Understanding the Effect of Illegal Immigration on Total Health Expenditures and Real-Per Capita Health Expenditures

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Abstract: Rising health care costs is a major issue facing the United States today. In 1990, $714 billion was spent on health care; by 2008, this amount had more than tripled to approximately 2.3 trillion dollars, which is approximately 16.2 percent of U.S. GDP. One aspect of health care that has not been examined extensively is the effect of illegal immigration. Despite economic and political concerns over illegal immigration, the effect of illegal immigration on health care costs is not well-understood. In this paper, we will examine the effect of illegal immigration on health care spending by constructing a panel data set of state-level data. In addition, the effect of other key determinants of health care costs, such as obesity, real income, proportion of the population over the age of 65, and the ownership structure of the hospital and nursing home sectors will be analyzed through a fixed-effects linear regression model. The results show that illegal immigration has no significant effect on real total health expenditures nor do we find any evidence that illegal immigration raises Medicaid spending.

I. Introduction

Rising health care costs is a major issue facing the United States today. In 1990, $714 billion was spent on health care; by 2008, this amount had more than tripled to approximately 2.3 trillion dollars. This amount is about 16.2percent of 2008 GDP and amounts to approximately $7681 dollars per resident (National Health Statistics 2010). During 2008, health care costs grew at a rate of 4.4percent, which is higher than the combined rate of inflation and national income growth in 2008. This rapid increase in health care costs is putting enormous burden on both employer-sponsored health insurance coverage and public insurance programs such as Health Care and Medicate. Between 1999 and 2008, there was an increase of 131 percent in family premiums for employer-sponsored health coverage workers' wages have not been able to keep up with this rapid growth in health care costs. Similarly, Medicare spending has increased at an average annual rate of 6.8percent between 1999 and 2008 (Kaiser 2009).

Given the large increases in health costs, the federal government, U.S. states, and health insurance companies have scrambled to explain the rising costs. Recent papers have argued that health care costs are rising because the population is aging (Reinhardt 2003), medical technology is advancing (Weinberg 1999), and obesity is becoming more common (Seidell 1995). However, illegal immigration may also explain some of the rise in health care costs.

According to the Center for Immigration Studies, the estimated illegal immigrant population in 2008 was approximately 11 million. Most of these illegal immigrants are low-skilled workers from Mexico and Central-American countries. There is significant controversy about the economic impacts of illegal immigrants. Because state and local governments spend

money providing services to illegal immigrants, government officials often complain that taxes paid by illegal immigrants do not cover the cost of the government services illegal immigrants consume. Worse yet, some studies have shown that illegal immigrants decrease the wages for native-born workers, especially high-school dropouts (Borjas 1987). By contrast, immigrant advocates claim that illegal aliens benefit the U.S. economy through increased consumption, lower product prices, and unrequited Social Security and unemployment insurance payments.

Despite the controversy over illegal immigration, its effect on health care costs is not well understood. Fifty-nine percent of illegal immigrants in the U.S. do not have health insurance. This amounts to approximately 15 percent of the approximately 47 million uninsured Americans. Another concern is that illegal immigrants may raise Medicaid expenditures. Illegal immigrants are generally not eligible for Medicaid, but in emergency circumstances, such as childbirth, certain groups of illegal immigrants, such as children and families with dependent children, can receive Medicaid. From 2001-2004, this emergency care for illegal immigrants constituted 1percent of Medicaid costs in North Carolina. Despite these concerns, no study has examined the link between illegal immigration and the overall level of health expenditure on the state level. In this paper, we will examine this link using panel data for U.S. states in the years of 1990, 1994, 1996, and 2000. We find that illegal immigration has no significant effect on real total health expenditures nor do we find any evidence that illegal immigration raises Medicaid spending.

II. Literature Review

The economic literature advances a series of explanations for increasing health care costs. Among the most important explanations are the structure of the health care market and increased use of advanced medical technology. However, the impact of illegal immigration on health care

expenditure has received little attention in the literature. The rest of this literature review will describe the economic impacts of illegal immigration and studies of legal immigrants' use of health care.

Most research on illegal immigration analyzes the impact of illegal immigration on labor markets. Numerous studies have examined the economic impact of illegal immigration to the United States. For instance, Chiswick (1988) finds that illegal immigration increases supply of low-skilled workers and decreases the marginal productivity of all low-skilled workers. This, in turn, leads to lower wages for all low-skilled workers (Chiswick 1988). In addition, this influx of illegal immigrants may lead to decreased employment of low-skilled workers. However, illegal immigration leads to higher marginal productivity for all high-skilled native workers and thus higher wages for all these higher-skilled workers. Chiswick (1988) estimates that the gains to high-skilled native workers from illegal immigration exceed the losses incurred by low-skilled native workers. Furthermore, illegal immigrants often accept wages that are below minimum wages, leading to reduced product prices that all American consumers enjoy.

The low wages that illegal immigrants receive imply that their tax payments are also low. Consequently, they may not cover the costs of the medical care they consume. Mohanty (2005) compared the health care expenditure of native born U.S. citizens with that of immigrants living in the United States. The study used the 1990 Medical Expenditure and Panel Survey and the 1996-1997 National Health Interview Survey to collect data 18398 native-born U.S. citizens and 2843 immigrants. To estimate total health care expenditure and expenditures for emergency department visits, physician-office based visits, hospital-based outpatient visits, inpatient visits, and prescription drugs, the authors used a regression model. The per-capita total health care expenditure for immigrants residing in the Unites States was calculated to be approximately

$1139 dollars, while the per-capita total health care expenditure for native residents was $2546 dollars. This corresponds to a 55 percent decrease in the per-capita expenditure for immigrants compared to native citizens. Similarly, the per-capita total health care expenditure for immigrant children was 74 percent than the per-capita total health care expenditure for native-born children. Due to these calculations, the study concluded that immigrants do not pose a disproportionate burden on the health care system. However, this study did not distinguish between legal and illegal immigrants. Worse yet, Hadley and Holahan (2003) explain that the MEPS data suffers from systematic underreporting. Because of this underreporting, MEPS data report expenditures that are about 24% lower than the National Health Expenditure Accounts (NHEA) data.

MEPS does not include expenditures that cannot be linked to a particular patient (except for Medicaid payments to public hospitals and clinics). Thus, MEPS fails to include overheads for individuals in Medicaid capitated health plans. In addition, payments from Medicaid to hospitals that serve a large number of low-income patients (i.e., disproportionate share payments) are also not included. Finally, Hadley and Holahan (2003) note that respondents to MEPS often fail to report Medicaid expenditures or misreport Medicaid coverage as private coverage. Aside from any problems with MEPS, health care expenditure patterns for legal immigrants may be quite different than the health care expenditure patterns for illegal immigrants. This study will look into the health expenditure patterns of illegal immigrants by measuring the correlation between health care expenditure at the state level and levels of illegal immigration in each state using NHEA data.

But, of course, a series of factors may affect health care spending. Economic and medical researchers have argued that medical care costs have risen because of demographic shifts

associated with the aging Baby Boomers, rising income, lack of competition among health care providers, medical technological innovation, and failures of preventive medicine.

As members of the Baby Boom generation enter old age, they will require more health care services that are expensive. However, many research articles have demonstrated that the relationship between demographic change and health care costs is tenuous at best. Reinhardt has demonstrated that the observed correlation between aging of the U.S. population and rising health care was only seen in data that compared health expenditure of individuals of different ages at a single point in time. However, this analysis can lead to erroneous conclusions; cross-sectional data that shows the health expenditure of a specific population as the population ages over time is necessary to determine whether age contributes to rising health care costs. Reinhardt (2003) conducted time series analyses of twenty countries from the years of 1960 to 1988 and found that the correlation of increased health costs with increased expenditure is due to the secondary association of age with other variables, such as income. Controlling for these variables illustrated that there is no significant correlation between age and health care costs.

Wennberg (1999) shows that the aging of the U.S. population does not explain increasing health care costs. This study showed that the true causes for the increases in health care expenditure are variables that lead to health care spending growth for people of all ages in the population, not just elderly people. These factors include increased per capita income, the structure of the health care market that gives significant oligopoly power to suppliers of health care, and the increased use of expensive new medical technologies (Wennberg 1999). Weinberg shows that there are significant differences in expenditure per Medicare enrollee in different states after controlling for demographic differences in these states, such as age. The bulk of literature indicates that age is not an adequate explanatory variable for the increased health care

expenditure in the U.S; other explanations need to be investigated.

Another possible explanation for increasing health care in the U.S. is the lack of preventive medicine. Early preventive treatment would keep people healthier and eliminate the need for expensive medications and procedures later on in life. Despite this, the economic evidence on the value of preventive measures is mixed. Maciosek (2006) found that certain preventive measures, such as counseling sessions for smokers, early cancer screenings, and flu vaccinations, would reduce mortality and lower costs. However, studies have also shown that some preventive treatments can actually increase health care costs (Weinstein 1999). In many cases, preventive measures will only help a small proportion of the population; most people would not have developed the illness with or without these preventive measures. When this is the case, the savings from reduced treatments for the illness will be dwarfed by the cost of the preventive procedures. Usually preventive procedures can only be cost-effective if they are targeted to people within the population that actually have a high risk of developing the disease (Weinstein 1999).

Cohen (2008) compared the cost-effectiveness of preventive treatments with that of treatments for illnesses. The cost-effectiveness of a procedure was estimated by dividing the cost of the procedure by the health benefits of the procedure. The health benefits of a procedure were measured in quality-adjusted life-years (Cohen 2008). A lower ratio indicates higher cost effectiveness; a relatively small amount of money needs to be spent to produce a substantial health benefit. An analysis of all the ratio for preventive measures and all the ratios for treatments specific to certain illnesses showed that in general, there is no difference in cost-effectiveness between preventive measures and treatments tailored to specific diseases. The body of literature on preventive treatment indicates that preventive treatment would not be a strong

predictor for health care costs; other variables need to be investigated.

Another important explanation for rising health care costs is technological innovation. Many economists believe that technological innovation is an important cause of increased health care costs. A case in point is that of the treatment for acute myocardial infection. Initially, treatment for this was 1 week of bed rest with administration of drugs to control for complications. However, now treatment involves complex procedures such as angiography, angioplasty, and coronary bypass surgery. This new treatment is more expensive due to new cardiac catheterization laboratories, the increased labor of physicians and nurses, and increases costs associated with the dissemination of knowledge (Reinhardt 2002).

In addition, these advanced technological procedures are widely available and easily accessible. The number of magnetic resonance imaging scanners per capita in the U.S. is approximately two times the number in other developed nations; the number of cardiac surgery units and catheterization laboratories in the U.S. is approximately three time the number in other developed countries (Reinhardt 2002). Because these procedures are so easily accessible, per capita health expenditure has increased dramatically. In addition, the fee for service payment system goes hand in hand with technological innovation to increase health care costs. Because physicians are compensated for the volume of procedures they carry out, they are more willing than physicians in other countries to approve patients for these novel complex procedures (Geljins 1994).

Thorpe (2004) argues that in order to explain rising health care costs, health care spending associated with various medical illnesses needs to be analyzed. If the prevalence of medical illnesses is increasing, then health care spending is likely to increase as well. A recent study attempted to explain the increase in U.S. health costs due to illnesses. For each illness, the

study highlighted the percentage of the rise in health care spending that could be attributed to changes in treatment for that that medical condition. For each medical condition, the rise in expenditure for that condition was divided into three parts. These three parts are changes in the frequency of treatment, changes in the cost per treatment for the illness, and population growth. This study found that the fifteen most expensive illnesses explain about 50percent of the growth in health care expenditure (Thorpe 2004).

Increased prevalence, or frequency, of treatment account for most of the rise in spending for certain illnesses, such as mental disorders. Either increased accessibility for treatment or increased incidence of the illness could explain increased frequency treatment. In the case of mental disorders, treatment frequency has increased substantially, while the proportion of the population that suffers from mental disorders has remained relatively constant over time. For illnesses like mental disorders, where treatment used to be relatively inaccessible, these increases in expenditure are probably outweighed by the health benefits; treatment is efficient and cost-effective for these illnesses.

For a substantial number of other illnesses, the increase in expenditure for the illness can be attributed to changes in the cost per treatment for the illness. For these illnesses, the increase in expenditure can be attributed to new technological advances that are more expensive but more successful at treating the illness and reducing mortality (Thorpe 2004). This is the case for illnesses such as heart disease, where substantial advances in medical technology, such as drugs, angioplasty, and catheterization, have lead to decreased mortality. This trend of technological advancement will be further discussed later on in this literature review section.

While aging, lack of prevention and changing treatment options may explain some portion of rising medical costs, market interactions may also drive changes in costs. One

generally accepted explanation given for rising health care costs is the lack of competition. It is argued that the presence of a free market for health care costs would drive down costs. Numerous studies have shown that a competitive free market does not exist. Keebler (1999) showed that over a 9 year period, from 1986-1994, the association of hospital prices with market concentration, which is a measure of competition in the health care market, underwent a significant change. Hospital, both profit and non-profit, that operated in areas that had less competitors had significantly higher costs. Robinson (2004) highlights the consolidation of the health care insurance industry, leading to reduced competition. Due to mergers and acquisitions of smaller health insurance companies by larger health insurance companies, the number of competing health plans has decreased dramatically. In many states, there are only two to three competing health care plans In 38 states, 1/3 or more of the marker is controlled by the largest firm; in 16 states, more than half of the market is controlled by the largest firm.

III. Data and Methods

In this investigation, a fixed-effects regression procedure was used to determine the factors that contribute to the total real health spending and total real Medicaid spending in a state. Our primary focus is on the effect of illegal immigration on health care costs. To discern the effect of illegal immigration on health care costs, we regress total health expenditures at the state level (totrhspend) the legal population of a state in thousands (legal) and the illegal population of a state in thousands (illegal). We include controls for real per capita income in thousands of 1996 dollars (rincpc), the number of hospitals in a state that are for-profit (hprof), the number of nursing homes in a state are for-profit (nprof), the percentage of the population over 18 years of age that is obese (obese), the percentage of the population that is alcoholic

(alcoholi), the percentage of the population that is a heavy smoker (smoke), the percentage of the total population over 65 years of age (pop65pc), the percentage of the population that is covered for medical expenses under a HMO (hmo), and the number of new molecular entites, or pharmaceutical drugs, produced that year (nme).

While illegal immigrants are not generally eligible for Medicaid benefits, they may consume emergency room care financed Medicaid and their US -born children are entitled to the full gamut of services. Consequently, we attempt to measure the effect (if any) of illegal immigration using a fixed effects regression procedure. We regress total real Medicaid spending (rmedicad) the aforementioned independent variables. For both the regression for total healthcare spending and Medicaid spending, two procedures were used. Originally, the parameter coefficients were estimated using robust standard errors; however, it was observed that under this method, serial correlation was significant. Accordingly, we used a transformation technique, developed by Driscoll and Kraay (1998), to estimate standard errors that were robust to both serial correlation and heteroskedasticity. This transformation technique was used for both the regression of total health spending and total Medicaid spending, which resulted in more accurate coefficient estimates with lower standard errors.

After these regressions were run, a major concern was that there may be a significant correlation between the illegal variable and other variables, including obese, alcoholi, and smoking, among others. For example, if the proportion of illegal immigrants who are obese is significantly lower than the proportion of legal residents who are obese, then the coefficients for the illegal variable and legal variables may be inaccurate. Accordingly, for both the total health spending and total Medicaid spending variables, a second regression, which omitted these suspect dependent variables, was run. For these regressions, the only dependent variables used

were those that would not change with a change in the legal or illegal population, specifically the number of for-profit hospitals, the number of for-profit nursing homes, and the number of new molecular entities introduced. By comparing the coefficients for the legal and illegal variables obtained with these regressions with the coefficients calculated in the regressions that include all the independent variables, one will get a more accurate sense of the effects of changes in the legal and illegal population on total health expenditures and total Medicaid expenditures.

The statistics for the illegal immigrant population are only estimates; there is no official exact count for the total number of illegal immigrants residing in the United States or in any state for a given year. Using data collected from its censuses, the U.S. Census Bureau has released estimates for the total number of illegal immigrants residing in the 17 states with the largest alien populations for the years of 1990, 1994, 1996, and 2000. This was the data source used for the study. There are 68 data points in this panel data, which consists of 17 cross sections and 4 years. The Office of Policy and Planning of the U.S. Immigration and Naturalization Service provided estimates of the unauthorized immigrant population residing in all 50 states for the years of 1990 and 2000. The U.S. Immigration and Naturalization Service also released an estimate of the 1996 unauthorized immigrant population in the 20 states with the most illegal immigrants. The U.S. Bureau of the Census released the 1994 data for the estimates of illegal immigrants in all 50 states. The 68 data points will be correlated with the state level health expenditure data provided by the National Health Expenditure Accounts. There is a general trend of steady increase in total medical spending from 1990 to 2000. In addition, there is a high degree of divergence in the total amount of medical spending in different states. In 2000, total health spending ranged from a minimum of approximately $6.37 billion in Nevada to approximately $114 billion in California.

In 2000, per capita health expenditure ranged from a minimum of $2876 in Arizona to $4712 in Massachusetts.

Data for the independent variables was collected from *The Statistical Abstract of the U.S.* (per-capita income, percentage of the population over 65, poverty rate). Real per-capita income is state personal income per capita in 1996 dollars. In the results reported below, nominal values are converted using the GDP deflator. Data on the employment variables are taken from the Bureau of Labor Statistics' Local Area Unemployment Statistics (unemployment rate).

Data on obesity, chronic alcohol consumption, and smoking is taken from the Centers for Disease Control and Prevention's (*CDC*) Behavioral Risk Factor Surveillance System (*BRFSS).* Obesity is based on Body Mass Index (BMI) where BMI is weight in kilograms divided by height in meters squared. An individual with a BMI $\geq$ 30 is considered obese. Missing values in the alcohol consumption data were filled using the average for the earlier and later year. If data were missing for two or more consecutive years, we did not interpolate the missing values. Instead, we simply dropped the observation from the analysis. Inter-study Competitive Edge *HMO Industry Report* provides HMO enrollment rates and data on *New Molecular Entities* is collected from the U.S. Food and Drug Administration Center for Drug Evaluation and Research.

Both the legal population and the illegal population have been growing steadily over time; the purpose of this study is to separate changes in health expenditures into those brought about by changes in the legal population over time and those brought about by changes in the illegal population over time. It is expected that in the regression for total health expenditures and total Medicaid expenditures, an increase in both the legal and illegal immigrant populations will raise health expenditures. However, based on a review of the literature, described in the previous section, it is expected that the increase in health spending associated with an increase in the

illegal alien population will be less than that associated with an increase in the legal population. Studies indicate that in general, immigrants spend less on health care than native-born citizens of the United States. Furthermore, an increase in real income, the obesity rate, the smoking rate, the rate of alcoholism, the number of new molecular entities introduced, and the proportion of the population over the age of 65 is expected to increase total health and Medicaid expenditures. However, an increase in the hprof1, nprof1, and HMO variables is expected to lead to a decrease in the total health expenditures. For-profit hospitals and nursing homes are expected to price their services at a more competitive efficient lower level, leading to reduced health care expenditures. Health Maintenance Organizations (HMO) manage the care of their enrollees and selectively contract with physicians to minimize health expenditures; so an increase in the HMO variable should lead to decreased total health and total Medicaid expenditures.

IV. Discussion of Results

Tables 2, 3, and 4 show the fixed-effects regression results. Table 2 highlights the effects of the size of the legal population, the size of the illegal immigrant population, number of for-profit hospitals, number of for-profit nursing homes, real per-capita income, percentage of the population over 65 years of age, obesity rates, smoking rates, alcoholism rates, the number of for-profit hospitals, the number of for-profit nursing homes, the percentage of people covered under a HMO, and the number of NMEs on total real health spending. Table 3 shows the effect of these same independent variables on total real Medicaid expenditures. Table 4 shows the effects of the size of the legal population, the size of the illegal immigrant population, number of for-profit hospitals, number of for-profit nursing homes, and number of NMEs on total real health spending and total real Medicaid spending.

The effects of the size of the illegal immigration population on total health and total Medicaid expenditures are inconclusive, according to the regression model which uses all the independent variables. It is not certain whether or an additional illegal immigrant in a state will lead to an increase or decrease in health expenditures. However, in the omitted variable model, an increase in the illegal immigrant population does have a significant impact on total Medicaid expenditures at the 0.15 significance level; an additional illegal immigrant will lead to an increase of $684 in total Medicaid expenditures. Even so, the size of the legal population has a significant impact on total health and Medicaid expenditures; an additional legal member of the state population will increase total health expenditures, on average, by $3334 and total Medicaid expenditures by $719. When the regression with the omitted variables run, there is still a significant effect; in this omitted variable model, an additional legal member of the state population will increase total health expenditures, on average, by $3516 and total Medicaid expenditures by $596. These results show that contrary to the protests of certain political groups, illegal immigration does not significantly increase health care costs.

Obesity leads to many health complications, including severe cardio-vascular diseases that require expensive medical treatment. Therefore, an increase in the obesity rate is expected to increase total health expenditures and real health expenditures. This was supported by the results, which showed that a 1% increase in the obesity rate increased total health expenditures by approximately $254,000. Smoking and alcoholism also lead to severe health complications; thus one would expect medical expenditures to increase with an increase in the rates of smoking and alcoholism. However, the results did not agree with these findings. The results showed that a 1% increase in the alcoholism rate decreased total health care expenditures by $471,000 and total

Medicaid expenditures by $427,00; this is contrary to expectations. In addition, the rate of smoking did not appear to have a significant effect on the medical expenditures.

The number of hospitals that are for-profit and the number of nursing homes that are for-profit are expected to have a significant inverse effect on total health expenditures. The effect of for-profit nursing homes was significant; an additional for-profit nursing home in a state decreased total health spending by $251,000 and total Medicaid spending by $150,000. This is in accordance with economic theory; investor-owned nursing homes lead to increased competition in the health care sector, leading to lower prices for health services and lower expenditures overall. However, the results indicate that an additional for-profit hospital in a state has no significant effect on medical expenditures.

Because health care is a normal good, an increase in real per-capita income is expected to lead to an increase in total health care expenditures. The effect of real-per capita income on total health expenditures was significant. A $1000 increase in real per-capita income raises total health expenditures by $591,000 and total Medicaid expenditures by $211,000.

Furthermore, the percentage of the population that is 65 years of age or over has a significant impact on health expenditures. A one percentage-point increase in the percentage of the population that is 65 or older leads to a $752,000 increase in total health expenditures and a $126,000 decrease in per-capital real healthcare expenditures. This is expected, due to the fact that elderly people require more expensive medical services due to the deterioration of their health. At the same time, elderly people used Medicare services, so they are not likely to be eligible for Medicaid services, explaining the negative coefficient for total Medicaid spending.

Even though it was expected that increased HMO participation would decrease medical costs, the results show that HMO enrollment actually has a significant effect in the opposite

direction. A 1% point increase in the HMO enrollment rate increased total health care costs by $86,000 and total Medicaid costs by $95,000. This shows that contrary to the claims of promoting efficiency and reducing costs, HMOs may actually be increasing health care costs.

The amount of NMEs had no significant effect on the level of health expenditures; this indicates that new prescription drugs are not as important a contributor to health expenditures as thought. One reason why this may be the case is that there may be a long period of time before information about a new drug is disseminated to the general public, creating a lag time.

V. Conclusion

This study showed that in comparison to legal inhabitants of the United States, illegal aliens play a relatively unimportant role with regards to health care expenditure increases. The increase of the illegal alien population between 1990 and 2000 cannot be considered a significant explanatory variable for the rise in total health care expenditures and total Medicare spending during that same period. This study conclusively demonstrates that an increase in the legal population will lead to increase in total health and Medicaid expenditures; however, there was no significant relationship between the size of the illegal alien population and total health expenditures. One cannot be certain whether an additional illegal alien in a state will increase or decrease the health expenditures of that state. It is highly likely that the size of the illegal population is significantly correlated with certain causal variables. One hypothesis is that because illegal aliens have lower incomes than legal inhabitants, states with a higher proportion of illegal aliens will have lower per-capita heath expenditures. Another effect that may be in play is the relationship between illegal aliens and the proportion of a population that is elderly. Most illegal aliens are young and healthy, so it is possible that states with a higher proportion of illegal

aliens will have a lower proportion of elderly inhabitants, which would lead to decreased medical expenditures. These and other avenues of inquiry can be the basis for further research.

The results also show that the number of investor-owned (for-profit) nursing homes is a significant determinant of total health care expenditures and total Medicaid expenditures. Through competition, lower prices for health care services are realized, leading to lower individual spending and total health care spending. Surprisingly, however, an increasing number of privately-owned hospitals did not have any significant effect on medical expenditures. In addition, the percentage of the population that is elderly has a significant impact on both total health and total Medicaid expenditures. Because the elderly population requires more medical services, an increase in the percentage of the population that is elderly leads to significant increases total real health spending. However, the elderly population, for the most part, uses Medicare and is generally not eligible for Medicaid. As a result, an increase in the elderly population leads to a significant decrease in medical expenditures. Further observation of health care expenditures as more and more members of the baby boom generation reach retirement is critical in order to determine if this trend of rising health care expenditures continues.

Similarly, obesity and chronic drinking are significant determinants of real per-capita hospital expenditures and real per-capita total medical expenditures. Increases in these public health indicators cause increases in expenditures. Chronic drinking and obesity are both associated with a variety of health risks, so it is logical that a decrease in either of those variables can cause a reduction in total health spending and total Medicaid spending. It is interesting to note, however, that the rate of smoking had no significant effect on medical expenditures.

Furthermore, increases in real per-capita income led to a significant increase in both total health and Medicaid expenditures. This conforms with economic theory; health services are

normal goods. Surprisingly, an increased HMO enrollment rate lead to a significant increase in both total health spending and Medicaid spending; this clashes against expectations that through patient management, HMOs decrease medical costs. Perhaps, HMOs are not as efficient as was previously thought. There was no significant effect of NMEs on medical expenditures; this could be due to the fact there may be a lag period between introduction of a drug into the market and widespread awareness and dissemination of the drug.

III. Data and Methods

In this investigation, two regression models were used to determine the factors that contribute to the total level of health expenditure in a state. For both regression models, a fixed-effects panel data mode was used. In the first model, total health expenditures at the state level (totrhspend) was regressed on the legal population of a state in thousands (legal), the illegal population of a state in thousands (illegal), real per capita income in thousands of 1996 dollars (rincpc), percentage of the total population that is uninsured (uninsure), the percentage of hospitals in a state that are for-profit (hprof), percentage of the population over 18 years of age that is obese (obese), and the percentage of the total population over 65 years of age (pop65pc). In the 2nd regression model, which was also a fixed effects model, the changes in total health spending was regressed onto the changes in all the independent variables.

The statistics for the illegal immigrant population are only estimates; there is no official exact count for the total number of illegal immigrants residing in the United States or in any state for a given year. Using data collected from its censuses, the U.S. Census Bureau has released estimates for the total number of illegal immigrants residing in the 17 states with the largest alien populations for the years of 1990, 1994, 1996, and 2000. This was the data source used for the

study. The 68 observations in this panel consists of 17 cross sections and 4 years. The Office of Policy and Planning of the U.S. Immigration and Naturalization Service provided estimates of the unauthorized immigrant population residing in all 50 states for the years of 1990 and 2000. The U.S. Immigration and Naturalization Service also released an estimate of the 1996 unauthorized immigrant population in the 20 states with the most illegal immigrants. The U.S. Bureau of the Census released the 1994 data for the estimates of illegal immigrants in all 50 states.

The 68 observations will be correlated with the state level health expenditure data provided by the Medical Expenditure Panel Survey, which also provided the data for all the other explanatory independent variables. There is a general trend of steady increase in total medical spending from 1990 to 2000. In addition, there is a high degree of divergence in the total amount of medical spending in different states. In 2000, total health spending ranged from a minimum of approximately $6.37 million in Nevada to approximately $114 million in California. In 2000, per capita health expenditure ranged from a minimum of $2876 in Arizona to $4712 in Massachusetts. Both the legal population and the illegal population have been growing steadily over time; the purpose of this study is to separate changes in health expenditures into those brought about by changes in the legal population over time and those brought about by changes in the illegal population over time.

It is expected that in the regression for total health expenditures, an increase in both the legal and illegal immigrant populations will raise health expenditures. However, based on a review of the literature, described in the previous section, it is expected that the increase in total health spending associated with an increase in the illegal alien population will be less than that associated with an increase in the legal population. Studies indicate that in general, immigrants

spend less on health care than native-born citizens of the United States. Furthermore, an increase in real income, the obesity rate, and the proportion of the population over the age of 65 is expected to decrease total health expenditures. However, an increase in the hprof and uninsured variables is expected to lead to a decrease in the total health expenditures. For-profit hospitals are are expected to price their services at a more competitive efficient lower level, leading to reduced health care expenditures. Uninsured people lack the ability to pay for expensive medical services, so all other things being equal, states with a higher uninsurance rate should have lower health care expenditures.

IV. Discussion of Results

Tables 2, 3, and 4 shows the fixed-effects regression results. Table 2 reports regressions on total real health care spending. Table 3 reports regressions real Medicaid spending. Table 4 reports regressions on both total real health care spending and real Medicaid spending. In Tables 2 and 3 we report both fixed effect estimates with robust standard errors and fixed effect estimates with Driscoll/Kraay standard errors. In Table 4, we report only fixed effect estimates with Driscoll/Kraay standard errors. We discuss only the Driscoll/Kraay estimates as a Wooldridge test for serial autocorrelation provides very strong evidence of serial correlation across both the total real health care equation and the real Medicaid equation.

Looking across both Table 2 and Table 4, we see that illegal immigration has no significant effect on real total health expenditures. While the size of the illegal immigrant estimate is roughly the same size as the estimate for the legal population, the standard error is large. From Table 4, we can see that deleting all the control variables that may be correlated with the relative size of the illegal immigrant population has no effect on this basic conclusion. In

20

contrast, the size of the legal population has a significant impact on total health expenditures. From Table 2 we can see that an additional legal member of the state population will increase total health expenditures, on average, by $3,334. If we delete all controls that may be correlated with the relative size of the legal population, the estimate is still significant and roughly the same as it was in Table 2. These results are displayed in the first column of Table 4 where we see that a one person increase in the population raises total real health care spending $3,515.

In Tables 3 and 4, we report estimates of the impact of illegal and legal populations on real Medicaid spending. Once again, the legal population has a significant impact on spending while illegal immigrants show no significant impact. Looking across both Table 3 and Table 4, we see that illegal immigration has no significant effect on real Medicaid expenditures. As above, the standard error is large. From Table 4, we can see that deleting all the control variables that may be correlated with the relative size of the illegal immigrant population has no effect on this basic conclusion. In contrast, the size of the legal population has a significant impact on real Medicaid expenditures. From Table 2, we can see that an additional legal member of the state population will increase real Medicaid expenditures, on average, by $719. If we delete all controls that may be correlated with the relative size of the legal population, the estimate is still significant and roughly the same as it was in Table 2. These results are displayed in the first column of Table 4 where we see that a one person increase in the population raises real Medicaid spending $596.

While we find no significant effects for illegal immigration, several of the control variables in Tables 2 and 3 yield interesting results. A one thousand dollar increase in real income per capita income raises total real health care spending by about $591 million. A one thousand dollar increase in real income per capita income raises real Medicaid spending by about

$211 million. Further, a one percentage point increase in the percentage of the population over 65 increases total real health care spending by about $750 million while a one percentage point increase in the percentage of the population over 65 increases real Medicaid spending by about $126 million.

A one percentage point increase in the percentage of hospitals that are for-profit raises increases total real health care spending by about $18 million. However, the percentage of hospitals that are for-profit has no effect on Medicaid spending. This may be the result of bargaining behavior. While private health plans bargain with individual health care providers. Medicaid does not. While for-profit hospitals seem to raise costs, for-profit nursing homes seem to lower them. A one percentage point increase in the percentage of nursing homes that are for-profit raises decreases total real health care spending by about $250 million. A one percentage point increase in the percentage of nursing homes that are for-profit increases real Medicaid spending by about $126 million.

The HMO estimates suggest that while they cause overall costs to rise, they may lower non-Medicaid health care expenditures. A one percentage point increase in the percentage of the population insured by HMOs increases total real health care spending by about $85 million but a one percentage point increase in the percentage of the population insured by HMOs increases real Medicaid spending by about $95 million. This suggests that a one percentage point increase in the percentage of the population insured by HMOs lowers non-Medicaid spending by about 10 million. Finally, we find that a one percentage point increase in chronic drinking rates lowers real total health care expenditures and real Medicaid expenditures by a similar amount (about $427 million).

V. Conclusion

Real per-capita medical expenditures and total medical expenditures increased dramatically from 1990 to 2000. During this same period, the illegal alien population rose significantly. Some commentators have asserted that these illegal aliens hurt the American economy and may actually be increasing health care costs. This paper examines the effect of illegal immigration on health care expenditures, in addition to examining other determinants of health care spending. This study conclusively shows that in comparison to legal inhabitants of the United States, illegal aliens play a relatively unimportant role with regards to health care expenditure increases. We find no evidence that the increase of the illegal alien population between 1990 and 2000 is a significant explanatory variable for the rise in total health care expenditures and Medicaid expenditures during that same period. Despite this, we find that an increase in the legal population will lead to an increase in total health and Medicaid expenditures.

One reason that we fail to find an effect from illegal immigrants may be the quality of the data. Illegal immigrants have every reason to fear the federal government and as a result the methods employed to estimate their numbers may be highly inaccurate. Another complicating factor is the relationship between illegal aliens and the proportion of a population that is elderly. Most illegal immigrants are young, healthy and poor so it is possible that states with a higher proportion of illegal aliens will have a lower proportion of elderly inhabitants and lower per-capita incomes, which would lead to decreased medical expenditures. These and other avenues of inquiry can be the basis for further research.

Indeed, we find that the percentage of the population that is elderly has a significant positive impact on total health expenditures. Because the elderly population requires

more medical services, an increase in the percentage of the population that is elderly leads to significant increases in both per-capita and total real health spending. Further observation of health care expenditures as more and more members of the baby boom generation reach retirement is critical in order to determine if this trend of rising health care expenditures continues. Likewise, increases in real per-capita income lead to a significant increase in real health expenditures. This conforms with economic theory; health services are normal goods.

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Table 1. Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
totrhspend	32500000	25900000	3371515	114000000
rmedicad	5005514	5582786	342788	27800000
illegal	244.74	444.34	12	2209
legal	9382.25	7193.25	1499.93	31799.5
obese	14.88	3.72	6.9	23.1
rincpc	25.29	4.14	17.17	38.94
hprof1	13.78	13.86	0	68.25
pop65pc	12.45	2.16	9.55	18.56
nme	31.25	12.79	22	53
nhprof1	67.66	9.71	44.19	84.49
hmo	24.26	11.15	5.4	53.4
alcoholi	3.9	0.98	1.7	6.1
smoke	22.36	1.99	17.2	29.1

totrhspend: Real total medical expenditures (thousanss of 1996 Dollars)
rmedicad: Real total Medicaid expenditures (thousands of 1996 Dollars)
illegal: Total illegal alien population (in thousands)
legal: Total legal population (in thousands)
obese Percentage of the population 18 years and older that is obese (BMI $\geq$ 30).
Rincpc: Real per-capita income (thousands of 1996 Dollars).
Hprof1: Number of hospitals that are investor-owned (for-profit)
Pop65pc: Percentage of the total population 65 years and older
Nme: Number of new molecular entities approved by the FDA
Nhporf1: Number of nursing homes that are investor-owned (for-profit)
Hmo: Percentage of the total population enrolled in an HMO
Alcoholi: Percentage of the population 18 years and older that is a chronic drinker
Smoke: Percentage of the population 18 years and older that smoke

Table 2. Fixed Effects Regression Results for Total Health Expenditures

Variable	Robust Coefficient	Robust Standard Error	Driscoll/Kraay Coefficient	Driscoll/Kraay Standard Error
Illegal	9722.61	4448.16	3183.016	3161.703
Legal	5666.19	982.14	3334.055***	139.3587
Obese	115000.2	320201.5	253694.9	153387.3
Rincpc	-1067.34	420781.1	591184.6***	88010.92
Hprof1	-77931.29	79165.82	18518.44*	9570.52
Pop65pc	885570.4	1913405	752325.7***	32127.63
Nme	-14390.96	29343	11186.24	12608.31
Nhprof1	-8953.94	265238.9	-250591.4***	31624.32
Hmo	238496.4	216029.2	85536.68***	15046.5
Alcoholi	456405	1046676	-470528.5**	189722.7
Smoke	-284641.4	266892.1	-83157.44	282476.4

***=significant at 0.01

**=significant at 0.05

Table 3. Fixed Effects Regression Results for Total Medicaid Expenditures

Variable	Robust Coefficient	Robust Standard Error	Driscoll/Kraay Coefficient	Driscoll/Kraay Standard Error
Illegal	1720.56	3285.66	-1321.58	4370.49
Legal	762.68	496.52	718.93***	34.7
Obese	116600.8	113298.8	-51928.97	108066.3
Rincpc	-126505.5	200038.4	211056.2***	22146.23
Hprof1	-32863.4	39455.38	-25496.14	20899.44
Pop65pc	64380.6	947203.6	-126350.2***	37043.35
Nme	-5091.01	12877.51	1427.7	7088.61
Nhprof1	20227.74	144708.6	-149544.4***	30405.25
Hmo	117456.9	124203.2	95407.45***	13441.89
Alcoholi	234548.3	582400	-427453.4***	58882.29
Smoke	-93705.96	111034	-165705.1	131822.2

***=significant at 0.01

**=significant at 0.05

Table 4. Results with Omitted Variables for Total Health and Total Medicaid Expenditures

Variable	Total Health Driscoll/Kraay Coefficient	Driscoll/Kraay Standard Error	Medicaid Driscoll/Kraay Coefficient	Driscoll/Kraay Standard Error
Illegal	558.15	2261.14	684.4	441.99
Legal	3515.75***	267.62	595.69***	79.77
Hprof1	-40033.68***	16328.92	-66455.08***	26095.02
Nme	61253.68	63019.77	22938.76	21425.08
Nhprof1	-243121.9***	29583.83	-148568.7***	23301.39

***=significant at 0.01

**=significant at 0.05