Did the ACA Inject a Healthy Dose of Discipline in the U.S. Health Insurance Market?

Abstract

The complex and opaque nature of health insurance is often seen as being anti-consumer, and the Affordable Care Act (ACA) sought to decrease this complexity in order to create a more transparent market. We examine the efficacy of the legislation on the industry for both price and quantity with two risk measures: surplus volatility and insurer rating. Our findings extend prior research on market discipline in several ways. First, we present evidence that health insurers with lower risk are able to command higher prices for their products. Second, we find changes in financial strength are more notable for drops below "A-" than other ratings. Finally, we analyze the industry dynamics before and after the ACA and find that post-ACA the health insurance market exhibits more market discipline.

Keywords: Market Discipline, Insolvency Risk, Financial Strength, Regulation, Health Insurance, Affordable Care Act

JEL classification:

1. Introduction

The United States health insurance industry has long been a dynamic market for both buyers and sellers. From plan variations, managed care networks, public programs, and numerous legislative amendments, the industry itself is quite distinct from other financial institutions. Since 2010 much of the public policy focus has been on patient outcomes and transparency – indeed many of the legal requirements of recent policy were centered around patient welfare and open plan offerings.[1] We analyze the extent the Affordable Care Act's dedication to transparency and consumer choice affected the health insurance industry and provide empirical evidence of the legislative outcomes with respect to market discipline.

Market discipline has often been analyzed within the spectrum of firm risk and market price sensitivity (Avery, Belton, and Goldberg, 1988; Lane, 1993). The effect of insolvency risk has been shown to impact firm perceptions in banking and property-casualty insurance markets (Flannery and Sorescu, 1996; Sommer, 1996). For banks, the potential for decreased market discipline via decreased risk sensitivity of demand stems from deposit insurance. For insurers, the source of less market discipline stems from guaranty funds, state-managed liability accounts designed to pay policyholders in the event of insurer insolvency.[2] The traditional view of market discipline generally focuses on what discipline the private market can provide in lieu of legislative intervention. Our research, however, extends upon this by offering evidence on the outcomes of public policy changes on market discipline. Specifically, we analyze the United States Health Insurance industry pre- and post-Affordable Care Act to identify the effects of the legislation on the sensitivity of policy demand to firm risk.

While the majority of the debate surrounding the Affordable Care Act (ACA) focuses on implementation, welfare outcomes, or potential changes to the legislation, we analyze

[1] In particular, Section 1311 of the Affordable Care Act seeks transparency in the market with the primary goal of broadening consumer choice.

[2] New York is the only state that utilizes a funded reserve account for state insurer insolvencies.

market discipline in the health insurance market before and after the ACA. From the purview of product demand and firm risk we find lower–risk health insurers are able to command higher prices than their higher–risk counterparts, consistent with market discipline theory. Additionally we note changes in A.M. Best ratings are more notable for drops below "A-" Finally, the data suggest that post the ACA the health insurance industry exhibits relatively more market discipline with respect to changes in financial ratings and price.

Our analyses result in several significant contributions to the literature. First, we provide evidence as to the efficacy of the ACA with respect to market discipline dynamics. Second, we are the first to our knowledge to provide evidence of the existence of market discipline in the United States health insurance industry. Third, we are the first to analyze market discipline dynamics pre- and post- regulatory regime changes, providing evidence on the effect regulatory scrutiny has on market discipline. Finally we are the first, to our knowledge, to analyze both quantity and price sensitivity to firm volatility and financial strength in the health insurance setting.

The remainder of the paper proceeds as follows. In the *Market Discipline and Insolvency Measures* section we provide an overview of our measures of risk, price, and demand for the U.S. health industry. In the *Institutional Background* section we provide background related to health insurers and the Affordable Care Act. In the *Hypothesis Development* section we construct testable hypotheses. In the *Empirical Strategies* section we describe the equations implemented to test our hypotheses, and in *Results* we present the outcomes of our analyses. And finally, the *Conclusion* section provides a brief overview of our empirical findings and future research avenues.

2. Market Discipline and Insolvency Risk Measures

In this portion of the paper we discuss our definitions of market discipline, price, quantity, and insolvency. Additionally we provide our metrics for insolvency risk – one based on option pricing theory and a complementary metric based on health insurer financial strength ratings.

Market discipline requires that firms have incentives to set prices and take action to avoid their potential insolvency, with the necessary condition that prices and quantity are negatively related to firm risk – a demand sensitivity with respect to firm risk. As a result the risk firms choose to take on are priced in by the market, and product demand would react accordingly. If this necessary condition regarding risk and demand are met, by way of price and/or quantity changes, then market discipline exists. We now define our price, quantity, and risk metrics.

2.1. Price

Sommer (1996) defines the price of insurance products as the discounted value of liabilities less a financial put. This option pricing model is heavily influenced by the previous work of Winter (1991), Berger, Cummins, and Tennyson (1992), and Cummins and Danzon (1997), and predicts that greater insolvency risk leads to a higher put option value of the insurance product. Thus, if the price of an insurance product represents the true value of the product then riskier firms should receive lower prices per product, *ceteris paribus.*

However, pricing for insurers is often difficult to disentangle from the premiums charged by the firm (Epermanis and Harrington, 2006; Harrington and Danzon, 1994). For insurance products the true cost is not known until well after the premiums have been set. Long-tail risk lines found in property-casualty insurance, along with the long term products offered by life insurers tend to create a need for cost and price estimation. This inherently results in a product with uncertain long term costs, and estimation based pricing. For health insurers the opacity is increased by managed care network systems that add a new layer of complexity on an already dense insurer/provider market.[3] Therefore the health insurance

[3]Many consumer advocacy groups critiqued managed care plans for increasing policyholder uncertainty, and HMO/PPO plans have been shown to lead to customer confusion and disorganization (Rodwin, 1996; Root and Stableford, 1999).

industry is historically prone opacity, not unlike other financial institutions like banking, property-casualty insurance, and life insurance.

Harrington and Danzon (1994) use loss forecast revisions as a proxy for (inadequate) pricing. Epermanis and Harrington (2006) capture abnormal changes in premium growth following A.M. Best rating downgrades as a proxy for changes in price. However this metric cannot truly tease out the difference between price and quantity. We therefore utilize the method of Cummins and Xie (2008), and calculate price as the sum of premium and investment inflow minus change in reserve and then divided by change reserve [4], smoothed in order to mitigate the effect of outliers.[5]

2.2. Quantity

Epermanis and Harrington (2006) analyze market discipline within the property-casualty insurance industry by examining the correlation between premiums written and changes in financial strength ratings. The authors further acknowledge the difficult task of separating premium changes from quantity or price changes, and therefore calculate changes in net premiums written as their proxy for quantity demand changes. The data limitations the authors face in their study are an artifact of the National Association of Insurance Commissioners (NAIC) statutory requirements for property-casualty insurers. Fortunately these same limitations do not exist in our sample, and we are able to analyze policies in force for health insurers. Our proxy for quantity is the number of new policies issued during the year, scaled by premiums.[6]

[4]Cummins and Weiss (2000) define change in reserve as "output" for the efficiency analysis and is from line 20 of NAIC statements page ANALYSIS OF OPERATIONS BY LINES OF BUSINESS.

[5]Specifically, the measure is the sum of inflow from line 9 of the NAIC statements page ANALYSIS OF OPERATIONS BY LINES OF BUSINESS, and smoothed as with Cummins and Xie (2008).

[6]Our results are consistent when scaling policies by assets as well as surplus.

2.3. Risk Measures

Our first risk measure is based on firm capital allocation as a proxy for insolvency risk. For insurers, capital standards and ratios are used by regulators to regulate the industry as a whole, and provide an indicator of firm capital management. Insurers have been subject to several financial monitoring regimes, from Insurance Regulatory Information Systems (IRIS) ratios, Financial Analyst Solvency Tools (FAST), and Risk Based Capital (RBC) requirements. We focus on capital risk as IRIS ratios were declared inadquate in 1992, and the subsequent FAST scoring systems are not publicaly available. Additionally, the (NAIC) still enforces uniform RBC standards across life, health, and property casualty insurers. Since the health insurance industry is a dynamic market, Klein (2012) notes many financial ratios only capture a static representation of firm solvency. In order to mitigate this static effect we calculate one year changes across our two risk metrics.

In order to capture volatility risk, we utilize the option pricing model proposed by Cummins and Sommer (1996) and empirically examined by Sommer (1996), which focuses on firm capital allocation. This model views the value of an insurance product as a financial put that recognizes firm default risk. This results in a pricing model that represents the market value of insurance to the policyholder. The model proposed interprets the value of an insurance product (D) as a function of firm liability (L) and a financial put (Put), such that:

$$D = Le^{-r^{*}\tau} - Put(A, L, \sigma, \tau) \tag{1}$$

where $A =$ assets of the firm;

$L =$ liabilities of the firm;

$r^* =$ the risk-free interest rate, r_f, minus the inflation rate for insurance liabilities, r_L;

$\sigma^2 =$ the insurer's risk parameter $= \sigma_A^2 + \sigma_L^2 - 2\,\rho\,\sigma_A\,\sigma_L$; and

$Put(A, L, \sigma, \tau) =$ standard put option with an exercise price of L, volatility σ, and time to expiration τ.

For our purposes the variance of the underlying put option, denoted σ, is the risk of insolvency for the firm offering the policy. This metric is consistent with insolvency risk, as the partial effect of firm risk, σ, is negative with respect to the market value, D. Specifically we use the volatility of the put option further defined by Cummins and Sommer (1996) as our first risk measure. The model is as follows:

$$\sigma^2 = \sigma_A^2 + \sigma_L^2 - 2\,\rho\,\sigma_A\,\sigma_L \tag{2}$$

where σ_A^2 represents the variance of return on assets;

σ_L^2 represents the variance of liability returns; and

ρ represents the correlation between return on assets and return on liabilities.

Using this model of put option volatility, our first measure of firm risk is therefore the full variance of the option, σ^2.

Our second risk measure is firm financial rating. Because our first measure of firm risk is less direct and not publicly available, it does not fully capture the information available to consumers participating in the market. However, firm ratings are publicly available to all market participants and provide a straightforward representation of overall firm risk. Additionally, ratings agencies consider more than just financial information to give potential consumers a complete view of a firm's risk (Pottier, 2007). Therefore, we include firm financial ratings as a measure of firm risk.

3. Institutional Background

The United States Health Insurance industry is unique in many ways. First, the industry is composed of a combination of both private and public plan offerings, with some markets offering both.[7] Moreover U.S. healthcare has a storied past of regulation, attempts aimed to deal with the adverse selection that occurs due to the uniqueness of the demand for healthcare as opposed to other insurable risks. More recently, current regulation has focused on limiting health insurers when it comes to pricing and selection, resulting in new challenges for insurers when it comes to pricing strategy and plan offerings.[8]

For our research the most significant regulatory shifts stem from the ACA. A significant portion of the legislation was focused on the individual care market, though less than 6% of Americans receive healthcare by this avenue (Morrisey, 2013). Indeed, the implementations of the exchanges and the individual mandate were focused on reducing the uninsured rate, a goal the ACA has achieved with some success.[9] The combination of transparent policies,

[7] Medicare Part C, or Medicare Advantage, plans are private plans that generally offer the same or better coverage than Medicare parts A and B, allowing consumers to opt for priavet plns that meet Medicare requirements.

[8] For example, the ACA requires minimum medical loss ratios of 80% and 85% for single and group insurance plans, respectively.

[9] The uninsured rate in the United States dropped from 16% in 2009 to 9% in 2016 (Rejda and McNamara, 2017).

rate filing, underwriting limitations, policy requirements, and overall increased scrutiny on the industry result in a traditionally opaque market having a new light shining upon it.[10]

In 2014 the final consumer protection and individual mandates of the ACA were enforced, the states who chose to expand Medicaid opted to do so, and health plans that were not ACA-compliant were no longer renewable. The *ex-post* ACA provisions that have been changed, added, or removed since inception (e.g. open enrollment on the exchanges being reeduced to 6 weeks in 2017, exchange plans requiring dental coverage options in the same year, and the individual mandate being removed in 2019, respectively), are all alterations that are not captured in our ACA time period. A more comprehensive examination of the planned ACA legislation requirements (market or otherwise) can be found in Harrington (2010a) and further discussed in Harrington (2010b).

4. Hypothesis Development

4.1. Market Discipline

The first step of our analysis is examine the health insurance industry collectively and identify the existence (or lack) of market discipline. As we are the first to our knowledge to analyze demand sensitivity and risk within the industry, we approach the question with market discipline's existence as our *a priori*. Our first set of hypotheses therefore deal with the relationship between our risk metrics with respect to price and quantity demanded.

As we have two measures of insolvency risk, we present two sets of hypotheses. Our first measure of volatility, σ^2, is a more opaque measure when compared to publicly available A.M. Best Ratings, and is therefore tested separately. We also have two demand side measurements – price and quantity. This results in four hypotheses regarding market discipline.

Our first hypothesis is that insurers with higher overall firm risk will suffer a pricing

[10] The complex and opaque nature of health insurance is often seen as being anti-consumer, and the ACA sought to decrease the complexity of plan offerings on the exchanges.

penalty. First, since the opaque measure (σ^2) shows the insolvency risk level based on capital allocation, and our measure shows firm pricing power, we expect the correaltion between the σ^2 and price to be significant and negative, in accordance with the findings of Sommer (1996) for property–casualty insurers. Thus we describe Hypothesis 1 as follows:

> ***H1: Volatility Pricing Penalty Hypothesis****: The price of health insurance is negatively related to insurer insolvency risk, as measured by volatility (σ^2).*

Our next step is to test the relation between ratings and pricing, by utilizing A.M. Best ratings as a firm insolvency risk measure. We also expect price and ratings to be negatively related, and Hypothesis 2 is noted as:

> ***H2: Ratings Pricing Penalty Hypothesis****: The price of health insurance is negatively related to insurer insolvency risk, as measured by A.M. Best Rating.*

Our next set of hypotheses deals with the risk and quantity relationship. While overall we hypothesize risk and quantity should be negatively related, we still separate each proposition based on the transparency (or lack thereof) of our two risk metrics. Ultimately, health insurers with greater firm risk will suffer reduced demand. With respect to volatility, Hypotheses 3 and 4 are therefore written as:

> ***H3: Volatility Quantity Penalty Hypothesis****: The quantity of health insurance policies demanded is negatively related to insurer insolvency risk, as measured by volatility (σ^2).*

> ***H4: Ratings Quantity Penalty Hypothesis****: The quantity of health insurance policies demanded is negatively related to insurer insolvency risk, as measured by A.M. Best Rating.*

4.2. Regulation and Market Discipline

Since poor market discipline can stem from incomplete information, regulation has often been posed as a way to mitigate asymmetric information and therefore improve market dynamics (Lane, 1993). Within the framework of the U.S. health insurance industry, the ACA sought to increase consumer knowledge and offer a transparent market place in which individuals can compare and shop for health insurance. Specifically, Section 1311 of the ACA requires transparency in coverage including, but not limited to, claims payments, financial disclosures, enrollment data, ratings practices, cost sharing, subsidies, and waivers. Additionally, Section 1312 seeks to "empower consumer choice" in health insurance offerings in reference to section 1311. Therefore, the ACA could result in increased market discipline in the industry. However, since the individual market makes up such a small proportion of health insurance policies (Morrisey, 2013), the effect may be limited. Additionally, research has shown that even with regulation an industry may exhibit poor market discipline (Allen, Carletti, and Marquez, 2011). Therefore, we offer the following hypotheses regarding the effects of the ACA on health insurer market discipline:

H5a: *The implementation of the ACA improved market discipline in the health insurance industry.*

H5b: *The implementation of the ACA impaired market discipline in the health insurance industry.*

For market discipline to change, so too must the relationship between firm risk with respect to price and/or quantity. If there is a significant increase (decrease) in the negative effect firm risk has on price or quantity demanded, then market discipline has shifted relatively to be weaker (stronger). Specifically, if the effect of risk, either by volatility (σ^2) or A.M. Best Rating, has less (more) of a negative effect on quantity and/or price, then market discipline has decreased (increased) following the ACA.

5. Research Design

5.1. Data

Our firm-level data are collected from annual statutory filings made by health insurers to the National Association of Insurance Commissioners (NAIC) for the years 1996 and 2016. We exclude firms that have zero or negative assets, surplus, or premiums written. We also remove firms writing more than 50 percent of their business as life insurance and annuities.[11] We also require two years of lagged variables in our first models. Finally, we combine the NAIC dataset with the ratings data from A.M. Our final sample represents 2,314 firm-year observations, with an average of 121 surviving firms from 1996 to 2016. Summary statistics are reported in Table 1.

Our primary variables of interest are *Price*, *Quantity*, and *Risk*. *Price* is defined as the sum of total premium inflow and investment income divided by change in reserve. *Quantity* is specified as the number of new policies issued during the year scaled by premiums. Finally, *Risk* is represented in one of two ways - financial strength rating and volatility. The rating risk metric represents the insurer's ratings from A.M. Best, which is coded 1-14 for ratings A++ to E, respectively. The volatility risk measure represents the volatility of the surplus rate of return of the firm's surplus portfolio.[12]

We control for firm specifics in a number of ways. First, we isolate the effect of organizational form by accounting for group, public, and mutual structure. Single is a binary variable equal to one if insurer is not a member of a group and zero otherwise.[13] Public is

[11] The NAIC reports life and health insurers collectively which results in a large number of life and annuity writers in our original data. Additionally, many life (health) insurers own health (life) subsidiaries, and file cooperatively.

[12] Surplus is defined as assets less liabilities.

[13] Some insurers are organized in groups under a common ownership structure. For example, in 2014, Cigna Healthcare Group comprised numerous subsidiaries, such as Allegiance Life and Health Insurance

a binary variable indicating whether a firm is publicly traded or not. Mutual is a binary variable equal to one if an insurer is organized as a mutual in the given year and zero otherwise.[14] We control for size by taking the natural log of assets. National is a binary variable indicating whether a firm operates in more than 30 states. NYREG is a binary variable indicating whether a firm is domiciled in the state of New York. Grp and Cdt variable are binary variables indicating whether a firm is writing more than 50% of group (or credit) policies in health and accident business. We also include firm age, product herfindahl, and reinsurance utilization. We provide summary statistics for all variables used in our models in Table 1.

6. Empirical Strategies

6.1. Market Discipline

In order to test the existence of market discipline in the health insurance industry we follow Sommer (1996) and Cummins and Sommer (1996) and fit a two-stage least squares (2SLS) model with respect to price and volatility across our full sample from 1996 to 2016.

In first stage, we respectively regress endogenous variables, $Risk_{i,t-1}$ and capital to assets ratio, on their second-lagged values and other first-lagged control. Then, we use the fitted values from the first stage to fit the following primary model:

$$Price_{i,t} = \beta_0 + \beta_1 \cdot \widehat{Risk}_{i,t-1} + \beta_2 \cdot X_{i,t} + \beta_3 \cdot I_t + \epsilon_{i,t} \tag{3}$$

Company, Cigna Healthcare of Georgia, and Cigna Healthcare MidAtlantic. Annual statutory statements for health insurers are reported at the individual company level. Approximately 70 percent of our sample firms are group members.

[14]In addition to stock firms, the insurance industry also includes mutual organizations, where policyholders are the owners of the firm. This ownership structure creates different agency conflicts within mutual organizations versus the agency conflicts within stock firms (see, Cummins, Tennyson, and Weiss (1999) and Mayers and Smith Jr (1988)). Though mutual insurers are not common in the health insurance industry nor in our sample, we control for any heterogeneity across the groups accordingly.

$$Quantity_{i,t} = \beta_0 + \beta_1 \cdot \widehat{Risk}_{i,t-1} + \beta_2 \cdot X_{i,t} + \beta_3 \cdot I_t + \epsilon_{i,t} \tag{4}$$

Where *Price* is calculated as the sum of premium and investment inflow minus change in reserve and then divided by change in reserve, smoothed in order to mitigate the effect of outliers (Cummins and Xie, 2008). *Quantity* is the number of new polices issued during the year scaled by premiums. *Risk* is defined as either firm volatility, $sigma^2$, or A.M. Best Rating. X is a vector of firm specifics including a fitted endogenous variable, lagged capital to assets ratio, and I are year fixed effects. All model standard errors are clustered at the firm level, per the findings of Petersen (2009).

Models (3) and (4) above will enable us to isolate the effect of firm risk with respect to price and quantity demanded to test our hypotheses regarding market discipline and volatility in the health insurance industry. Specifically we are able to identify the effect opacity has on market discipline by testing *Risk* by way of volatility and A.M. Best Ratings.

6.2. Market Discipline and Regulation

We utilize a methodology similar to that of Berry-Stölzle, Nini, and Wende (2014).[15] In order to analyze the sensitivity of price and quantity with respect to firm risk following the ACA, we propose the following OLS equation:

$$\begin{aligned} Price_{i,t} = \beta_0^{'} &+ \textit{Pre-ACA} \cdot (\beta_1^{'} \cdot \widehat{Risk}_{i,t-1} + \beta_2^{'} \cdot X_{i,t}) \\ &+ \textit{Post-ACA} \cdot (\beta_3^{'} \cdot \widehat{Risk}_{i,t-1} + \beta_4^{'} \cdot X_{i,t}) + \epsilon_{i,t} \end{aligned} \tag{5}$$

[15]Berry-Stölzle, Nini, and Wende (2014) analyze the determinants and outcomes of capital issuance for life insurance in a pre- and post- crisis framework. We borrow from their models in order to test market discipline dynamics in the health insurance industry.

$$
\begin{aligned}
Quantity_{i,t} = \beta_0^{'} + Pre\text{-}ACA \cdot (\beta_1^{'} \cdot \widehat{Risk}_{i,t-1} + \beta_2^{'} \cdot X_{i,t}) \\
+ Post\text{-}ACA \cdot (\beta_3^{'} \cdot \widehat{Risk}_{i,t-1} + \beta_4^{'} \cdot X_{i,t}) + \epsilon_{i,t}
\end{aligned} \tag{6}
$$

Where *Pre-ACA* is an indicator variable equal to one in the year leading up to the passage of the ACA (1996-2010 in our sample). *Post-ACA* is an indicator equal to 1 for those years after the implementation of the ACA (2011-2016). *Price* is calculated as the sum of premium and investment inflow minus change in reserve and then divided by change in reserve, smoothed in order to mitigate the effect of outliers (Cummins and Xie, 2008). *Quantity* is the number of new polices issued during the year scaled by premiums. *Risk* is defined as either firm volatility, σ^2, or A.M. Best Rating. Finally, X is a vector of firm specifics. All model standard errors are clustered at the firm level, per the findings of Petersen (2009).

We follow these linear models by testing for significance across β_1 and β_2 for both firm volatility ($sigma^2$) and A.M. Best Rating. Using Wald tests to compare and contrast coefficients in the *Pre-ACA* and *Post-ACA* periods will allow us to test for significant changes in the sensitivity of *Price* and *Quantity* to firm risk. Specifically, if the Wald tests for coefficient differences indicate significant negative (positive) changes in β_1 and β_2 for risk, then our results would be consistent with more (less) health insurance market discipline following the ACA.

7. Results

7.1. Market Discipline

Tables 2 and 3 present the results of models 3 and 4, respectively. Table 2 presents the results of our analysis of price and risk sensitivity for the United States health insurance market. Column (1) is based on Sommer (1996) using our health insurer data, column (2) provides more control variables related to pricing, and column (3) uses A.M. Best rating as a measure of firm risk. Across all linear models we see a significant and negative relation between firm risk, whether by volatility or financial rating proxy, and price. These results are consistent with hypotheses 1 and 2, and are consistent with the existence of market discipline in the health insurance industry where pricing is concerned.

For quantity demanded, Table 3 provides the results of model 4. While we do not see a significant relation between our volatility metric and the number of new policies in force, we do see a negative relation between rating and quantity. These results are consistent with opacity theory, and do not oppose the existence market discipline in the health insurance industry when policy demand is taken into account. Overall, our results in Tables 2 and 3 are consistent with market discipline theory for our entire sample period.

7.2. Differential Rating Effect

As an alternative of coding the rating variable as discrete numbers from 1 to 14, we test for differential rating effect by treating *Risk* as an indicator of whether a firm is rated below certain threshold. Tables 4 and 5 present the results of this analysis. For Table 4, note an asymmetric response to ratings downgrades, specifically from "A" to "A-" and lower downgrades. For quantity demanded the results show a significant decrease in quantity with ratings downgrades, but only from "B+" to lower ratings.

7.3. Regulation

Tables 6 and 7 provide the results of models 5 and 6, respectively. We test for significant changes in the sensitivity relation between price and quantity with respect to firm risk, utilizing a methodology similar to that of Berry-Stölzle, Nini, and Wende (2014). Columns (3) and (6) for both tables indicate Wald test p-values for significant differences across coefficients in columns (1) and (2), and (4) and (5), respectively.

The price sensitivity pre- and post-ACA estimates are presented in Table 6, using both volatility and ratings proxies for firm risk. Column (3) presents the Wald test for differences in columns (1) and (2), while column (6) presents the same comparison for columns (4) and (5). We see no significant change in the effect firm volatility has on firm pricing post-ACA, but do find a significant difference for ratings changes and price post-ACA. The post-ACA effect is more negative, and consistent with increased pricing sensitivity with respect to ratings downgrades.

The quantity sensitivity pre- and post-ACA analysis is captured in Table 7, again using volatility and ratings as proxies for firm risk. Though we see a higher magnitude and changes in the significance of volatility's relation to firm price, the Wald test indicates significance at only the 10.7% level, and we therefore find no evidence of increased quantity sensitivity with respect to firm risk pre- and post-ACA.[16]

8. Conclusion

Prior literature shows market discipline exists in the property-casualty insurance industry. However for the health insurance industry there is little research on market discipline. We extend prior research on market discipline and health insurers in several ways. First, we present evidence that health insurers with lower risk are able to command higher prices for their products. Second, we find changes in financial strength are more notable for drops to "A-" than other ratings. Finally, we analyze the industry dynamics in the face of the Affordable Care Act (ACA) and find that post-ACA the health insurance market exhibits relatively more market discipline with respect to price sensitivity and ratings downgrades.

[16] It could very well be that the individual mandate, which required individuals purchase health insurance or pay a penalty, could have a strong effect on quantity demanded, weakening our results.

9. Tables

Table 1: Summary Statistics

Statistic	Mean	St. Dev.	Min	Max
PRICE	0.079	0.071	−0.081	0.301
QUANTITY	0.717	2.777	0.000	23.026
VOLATILITY	0.348	0.336	0.036	1.838
RATING	4.653	2.094	1	14
CAP	0.310	0.192	0.033	0.875
SIZE	19.216	1.984	14.590	25.469
STOCK	0.923	0.267	0	1
NATIONAL	0.630	0.483	0	1
SINGLE	0.162	0.369	0	1
NYREG	0.204	0.403	0	1
AGE	52.350	28.545	2.416	169.477
HERF	0.203	0.357	0.009	1.000
REINS	0.177	0.237	0.000	0.970
SPV	1.071	0.442	0.531	2.308
LGVBV	1.071	0.524	0.326	2.727
IP	0.014	0.041	−0.122	0.069
IMBY	0.040	0.013	0.018	0.063
GRP	0.496	0.500	0	1
CRDT	0.003	0.055	0	1
N = 2,462				

Note: This table reports summary statistics for our study. PRICE for health insurance is the sum of premiums and investment income minus change in reserve and then divided by change in reserve. QUANTITY is the number of new policies issued during the year scaled by premiums. VOLATILITY represents insolvency risk, which is the volatility of the surplus rate of return, treating each company as a portfolio of assets less liabilities. RATING is the life insurer ratings from A.M. Best, which is scaled 1-14 with A++:1 and E:14. CAP is the capital ratio defined as statutory capital divided by total assets. SIZE is calculated by taking natural log of total assets. In order to control the organization form, both mutual and stock firms are included. STOCK is equal to one for stock firms, zero otherwise. NATIONAL is equal to one if a firm is licensed in more than 30 states, zero otherwise. SINGLE is equal to one if a firm is not in any group, zero otherwise. HERF, Herfindahl index, is calculated at the group level according to the Group Code. As New York state is generally considered having relatively more stringent insurance regulation, we include the indicator variable NYREG coded equal to one if a firm is licensed in New York state. REINS is the ratio between reinsurance ceded and the sum of direct and assumed reinsurance of the year. AGE of a firm is calculated in terms of year from the starting of the business. IP is industrial production growth, calculated as $ln(P_t/P_{t-1})$, where P_t is industrial production index (U.S. Department of Commerce, Survey of Current Business). IMBY is intermediate term U.S. government bond yield taken from annual return of 10-year U.S. government bond (ticker: USGG10YR, Bloomberg). LGVBV is long-term government bond volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of long-term government bond yield. The yield used here is 30-year U.S. government bond yield (ticker: USGG30YR, Bloomberg). SPV is S&P 500 volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of Standard and Poor's 500 Stock Index (ticker: SPX, Bloomberg). The final sample consists of 2,462 firm-year observations of health insurers in the United States from 1996 to 2016.

Table 2: Price-Risk Sensitivity in the U.S. Health Insurance Market

	Dependent variable:		
	PRICE		
	(1)	(2)	(3)
lag1VOLATILITY.F	−0.035***	−0.035**	
	(0.013)	(0.014)	
lag1CAP.F	0.097***	0.092***	0.050**
	(0.023)	(0.024)	(0.024)
lag1RATING.F			−0.013***
			(0.002)
SIZE	0.013***	0.013***	0.004
	(0.003)	(0.003)	(0.003)
SINGLE	0.061**	0.061**	0.053*
	(0.026)	(0.026)	(0.027)
NATIONAL	−0.009	−0.007	−0.011
	(0.009)	(0.009)	(0.009)
NYREG	0.006	0.006	−0.002
	(0.011)	(0.011)	(0.010)
STOCK	0.032**	0.031**	0.026*
	(0.013)	(0.015)	(0.014)
HERF	−0.061**	−0.062**	−0.042
	(0.029)	(0.029)	(0.030)
AGE		−0.00004	0.0002
		(0.0002)	(0.0002)
lag1REINS		−0.010	−0.009
		(0.015)	(0.014)
GRP		0.003	−0.005
		(0.009)	(0.009)
CRDT		0.039*	0.038
		(0.024)	(0.025)
Year Fixed Effects	Yes	Yes	Yes
Firm Clustered Standard Errors	Yes	Yes	Yes
Observations	2,314	2,314	2,314
R^2	0.165	0.168	0.209

Note: This table reports summary statistics for our study. PRICE for health insurance is the sum of premiums and investment income divided by change in reserve . QUANTITY is the number of new policies issued during the year. VOLATILITY represents insolvency risk, which is the volatility of the surplus rate of return, treating each company as a portfolio of assets less liabilities. RATING is the life insurer ratings from A.M. Best, which is scaled 1-14 with A++:1 and E:14. CAP is the capital ratio defined as statutory capital divided by total assets. SIZE is calculated by taking natural log of total assets. In order to control the organization form, both mutual and stock firms are included. STOCK is equal to one for stock firms, zero otherwise. NATIONAL is equal to one if a firm is licensed in more than 30 states, zero otherwise. SINGLE is equal to one if a firm is not in any group, zero otherwise. HERF, Herfindahl index, is calculated at the group level according to the Group Code. As New York state is generally considered having relatively more stringent insurance regulation, we include the indicator variable NYREG coded equal to one if a firm is licensed in New York state. REINS is the ratio between reinsurance ceded and the sum of direct and assumed reinsurance of the year. AGE of a firm is calculated in terms of year from the starting of the business. IP is industrial production growth, calculated as $ln(P_t/P_{t-1})$, where P_t is industrial production index (U.S. Department of Commerce, Survey of Current Business). IMBY is intermediate term U.S. government bond yield taken from annual return of 10-year U.S. government bond (ticker: USGG10YR, Bloomberg). LGVBV is long-term government bond volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of long-term government bond yield. The yield used here is 30-year U.S. government bond yield (ticker: USGG30YR, Bloomberg). SPV is S&P 500 volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of Standard and Poor's 500 Stock Index (ticker: SPX, Bloomberg). The final sample consists of 2,462 firm-year observations of health insurers in the United States from 1996 to 2016.

Table 3: Quantity-Risk Sensitivity in the U.S. Health Insurance Market

	Dependent variable:	
	QUANTITY	
	(1)	(2)
lag1CAP.F	0.512	−0.019
	(0.996)	(0.924)
lag1VOLATILITY.F	−0.398	
	(0.365)	
lag1RATING.F		−0.168**
		(0.070)
SIZE	−0.253**	−0.362***
	(0.110)	(0.125)
SINGLE	0.244	0.121
	(1.785)	(1.786)
NATIONAL	−0.060	−0.102
	(0.347)	(0.353)
NYREG	0.169	0.072
	(0.278)	(0.285)
STOCK	−0.457	−0.509
	(0.493)	(0.489)
HERF	−0.225	0.045
	(1.908)	(1.908)
AGE	0.006	0.008
	(0.005)	(0.005)
lag1REINS	2.531**	2.545**
	(0.993)	(1.002)
GRP	−0.268	−0.358
	(0.230)	(0.243)
CRDT	11.197*	11.169*
	(6.345)	(6.392)
Year Fixed Effects	Yes	Yes
Firm Clustered Standard Errors	Yes	Yes
Observations	2,314	2,314
R^2	0.160	0.165

Note: This table reports summary statistics for our study. PRICE for health insurance is the sum of premiums and investment income minus change in reserve and then divided by change in reserve. QUANTITY is the number of new policies issued during the year scaled by premiums. VOLATILITY represents insolvency risk, which is the volatility of the surplus rate of return, treating each company as a portfolio of assets less liabilities. RATING is the life insurer ratings from A.M. Best, which is scaled 1-14 with A++:1 and E:14. CAP is the capital ratio defined as statutory capital divided by total assets. SIZE is calculated by taking natural log of total assets. In order to control the organization form, both mutual and stock firms are included. STOCK is equal to one for stock firms, zero otherwise. NATIONAL is equal to one if a firm is licensed in more than 30 states, zero otherwise. SINGLE is equal to one if a firm is not in any group, zero otherwise. HERF, Herfindahl index, is calculated at the group level according to the Group Code. As New York state is generally considered having relatively more stringent insurance regulation, we include the indicator variable NYREG coded equal to one if a firm is licensed in New York state. REINS is the ratio between reinsurance ceded and the sum of direct and assumed reinsurance of the year. AGE of a firm is calculated in terms of year from the starting of the business. IP is industrial production growth, calculated as $ln(P_t/P_{t-1})$, where P_t is industrial production index (U.S. Department of Commerce, Survey of Current Business). IMBY is intermediate term U.S. government bond yield taken from annual return of 10-year U.S. government bond (ticker: USGG10YR, Bloomberg). LGVBV is long-term government bond volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of long-term government bond yield. The yield used here is 30-year U.S. government bond yield (ticker: USGG30YR, Bloomberg). SPV is S&P 500 volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of Standard and Poor's 500 Stock Index (ticker: SPX, Bloomberg). The final sample consists of 2,462 firm-year observations of health insurers in the United States from 1996 to 2016.

Table 4: Price Model - Differential Rating Effect

	Dependent variable:						
	PRICE						
	x=A+	x=A	x=A-	x=B++	x=B+	x=B	x=B-
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
lag1CAP.F	0.081***	0.080***	0.069***	0.052**	0.059**	0.062**	0.072***
	(0.024)	(0.024)	(0.023)	(0.024)	(0.024)	(0.024)	(0.024)
I(lag1RATING.F >x)	0.085***	−0.003	−0.038***	−0.032***	−0.030***	−0.032***	−0.031***
	(0.019)	(0.026)	(0.011)	(0.011)	(0.008)	(0.007)	(0.007)
SIZE	0.013***	0.013***	0.009***	0.007**	0.008**	0.010***	0.011***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
SINGLE	0.072***	0.072***	0.072***	0.074***	0.077***	0.071***	0.058**
	(0.026)	(0.025)	(0.025)	(0.025)	(0.026)	(0.026)	(0.027)
NATIONAL	−0.008	−0.008	−0.005	−0.005	−0.008	−0.011	−0.010
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
NYREG	0.007	0.007	0.004	0.001	0.003	0.004	0.006
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
STOCK	0.025*	0.025*	0.021	0.021	0.024*	0.021	0.025*
	(0.015)	(0.015)	(0.016)	(0.015)	(0.014)	(0.014)	(0.015)
HERF	−0.071**	−0.071**	−0.071**	−0.069**	−0.067**	−0.064**	−0.056*
	(0.029)	(0.029)	(0.028)	(0.028)	(0.029)	(0.029)	(0.030)
AGE	−0.00003	−0.00003	0.00001	0.00002	0.00004	0.00003	0.00001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
lag1REINS	−0.013	−0.014	−0.016	−0.013	−0.012	−0.010	−0.010
	(0.015)	(0.015)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)
GRP	0.0002	0.0002	−0.0001	−0.003	−0.003	−0.0002	−0.0002
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
CRDT	0.046*	0.046*	0.048*	0.043	0.044	0.039*	0.043*
	(0.025)	(0.025)	(0.025)	(0.029)	(0.028)	(0.024)	(0.024)
Year Fixed Effects	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Clustered s.e.	*Firm*	*Firm*	*Firm*	*Firm*	*Firm*	*Firm*	*Firm*
Observations	2,314	2,314	2,314	2,314	2,314	2,314	2,314
R^2	0.147	0.146	0.175	0.173	0.168	0.168	0.159

Note: This table reports summary statistics for our study. PRICE for health insurance is the sum of premiums and investment income minus change in reserve and then divided by change in reserve. QUANTITY is the number of new policies issued during the year scaled by premiums. VOLATILITY represents insolvency risk, which is the volatility of the surplus rate of return, treating each company as a portfolio of assets less liabilities. RATING is the life insurer ratings from A.M. Best, which is scaled 1-14 with A++:1 and E:14. CAP is the capital ratio defined as statutory capital divided by total assets. SIZE is calculated by taking natural log of total assets. In order to control the organization form, both mutual and stock firms are included. STOCK is equal to one for stock firms, zero otherwise. NATIONAL is equal to one if a firm is licensed in more than 30 states, zero otherwise. SINGLE is equal to one if a firm is not in any group, zero otherwise. HERF, Herfindahl index, is calculated at the group level according to the Group Code. As New York state is generally considered having relatively more stringent insurance regulation, we include the indicator variable NYREG coded equal to one if a firm is licensed in New York state. REINS is the ratio between reinsurance ceded and the sum of direct and assumed reinsurance of the year. AGE of a firm is calculated in terms of year from the starting of the business. IP is industrial production growth, calculated as $ln(P_t/P_{t-1})$, where P_t is industrial production index (U.S. Department of Commerce, Survey of Current Business). IMBY is intermediate term U.S. government bond yield taken from annual return of 10-year U.S. government bond (ticker: USGG10YR, Bloomberg). LGVBV is long-term government bond volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of long-term government bond yield. The yield used here is 30-year U.S. government bond yield (ticker: USGG30YR, Bloomberg). SPV is S&P 500 volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of Standard and Poor's 500 Stock Index (ticker: SPX, Bloomberg). The final sample consists of 2,462 firm-year observations of health insurers in the United States from 1996 to 2016.

Table 5: Quantity Model - Differential Rating Effect

	Dependent variable:						
	QUANTITY						
	x=A+	x=A	x=A-	x=B++	x=B+	x=B	x=B-
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
lag1CAP.F	0.372	0.324	0.311	0.468	0.242	0.060	0.201
	(0.987)	(0.985)	(1.000)	(1.076)	(0.926)	(0.908)	(0.926)
I(lag1RATING.F >x)	0.228	−0.576	−0.199	0.114	−0.184	−0.571*	−0.702*
	(0.847)	(0.400)	(0.176)	(0.187)	(0.336)	(0.335)	(0.396)
SIZE	−0.251**	−0.264**	−0.273**	−0.231*	−0.279**	−0.304***	−0.287***
	(0.110)	(0.113)	(0.121)	(0.126)	(0.114)	(0.108)	(0.109)
SINGLE	0.367	0.379	0.368	0.356	0.402	0.358	0.067
	(1.811)	(1.812)	(1.805)	(1.813)	(1.804)	(1.777)	(1.753)
NATIONAL	−0.061	−0.064	−0.045	−0.069	−0.061	−0.117	−0.114
	(0.349)	(0.347)	(0.350)	(0.351)	(0.346)	(0.359)	(0.364)
NYREG	0.185	0.191	0.169	0.207	0.157	0.122	0.166
	(0.278)	(0.277)	(0.271)	(0.264)	(0.282)	(0.297)	(0.286)
STOCK	−0.517	−0.523	−0.540	−0.501	−0.524	−0.589	−0.533
	(0.487)	(0.485)	(0.495)	(0.501)	(0.492)	(0.481)	(0.488)
HERF	−0.334	−0.353	−0.334	−0.340	−0.307	−0.204	0.007
	(1.942)	(1.943)	(1.936)	(1.938)	(1.925)	(1.898)	(1.867)
AGE	0.006	0.006	0.006	0.006	0.006	0.007	0.007
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
lag1REINS	2.483**	2.489**	2.472**	2.480**	2.494**	2.553**	2.562**
	(0.990)	(0.988)	(0.990)	(0.985)	(0.998)	(1.004)	(1.010)
GRP	−0.294	−0.298	−0.296	−0.283	−0.315	−0.302	−0.304
	(0.233)	(0.232)	(0.232)	(0.227)	(0.238)	(0.235)	(0.236)
CRDT	11.276*	11.273*	11.285*	11.288*	11.262*	11.151*	11.193*
	(6.366)	(6.362)	(6.364)	(6.350)	(6.399)	(6.353)	(6.356)
Year Fixed Effects	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Clustered s.e.	*Firm*	*Firm*	*Firm*	*Firm*	*Firm*	*Firm*	*Firm*
Observations	2,314	2,314	2,314	2,314	2,314	2,314	2,314
R^2	0.158	0.159	0.159	0.158	0.159	0.163	0.162

Note: This table reports summary statistics for our study. PRICE for health insurance is the sum of premiums and investment income minus change in reserve and then divided by change in reserve. QUANTITY is the number of new policies issued during the year scaled by premiums. VOLATILITY represents insolvency risk, which is the volatility of the surplus rate of return, treating each company as a portfolio of assets less liabilities. RATING is the life insurer ratings from A.M. Best, which is scaled 1-14 with A++:1 and E:14. CAP is the capital ratio defined as statutory capital divided by total assets. SIZE is calculated by taking natural log of total assets. In order to control the organization form, both mutual and stock firms are included. STOCK is equal to one for stock firms, zero otherwise. NATIONAL is equal to one if a firm is licensed in more than 30 states, zero otherwise. SINGLE is equal to one if a firm is not in any group, zero otherwise. HERF, Herfindahl index, is calculated at the group level according to the Group Code. As New York state is generally considered having relatively more stringent insurance regulation, we include the indicator variable NYREG coded equal to one if a firm is licensed in New York state. REINS is the ratio between reinsurance ceded and the sum of direct and assumed reinsurance of the year. AGE of a firm is calculated in terms of year from the starting of the business. IP is industrial production growth, calculated as $ln(P_t/P_{t-1})$, where P_t is industrial production index (U.S. Department of Commerce, Survey of Current Business). IMBY is intermediate term U.S. government bond yield taken from annual return of 10-year U.S. government bond (ticker: USGG10YR, Bloomberg). LGVBV is long-term government bond volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of long-term government bond yield. The yield used here is 30-year U.S. government bond yield (ticker: USGG30YR, Bloomberg). SPV is S&P 500 volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of Standard and Poor's 500 Stock Index (ticker: SPX, Bloomberg). The final sample consists of 2,462 firm-year observations of health insurers in the United States from 1996 to 2016.

Table 6: Primary Model - Price-Risk Sensitivity Pre- and Post- ACA

	Dependent variable:					
	PRICE					
	Pre-ACA	Post-ACA	Wald p-value	Pre-ACA	Post-ACA	Wald p-value
	(1)	(2)	(3)	(4)	(5)	(6)
lag1CAP.F	0.111***	0.051	0.098	0.070***	−0.003	0.037
	(0.026)	(0.036)		(0.025)	(0.034)	
lag1VOLATILITY.F	−0.028**	−0.049**	0.339			
	(0.011)	(0.024)				
lag1RATING.F				−0.012***	−0.020***	0.064
				(0.002)	(0.005)	
SIZE	0.013***	0.012***	0.806	0.005	0.001	0.469
	(0.003)	(0.004)		(0.003)	(0.005)	
SINGLE	0.063**	0.066*	0.952	0.061*	0.036	0.586
	(0.028)	(0.040)		(0.034)	(0.035)	
NATIONAL	−0.005	−0.009	0.778	−0.009	−0.008	0.939
	(0.010)	(0.014)		(0.009)	(0.014)	
NYREG	0.009	−0.004	0.411	0.002	−0.013	0.367
	(0.012)	(0.015)		(0.012)	(0.015)	
STOCK	0.035**	0.013	0.218	0.032**	0.003	0.139
	(0.016)	(0.020)		(0.014)	(0.020)	
HERF	−0.065**	−0.066	0.986	−0.055	−0.011	0.354
	(0.031)	(0.042)		(0.037)	(0.039)	
AGE	−0.0001	0.00002	0.678	0.0001	0.0003	0.445
	(0.0002)	(0.0003)		(0.0002)	(0.0003)	
lag1REINS	−0.011	−0.008	0.909	−0.010	−0.009	0.952
	(0.017)	(0.021)		(0.015)	(0.020)	
GRP	−0.002	0.013	0.155	−0.010	0.009	0.087
	(0.009)	(0.012)		(0.009)	(0.012)	
CRDT	0.022	0.044*	0.439	0.016	0.045*	0.328
	(0.015)	(0.024)		(0.014)	(0.027)	
Firm Clustered Standard Errors	Yes	Yes		Yes	Yes	
Year Fixed Effects	Yes	Yes		Yes	Yes	
Observations	1700	614		1700	614	
R^2	0.060	0.166		0.194	0.190	

Note: This table reports summary statistics for our study. PRICE for health insurance is the sum of premiums and investment income minus change in reserve and then divided by change in reserve. QUANTITY is the number of new policies issued during the year scaled by premiums. VOLATILITY represents insolvency risk, which is the volatility of the surplus rate of return, treating each company as a portfolio of assets less liabilities. RATING is the life insurer ratings from A.M. Best, which is scaled 1-14 with A++:1 and E:14. CAP is the capital ratio defined as statutory capital divided by total assets. SIZE is calculated by taking natural log of total assets. In order to control the organization form, both mutual and stock firms are included. STOCK is equal to one for stock firms, zero otherwise. NATIONAL is equal to one if a firm is licensed in more than 30 states, zero otherwise. SINGLE is equal to one if a firm is not in any group, zero otherwise. HERF, Herfindahl index, is calculated at the group level according to the Group Code. As New York state is generally considered having relatively more stringent insurance regulation, we include the indicator variable NYREG coded equal to one if a firm is licensed in New York state. REINS is the ratio between reinsurance ceded and the sum of direct and assumed reinsurance of the year. AGE of a firm is calculated in terms of year from the starting of the business. IP is industrial production growth, calculated as $ln(P_t/P_{t-1})$, where P_t is industrial production index (U.S. Department of Commerce, Survey of Current Business). IMBY is intermediate term U.S. government bond yield taken from annual return of 10-year U.S. government bond (ticker: USGG10YR, Bloomberg). LGVBV is long-term government bond volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of long-term government bond yield. The yield used here is 30-year U.S. government bond yield (ticker: USGG30YR, Bloomberg). SPV is S&P 500 volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of Standard and Poor's 500 Stock Index (ticker: SPX, Bloomberg). The final sample consists of 2,462 firm-year observations of health insurers in the United States from 1996 to 2016.

Table 7: Primary Model - Quantity-Risk Sensitivity Pre- and Post-ACA

	Dependent variable:					
	Quantity					
	Pre-ACA	Post-ACA	Wald p-value	Pre-ACA	Post-ACA	Wald p-value
	(1)	(2)	(3)	(4)	(5)	(6)
lag1CAP.F	1.509	−1.467	0.133	1.137	−2.097	0.100
	(1.053)	(1.751)		(0.880)	(1.845)	
lag1VOLATILITY.F	0.056	−0.998*	0.107			
	(0.455)	(0.517)				
lag1RATING.F				−0.166*	−0.198	0.850
				(0.086)	(0.152)	
SIZE	−0.085	−0.543**	0.028	−0.204***	−0.647**	0.079
	(0.058)	(0.230)		(0.079)	(0.269)	
SINGLE	2.365*	−2.747	0.049	2.117*	−3.035	0.060
	(1.217)	(2.438)		(1.123)	(2.618)	
NATIONAL	−0.402	0.581	0.164	−0.460	0.576	0.146
	(0.356)	(0.655)		(0.375)	(0.649)	
NYREG	−0.227	0.832	0.108	−0.346*	0.771	0.086
	(0.158)	(0.668)		(0.198)	(0.644)	
STOCK	−0.074	−1.868	0.258	−0.044	−2.023	0.199
	(0.237)	(1.606)		(0.248)	(1.568)	
HERF	−2.502*	2.878	0.049	−2.150*	3.438	0.055
	(1.421)	(2.522)		(1.293)	(2.774)	
AGE	0.004	0.005	0.914	0.007	0.009	0.867
	(0.004)	(0.010)		(0.005)	(0.010)	
lag1REINS	1.655	3.958**	0.246	1.741	3.920**	0.275
	(1.191)	(1.631)		(1.215)	(1.634)	
GRP	−0.654***	0.477	0.023	−0.723***	0.428	0.021
	(0.222)	(0.488)		(0.249)	(0.480)	
CRDT	−1.992**	12.898**	0.013	−2.237**	13.015**	0.012
	(0.863)	(5.939)		(0.888)	(6.048)	
Firm Clustered Standard Errors	Yes	Yes		Yes	Yes	
Year Fixed Effects	Yes	Yes		Yes	Yes	
Observations	1700	614		1700	614	
R^2	0.120	0.166		0.153	0.190	

Note: This table reports summary statistics for our study. PRICE for health insurance is the sum of premiums and investment income minus change in reserve and then divided by change in reserve. QUANTITY is the number of new policies issued during the year scaled by premiums. VOLATILITY represents insolvency risk, which is the volatility of the surplus rate of return, treating each company as a portfolio of assets less liabilities. RATING is the life insurer ratings from A.M. Best, which is scaled 1-14 with A++:1 and E:14. CAP is the capital ratio defined as statutory capital divided by total assets. SIZE is calculated by taking natural log of total assets. In order to control the organization form, both mutual and stock firms are included. STOCK is equal to one for stock firms, zero otherwise. NATIONAL is equal to one if a firm is licensed in more than 30 states, zero otherwise. SINGLE is equal to one if a firm is not in any group, zero otherwise. HERF, Herfindahl index, is calculated at the group level according to the Group Code. As New York state is generally considered having relatively more stringent insurance regulation, we include the indicator variable NYREG coded equal to one if a firm is licensed in New York state. REINS is the ratio between reinsurance ceded and the sum of direct and assumed reinsurance of the year. AGE of a firm is calculated in terms of year from the starting of the business. IP is industrial production growth, calculated as $ln(P_t/P_{t-1})$, where P_t is industrial production index (U.S. Department of Commerce, Survey of Current Business). IMBY is intermediate term U.S. government bond yield taken from annual return of 10-year U.S. government bond (ticker: USGG10YR, Bloomberg). LGVBV is long-term government bond volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of long-term government bond yield. The yield used here is 30-year U.S. government bond yield (ticker: USGG30YR, Bloomberg). SPV is S&P 500 volatility, calculated as the ratio of current to prior year's annualized monthly standard deviation of Standard and Poor's 500 Stock Index (ticker: SPX, Bloomberg). The final sample consists of 2,462 firm-year observations of health insurers in the United States from 1996 to 2016.

References

Allen, F., E. Carletti, and R. Marquez, 2011, Credit Market Competition and Capital Regulation, *The Review of Financial Studies*, 24: 983–1018.

Avery, R. B., T. M. Belton, and M. A. Goldberg, 1988, Market Discipline in Regulating Bank Risk: New Evidence from the Capital Markets, *Journal of Money, Credit and Banking*, 20: 597–610.

Berger, L. A., J. D. Cummins, and S. Tennyson, 1992, Reinsurance And The Liability Insurance Crisis, *Journal of Risk and Uncertainty*, 5: 253–272.

Berry-Stölzle, T. R., G. P. Nini, and S. Wende, 2014, External Financing in the Life Insurance Industry: Evidence from the Financial Crisis, *Journal of Risk and Insurance*, 81: 529–562.

Cummins, J. D., and P. M. Danzon, 1997, Price, financial quality, and capital flows in insurance markets, *Journal of financial intermediation*, 6: 3–38.

Cummins, J. D., and D. W. Sommer, 1996, Capital and Risk in Property-Liability Insurance Markets, *Journal of Banking & Finance*, 20: 1069–1092.

Cummins, J. D., S. Tennyson, and M. A. Weiss, 1999, Consolidation and Efficiency in the US Life Insurance Industry, *Journal of Banking & Finance*, 23: 325–357.

Cummins, J. D., and M. A. Weiss, 2000, Analyzing firm performance in the insurance industry using frontier efficiency and productivity methods, in *Handbook of insurance*: Springer 767–829.

Cummins, J. D., and X. Xie, 2008, Mergers and Acquisitions in the US Property-Liability Insurance Industry: Productivity and Efficiency Effects, *Journal of Banking & Finance*, 32: 30–55.

Epermanis, K., and S. E. Harrington, 2006, Market Discipline in Property/Casualty Insurance: Evidence From Premium Growth Surrounding Changes in Financial Strength Ratings, *Journal of Money, Credit, and Banking*, 1515–1544.

Flannery, M. J., and S. M. Sorescu, 1996, Evidence of Bank Market Discipline in Subordinated Debenture Yields: 1983–1991, *The Journal of Finance*, 51: 1347–1377.

Harrington, S. E., 2010a, The Health Insurance Reform Debate, *Journal of Risk and Insurance*, 77: 5–38.

Harrington, S. E., 2010b, US Healthcare Reform: The Patient Protection and Affordable Care Act, *Journal of Risk and Insurance*, 77: 703–708.

Harrington, S. E., and P. M. Danzon, 1994, Price Cutting In Liability Insurance Markets, *Journal of Business*, 511–538.

Klein, R. W., 2012, Principles for Insurance Regulation: An Evaluation of Current Practices and Potential Reforms, *The Geneva Papers on Risk and Insurance-Issues and Practice*, 37: 175–199.

Lane, T. D., 1993, Market Discipline, *International Monetary Fund Staff Papers*, 40: 53–88.

Mayers, D., and C. W. Smith Jr, 1988, Ownership structure across lines of property-casualty insurance, in *Foundations of Insurance Economics*: Springer 532–559.

Morrisey, M. A., 2013, Health Insurance in the United States, *The Handbook of Insurance, 2nd Edition*, 957–996.

Petersen, M. A., 2009, Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches, *The Review of Financial Studies*, 22: 435–480.

Pottier, S. W., 2007, The Determinants of Private Debt Holdings: Evidence from the Life Insurance Industry, *Journal of Risk and Insurance*, 74: 591–612.

Rejda, G. E., and M. McNamara, 2017, *Principles of Risk Management and Insurance*: Pearson Education.

Rodwin, M. A., 1996, Consumer Protection and Managed Care: The Need for Organized Consumers, *Health Affairs*, 15: 110–123.

Root, J., and S. Stableford, 1999, Easy-To-Read Consumer Communications: a Missing Link in Medicaid Managed Care, *Journal of Health Politics, Policy and Law*, 24: 1–26.

Sommer, D. W., 1996, The Impact of Firm Risk on Property-Liability Insurance Prices, *Journal of Risk and Insurance*, 501–514.

Winter, R. A., 1991, The Liability Insurance Market, *Journal of Economic Perspectives*, 5: 115–136.