Regulating Markups in U.S. Health Insurance *

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Abstract

A health insurer's Medical Loss Ratio (MLR) is the share of premiums spent on medical claims, or the inverse markup over average claims cost. The Affordable Care Act introduced minimum MLR provisions for all health insurance sold in fully-insured commercial markets, thereby capping insurer profit *margins*, but not levels. While intended to reduce premiums, we show this rule creates incentives to increase costs. Using variation created by the rule's introduction as a natural experiment, we find medical claims rose nearly one-for-one with distance below the regulatory threshold: 7% in the individual market, and 2% in the group market. Premiums were unaffected.

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I Introduction

One approach to mitigating the exercise of market power is to regulate a firm's markup over its costs directly. Administratively determining prices in this manner has been pervasive in sectors deemed essential and prone to high concentration: water, electricity, transportation, and telecommunications, to name a few. However, the perverse incentive to pad costs in order to increase returns has motivated widespread transitions to more market-based pricing mechanisms in each of these sectors. In this paper we evaluate a similar regulation in a sector that has moved counter to this deregulatory trend–the U.S. market for health insurance.

As part of the Affordable Care Act (ACA), the U.S. Federal government instituted minimum requirements on insurers' medical loss ratios (MLR).[1] The MLR is the ratio of a firm's expenditures on medical claims to its premium revenues, or the inverse markup over average claims costs. On a state by state and segment by segment basis, the regulation requires insurers to maintain an MLR of at least 80% in the individual and small group market segments and 85% in the large group market segment (it has become colloquially known as the '80/20 rule'). Non-compliant insurers issue rebates to customers based on their realized MLR each year.

As an example, if an insurer collects \$100 in premiums in the individual market, but spends only \$79 paying medical claims that year, it is required to write a \$1 check to policyholders. This regulation was indeed binding for many insurers, and over \$1 billion was issued in rebates to policyholders in 2011. MLRs have risen (and rebates have fallen) in subsequent years, with an additional \$1.8 billion rebated in total between 2012–2015.

At its simplest level, this paper observes that our hypothetical insurer with \$100 in premium revenue and \$79 in claims costs finds it must bear the full administrative cost of keeping medical claims below \$80, but reaps none of the reward. That is, minimum MLR requirements encourage higher costs, not lower. We model the impact of MLR regulation and show empirically that the 80/20 rule has, indeed, led insurers to have substantially higher medical claims costs–nearly one-for-one with their distance below the regulatory threshold. [2] Premiums have been virtually

[1] This regulation was established by Section 2718 of the ACA, entitled "Bringing Down the Cost of Health Coverage." A similar regulation also went into effect for the Medicare Advantage market beginning in 2014. The market for "fully-insured" health insurance products is distinct from the market for "self-insured" products often purchased by large employers. In the former "fully-insured" case, the health insurance company bears the financial risk of adverse health events and performs the risk pooling function; in the latter "self-insured" case, the health insurance company (or "third party administrator") merely sells its services as a claims administrator and does not bear any risk. As they are not insurance products, self-insured products are not subject to the regulation. Fully-insured products account for roughly 58% of lives in the private commercial health insurance market as of 2013 (Henry J. Kaiser Family Foundation and Health Research & Educational Trust, 2015). Non-profit insurers were also exempt from the regulation.

[2] We note the important distinction here between *insurers'* medical expenditures and *total* medical expenditures, where the difference is accounted for by out-of-pocket costs. While we find that insurers' medical expenditures have risen as a result of MLR regulation, we do not have strong evidence on its effects on total medical

unaffected.

This paper joins two main areas of research: the study of price-regulated industries and the determinants of cost in the provision of health care. We model the behavior of a monopolistic insurer offering coverage of a fixed health shock at a chosen price per dollar of insurance. We show that the imposition of an MLR constraint yields a model that parallels those from the cost of service regulation literature in which a firm earns returns based on a markup over its input costs (Averch and Johnson, 1962). We then endogenize the cost of insuring the health shock by allowing the insurer to also choose how much effort to exert to keep costs down, in the spirit of Laffont and Tirole (1993). We show that minimum MLR regulations are predicted to curtail cost-reducing effort and increase medical claims, while the impact on premiums is ambiguous (and depends on the relative curvatures of the demand and cost-reducing effort functions).

We measure the impact of the 80/20 rule on MLRs, medical claims per life-year, and premiums per life-year using annual data from 2005–2013 from the National Association of Insurance Commissioners (NAIC). This organization standardizes state-level reporting of insurer finances and formed the basis of reporting requirements that were adopted as part of federal MLR regulation. These data allow the construction of a panel both preceding and after the implementation of federal MLR regulation at the unit of observation at which the regulation applies: for each insurer, in each market segment, in each state, for each year.[3]

We use a difference-in-differences framework that compares changes in outcomes over time between insurers with historically low MLRs versus those who were persistently already in compliance with the rule before it took effect. We show that this regulation is associated with an abrupt increase in MLRs for "treated" firms that is approximately one-for-one with their distance from the mandated MLR minimum. This increase was accomplished (particularly after a year of adjustment) almost entirely by increases in insurers' medical claims expenditures. Our preferred estimates show a 7% increase in claims in the individual market for firms that were previously out of compliance; in the group market, we estimate a 2% increase in claims, though the latter estimate is imprecise. These increases occur with a sharp break from historical trends. We find little evidence of a reduction in premiums. Consistent with our model of cost-reducing effort, we find suggestive evidence that insurers cut administrative spending when the regulation was binding, but that the magnitudes of the changes in administrative costs are small relative to the magnitude of changes in claims costs (and thus simple "relabelling" of administrative costs as claims costs cannot explain our results).

spending.

[3] Federal MLR regulation distinguishes between the large and small group market segments, but the NAIC data reports these segments jointly. Thus, our analysis of the group market looks at these two market segments together; we discuss this in greater detail below.

There are two main challenges to interpreting our results as causal estimates of the impact of the 80/20 rule. First, we cannot actually observe treatment, i.e., whether an insurer's unregulated MLR would have been beneath the minimum threshold, since we only observe realized MLRs. Because insurers' MLRs are quite persistent from year to year (and to avoid issues of mean-reversion), we use the five-year average MLR preceding the ACA to measure treatment intensity, and show general robustness to the width of this window. This is a noisy proxy for true treatment, and therefore attenuates our estimates somewhat. Second, MLRs are not randomly assigned, but reflect endogenous decisions of firms in response to demand, market structure, regulations, provider negotiations, etc. Our empirical strategy allows us to identify the relative effect of MLR regulation historically low- versus high-MLR firms, but does not allow us to separately identify industry-wide effects of MLR regulation from those of concurrent regulatory changes. At a minimum, we show there has been a stark, abrupt relative change in outcomes for low-MLR firms following the implementation of the ACA rule.

The Centers for Medicare and Medicaid Services (CMS), which administer the rule, routinely cite rebates and increased MLRs as evidence of the program's success, calculating consumer savings by applying pre-2011 MLRs to present-day claims costs to estimate how much higher premiums would have been if not for the regulation (The Centers for Medicare & Medicaid Services, 2014a). These rebates measure the change that must be made to come in to compliance, but do not bound the level of the regulation's importance for determining costs and premiums. This is because a firm's rebates vanish once they have come in to compliance, but their claims and premiums continue to be determined by the minimum ratio going forward. A weakly binding regulation therefore indicates little variation to estimate firm response, but does not suggest the regulation is unimportant. Our results suggest a much wider impact of MLR regulation when considering the extent of pre-ACA compliance stemming from state laws already in place: our analysis is based on the change in treatment status among the last insurers to receive treatment.

It is important to note at the outset that while our results show impacts of MLR regulations that are sharply divergent from their original intention (lowering premiums), it is difficult to make a statement about net welfare. To the extent that higher claims result from more generous coverage and additional care, the presence of moral hazard in the consumption of insured health care would suggest that such costs exceed policyholder willingness to pay for them. On the other hand, if insurers were inefficiently restricting the generosity of plans, this increase in insured medical spending has a positive net value to society insofar as it moves equilibrium toward the intersection of the marginal cost and marginal willingness to pay for insurance Einav et al. (2010). Even if the entire increase in claims costs were due to higher provider prices with no change in quantities (a transfer to providers), one would still need to account for the benefit to insurers of less price-reducing negotiation effort. Instead of making net welfare statements, our goal in this paper is to take a first step in characterizing the nature (and magnitude) of the problem so that the tools developed elsewhere for such settings might be brought to bear in the future.[4]

Recent empirical work has shown the importance of Averch and Johnson (1962)-type bias in input choices both in health care (Acemoglu and Finkelstein, 2008) and the electricity sector (Cicala, 2015; Fowlie, 2010). In our setting, the regulatory instrument is even more blunt than favoring one input over another, and the regulator has no authority to deny reimbursement for 'imprudent' expenditures. It has also been shown that both providers and insurers respond to such economic incentives: doctors and hospitals change how they treat patients in response to Medicare reimbursement incentives (Einav et al., 2017; Clemens and Gottlieb, 2014), drug makers charge higher prices to more price-inelastic customers (Duggan and Scott Morton, 2006), and insurers free-ride on Medicare reimbursement schedules to economize on negotiation costs (Clemens and Gottlieb, 2017; Clemens et al., 2015). Such responses have not been studied in the context of minimum MLR regulations, where existing work has focused on its connection to markups, and the response of firms in imperfectly competitive markets to such regulation, holding costs fixed (Starc, 2014; Ericson and Starc, 2015; Karaca-Mandic et al., 2015; Abraham and Karaca-Mandic, 2011).[5] By shedding light on how insurers comply with these regulations, we also facilitate the analysis of insurer pricing in imperfectly competitive markets where such regulations apply (Ho and Lee, 2017; Tebaldi, 2016; Jaffe and Shepard, 2017).

There is a small but growing literature on the impacts of the ACA's MLR regulation (Abraham et al., 2014; McCue et al., 2013; McCue and Hall, 2015; Clemans-Cope et al., 2015). These papers use data from 2010-2012 and have found that MLRs increased, particularly in the individual market and for for-profit insurers.[6] While McCue et al. (2013) and McCue and Hall (2015) study the reduced form impact of the change in regulation on outcomes, Abraham et al. (2014) and Clemans-Cope et al. (2015) study outcomes as a function of a firm's 2010 MLR. Because these studies rely on a single year of data before the regulations went into effect, it is not clear whether the estimated changes are reflecting other underlying trends in the insurance market or are causal impacts of the regulation. Our work complements these studies by explicitly linking the regulation to the theoretical literature on cost of service regulation and using data from a much longer time frame in combination with a research design that allows us to address concerns about underlying trends and mean reversion.

The paper is organized as follows: in the next section, we provide background on minimum

[4] See Laffont and Tirole (1993), for example, for a comprehensive treatment.

[5] Harrington (2013) qualitatively connects minimum MLRs to economic regulation broadly, and reviews a number of potential unintended consequences–in particular the asymmetry created when rebates limit the upside risk to insurers.

[6] These studies have also explored the impacts on a number of financial outcomes such as administrative costs, profits, and quality improvement expenditures.

MLR regulation and present descriptive evidence of its impact on insurers to motivate our estimation strategy. The third section demonstrates the equivalence of this rule with cost of service regulation and derives theoretical predictions of its effect on claims costs and premiums. The fourth section describes the data and the fifth details the estimation strategy. The sixth section presents the results and the final section concludes. Proofs, ancillary empirical results, and robustness checks are included in the online appendices.

II Background and Motivating Evidence

MLR regulation was only one of many systemic changes to the health insurance industry set in motion by the ACA, which was passed on March 23, 2010. The most important changes made by the ACA in the individual and small group insurance markets were the establishment of the public health insurance exchanges, a near total ban on individual risk rating, the individual health insurance mandate, and the creation of a set of Essential Health Benefits that plans must cover. These changes fundamentally altered the business of writing individual and small group insurance policies, and were implemented in 2014.[7] As such, we end our study period in 2013.[8]

There were, however, a number of provisions in the ACA that went into effect at the end of 2010 or the start of 2011. Those changes which were likely to have affected the private, fully-insured health insurance market are the extension of coverage of dependents up to the age of 26, the elimination of cost sharing for a set of preventive care procedures (e.g., mammograms), the prohibition on lifetime limits on coverage, and the creation of a national high-risk pool. For example, research on the coverage of dependents up to the age of 26 has found that this provision reduced uninsurance levels and led to somewhat higher insurance premiums (Antwi et al., 2013; Depew and Bailey, 2015). Section VI discusses how these contemporaneous policy changes affect the interpretation of our results.

Prior to the ACA, 29 states had some form of MLR regulations on the books, but the regulations do not appear to have been strongly enforced based on *realized* MLRs (as opposed to those anticipated *ex ante*). In some cases, states had thresholds that were very low; the median MLR threshold among states with some regulation was only 0.65. Even where the MLR thresholds were higher, states often appear to have lacked the ability to enforce the regulation. For example, in states where the MLR threshold was 0.75 or higher in the individual market,

[7] These regulations applied to all new plans offered as of 2014, but plans already in existence were given "grandfathered" status and allowed to remain unchanged. Insurers may have differed in the extent to which they utilized these "low value" health plans prior to the ACA, and the effect may play out over time as these "grandfathered" plans are phased out gradually.

[8] Our discussion of ACA provisions is based primarily upon information from Henry J. Kaiser Family Foundation (2013).

more than 40 percent of life-years were in plans that did not meet the requirement in 2010. Harrington (2013) explains this apparent non-enforcement in the context of the rate hearings process: state commissioners would use projections of costs to approve premium increases based on the MLR, but did not enforce regulations based on the *ex post* realizations of costs.

Regulation of minimum MLR thresholds was brought to the federal level as part of the ACA. These thresholds are not enforced on a plan-by-plan, nor an insurer-by-insurer, basis. Instead, the insurer aggregates all of its business within a given state, market segment, and year, and the MLR realized over this block of business must meet the MLR threshold. The threshold is 0.80 for the individual and small group markets and 0.85 for the large group market. In the year immediately preceding the implementation of MLR regulation, more than 52 percent of consumers insured in the individual market were in plans with an MLR below 0.80.[9] Beginning in 2011, if an insurer fell below the applicable MLR threshold, it had to send rebates to its policyholders.[10]

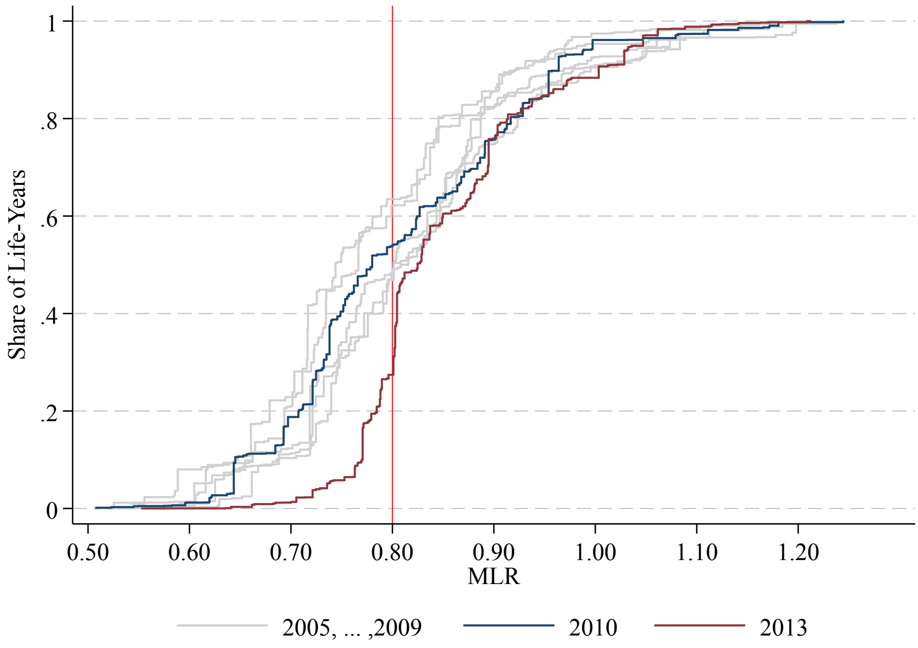
Figure 1 shows the cumulative density function (CDF) of MLRs in the individual market for the years 2005 through 2010 as well as for 2013. The gray lines show the CDFs for each year from 2005 through 2009. Although there is some variation from year to year, the CDFs remain fairly similar over this period, and 2010 (the blue line) does not appear to be systematically different from the other pre-ACA years. However, by 2013, the distribution of MLRs has moved to the right as MLRs increased, but not evenly throughout the distribution. The increase in MLRs is heavily concentrated among firms with MLRs below the federal 0.80 threshold (denoted by the vertical red line). As mentioned previously, in 2010, 52 percent of lives were covered by insurers with MLRs below the regulated threshold, but by 2013, only 30 percent of covered lives were below the threshold. One can also note the sharp jump in density in the neighborhood of the threshold in 2013, while prior distributions are far less concentrated around this point. Those insurers below the threshold in 2013 were required to pay rebates.

The corresponding distribution for the group market is somewhat less informative because prior to the ACA, the NAIC did not collect information separately for the small group and large group market segments. This creates measurement error in our aggregated data. A firm could be far below the ACA threshold in one market segment and above the threshold in the other. The degree to which we expect to see a response in the aggregate data depends upon

[9] Unfortunately, we are not able to separate insurers' small and large group business in the data used for this calculation. As a result, we can not directly calculate the fraction of consumers in group plans in 2010 with MLRs below the ACA group thresholds. However, we can bound this fraction. Using a threshold of 0.80 (correct for the small group market), we find that 20 percent of consumers in the group market were in plans below the ACA threshold; using the threshold of 0.85 (correct for the large group market), approximately half of the consumers would have been in plans that did not meet the threshold.

[10] Rebates are calculated such that after the insurer has paid out the rebates, and the rebates are counted as claims, its MLR would be equal to the regulated threshold.

Figure 1: Distributions of MLRs in the Individual Market Over Time



Note: Each CDF represents the fraction of life-years (not firms) at a particular MLR level, where MLR is defined as claims over premiums. The figure is based on NAIC data (see Section IV for details).

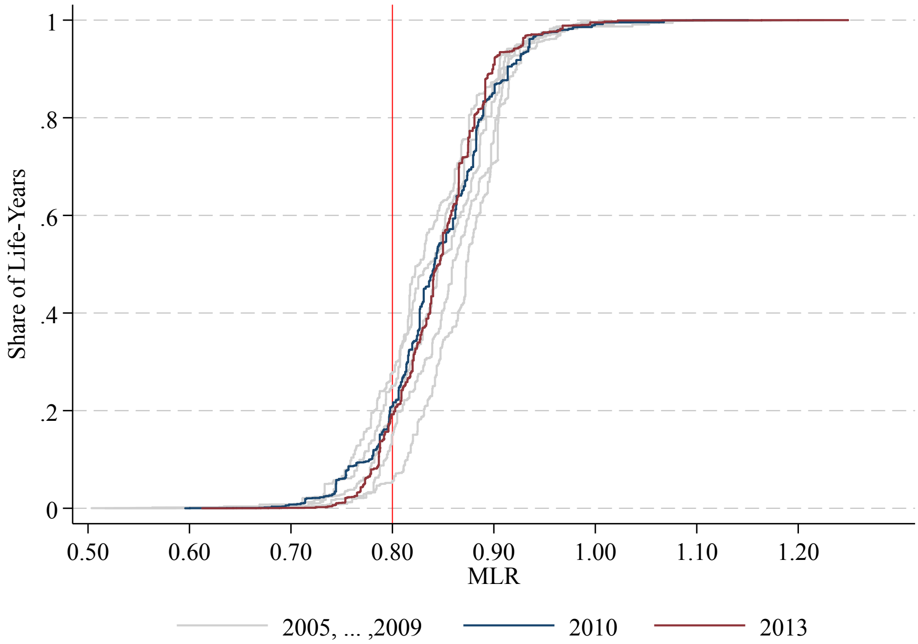
how much of the firm's group business was in the segment below the threshold, something we do not observe. With that caveat in mind, Figure 2 presents the CDFs of MLRs for the aggregate group market from 2005 through 2010 and for 2013.

Comparing 2010 and 2013, there appears to be a small increase in MLRs at the low end of the distribution. Because 0.80 is the minimum threshold set by the ACA, it is quite likely that firms with an aggregate MLR below 0.80 are below their relevant threshold.[11] Above 0.80, there is very little difference between the 2010 and 2013 distributions. This is consistent with the changes observed in the individual market, which were that the distribution of MLRs appears to have been shifted to the right for low MLR firms, but there was very little movement above the MLR thresholds.

By the end of 2015, insurers had paid nearly $2.8 billion in rebates to consumers as a result of not meeting the MLR thresholds. Figure 3 shows these rebates by market segment and year, where the left panel shows total rebates, and the right panel shows rebates per life-year of enrollment (i.e., per enrollee). We combine the small and large group market segments into one "group" market to be consistent with our later analysis. In 2011, $400 million in rebates were paid in the individual market and $700 million in the group market. Significantly lower

[11] There are adjustments to the ACA MLR threshold that can reduce the target level further. These are discussed in Section IV

Figure 2: Distributions of MLRs in the Group Market Over Time



Note: Each CDF represents the fraction of life-years (not firms) at a particular MLR level, where MLR is defined as claims over premiums. The figure is based on NAIC data (see Section IV for details).

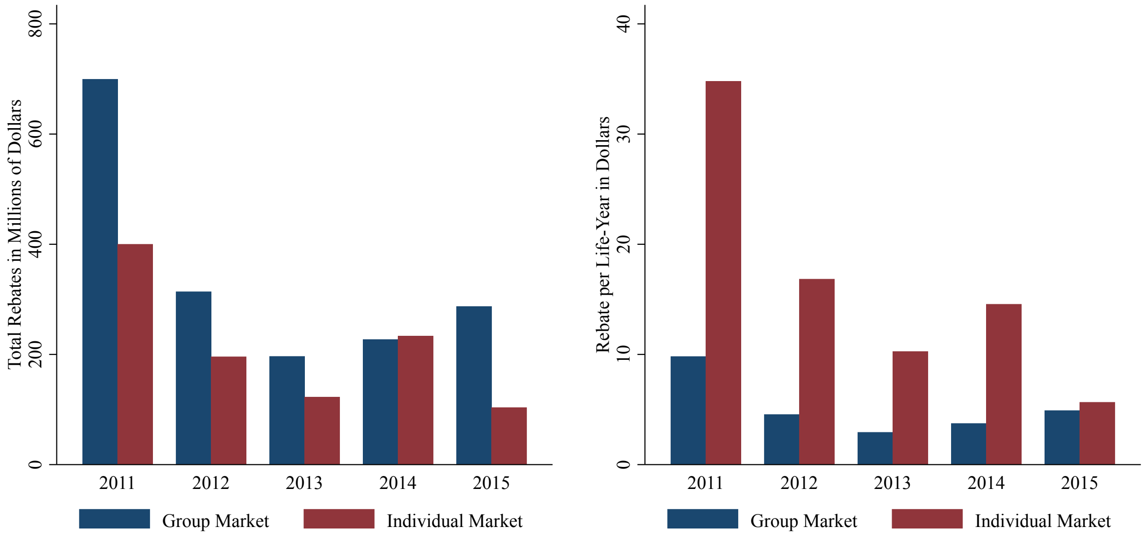
rebates were paid in subsequent years. Rebates in 2012 were approximately half of those paid in 2011, and in 2013, they were approximately one-third of 2011 rebates. There appears to have been slight increases after the exchanges came online in 2014, which were likely the result of significant uncertainty around the health of the population entering the market.

Much of the relative magnitude of total rebates between the individual and group markets can be attributed to total enrollment: in 2011, 11.5 million people obtained coverage in the individual market and 71.4 million in the group market.[12] On a per life-year basis, however, rebates in the individual market are far greater, reflecting the lower MLRs in this market segment. In 2011, insurers in the individual market paid approximately \$35 in rebates per enrollee; in the group market, the analogous number is \$10.

While the magnitude of the rebates is small relative to the overall size of the market for health insurance, as described in the introduction they provide a measure of the amount of *identifying variation* that exists, not the potential impact of MLR regulation on the market as a whole. Many firms might have maintained high MLRs as a result of competitive forces, but it is also possible that the mechanism that we seek to measure was already at work on a forward-looking basis during state rate hearings before the ACA. The reduction in rebates

[12] Authors' calculation based upon CCIIO data (see Section IV for details).

Figure 3: Rebates Paid by Year and Market Segment



Note: Rebates are tabulated from CCIIO data, combining large and small group market segments to form the "Group Market" (see Section IV for details).

over time suggests that firms made changes to bring their business into compliance with the regulated MLR minima.

III Minimum MLRs as Cost of Service Regulation

We next present a model of insurer behavior subject to MLR regulation to derive predictions of the industry's response. Moreover, we show minimum MLR requirements are equivalent to cost of service regulation. To demonstrate this equivalence, we consider the decision of a monopolistic insurance provider choosing a price p per dollar of coverage against a negative health shock H that occurs with probability r in a homogenous population. Consumers choose a level of coverage $q \in [0, H]$ that pays off q dollars if they experience the health shock, and have an elastic demand for coverage $q(p)$. The level of coverage q chosen by the consumer determines the actuarial value of the plan, equal to $\frac{q}{H}$. In this setting, the actuarially fair price per dollar of insurance would be $p = r$, at which the insurer would make zero profits in expectation. Without any regulatory constraints the monopolist would maximize expected profits

$$\max_{p} \quad pq(p) - rq(p)$$

with the usual results. MLR regulation requires that expenditures on medical care (expressed here as the insurer's expected liability, $rq(p)$) exceed some share of premium revenues, so that $\frac{rq(p)}{pq(p)} \geq k$ for some $k \in (0, 1)$. Under MLR regulation, the firm therefore faces the objective function

$$\max_{p} \quad pq\,(p) - rq(p) + \lambda\,[rq(p) - kpq(p)] \tag{1}$$

Note that this constrained maximization is equivalent to the Lagrangian of Averch and Johnson (1962), equation (7), but with a single input, and the probability of the health shock playing the role of the marginal cost of the input. When the constraint binds, this yields

$$p\left(1 + \frac{1}{\varepsilon^D}\right) = \frac{1-\lambda}{1-k\lambda} r < r \tag{2}$$

The relationship between the optimal MLR and the inverse of the elasticity of demand makes clear that this is a markup regulation for all intents and purposes. The more inelastic is demand, the higher the optimal markup (and lower the MLR) for the unconstrained monopolist, and the more heavily behavior will be impacted by a minimum MLR requirement. Compared with the unconstrained monopolist, MLR regulation in this framework leads to more comprehensive coverage (i.e., higher actuarial value policies), as well as a lower price *per dollar* of insurance (i.e., a lower price per dollar of expected covered loss) for consumers. While MLR regulation reduces the monopoly distortion, it may not necessarily improve welfare: One must weigh the loss due to inefficient medical spending generated by moral hazard against the gain from, among other things, lowering the uncertainty in out-of-pocket health care spending to risk averse consumers. In any case, it certainly does not lead to a reduction in the insurer's premium revenue or claims costs: the elastic demand implied by the first order condition leads to an increase in total premium revenue ($pq(p)$), and total claims paid ($rq(p)$) increase with the more comprehensive coverage.

Having shown the equivalence of minimum MLR regulation with cost of service regulation, we now introduce the notion that the insurer decides how much effort, e, to exert in order to keep marginal costs down. That is, instead of just paying some share of the cost of the exogenous health shock, insurers participate in the the determination of the prices and quantities of health care services. In practice, this is a more accurate description of U.S. health insurance, in which insurers establish networks of doctors and hospitals with whom prices are negotiated (Dranove et al., 1993; Ho, 2009; Ho and Lee, 2017). Using the framework of Laffont and Tirole (1993), this effort is measured in dollars of reduced marginal costs, which are $c = \beta - e$ where $e \in [0, \beta]$. Effort is treated as a fixed cost, and reduces profits according to a convex function $\psi(e)$, where $\psi'(e) > 0$, $\psi''(e) > 0$.[13] The insurer therefore solves

$$\begin{aligned} \max_{p,e} \quad & [p - (\beta - e)]\,q\,(p) - \psi(e) \\ s.t. \quad & (\beta - e) \geq kp \end{aligned} \tag{3}$$

[13] Spending on effort in this setting can be appropriately thought of as spending on administrative costs, which detract directly from profits, and do not enter the numerator of MLR.

where k continues to denote the minimum allowable MLR. Supposing the constraint binds, one can substitute in for price to solve an unconstrained objective function in effort. This yields the first order condition:

$$q(p) + pq'(p) = -\frac{k}{(1-k)}\psi'(e)$$

The following result is proven in Appendix A:

Proposition 1 *Suppose the conditions necessary for (3) to be concave hold, and denote* (p^M, e^M) *the monopolist's optimal price per dollar of coverage and effort, respectively, when the constraint does not bind. Then the optimal level of effort under MLR regulation* k, $e^R(k) \leq e^M$, *with strict inequality if the regulation binds.*

Differentiating the binding regulatory constraint, the impact of a marginal increase in k on the price per dollar of coverage is

$$\frac{dp}{dk} = -\left(\frac{1}{k}\right)\left[p + \frac{de}{dk}\right] \tag{4}$$

This shows that in the absence of moral hazard's impact on the insurer's effort, the immediate effect of the MLR regulation is to reduce the price of a dollar of insurance (though, again, this causes an increase in total premiums due to the elastic demand for insurance). The ability to decide how hard to work to reduce marginal costs, however, erodes this effect, as $\frac{de}{dk} < 0$ (included in the proof of Proposition 1). If effort is sufficiently responsive (i.e., if the effort function $\psi(e)$ is not too convex relative to the curvature of premium revenues), an increase in the minimum allowable MLR will be accompanied by an *increase* in the price per dollar of insurance. Thus the impact on total premium revenues (and the comprehensiveness of coverage) is ambiguous.

The impact of MLR regulation on insurer claims costs depends on the potentially offsetting effects of higher marginal costs of providing insurance due to reduced effort and changes in the level of coverage purchased $q(p)$. The second order condition for (3) is nonetheless sufficient to ensure that total insurer claims rise, also proven in Appendix A:

Proposition 2 *Retaining the assumption that the solution to (3) is a maximum is sufficient to ensure that total claims under minimum MLR regulation,* $C^R(k) \equiv (\beta - e^R(k))\, q(p^R(k)) \geq C^M$, *the total claims under unconstrained monopoly, with strict inequality when the regulation binds.*

This model makes strong predictions about the impact of minimum MLR regulation on insurer claims costs, but abstracts away from several important features of insurance and health care markets to focus on parallels with cost of service regulation. Two additional margins of complexity strike us as promising for further study. First, insurers face demand uncertainty when setting premiums and choosing their level of cost-reducing effort. Thus, MLR regulation may affect the behavior of insurers for whom the regulation is non-binding, even in expectation, because they have optimized over the range of realizations of the demand distribution for which the regulation would bind. The law of large numbers implies this consideration would be more salient for smaller insurers than large ones, who face less uncertainty. Second, this model abstracts from consumer heterogeneity, a key focus of modern health economics research. One could imagine that another method by which to raise MLR could be to reduce screening effort aimed at avoiding high-cost consumers, thus expanding the cost base. The framework presented here does, however, provide a foundation to guide our empirical analysis of the impact of minimum MLR regulations on claims, utilization, and premiums per life-year, to which we now turn.

IV Data

In this section, we describe the sources of data used in our empirical analysis, discuss the sample restrictions used to create our analysis datasets, and present summary statistics overviewing the data.

Description of Data

The main source of data we use is from the National Association of Insurance Commissioners (NAIC), which is a standard-setting and regulatory support organization governed by insurance regulators from each state. As part of its mandate to coordinate regulatory oversight, the NAIC collects and publishes operational data from insurance companies. The data used in this study comes from the health insurance *Exhibit of Utilization, Premiums, and Enrollment* files, which include data on enrollment, claims expenses, and premiums written. These data are currently available for all health insurers by state and market segment between 2001 and 2014.[14] The market segments we will use in our analysis are the individual segment and the group segment. The NAIC data prior to 2011 does not distinguish between the small group (employer groups under 100 people) and large group (employer groups over 100 people) market segments; thus, we will pool the small and large group segments together throughout our analysis. We use

[14] A notable omission from the NAIC datasets are the majority of insurers in California, which follow different reporting requirements and report directly to the state as opposed to the NAIC.

this data for years 2005–2013, as reporting rule changes create compositional shifts during the 2001–2004 period, and major non-MLR regulatory changes begin in 2014 (described in Section II).

The second data source we use is a regulatory database maintained by the federal government. In order to implement the myriad changes set in motion in 2010, the ACA gave a new regulatory mandate to the Centers for Medicare and Medicaid Services (CMS), with the goal of coordinating and overseeing the major reforms in the health insurance industry. In fact, an entire new regulatory entity was created under the umbrella of CMS, named the Center for Consumer Information and Insurance Oversight (CCIIO). As part of this effort, CCIIO implemented its MLR enforcement system in 2011 by setting new data reporting requirements for health insurers and collecting these data into a new regulatory database. This database contains detailed financial information about health insurers across different market segments (individual, small group, and large group) at the state level and is currently available for 2011–2015. Among many other measures, this data contain enrollment, insurer MLRs, rebate payments, administrative costs, health improvement expenses, medical claims costs, and premium revenue by insurer, state, and market segment. To help insurers (and the government) prepare for this administrative burden, NAIC introduced the *Supplemental Health Care Exhibit* (SHCE) in 2010, which we append to the CCIIO database to provide us with a single year of pre-ACA data on these more detailed outcomes. We also use the CCIIO data to present the magnitudes of MLR rebate payments, and show how they have changed between 2011–2015.

From the NAIC data, we create an unbalanced panel dataset at the market segment-insurer-state (i) by year (t) level, and define insurer MLR as follows:[15,16]

$$MLR_{it} \equiv \frac{Claims_{it}}{Premiums_{it}} \tag{5}$$

The MLR calculated for 80/20 compliance is also a function of an insurer's "Quality Improvement Expenditures," which are allowed to enter the numerator of the MLR in order not to discourage spending on quality. Expenses that can fall into this category are specifically designated by the regulator as "activities that are likely to improve health outcomes, prevent hospital readmissions, improve patient safety and reduce medical errors, and increase wellness and health promotion" (The Centers for Medicare & Medicaid Services, 2014b). Additionally, insurers are allowed to make deductions from the MLR denominator for taxes and regulatory fees. We

[15] Note that an "insurer" as defined here is a unique reporting entity within a state, not a unique insurer "group" within a state. For example, LifeWise Health Plan of Washington is owned and operated by Premera Blue Cross, but reports to the NAIC under a separate licensing number, thus LifeWise and Premera are considered different insurers for the purposes of this analysis. Additionally, insurers commonly report their HMO business separately from the rest of their business, and thus these are treated separately.

[16] The field used to define *Claims* is Claims Incurred: "Amount incurred for provision of health services;" the field used to define *Premiums* is Premiums Earned: "Health premiums earned."

cannot observe these additional items in the pre-period and therefore do not use them in our calculation of insurers' MLR. Both of these omissions will bias our calculated insurer MLRs downwards. This will have the effect of attenuating our estimates by classifying some insurers as persistently below the minimum threshold even if they were in compliance once these adjustments were made (see Section V for more details).

To arrive at the final analysis dataset, we censor outlier observations with MLRs below the 1st and above the 99th percentiles, exclude observations with missing or negative data in key fields (claims, premiums, enrollment), and exclude insurer observations with fewer than 1,000 covered lives.[17] The majority of outlier observations are those for which the insurer had fewer than 1,000 covered lives, so the restrictions are highly overlapping. Geographically, we exclude observations from California (for reasons noted above) and U.S. territories. We also exclude a handful of observations manually that are clearly data errors.[18] We also omit insurers present in the NAIC data that are not present in the CCIIO data, to ensure we are studying only insurers that were subject to MLR regulation. Finally, given that our identification strategy relies on determining whether an insurer is likely to be directly affected by MLR regulation by examining their pre-period MLRs, we limit to insurers with at least one year of pre-period (2010 or earlier) data.[19]

Summary Statistics

As a graphical summary of our data, Figure 4 presents average per life-year premiums and claims over our analysis period, 2005–2013, normalized relative to their level in 2005. Additionally, means are enrollment-weighted to reflect the experience of the average enrollee, as opposed to the average insurer. In the group market, average per life-year claims and premiums in 2005 were $2,460 and $2,964, respectively. In the individual market, average per life-year claims and premiums in 2005 were $1,740 and $2,220, respectively. Growth in both claims and premiums has been substantial over this time period. This figure also makes clear that the variation among insurers used in this paper is unlikely to have had a noticeable impact on overall mean outcomes, as historical trends have largely persisted unabated at the aggregate level.

Next, Table 1 presents summary statistics from the analysis datasets in each market segment (group and individual) during the pre-period (2005–2010). It shows the average policyholder purchased a plan that was *just* in compliance with the eventual federal regulations. Premiums

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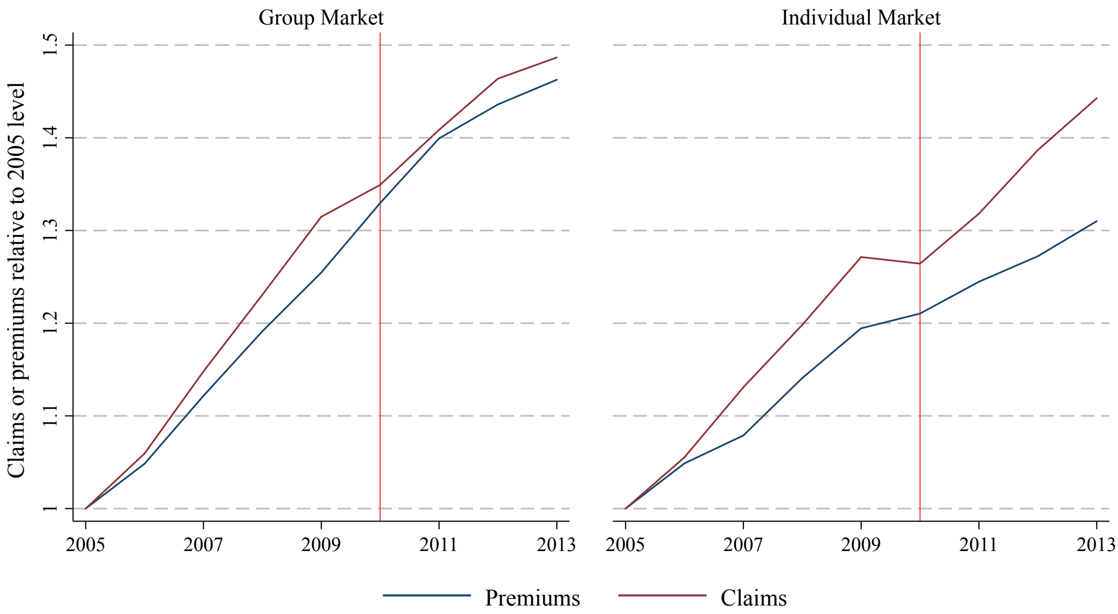
[17] 1,000 lives in the threshold for an insurer to be considered "credible" and to be subject to MLR regulation at all.

[18] A list of these errors is available from the authors upon request.

[19] We test the sensitivity of our results to this particular decision in Appendix C.5, finding that varying the number of pre-period observations required between one and four does not affect the results.

Figure 4: Growth of Claims and Premiums by Market Segment: 2005–2013



Note: Claims and premiums are measured as enrollment-weighted averages of per life-year values, taken from the panel of insurers used in our analysis from the NAIC data. The 2005 value of each series has been normalized to one.

account for 4–6% of median income over this period (∼$55,000/year). Claims and premiums tend to be higher in the group market than individual market. This is a highly concentrated industry, as is well-known, with even greater concentration in the market for individual insurance (scaling the HHI to be between 0 and 1, with the latter representing perfect monopoly, and the Department of Justice defines concentrations in excess of 0.25 to be *highly concentrated*). We have found the utilization measures in the NAIC data ("Ambulatory encounters" and "Inpatient admissions") to be somewhat noisy (and do not use them elsewhere in our analysis), but the means broadly reflect the difference in claims between market segments.[20]

[20] "Ambulatory encounters" are any broadly defined contacts with health providers on an outpatient basis.

Table 1: Insurer Summary Statistics (2005–2010)

	Group Market	Individual Market
MLR	0.85	0.81
	[*0.06*]	[*0.13*]
Claims per Life-Year (Dollars)	2,898	2,029
	[*707*]	[*868*]
Premiums per Life-Year (Dollars)	3,414	2,491
	[*806*]	[*814*]
# of Insurers per State	12.4	4.3
	[*6.2*]	[*2.9*]
State Market Scaled HHI	0.26	0.59
	[*0.18*]	[*0.26*]
Share Non-Profit	0.39	0.39
	[*0.49*]	[*0.49*]
Ambulatory Encounters per Life-Year	9.3	7.4
	[*4.6*]	[*3.8*]
Inpatient Admissions per Life-Year	0.07	0.05
	[*0.02*]	[*0.02*]
Lives per Insurer in 2010 (000s)	107.8	37.4
	[*207.9*]	[*62.5*]
Total Lives in 2010 (000s)	42,596	6,691
# of Insurers in 2010	395	179

Note: Insurer statistics are enrollment-weighted. Standard deviations are given in brackets. HHI is divided by 10,000 so that it ranges between 0 and 1. Statistics taken from the panel of insurers use in our anaylsis from the NAIC data.

V Empirical Strategy

Estimating the causal impact of minimum MLR requirements on insurer behavior in this setting presents two main empirical challenges. First, the level of "treatment," meaning the difference between an insurer's unconstrained MLR and the regulated minimum, is unobserved. Second, treatment is not randomly assigned, but depends on equilibrium objects determined endogenously. In this section, we describe how features of the regulation permit the use of a difference-in-difference design to bound the causal impact under standard assumptions.

Minimum MLR regulation requires that firm i in year t refund its customers if its realized MLR, m_{it}, is below some threshold k.[21] Nothing is required of the firm if its MLR is above k. However, m_{it} is an equilibrium outcome determined after annual claims cost uncertainty is

[21] In practice, this exact threshold allows for adjustments based on the number of lives covered by the insurer and special exemptions. We assume a single threshold here for ease of exposition, but use the modified thresholds in our empirical analysis. In addition, the unit of observation i is technically a firm-state-market combination.

resolved, so the contemporaneous distance from k cannot be used as a measure of the intensity of treatment. Instead, let m_{it}^* denote what the firm's profit maximizing *target* MLR would have been if not for the regulation.[22] This suggests the kinked treatment design

$$d_{it}^* = \begin{cases} 0 & if\ m_{it}^* \geq k \\ (k - m_{it}^*) & if\ m_{it}^* < k \end{cases}$$

Where d_{it}^* is firm i's true continuous level of treatment in year t. Although in reality firms are either "treated" or "untreated" on a yearly basis, our empirical strategy will rely only upon a firm's estimated treatment based on the mean of observed MLRs in the five years preceding the ACA, defined as $\hat{m}_i$, to measure the persistent component of a firm's distance from k.[23] Our continuous treatment measure $\hat{d}_i$ is defined analogously to the true treatment measure above, but uses these noisy estimates $\hat{m}_i$ instead of the true unobserved m_{it}^*. This treatment definition is motivated by the fact that 70% of the MLR variation in the individual market during the baseline period is due to these time-invariant differences across insurers. Using the mean m_{it} from the five-year baseline period 2006–2010 also prevents an anomalously low MLR just before the ACA from categorizing a firm into treatment, and subsequent mean-reversion from producing spurious results.

Measurement error in the treatment variable introduces attenuation bias to our estimates of the impact of minimum MLR regulations. Attenuation takes two forms: first, on the extensive margin, firms are mis-categorized in and out of treatment depending on whether the error is larger or smaller than $k - m_{it}^*$. Second, on the intensive margin the mis-measurement of treatment *intensity* induces classical measurement error.

Converting treatment into a binary measure depending on the sign of $k - \hat{m}_i$ limits measurement error to the extensive margin of mis-categorization. This is particularly helpful in the kinked design because firms most likely to be mis-categorized are those with the lowest levels of treatment. This substantially reduces the attenuation of treatment effect estimates relative to situations in which treatment is uniform once the running variable crosses the threshold. On the other hand, when much of the treated data is close to the threshold (as it is in our case), fitting a slope parameter allows the insurers predicted to be most treated (those with low $\hat{m}_{it}$) to exert greater influence on the estimate of the effect. Ultimately, the binary treatment measures the average effect on the treated population (and will be small if most of the sample is lightly treated), while the kinked design estimates the effect of an additional MLR-point of distance below the minimum threshold. In Appendix C.7, we employ an instrumental variables

[22] We emphasize that a firm's target MLR, m_{it}^*, is based on decisions made at the beginning of the year (regarding, e.g., premiums and effort) as well as on *expected* claims costs. *Realized* claims costs will not be known until the end of the year.

[23] General robustness to the width of this window is shown in Appendix C.2.

strategy to assess the importance of measurement error. We use noisy estimates from part of the pre-period to instrument for noisy-estimates from the other part of the pre-period. We find qualitatively similar and statistically indistinguishable results, suggesting that measurement error has a relatively minor impact on our estimates.[24]

The second main empirical challenge is that MLRs are not randomly assigned: costs and premiums are choice variables, so that firms are treated according to endogenous business decisions. Using the time-invariant definition of treatment assignment described above ensures that transitory shocks are not pushing firms in to one group or another. Combining this treatment definition with a complete set of insurer (γ_i) and year (δ_t) fixed effects yields a difference-in-difference framework of the form

$$y_{it} = \gamma_i + \delta_t + \tau D_{it} + \beta t \mathbb{1}\left\{\hat{d}_i > 0\right\} + u_{it} \tag{6}$$

where $D_{it} \equiv \mathbb{1}\left\{\hat{d}_i > 0;\ t > 2010\right\}$ in the binary treatment version (and $\mathbb{1}\{\cdot\}$ is an indicator function evaluating to one if the statement inside is true), or $D_{it} \equiv \hat{d}_i$ for the continuous treatment version, and y_{it} is an outcome variable of interest. The parameter β measures the slope of a treatment group-specific linear trend, which is omitted in the event-study figures that estimate year-specific τ_t. This framework identifies the treatment effect based on the change in exposure to MLR regulation experienced between the pre- and post-period, recognizing that firms with $\hat{d}_i < 0$ were already in compliance before the regulation took effect, and therefore serve as the control group. This requires that unobservable determinants of outcomes be either time-invariant, common across firms, or linear in time according to treatment group assignment. We use event-study-type figures to diagnose the potential for confounding differential trends, as well as demonstrate the robustness of our results to various specifications of unobservables. While MLR remains an endogenous equilibrium object, our definition of treatment is based on the pre-treatment period while also conditioning on the time-invariant determinants of these outcomes.

The key remaining threat to identification is that other regulations also implemented as part of the ACA might have had a differential impact on firms depending on their baseline MLR. To diagnose the potential magnitude of this concern, we also evaluate enrollment as an outcome variable: regulations mandating coverage for particular groups (such as dependents up to age 26) should lead to a differential change in enrollment if it were to confound our estimates of the impact of minimum MLR regulations. On the other hand, signing up a disproportionate number of high-risk individuals might also be an insurer's strategy for MLR compliance. Thus

[24] It is unfortunately not possible to use states' heterogenous MLR regulation preceding the ACA as an instrumental variable for treatment. Only eight firms experienced a state-based change in MLR regulation during the baseline period, making the instrument nearly completely collinear with firm fixed effects.

this diagnostic rules out a potential threat if an effect is not detected, but does not *necessarily* invalidate the exercise if there is a relative change in enrollments coincident with the ACA.[25]

Table 2 presents summary statistics for firms separated by the binary measure of treatment ($D_i \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$) during the baseline period for both the group and individual market segments. Consistent with Table 1, it shows a substantially larger MLR gap between treated and untreated firms in the individual market than the group market. While treated insurers in both market segments have slightly lower premiums than their untreated counterparts, their claims per enrollee are so much lower that their MLRs are not in compliance.[26]

Table 2: Insurer Summary Statistics by Treatment (2005–2010)

	Group Market		Individual Market	
	Treated	Untreated	Treated	Untreated
MLR	0.80	0.87	0.71	0.87
	[*0.04*]	[*0.05*]	[*0.07*]	[*0.12*]
Claims per life-year	2,680	2,979	1,645	2,259
	[*598*]	[*727*]	[*354*]	[*995*]
Premiums per life-year	3,366	3,431	2,329	2,589
	[*716*]	[*837*]	[*426*]	[*962*]
# of insurers per state	3.1	10.5	2.3	3.8
	[*1.5*]	[*5.6*]	[*1.5*]	[*3.0*]
State Market Scaled HHI	0.26	0.26	0.62	0.57
	[*0.14*]	[*0.19*]	[*0.24*]	[*0.27*]
Percent nonprofit	0.00	0.53	0.00	0.62
	[*0.00*]	[*0.50*]	[*0.00*]	[*0.49*]
Ambulatory encounters per life-year	8.8	9.6	6.2	8.0
	[*3.9*]	[*4.8*]	[*2.5*]	[*4.2*]
Inpatient admissions per life-year	0.06	0.07	0.04	0.05
	[*0.02*]	[*0.02*]	[*0.01*]	[*0.02*]
Lives per insurer in 2010 (000s)	127.6	101.7	49.2	32.3
	[*192.0*]	[*212.5*]	[*87.6*]	[*47.4*]
Total lives in 2010 (000s)	11,990	30,606	2,655	4,036
# of insurers in 2010	94	301	54	125

Note: Insurer statistics are enrollment-weighted. Standard deviations are given in brackets. HHI is divided by 10,000 so that it ranges between 0 and 1. Statistics taken from the panel of insurers use in our anaylsis from the NAIC data.

There are other systematic differences between treated and untreated firms: treated firms tend to operate in markets with less competition and also tend to be larger. Lower claims for these larger insurers is consistent these firms' ability to negotiate lower prices with providers

[25] The wider roll-out of exchanges for individual coverage in 2014 substantially disrupts the individual market for health insurance, and thus as mentioned previously, we end our analysis in 2013.

[26] Nonprofits were exempt from minimum MLR regulation, and so are never classified as treated, regardless of their MLR.

(Roberts et al., 2017), take advantage of economies of scale, and perhaps otherwise leverage market power. Their overall lower MLRs suggest that any cost savings are not making their way to consumers.

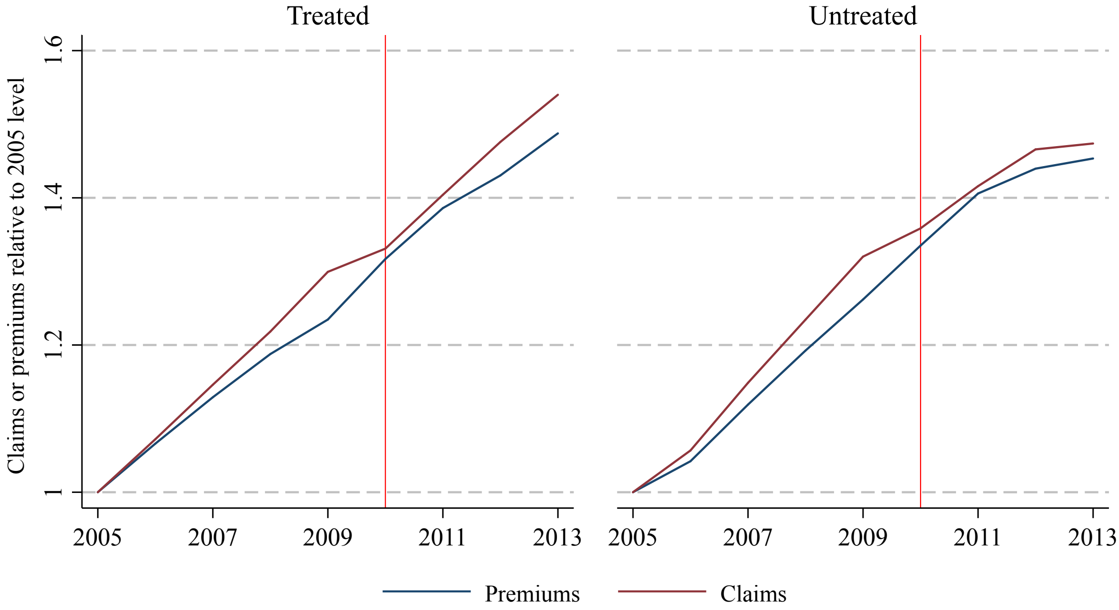
Finally, using our binary measure of treatment, we can present a graphical description of the data that is now broken out between treated and untreated insurers. Figures 5 and 6 recreate the same plots shown in Figure 4, but now separately for treated and untreated insurers for each market segment. As before, weighted average per life-year claims and premiums are normalized by their 2005 levels. Starting with the individual market in Figure 5, it is immediately evident that there appears to be a break in trend in the growth of claims costs of treated insurers in 2011, with no such break experienced by untreated insurers or in the premium series of either set of insurers. In the group segment, shown in Figure 6, there is not as obvious of a movement in means between treated and untreated insurers, but it appears that claims and premiums for treated insurers grow more quickly than those of untreated insurers after 2011. In the next section, we aim to formalize and quantify the findings suggested in these figures using regression analysis.

Figure 5: Growth of Claims and Premiums in the Individual Market, by Treatment

Note: Claims and premiums are measured as enrollment-weighted averages of per life-year values, taken from the panel of insurers used in our analysis from the NAIC data. The 2005 value of each series has been normalized to one. $Treatment \equiv D_i \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$.

The MLR CDFs shown in Figure 2 and the effects on treated firms' claims and premiums shown in Figure 6 suggest a much smaller scope for potential effects in the group market relative to the individual market. This is not particularly surprising given our inability to separate the

Figure 6: Growth of Claims and Premiums in the Group Market, by Treatment



Note: Claims and premiums are measured as enrollment-weighted averages of per life-year values, taken from the panel of insurers used in our analysis from the NAIC data. The 2005 value of each series has been normalized to one. $Treatment \equiv D_i \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$.

small and large group markets in the NAIC data. We therefore have much less variation for identifying causal effects of MLR regulation in the group segment. For this reason, we focus the figures in the remainder of the body of the paper on our findings from the individual market segment, and collect figures showing our group market results together in Appendix B.

VI Results

In this section, we begin by presenting event-study plots of our main empirical specifications, which serve to provide a graphic illustration of our findings as well as motivate our final regression specification. We then present our main results using the outcome variables of MLR, $ln(Claims)$, and $ln(Premiums)$, using both our binary and continuous definitions of treatment. We also present the results using various alternative specifications, confirming the robustness of our results. We then use enrollment as the outcome variable to bound the extent to which differential changes might explain our results. Finally, we use Quality Improvement expenditures and administrative costs as outcome variables to provide suggestive evidence of how insurers may have complied with MLR regulation.

Estimates by Year to Implementation

Figure 7 presents regression-adjusted estimates of the difference in average MLRs across the treated and control groups for each year, relative to 2010. These estimates are based on our empirical specification in equation (6), but instead each τ_t is estimated separately, and the regression does not control for a differential treatment-group-specific trend. By omitting this variable, we are able to assess the extent to which a difference in trends across our treated and control groups might contribute to the overall point estimate. The figures reveals that in the individual market, the treated and control groups have similar MLRs between 2005 and 2010. However, as soon as the rule is implemented, MLRs rise in the treated group relative to those in the control group.

Figure 7: Treatment Effects by Year in Individual Market: MLR

Note: Figure is based on estimation of equation (6) using MLR as the outcome variable and the binary definition of treatment, with year-specific treatment effects relative to 2010, and omitting the treatment group-specific linear trend. Regressions are weighted by enrollment. The broken lines are pointwise 95 percent confidence intervals based on standard errors clustered at the insurer level. $Treated \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$.

Next, Figure 8 shows analogous results using the natural log of claims per life-year as the outcome variable, showing that claims for treated firms appear to be falling slightly relative to untreated firms. Upon the implementation of the ACA's MLR regulation in 2011, the treated group's claims jump up and continue to rise.

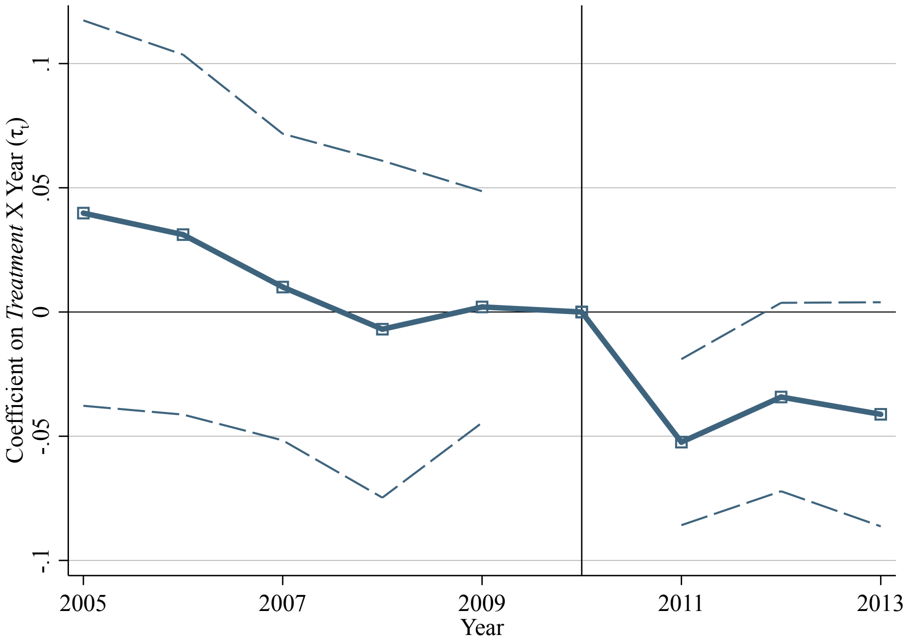
Figure 9 presents the same analysis using the natural log of premiums per life-year as the outcome variable. Again, we see a downward trend during the pre-period. In this case, it is not

Figure 8: Treatment Effects by Year: $ln(Claims)$

Note: Figure is based on estimation of equation (6) using claims as the outcome variable and the binary definition of treatment, with year-specific treatment effects relative to 2010, and omitting the treatment group-specific linear trend. Regressions are weighted by enrollment. The logged outcome variable $Claims$ is measured on a per life-year basis. The broken lines are pointwise 95 percent confidence intervals based on standard errors clustered at the insurer level. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$.

clear whether the lower premiums observed after 2011 are actually a response to the regulation, or simply the continuation of a previous trend. The differential pre-trends observed in claims costs and premiums motivate the inclusion of treatment group-specific linear trends in our main empirical specification.

Figure 9: Treatment Effects by Year: $ln(Premiums)$



Note: Event-study figures are based on estimation of equation (6) using the binary definition of treatment, with year-specific treatment effects relative to 2010, and omitting the treatment group-specific linear trend. Regressions are weighted by enrollment. The logged outcome variable *Premiums* is measured on a per life-year basis. The broken lines are pointwise 95 percent confidence intervals based on standard errors clustered at the insurer level. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$.

Main Specifications

We now move to estimation of our main specifications, which we will present for both our binary and continuous definition of treatment. First, Table 3 reports the results of estimating equation (6) in the individual market with our binary treatment specification. We present results for three outcome variables: MLR, $ln(Claims)$, and $ln(Premiums)$.[27] If interpreted causally, the coefficients on *Year* $\geq$ *2011 * Treatment* indicate the average treatment effect of MLR regulation on the treated insurers. The coefficients on *[Year] * Treatment* for 2011, 2012, and 2013 show how the estimated treatment effect varied over the post-ACA period.

Our estimates suggest that after 2010, treated insurers experienced an increase in MLR that was 7.3 percentage points higher than the counterfactual, an amount roughly equal to treated insurers' average distance below the regulatory threshold (about 8%). Column (2) confirms the patterns in Figure 7: treated insurers experienced an immediate jump in MLRs in 2011 and small additional increases in each subsequent year. Moving to column (3), the claims costs of treated insurers rose by an average of 6.8% in the three years after the implementation of

[27] We note again here that *Claims* and *Premiums* are measured on a per life-year basis.

Table 3: Effects of Minimum MLR Regulations: Individual Market, Binary Treatment

	MLR		ln(Claims)		ln(Premiums)	
	(1)	(2)	(3)	(4)	(5)	(6)
Year $\geq$ 2011 * *Treatment*	0.073		0.068		-0.025	
	(0.018)***		(0.030)**		(0.024)	
2011 * *Treatment*		0.066		0.048		-0.036
		(0.017)***		(0.027)*		(0.022)
2012 * *Treatment*		0.082		0.095		-0.010
		(0.020)***		(0.035)***		(0.027)
2013 * *Treatment*		0.094		0.112		-0.008
		(0.025)***		(0.042)***		(0.035)
R^2	0.75	0.75	0.89	0.89	0.86	0.86
# Insurers	184	184	184	184	184	184
Observations	1,417	1,417	1,417	1,417	1,417	1,417

Note: Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. The outcome variables *Claims* and *Premiums* are measured on a per life-year basis. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

federal MLR regulation, above what their past trends and the experience of untreated firms would predict. Treated firms in the individual market appear to have adjusted their claims costs somewhat gradually; column (4) shows that the impact on treated insurers' claims rose from a 4.8% increase in the first year of the regulation to more than 11% by 2013. In column (5), our point estimate suggests that premiums might have fallen slightly for treated insurers after the regulation went into effect, but we lack the statistical precision to reject the null of no effect. That said, the time path of the effect on premiums shown in column (6) is consistent with a small reduction in the first year of the regulation, but then subsequent adjustments with the effect that there was no impact on premiums three years out. In all specifications, we weight (insurer-state-year) observations by the number of life-years to reflect the experience of the average enrollee; our results are qualitatively similar, and quantitatively larger, when unweighted (see Appendix C.1).

Next, Table 4 presents the results of the same analysis, but using our continuous definition of treatment, namely the distance below the MLR threshold a treated insurer was predicted to be in 2011. Here, a coefficient of one would imply that moving an insurer's target MLR one percentage point farther below the regulated threshold in 2011 would increase the corresponding outcome by 1%, a sort of MLR distance-elasticity. Using this specification, we can see that, as expected, the treatment effect is strongly increasing in insurers' exposure to the regulation. In other words, insurers further below the regulatory threshold experience larger responses in both MLR and claims costs. In terms of magnitudes, the point estimates in columns (1) and

(2) suggest that increasing treatment intensity by one MLR point (e.g., going from 0.07 to 0.08 below the MLR threshold) increases a firm's MLR in the post period by almost 0.007 (e.g., the rise in MLR goes from 0.049 to 0.056). Column (3) shows that the effect on claims is nearly identical and growing over time.

Table 4: Effects of Minimum MLR Regulations: Individual Market, Continuous Treatment

	MLR		ln(Claims)		ln(Premiums)	
	(1)	(2)	(3)	(4)	(5)	(6)
Year $\geq$ 2011 * *Treatment*	0.695		0.700		-0.311	
	(0.117)***		(0.199)***		(0.148)**	
2011 * *Treatment*		0.597		0.415		-0.450
		(0.120)***		(0.184)**		(0.143)***
2012 * *Treatment*		0.719		0.836		-0.214
		(0.112)***		(0.210)***		(0.162)
2013 * *Treatment*		0.835		1.013		-0.200
		(0.162)***		(0.263)***		(0.187)
R^2	0.75	0.76	0.89	0.89	0.86	0.86
# Insurers	184	184	184	184	184	184
Observations	1,417	1,417	1,417	1,417	1,417	1,417

Note: Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. The outcome variables *Claims* and *Premiums* are measured on a per life-year basis. $Treatment \equiv \hat{d}_i$. * p<0.10, ** p<0.05, *** p<.01.

This specification again finds that treated insurers responded in the short run by lowering premiums, but that this effect diminished over time. Unlike the binary treatment specification, we now have the statistical power to reject the null of no effect on premiums in the first year following the implementation of MLR regulation. If there are greater adjustment costs to raising claims costs as opposed to simply dropping premiums, firms might choose to lower premiums in the short run, but in the longer run, might reoptimize over inputs (e.g., effort) such that claims ultimately rise and premiums return to whatever levels the market will bear.

Appendix Tables B.1 and B.2 present equivalent analyses for the group market. Qualitatively, the results closely parallel those we found for the individual market: MLRs and claims costs grew each year after the new regulation went into effect. Our coefficient estimates in the group market are closer to zero, reflecting the fact that the group market as a whole was much closer to compliance than the individual market. Our preferred specifications using the binary treatment definition show a 1.5% increase in MLR, a 2% increase in claims, and no change in premiums for treated insurers in the post period.

Robustness and Alternative Specifications

Changes in the market landscape such as increased consolidation of providers or the entry of new health insurers seem likelier to occur in markets where health insurers have market power. Since Karaca-Mandic et al. (2015) have found that low MLRs are associated with market power, we might think these other changes are happening more frequently in states and years in which there is a higher concentration of low MLR insurers. To rule out these stories, and others that would create confounding variation at the state-by-year level (such as the early Medicaid expansions), we also include state-by-year fixed effects into our specifications. Table 5, column (2) presents these results for the individual market, binary treatment specification, with MLR as the outcome of interest. The first column reproduces our baseline results, and column (2) shows the results once state-by-year fixed effects have been included. The results are qualitatively similar (if not somewhat stronger), and statistically indistinguishable from each other.

Table 5: Sensitivity Analysis: Individual Market, Binary Treatment

	MLR				
	(1)	(2)	(3)	(4)	(5)
Year $\geq$ 2011 * *Treatment*	0.073	0.081	0.077		
	(0.018)***	(0.024)***	(0.022)***		
Year $\geq$ 2011 * *Treatment* * *Treated State*				0.089	0.100
				(0.023)***	(0.035)***
Year $\geq$ 2011 * *Untreated* * *Treated State*				0.026	0.027
				(0.020)	(0.022)
Year $\geq$ 2011 * *Untreated* * % *Treated*					-0.006
					(0.027)
State-by-year FE	No	Yes	No	No	No
Exclude nonprofits	No	No	Yes	No	No
R^2	0.75	0.85	0.70	0.75	0.75
# Insurers	184	184	126	184	184
Observations	1,417	1,417	931	1,417	1,417

Note: The dependent variable in all columns is MLR. Column (1) reproduces results from our main specification. Column (2) includes state-by-year fixed effects. Column (3) drops insurers that were ever nonprofits. Columns (4) and (5) present effects on untreated insurers in states with treated insurers versus those in states without treated insurers. *Treated State* is a state-level indicator variable for whether any treated insurer existed in a given state. % *Treated* is a state-level variable that measures the fraction of life-years that were treated in 2011. Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include insurer fixed effects and a treatment group linear time trend. *Treatment* $\equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table 5 also presents results where we have dropped nonprofit insurers. Nonprofit insurers were required to report their financial information just as for-profit insurers were, but they were not actually subject to the same MLR requirements. It was not until 2014 when nonprofit insurers faced any penalties for not meeting the federal MLR thresholds.[28] Up to this point in the

[28] Nonprofit insurers were faced with losing the tax advantages they gain through their nonprofit status (Kirchhoff,

analysis, we have treated nonprofits as firms that were in compliance with their MLR requirements, regardless of their actual MLRs. However, unlike the hospital market where for-profit and nonprofit hospitals behave very similarly (Norton and Staiger, 1994; Sloan, 2000; Picone et al., 2002), for-profit and nonprofit insurers do not appear to do so (Dafny and Ramanarayanan, 2012; Lieber, n.d.). Because of this, it is not clear that nonprofit insurers can be reasonably included in our control group. Despite these potential differences, column (3) shows that nonprofit insurers are not driving our results, as our point estimates are largely unaffected when we drop nonprofit insurers altogether.

Finally, given the small number of firms operating in these markets, it is likely that insurers respond to actions taken by their competitors. Thus, it is plausible that untreated insurers could have been indirectly affected by MLR regulation if they operated in the same market as treated insurers. Such an effect, if it exists, would be additive with our primary estimation of the *relative* effect of MLR regulation between treated and untreated firms. Our results would be biased towards zero, for example, if a competing, but untreated firm raised the actuarial value of its insurance product to compete with a treated insurer. To test for this effect, columns (4) and (5) of Table 5 present the results of a specification in which our treatment variable is interacted with state-level measures of treatment. In this way, we can determine whether there was a differential response among *untreated* insurers based on the extent to which other insurers in their same market were treated. The variation we use for this analysis arises from the fact that, in the individual market, almost one third of the insurers in our sample are in one of the 17 states in which there were zero treated insurers. This leaves roughly another third of insurers that are untreated but located in a state with treated insurers, and the final third of insurers are treated. We construct both a binary and a continuous measure of treatment at the state level: $Treated\ State$ measures whether or not any insurer was treated in that state-market segment, and $\%\ Treated$ measures the fraction of life-years in the state that were treated. Table 5, column (4) includes only the binary indicator of state treatment, while column (5) also includes the continuous measure. We find evidence that untreated insurers in states with treated insurers do experience slightly higher MLRs than their counterparts in states without treated insurers, but are unable to reject a null effect.

We have reproduced all specifications in Table 5 for the additional outcomes of claims and premiums, as well as conducted these alternative analyses for our continuous treatment measure in the individual market. In each case, the state-by-year fixed effects and the exclusion of nonprofits from our sample either increase the magnitude of our estimates or has no effect. Tables with these results are included in Appendix C.2.

To address directly whether our results can be explained by variation in market power or

2014).

market concentration, we next present specifications in which we interact our main treatment variables with such measures. Table 6 presents our main specifications using the binary treatment definition in the individual market, but adding interactions with either insurer market share or state Herfindahl-Hirschman Index (HHI). The variable *Market Share* is constructed at the insurer-state level, and gives each insurer's market share in the relevant market segment. The variable *HHI* is constructed at the state level, and measures the market concentration in the relevant market segment of that state. Both measures are based on 2010 data. We do not find strong evidence that the magnitude of treatment effects are correlated with either insurer market share or market structure. However, given that these variables are strongly correlated with whether an insurer was treated in the first place (see Table 2), the presence of these controls reduces the precision of our treatment effect estimates. The HHI interactions suggest that more competitive markets are more likely to achieve MLR increases with a balanced combination of premium reductions and claims increases, while concentrated areas focus on increasing claims (complementary to the findings of Cabral et al. (2015)), but we lack statistical precision to reject identical responses. The corresponding results for our continuous treatment measure are presented in Appendix C.3; we find similar results.

Table 6: Heterogeneity by Market Structure: Individual Market, Binary Treatment

	MLR		ln(Claims)		ln(Premiums)	
	(1)	(2)	(3)	(4)	(5)	(6)
Year $\geq$ 2011 * *Treatment*	0.081	0.080	0.079	0.056	-0.031	-0.054
	(0.023)***	(0.027)***	(0.049)	(0.062)	(0.042)	(0.050)
Year $\geq$ 2011 * *Treatment* * *Market Share*	-0.014		-0.018		0.009	
	(0.028)		(0.059)		(0.060)	
Year $\geq$ 2011 * *Treatment* * *HHI*		-0.012		0.022		0.050
		(0.036)		(0.080)		(0.079)
Interaction var. mean	0.29	0.54	0.29	0.54	0.29	0.54
R^2	0.75	0.75	0.89	0.89	0.86	0.86
# Insurers	184	184	184	184	184	184
Observations	1,417	1,417	1,417	1,417	1,417	1,417

Note: Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. The outcome variables *Claims* and *Premiums* are measured on a per life-year basis. HHI is divided by 10,000 so that it ranges between 0 and 1. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Our results are generally robust to different metrics used to define treatment. While in our main analyses we use 2006–2010, one can vary the set of years used to predict whether a firm's target MLR $\hat{m}_i$ was below the regulatory threshold in 2011. Appendix C.4 present results from our main specifications for both the binary and continuous treatment definitions using data from windows leading up to 2010 of varying width (including 2010 alone) to predict treatment status; our results are quite robust to these variations. The results are also robust to the number of pre-period observations a firm was required to have in order to predict whether or not it would be treated by the new MLR regulations. One potential concern is that a single measurement during the 2006–2010 period might be a poor predictor of what the firm's MLR would be in 2011, and thereby provide a particularly noisy measure of which firms are actually treated (in addition to one which would be more likely subject to mean reversion). In our main analyses presented above, we require firms to have only one pre-period observation. Appendix C.5 presents results for specifications that vary the required number of pre-period observations between 2 and 4. Again, in light of the fact that large insurers are consistently present in the data, the results are not sensitive to which method is used.

Finally, we pursue an instrumental variables strategy in Section C.7 to diagnose the extent of noise in the definition of treatment. We create one estimate for a firm's treatment status using data from 2006–2008 and another using data from 2009–2010. We instrument for the 2009–2010 measure with the 2006–2008 measure. For our binary treatment variable, the potential measurement error is non-classical. In this setting, IV will be upwards-biased, and allows us to bound the true effect (Black et al., 2000; Kane et al., 1999). Our IV estimates are generally quite similar to our OLS estimates, again suggesting that measurement error is not playing a major role in our results.

Effects on Enrollment

One way that we can investigate whether treated and untreated firms were differentially impacted by concurrent ACA regulations, such as the requirement to extend coverage to dependents up to age 26, is to test whether our treated firms experienced differential changes in enrollment in the post period. Furthermore, this analysis provides evidence on whether treated insurers may have responded to MLR regulation by increasing the quality of their products, which could then translate into a differential demand response for these firms.

Table 7 presents the results of estimating equation (6) with the natural log of enrollment as the outcome variable. Our point estimate suggests that enrollment increased disproportionately among treated insurers, but we are unable to reject a null effect due to imprecision. One pattern that is reassuring (though also not statistically significant) is that this enrollment increase does not become stronger over time, suggesting it is not driving our estimates of rising claims costs among treated insurers. To gauge the extent to which a differential increase in enrollment could explain our results, suppose treated insurers experienced an increase in enrollment of 20%, at the upper end of what our point estimates fail to reject. In order for a 20% increase in enrollment to explain a 7% increase in claims costs, the new enrollees would have to be 42% sicker than the incumbent population. This change in risk pool health would have to become even stronger over time. However, the contemporaneous changes that occurred with the implementation of the 80/20 rule were the extension of coverage to dependents under 26 (which would likely pull claims per life-year down) and coverage of preventive care. We view these offsetting effects as unlikely to explain the observed cost changes.

Table 7: Effect of Minimum MLR Regulations on Enrollment, Individual Market

	ln(Enrollment)	
	(1)	(2)
Year $\geq$ 2011 * *Treatment*	0.072	
	(0.089)	
2011 * *Treatment*		0.081
		(0.072) *
2012 * *Treatment*		0.052
		(0.120)
2013 * *Treatment*		0.083
		(0.164)
R^2	0.91	0.91
# Insurers	184	184
Observations	1,417	1,417

Note: The dependent variable is $ln(Enrollment)$. Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Cost-Reducing Effort and Utilization

Our theory predicts that minimum MLR regulations will reduce insurers' incentives to keep claims costs down. At the same time, insurers are permitted to count quality improvements as claims, which could contribute to increased MLRs. We now present suggestive evidence of how these mechanisms interacted with MLR regulation using data on two additional outcomes: administrative expenses and quality improvement expenditures. A key limitation of our data on these measures is that reporting only began in 2010.[29] We therefore present these results as merely suggestive because we are unable to examine pre-existing differential trends across the treatment and control insurers that might be driving the results.

Administrative expenses are insurers' non-medical costs for items such as salaries and advertising, which much like the cost of effort $\psi(e)$ in our model, do not enter the numerator of the

[29] Other utilization measures reported to NAIC throughout the study period are sufficiently noisy that we are unable to reject large changes (positive or negative).

MLR calculation. Thus, the portion of premium revenue that is not spent paying medical claims (at most 20% or 15% under MLR regulation) must be split between administrative expenses and profits. As of 2010, administrative costs represent approximately 10% of total premiums revenue, and thus the balance represents insurer profit margins. To the extent that administrative spending reflects the direct costs of managing care or negotiating provider prices, our theory predicts that such spending should fall when the minimum MLR regulation binds.

As described in section II, qualifying quality improvement (QI) expenditures are defined as insurer expenses to directly improve enrollee health outcomes (such as programs to reduce medical errors and prevent hospital readmission). These are considered medical claims for the purpose of MLR calculation under the ACA, and thus enter the numerator of MLR. To the extent that there are certain administrative expenses that could be considered QI, one would suspect there might be some relabelling in pursuit of MLR compliance. However, QI expenditures are generally small, representing about 1% of premiums, so it would be difficult to make a material change in MLR without substantially increasing QI expenditures, which could raise red flags. We nonetheless expect such expenses to increase when the regulation binds.

Tables 8 presents the results of our main specifications using QI and administrative expenses as outcomes for the individual market, using our binary definition of treatment based on historical MLRs during the 2006–2010 period. Now, however, the sample only exists between 2010–2013, and thus the baseline period is only 2010.[30] While the results generally lack precision, the signs are consistent with what one might expect: QI spending goes up, and administrative costs fall.

Given that administrative costs account for a roughly 10 times larger portion of premium revenue than does QI, the fall in administrative costs is substantially larger than the increase in QI expenditures, supporting the notion that this is not simply an exercise in relabelling. Indeed, in Appendix C.6 we show that the total impact of adjustments between "raw" (unadjusted) and "final" (including adjustments) claims is only 2 percentage points higher for firms that would owe a rebate in a particular year, suggesting relatively limited leeway for relabelling one's way into minimum MLR compliance. Instead, the results of Tables 8 are consistent with a fall in the marginal product of claims cost-reducing activities that are costly to undertake, leading insurers to scale back these efforts. We again caution that these estimates omit the treatment group-specific trends included in our main results.

[30] The data used for this analysis is from the NAIC *Supplemental Health Care Exhibit*.

Table 8: Effects of Minimum MLR Regulations on Other Outcomes, Individual Market

	ln(QI Spending)		ln(Admin. Costs)	
	(1)	(2)	(3)	(4)
Year >= 2011 * *Treatment*	0.120		-0.136	
	(0.126)		(0.078)*	
2011 * *Treatment*		0.022		-0.180
		(0.090)		(0.070)**
2012 * *Treatment*		-0.036		-0.193
		(0.118)		(0.064)***
2013 * *Treatment*		0.369		-0.035
		(0.233)		(0.149)
Mean Share of 2010 Premiums	0.01	0.01	0.13	0.13
R^2	0.71	0.73	0.72	0.72
# Insurers	171	171	171	171
Observations	617	617	602	602

Note: The dependent variable is given in the column headings ("QI Spending" is Quality Improvement Spending, and "Admin. Costs" are administrative costs). All dependent variables are on per life-year basis. Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include insurer and year fixed effects. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

VII Conclusion

This paper connects regulations of actuarial fairness to cost of service regulation, and uses the recently-implemented '80/20' rule in the ACA to estimate the role these forces play in the determination of insurer claims costs and premiums in the private health insurance market. The 80/20 rule requires health insurers in the commercial, fully-insured market to keep the share of their premium revenue spent on medical claims, known as the Medical Loss Ratio (MLR), above a minimum threshold, and to rebate the difference to customers if they fall short of this minimum. We find robust evidence that insurers increased their MLRs to comply with the regulation, and that this increase came largely through increases in claims costs, not premium reductions.

We find that insurers in the individual market were most strongly impacted by the 80/20 rule, with affected insurers increasing their claims costs 7% on average and as much as 11% after two years of adjustment. We find that the rule also resulted in higher MLRs and claims costs in the group market, though the regulation was less binding in this segment. We generally find that the magnitude of the increase in claims costs scales with the initial distance from the minimum threshold. These results stand in stark contrast to the original intention of the rule: lower premiums. We do not find that insurers lowered per-enrollee premiums as a means to increase their MLR.

Although the exact mechanism by which insurers increased claims costs remains unclear, we believe there are three possible explanations: (1) affected insurers experienced a decline in the health of their insured populations, (2) affected insurers increased the comprehensiveness (i.e., actuarial value) of their insurance products, or (3) affected insurers reduced costly efficiency effort and thus increased input costs, holding product characteristics fixed. Concurrent industry changes such as requiring coverage of dependents under 26 years old and mandatory coverage of preventative care potentially have impacts parallel with explanation (1) to the extent such rules fell disproportionately on historically low-MLR insurers. Our results on enrollment changes suggest that route (1) is unlikely: if we were to suppose there were a 20% increase in enrollment for treated insurers (at the upper end of what our data can fail to reject, given imprecise estimates), these individuals would have to be 42% more costly to insure than the average policyholder in order to explain our claims costs estimates.

Instead, it is more likely that insurers raised their claims costs from a combination of more comprehensive coverage and reduced cost-containment effort, such as negotiations with providers or claims utilization management practices. While the difference between these two mechanisms is pivotal for interpreting the welfare effects of the regulation, our data does not allow us to observe plan cost-sharing characteristics. As an indirect measure of such effort, we consistently find across market segments that insurers with historically low MLRs reduced their administrative expenses when minimum MLR rules were instituted. This is consistent with a fall in the value of cost-reducing effort once profits and costs are coupled by regulatory constraint.

The implications of this type of regulatory mechanism in health care are substantial. Although a relatively small share of the population was directly impacted by the 80/20 rule, our results suggest minimum MLR regulations have played an important role in shaping incentives in the health insurance industry: these incentives persist as firms come in to compliance and rebates become minimal. A robust literature has grown out of the original insight that cost of service regulation distorts firm incentives in the utilities sector. Drawing parallels between this form of regulation and rules in force for health insurers raises the possibility of transferring some of those lessons over to reduce the cost of health care.

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Appendix A Theory Appendix

Proof of Proposition 1

Let k^M denote the MLR of the unregulated monopolist, so that the constraint of (3) would just bind if it were mandated as the minimum allowable MLR. Then the change in effort with the introduction of MLR regulation k is

$$e^R(k) - e^M = \int_{k^M}^{k} \frac{de}{d\kappa} d\kappa$$

Total differentiation of the first order condition of (3), having substituted the constraint for an unconstrained function of e yields

$$\frac{de}{dk} = \left\{ \frac{[q(p) + pq'(p)] + (1-k)\, p\, [2q'(p) + pq''(p)]}{k^2 \psi''(e) - (1-k)\,[2q'(p) + pq''(p)]} \right\}$$

In the numerator, the first term in brackets is negative from the first order condition since $\psi'(e) > 0$ and $k \in (0,1)$. The sign of the second term depends on the second derivative of premium revenue with respect to price, which must be negative for the unconstrained monopolist's objective function to be concave (i.e., downward sloping marginal revenue). The denominator is the opposite sign of the second order condition, and is therefore positive for the regulated insurer's solution to be a maximum. Effort is therefore declining in the MLR regulation whenever the constraint binds, so that $e^R(k) - e^M < 0$ so long as the insurer's decision is affected by the regulation.$\blacksquare$

Proof of Proposition 2

The derivative of total insurer claims, $C \equiv (\beta - e)\, q(p)$ with respect to k, assuming a binding constraint is

$$\frac{dC}{dk} = -q(p) \left\{ \varepsilon^D \left[p + \frac{de}{dk} \right] + \frac{de}{dk} \right\}$$

after substituting equation (4) in for $\frac{dp}{dk}$, and letting $\varepsilon^D < -1$ denote the elasticity of demand. Then insurer claims will rise with k so long as the expression in the braces is negative. Suppose instead that this term in braces were positive, so that

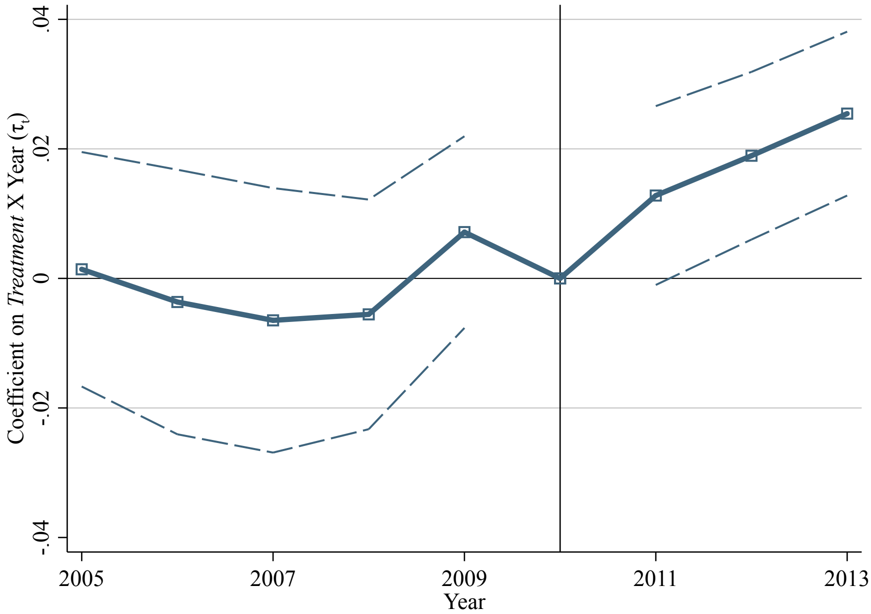
$$\varepsilon^D > -\frac{\frac{de}{dk}}{\left[p + \frac{de}{dk}\right]} = -\frac{[q(p) + pq'(p)] + (1-k)\, p\, [2q'(p) + pq''(p)]}{[q(p) + pq'(p)] + pk^2 \psi''(e)} \tag{7}$$

However, the second order condition requires that $(1-k)\left[2q'(p)+pq''(p)\right]-k^2\psi''(e)<0$ for a maximum. Some rearranging of the second order condition shows that the right hand side of (7) is greater than minus one in magnitude, in contradiction of the requirement that demand be elastic. $\frac{dC}{dk}$ is therefore positive so long as the regulatory constraint is binding.■

Appendix B Group Market Results

This Appendix contains results from out main specifications for the group market. Figure B.1 shows the year-by-year treatment effects for insurers in the group market. While there is a much smaller effect than measured in the individual market, there is still an uptick in MLRs in the post period.

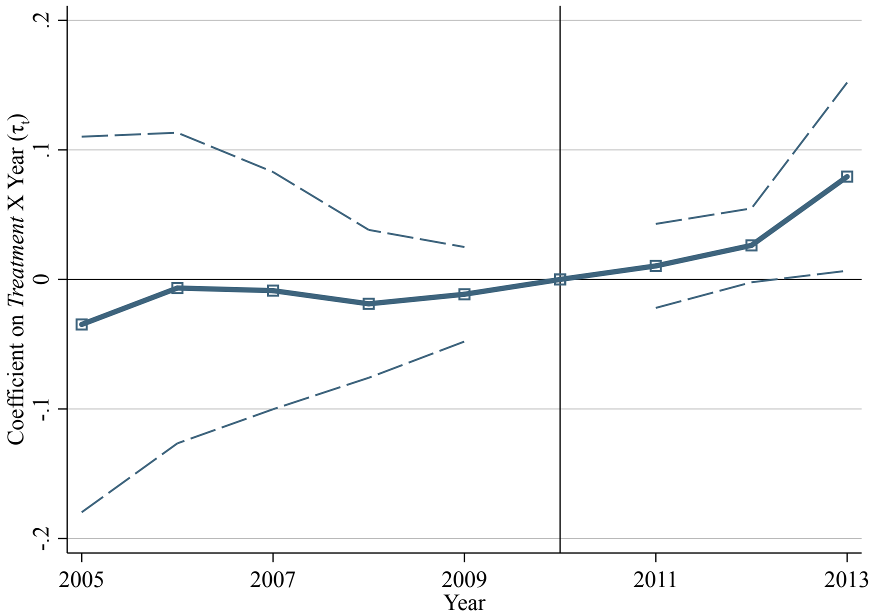
Figure B.1: Treatment Effects by Year in Group Market: MLR



Note: Event-study figures are based on estimation of equation (6) using MLR as the outcome variable and the binary definition of treatment, with year-specific treatment effects relative to 2010, and omitting the treatment group-specific linear trend. Regressions are weighted by enrollment. The broken lines are pointwise 95 percent confidence intervals based on standard errors clustered at the insurer level. $Treated \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$.

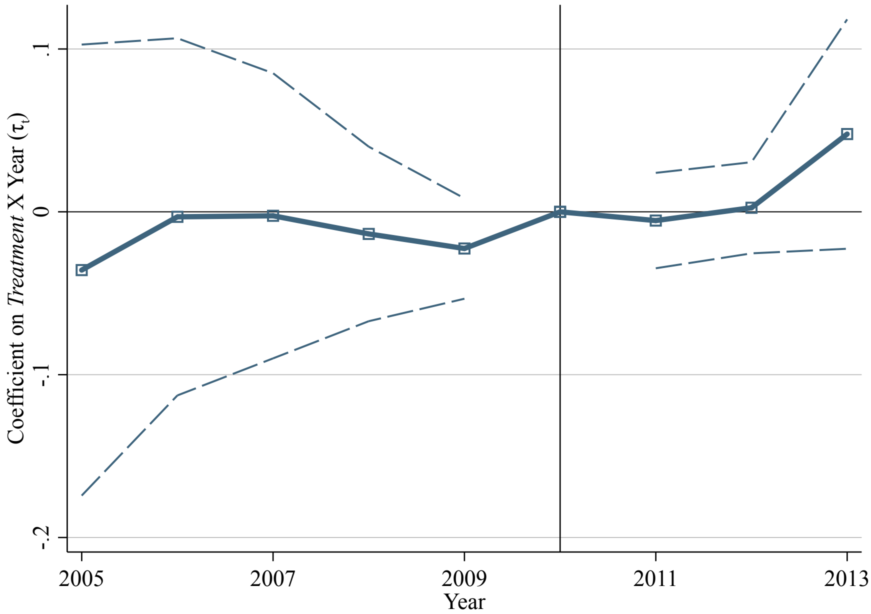
Figure B.2 shows the results using claims as the outcome variable. Treated and control firms have similar claims costs prior to the ACA, but after MLR regulation goes into effect, claims in the treated group appear to grow slightly relative to those in the control group. However, the estimates are imprecise and there appears to be a role for differential trends to play in lowering the ultimate point estimate. Finally, Figure B.3 shows a pattern quite similar to those of claims.

Figure B.2: Treatment Effects by Year in Group Market: $ln(Claims)$



Note: Figure is based on estimation of equation (6) using claims as the outcome variable and the binary definition of treatment, with year-specific treatment effects relative to 2010, and omitting the treatment group-specific linear trend. Regressions are weighted by enrollment. The logged outcome variable $Claims$ is measured on a per life-year basis. The broken lines are pointwise 95 percent confidence intervals based on standard errors clustered at the insurer level. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$.

Figure B.3: Treatment Effects by Year: $ln(Premiums)$



Note: Event-study figures are based on estimation of equation (6) using the binary definition of treatment, with year-specific treatment effects relative to 2010, and omitting the treatment group-specific linear trend. Regressions are weighted by enrollment. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. The logged outcome variable $Premiums$ is measured on a per life-year basis. The broken lines are pointwise 95 percent confidence intervals based on standard errors clustered at the insurer level.

Tables B.1 and B.2 present our primary regression analysis for the group market. Qualitatively, the results closely parallel those we found for the individual market: MLRs and claims costs grew each year after the new regulation went into effect. Our coefficient estimates in the group market are closer to zero, reflecting the fact that the group market as a whole was much closer to compliance than the individual market. However, instead of finding reductions in premiums in the first year which then dissipated over time, our point estimates suggest that premiums might have risen in the group market during the post period. The relatively low treatment intensity received by insurers in the group market makes it difficult to distinguish the claims/premiums components of change as statistically different from zero.

Table B.1: Effects of Minimum MLR Regulations: Group Market, Binary Treatment

	MLR		ln(Claims)		ln(Premiums)	
	(1)	(2)	(3)	(4)	(5)	(6)
Year $\geq$ 2011 * *Treatment*	0.015		0.019		0.003	
	(0.007)**		(0.024)		(0.022)	
2011 * *Treatment*		0.011		0.009		-0.004
		(0.007)		(0.019)		(0.016)
2012 * *Treatment*		0.017		0.020		0.001
		(0.009)*		(0.029)		(0.025)
2013 * *Treatment*		0.023		0.069		0.043
		(0.009)**		(0.060)		(0.057)
R^2	0.69	0.69	0.86	0.86	0.87	0.87
# Insurers	406	406	406	406	406	406
Observations	3,295	3,295	3,295	3,295	3,295	3,295

Note: Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. The outcome variables *Claims* and *Premiums* are measured on a per life-year basis. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table B.2: Effects of Minimum MLR Regulations: Group Market, Continuous Treatment

	MLR		ln(Claims)		ln(Premiums)	
	(1)	(2)	(3)	(4)	(5)	(6)
Year $\geq$ 2011 * *Treatment*	0.523		1.255		0.577	
	(0.123)***		(0.651)*		(0.654)	
2011 * *Treatment*		0.464		0.930		0.333
		(0.117)***		(0.695)		(0.712)
2012 * *Treatment*		0.502		1.104		0.446
		(0.142)***		(0.631)*		(0.623)
2013 * *Treatment*		0.634		1.917		1.095
		(0.146)***		(0.827)**		(0.808)
R^2	0.70	0.70	0.86	0.87	0.87	0.87
# Insurers	406	406	406	406	406	406
Observations	3,295	3,295	3,295	3,295	3,295	3,295

Note: Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. The outcome variables *Claims* and *Premiums* are measured on a per life-year basis. *Treatment* $\equiv \hat{d}_i$. * p<0.10, ** p<0.05, *** p<.01.

Appendix C Sensitivity Analysis and Ancillary Results

C.1 Unweighted regressions

Below we present the results of our main specifications, replicating Tables 3 and 4, without weighting observations by number of life-years.

Table C.1: Effects of Minimum MLR Regulations: Individual Market, Binary Treatment

	MLR		ln(Claims)		ln(Premiums)	
	(1)	(2)	(3)	(4)	(5)	(6)
Year $\geq$ 2011 * *Treatment*	0.106		0.149		0.010	
	(0.021)***		(0.049)***		(0.037)	
2011 * *Treatment*		0.095		0.130		0.004
		(0.021)***		(0.042)***		(0.033)
2012 * *Treatment*		0.123		0.182		0.025
		(0.025)***		(0.064)***		(0.050)
2013 * *Treatment*		0.138		0.172		-0.007
		(0.032)***		(0.080)**		(0.063)
R^2	0.62	0.62	0.83	0.83	0.81	0.81
# Insurers	184	184	184	184	184	184
Observations	1,417	1,417	1,417	1,417	1,417	1,417

Note: Regressions are **not** weighted by enrollment, and standard errors are clustered by insurer. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. The outcome variables *Claims* and *Premiums* are measured on a per life-year basis. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.2: Effects of Minimum MLR Regulations: Individual Market, Continuous Treatment

	MLR		ln(Claims)		ln(Premiums)	
	(1)	(2)	(3)	(4)	(5)	(6)
Year $\geq$ 2011 * *Treatment*	0.783		1.249		0.058	
	(0.179)***		(0.375)***		(0.232)	
2011 * *Treatment*		0.684		0.982		-0.071
		(0.190)***		(0.309)***		(0.225)
2012 * *Treatment*		0.751		1.416		0.279
		(0.209)***		(0.454)***		(0.301)
2013 * *Treatment*		1.001		1.520		0.012
		(0.218)***		(0.480)***		(0.309)
R^2	0.62	0.62	0.83	0.83	0.81	0.81
# Insurers	184	184	184	184	184	184
Observations	1,417	1,417	1,417	1,417	1,417	1,417

Note: Regressions are **not** weighted by enrollment, and standard errors are clustered by insurer. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. The outcome variables *Claims* and *Premiums* are measured on a per life-year basis. $Treatment \equiv \hat{d}_i * \mathbb{1}\left\{\hat{d}_i > 0\right\}$.
* p<0.10, ** p<0.05, *** p<.01.

C.2 Sensitivity Results: State Effects and Excluding Non-Profits

Below we present results analogous to those in Table 5, for the additional outcomes of claims and premiums, as well as for the continuous treatment definition.

Table C.3: Sensitivity Analysis: Individual Market, Binary Treatment

	ln(Claims)				
	(1)	(2)	(3)	(4)	(5)
Year $\geq$ 2011 * *Treatment*	0.068 (0.030)**	0.146 (0.068)**	0.079 (0.035)**		
Year $\geq$ 2011 * *Treatment* * *Treated State*				0.058 (0.035)	0.040 (0.073)
Year $\geq$ 2011 * *Untreated* * *Treated State*				-0.016 (0.042)	-0.010 (0.048)
Year $\geq$ 2011 * *Untreated* * % *Treated*					-0.030 (0.120)
State-by-year FE	No	Yes	No	No	No
Exclude nonprofits	No	No	Yes	No	No
R^2	0.89	0.92	0.89	0.89	0.89
# Insurers	184	184	126	184	184
Observations	1,417	1,417	931	1,417	1,417

Note: The dependent variable in all columns is ln(Claims). Column (1) reproduces results from our main specification. Column (2) includes state-by-year fixed effects. Column (3) drops insurers that were ever nonprofits. Columns (4) and (5) present effects on untreated insurers in states with treated insurers versus those in states without treated insurers. *Treated State* is a state-level indicator variable for whether any treated insurer existed in a given state. % *Treated* is a state-level variable that measures the fraction of life-years that were treated in 2011. Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include insurer fixed effects and a treatment group linear time trend. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.4: Sensitivity Analysis: Individual Market, Binary Treatment

	ln(Premiums)				
	(1)	(2)	(3)	(4)	(5)
Year $\geq$ 2011 * *Treatment*	-0.025	0.035	-0.019		
	(0.024)	(0.050)	(0.031)		
Year $\geq$ 2011 * *Treatment* * *Treated State*				-0.051	-0.089
				(0.035)	(0.063)
Year $\geq$ 2011 * *Untreated* * *Treated State*				-0.040	-0.035
				(0.037)	(0.044)
Year $\geq$ 2011 * *Untreated* * % *Treated*					-0.026
					(0.119)
State-by-year FE	No	Yes	No	No	No
Exclude nonprofits	No	No	Yes	No	No
R^2	0.86	0.90	0.87	0.86	0.86
# Insurers	184	184	126	184	184
Observations	1,417	1,417	931	1,417	1,417

Note: The dependent variable in all columns is ln(Premiums). Column (1) reproduces results from our main specification. Column (2) includes state-by-year fixed effects. Column (3) drops insurers that were ever nonprofits. Columns (4) and (5) present effects on untreated insurers in states with treated insurers versus those in states without treated insurers. *Treated State* is a state-level indicator variable for whether any treated insurer existed in a given state. % *Treated* is a state-level variable that measures the fraction of life-years that were treated in 2011. Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include insurer fixed effects and a treatment group linear time trend. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.5: Sensitivity Results: Individual Market, Continuous Treatment

	MLR				
	(1)	(2)	(3)	(4)	(5)
Year $\geq$ 2011 * *Treatment*	0.695	0.600	0.681		
	(0.117)***	(0.155)***	(0.119)***		
Year $\geq$ 2011 * *Treatment* * *Treated State*				0.746	1.096
				(0.131)***	(0.269)***
Year $\geq$ 2011 * *Untreated* * *Treated State*				0.018	0.020
				(0.019)	(0.020)
Year $\geq$ 2011 * *Untreated* * % *Treated*					-0.006
					(0.027)
State-by-year FE	No	Yes	No	No	No
Exclude nonprofits	No	No	Yes	No	No
R^2	0.75	0.85	0.72	0.76	0.76
# Insurers	184	184	126	184	184
Observations	1,417	1,417	931	1,417	1,417

Note: The dependent variable in all columns is MLR. Column (1) reproduces results from our main specification. Column (2) includes state-by-year fixed effects. Column (3) drops insurers that were ever nonprofits. Columns (4) and (5) present effects on untreated insurers in states with treated insurers versus those in states without treated insurers. *Treated State* is a state-level indicator variable for whether any treated insurer existed in a given state. % *Treated* is a state-level variable that measures the fraction of life-years that were treated in 2011. Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include insurer fixed effects and a treatment group linear time trend. $Treatment \equiv \hat{d}_i * \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.6: Sensitivity Results: Individual Market, Continuous Treatment

	ln(Claims)				
	(1)	(2)	(3)	(4)	(5)
Year $\geq$ 2011 * *Treatment*	0.700	1.561	0.713		
	(0.199)***	(0.510)***	(0.219)***		
Year $\geq$ 2011 * *Treatment* * *Treated State*				0.655	1.576
				(0.212)***	(0.708)**
Year $\geq$ 2011 * *Untreated* * *Treated State*				-0.016	-0.011
				(0.038)	(0.045)
Year $\geq$ 2011 * *Untreated* * % *Treated*					-0.030
					(0.120)
State-by-year FE	No	Yes	No	No	No
Exclude nonprofits	No	No	Yes	No	No
R^2	0.89	0.92	0.90	0.89	0.89
# Insurers	184	184	126	184	184
Observations	1,417	1,417	931	1,417	1,417

Note: The dependent variable in all columns is ln(Claims). Column (1) reproduces results from our main specification. Column (2) includes state-by-year fixed effects. Column (3) drops insurers that were ever nonprofits. Columns (4) and (5) present effects on untreated insurers in states with treated insurers versus those in states without treated insurers. *Treated State* is a state-level indicator variable for whether any treated insurer existed in a given state. % *Treated* is a state-level variable that measures the fraction of life-years that were treated in 2011. Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include insurer fixed effects and a treatment group linear time trend. $Treatment \equiv \hat{d}_i * \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.7: Sensitivity Results: Individual Market, Continuous Treatment

	ln(Premiums)				
	(1)	(2)	(3)	(4)	(5)
Year $\geq$ 2011 * *Treatment*	-0.311	0.584	-0.295		
	(0.148)**	(0.495)	(0.168)*		
Year $\geq$ 2011 * *Treatment* * *Treated State*				-0.409	-0.088
				(0.179)**	(0.571)
Year $\geq$ 2011 * *Untreated* * *Treated State*				-0.036	-0.031
				(0.033)	(0.040)
Year $\geq$ 2011 * *Untreated* * % *Treated*					-0.026
					(0.119)
State-by-year FE	No	Yes	No	No	No
Exclude nonprofits	No	No	Yes	No	No
R^2	0.86	0.90	0.87	0.86	0.86
# Insurers	184	184	126	184	184
Observations	1,417	1,417	931	1,417	1,417

Note: The dependent variable in all columns is ln(Premiums). Column (1) reproduces results from our main specification. Column (2) includes state-by-year fixed effects. Column (3) drops insurers that were ever nonprofits. Columns (4) and (5) present effects on untreated insurers in states with treated insurers versus those in states without treated insurers. *Treated State* is a state-level indicator variable for whether any treated insurer existed in a given state. % *Treated* is a state-level variable that measures the fraction of life-years that were treated in 2011. Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include insurer fixed effects and a treatment group linear time trend. $Treatment \equiv \hat{d}_i * \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

C.3 Ancillary Results: Heterogeneity by Market Structure

Table C.8: Heterogeneity Results by Market Structure: Individual Market, Cont. Treatment

	MLR		ln(Claims)		ln(Premiums)	
	(1)	(2)	(3)	(4)	(5)	(6)
Year $\geq$ 2011 * *Treatment*	0.820	0.619	1.241	0.512	-0.046	-0.476
	(0.169)***	(0.175)***	(0.409)***	(0.612)	(0.374)	(0.589)
Year $\geq$ 2011 * *Treatment* * *Market Share*	-0.214		-0.933		-0.458	
	(0.223)		(0.584)		(0.534)	
Year $\geq$ 2011 * *Treatment* * *HHI*		0.157		0.389		0.341
		(0.301)		(1.130)		(1.112)
Interaction var. mean	.29	.54	.29	.54	.29	.54
R^2	0.75	0.75	0.89	0.89	0.86	0.86
# Insurers	.	.	.	.	.	.
Observations	1,417	1,417	1,417	1,417	1,417	1,417

Note: Regressions are weighted by enrollment, and standard errors are clustered by insurer. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. The outcome variables *Claims* and *Premiums* are measured on a per life-year basis. HHI is divided by 10,000 so that it ranges between 0 and 1. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

C.4 Sensitivity Results: Varying Years Used to Determine Treatment

Below we present results showing the robustness of our main results to varying the set of pre-period years that are used to determine treatment.

Table C.9: Sensitivity Results: Individual Market, Binary Treatment

	MLR					
	2005-2010	2006-2010	2007-2010	2008-2010	2009-2010	2010 only
Year $\geq$ 2011 * *Treatment*	0.072	0.073	0.083	0.082	0.080	0.082
	(0.018)***	(0.018)***	(0.018)***	(0.018)***	(0.018)***	(0.018)***
R^2	0.75	0.75	0.75	0.75	0.75	0.75
# Insurers	185	184	182	182	182	179
Observations	1,421	1,417	1,408	1,408	1,408	1,387

Note: The dependent variable in all columns is MLR. Column headers refer to the time period used to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.10: Sensitivity Results: Individual Market, Binary Treatment

	ln(Claims)					
	2005-2010	2006-2010	2007-2010	2008-2010	2009-2010	2010 only
Year $\geq$ 2011 * *Treatment*	0.068	0.068	0.074	0.062	0.063	0.067
	(0.030)**	(0.030)**	(0.029)**	(0.029)**	(0.029)**	(0.029)**
R^2	0.89	0.89	0.89	0.89	0.89	0.89
# Insurers	185	184	182	182	182	179
Observations	1,421	1,417	1,408	1,408	1,408	1,387

Note: The dependent variable in all columns is ln(Claims). Column headers refer to the time period used to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.11: Sensitivity Results: Individual Market, Binary Treatment

	ln(Premiums)					
	2005-2010	2006-2010	2007-2010	2008-2010	2009-2010	2010 only
Year $\geq$ 2011 * *Treatment*	-0.024	-0.025	-0.032	-0.043	-0.040	-0.038
	(0.024)	(0.024)	(0.024)	(0.024)*	(0.024)*	(0.024)
R^2	0.86	0.86	0.86	0.86	0.86	0.86
# Insurers	185	184	182	182	182	179
Observations	1,421	1,417	1,408	1,408	1,408	1,387

Note: The dependent variable in all columns is ln(Premiums). Column headers refer to the time period used to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.12: Sensitivity Results: Individual Market, Continuous Treatment

	MLR					
	2005-2010	2006-2010	2007-2010	2008-2010	2009-2010	2010 only
Year $\geq$ 2011 * *Treatment*	0.665	0.695	0.773	0.770	0.670	0.475
	(0.109)***	(0.117)***	(0.127)***	(0.119)***	(0.123)***	(0.140)***
R^2	0.75	0.75	0.75	0.75	0.75	0.75
# Insurers	185	184	182	182	182	179
Observations	1,421	1,417	1,408	1,408	1,408	1,387

Note: The dependent variable in all columns is MLR. Column headers refer to the time period used to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \hat{d}_i * \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.13: Sensitivity Results: Individual Market, Continuous Treatment

	ln(Claims)					
	2005-2010	2006-2010	2007-2010	2008-2010	2009-2010	2010 only
Year $\geq$ 2011 * *Treatment*	0.650	0.700	0.633	0.600	0.635	0.500
	(0.186)***	(0.199)***	(0.190)***	(0.182)***	(0.173)***	(0.158)***
R^2	0.89	0.89	0.89	0.89	0.89	0.89
# Insurers	185	184	182	182	182	179
Observations	1,421	1,417	1,408	1,408	1,408	1,387

Note: The dependent variable in all columns is ln(Claims). Column headers refer to the time period used to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \hat{d}_i * \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.14: Sensitivity Results: Individual Market, Continuous Treatment

	ln(Premiums)					
	2005-2010	2006-2010	2007-2010	2008-2010	2009-2010	2010 only
Year $\geq$ 2011 * $Treatment$	-0.317	-0.311	-0.480	-0.511	-0.351	-0.207
	(0.144)**	(0.148)**	(0.159)***	(0.162)***	(0.200)*	(0.201)
R^2	0.86	0.86	0.86	0.86	0.86	0.86
# Insurers	185	184	182	182	182	179
Observations	1,421	1,417	1,408	1,408	1,408	1,387

Note: The dependent variable in all columns is ln(Premiums). Column headers refer to the time period used to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \hat{d}_i * \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

C.5 Sensitivity Results: Number of Observations Determining Treatment

Below we present results showing the robustness of our main results to varying the number of pre-period years required in order to be included in the sample.

Table C.15: Regression Results: Individual Market, Binary Treatment

	MLR			
	1 Observation	2 Observations	3 Observations	4 Observations
Year $\geq$ 2011 * *Treatment*	0.073	0.072	0.070	0.069
	(0.018)***	(0.018)***	(0.018)***	(0.018)***
R^2	0.75	0.75	0.75	0.76
# Insurers	184	168	158	141
Observations	1,417	1,356	1,305	1,204

Note: The dependent variable in all columns is MLR. The column headings indicate the minimum number of observations required to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.16: Regression Results: Individual Market, Binary Treatment

	ln(Claims)			
	1 Observation	2 Observations	3 Observations	4 Observations
Year $\geq$ 2011 * *Treatment*	0.068	0.066	0.064	0.071
	(0.030)**	(0.030)**	(0.031)**	(0.031)**
R^2	0.89	0.89	0.89	0.88
# Insurers	184	168	158	141
Observations	1,417	1,356	1,305	1,204

Note: The dependent variable in all columns is ln(Claims). The column headings indicate the minimum number of observations required to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.17: Regression Results: Individual Market, Binary Treatment

	ln(Premiums)			
	1 Observation	2 Observations	3 Observations	4 Observations
Year $\geq$ 2011 * *Treatment*	-0.025	-0.025	-0.024	-0.017
	(0.024)	(0.024)	(0.025)	(0.025)
R^2	0.86	0.86	0.86	0.85
# Insurers	184	168	158	141
Observations	1,417	1,356	1,305	1,204

Note: The dependent variable in all columns is ln(Premiums). The column headings indicate the minimum number of observations required to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.18: Regression Results: Individual Market, Continuous Treatment

	MLR			
	1 Observation	2 Observations	3 Observations	4 Observations
Year $\geq$ 2011 * *Treatment*	0.695	0.685	0.665	0.681
	(0.117)***	(0.119)***	(0.116)***	(0.124)***
R^2	0.75	0.75	0.76	0.77
# Insurers	184	168	158	141
Observations	1,417	1,356	1,305	1,204

Note: The dependent variable in all columns is MLR. The column headings indicate the minimum number of observations required to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \hat{d}_i * \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.19: Regression Results: Individual Market, Continuous Treatment

	ln(Claims)			
	1 Observation	2 Observations	3 Observations	4 Observations
Year $\geq$ 2011 * *Treatment*	0.700	0.648	0.607	0.612
	(0.199)***	(0.183)***	(0.178)***	(0.180)***
R^2	0.89	0.89	0.89	0.88
# Insurers	184	168	158	141
Observations	1,417	1,356	1,305	1,204

Note: The dependent variable in all columns is ln(Claims). The column headings indicate the minimum number of observations required to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \hat{d}_i * \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

Table C.20: Regression Results: Individual Market, Continuous Treatment

	ln(Premiums)			
	1 Observation	2 Observations	3 Observations	4 Observations
Year $\geq$ 2011 * *Treatment*	-0.311	-0.338	-0.355	-0.363
	(0.148)**	(0.144)**	(0.146)**	(0.152)**
R^2	0.86	0.86	0.86	0.85
# Insurers	184	168	158	141
Observations	1,417	1,356	1,305	1,204

Note: The dependent variable in all columns is ln(Premiums). The column headings indicate the minimum number of observations required to determine treatment. All specifications include year fixed effects, insurer fixed effects, and a treatment group linear time trend. Regressions are weighted by enrollment, and standard errors are clustered by insurer. $Treatment \equiv \hat{d}_i * \mathbb{1}\left\{\hat{d}_i > 0\right\}$. * p<0.10, ** p<0.05, *** p<.01.

C.6 Adjustments between Raw and Final MLR

In the main body of the paper, we show that insurers with persistently low MLRs came in to compliance with new regulations primarily by increasing their claims costs. A separate question is how firms behave once claims and premiums have been realized and they find themselves liable to pay a rebate. The multitude of components that modify an insurer's raw claims or premiums in the MLR calculation process might provide additional opportunities to come into compliance. For example, an insurer could increase its current claims bill by increasing reserves used to pay unresolved medical claims, reserves for specific contracts, or reserves for experience rating refunds.[31] Although there appear to be simple changes to accounting that could bring firms into compliance, the $2.8 billion in rebates paid up through 2015 suggest that there are limits to this strategy.

To gauge the scope of such behavior, we study the extent to which a firm's incurred medical claims, the most direct measure of dollars spent on insureds' medical care in the data, differ from the final "claims" number reported for the MLR calculation. We refer to incurred medical claims as the "raw" claims while the claims value used for the MLR rebate calculation is referred to as the "final" claims; we use analogous terminology for changes in premiums.

We study these differences in claims and premiums for two groups of firms: (1) firms whose raw claims and premiums would put them below the threshold used to determine whether a rebate must be paid, and (2) firms whose raw claims and premiums put them at or above the threshold. When determining whether a firm is in the first or second group, we apply the credibility adjustments that modify the relevant MLR threshold and use that modified threshold as the relevant value. We do this because at the time that the firm is filling out its MLR reporting form, it knows what those adjustments will be and so can determine whether it needs to manipulate any other margins to come into compliance with the modified threshold.

This comparison provides an upper bound on the amount of *ex post* adjustment firms conduct after claims and premiums have been realized: If a firm were aiming for a just-compliant MLR and knew they would face a large tax bill at the end of the year, they would deliberately overshoot the threshold so that their post-adjustment MLR would be on-target. There are a number of such dimensions of adjustment that are predictable before the uncertainty surrounding the year's claims or premiums has been resolved. As a consequence, this exercise overstates the

[31] Under the ACA's MLR regulations, a firm may adjust its incurred (medical) claims for direct claim liability, claim reserves, contract reserves, experience rating refunds, reserves for experience rating refunds, medical incentive pools and bonuses, healthcare receivables, group conversion charges, blended rate adjustments, and quality improvement expenditures. Similarly, a firm may adjust its direct premiums written by unearned premiums, experience rating refunds, reserves for experience rating refunds, premium balances written off, group conversion charges, federal and state high risk pools, and other adjustments that are included in premiums for financial statement purposes.

amount that firms are adjusting their claims or premiums in order to come into compliance. By comparing the adjustments of firms whose raw MLRs are in and out of compliance, we can net out some of the adjustments which are not discretionary, e.g., federal and state taxes. However, these are not interpretable as causal effects, merely as a descriptive guide to the scope of the adjustments being made. We use the CCIIO data from 2011 through 2013 for this analysis.

Table C.21 presents the mean percentage difference between raw and final claims and premiums for each market based on whether an insurer's raw MLR was above or below the regulatory threshold. In the individual market, there was a 3.9 percent upwards adjustment between raw and final claims for firms that would have had to pay a rebate in the absence of any adjustments in a particular year. Firms that would not have had to pay a rebate adjusted their claims numbers up by 1.4 percent, for a difference of approximately 2.5 percent. Although firms in the individual market with low raw MLRs do reduce premiums slightly more than firms that have raw MLRs in compliance, the magnitude of the difference is again relatively small. The results for the small and large group markets are qualitatively the same as those for the individual market. Overall, it appears that these accounting adjustments have played a relatively minor role in affecting MLRs.

Table C.21: Adjustments Between Raw and Final Claims and Premiums

	Claims		Premiums	
	Raw MLR below threshold	Raw MLR at or above threshold	Raw MLR below threshold	Raw MLR at or above threshold
Individual market	0.039	0.014	-0.032	-0.002
Small group market	0.027	0.019	-0.045	-0.023
Large group market	0.045	0.023	-0.030	-0.020

Note: Average percentage adjustment to claims or premiums presented for each market. Raw MLR below threshold indicates that the firm's raw MLR is below the credibility-adjusted threshold that determines whether a rebate must be paid. Raw MLR at or above threshold indicates the firm would not need to pay a rebate. Means are weighted by life-years. CCIIO data from 2011–2013 is used for this analysis.

C.7 Instrumental Variables

In this subsection, we implement an instrumental variables approach to further address concerns of regression to the mean, or more generally, measurement error in our treatment variable. In particular, we use data from 2006–2008 and data from 2009–2010 to separately predict whether an insurer will be treated by the new federal regulations that went into effect in 2011. To fix ideas, recall that our difference-in-differences treatment variable is $D_{it} \equiv \mathbb{1}\left\{\hat{d}_i > 0;\ t > 2010\right\}$. Let $\hat{d}_i^{10}$ be a measure of $\hat{d}_i$ based on data from 2009 and 2010 and let $\hat{d}_i^{08}$ be a measure of $\hat{d}_i$ based on data from 2006 to 2008. Then we have corresponding treatment variables D_{it}^{10} and D_{it}^{08} constructed with $\hat{d}_i^{10}$ and $\hat{d}_i^{08}$.[32] Because our predicted distance from the MLR threshold enters our primary estimating equation through both D_{it} and $t\mathbb{1}\left\{\hat{d}_i > 0\right\}$, we need to instrument for both terms. We use D_{it}^{08} and $\mathbb{1}\left\{\hat{d}_i^{08} > 0\right\}$ as instruments to estimate the following system of equations via two-stage least squares.

$$y_{it} = \gamma_i + \delta_t + \tau D_{it}^{10} + \beta t\mathbb{1}\left\{\hat{d}_i^{10} > 0\right\} + u_{it} \tag{8}$$

$$D_{it}^{10} = \lambda_i + \lambda_t + \alpha_1 D_{it}^{08} + \alpha_2 t\mathbb{1}\left\{\hat{d}_i^{08} > 0\right\} + \eta_{it} \tag{9}$$

$$t\mathbb{1}\left\{\hat{d}_i^{10} > 0\right\} = \widetilde{\lambda}_i + \widetilde{\lambda}_t + \widetilde{\alpha}_1 D_{it}^{08} + \widetilde{\alpha}_2 t\mathbb{1}\left\{\hat{d}_i^{08} > 0\right\} + \omega_{it} \tag{10}$$

The first stage results are shown for the individual market in Table C.22. As seen in column (1), predicted treatment based on 2006–2008 is closely and positively related to predicted treatment based on 2009–2010 data. Not surprisingly then, column (2) shows that the differential linear trend for our 2009–2010 predicted treatment group is also closely related to that for our 2006–2008 predicted treatment group. We find similar results, shown in the remaining columns of the table, for the instruments when we use our continuous treatment measures as well.

The instrumental variables results for the individual market with the binary treatment variable are presented in Table C.23. The results are quite similar to the corresponding OLS results in shown Table 3. The estimated impact of the federal regulation goes from a 7.3 percentage point increase in the MLR to an 8.3 percentage point increase; for claims, our OLS results indicate that the regulation increased claims by 6.8 percent while our IV estimates suggest a 9.6 percent increase. Our IV results do not suggest any impacts on premiums. Results for the individual market using the continuous measure of treatment are in Table C.24, and closely mirror those of OLS from the main text.

[32] As we saw in Tables C.9 through C.14, our estimated results using D_{it} and D_{it}^{10} are quite similar.

Table C.22: First Stage Results: Individual Market

	Binary treatment		Continuous treatment	
	D_{it}^{10}	$t\mathbb{1}\left\{\hat{d}_i^{10} > 0\right\}$	D_{it}^{10}	$t\hat{d}_i^{10}$
	(1)	(2)	(3)	(4)
Year $\geq$ 2011 * *Treatment*	0.529	0.035	0.497	-3.231
	(0.077)***	(0.108)	(0.164)***	(1.615)**
Year * *Treatment*	-0.001	0.513	-0.005	4.787
	(0.004)	(0.087)***	(0.014)	(0.748)***
F-test on instruments	23.53	22.85	9.13	21.44
# Insurers	184	184	184	184
Observations	1,311	1,311	1,311	1,311

Note: Regressions are weighted by enrollment and standard errors are clustered by insurer. All specifications include year fixed effects and insurer fixed effects. D_{it}^{10} interacts a measure of treatment based on data from 2009–2010 with an indicator for $Year \geq 2010$. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i^{08} > 0\right\}$ for columns (1) and (2); $Treatment \equiv \hat{d}_i^{08}$ for columns (3) and (4), where $\hat{d}_i^{08}$ measures MLR compliance based on data from 2006 to 2008. * p<0.10, ** p<0.05, *** p<.01.

Table C.23: Instrumental Variables Results: Individual Market, Binary Treatment

	MLR		ln(Claims)		ln(Premiums)	
	(1)	(2)	(3)	(4)	(5)	(6)
Year $\geq$ 2011 * *Treatment*	0.083		0.096		-0.008	
	(0.024)***		(0.042)**		(0.035)	
2011 * *Treatment*		0.078		0.073		-0.025
		(0.023)***		(0.038)*		(0.031)
2012 * *Treatment*		0.088		0.121		0.011
		(0.027)***		(0.048)**		(0.040)
2013 * *Treatment*		0.094		0.145		0.028
		(0.035)***		(0.060)**		(0.051)
Wu-Hausman p-value	0.000	0.000	0.003	0.033	0.150	0.455
# Insurers	184	184	184	184	184	184
Observations	1,311	1,311	1,311	1,311	1,311	1,311

Note: Regressions are weighted by enrollment and standard errors are clustered by insurer. All specifications include year fixed effects and insurer fixed effects. The outcome variables *Claims* and *Premiums* are measured on a per life-year basis. $Treatment \equiv \mathbb{1}\left\{\hat{d}_i^{10} > 0\right\}$, instrumented with $\mathbb{1}\left\{\hat{d}_i^{08} > 0\right\}$, where $\hat{d}_i^{08}$ and $\hat{d}_i^{10}$ are measures of MLR compliance based on data from 2006 to 2008, and 2009–2010, respectively. * p<0.10, ** p<0.05, *** p<.01.

Table C.24: Instrumental Variables Results: Individual Market, Continuous Treatment

	MLR		ln(Claims)		ln(Premiums)	
	(1)	(2)	(3)	(4)	(5)	(6)
Year $\geq$ 2011 * *Treatment*	0.578		0.700		-0.090	
	(0.198)***		(0.272)**		(0.303)	
2011 * *Treatment*		0.519		0.468		-0.241
		(0.191)***		(0.244)*		(0.278)
2012 * *Treatment*		0.645		0.960		0.082
		(0.234)***		(0.328)***		(0.340)
2013 * *Treatment*		0.732		1.309		0.286
		(0.232)***		(0.415)***		(0.418)
Wu-Hausman p-value	0.000	0.000	0.023	0.060	0.268	0.774
# Insurers	184	184	184	184	184	184
Observations	1,311	1,311	1,311	1,311	1,311	1,311

Note: Regressions are weighted by enrollment and standard errors are clustered by insurer. All specifications include year fixed effects and insurer fixed effects. The outcome variables *Claims* and *Premiums* are measured on a per life-year basis. $Treatment \equiv \hat{d}_i^{10} * \mathbb{1}\left\{\hat{d}_i^{10} > 0\right\}$, instrumented with $\hat{d}_i^{08} * \mathbb{1}\left\{\hat{d}_i^{08} > 0\right\}$, where $\hat{d}_i^{08}$ and $\hat{d}_i^{10}$ are measures of MLR compliance based on data from 2006 to 2008, and 2009–2010, respectively. * p<0.10, ** p<0.05, *** p<.01.