**Sample Exam 1: The U.S. Market for Vaccines**

The U.S. has a pharmaceutical industry that has produced a vast array of drugs to reduce and cure a myriad of ills, yet we are confronting another flu season with inadequate supplies of influenza vaccine and the specter of a worldwide pandemic from swine flu.

a. Pharmaceutical companies face very high research and development costs to bring a new drug to market. It is estimated that it costs about $800 million and 12 years to bring a new drug to market, which is more than twice the $350 million that was estimated for 1990. Once a drug is developed, the marginal cost of producing an additional dose is typically very small. Some economists have argued that patent protections are important in preserving the dynamic efficiency of the industry even though it reduces the static efficiency achieved in the pharmaceutical industry. Explore this issue using one or more diagrams that incorporate average cost, marginal cost, and marginal benefit curves.

b. Drug companies want to pursue pharmaceuticals that can either be sold at high prices because there are no alternative treatments or that can be prescribed for years to treat chronic conditions. They are understandably less interested in pursuing drugs that have low profit margins, are used infrequently, and where there is a high likelihood of liability lawsuits. Vaccines have these characteristics. Each person who is vaccinated reduces the likelihood that not only they will fall ill, but they also protect others who might be exposed if they were to catch the illness. Use an appropriate model(s) to explain why the market is not likely to produce the optimal level of vaccines.

c. The Center for Disease Control (CDC) recommends that everyone get a flu shot, but particularly advocates the vaccine for the following: people with chronic medical conditions such as lung and breathing problems, heart disease, or diabetes; pregnant women; children more than six months old; health care workers; and, people fifty years and older. These groups either have an increased risk of serious complications from the flu or could expose a high risk person to the virus. To get a better understanding of the factors determining whether an individual was vaccinated, a linear regression model was estimated using data from the National Health Interview Survey for 2008 on samples of adults and children. Use the results presented in Table 1 to suggest strategies or policies that the government could use to increase the vaccination rate. In your description of the results, make sure that you indicate why these independent variables have been included and interpret the coefficients, including their economic and statistical significance.

**Table 1**

| Adults | Means (st. error) | OLS (t-statistic) | Children | Means (st. error) | OLS (t-statistic) |
|---|---|---|---|---|---|
| Received flu vaccine | 0.343 | ------ | Received flu vaccine | 0.296 | ------ |
| | (0.475) | | | (0.456) | |
| Lung or breathing problems | 0.089 | 0.089 | Lung or breathing problems | 0.093 | 0.158 |
| | (0.285) | (7.94)*** | | (0.291) | (8.66)*** |
| Heart condition | 0.031 | 0.085 | Heart condition | 0.011 | 0.105 |
| | (0.174) | (4.44)*** | | (0.106) | (2.17)** |
| Diabetes | 0.028 | 0.099 | Diabetes | 0.002 | 0.262 |
| | (0.166) | (4.74)*** | | (0.047) | (2.47)** |
| Pregnant | 0.010 | -0.016 | Aged less 1 year | 0.054 | -0.024 |
| | (0.101) | (0.60) | | (0.226) | (1.22) |
| Heath care worker | 0.099 | 0.15 | Aged 1 to 2 years | 0.116 | 0.291 |
| | (0.299) | (13.29)*** | | (0.32) | (16.67)*** |
| Aged less than 30 years | 0.188 | -0.041 | Aged 3 to 5 years | 0.167 | 0.200 |
| | (0.391) | (5.42)*** | | (0.373) | (13.51)*** |
| Aged 50 to 65 years | 0.243 | 0.129 | Aged 6 to 10 years | 0.250 | 0.069 |
| | (0.429) | (14.91)*** | | (0.433) | (5.77)*** |
| Aged greater than 65 years | 0.204 | 0.246 | Female | 0.488 | -0.010 |
| | (0.407) | (12.86)*** | | (0.500) | (1.09) |
| Female | 0.565 | 0.031 | African-American | 0.176 | 0.016 |
| | (0.496) | (5.02)*** | | (0.381) | (1.17) |
| African-American | 0.155 | -0.069 | Hispanic | 0.288 | 0.038 |
| | (0.362) | (8.02)*** | | (0.453) | (3.05)*** |
| Hispanic | 0.169 | -0.045 | Asian | 0.063 | 0.054 |
| | (0.375) | (5.27)*** | | (0.244) | (2.54)** |
| Asian | 0.058 | -0.018 | Other race | 0.010 | 0.146 |
| | (0.233) | (1.34) | | (0.098) | (2.59)*** |
| Other race | 0.008 | 0.02 | Parents with less than a high school education | 0.147 | -0.011 |
| | (0.089) | (0.60) | | (0.355) | (0.67) |
| Less than a high school education | 0.172 | -0.002 | Parents with some college | 0.327 | 0.014 |
| | (0.378) | (0.16) | | (0.469) | (1.04) |
| Some college | 0.295 | 0.016 | Parents are college graduates | 0.328 | 0.070 |
| | (0.456) | (2.10)** | | (0.469) | (4.78)*** |
| College graduates | 0.259 | 0.052 | Live with elderly family member | 0.595 | 0.012 |
| | (0.438) | (6.00)*** | | (0.491) | (1.25) |
| Live with elderly family member | 0.104 | 0.063 | Live with other children | 0.044 | 0.019 |
| | (0.306) | (5.46)*** | | (0.206) | (0.82) |
| Live with children | 0.327 | 0.0005 | Private health insurance coverage | 0.558 | 0.079 |
| | (0.469) | (0.07) | | (0.497) | (5.28)*** |
| Private health insurance coverage | 0.628 | 0.113 | Medicaid coverage | 0.248 | 0.103 |
| | (0.483) | (15.99)*** | | (0.432) | (6.39)*** |
| Medicaid coverage | 0.090 | 0.084 | State children's health insurance plan coverage | 0.061 | 0.064 |
| | (0.286) | (7.13)*** | | (0.239) | (2.77)*** |
| Medicare coverage | 0.226 | 0.145 | Other type of health insurance coverage | 0.0472 | 0.130 |
| | (0.418) | (8.10)*** | | (0.212) | (4.98)*** |
| Other type of health insurance coverage | 0.050 | 0.162 | | | |
| | (0.218) | (10.65)*** | | | |
| Smoker | 0.204 | -0.052 | | | |
| | (0.403) | (7.05)*** | | | |
| Currently working at a job | 0.609 | -0.026 | | | |
| | (0.488) | (3.42)*** | | | |
| Constant | ------ | 0.126 | Constant | ------ | 0.069 |
| | | (10.55)*** | | | (3.71)*** |
| Observations | 21231 | 21231 | Observations | 8481 | 8481 |
| R-squared | ------ | 0.190 | R-squared | ------ | 0.080 |

All variables have values of zero or one, with yes equal to one. Robust t statistics are in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

**Sample Exam 2: Protecting Oysters, Pearls, and Profits**

Japan and Australia are the two largest producers of pearls in the world. However, they occupy very different niches in the market: Australia dominates the market for high-quality pearls, while Japan dominates the market for low- and middle-quality pearls. Australia's pearls are produced in the territorial waters of Western Australia where the combination of pristine ocean waters, sheltered bays, and huge tides provide the ideal environment for oysters to produce large and exquisitely beautiful pearls. Only a small number of pearls were harvested in Australia prior to the introduction of diving equipment and air pumps in the 1880s. By the early 1970s, Australian pearling companies were typically using boats with large crews and sophisticated electronics to track down oysters. The competition among Australian companies to snare oysters from freely accessible waters raised the specter that oysters were being tracked down faster than was efficient. In this case, the total number of hours spent diving for oysters each year would have exceeded the efficient number.

a. In the mid-1970s, the ten owners of the Australian oyster fleet met to discuss their concerns that too many divers were being used to harvest oysters. They agreed among themselves to reduce their effort by accepting limits on the total number of diving hours that each of the ten firms would employ in harvesting oysters. However, all of them cheated on the agreement, using more divers and spending more time harvesting oysters than they had agreed to. If it was efficient to reduce their effort, why were they unable to solve this problem? Suppose the oyster population would have eventually been decimated had none of the companies changed their behavior. Would you have expected the companies to have eventually solved the problem? Use the prisoner's dilemma model to support your answer.

b. In the early 1980s, the Australian government passed the *Pearling Act*, which imposed an annual quota on the total allowable catch of oysters. The quota was initially set at 460,000 oysters in 1982 and was divided among the 10 pearling companies in proportion to the size of their recent harvests. For example, the largest pearling company was allowed to harvest 3 times the number of oysters as the smallest company. The Australian government sought to ensure compliance by requiring that the companies maintain logbooks of their catches and by patrolling the area with boats and diving teams. Table 1 presents summary statistics. Table 2 presents the results of an ordinary least squares regressions using Australian pearl production data from 1979-2001. Use these results to determine the effect of the quotas on the average number of oysters harvested per hour of effort. Be sure to careful interpret the relevant coefficient estimates and to discuss their economics and statistical significance.

c. Pearl production is very sensitive to the cleanliness of oyster habitats. Australian pearl producers have experienced decreases in pearl production due to the increased runoff of chemical pesticides from the large number of coastal farms. Coastal farmers could stop using pesticides on their crops. Assume that this would cost them $12 million per year in terms of lost agricultural production, but would save $6 million per year on the cost of pesticides. Alternatively, Australian pearling companies to move their oyster nets further out to sea. Assume that this would result in a one-time cost of $60 million, and would cost the pearl industry an additional $1 million per year thereafter. Assuming a discount rate of 10 percent, which of these solutions it the most efficient? How would the Coase Theorem apply to this situation? How would your answer depend on the level of the threat in this case?

**Table 1: Summary Statistics**

| Variable | Definition | Mean | Standard deviation |
|---|---|---|---|
| Oyster harvest | Oysters harvested per hour diving | 32 | 9.4 |
| Dive hours | Total hours spent diving per year in thousands | 15.8 | 4.0 |
| Quota | Dummy variable equal to 1 in quota years | 0.87 | 0.34 |

**Table 2: Regression Results**
(Dependent variable: Oysters harvested per hour diving)

| Variable | Coefficient estimate | Standard error | t statistic |
|---|---|---|---|
| Constant | 74.5 | 7.47 | 9.96 |
| Dive hours | -0.198 | 0.0343 | -5.76 |
| Quota | -13.2 | 3.94 | -3.36 |
| Observations | 23 | | |
| Adjusted $R^2$ | 0.64 | | |

**Sample Exam 3: Education in America**

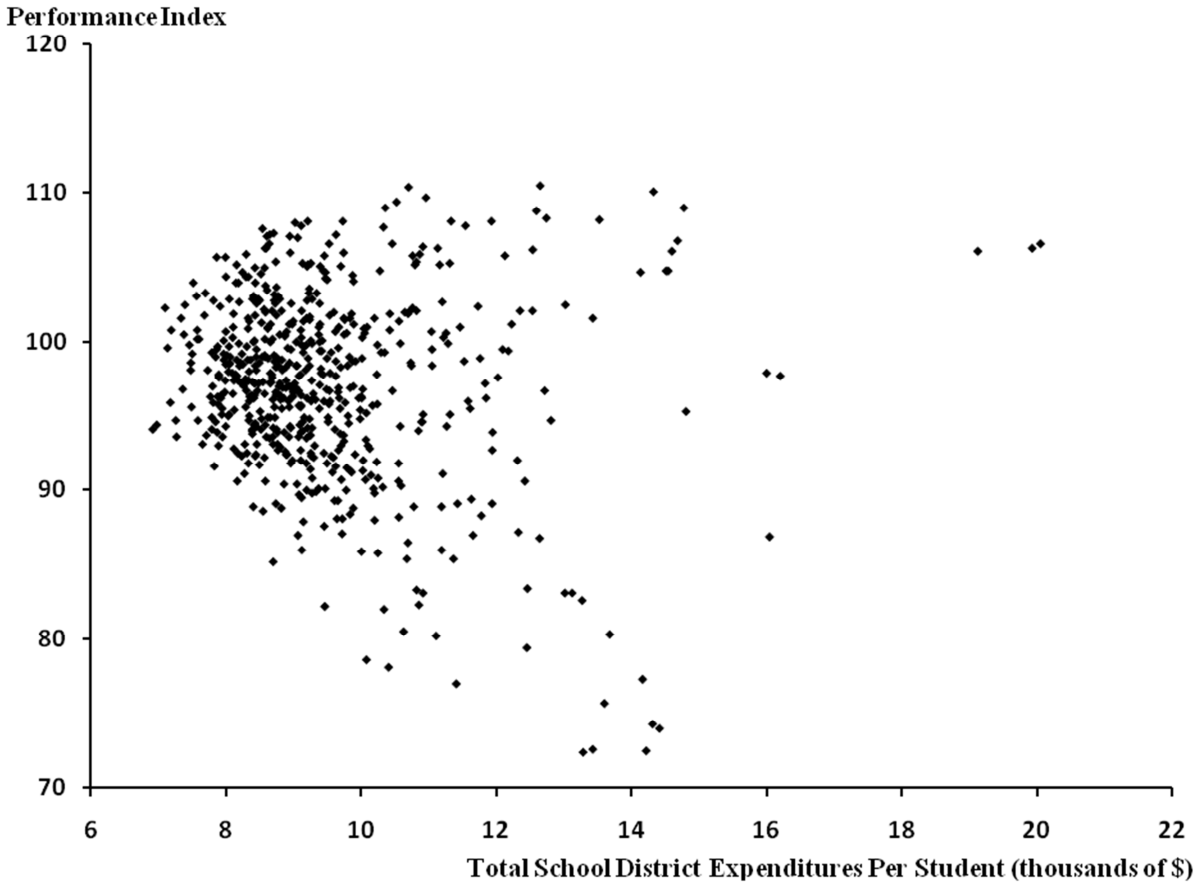
The idea that the American public education system is in need of reform is not new but it appears to be gaining traction. Lexis-Nexis identifies 650 articles published in American newspapers in 2010 containing the terms "education reform" and "America", compared to 566 articles in 2009 and 459 articles in 2008. The issue of education reform hit theaters in September 2010 with the release of "Waiting for Superman", an unflattering documentary of public education in America. While concern regarding student performance remains a primary motivating factor for reform, the current state of the economy has generated increased urgency. Declining property values, increasing property tax delinquencies, and reduced state funding are forcing many school districts to make significant cuts and/or seek tax increases. Given these conditions it is not surprising that calls for greater cost effectiveness have increased. While there is unlikely to be a panacea for the problems in American public education, an understanding of the relevant issues is useful in trying to design and assess potential solutions.

a. Since the late 1800s, primary and secondary education has been heavily subsidized in America. Most often this subsidy has taken the form of public provision. It is commonly held that allowing the education market to operate free of intervention would result in a market failure. Explain and illustrate the market failure commonly associated with education.

b. Ohioans voted down approximately 75 percent of the levies seeking new tax funds in 2010. At least one of the "no" votes was cast by someone who believed school districts were not effectively utilizing existing funds. To test this claim they collected data on Ohio school districts for the 2009-2010 school year. Figure 1 shows student performance plotted against total school district expenditures per student. (A school district's *performance index* is an aggregate measure of their students' performance on the Ohio Achievement Assessment in grades 3-8 and the Ohio Graduation Test in grade 10. Higher index values correspond to stronger performance.) Discuss what Figure 1 reveals. The ever vigilant nameless voter continued forth and produced the descriptive statistics shown in Table 1 and linear regression estimates shown in Table 2. Interpret the regression estimates. Do you believe the results? If so, why? If not, how would you change the model to address your concerns?

c. In most public school districts, a teacher's salary is determined by their years of experience and highest attained degree. Implicit in this system is the idea that teachers with more years of experience or education are better teachers. Few, if any, teachers are rewarded or penalized for their actual performance in the classroom. This has the potential to create a *market for lemons* problem in the labor market for teachers. Explain this problem and discuss whether you believe it is likely to exist in the labor market for teachers.

**Figure 1. Performance and Expenditures**
(All public school districts in Ohio for the 2009-2010 school year)




**Data Source**: *Local Report Card data files for the school year 2009-2010*
(Ohio Department of Education, http://ilrc.ode.state.oh.us/Downloads.asp)

## Table 1. Descriptive Statistics

| Variable | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|
| *Performance Index* | 97.11 | 6.24 | 72.40 | 110.50 |
| *Expenditures per student (thousands of dollars)* | 9.53 | 1.67 | 6.93 | 20.04 |
| *Median income in the school district (thousands of dollars)* | 32.82 | 7.59 | 17.21 | 70.68 |

**Data Source**: *Local Report Card data files for the school year 2009-2010* (Ohio Department of Education, http://ilrc.ode.state.oh.us/Downloads.asp)

## Table 2. Linear Regression Estimates

(Dependent variable: *Performance Index*)

| Variable | Coefficient | Standard Error |
|---|---|---|
| *Expenditures per student (thousands of dollars)* | -1.006 | 0.108 |
| *Median income in the school district (thousands of dollars)* | 0.597 | 0.024 |
| *Intercept* | 87.111 | 1.166 |
| Number of observations: | 608 | |
| Adjusted R square | 0.517 | |

**Sample Exam 4: Social Security**

The Social Security Act was enacted by Congress in 1935 as part of the New Deal. The social security program pays benefits to retirees and their dependents. These benefits are financed by a payroll tax on current workers. The provision of social security benefits is enormously popular with the American public and can be shown to be a fundamental cause of the reduction in poverty among the elderly. However, policymakers are concerned about the effects of the social security program on labor supply and saving decisions. They are also concerned with the long-term ability of the federal government to continue to provide the current level of benefits to future retirees.

a. The social security retirement system is financed by a payroll tax of 12.4 percent, half of which is paid by the employer and half paid by the employee. Analyze the economic incidence of the payroll tax, as well as its effects, if any, on equilibrium wages and employment levels, and its implications for economic efficiency. You should clearly state any assumptions you make about the relative elasticity of labor supply and labor demand.

b. Individuals born after 1960 may retire at age 67 with full benefits or as early as age 62 with a permanent reduction in their benefits that is actuarially fair, on average. Some recipients of social security retirement benefits face a retirement earnings test if they continue to earn income from working. Currently, recipients between the ages of 62 to 67 have their benefits reduced by $.50 for every dollar of earnings over $15,120. Suppose Congress is considering eliminating this earnings test. Use graphical analysis of the choice between consumption and leisure to analyze the effect that eliminating the retirement earnings test would have on the labor supply decisions of individuals between the ages of 62 and 67.

c. Policy-makers have long worried that provision of social security benefits has encouraged workers to exit the labor force earlier than they would without the benefits, increasing program costs and reducing payroll tax revenues. Using a sample from the Retirement History Study of 4354 white married men aged 58-63 who were able to work, economist Joseph Quinn estimated the impact of the eligibility for social security benefits and other pensions on the probability that an individual would be in the labor force. Quinn controlled for a number of other factors that might affect the decision to retire such as the individual's wage rate, asset income, the presence of health limitations on the kind or amount of work, the presence of dependents, local labor market conditions, and job characteristics. Use the results for the full sample in the first column of the table below to evaluate the effect of social security benefits on the decision to retire. What other factors are important? Be sure to careful interpret the relevant coefficient estimates and to discuss their economic and statistical significance. Finally, examine what happens to the estimated effects of being eligible for social security and/or other pension benefits when the sample is split into those without and with health limitations on their ability to work (the second and third columns of results)?

| OLS Regression of Labor Force Status<br>Dependent variable = 1 if in labor force<br>(absolute value of t-statistics in parentheses) | | | |
|---|---|---|---|
| Independent Variables | Full Sample | Without Health Limitation | With Health Limitation |
| Mean of Dependent Variable | 0.892 | 0.949 | 0.891 |
| Financial characteristics | | | |
| Eligible for Social Security (1=yes) | -0.113 | -0.035 | -0.278 |
| | (9.52)** | (3.32)** | (8.99)** |
| Eligible for other pension (1=yes) | -0.072 | -0.048 | -0.141 |
| | (5.98)** | (4.67)** | (3.84)** |
| Eligible for both (1=yes) | -0.073 | -0.125 | 0.032 |
| | (3.63)** | (3.63)** | (3.63)** |
| Wage rate ($/hour) | 0.002 | 0.001 | 0.004 |
| | (0.83) | (0.39) | (0.69) |
| Asset Income ($1000/year) | -0.009 | -0.007 | -0.024 |
| | (4.23)** | (3.97)** | (2.64)** |
| Personal characteristics | | | |
| Health limitation (1=yes) | -0.204 | --- | --- |
| | (20.71)** | | |
| Presence of dependents under the age of 18 (1=yes) | 0.032 | 0.02 | 0.08 |
| | (2.97)** | (2.18)** | (2.44)** |
| Local labor market conditions | | | |
| Unemployment rate < 3.5% | 0.033 | 0.03 | 0.027 |
| | (2.12)** | (2.62)** | (0.57) |
| Unemployment rate > 4.5% | -0.002 | -0.006 | 0.003 |
| | (0.26) | (0.81) | (0.11) |
| Growth in employment < 2% | -0.001 | -0.008 | 0.023 |
| | (0.08) | (0.65) | (0.51) |
| Growth in employment > 4% | -0.060 | -0.66 | -0.036 |
| | (4.77)** | (6.19)** | (0.98) |
| Job Characteristics | | | |
| Low autonomy (1=yes) | -0.014 | -0.001 | -0.014 |
| | (1.39) | (0.14) | (1.59) |
| Physical strain (1=yes) | -0.015 | -0.005 | -0.015 |
| | (0.91) | (0.34) | (0.86) |
| Bad working conditions (1=yes) | -0.002 | 0.008 | -0.002 |
| | (0.22) | (0.94) | (0.90) |
| Constant | 1.019 | 0.997 | 0.891 |
| R-squared | 0.18 | 0.18 | 0.18 |
| N | 4354 | 3199 | 1155 |
| ** indicates significance at the 1% level and the * indicates the 5% level. | | | |