.<sup>16</sup> Only models which are not rejected by any of these tests are used in the analysis to follow.

### **III. THE MODEL AND DATA**

#### **A. The General Model**

A model of the form:

$$(1) \text{ Fatalities} = \beta_0 + \beta_1 \mathbf{X} + \beta_2 \text{ CELLS} + \mu$$

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<sup>16</sup> These include a Regression Specification Error Test, a Jarque-Bera test, and a Durbin-Watson test.

is suggested where  $\mathbf{X}$  is a matrix of socioeconomic and motor vehicle related variables thought to be determinants of the dependent variable. CELLS is a measure of cell phone availability/usage whose influence on the dependent variable is to be examined.  $\mu$  is a random error term assumed to comply with the full ideal conditions underlying the classical linear regression model which would result in Best Linear Unbiased Estimates of the coefficients when the model is estimated by Ordinary Least Squares. Cell phone usage by drivers is not measured directly but is proxied by cell phone subscribers.<sup>17</sup> Glassbrener (2005) has estimated that approximately ten percent of all drivers at any daylight moment are making use of a cell phone device. Therefore, the number of cell phone subscribers should serve as a reasonable proxy for the potential distracting influence on drivers which may result in an accident and fatality.<sup>18</sup> In the models suggested, CELLS is entered so that the model appears as a polynomial of degree three. This conforms with similar models in the Industrial Organization literature examining the determinants of Research and Development.<sup>19</sup>

The variables considered for possible inclusion in  $\mathbf{X}$  are:

UNEMP - the civilian unemployment rate.

ETHOTOTAL - apparent total per capital ethanol consumption (in gallons) based on population aged 14 and over.

VEHMI - vehicle miles driven (billions).

TOTALMI - total highway mileage (in thousands).

INTERMI - interstate highway mileage (in thousands).

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<sup>17</sup> In addition, it may capture the effect of cell phone availability to those not involved in accident on the outcome of an accident.

<sup>18</sup> Again, as the number of cell phones among the general public increases, there may be a reduction in fatalities given an accident due to the increased speed in which medical assistance may be acquired.

<sup>19</sup> See Loeb and Lin (1977) and Scherer (1965a, 1965b).

URBANMI – urban highway mileage (in thousands).

RURALMI - rural highway mileage (in thousands).

POP - total population (in thousands).<sup>20</sup>

BAC – a dummy variable indicating the blood alcohol threshold associated with driving under the influence of alcohol. State laws vary over time. A BAC of “1” indicates either a 0.1 or a 0.08 BAC threshold is in effect while a BAC of “0” indicates no such legal threshold exists.<sup>21</sup>

SPEED95 - a dummy variable indicating the repeal of the maximum speed limit by the National Highway System Designation Act of 1995 in December 1995 which allowed states to set their own limits for the first time since 1974.<sup>22</sup> SPEED95 is set equal to 0.083333 in 1995, set equal to 1 from 1996 to 2003 and set to zero for all other time periods.

CELLS - estimated number of cell phone subscribers.

We anticipate a negative effect on the dependent variable by UNEMPL and BAC.

We expect a positive effect by ETHOTOTAL, the ratio of rural mileage to urban mileage (RURALMI/URBANMI), and CELLS. We do not have strong a priori expectations regarding the effects of INTERMI and POP.<sup>23</sup>

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<sup>20</sup> Additional population variables were examined as well where the entire population was decomposed into those aged 16-19, 20-24, 25-44, 45-64, 65 and older. This allowed for examining whether certain groups of the population contributed to accidents more so than others. Results using POP were superior to other variations of population. The alternative results are available from the authors.

<sup>21</sup> The BAC data are by state and over time. An annualized value is obtained by weighting each state's BAC threshold for a given year by its relative share of the population for the year. We are grateful to Michael Grossman for the data and weighting mechanism used to generate this variable.

<sup>22</sup> An alternative dummy variable to account for the speed limit was also evaluated. SPEED87 indicated the years Congress allowed states to increase speed limits to 65 mph on rural interstates. These results are available from the authors.

<sup>23</sup> As mentioned previously, population and vehicle miles drive were found to be highly correlated with other variables, e.g., the time trend and other measures of miles driven. As such, most models estimated restricted the number of such variables included so as to minimize the risk of multicollinearity. A correlation matrix is available from the authors.

## B. The Data

Data generally cover the period 1975 to 2003, but may vary depending on the model and variables included. The dependent variable (FATTOT) is measured as total motor vehicle fatalities and is reported in NHTSA (2005). Vehicle miles driven, measured in billions of miles (VEHMI), are reported in NHTSA (2005) as well. The unemployment rate (UNEMP) and population data (POP) are reported in the Economic Report of the President (2005). Total apparent per capita ethanol consumption (ETHOTOTAL) is reported by the National Institute on Alcohol Abuse and Alcoholism and is found at: <http://www.niaa.nih.gov/Resources/DatabaseResources/QuickFacts>. Data on highway mileage, i.e., Total mileage (TOTALMI), interstate mileage (INTERMI), rural mileage (RURALMI), and urban mileage (URBANMI) are reported in the U.S. Bureau of the Census (various years). The speed limit variable (SPEED95) was generated as a dummy variable taking on the value of “1” for the years in which the National Highway System Designation Act of 1995 was in effect and “0” otherwise. In the year 1995, the variable was set equal to 0.083333 to reflect the proportion of that year the act was in effect. Data associated with the BAC laws are provided by MADD (<http://www.madd.org/laws/>) and the U.S. Bureau of the Census ([http://www.allcountries.org/uscensus/1046\\_state\\_legislation\\_alcohol\\_and\\_road\\_safety.html](http://www.allcountries.org/uscensus/1046_state_legislation_alcohol_and_road_safety.html)). Data for the number of cell phone subscribers (CELLS) are in millions and are reported by CTIA (2005) for the years 1985 to 2004. CTIA does not report the number of cell phone subscribers prior to 1985 and one could infer that none existed. However, AT&T put into place a trial system involving 2000 customers in 1977. As such, rather than assume there were no cell customers prior to 1985, we extrapolate potential

subscribers for the period 1977 to 1984. Relatively speaking, these do not amount to significant numbers, but do take account of the fact that cell phones were in very limited use prior to 1985.<sup>24</sup>

#### **IV. MODEL SELECTION AND EMPIRICAL RESULTS**

##### **A. Model Selection**

Equation (1) can be respecified to introduce a polynomial effect of CELLS on the dependent variable as:

$$(2) \text{ FATTOT} = \beta_0 + \beta_1 \mathbf{X} + \beta_2 \text{ CELLS} + \beta_3 \text{ CELLS}^2 + \beta_4 \text{ CELLS}^3 + \mu$$

and where  $\mathbf{X}$  includes various combinations of the other regressors discussed above.<sup>25</sup>

Variations of equation (2) are estimated by OLS. Under the full ideal conditions, OLS results in Best Linear Unbiased Estimates (BLUE). Concern arises due to the possibility of not only serial correlation, given the use of time-series data, but also the possibility of biased estimates due to the potential omission of variables, simultaneous equation problems, and misspecification of the structural form of the model. As such, the various specifications estimated were subjected to a set of specification error tests. These tests are used to detect violations of the full ideal conditions. They include the regression specification error test (RESET) developed by Ramsey (1974), the Jarque-Bera test (J-B) for normality, and the Durbin-Watson test (D-W) for serial correlation. RESET examines the residuals of a given regression for the possibility of omission of variable(s),

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<sup>24</sup> Even in 1985, there were only slightly more than 340,000 cell phone subscribers. See CITA (2005). It should be further noted that model (1) was expanded to include additional variables to account for the influence of hospital availability, income, technology, and other factors. However, these variables are not included in what follows since their inclusion either did not add substantially to the results reported or they introduce potential specification errors such as multicollinearity or errors resulting in biased estimates or non-normal errors.

<sup>25</sup> These would include the ratio of RURALMI to URBANMI and Vehicle Miles per Capita (VEHMI/POP), among others.

simultaneous equation bias, and misspecification of the structural form of the regressors, any of which may result in biased estimates.<sup>26</sup> Any given specification estimated is rejected if one or more of the above mentioned tests rejects the hypothesis of the presence of the full ideal conditions. This is a rather severe requirement imposed on the model selection process as compared to relying on student t-statistics or  $R^2$ 's.<sup>27</sup> Those specifications which are not rejected provide reasonable specifications to evaluate at least from a single equation perspective.

## B. Empirical Results

Models suggested by equation (2) were estimated by Ordinary Least Squares and examined for specification errors. Table 1 provides summary statistics for variables used in the equations not rejected for specification errors mentioned above or for multicollinearity.<sup>28</sup> Table 2 provides a set of models for FATTOT which were not rejected for specification errors.

The estimated coefficients tend to be stable (non-fragile) and consistent across the various specifications. Those reported are not rejected by the various specification error tests and all have adjusted  $R^2$ 's above 0.91. The coefficient associated with the unemployment rate is consistently negative and statistically significant at better than the 0.005 significance level across all the specifications estimated. The coefficient associated with alcohol consumption is, as expected, always positive and statistically significant at better than the 0.005 significance level. The ratio of rural to urban highway mileage has a positive influence on the dependent variable as seen across all

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<sup>26</sup> RESET's ability to detect misspecification associated with structural form is of particular interest given the polynomial specification suggested.

<sup>27</sup> See Ramsey and Zarembka (1971) on this.

<sup>28</sup> A correlation matrix is available from the authors.

specifications, as expected, with the associated coefficients varying in significance with most near the 0.1 one-tail level. The BAC coefficients were negative and significant at approximately the 5% or better one-tail level. The interstate mileage driven and population variables did not have coefficients which were statistically significant.

The variables of particular interest in this study are variants of CELLS indicating the potential effect of cell phone usage on motor vehicle related fatalities. The coefficients associated with the variables which account for cell-phone usage are always non-fragile across specifications and are statistically significant at the two-tail significance level of 0.05 or better (with the vast majority of these coefficients significant at the 0.01 level or better). They suggest that the effect of cell phones on fatalities is positive. In addition, cell phone results suggest that their influence on fatalities is non-linear. The effect on fatalities increases at a decreasing rate as noted by the coefficients associated with CELLS and CELLS<sup>2</sup>, but the effect on fatalities is significantly impacted by CELLS<sup>3</sup>. At some point, the effect of cell phones may actually decrease the number of fatalities. Using specification (1) from Table 2, we can see that the marginal effect of CELLS on fatalities depends on the level of CELLS. Evaluated at the mean of CELLS indicates a value of 41.575, all else equal. However, examining specification (1) for the volume of cells associated with a maximum or minimum number of fatalities requires that we examine the partial derivative of FATTOT with respect to CELLS. Setting  $\partial FATTOT / \partial CELLS = 0$  gives rise to a quadratic with the two roots being 34.49 and 97.76. Evaluating the second derivatives results in CELLS > 66.13 is associated with a minimum and CELLS < 66.13 is associated with a maximum. More precisely, evaluating the original specification (1) for the effect of CELLS on FATTOT, holding all else equal,

reveals an initial maximum at 34.49 CELLS and a minimum at 97.76 CELLS. As such, the effect of CELLS initially exacerbates fatalities and then fatalities decline with additional phone subscribers. However, the analysis must not cease at this point, for the above maximum and minimum values are local maxima and minima. The function then increases without end after reaching the minimum.<sup>29</sup> This may explain some of the different results found by other researchers.

As such, we first note a contributing effect of cell phones on motor vehicle related deaths. This may be due to several factors including inexperience among drivers using cell phones (much like not being able to chew gum and do another task at the same time), the distracting effect of cell phones, and an insufficient number of cell phones among the public to afford a faster response time to an accident due to cell phone calls which might counter the negative effects of cell phone use. After a critical amount of subscribers is reached, the life saving effect of cell phones among the public may, for example increase the likelihood of survivorship in an accident due to the ability to immediately call for medical assistance. Hence, the lifesaving effects of cell phones outweigh the life-taking effect after some point. However, beyond a certain level once again, the life-taking effect overwhelms the life-saving effect again. With the explosive growth in the number of cell phones, drivers have become more accustomed to using cell phones while driving. This may reflect a change in attitudes and habits regarding cell phone usage over time. This change is documented by NHTSA which reports a 50% increase in drivers using cell phones in the daylight hours since 2002.<sup>30</sup> An examination of Charts A and B add to the analysis. Chart A indicates that motor vehicle fatalities tend to trend downward until the

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<sup>29</sup> See Chart C for the estimated response rate of fatalities to cell phones.

<sup>30</sup> Reported by the Associated Press in <http://www.msnbc.msn.com/id/8545779/>. See Glassbrenner (2005) as well on increases of cell phones by drivers.

early to mid 1990s. By the year 2000, motor vehicle fatalities were close to 42,000 and rising. Meanwhile, cell phone subscribers had surpassed in number the 97.8 million mark. Hence, the visual evidence adds additional support to the conclusion that cell phones and their usage above a critical threshold add to motor vehicle fatalities.<sup>31</sup>

## **V. CONCLUDING COMMENTS AND POLICY RECOMMENDATIONS**

This study examines the effect of cell phones on motor vehicle related fatalities using econometric models and specification error tests. The models adjust for unemployment rates, alcohol consumption, blood alcohol legislation, and other factors as well as cell phones. Data are obtained for the years 1975 to 2003 and the models are evaluated using Ordinary Least Squares. Only models which fail to be rejected for specification errors are considered in the analysis.

As expected, alcohol consumption is shown to have a positive and statistically significant effect on fatalities with coefficients which are stable across specifications. This lends support for public policies which would result in reduced alcohol consumption. Such policies may include increased taxes on alcohol or possibly raising the minimum legal drinking age.<sup>32</sup> The ratio of rural highway mileage to urban highway mileage also has an impact but at a lower significance level. The unemployment rate, as expected, has a negative and statistically significant effect on fatalities. Similarly, the use of BAC laws to define driving while under the influence of alcohol also reduces

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<sup>31</sup> Models in terms of rates, i.e., fatalities/capita, were estimated as well. The results conform with those presented in Table 2 especially in those models which do not include BAC. These results are available from the authors.

<sup>32</sup> See Chaloupka et al (1993) on the effect of alcohol control policies.

fatalities. As such, reducing the blood alcohol limit indicating when driving under the influence may prove to be a valuable policy to reduce motor vehicle fatalities.

Most significantly, cell phones are found to have an adverse effect on fatalities initially as cell phones become more readily available. After a point, some lifesaving effects of cell phones overtake the life-taking effects. However, with cell phone subscribers reaching about 100 million or more, the life-taking effect overtakes the potential lifesaving effect once again. These results are non-fragile across specifications and are statistically significant. Given that there are over 180 million cell phone subscribers leads one to believe that the life-taking effect of cell phones is greater than the life-saving effect. As such, policies which would reduce cell phone use by drivers may be warranted. This might be accomplished through an appropriate fine structure combined with active enforcement.

**Table 1**

**Summary Statistics of Selected Variables**

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<b>Variable Name</b>	<b>Mean</b>	<b>Standard Deviation</b>
FATTOT	44356.64	3300.725
UNEMP	6.425	1.466
ETHOTOTAL	2.445	0.24
VEHMI	2049.464	478.932
TOTALMI	3892.643	33.260
INTERMI	44.050	3.43
URBANMI	746.464	83.49
RURALMI	3147.250	57.12
POP	249334.5	22114.98
SPEED95	0.253	0.439
CELLS	26.401	42.235
RURALMI/URBANMI	4.275	0.551
VEHMI/POP	0.008	0.001
BAC	0.725	0.31

**Table 2 - Regression Results for Models of FATTOT<sup>a</sup>**

<b>Equation #/</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>	<b>(7)</b>
<b>Independent Variable Name</b>							
<b>Constant</b>	4159.003 (0.247)	69.774 (0.008)	87.115 (0.014)	3346.150 (0.210)	4698.404 (0.269)	9910.879 (1.099)	11020.58 (1.252)
<b>UNEMP</b>	-2241.382 (-8.633)	-2254.079 (-9.014)	-2254.109 (-9.246)	-2248.608 (-8.969)	-1966.420 (-9.692)	-1946.920 (-10.611)	-2178.663 (-9.17)
<b>ETHOTOTAL</b>	17335.02 (3.460)	17814.51 (3.852)	17811.30 (4.087)	17364.19 (3.554)	22919.23 (6.112)	19541.31 (5.832)	14970.70 (3.332)
<b>CELLS</b>	242.780 (3.306)	244.027 (3.407)	244.038 (3.497)	243.911 (3.415)	252.338 (3.318)	181.972 (2.338)	183.362 (2.422)
<b>CELLS<sup>2</sup></b>	-4.761 (-3.838)	-4.842 (-4.1)	-4.842 (-4.224)	-4.815 (-4.081)	-4.614 (-3.590)	-3.77 (-3.043)	-3.965 (-3.270)
<b>CELLS<sup>3</sup></b>	0.024 (4.131)	0.024 (4.426)	0.024 (4.570)	0.024 (4.419)	0.022 (3.759)	0.019 (3.41)	0.020 (3.73)
<b>INTERMI</b>	22.947 (0.194)	0.232 (0.003)			55.188 (0.456)		
<b>POP</b>	-0.014 (-0.292)			-0.008 (-0.224)	-0.030 (-.0616)		
<b>RURALMI/ URBANMI</b>	3158.385 (1.607)	3277.626 (1.745)	3277.854 (1.790)	3223.214 (1.706)			2647.787 (1.478)
<b>BAC</b>						-2148.064 (-1.998)	-1822.012 (-1.704)
<b>Adjusted R<sup>2</sup></b>	0.918	0.922	0.925	0.922	0.911	0.928	0.932
<b>D-W<sup>b</sup></b>	1.771	1.804	1.804	1.780	1.86	1.839	1.736
<b>J-B<sup>c</sup></b>	2.775	2.719	2.717	2.705	0.844	0.411	1.664
<b>RESET<sup>d</sup></b>	1.335	1.291	1.361	1.389	2.353	2.356	1.3

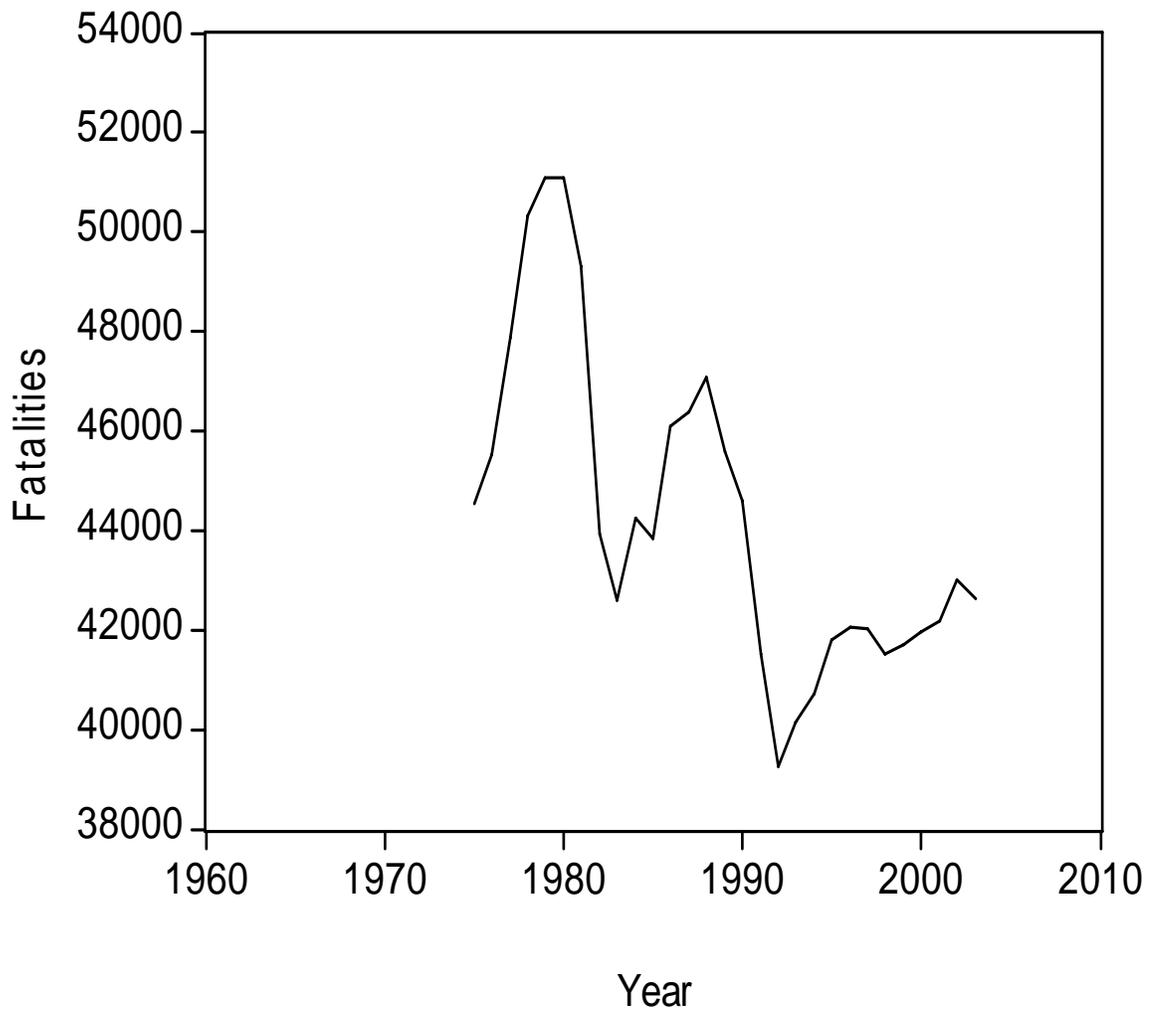
<sup>a</sup>Numbers shown within parentheses below the coefficients are t-statistics.

<sup>b</sup>Durbin-Watson Statistic.

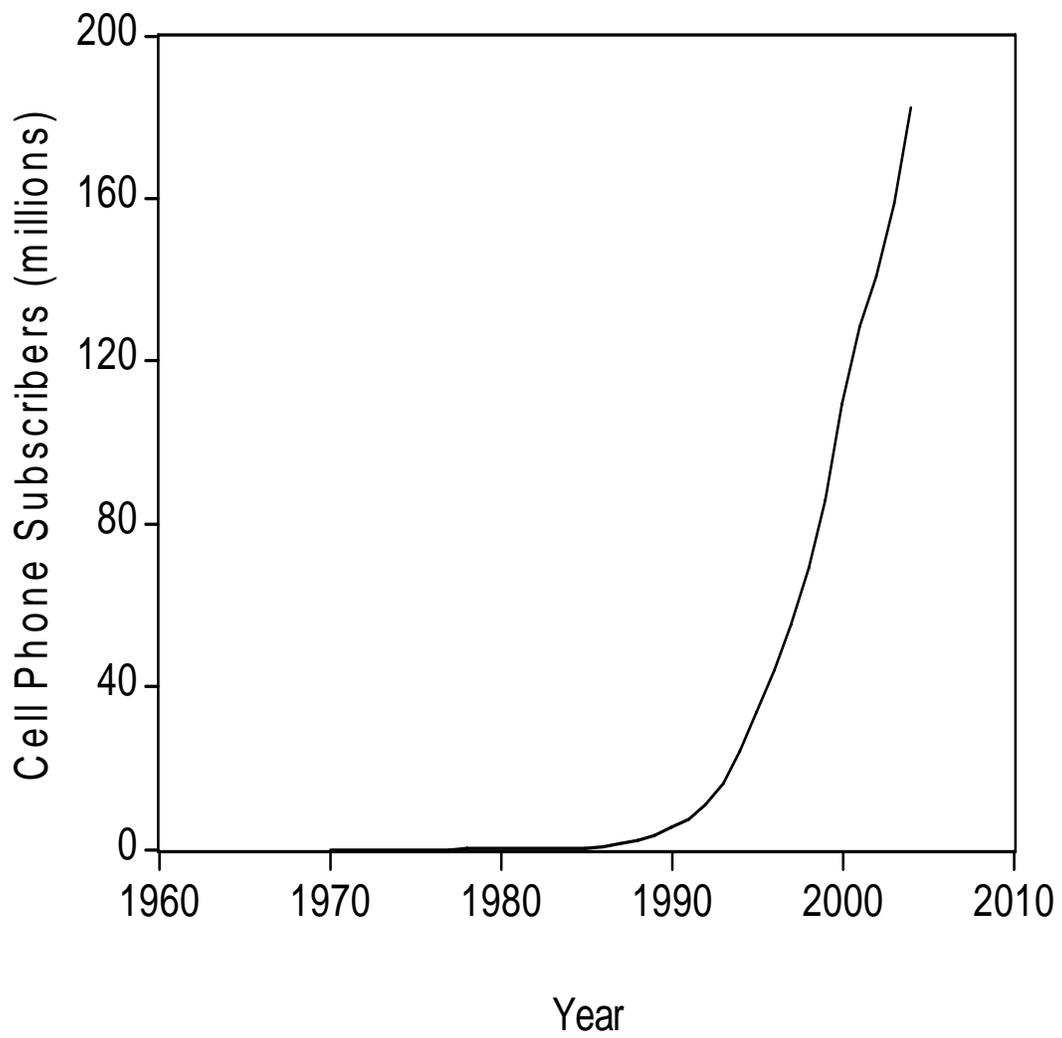
<sup>c</sup>Jarque-Bera Test.

<sup>d</sup>Regression Specification Error Test.

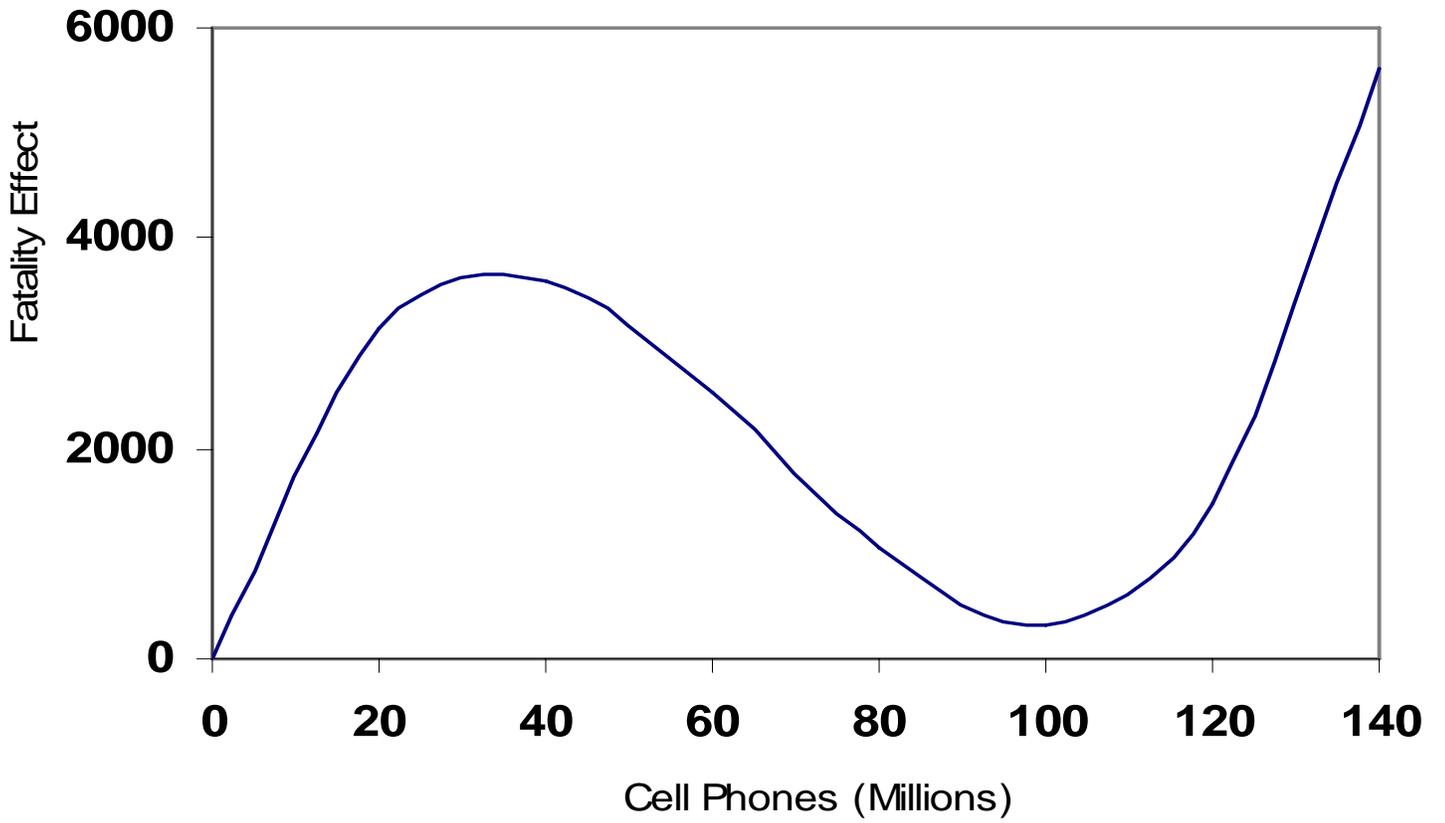
**Chart A: Motor Vehicle Fatalities Over Time**



**Chart B: Cell Phone Subscribers Over Time**



**Chart C: Estimated Response Rate of Fatalities to Cell Phones**



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