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research article

## A Tale of Two Vices: An Applied Economic Analysis of Alcohol and Tobacco Consumption

—John Rolfe (Edited by Jennifer Lee)

The consumption of alcoholic beverages and tobacco has been common for centuries around the world. Much has been said about the many factors that influence this consumption as well as what we should do to minimize it to prevent harm to ourselves and others. But how do we uncover what has the most power to influence the use of alcohol and tobacco?

I was born and raised in The Netherlands. Upon arrival at the University of New Hampshire in 2007, I was exposed to new views about alcohol and tobacco use. Most striking were anecdotal stories from friends and acquaintances about the degree of their alcohol use and the age at which they started drinking casually, which were very different from what I was used to hearing in Europe. While browsing for a research topic for the upper-level economics course “Introduction to Econometrics” during my junior year, I stumbled upon statistics comparing worldwide consumption of alcohol and tobacco. This was the starting point for a research project about what influences consumptions of alcoholic beverages and tobacco products in sixty-three countries, which delivered some expected and unexpected results.

I employed an economics method known as regression analysis, in which I measured the effects of eleven independent variables upon the dependent variable, household expenditure on alcohol and tobacco consumed at home during 2007 (henceforth known as A&T consumption.) Data for the dependent variable came from the US Department of Agriculture, published in the *American Statistical Abstract* of 2007.

In the results of my study, six independent variables showed a statistically significant effect. These included the total unemployment rate, health expenditures, and a government mandated health warning on tobacco packaging. The last, to my surprise, was shown to be correlated to an increase in alcohol and tobacco consumption. This is contrary to what a health warning aims to accomplish, and the implications of this result require more thorough investigation.



*The author engaged in econometric research and analysis in the public library of his hometown Amsterdam, The Netherlands.*

### Econometrics and Regression Analysis

Econometrics involves applying statistical methods to the analysis of economic data and to the assessment of economic theories. This means that by establishing an economic model based on empirical data and testing this model with statistical methods, an economic theory can be accepted or rejected. Econometrics is distinguished from other branches of statistics by its reliance upon observed economic data. While many fields of science are able to set up controlled experiments, economists cannot subject a country to such experiments. For this reason, economists rely on regression analysis to estimate or discover relationships among their research subjects. Specifically, regression analysis is used to investigate the effect of changes in the variable of interest (the dependent variable) and other variables (independent

variables); thus a regression model will show how an increase in one independent variable will affect the dependent variable, holding all other independent variables constant. Regression models are commonly used by economists within the private sector as well as in government and academia, and are readily applied to real world issues such as public health policies.

The steps to setting up a regression model are as follows. First, the dependent variable (Y) must be identified. This is the event that is being studied and expected to change due to influence by the independent variables. The second step is to select the independent variables that may have an effect on Y and collect the data for them and for Y. Third, we develop a hypothesis test for each independent variable, positing that the independent variable has no influence. This is often called the “null” or “no effect” hypothesis. Based on our statistical evidence, we may conclude whether we can reject this hypothesis. If we do reject this null hypothesis, we can accept an “alternative” hypothesis where the independent variable does have an influence. The fourth step is to conduct the regression analysis through a statistical software package (SAS). The results of this analysis will tell us which of our selected independent variables have a statistically significant effect upon Y and whether our hypotheses are correct.

It should be noted that a variable with statistical significance doesn't necessarily mean that it is also economically significant. A more sophisticated regression model may be necessary to obtain reliable economic predictions. It is also not possible to infer causation from two correlated variables within regression analysis. For example, my study found a connection between a high unemployment rate and an increased rate of A&T consumption. These two variables are thus correlated, but we cannot say that higher unemployment leads to higher A&T consumption; there may be a third, unconsidered or unknown variable that is the cause of this correlated relationship.

## Setting up the Regression Model

The first step of my research was to select the dependent variable, household expenditure on alcohol and tobacco consumed at home during the year 2007. I collected data from sixty-three countries, representing six of the world's continents and nations from both the developed world, with advanced standards of living, to emerging and developing economies. (See Appendix, Table 1) Unfortunately, China and India were not included in the dataset due to the lack of available statistics. This omission represents a huge gap when trying to compare world populations, but these countries can also negatively skew the dataset due to their extraordinary population size and cultural dimensions. Further research to compile data on both China and India is needed to measure A&T consumption in these countries.

My next step was to determine the independent variables for an optimal regression model. Such an optimal, or ideal, model would include any possible variable whatsoever that could potentially be statistically significant and therefore have an influence upon A&T consumption. After browsing through studies in academic journals related to health economics, I found the following factors to be considered as having an effect on A&T consumption: a country's unemployment rate, average years of schooling, labor participation rate, unhealthy life expectancy, prevalence of health insurance, strict government regulation, and a country's economic dependency on alcohol and/or tobacco production (closely connected to continent location.)

Based on the above factors, I specified eleven independent variables. (See Appendix, Table 2) Among these variables, relevant statistical information was available for four: (1) total unemployment rate, defined as the percent of a country's labor force without a job and currently seeking employment; (2) unhealthy life expectancy, defined as the percent of one's lifespan that is spent in less than full health due to disease and/or injury; (3) percent of women in a country's labor force; and (4) total expenditures on health as a percent of its Gross Domestic Product (GDP.)

Among the eleven independent variables, I included seven indicator variables. These are called “dummy” variables and are characterized with a value of zero or one. For instance, one of my dummy variables indicated whether a country's official language was English. This dummy variable takes on a value of one for countries with English as the official language and takes on a value of zero for all other countries. The mathematical coefficient resulting from analysis by a statistical software package (SAS) indicates the dummy's effect on the dependent variable. My other six dummy variables indicated whether or not a nation required health warnings covering at least 30% of tobacco packaging, and on which continent the country was located. For statistical reasons, the continents of Antarctica and North America were excluded.

Whereas each independent variable had a null hypothesis claiming no effect upon A&T consumption, the alternative hypotheses were categorized as having an increasing or a decreasing effect upon such consumption. The following variables were hypothesized as having an increasing effect, that is, the greater they were, the greater would be the A&T consumption: total unemployment rate and unhealthy life expectancy. The dummy variables for countries located in Europe and South America were also hypothesized as having an increasing effect because my literature review suggested that countries in these two continents were more accepting of alcohol use. I hypothesized a decreasing effect on A&T consumption due to an increase in female labor participation rate and in the percent of a country's GDP spent on health. After reviewing the cultural differences of my selected countries, I also hypothesized that A&T consumption will decrease in the presence of a health warning on tobacco packaging; English as a country's official language; and location of a country in Asia, Oceania, or Africa. (My mentor suggested adding the dummy variable English as official language to see if it would make a statistical difference; it did not.) (See Appendix, Table 2)

## Results of the Model

Out of the eleven independent variables, only six variables had separate statistically significant effects on A&T consumption: total unemployment; total health expenditures; a mandated health warning covering at least 30% of tobacco packaging; and countries located in the continents of Asia, Africa, and South America. The alternative hypotheses of four of these variables were in line with my expectations, while two of the results came as a surprise.



*The author at UNH's Huddleston Ballroom receiving a Whittemore School scholarship award in October 2010 from faculty sponsor Dr. Andrew J. Houtenville. (UNH Photographic Services)*

I had hypothesized that a country's location in South America would have an increasing influence on the rate of A&T consumption, due to the continent's history of tobacco cultivation. However, the results showed that location in South America had a decreasing effect on A&T consumption. This suggests that South Americans may be prone to consume less alcohol and tobacco compared to other world populations, although we cannot directly conclude this from the data. After all, correlation does not necessarily imply causation. I had also hypothesized that a mandatory health warning on tobacco packaging would lead to a decrease in A&T consumption; however, my model showed that a health warning actually correlates with an increase in A&T consumption. This was alarming as many policymakers in the world expect that such government requirements will lead to a decrease in tobacco consumption.

While the limitations of my model should be taken into consideration, I feel that my result on tobacco health warnings deserves further research and analysis. One possibility would be to separate alcohol and tobacco consumption into two dependent variables and to run the regression model on each. Another option is to collect the latest available data and include more independent variables as well as additional countries. An increase in sample size will allow for more accurate results, especially if data for China and India can be incorporated. A time series analysis could also be performed with data from several years where the effects of a health warning on tobacco packaging could be measured over time.

Regression analysis as described in this article has practical use beyond economics; it is widely applied in other social and behavioral sciences as well as in multinational enterprises, government entities, and non-governmental organizations. This research experience of applying economics to a real world problem has contributed so much to my undergraduate education: it has increased my passion for economics as well as allowing me to reach out to my professors and peers in the Whittemore School for Business and Economics. My hope is that more people, especially young adults in college, develop an appreciation for the ongoing research on pivotal economic topics that affect their lives.

*I wish to thank my research mentor, Dr. Andrew J. Houtenville, for sharing his expertise in econometrics and for his encouragement to submit my research to Inquiry journal. I am also indebted to the Whittemore School of Business and Economics for all they have contributed over the years. Finally, for their moral support during the research process, I wish to honor my peers: Joseph Breda, Mathieu Feraud, Brittany Hill, and Dave Runnals.*

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## Appendix:

**Table 1.** Countries Included in the Study

|                |               |                      |
|----------------|---------------|----------------------|
| Algeria        | Indonesia     | Poland               |
| Australia      | Ireland       | Portugal             |
| Austria        | Israel        | Romania              |
| Azerbaijan     | Italy         | Russia               |
| Belarus        | Japan         | Saudi Arabia         |
| Belgium        | Jordan        | Singapore            |
| Bolivia        | Kazakhstan    | Slovakia             |
| Brazil         | Korea (South) | Slovenia             |
| Bulgaria       | Kuwait        | South Africa         |
| Canada         | Latvia        | Spain                |
| Chile          | Lithuania     | Sweden               |
| Colombia       | Malaysia      | Switzerland          |
| Croatia        | Mexico        | Thailand             |
| Czech Republic | Morocco       | Tunisia              |
| Ecuador        | Netherlands   | Turkey               |
| Egypt          | New Zealand   | Ukraine              |
| Estonia        | Nigeria       | United Arab Emirates |
| Finland        | Norway        | United Kingdom       |
| France         | Pakistan      | United States        |
| Germany        | Peru          | Venezuela            |
| Hungary        | Philippines   | Vietnam              |

**Table 2.** The Alternative Hypotheses for the Eleven Independent Variables and the Results of the Statistical Regression Analysis. (Asterisks indicate the dummy variables.)

| Independent Variable  | Alternative Hypothesis                  | Results   |
|---|---|---|
| Total Unemployment Rate   | An increasing effect on A&T consumption | Statistically significant, alternative hypothesis accepted.                     |
| Unhealthy Life Expectancy   | An increasing effect on A&T consumption | No statistical evidence was found.  |
| Female Labor Force participation Rate   | A decreasing effect on A&T consumption  | No statistical evidence was found.  |
| Total Health Expenditure as a percent of GDP  | A decreasing effect on A&T consumption  | Statistically significant, alternative hypothesis accepted.                     |
| A Mandated Health Warning on Tobacco Products that covers at least 30% of the packaging * | A decreasing effect on A&T consumption  | Statistically significant, with an <i>increasing</i> effect on A&T consumption. |
| English as a nation's official language *   | A decreasing effect on A&T consumption  | No statistical evidence was found.  |
| Country located in Europe *   | An increasing effect on A&T consumption | No statistical evidence was found.  |
| Country located in Asia *   | A decreasing effect on A&T consumption  | Statistically significant, alternative hypothesis accepted.                     |
| Country located in Oceania*   | A decreasing effect on A&T consumption  | No statistical evidence was found.  |
| Country located in Africa *   | A decreasing effect on A&T consumption  | Statistically significant, alternative hypothesis accepted.                     |
| Country located in South America*   | An increasing effect on A&T consumption | Statistically significant, with a <i>decreasing</i> effect on A&T consumption.  |

### ***Author Bio***

*When **John Rolfe** arrived at the University of New Hampshire from his hometown of Amsterdam in The Netherlands, he found different attitudes toward the use of alcohol and tobacco. A comparison of worldwide alcohol and tobacco consumption became his research subject in Dr. Houtenville's econometrics course. John said, "I gained so much appreciation for and insight into the work of economists by following their research process." He appreciated that his faculty mentor, Dr. Houtenville, "was always available for assistance during the project" and that he suggested John submit to Inquiry.*

*John plans to graduate in 2012 with a Bachelor of Science in a dual major in Economics and Business Administration: Accounting and Entrepreneurship (Honors in Major Program.) "After graduation," he said, "I intend to begin a career in accounting as a stepping stone to social entrepreneurship."*

### ***Mentor Bio***

*Dr. **Andrew J. Houtenville** is an associate professor in the Economics Department and the research director of the Institute on Disability. He joined the University of New Hampshire faculty two years ago and specializes in applied microeconomics and disability policy. This is his first experience in mentoring an Inquiry author. He said that "it has been really nice to see a student maintain interest in a project well beyond the confines of a course or term paper." Dr. Houtenville has participated in the revising of John's term paper into an article for Inquiry, and said, "It is critical that students in the social sciences learn to convey their research and findings to many audiences."*