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GEOGRAPHIC ADVERSE SELECTION, MARKET INSTABILITY, AND THE PPACA

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In the United States, reforms to the way healthcare is distributed and paid for have highlighted some of the most contentious domestic policy debates of the past 100 years. In 2010, major reform was passed through Congress in the form of the Patient Protection and Affordable Care Act (PPACA). This paper seeks to model how specific reforms proposed by this law may affect the geographic distribution of population, risk, and wealth.

Past literature and empirical work has shown that incomes will downwardly-adjust to locally-imposed progressive tax structures. This same effect is predicted to occur in the newly mandated community-rated health insurance plans, which seem to share a number of dynamics with such tax codes. The model suggests that over time, healthy individuals of sufficient means and price sensitivity will select the markets in which they participate, leaving behind areas of low income and high healthcare costs.

This paper extends adverse selection theory. In "lemon" markets with compulsory participation, the existence of multiple markets of varying quality or risk profiles and free or imperfectly-restricted movement between markets will result in agents selecting the market in which he or she participates in a manner that is unbalancing to risk pools. Where those markets are geographically defined, this phenomenon may be referred to as "geographic adverse selection."

JEL Classifications: D02, D40, D47, D62, D80, D81, D82, D86, D89, H71, I11, I13, I18, R19

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I. Introduction

The Patient Protection and Affordable Care Act represents a major pivot in US healthcare policy. As healthcare in the United States accounts for upwards of 1/6 of GDP,[1] this sweeping overhaul of such a large sector of the economy can be expected to have considerable far-reaching and unintended effects.

Enacted in part to balance out risk pools and stabilize prices in the individual insurance market, the law employs a wide range of regulatory tools to ensure that all citizens and legal residents purchase and maintain adequate health insurance.

In this paper, I contend that these regulations create the potential for a perverse system of incentives that will encourage high-income individuals to select into low-risk geographic markets in a way that adversely affects markets with above-normal health risk profiles. This is a similar concept to literature that suggests that voter-consumers can self-select into jurisdictions that represent their demand for locally-provided public goods, based upon tax structures and the voter-consumer's household income.

The incentivization of this type of behavior, referred to geographic adverse selection, creates an unstable market structure that may cause risk and premiums to rise in these high-risk markets as they are abandoned by high-income individuals, undermining the stated purpose of the PPACA.

[1]The World Bank. (2013). *Health expenditure, total (% of GDP).* Retrieved November 30, 2013, from The World Bank: http://data.worldbank.org/indicator/SH.XPD.TOTL.ZS.

II. A Policy Background on the PPACA

On March 23, 2010, the Patient Protection and Affordable Care Act (PPACA) was signed into law. The implementation of this legislation represents possibly the largest and widest-ranging regulatory overhaul of the health insurance industry in the history of the United States. (Elmendorf, 2011). Though having a large number of effects and provisions, the PPACA can be largely distilled to three primary "legs," or reform tools: provider reform (to include regulations guiding how premiums and benefits are determined), a mandate for nearly all legal US residents to purchase insurance, and subsidies to make insurance affordable for low-income individuals and families (Gruber, 2011).

II-A. Provider Reform

A provision of the law describes minimum benefits that policies must cover. Many buyers of individual insurance policies do not have the time or education to review dozens of policies with widely-ranging costs and benefits packages. Creating a uniform "core" of benefits – ten of them, to be precise (Gruber, 2011) – and mandating that insurers provide a "summary of benefits" that does not exceed 4 pages reduces the cost of reviewing and comparing policies, increasing the likelihood that buyers are in fact informed buyers. This also creates a more homogenized product across insurers, moving the market towards one of more perfect competition and thus lower prices.

Another reform is due to come in the form of guaranteed access. The PPACA provides that "A group health plan and a health insurance issuer offering group or individual health insurance coverage may not impose any preexisting condition exclusion with respect to such plan or coverage." (Congress, 2010)

Gruber (2011) notes that similar reform was introduced in Massachusetts in 1997. The Massachusetts law introduced a perverse incentive for residents of that state to "free ride" by holding off on purchasing insurance until illness or injury, at which time they could purchase insurance without penalty. Massachusetts, along with 4 other states that implemented similar reforms, became one of the most expensive states in the US to purchase individual coverage.

This provided the impetus for further reform in 2006 (The General Court of Massachusetts, 2006). The new law introduced a mandate for all residents of Massachusetts to purchase health insurance. The purpose of the mandate is to ensure that free-riding and moral hazard are contained to the extent possible. Predictably, after the passage of Chapter 58 in Massachusetts, rates came down significantly, though they remained among the highest in the country.[2] This success would heavily inspire a similar mandate in the PPACA.

The last major policy point of the PPACA's provider reforms guides how insurers may determine premiums for their customers (Gruber, 2011). The law will allow rates to differ according to four specific criteria; self-only or family enrollment, geographic area, age (except the rate cannot vary by more than 3 to 1 for adults), and tobacco use (except the rate cannot vary by more than 1.5 to 1).[3]

Because rates cannot differ based upon the health status of an individual (except smoking status and age), insurance companies must charge the same rates to individuals with differing health profiles and qualities of risk, so long as those individuals reside in the same geographic area.

[2] Kaiser Family Foundation. (2012, May). *Massachusetts Health Care Reform: Six Years Later.* Retrieved 11 30, 2013, from Kaiser Family Foundation: http://kaiserfamilyfoundation.files.wordpress.com/2013/01/8311.pdf

[3] American Cancer Society. (2013). *New Federal Rating Rules.* Retrieved November 2, 2013, from American Cancer Society: http://www.acscan.org/pdf/healthcare/implementation/background/NewFederalRatingRules.pdf

This effectively means that health insurance premiums will be determined by a "community rate."

II-B. The Individual Mandate

The individual mandate, which states that legal US residents must purchase insurance coverage that begins in 2014 or pay a tax penalty, is seen to be essential to the law's success (Clement, 2012).

Adverse selection theory suggests that when sellers know more than buyers (or when the insured know more about their health risks than insurance companies), prices are determined by the average quality of that pool. This information asymmetry causes sellers of high-quality goods (or healthy insurance customers), acting in their own self interest using information that is unavailable to other parties, to select whether to participate in the market to the detriment of others. Participants with low-quality goods or risks are strongly incentivized to participate in the market, whereas participants with high-quality goods or risks are strongly incentivized to leave it. In terms of insurance, this means that healthy individuals who balance out the risk pool drop out of the market, driving risk and price up (Akerlof, 1970).

The purpose of the individual mandate is to eliminate the adverse selection problem. Healthy individuals must, by law, participate in the marketplace. Their continued participation eliminates much of the information problem by ensuring a consistent risk pool, allowing prices to stabilize at the socially optimal level (Gruber, 2011).

II-C. Subsidies to Low-Income Individuals

The final leg of the PPACA, subsidies to low-income individuals, is much more straightforward. Because the individual mandate requires that US residents purchase community-rated policies regardless of income status, a federal subsidy has been created to lessen the impact on low-

income individuals (Gruber, 2011). Without such a subsidy, it is possible that low-income individuals may be more sensitive to prices in the market due to greater income-elasticity. By offering subsidies that limit premiums to a certain percentage of income, it is thought that low-income individuals can be made less sensitive to price and therefore more likely to participate in the marketplace.

Under the law, subsidies will be made available to individuals purchasing insurance on a government-sponsored "exchange," or web-based marketplace. These subsidies will be available on a sliding-scale according to income and relative price of policy, and available to individuals and families earning up to 400% of the Federal Poverty Level (Congress, 2010). In 2013, 400% of the Federal Poverty Level is defined by the US Department of Health and Human Services as $45,960 for an individual and $94,200 for a family of four.[4]

III. Literature Review

The intuition of this model revolves largely around two core concepts: adverse selection and how location choice is impacted by local tax structures.

Adverse selection describes a fundamental problem of information economics (Akerlof, 1970). Imperfect information about the quality of heterogeneous goods impedes the market's ability to set a price that buyers and sellers can agree to, and the market fails to clear. The classic example is that of a used car, or "lemon", market. The existence of some poor quality vehicles drives the market price down, causing the sellers of higher-quality vehicles to withdraw from the market. Their withdrawal from the market drives prices further down, and the process repeats until the market becomes unviable. There is a significant literature dealing with the empirical evidence of

[4] Families USA. (2013). *2013 Federal Poverty Guidelines.* Retrieved November 17, 2013, from FamiliesUSA: http://www.familiesusa.org/resources/tools-for-advocates/guides/federal-poverty-guidelines.html

adverse selection in numerous market types, including insurance. (Browne, 1992; Finkelstein & Poterba, 2000; Cardon & Hendel, 2001; Buchmueller & DiNardo, 2002; Abbring et al, 2003).

Akerlof's theory has been extensively applied to insurance markets. Wilson (1977) finds that there is no stable equilibrium in insurance markets with static expectations as to the policy offers of other firms. While he also finds that, by altering the behavior of firms to include the expectation that unprofitable policies will be withdrawn, a stable equilibrium can be reached, the first finding is more relevant to this paper. Geographic markets for insurance can be thought of as proxies for the insurance firms in his model (especially when the assumption of perfectly competitive firms is made). Expectations are necessarily static, because of the regulations imposed in the PPACA that insurance must be offered in all markets to all consumers. These community-rated offers cannot be withdrawn, and thus the market is likely to exhibit a degree of instability.

Rothschild & Stiglitz (1976) show that, due to the imperfect information problem, equilibria in insurance markets require pricing to be contingent upon not only demonstrated risk, but on quantity demanded (i.e. the "fullness" of coverage offered). High-risk individuals cannot be counted upon to fully reveal their risk profile. As such, the fullness of the contract demanded is looked to by insurers as a mechanism for determining risk. A high-risk individual will seek out fuller insurance than a low-risk individual, forcing insurers to price their contracts based upon the quantity of insurance demanded. Extending this notion to its application to the PPACA, requiring contracts to have a minimum core of benefits and coverage can be expected to generate inefficiencies in the ways consumers reveal their risk profiles and therefore in how insurance products are priced in such a system.

Pauly (1974) argues that compulsory provision of insurance offers a mechanism that defeats the adverse selection problem. By instituting a mandatory minimum level of coverage and allowing the insured to purchase optional additional levels of insurance, insurers can discern good risks from bad ones by their revealed preference and charge appropriate rates. He admits, however, that this can lead to inefficient levels of over-insurance, especially for healthy individuals whom may be mandated to purchase more insurance than they need. He also argues that moral hazard may arise when good risks who are over-insured are incentivized to act in a fashion that increases their risk profile, leading to inefficient levels of risk that raise premiums for the entire market.

Charles Tiebout (1956) presents the first cogent argument that residents can "self-select" their level of taxation by moving to areas that have taxation levels that represent their preference for public goods. His argument revolves around the notion that consumer-voters (consumer in the sense of public goods) are generally mobile, and able to freely move between jurisdictions. While lacking in rigor and making unrealistic assumptions (such as a lack of movement costs and homogenous incomes) (Bewley, 1981), Tiebout's basic framework inspired a great deal of additional literature that corrected these shortcomings.

According to Ellickson (1971), the urbanization of the United States and the expansion of transportation infrastructure and technology have allowed individuals a greater degree of freedom in selecting their residential preference.

> *In most metropolitan areas, households find a wide variety of political jurisdictions within feasible commuting range. Preferences for local public services can now be expressed through choice of residence as well as through the ballot.*[5]

Ellickson proposes a model in which high-income individuals, with a lower demand for public goods and a higher degree of job mobility, may push for jurisdictional subdivision in urban areas in order to take advantage of autonomy in setting local taxes. He finds that wealthier households could stand to benefit from such a strategy at the expense of poorer ones, and suggests that this is one reason for the stratification of wealth between urban and suburban areas that had occurred in the previous 20 years.

Nechyba (1996) offers the first fully closed general equilibrium model of a Tiebout economy, including local and national taxes and governments, public goods, and heterogeneous incomes and public goods preferences. His extensive model shows that differences in local tax structures resulting from differing voter preferences tend to result in a vast "wealth stratification" that manifests itself in sharp contrasts between jurisdictions that go beyond geographic, demographic, or resource advantages. These contrasts have empirical support from Hansen & Kessler (2001) and Schmidheiny (2003).

IV. The Model

To demonstrate the impact of how PPACA market reforms affect the decision-making process of agents, I utilize a stylized model of how rational utility-maximizing agents make decisions as to their insurance and location preferences. The decisions of agents within the model are made in a single period, though they rationally base their decisions upon the net present value of future

[5] Ellickson (1971), p. 334

incomes and costs. Agents are defined as buyers of insurance contracts whom receive utility in the form of wealth, which is the net present value of expected lifetime income net of expected costs.

Insurance is a contract that serves as a bridge between two states of the world; one in which nothing happens, and another in which an event occurs that reduces the wealth of the agent (Rothschild and Stiglitz, 1976). The event within this model is an illness, which has a fixed cost. Purchased contracts are for full insurance.

There is a probability of the illness event occurring for each agent, referred to as risk. Each agent knows his own risk, but insurers know only the aggregate risk of the market and the number of participants. Prices are therefore determined by the total expected costs of insuring a group, which is the average risk of illness multiplied by the cost; this is referred to as a "community rate". Agents have two choices; they may choose to purchase or forego insurance, and they may choose to remain in their market or defect to another with a different risk profile and community rate for a static movement cost. A penalty for not purchasing insurance is imposed with the explicit purpose of dissuading agents from foregoing insurance.

To simplify the model, insurance companies set distinct prices for each geographic region and are assumed to be perfectly-competitive firms with zero economic profits, following the example of Pauly (1974) and Rothschild & Stiglitz (1976). The agent is assumed to be risk-averse to the extent that where the utility of insurance equals the utility of foregoing insurance, he will elect to buy insurance.

Because of the discrete nature of the agents' choices (purchase or forego insurance, stay or defect to the 2nd market), solution concepts are presented as Nash equilibria, where their heterogeneous risk and income profiles are the primary determinants of their decisions.

IV-A. An Insurance Model with a Single Market

Each agent expects to live a certain number of periods, *L*. In each of these periods, each agent receives an income, *I*. The income profile of the pool of agents is heterogeneous; agents differ with respect to their income levels. Each agent also has a risk of becoming ill, ρ, which comes with a cost, *C*. The risk profile of the pool of agents is also heterogeneous. An agent gets his utility from his wealth, *W*, which is the net present value of his expected lifetime incomes minus costs. Therefore, where *d* represents the subjective discount rate and θ represents the timing of the income flow $\theta \in (0, 1, \ldots, L)$, the wealth of an agent is represented by

$$W = (1-\rho)\sum_{\theta=0}^{L}\frac{I}{(1+d)^{\theta}} + \rho\left(\sum_{\theta=0}^{L}\frac{I-C}{(1+d)^{\theta}}\right) = \sum_{\theta=0}^{L}\frac{I-\rho C}{(1+d)^{\theta}} \tag{1.1}$$

Each agent may select whether to purchase an insurance contract. This decision may be represented by the discrete variable $\alpha \in (0,1)$. Insurance contracts are for full insurance, meaning that the expected benefit conferred by the contract in the event of illness, *B*, is equal to the probability of contracting an illness times the cost of that illness, ρC. The insurance contract comes at the cost of a premium, *P*. Therefore, the net benefit of the insurance contract, and the decision to purchase it α, can be expressed as

$$\alpha_i\left(\sum_{\theta=0}^{L}\frac{B-P}{(1+d)^{\theta}}\right) \tag{1.2}$$

Combining (1.1) and (1.2) yield an agent's utility function for insurance.

$$U = W + \alpha\left(\sum_{\theta=0}^{L}\frac{B-P}{(1+d)^{\theta}}\right) = \sum_{\theta=0}^{L}\frac{I-\rho C}{(1+d)^{\theta}} + \alpha\left(\sum_{\theta=0}^{L}\frac{B-P}{(1+d)^{\theta}}\right) \tag{1.3}$$

Because his choice is binary, $\max U(\alpha)$ will yield a decision to purchase insurance if and only if $P \leq \rho C$. If $P < \rho C$, then the insurance contract will not be offered as it will result in a loss for the insurance company. Therefore, the equilibrium price in a market with full insurance and individually determined premiums is $P = \rho C$.

Thus far, this model describes how the market for individual insurance contracts has worked in the past. The implementation of the PPACA has, however, changed the nature of the market. One of the most obvious changes has been to incorporate community rating into the market.

In a community-rated market with *N* participants, actuarially fair premiums are determined by the function $\frac{\sum_{i=1}^{N}\rho_i}{N}C$. Substituting this new premium into (1.3) yields the utility function for the i[th] agent.

$$U_i = \sum_{\theta=0}^{L_i}\frac{I_i-\rho_i C}{(1+d_i)^{\theta}} + \alpha_i\left(\sum_{\theta=0}^{L_i}\frac{B_i-\frac{\sum_{i=1}^{N}\rho_i}{N}C}{(1+d_i)^{\theta}}\right) \tag{1.4}$$

$\max U_i(\alpha_i)$ yields a condition for purchase similar to before; the i[th] agent will purchase insurance when $P \leq \rho_i C \equiv \frac{\sum_{i=1}^{N}\rho_i}{N}C \leq \rho_i C$. Because insurance premiums are determined by community

risk rather than being individually set, he will maximize his utility by electing to forego insurance if $\rho_i < \frac{\sum_{i=1}^{N} \rho_i}{N}$. As a result, less-risky members of the community will elect to forego insurance.

As an illustration, assume that

$$\rho_i < \frac{\sum_{i=1}^{N} \rho_i}{N} \text{ and } \rho_{i+1} = \frac{\sum_{i=1}^{N} \rho_i}{N}$$

Because the i^{th} person foregoes insurance, and the i^{th} person had a risk profile that is less than the average of the market, the market becomes riskier.

$$\frac{\sum_{i=1}^{N} \rho_i}{N} < \frac{\sum_{-i=1}^{N-1} \rho_{-i}}{N-1} \text{ and } \rho_{i+1} < \frac{\sum_{-i=1}^{N-1} \rho_{-i}}{N-1}$$

Because person i+1 is now less risky than the market average, he foregoes insurance as well, causing the market to become even more risky. This process repeats, with more participants dropping out until the market collapses. Given the assumption of limited risk aversion, this result represents an adverse selection "death spiral" in equilibrium, just as originally described by Akerlof (1970). If this assumption is relaxed, a Nash equilibrium short of total market collapse can be reached, though the result is still that healthier individuals forego insurance, creating high (but actuarially fair) rates for sicker individuals.

The potential for such adverse selection behavior in community-rated systems is well known (Marquis, 1992; Barrett & Conlon, 2003; Simon, 2005). As a result, the PPACA provides for a

penalty that is designed to discourage less risky market participants from dropping out, maintaining a balanced risk pool.

Assume that the government, in response to the death spiral effect, institutes a penalty, Φ. This penalty is to be imposed on any person whom elects to forego insurance, altering the utility function

$$U_i = \sum_{\theta=0}^{L_i} \frac{I_i - \rho_i C}{(1+d_i)^{\theta}} - (1-\alpha_i) \sum_{\theta=0}^{L_i} \frac{\Phi}{(1+d_i)^{\theta}} + \alpha_i \left(\sum_{\theta=0}^{L_i} \frac{B_i - \frac{\sum_{i=1}^{N} \rho_i C}{N}}{(1+d_i)^{\theta}} \right) \tag{1.5}$$

In order for this penalty to be effective, it must make our marginally risk-averse agents at least indifferent between being insured and not being insured. Any penalty that does not dissuade the least risky agent from foregoing insurance would result in at least a partial death spiral. Therefore, the simplest effective penalty is one that is large enough to make the least risky agent otherwise indifferent to the purchase of insurance.

$$\textit{Where } \min(\rho_1 \ldots \rho_N) = \rho_i,$$
$$\Phi = \frac{\sum_{i=1}^{N} \rho_i}{N} C - \rho_i C \tag{1.5}$$

Given the assumption of minimal risk aversion, such a penalty succeeds in establishing a stable Nash Equilibrium, where $\max U_i\ (\alpha_i) = 1$. Such an equilibrium implies that even a person whose expected benefit of insurance is zero can be relied upon to purchase insurance.

IV-B. An Insurance Model with Multiple Markets

Given only a single market, there would be little else to consider. All agents purchase insurance, and there would be no unraveling of the market due to adverse selection. In reality, however, there are many geographical regions, each with a competing market that consumers select between. Under the PPACA, premiums may differ by geographic region.[6] There is no mechanism within the law to prevent people from moving from region to region, much as there is no way to prevent people from taking advantage of differing local tax rates. This possibility of selection between competing geographic markets must be accounted for.

Assume a world consisting of two separate geographical regions. The second region has a distinct insurance market. Market 2's insurance policy for the j[th] agent, with *M* market participants, is structured identically to (1.5), where

$$P_2 = \frac{\sum_{j=1}^{M} \rho_j}{M} C \tag{1.6}$$

$$U_j = \sum_{\theta=0}^{L_j} \frac{I_j - \rho_j C}{\left(1+d_j\right)^{\theta}} - \left(1-\alpha_j\right) \sum_{\theta=0}^{L_j} \frac{\Phi}{\left(1+d_j\right)^{\theta}} + \alpha_j \left(\sum_{\theta=0}^{L_j} \frac{B_j - \frac{\sum_{j=1}^{M} \rho_j C}{M}}{\left(1+d_j\right)^{\theta}} \right) \tag{1.7}$$

[6] American Cancer Society. (2013). *New Federal Rating Rules.* Retrieved November 2, 2013, from American Cancer Society: http://www.acscan.org/pdf/healthcare/implementation/background/NewFederalRatingRules.pdf

The only difference between the two is the average risk of individuals located within the geographical region. Market 2 is less risky, such that $\frac{\sum_{j=1}^{M}\rho_j C}{M} < \frac{\sum_{i=1}^{N}\rho_i C}{N}$. Thus, if the cost of an illness *C* is the same in each market, $P_2 < P_1$.

Whereas before agents had a choice only between insuring and not insuring, let agents now have an additional choice between remaining in Market 1 or defecting to Market 2. Again, because this choice is binary, the decision may take the form of a discrete variable $\delta \in (0,1)$. If the agent decides to defect to Market 2, a movement cost, *T*, must be paid. Person *i*'s decision now becomes to maximize the following with respect to α and δ.

$$U_i = (1-\delta)\left[\sum_{\theta=0}^{L_i}\frac{I_i-\rho_i C}{(1+d_i)^{\theta}} - (1-\alpha_i)\sum_{\theta=0}^{L_i}\frac{\Phi}{(1+d_i)^{\theta}} + \alpha_i\left(\sum_{\theta=0}^{L_i}\frac{B_i - \frac{\sum_{i=1}^{N}\rho_i C}{N}}{(1+d_i)^{\theta}}\right)\right] \tag{1.8}$$
$$+\delta\left[\sum_{\theta=0}^{L_i}\frac{I_i-\rho_i C}{(1+d_i)^{\theta}} - (1-\alpha_i)\sum_{\theta=0}^{L_i}\frac{\Phi}{(1+d_i)^{\theta}} + \alpha_i\left(\sum_{\theta=0}^{L_i}\frac{B_i - \frac{\sum_{j=1}^{M}\rho_j C + \rho_i C}{M+1}}{(1+d_i)^{\theta}}\right) + T\right]$$

Here, $\max U_i(\alpha_i, \delta_i)$ reveals that a defection from Market 1 to Market 2 will occur when

$$T < \frac{\sum_{i=1}^{N}\rho_i C}{N} - \frac{\sum_{j=1}^{M}\rho_j C + \rho_i C}{M+1} \tag{1.9}$$

If the values of N and M are sufficiently high, the marginal effect on the community rate of any single person defecting would be trivial. Therefore, the expectation is that defections would occur when movement costs outweigh the difference between the present discounted values of future premiums. In this case, if the movement cost is less than the difference in premiums, all agents would defect, regardless of income or risk-profile.

(1.10) $$T < \sum_{\theta=0}^{L_i} \frac{P_1}{(1+d_i)^{\theta}} - \sum_{\theta=0}^{L_i} \frac{P_2}{(1+d_i)^{\theta}}$$

It is important here to recognize that the movement cost, as a one-time expenditure, is valued differently from other factors in the consumer's decision making process. This distinction shows that movement decisions between geographic locations are influenced not only by the difference between premiums, but by the subjective discount rate d_i and the number of years an agent expects to live L_i as well.

The final policy leg of the PPACA deals with subsidies for premiums for low-income individuals. Under the law, individuals and families making up to 400% of the Federal Poverty Level would qualify for partial or full subsidies, which would be awarded based upon income and the local price of one's premiums (Gruber, 2011). According to the Kaiser Family Foundation, 67% of the US population falls below this threshold and therefore could potentially qualify for subsidies.[7]

The actual formula used to calculate subsidies for individuals is complex; this model offers a simplified formula that fully subsidizes premiums for individuals in the lower half of the global income bracket. Such a subsidy (S_1 in Market 1, S_2 in Market 2) would take the form of

[7] Kaiser Family Foundation (2013) "Distribution of the Total Population by Federal Poverty Level (above and below 400% FPL)" http://kff.org/other/state-indicator/population-up-to-400-fpl/ Accessed 11/17/2013

$(S_1, S_2) = (P_1, P_2)\ if\ I_i \leq \frac{\sum I_i + \sum I_j}{N+M}, otherwise\ (S_1, S_2) = 0$. Because this addition of a subsidy to the model has the potential to change the selection behavior of agents, separate utility functions must be offered; one for high income individuals U^H and one for low income individuals U^L. Because they do not receive a subsidy, the utility function for higher-income types, where $I_i > \frac{\sum I_i + \sum I_j}{N+M}$, remains unchanged.

$$U_i^H = (1-\delta_i)\left[\sum_{\theta=0}^{L_i}\frac{I_i - \rho_i C}{(1+d_i)^\theta} - (1-\alpha_i)\sum_{\theta=0}^{L_i}\frac{\Phi}{(1+d_i)^\theta} + \alpha_i\left(\sum_{\theta=0}^{L_i}\frac{B_i - P_1}{(1+d_i)^\theta}\right)\right] + \delta_i\left[\sum_{\theta=0}^{L_i}\frac{I_i - \rho_i C}{(1+d_i)^\theta} - (1-\alpha_i)\sum_{\theta=0}^{L_i}\frac{\Phi}{(1+d_i)^\theta} + \alpha_i\left(\sum_{\theta=0}^{L_i}\frac{B_i - P_2}{(1+d_i)^\theta}\right) - T\right] \quad (1.11)$$

However, the utility functions for lower-income types, where $I_i \leq \frac{\sum I_i + \sum I_j}{N+M}$, change significantly with the addition of a subsidy.

$$U_i^L = (1-\delta_i)\left[\sum_{\theta=0}^{L_i}\frac{I_i - \rho_i C}{(1+d_i)^\theta} - (1-\alpha_i)\sum_{\theta=0}^{L_i}\frac{\Phi}{(1+d_i)^\theta} + \alpha_i\left(\sum_{\theta=0}^{L_i}\frac{B_i - P_1 + S_1}{(1+d_i)^\theta}\right)\right] + \delta_i\left[\sum_{\theta=0}^{L_i}\frac{I_i - \rho_i C}{(1+d_i)^\theta} - (1-\alpha_i)\sum_{\theta=0}^{L_i}\frac{\Phi}{(1+d_i)^\theta} + \alpha_i\left(\sum_{\theta=0}^{L_i}\frac{B_i - P_2 + S_2}{(1+d_i)^\theta}\right) - T\right] \quad (1.12)$$

Optimizing utility with respect to the purchase and movement variables yields a Nash equilibrium at $\max U_i^H(\alpha_i, \delta_i) = (1,1)$ and $\max U_i^L(\alpha_i, \delta_i) = (1,0)$. Because $S_1 = P_1$ and $S_2 = P_2$, a fundamental tension of the model becomes clear; the subsidization of premiums make low-income individuals indifferent as to which market in which they participate, regardless of risk profile. The only difference between the two markets for a low-income individual is the un-subsidized movement cost he would have to bear in moving. Therefore, if all else is the same, he

will elect not to move. Conversely, higher income individuals who do not qualify for premium subsidies are sensitive to price, which is a function of riskiness, leading to high-income individuals electing to defect to less-risky markets.

It is worth mentioning that these subsidies and their effects are extreme. However, they serve an important tension in the model; income-based subsidies reduce the sensitivity of low-income individuals to price. This is not unlike literature that describes wage adjustment in the face of local- and state-based progressive income tax structures that tend to drive away high-income high-skill individuals and jobs (Hansen & Kessler, 2001; Schmidheiny, 2003). Given that approximately two-thirds of the US population could potentially qualify to receive subsidies should they find themselves on the individual market, this tension, simple as it is, has the potential to have a very non-trivial effect on how individuals select the community-rated markets in which they participate.

V. Implications and Extensions

The most obvious implication of this model is that it suggests that higher-income individuals may be more incentivized to seek out lower-risk communities. This type of geographic adverse selection could have negative economic effects on the areas they abandon. A recent example of this is the mid-twentieth century migration of predominantly white, middle-class families from urban centers to suburbs, popularly known as the "white flight" phenomenon. Falling wages, fewer high-income taxpayers, and lower land values have all been demonstrated to have deleterious effects on local government revenues, adversely impacting public expenditures such as education, transportation, public safety, and (ironically) public health (Clotfelter, 1975; Alesina, Baqir, & Easterly, 1999; Bayer, McMillan, & Rueben, 2005).

Beyond this most immediate concern, there are a host of empirical and theoretical studies into interactions between income, health risk factors and discount rates that may offer insight into additional implications and extensions of the model.

The first is the notion that income and risk factors for various illnesses have a negative relationship. This model has assumed that there is an even distribution of risk among high- and low-income individuals. Various studies, however, have suggested otherwise. Borg and Kristensen (2000) studied 5001 Danish citizens and found that many environmental factors associated with low-wage occupations and lower socioeconomic status had strong correlations with specific risk factors, such as obesity and smoking, as well as more esoteric measures such as self-reported health and happiness. Sareen et al. (2011) finds in a psychological study of more than 34,000 participants that lower income levels due to the global economic recession have lead affected individuals to have higher incidences of Axis I (depression, schizophrenia, panic disorders) and Axis II (mental retardation, learning disabilities) disorders, as well as increased suicide attempts. Newacheck et al. (1980) analyzed data from the National Center for Health Statistics and found that, while poor and nonpoor individuals suffered from a similar array of chronic conditions requiring disability considerations and bed-care, poorer individuals disproportionately suffer a greater prevalence of them.

These and other studies (Winkelby et al, 1992; Smith, 1999; Wilkinson & Marmot, 2003) illustrate a particular danger of the adversarial selection behavior described by this model. If higher-income individuals are indeed more incentivized than subsidized lower-income individuals to relocate to lower-priced and lower-risk communities, and if higher income levels are an indicator (if not cause) of lower health risk, then this migration of the wealthy from high-risk high-price communities to low-risk low-price communities could potentially unbalance the

risk pool in areas abandoned by the wealthy, increasing risk and price. As prices for subsidized health care rise, so too must the subsidies that sustain them. These subsidies must be paid for either through increased taxation of higher-income workers, in which case the higher taxes would offset the lower premiums they ostensibly pay (leaving the movement costs of their migration as a deadweight loss), or through increased public debt, which comes with its own costs and problems.

Another interesting aspect that may be explored is the relationship between income and time preference, in that income may have a negative relationship with the subjective discount rate (Harrison, Lau, & Sullivan, 2002; Bauer & Chytilova, 2009). There are several possible explanations for such a correlation. Chao et al (2007) suggest that higher-income individuals live longer lives, and this lower mortality leads one to value higher future earnings more. Others suggest that having a higher income simply leads one to have a more positive outlook, and to value future income at a higher rate (Harrison, Lau, & Sullivan, 2002).

Whatever the cause, if there is indeed a difference in the discount rate among persons of differing income levels, this could have an interesting effect on geographic adverse selection behavior. As previously offered, the tension triggering movement within the model is where $T < \sum_{\theta=0}^{L} \frac{P_1 - S_1}{(1-d)^{\theta}} - \sum_{\theta=0}^{L} \frac{P_2 - S_2}{(1-d)^{\theta}}$, or whether the cost of movement exceeds the difference in the discounted sum of future premiums net of subsidies. If the discount rate *d* is indeed a negative function of income, this would indicate that geographic adverse selection behavior could occur even when subsidies are absent. As the income of an agent increases (and the discount rate decreases), so too do the subjectively discounted values of the stream of premiums in Market 1 and Market 2.

VI. Conclusion

The PPACA is a highly complex piece of legislation, introducing new regulation upon fully one-sixth of the US economy. It is inevitable that such a piece of legislation will have unintended consequences.

The results of this model suggest that the law will create a new system of perverse incentives for market participants to select adversely, ultimately undermining the goals of the law. High-income individuals, sensitive to price, are incentivized to move away from high-risk high-premium areas. Given the prevailing relationships between income and health risk factors, this process of adverse geographic selection may well serve to destabilize the market, resulting in a stratification of wealth and risk to the benefit of the rich and healthy and the detriment of the poor and sick.

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