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Projecting the Effect of the Excise Tax on High Cost Employer-Sponsored Health Coverage on Health Care Consumption

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This paper estimates the impact of what has come to be referred as the "Cadillac tax" provision of the Patient Protection and Affordable Care Act on health care consumption and the employer offer rate of health insurance in the United States. Because this tax on high cost health plans has yet to be implemented, no data currently exist regarding its effect. Therefore, the datasets used in this paper involve past figures of premium cost distributions, employer offer rates, plan characteristics, and individual-level healthcare data aggregated by the Kaiser Family Foundation's (KFF-HRET) Annual Survey of Employer Health Benefits and the Medical Expenditure Panel Survey Household Component (MEPS-HC). Using this data, I forecast the growth in premiums and the effective increase in price due to the excise tax. Subsequently, I determine the price elasticity of demand of health insurance and use this figure to estimate the change in employer offer rates due to the excise tax. I also employ regression analysis using the MEPS Household Component dataset to calculate the change in health expenditures with respect to a change in the price of premiums. I estimate that in 2018, the employer offer rate will decrease by between .42% and .48% and health care expenditures of individuals with employer-provided insurance will decrease by between .06% and .07%. I estimate that in 2029, the offer rate will decrease by between 1.92% and 2.45% and health care expenditures will decrease by between .33% and .43%.

I. INTRODUCTION

The Patient Protection and Affordable Care Act (PPACA), signed into law in 2010, is designed to reform the nation's health care system so that all Americans have access to quality, affordable health care while stemming the growth of health care costs. Comprehensive market reform measures include the elimination of pre-existing condition exclusions, requiring coverage for certain medical procedures, enhancing the appeals process, establishing coverage standards and the American Health Benefit Exchange, and implementing coverage penalties and tax credits. The legislation also incentivizes states to expand Medicaid and the Children's Health Insurance Program, and improves benefits. To remedy the current medical care payment system, the PPACA creates a value-based Medicare purchasing program for hospitals, patient care models that focus on cost saving, and new methods to calculate Medicare Advantage payments and home health payments. The PPACA contains additional provisions related to improved public health, the health care workforce, and program integrity.

In order to offset a portion of the cost of the PPACA as well as accomplish other policy objectives, certain revenue provisions are included in Title IX of the bill, the most significant of which is the Excise Tax on High Cost Employer-Sponsored Health Coverage. Originally set to be implemented in 2013 but delayed until 2018, it applies a tax rate of 40% to every dollar of employer-sponsored individual and family premium cost above a set threshold, including contributions to tax-preferred health accounts. The thresholds will be set at $10,200 and $27,500 in 2018 for individual and family plans, respectively, and will be indexed to the CPI in all subsequent years except for 2019, in which an adjustment of the CPI plus 1% will be made. Additional threshold adjustments will be made for certain groups who might be inequitably affected by the tax, namely industries concentrated with high-risk employers (PPACA, 2010).

The excise tax seeks to further the goals of the Affordable Care Act by slowing the growth in health care spending, as well as reducing the federal deficit by offsetting the cost of the Affordable Care Act. By increasing the marginal cost of generous plans, the tax essentially opposes the well-established tax subsidy for employment-based insurance. This seemingly roundabout approach is more politically favorable than simply altering the existing subsidy structure, because the insurers themselves remit the tax, even though most of the tax burden will be borne by workers and employers (Herring & Lentz, 2011). By counteracting the subsidy, the tax will discourage workers from shifting their wages to health

benefits in order to reduce the amount of their income tax, which will ultimately increase federal income tax revenue as well as reduce the amount of excessively generous health plans. The CBO estimates that the excise tax will raise $80 billion in revenue from its implementation to 2023 (Banthin & Masi, 2014).

This paper seeks to shed light on a relatively untouched aspect of the excise tax; specifically, how it will change health care consumption and employer offer rates. If indeed the current federal tax expenditure on employer-provided health insurance generates a surplus of health care consumption and therefore deadweight loss, the tax may be considered Pigouvian to the extent it reverses the effect of the subsidy on employees' spending behavior. Regardless, policymakers and economists should be interested in estimating and eventually calculating this change so the tax can be comprehensively analyzed and perhaps adjusted or implemented elsewhere. Being able to estimate the change in health care expenditures is also one of many steps in measuring the success of the tax.

Much of the analysis of the effect on health care consumption in this paper builds upon the research of Herring & Lentz (2011), who performed a study regarding the effectiveness of the excise tax from 2018 to 2029, estimating that 16% of plans will incur the tax upon implementation, while 75% of plans will incur the tax in 2029. Using data from KFF-HRET surveys in 2008 and 2009, they estimated that the tax will reduce private health care benefits by .7% in 2018 and 3.1% in 2029 as well as generate $931 billion in revenue from 2020 to 2029. They concluded that the number of people with private insurance affected by the tax will grow rapidly over time, and because of this consider its longevity unsound. Likewise, in this paper I estimate that 17% of individual plans and 10% of family plans will incur the tax in 2018, while 48% of individual plans and 67% of family plans will incur the tax in 2029. However, I expand the premium cost dataset to include years 2010 through 2013 and therefore use an individual premium growth rate of 5.0% and a family premium growth rate of 5.8%, which are slightly lower than the figures used by Herring & Lentz. Additionally, I estimate that the tax will reduce health care consumption by between .06% and .07% in 2018 and between .33% and .43% in 2029, figures which Herring & Lentz did not calculate in their study. Although these studies are partially similar, the dataset and methodology I use to calculate these figures are sufficiently different from that of Herring & Lentz to merit a separate report. Among other variations, the model in this paper uses more recent KFF-HRET and MEPS data, assumes lower premium growth rates in general, estimates change in demand by employer offer rates,

incorporates the elasticity of health care demand with respect to premium price, and projects growth in premiums by region and industry using historical growth rates rather than regression analysis.

However, the results of both models are very similar, even without accounting for the difference in premium growth rates. This suggests that a significant and increasing amount of workers and employers will be affected by the excise tax in the absence of further changes to the legislation or delays in its implementation.

After a review of the health insurance economics literature, the paper will describe the sources and types of the data used in the model, as well as forecasted figures, growth trends, and elasticity calculations derived from the data. The paper will subsequently describe the model and discuss the results, their implications, and their limitations.

II. LITERATURE REVIEW AND HYPOTHESES

The structure of the model, as well as many of its assumptions, draws heavily from established health insurance literature. Most notably, the functional form of the regression equation to estimate the elasticity of health care consumption with respect to the price of employer-sponsored health insurance is derived from previous theories, models, and studies, and the conclusion that health care demand is inelastic with respect to the price of health insurance supports the literature.

One of the foundational models of health care demand was formulated by Grossman (1972), which was the first to treat health as a durable item and health care as both an investment and consumption commodity. Grossman recognized that the health stock of an individual must take into consideration depreciation as well as periods of illness, both of which would affect the individual's utility. By treating "good health" as an endogenous good, the model incorporated variables such as education, wage rates, wealth, and fluctuations in health over an individual's lifetime to determine the shadow price of health care. Through regression analysis, Grossman discovered that the marginal cost to an individual of improving his or her health is roughly 7.1 percent lower per year educated, age reduces health and increases health care expenditures, and the elasticity of demand for medical care is between -.1 and -.3. Today, this elasticity is higher, albeit still inelastic, because consumers spend a larger portion of their budgets on health care. Knowing the price elasticity of health care is important in finding the

elasticity of health care demand with respect to the price of health insurance, assuming the price of health care is partially reflected in the price of health insurance.

Two years later, Keeler, Newhouse, and Phelps (1974) issued a report concerning the impact of deductibles on health care demand. They formulated a theoretical dynamic stochastic model which takes into consideration the health status of an individual in a certain time period who makes his or her decision to purchase health care based on the current and future utility of consumption. In essence, the individual must take into account the probability of being sick in the future, as well as the marginal cost of health care, which decreases after the deductible is met. As consumption increases, a divergence between the marginal and effective price of health care is observed. Accordingly, Keeler, Newhouse, and Phelps theorized that the demand for medical services plotted against the size of the deductible is a decreasing logistic curve, reflecting this divergence. However, the rise of cost sharing in the past four decades has probably decreased the magnitude of the relationship between the deductible and the demand for medical services, therefore decreasing the curvature of the graph.

Beyond Grossman, a large amount of literature has been published regarding experiments undergone to estimate the elasticity of health care as well as health insurance. Most of this literature draws from the extensive data gathered between 1971 and 1982 by the RAND Health Insurance Experiment. The experiment consisted of randomly assigning a representative sample of 2,750 families with one of five types of health insurance ranging from free care to 95 percent coinsurance as well as an HMO plan. The service use, cost, quality of medical care, and health of each family were then monitored for 3-5 years. At the end of the study, RAND concluded that cost sharing had a substantial effect on the consumption behavior of families. Families with cost sharing visited physicians on average one to two times per year and experienced a hospitalization rate of 20 percent less than families who received free care (RAND, 2006). This reduction in treatment consisted of both effective and non-effective care. However, RAND also found that cost sharing did not significantly affect the quality of care measured in relation to best possible care, and quality of care on average did not improve over the life of the study. Even so, cost sharing in general did not seem to degrade participants' health, except for the poorest and sickest six percent of participants. Finally, participation in cost sharing did not reduce risky behavior, such as smoking or poor diet.

In an attempt to model the collective effects of continuous, discrete, and mixed explanatory variables on health expenditures, Gilleskie and Mroz (2004) formulated a conditional density function and a corresponding regression which accurately estimates the RHIE data. The model estimates that on average, ceteris paribus, a one percent increase in the coinsurance rate decreases overall annual health care expenditures by $6.37 (in 1999 dollars), a $1000 increase in household income increases expenditures by $0.97, and a unit increase in an individual's General Health Index decreases expenditures by $10.63. The effect of each explanatory variable is highly significant; with significant p-values and no multicollinearity. The model further specifies the effect of these covariates on subsets of individuals, but these results will not be used for the purposes of this paper.

From the RAND study and Gilleskie's model, we conclude that cost sharing affects consumption. Furthermore, the amount of cost sharing in the form of deductibles and coinsurance is reflected in the price of health insurance. More expensive plans generally have lower deductibles and coinsurance rates, and less expensive plans have more cost sharing. Therefore, assuming the amount of cost sharing is a determinant of the price of insurance, the price of insurance has an indirect effect on and is positively correlated with health care consumption.

In the absence of a concrete measure of the quantity of premiums in the health insurance market, researchers utilize a national measure of the percentage of firms offering health insurance called the employer offer rate. The change in the employer offer rate as a result of the excise tax is therefore a useful estimate as it is a well-understood measure. The price elasticity of the offer rate is found by measuring the change in the premium price or another equivalent measure and quantifying the subsequent change in the offer rate. Although selected estimates range from -5.82 to -.14, most studies show that demand for employer-sponsored health insurance is inelastic. This substantial variation is due to differing data sources and methodologies; however, these estimates have a central tendency of about -.6. A negative correlation between elasticity and firm size as well as between elasticity and level of workers' earnings has been observed (Liu & Chollet, 2006).

Next to Herring & Lentz, the effect of the excise tax on health care consumption has rarely been discussed or studied because of the substantial uncertainty that exists regarding consumer response to the tax as well as the singular and experimental nature of an excise tax on health insurance. However, the American Academy of Actuaries together with the Society of Actuaries issued a report in 2010 which

considered actuarial issues in light of the tax and created a model to project tax revenues. By simulating five scenarios, the researchers estimated that the tax would raise between $41.8 billion and $226.2 billion in total from 2013 to 2019, and would affect between 7.6 million and 40.1 million enrollees in 2019 (Badalamenti et al., 2010). However, this study was conducted before the five-year delay in the implementation of the tax was legislated, so its estimates are overstated. Additionally, they concluded that many high-cost plans do not offer overly generous benefits, but rather are more expensive due to region, individual risk, or a less healthy population and therefore taxing them may not be horizontally equitable. They concur with Herring & Lentz, predicting that most premiums would be subject to the tax in the future due to the growth rate of premiums with respect to inflation.

To restate and expand upon the two main hypotheses, the price of health insurance has an indirect effect on and is positively correlated with health care consumption and the employer offer rate is inelastic. Furthermore, because both health insurance and health care are price inelastic, I expect the elasticity of health care expenditures with respect to the price of health insurance to be even more inelastic. To illustrate this consequence, imagine in one year an individual is paying a $10,000 premium for health insurance and is spending $5,000 on health care. The next year, his premium increases by 10% to $11,000 due to more generous benefits in the form of lower cost sharing. Based on previous studies, his demand will decrease by 4%. However, because the individual has flexibility to change the quality of his health insurance, he will lessen the cost sharing benefits of his plan, assumedly to the extent to which he will be paying 6% more than what he was for his premium before its price increased rather than 10% more. In effect, his new plan will cost $10,600 and will have a decrease in the deductible and coinsurance rate reflected in the $600 increase in premium price. As we have seen, the cost sharing measures of a deductible and coinsurance reduce the marginal cost, or effective price, of health care. The individual, then, experiences a decrease of cost sharing less than a deductible decrease of $600. Subsequently, he faces an effective decrease in the price of health care equal to or less than the amount of the decrease in deductible. This price decrease is at most 8.3%, and based on previous studies, causes his health care demand to increase by 1.7%. In this example, the elasticity of demand for health care with respect to the price of health insurance is therefore approximately .17, a figure more inelastic than both of the price elasticities for insurance and consumption.

III. DATA/METHODOLOGY

Sources and type of data

The data used in the model is extracted from the Kaiser Family Foundation/Health Research & Educational Trust (KFF) Survey of Employer Health Benefits and the Medical Expenditure Panel Survey Household Component (MEPS-HC), both of which are conducted annually.

The KFF survey includes cross-sectional firm-level information regarding the cost of health insurance, health benefit offer rates, enrollment patterns, and premiums, which is aggregated from interviews with around 2,000 firms. This data is not treated as panel because although Kaiser attempts to maintain information from the same firms, a large portion of new firms are added to the dataset every year. The data is categorized by firm size, region, and industry, which will allow for more specific conclusions regarding the impact of the tax.

Similarly, the MEPS data used includes household-level panel data regarding health insurance plan, demographic, and health status characteristics. Compiling this data involved merging the 2011 Person Round Plan and Consolidated Data files. The entire survey spans 39,000 U.S. establishments, but only information for individuals who obtain private health insurance from their employer is used. For regression purposes, only one round of data is extracted so that it may be treated as cross-sectional. The specific variables are described in Table 1.

Variable	Observations	Mean	Std. Dev.	Min	Max
HEALTH INSURANCE PLAN CHARACTERISTICS					
Log-transformed total health care expenditures	5634	7.181351	1.636508	1.386294	12.87573
Health insurance covers dental	6454	.2606136	.4390034	0	1
Health insurance covers vision	6454	.3300279	.4702592	0	1
Health insurance covers prescription drugs	6454	.0511311	.2202821	0	1
Log-transformed annual out-of-pocket premium	5415	7.710479	.8850008	4.787492	10.26813
Anyone in household has an FSA account	6454	.8385497	.3679743	0	1

Plan is HMO	6454	.6659436	.4716961	0	1
DEMOGRAPHIC CHARACTERISTICS					
Age	6454	39.32337	18.85847	5	85
Census region	6454	2.724667	1.018938	1	4
Race	6454	1.543849	1.079161	1	6
Person's wage income	6454	31659.29	37171.3	0	238632
Family's total income	6454	84748.52	60540.78	-21130	462118
Sex	6454	.5159591	.499784	0	1
HEALTH STATUS CHARACTERISTICS					
Perceived health status	6454	2.049892	1.005481	1	5
High blood pressure diagnosis	6454	1.754881	.4301912	1	2
Coronary heart disease diagnosis	6454	1.97335	.1610712	1	2
Stroke diagnosis	6454	1.984196	.1247269	1	2
Emphysema diagnosis	6454	1.990858	.0951812	1	2
Had chronic bronchitis in the last 12 months	6454	1.984351	.1241237	1	2
Cancer diagnosis	6454	1.928262	.2580744	1	2
Diabetes diagnosis	6454	1.927332	.2596111	1	2
Had joint pain in the last 12 months	6454	1.747289	.4346006	1	2
Arthritis diagnosis	6454	1.828169	.3772631	1	2
Asthma diagnosis	6454	1.90502	.2932098	1	2
Wear eyeglasses or contacts	6454	1.441587	.4966146	1	2
Has difficulty hearing	6454	1.953362	.2108781	1	2
Has any functional, activity, or sensory limitations	6454	1.839015	.367546	1	2
Number of work and school days lost due to illness or injury	6451	.7398853	3.732022	0	115

Table 1 – Statistical summary of variables

Any observations for which the values of these variables were inapplicable, not ascertained, the respondent refused to answer, or the respondent did not know were not used in the regression. A total of 1,420 observations were dropped, and the final sample size is 4,718 individuals.

The regression equation to explain variation in health care expenditures of the subset of individuals with employer-sponsored health insurance is of the form

$$\ln(Y) = \beta_0 + \beta_1 \ln(X_1) + \sum_{k=2}^{35} \beta_k X_k + \beta_{36} X_{36} + \beta_{37} X_{36}^2 + \beta_{38} X_{36}^3 + \beta_{39} X_{36}^4 ,$$

where Y is total annual health care expenditures, X_1 is the annual out-of-pocket premium, X_2 to X_{35} are other aforementioned health insurance, demographic, and health status characteristics, and X_{36} is the number of work and school days lost due to illness or injury. Quadratic forms of this variable are included to alleviate quadratic variation in the dependent variable.

Dependent Variable: ln(Total Health Care Expenditures) Sample: Individuals covered by employer-sponsored health insurance			
Independent Variable	**Coefficient (Standard Error)**	**Independent Variable**	**Coefficient (Standard Error)**
Has Dental Insurance	-.0799 (.0560)	**High Blood Pressure Diagnosis**	.1320*** (.0566)
Has Vision Insurance	.0526 (.0500)	**Coronary Heart Disease Diagnosis**	.6094*** (.1187)
Has Prescription Medicine Insurance	.0164 (.0964)	**Stroke Diagnosis**	.0904 (.1642)
ln(Out-Of-Pocket Premium)	.0657*** (.0247)	**Emphysema Diagnosis**	-.0787 (.2549)
Insured Through HMO	-.0953** (.0457)	**Chronic Bronchitis Diagnosis**	.2164 (.1873)
Age	.0086*** (.0016)	**Cancer Diagnosis**	.5516*** (.0837)
Region (Base Northeast)	--	**Diabetes Diagnosis**	.4748*** (.0795)
Midwest	-.0297 (.0673)	**Joint Pain**	.1415*** (.0565)
South	-.2046*** (.0656)	**Arthritis Diagnosis**	.3486*** (.0661)
West	-.0787 (.0688)	**Asthma Diagnosis**	.4533*** (.0679)
Race (Base White)	--	**Wears Glasses**	.2659*** (.0477)
Black	-.2149*** (.0605)	**Has Difficulty Hearing**	-.0455 (.1128)

American Indian/Alaska Native	-.2169 (.2352)	**Has Any Physical Limitations**	.5328*** (.0754)
Asian	-.1677** (.0851)	**Number Of Sick Days**	.1446*** (.0188)
Native Hawaiian/Pacific Islander	-.7093*** (.1555)	**Number Of Sick Days Squared**	-.0056*** (.0013)
Multiple Races	.1066 (.1565)	**Number Of Sick Days^3**	.0001*** (.0000)
Wage (in $10,000s)	.0039 (.0066)	**Number Of Sick Days^4**	-3.48e-07*** 1.29e-07
Family Income (in $10,000)	.0122*** (.0041)	**Has FSA**	.2344*** (.0542)
Sex (Base Male)	.3101*** (.0434)	**Constant**	9.281*** (.4088)
Perceived Health Status (Base Excellent)	--		
Very Good	.0856* (.0519)	Note: Data from the 2011 MEPS-HC Person Round Plan and Full-Year Consolidated Data files. Table presents coefficients from a log-lin model. * implies significant at 10%; ** implies significant at 5%; *** implies significant at 1%	
Good	.1819*** (.0641)		
Fair	.3078*** (.0945)		
Poor	.8527*** (.1657)		

Table 2 – Regression results

The final model has an adjusted r-squared value of .237, and the coefficient which represents the elasticity of health care expenditures with respect to the price of health insurance is statistically significant, with a p-value of .008. Running diagnostics ascertained that this variable does not contribute to any violations of classical linear regression modeling assumptions. The model computed the elasticity of health care expenditures with respect to the price of health insurance to be .066, a figure consistent with the previously hypothesized estimate.

Compilation and analysis of data

Notable figures and trends

During the past five years, the average single premium has increased by an average of 4.58% per year, and the average family premium has increased by an average of 5.2% per year. An average of 18.4% of single premiums have exceeded 120% of the average single premium cost over the same time frame, and 19.5% of family premiums have exceeded 120% of the average family premium cost. The premium cost distributions of single and family plans, shown in Figures 1 and 2, respectively, are normal, the single distribution being markedly so. The CPI, the figure to which the premium threshold is indexed,

has experienced an average growth rate of 1.59% over the past five years. The fact that premium prices are increasing at a rate which is 3% higher than the CPI growth rate suggests that the tax will affect an increasing number of plans over time.

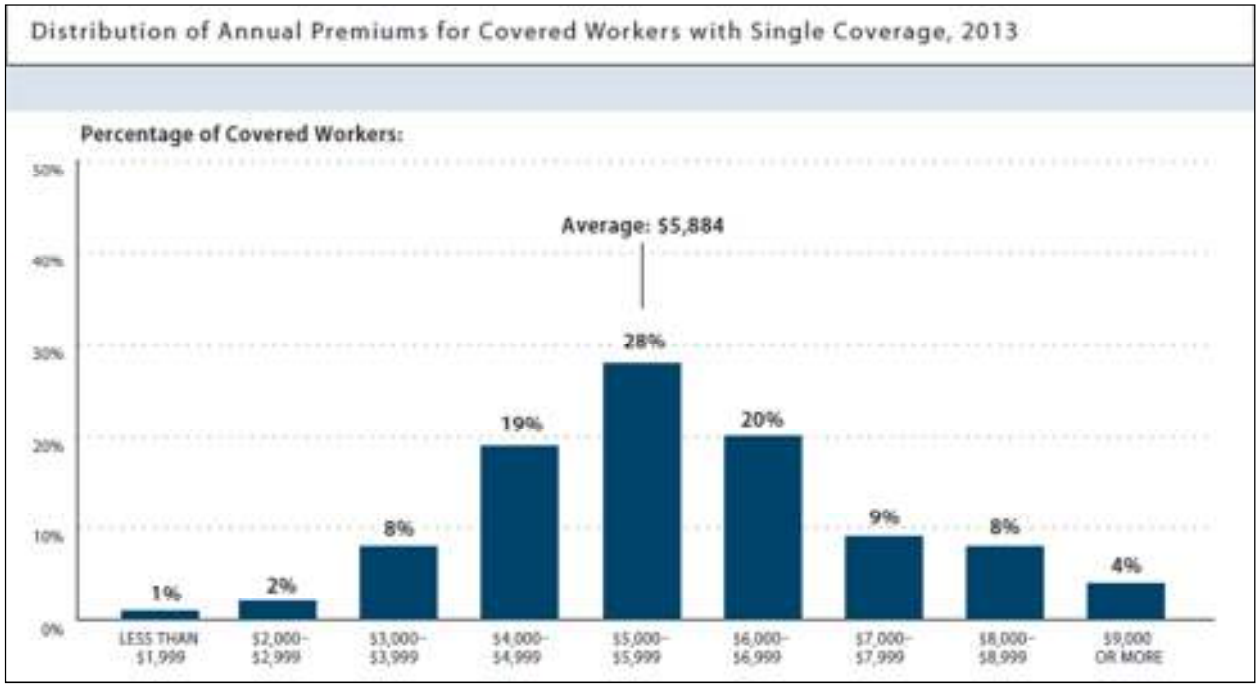

Figure 1 – Single premium cost distribution Source: *KFF/HRET Employer Health Benefits: 2013 National Survey*

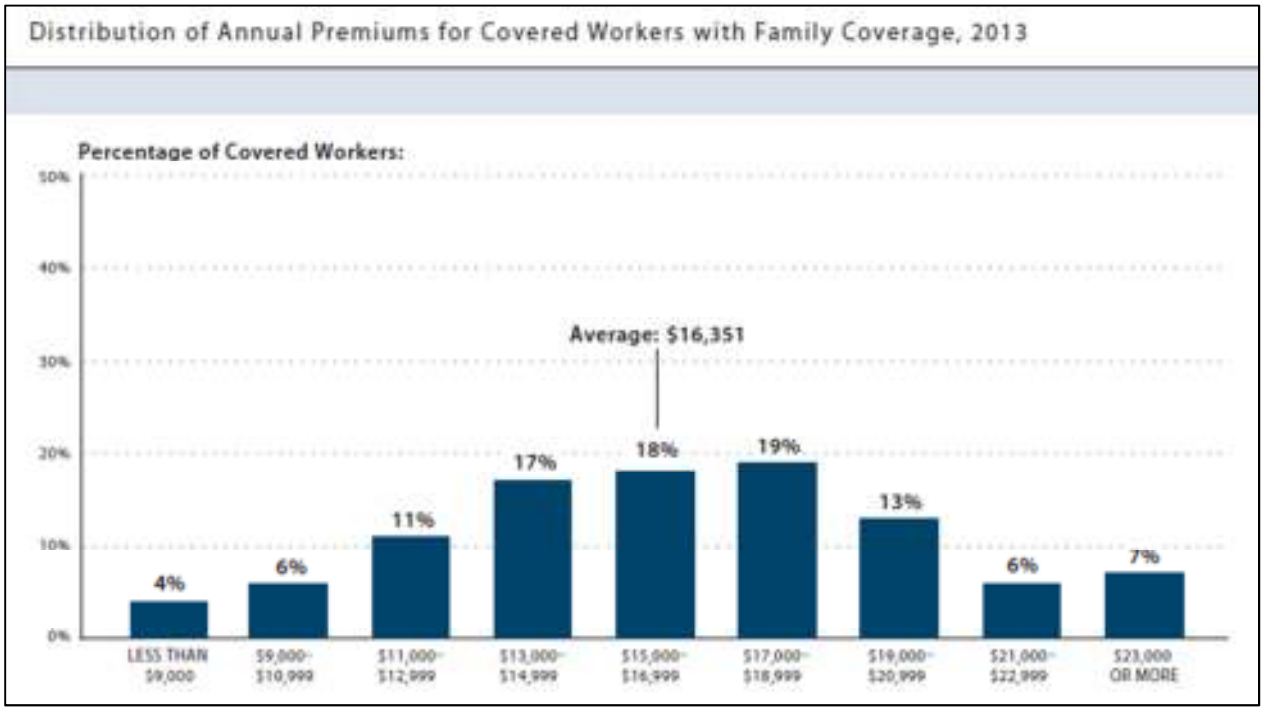

Figure 2 – Family premium cost distribution Source: *KFF/HRET Employer Health Benefits: 2013 National Survey*

The premium growth rates do not significantly differ by firm size, but exhibit discrepancy by region and industry. Premiums in the Midwest grew the slowest, with single and family premiums growing at 3.51% and 4.2%, respectively. In the West, however, premiums grew the fastest, with single and family premiums growing 5.57% and 6.2%, respectively. Premiums in the Finance industry grew the slowest, with single and family premiums growing at 2.1% and 4.0%, respectively. Single premiums in the agriculture, mining, and construction industry group grew the fastest, at 5.97%, and family premiums in the transportation, communications, and utilities industry group grew the fastest, at 7.3%. The discrepancy in growth rates between different regions and industries suggests that different regions and industries will be adversely affected by the tax.

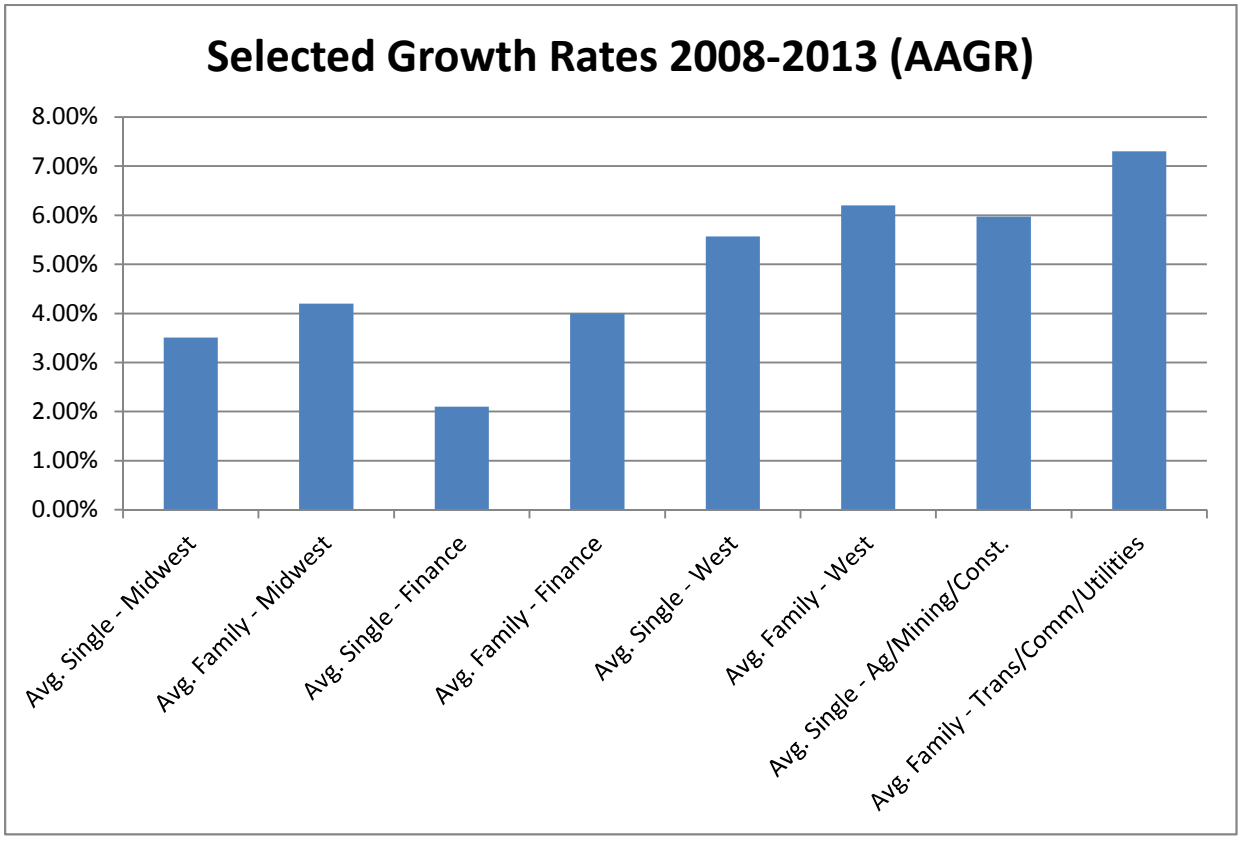

Figure 3 – Selected premium growth rates

Projections Absent Of Tax

Using this growth rate and cost distribution data, I project the premium cost and CPI values up to the year 2029, a decade after the implementation of the tax. For simplicity, I assume the cost distributions for all plans will remain the same indefinitely, as they have been historically stable.

Year	Average Single Plan	Standard Deviation	Average Family Plan	Standard Deviation	CPI
2008	$ 4,704	1860.906	$ 12,680	4978.01	215.30
2009	$ 4,824	1924.165	$ 13,375	5493.121	214.54
2010	$ 5,049	1939.598	$ 13,770	5609.48	218.06
2011	$ 5,429	2141.016	$ 15,073	6072.38	224.94
2012	$ 5,615	2190.21	$ 15,745	6316.179	229.59
2013	$ 5,884	2469.879	$ 16,351	6833.271	232.95
2014	$ 6,153	2446.731	$ 17,204	6982.185	236.65
2015	$ 6,435	2558.746	$ 18,101	7346.431	240.41
2016	$ 6,730	2675.89	$ 19,046	7729.678	244.22
2017	$ 7,038	2798.397	$ 20,039	8132.918	248.10
2018	$ 7,360	2926.513	$ 21,085	8557.195	252.04
2019	$ 7,697	3060.494	$ 22,185	9003.605	256.04
2020	$ 8,049	3200.609	$ 23,342	9473.304	260.11
2021	$ 8,418	3347.138	$ 24,560	9967.505	264.24
2022	$ 8,803	3500.376	$ 25,841	10487.49	268.43
2023	$ 9,206	3660.63	$ 27,189	11034.6	272.70
2024	$ 9,628	3828.22	$ 28,607	11610.25	277.03
2025	$ 10,069	4003.483	$ 30,100	12215.93	281.43
2026	$ 10,529	4186.769	$ 31,670	12853.21	285.90
2027	$ 11,012	4378.447	$ 33,322	13523.73	290.44
2028	$ 11,516	4578.9	$ 35,061	14229.24	295.05
2029	$ 12,043	4788.53	$ 36,890	14971.54	299.73

Table 3 – Premium and CPI projections

The premium cost threshold, above which the 40% marginal tax will be implemented, begins at $10,200 for individual plans and $27,500 for family plans in 2018. After 2018, the threshold is indexed to the CPI except in 2019, when the threshold is indexed to the CPI plus one percent. To calculate the percentage of plans above the threshold, I assume the individual and family plan cost distributions are normal. Using the cumulative distribution function,

$$p_y = 1 - \frac{1}{2}\left[1 + \frac{2}{\sqrt{\pi}} \int_0^{\frac{T_y - \mu_y}{\sqrt{2\sigma^2}}} \exp(-t^2)dt\right],$$

where p_y is the percentage of plans above the threshold T_y in year y, μ_y is the average premium cost in year y, and σ is the standard deviation of the premium cost distribution (to calculate σ, I assume

that the lowest premium cost is 40% of the average, and that the highest premium cost is 240% of the average).

Given the aforementioned growth rate and distribution figures and functions, 17% of single plans and 10% of family plans will exceed the premium threshold in the first year of the tax. However, due to a relatively higher growth rate in family plans, 48% of single plans and 67% of family plans will exceed the threshold by 2029. The percentage of plans above the threshold in 2018 and 2029 vary depending primarily on the growth rate, which exhibits discrepancies between region and industry category. Once again, premiums in the West are the most affected and premiums in the Midwest are the least affected. Likewise, premiums in the transportation, communications, and utilities industry group are the most affected, and premiums in the finance and manufacturing industries are the least affected. Complete tables of percentages of plans exceeding thresholds can be found in Appendix A.

Selected Percentages of Single Plans Exceeding Threshold						
Year	**Threshold**	**Average**	**Midwest**	**West**	**Finance**	**Trans/Comm/Utilities**
2018	$ 10,200	17%	9%	25%	5%	27%
2019	$ 10,464	18%	10%	28%	5%	30%
2020	$ 10,630	21%	11%	32%	5%	35%
2021	$ 10,799	24%	12%	36%	5%	39%
2022	$ 10,970	27%	14%	40%	5%	43%
2023	$ 11,145	30%	15%	44%	6%	47%
2024	$ 11,322	33%	17%	48%	6%	51%
2025	$ 11,501	36%	19%	52%	6%	55%
2026	$ 11,684	39%	20%	56%	6%	59%
2027	$ 11,870	42%	22%	59%	7%	62%
2028	$ 12,058	45%	24%	63%	7%	65%
2029	$ 12,249	48%	26%	66%	7%	68%

Table 4 – Single plans exceeding threshold

Selected Percentages of Family Plans Exceeding Threshold						
Year	**Threshold**	**Average**	**Midwest**	**West**	**Manufacturing**	**Trans/Comm/Utilities**
2018	$ 27,500	10%	5%	15%	3%	32%
2019	$ 28,212	14%	7%	21%	4%	42%
2020	$ 28,660	17%	9%	27%	7%	53%
2021	$ 29,115	23%	12%	36%	8%	63%
2022	$ 29,577	28%	13%	44%	11%	72%
2023	$ 30,047	34%	17%	52%	14%	79%
2024	$ 30,524	39%	19%	59%	16%	85%

2025	$ 31,009	45%	22%	66%	19%	89%
2026	$ 31,501	51%	26%	73%	23%	93%
2027	$ 32,001	56%	29%	78%	26%	95%
2028	$ 32,509	62%	33%	82%	30%	97%
2029	$ 33,026	67%	37%	86%	35%	98%

Table 5 – Family plans exceeding threshold

Elasticity calculations

A simple price elasticity of demand of health insurance in the form of employer offer rate used in the model and denoted e_o is calculated using the change in premium prices and offer rates of employer-sponsored health insurance from 2008 to 2013, using both KFF and MEPS data. Although this elasticity varies by region, industry, and firm size, the average elasticities of individual and family plans are -0.38 and -0.33, respectively. These findings are further supported by the generally accepted health economic theory that health insurance is price inelastic (Liu & Chollet, 2006). Detailed elasticity figures can be found in Appendix B.

Calculating the elasticity of health care demand in the form of expenditures with respect to the price of health insurance involved formulating the regression model to predict health care expenditures across individuals which was discussed previously.

IV. MODEL

Processes and formulas

The model essentially consists of a series of economic computations which render the change in demand for health insurance as well as the change in health care expenditures as a result of the implication of the excise tax. Once the percentage of plans above the threshold is calculated for years 2018 to 2029, as shown previously, the average plan above the threshold is calculated using a variation of the normal cumulative distribution function

$$x_y = \sqrt{\sum_{k=0}^{\infty} \frac{c_k}{2k+1} \left(\frac{\sqrt{\pi}}{2} \left(1 - p_y\right) \right)^{2k+1} \left(2\sigma^2\right)} + \mu_y ,$$

where $$c_k = \sum_{m=0}^{k-1} \frac{c_m c_{k-1-m}}{(m+1)(2m+1)}$$

and x_y is the average premium cost over the threshold in year y, p_y is the percentage of plans above the threshold in year y, σ is the standard deviation of the premium cost distribution, and μ_y is the average premium cost in year y.

The average tax per premium above the threshold t_y in year y is then calculated by

$$t_y = .4(x_y - T_y),$$

and the percent change in average premium cost due to the tax c_y in year y is calculated by

$$c_y = \frac{p_y t_y}{\mu_y}.$$

The last part of the model involves determining the subsequent change in employer offer rates and health care expenditures for individuals and families with employer-sponsored health insurance. After both the percent change in average premium cost due to the tax c_y and the price elasticity of demand of health insurance e_o are known, calculating the percent change in offer rate o_y in year y involves a variation of the elasticity formula

$$o_y = c_y e_o.$$

Similarly, to calculate the change in health care expenditures, the formula

$$h_y = c_y e_h$$

is used, where h_y is the percent change in health care expenditures and e_h is the elasticity of health care with respect to the price of health insurance.

IV. RESULTS

The changes in offer rates and consumption returned by the model are mutually exclusive; that is, changes in the offer rate preclude any change in consumption, and consumption changes preclude any change in the offer rate. In reality, however, because the tax may cause some combination of the two, the results should be treated as extreme cases.

Changes in employer offer rate

Upon the introduction of the excise tax and barring any change in health care consumption, businesses across the nation should expect to see a .42% decrease in offer rates of single plans and a .48% decrease in offer rates of family plans. By 2029, these figures will increase in magnitude to 1.92% and 2.45%, respectively. Recall that the price elasticity of the offer rate is inelastic, so these changes are brought about by larger relative changes in average premium prices.

Some discrepancies in offer rate changes between firm sizes, regions, and industries should be noted. In accordance with previous research, smaller firms indeed exhibit a lower elasticity than larger firms and therefore are less flexible in their response to higher premium prices (Liu & Chollet, 2006). Perhaps this is because larger employers, defined here as those that employ 200 or more workers, face a kind of economy of scale in managing their employees' health insurance benefits. Larger employers should be more adept at analyzing costs and benefits of offering insurance and operating at the margin, whereas smaller employers can benefit from starting or stopping offering insurance only when premiums experience a dramatic change in cost.

There is significant offer rate change variation between industries. Businesses in the manufacturing, retail, and finance sectors should expect to see the smallest decrease in health insurance offer rates, and the transportation, communication, and utilities and state and local government sectors will be the hardest hit. These discrepancies are due mostly to growth rate differences rather than elasticity differences between industries. Regardless, they should raise concern, as the adverse effect of the tax on certain industries might represent a violation of the equity of the tax. The IRS is yet to issue guidance on the tax, but should certainly take these discrepancies into consideration.

Firms in the West and Northeast will be more affected than firms in the Midwest, but this should only raise concern if higher premiums in the West and Northeast are caused by cost-of-living differentials. In such a case, policymakers should provide a cost-of-living adjustment to thresholds.

	Single, 2018	Single, 2029	Family, 2018	Family, 2029
Average	-.42%	-1.92%	-.48%	-2.45%
Small Firms	-.33%	-1.67%	-.31%	-2.15%
Large Firms	-.46%	-2.03%	-.56%	-2.58%
Northeast	-.52%	-1.79%	-.74%	-2.76%
Midwest	-.26%	-1.01%	-.32%	-1.70%
South	-.38%	-2.06%	-.41%	-2.43%
West	-.58%	-2.72%	-.59%	-2.93%
Ag/Mining/Const.	-.31%	-2.24%	-.27%	-1.89%
Manufacturing	-.10%	-.31%	-.21%	-1.53%
Trans/Comm/Utilities	-.64%	-2.87%	-.90%	-3.60%
Wholesale	-.21%	-1.11%	-.38%	-2.08%
Retail	-.12%	-.66%	-.15%	-1.39%
Finance	-.21%	-.33%	-.43%	-1.80%
Service	-.56%	-2.61%	-.52%	-2.50%
St/Loc Government	-.66%	-1.76%	-.50%	-2.38%
Health Care	-.65%	-2.62%	-.73%	-3.02%

Table 6 – Changes in offer rate by firm size, region, and industry

Changes in health care expenditures

The changes in health care expenditures generally follow the same trend as changes in the offer rate, although they are relatively smaller because expenditures are less elastic than the offer rate. Recall that these expenditure changes assume that the employer offer rate remains constant. In 2018, national health care expenditures of individuals who have employer-sponsored insurance will decline by .07% for

policyholders of single plans and by .06% for policyholders of family plans. Note that these expenditure changes are compared to a baseline of expenditures in the absence of the excise tax, not in the absence of the Affordable Care Act. In fact, the Centers for Medicare & Medicaid Services estimate that in 2018, the PPACA will actually increase private insurance and out-of-pocket expenditures by 7.2% (CMS, 2012).

	Single, 2018	Single, 2029	Family, 2018	Family, 2029
Average	-.07%	-.33%	-.06%	-.43%
Small Firms	-.06%	-.28%	-.31%	-.43%
Large Firms	-.08%	-.35%	-.11%	-.51%
Northeast	-.08%	-.26%	-.14%	-.52%
Midwest	-.03%	-.13%	-.05%	-.27%
South	-.07%	-.40%	-.09%	-.51%
West	-.12%	-.58%	-.14%	-.71%
Ag/Mining/Const.	-.07%	-.52%	-.05%	-.34%
Manufacturing	-.01%	-.03%	-.03%	-.25%
Trans/Comm/Utilities	-.14%	-.63%	-.26%	-1.05%
Wholesale	-.03%	-.17%	-.07%	-.37%
Retail	-.02%	-.09%	-.02%	-.23%
Finance	-.02%	-.02%	-.06%	-.27%
Service	-.12%	-.54%	-.10%	-.49%
St/Loc Government	-.08%	-.22%	-.09%	-.44%
Health Care	-.12%	-.50%	-.16%	-.68%

Table 7 – Changes in expenditures by firm size, region, and industry

V. LIMITATIONS

Because the model is rather unconventional, the reader should fully realize its limitations when considering its results. The model is somewhat narrow and generalizes employer and policyholder behavior with specific elasticities, meaning sensitivity analysis is important. Employers and policyholders will do what they must to avoid the tax, and evidence of such premium cost-containing measures has been documented. Indeed, employers stretch their price elasticity of health insurance by implementing wellness management through collecting employees' biometric information, conducting health risk assessments, and offering gym membership discounts, a variety of personal health programs, and resources for healthy living (Mercer, 2011).

There are specific limitations to both the offer rate and health care consumption elasticities. The former elasticity does not take into account the employer mandate, which requires larger businesses to provide affordable health insurance benefits to their employees or face a penalty. The offer rate changes provided here therefore represent the scenario under which firms do not change their behavior because of the employer mandate. The prospect of a penalty would perhaps decrease the opportunity cost of offering health insurance and therefore decrease the offer rate elasticity as well, suggesting that the current estimate is high. A sensitivity analysis is thus in order to demonstrate more realistic outcomes, as shown in Table 8.

Changes In Employer Offer Rate Sensitivity Analysis				
Offer Rate Elasticities	Average Single Plan, 2018	Average Single Plan, 2029	Average Family Plan, 2018	Average Family Plan, 2029
-0.0012	0.00%	-0.01%	0.00%	-0.01%
-0.0062	-0.01%	-0.05%	-0.02%	-0.07%
-0.0208	-0.04%	-0.16%	-0.05%	-0.22%
-0.0521	-0.10%	-0.40%	-0.13%	-0.54%
-0.1041	-0.20%	-0.79%	-0.26%	-1.08%
-0.1736	-0.33%	-1.32%	-0.43%	-1.81%
-0.2480	-0.47%	-1.89%	-0.62%	-2.58%
-0.3100	-0.58%	-2.36%	-0.77%	-3.23%
-0.3444	-0.65%	-2.62%	-0.86%	-3.59%

Table 8 – Offer rate sensitivity analysis

The magnitude of the actual offer rate change is considerably unclear because of the uncertainty of employer response to the tax. In fact, Dr. Ezekiel J. Emanuel, who served as a health policy advisor to the Obama administration and helped design the legislation, believes that the offer rate will decline to 20 percent by 2025, which represents a reduction of more than 50% in the baseline rate (Mandelbaum, 2014). This reduction, however, will not be due to the excise tax so much as to the affordability of premiums in the private exchange, a variable exogenous to this study. Indeed, there are other factors affecting offer rate and consumption that are larger than the excise tax.

The change in health care expenditures not only represents a scenario under which the offer rate remain constant, but also a scenario under which the elasticity of expenditures with respect to the price of insurance is independent of the price of health insurance. That is, using a constant elasticity of .066 assumes that policyholders of high cost plans respond identically to policyholders of less expensive plans when faced with similar relative changes in price. This elasticity may be understated because some policyholders of more generous plans might generally be more responsive to changes in price. The resulting changes in expenditures, then, could be understated. Limitations in the MEPS-HC dataset also led to limitations in the model. The main explanatory variable of interest, the log-transformed out of pocket expenditures, does not entirely reflect the actual variable of interest, namely, the premium cost. Although this figure could be considered a proxy and therefore be sufficient in predicting the dependent variable, the availability of the actual premium cost would improve the validity of this elasticity.

VI. CONCLUSION AND EXTENSIONS

The excise tax on high cost employer-sponsored health coverage is one of many pieces of legislation which further the goals of the much broader health care reform. These provisions are many times interdependent and are difficult to analyze outside the context of their counterparts; however, doing so is crucial in justifying their inclusion and implementation. Although the success or failure of the excise tax cannot presently be ascertained, the projection of its impact is vital to ensuring it will serve its purpose of raising revenue and reducing health costs, and to making adjustments to existing policy to verify that it achieves these purposes.

Some central figures in this model correspond with results of previous studies, bolstering the validity of this study. Herring & Lentz predict that 16% of plans will incur the tax in 2018, while 75% of

plans will incur the tax in 2029, and I predict this figure to be between 10% and 17% in 2018 and 48% and 67% in 2029. Individual and family plan offer rate price elasticity computations of -0.38 and -0.33, respectively, closely resemble the central tendency of previous studies of -.6.

The relative changes in offer rate and health care expenditures are closely related, and display notable discrepancies across plan types and industries. Policyholders of single plans will be less responsive to the tax than policyholders of family plans, decreasing their expenditures by .07% and .33% in 2018 and 2029, respectively, while policyholders of family plans will see expenditure decreases of .06% and .43%, respectively. In this study, this discrepancy does not raise significant concerns regarding the horizontal equity of the tax because policyholders of family plans in the MEPS-HC dataset earned, on average, $29,019 more in family income than policyholders of single plans. Rather, consideration of the equity of the tax should focus around the discrepancies in offer rate and consumption changes between industries. Businesses in the manufacturing, retail, and finance sectors should expect to see decreases of .10%, .12%, and .21% in offer rates in 2018, and the transportation, communication, and utilities and state and local government sectors will experience decreases of .64% and .66% in 2018. These differentials will increase in the following decade.

It is the responsibility of policymakers to ensure that the tax does not adversely affect premiums that are high cost because of risk factors, and would do well to consider or conduct studies such as this.

The model can easily be updated and improved upon with future surveys released by the Kaiser Family Foundation and the Medical Expenditure Panel Survey Household Component. As the results of the model are highly conditional upon historical growth trends, inclusion of updated datasets would improve the validity of the model by orders of magnitude. The availability of certain measures, namely the entire premium cost across individuals in the MEPS-HC dataset would ensure a more accurate elasticity.

If indeed the model holds true, the tax will face serious public opposition. If, by 2029, over half of employer-sponsored plans are subject to the tax, the tax will be extremely visible. In the past, the public has been very protective of the tax expenditure on employer-sponsored health insurance and has vehemently opposed its reduction. Because the excise tax is somewhat of a reversal of the tax expenditure, the public would be expected to react in the same way as to a reduction in the tax expenditure. The excise tax, however, is a more politically deft policy, as it targets insurance companies

as the actual remitters of the tax, although the burden will still be borne by individuals and employers in the form of higher premiums. Depending on the severity of the tax, legislators may be forced to again delay its implementation or perhaps reduce its rate.

The future of the excise tax is uncertain, but models like this pave the way for forthcoming analysis and provide a theoretical basis on which to enhance and expand upon. Having the capacity to estimate the impact of the tax on offer rate and consumption is valuable in predicting its success or failure, and analyzing the provision separately from the comprehensive legislation allows for justification of its inclusion in health reform. Although now we are restricted to a dimly-lit vision of the future, the continuation of such analyses illuminates and clarifies our sight.

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APPENDIX A

Threshold & Percentage of Plans Exceeding, Single						
Year	**Threshold**	**Average**	**Small Firms**	**Large Firms**	**Northeast**	**Midwest**
2018	$ 10,200.00	17%	14%	18%	17%	9%
2019	$ 10,463.97	18%	15%	20%	18%	10%
2020	$ 10,630.13	21%	18%	23%	20%	11%
2021	$ 10,798.92	24%	20%	26%	23%	12%
2022	$ 10,970.40	27%	23%	29%	25%	14%
2023	$ 11,144.60	30%	26%	32%	27%	15%
2024	$ 11,321.57	33%	29%	35%	29%	17%
2025	$ 11,501.35	36%	32%	38%	32%	19%
2026	$ 11,683.98	39%	35%	41%	34%	20%
2027	$ 11,869.51	42%	38%	44%	37%	22%
2028	$ 12,057.99	45%	41%	47%	39%	24%
2029	$ 12,249.46	48%	44%	50%	41%	26%

Threshold & Percentage of Plans Exceeding, Single						
Year	**Threshold**	**South**	**West**	**Ag/Mining/Const.**	**Manufacturing**	**Trans/Comm/Utilities**
2018	$ 10,200.00	17%	25%	17%	3%	27%
2019	$ 10,463.97	19%	28%	20%	3%	30%
2020	$ 10,630.13	22%	32%	24%	4%	35%
2021	$ 10,798.92	26%	36%	28%	4%	39%
2022	$ 10,970.40	29%	40%	33%	4%	43%
2023	$ 11,144.60	33%	44%	37%	5%	47%
2024	$ 11,321.57	36%	48%	42%	5%	51%
2025	$ 11,501.35	40%	52%	46%	6%	55%
2026	$ 11,683.98	43%	56%	50%	6%	59%
2027	$ 11,869.51	47%	59%	54%	7%	62%
2028	$ 12,057.99	50%	63%	58%	8%	65%
2029	$ 12,249.46	54%	66%	62%	8%	68%

Threshold & Percentage of Plans Exceeding, Single							
Year	**Threshold**	**Wholesale**	**Retail**	**Finance**	**Service**	**St/Loc Govt**	**Healthcare**
2018	$ 10,200.00	9%	5%	5%	24%	18%	25%
2019	$ 10,463.97	10%	5%	5%	27%	19%	27%
2020	$ 10,630.13	11%	6%	5%	30%	21%	31%
2021	$ 10,798.92	13%	7%	5%	34%	22%	34%
2022	$ 10,970.40	15%	9%	5%	38%	24%	38%
2023	$ 11,144.60	17%	10%	6%	42%	26%	41%
2024	$ 11,321.57	19%	11%	6%	46%	28%	45%
2025	$ 11,501.35	21%	13%	6%	50%	30%	48%
2026	$ 11,683.98	24%	14%	6%	53%	31%	52%
2027	$ 11,869.51	26%	16%	7%	57%	33%	55%
2028	$ 12,057.99	28%	18%	7%	60%	35%	58%
2029	$ 12,249.46	31%	20%	7%	63%	37%	61%

Threshold & Percentage of Plans Exceeding, Family						
Year	**Threshold**	**Average**	**Small Firms**	**Large Firms**	**Northeast**	**Midwest**
2018	$ 27,500.00	10%	6%	12%	16%	5%
2019	$ 28,211.68	14%	9%	16%	20%	7%
2020	$ 28,659.65	17%	12%	20%	24%	9%
2021	$ 29,114.75	23%	16%	26%	30%	12%
2022	$ 29,577.06	28%	21%	31%	35%	13%
2023	$ 30,046.72	34%	26%	37%	41%	17%
2024	$ 30,523.84	39%	31%	43%	46%	19%
2025	$ 31,008.53	45%	37%	48%	51%	22%
2026	$ 31,500.92	51%	43%	54%	56%	26%
2027	$ 32,001.13	56%	48%	59%	61%	29%
2028	$ 32,509.28	62%	54%	64%	65%	33%
2029	$ 33,025.50	67%	59%	69%	70%	37%

Threshold & Percentage of Plans Exceeding, Family						
Year	**Threshold**	**South**	**West**	**Ag/Mining/Const.**	**Manufacturing**	**Trans/Comm/Utilities**
2018	$ 27,500.00	8%	15%	5%	3%	32%
2019	$ 28,211.68	13%	21%	6%	4%	42%
2020	$ 28,659.65	16%	27%	8%	7%	53%
2021	$ 29,114.75	21%	36%	12%	8%	63%
2022	$ 29,577.06	27%	44%	14%	11%	72%
2023	$ 30,046.72	34%	52%	20%	14%	79%
2024	$ 30,523.84	40%	59%	23%	16%	85%
2025	$ 31,008.53	46%	66%	28%	19%	89%
2026	$ 31,500.92	53%	73%	33%	23%	93%
2027	$ 32,001.13	59%	78%	38%	26%	95%
2028	$ 32,509.28	64%	82%	43%	30%	97%
2029	$ 33,025.50	70%	86%	47%	35%	98%

Threshold & Percentage of Plans Exceeding, Family							
Year	**Threshold**	**Wholesale**	**Retail**	**Finance**	**Service**	**St/Loc Govt**	**Healthcare**
2018	$ 27,500.00	7%	2%	7%	11%	10%	18%
2019	$ 28,211.68	9%	3%	8%	15%	14%	26%
2020	$ 28,659.65	12%	4%	11%	18%	18%	31%
2021	$ 29,114.75	15%	8%	15%	23%	21%	38%
2022	$ 29,577.06	18%	8%	16%	29%	25%	45%
2023	$ 30,046.72	24%	11%	19%	35%	31%	52%
2024	$ 30,523.84	28%	13%	21%	40%	36%	59%
2025	$ 31,008.53	32%	16%	24%	46%	41%	65%
2026	$ 31,500.92	37%	20%	27%	52%	46%	71%
2027	$ 32,001.13	42%	23%	30%	57%	51%	76%
2028	$ 32,509.28	46%	27%	34%	62%	56%	80%
2029	$ 33,025.50	51%	31%	37%	67%	61%	84%

APPENDIX B

Offer Rate Elasticity by Firm Size and Region, 2008-2013							
	Average	All Small Firms	All Large Firms	Northeast	Midwest	South	West
Single	-0.38	-0.39	-0.38	-0.45	-0.51	-0.34	-0.31
Family	-0.33	-0.33	-0.33	-0.35	-0.42	-0.31	-0.27

Offer Rate Elasticity by Industry, 2008-2013					
	Average	Ag/Mining/Construction	Manufacturing	Trans/Comm/Utilities	Wholesale
Single	-0.38	-0.28	-0.66	-0.30	-0.44
Family	-0.33	-0.36	-0.40	-0.22	-0.37

Offer Rate Elasticity by Industry, 2008-2013						
	Average	Retail	Finance	Service	State/Local Gov't	Healthcare
Single	-0.38	-0.48	-0.87	-0.32	-0.53	-0.34
Family	-0.33	-0.39	-0.44	-0.33	-0.35	-0.29