

# **The Effect of Mandated Health Insurance on Physician Reimbursement: Evidence from the Massachusetts Health Reform**

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## **Abstract:**

In 2006, Massachusetts passed a health care reform which required individuals to purchase health insurance and provided subsidized health insurance to the poor. The reform greatly increased the health-insured proportion of the state population. In this study we use a large data set of private health insurance claims to analyze the effect of the increase in the number of insured on physician reimbursement. We find that reimbursement for well-infant visits rose by approximately 4 percent during the reform implementation period, but the increase did not persist. Reimbursement for well-adult visits and appendectomies remained unchanged. Triple difference estimates using appendectomies (for which demand is extremely inelastic) as an additional control group show a 2 percent rise in well-infant visit reimbursement during the implementation period and no effect afterwards or on well-adult visit reimbursement. Estimates imply a temporary increase in the cost of health services with relatively elastic demand following a large scale insurance mandate, such as the Affordable Care Act. Extensive robustness checks do not invalidate this claim.

## 1. Introduction

In 2006, Massachusetts passed a health care reform designed to expand health insurance coverage. The reform included a requirement that insurance companies adopt a community-rating pricing schedule to guarantee that individuals were not priced out of insurance and mandated individuals to purchase health insurance. Massachusetts also subsidized, to varying extents, the purchase of health insurance for individuals with incomes lower than 300 percent of the poverty line. A final component of the reform created a series of incentives to attract additional physicians to Massachusetts.

Estimates of the expansion of health coverage as a result of the reform range from approximately a 5 percentage point to almost a 10 percentage point increase in the number of covered individuals (Kolstad and Kowalski, 2010; Health Connector, 2012). Massachusetts initially underestimated the number of people that would enroll in the subsidized insurance program: 600,000 consumers enrolled in health insurance when the mandate took effect instead of the projected 400,000.

It is likely that the surge of newly insured individuals into the health insurance market had an effect on the average consumer price of health services, as well as on the quality of and access to care.<sup>1</sup> Consumers become less sensitive to the price of a service when they are not responsible for its full payment, as in the case of health insurance (Manning et. al 1987). This price insensitivity can lead to an increase in consumption of care, putting upward pressure on the equilibrium price of common procedures. It is also possible that the newly insured in the market

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<sup>1</sup> Masi and Long (2009) document an increase in access to care in Massachusetts during the years 2006 through 2008 using Current Population Survey data. They find an increase of approximately 7 percentage points, from 86.4 percent, in individuals reporting that they have a usual source of care, and about a 4 percentage point decrease, from 25.4 percent, in the number of individuals who reported that they did not receive care in the past year.

were less likely to be of poor health status, which would imply that the most ill patients were already enrolled in a health plan pre-reform. In this case of pre-reform adverse selection, the influx of new patients could lower the average cost of care and thus lower the equilibrium price of common procedures. Additionally, if the incentives for attracting doctors to Massachusetts were effective, the additional capacity in the market could lower the equilibrium price. These countervailing forces of upward pressure on price from patient influx and downward pressure on price from fighting adverse selection and increasing provider capacity leaves us without a clear prediction of the direction of the equilibrium price of care as a result of the health insurance mandate.

We use a large set of health insurance claims to private insurers to estimate the impact of the Massachusetts Health Insurance Reform on physician reimbursement for well-infant, well-adult, and appendectomy visits.<sup>2</sup> Estimates are obtained using a difference-in-differences strategy which compares Massachusetts to similar nearby states. We focus on well-infant, well-adult, and appendectomy visits as they are all required to be covered by insurance under the Massachusetts law, and because they have varying price elasticities of demand.

Well-infant visits are the most price-elastic of the services: parents may balk at the cost of a medical checkup for infants who seem healthy.<sup>3</sup> Empirically, uninsured children received fewer than half of the recommended number of well-care visits in their first year, and health insurance expansions to low income individuals has been shown to increase the utilization of child preventative care (Currie and Gruber, 1996; De La Mata, 2012).<sup>4</sup> Appendectomies are an

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<sup>2</sup> Data Source: FAIR Health, Inc., an independent, New York nonprofit corporation.

<sup>3</sup> A simple internet search for “Are infant well-care visits necessary?” leads to numerous parent forums debating the necessity of post-infant immunization well-infant visits, anecdotally indicating a high price elasticity of demand for infant well-care visits.

<sup>4</sup> Estimates from the National Survey of Early Childhood Health show that of the American Academy of Pediatrics recommended 6 well-care visits in the first year, privately insured children receive over 4 visits in their first year of

emergency procedure with a low price elasticity of demand: failure to get an appendectomy when it is needed can result in severe infection and possible death if the appendix bursts. Well adult visits have an elasticity somewhere in-between the other two procedures, they are neither as inelastic as appendectomies nor as elastic as well-child visits.

Our estimates show that infant well-care reimbursement rises 4 percent while the reform is being implemented, but the increases are not persistent. Reimbursements for adult well-care and appendectomy are unaffected by the mandate. The estimates can be further refined to remove the effect of unobservable health care market level characteristics by adding in a third difference between well visits (which likely had a large post-reform patient influx) and appendectomies (which likely did not). The impact of the mandate on reimbursements for well-infant visits during the implementation period is smaller in magnitude but still statistically significant at conventional levels.

## **2. The Massachusetts Health Insurance Reform**

In 2006, the state of Massachusetts passed “An Act Providing Access to Affordable, Quality, Accountable Health Care,” which mandated that all individuals in Massachusetts obtain health insurance coverage by mid-2007. The law required individuals to purchase health insurance or to pay a fine for lack of coverage. Most employer-provided health insurance plans were unaffected. The reform was designed to create a larger pool of insured, which included healthy individuals who had previously selected out of purchasing insurance. By eliminating selection into health insurance, the intention was to reduce total state spending on health care as well as to ensure near-universal health insurance coverage (Gruber, 2008).

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life, while uninsured children receive fewer than 3. The National Survey of Early Childhood Health data is made available by the Centers for Disease Control ([www.cdc.gov](http://www.cdc.gov)).

Under the law, individuals were required to purchase insurance that qualifies as minimum creditable coverage or face a fine administered through the tax system for non-compliance. Minimum creditable coverage included basic preventative, diagnostic, and emergency care. Appendix 1 details the specific coverage areas required to qualify as insured in Massachusetts after 2006. Partial or full subsidies for low-income adults and children were provided starting in January 2007 to ensure that the most financially needy individuals would be in compliance.<sup>5</sup>

Since 2007, over 400,000 people have entered the Massachusetts insurance pool. Over 98% of the state population was insured as of 2010 (Courtemanche and Zapata, 2012). This mass enrollment in health insurance applied a shock to the health services and insurance market: a sizeable portion of the patient population gained insurance coverage and became far more price inelastic with the coverage.<sup>6</sup> In addition, the majority of the newly insured required less care and were healthier than those who had purchased insurance before the mandate, as indicated by lower average hospital costs per capita after the mandate (Kolstad, Hackmann, and Kowalski 2012). As the average patient seeking care in Massachusetts became healthier, the average cost of health services was driven downward.

In order to address the influx of patients, Massachusetts in 2008 expanded existing financial incentives for doctors to treat underserved populations and geographical areas. The existing loan forgiveness program for health professionals was applicable only to U.S. citizens practicing in health professional shortage areas; the expansion to legal permanent residents and practices in medically underserved areas/populations (MUP) that were not in medical

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<sup>5</sup> Families who qualified for MassHealth, the state's Medicaid program before the reform continued to receive creditable coverage; individuals who earned up to 300% of the poverty line but who did not qualify for MassHealth received heavily state-subsidized health insurance. The mandate also required individuals to purchase insurance if it was "affordable;" those who could not afford health insurance were not penalized by the fine that ranges from \$0 to approximately \$1200 per year.

<sup>6</sup> The newly insured tend to buy health insurance with the lowest monthly premium – specifically plans featuring the highest possible deductible and copay rates allowed by law (Marzilli Ericson and Starc, 2012).

professional shortage areas was anticipated to ease the shortage of physician supply.

Massachusetts also increased incoming class sizes at state medical schools for students agreeing to specialize in general practice, also agreeing to defer student loans for a commitment to practice in an underserved area. Additionally, the private sector provided physician incentives: the Massachusetts League of Community Health Centers awarded loan funds of up to \$75,000 to professionals who chose to commit to practicing in community health centers.

The purpose of the physician financial incentives incentives was to increase provider capacity and to help minimize wait times as the patient base grew. An increase in provider capacity also would theoretically put downward pressure on the price of care.

### 3. Theoretical Considerations

A simple model follows to illustrate how an increase in the insured population and in provider capacity would influence the equilibrium price of health care. Consider a health care economy with two types of potential patients: healthy patients who have a low propensity to need medical services and sick patients who have a high propensity to need medical services. Each patient has a demand for health care

$$q_i = q_i(P, x, h), i \in (\text{healthy}, \text{sick}) \quad (1)$$

where  $q_i$  is the quantity of health care demanded by patient type  $i$  at a price level  $P$  given patient demographics  $x$ , and the type of insurance,  $h$ , that the patient has (if any).

$N_{\text{healthy}}$  is the number of healthy patients in the market and  $N_{\text{sick}}$  is the number of sick patients. The market demand,  $Q_i$ , for a particular patient type is the summation of all of the demands of individuals of that patient type and can be expressed as:

$$Q_i = \sum_{N_i} q_i \quad (2)$$

and the total market demand can be expressed as:

$$Q = Q_{healthy} + Q_{sick} \quad (3)$$

We assume that having health insurance makes patient demand for care less price elastic; this assumption comes directly from the findings of the Rand Health Insurance Experiment (Manning et al., 1988).<sup>7</sup> The market demand function for the entire market ( $Q$ ) is shown in Figure 1.

The marginal cost  $MC$ , of producing a unit of health care is

$$MC = MC(Q_{healthy}, Q_{sick}, g, w) \quad (4)$$

where  $g$  is the available technology for producing health care and  $w$  is a vector of the costs of factors of production. We assume that on the margin, production of a unit of health care is more expensive if the unit is produced for a sick patient than if the health care is produced for a healthy patient. However, health care providers cannot price discriminate and charge sick patients a higher price than healthy patients.

Now consider a health insurance mandate where all patients are now required to hold a health insurance policy of at least a minimum level of coverage. We assume that all the previously uninsured patients purchase a plan with the minimum acceptable level of coverage; this assumption follows the findings of Ericson and Stark (2012) that suggest that uninsured

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<sup>7</sup> Giving a patient insurance changes their effective demand for care as the effective price for a level of service is distorted. Treating a change in the effective demand curve as if it is a change in the underlying demand curve makes no difference analytically, so we will use the two terms interchangeably.

patients are more likely to choose the least costly health insurance plan when choosing insurance (where cost and quality of plan are positively correlated). We also assume that all patients that held insurance before the insurance mandate held an insurance policy acceptable under the mandate and chose not to change plans.

The mandate will have two major effects on the market. The first is that aggregate health care demand will become more inelastic as more patients purchase insurance. The change in the elasticity of demand will happen very quickly, as soon as individuals have insurance the effective price they are facing and their effective demand elasticity will change. The second effect is that healthy patients (who had the larger increase in insurance enrollment) will now demand more health care relative to sick patients than before the reform. The increase the quantity of care demanded by healthier patient demand will lower the marginal cost function for health services as it is less expensive on the margin to treat a healthy patient. The effect of healthier patients in the patient pool on expected costs will likely be slower, as physicians will need to experience treating a larger number of healthier patients before they expect to see more of them in the future. Both of these effects are shown in Figure 1.<sup>8</sup>

In addition to a mandate, state incentives for doctors to come to the market from other places could be represented as a decrease in physician wages. Part of the incentives would be offset via a compensative wage differential which would decrease the parameter  $w$  in equation (4). This would shift MC downward, and much like an influx of healthier patients, would create the effect shown in Figure 1.

The overall impact on the price of care from the reform is ambiguous, as there are both

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<sup>8</sup> The above analysis ignores the presence of deductibles or copays in the insurance policies, which are present in the Massachusetts health care reform. This omission is for simplicity's sake, deductibles and copays can be included with the same result as long as the size of deductibles and copays are small compared to the overall cost of the procedures used.



upward and downward forces. Which force dominates would need to be settled empirically. However, it does seem likely that the upward force on prices would come in to play more quickly. Physicians will need to experience treating a larger number of healthier patients before they expect to see more of them in the future, and it takes time for a physician lured by incentives to move, whereas patients with new insurance will have their effective demand elasticity change immediately.

## 4. Data

### *Price Data*

Our analysis uses physician reimbursement data from the Medical/Surgical Module of the FAIR Health Database between 2005 and 2009. The complete Medical/Surgical module accounts for roughly 28 percent of the total number of private insurer claims in the United States in a given year.<sup>9</sup> Within a claim, individual procedure types can be identified by line item via the American Medical Association's Current Procedure Terminology (CPT) codes. Each claim's date is known and is designated with the three digit zip code in which the service was provided.

For each line item we are able to observe how much the provider charges to the insurance company and how much the insurance company reimburses the provider. The amount charged to the insurance company comes from a provider's chargemaster (a list of prices for all procedures for that provider). Chargemaster prices are influenced by a number of factors, many of which change at the same time the mandate comes into play. For example, the

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<sup>9</sup> Kleiner, et. al (2012) discuss the representativeness of the data to the entirety of insurance claims in the United States in 2008. They find that the distribution of prices for well-baby (including well-infant) services in the Fair Health data and a nationally representative dataset (MarketScan) are extremely similar, leading them to infer that the price analysis would be representative of all well-infant health insurance claims in the United States.

charged amount is the fee that would be charged to uninsured individuals – who become a rarity after the reform. This introduces variation other than the effect of the reform into the amount providers charge insurance companies, and as such we focus on the amount that the insurance company reimburses providers, henceforth the allowed amount. The allowed amount is the final price paid for all medical services observed in the data.

We focus on three groups of line items as identified by their CPT codes. The first group is comprised of appendectomies, and includes CPT codes for appendectomies, laparoscopic appendectomies and appendectomies performed on an already burst appendix. The demand for appendectomies is extremely price inelastic, as failure to undergo surgery when an appendectomy is recommended by a physician can lead to severe infection and death. We do not expect the demand elasticity for appendectomies to change as a result of the health reform.

The second group of line items examined is well-infant visits. This group includes CPT codes for visits for patients under one year old (one code for new patients and one code for returning patients). Well-infant visits are likely an elastic set of procedures pre-reform, as expansions of health insurance coverage have been shown to increase well-infant visit usage (Currie and Gruber, 1996; De La Mata, 2012). An increase in the number of insured should decrease the price elasticity of demand for well-infant visits.

The final group of line items is for well-adult visits and includes CPT codes for 18 to 44 year old visits (one code for new patients and one code for returning patients) and for 44 to 65 year old visits (one code for new patients and one code for returning patients). Price elasticity of demand for well-adult visits is likely somewhere between that of appendectomies, which are inelastic, and well-infant visits, which are relatively elastic. Table 1 presents summary statistics for the allowed

amounts used in the analysis.<sup>10</sup> Mean allowed prices for well-adult visits are approximately 110 dollars, and mean well-infant visits are approximately 85 dollars. Mean appendectomy allowed prices are much higher at approximately 1000 dollars. As an appendectomy is an inpatient visit: the charge for the individual appendectomy CPT code is only a fraction of the total cost of getting the procedure (we do not observe anesthesia and other hospital services), thus the magnitude of the mean allowed amount of appendectomies can be misleadingly small.

### *Demographic Information*

Demographic information was collected from a commercial database purchased from Zip-codes.com and from the the publicly available American Community Survey. Zip-codes.com consolidates demographic, economic, and geographic information about each postal zip-code in the United States using raw data from existing sources including the United States Postal Service and the United States Census Bureau. Table 2 includes a list of the covariates in the analysis along with their means and standard deviations. Specifically, we control for measures of population density (population, housing units per zip code and persons per housing unit) and measures of the general price level (median household income and average price of a home) to control for population differences that could influence the price of health care. Zip-codes.com data is aggregated to the state level to avoid dummy oversaturation in the regression equation.

The American Community Survey (ACS) provides individual level demographic data that we population weight and aggregate to the state-by-year level. The variables include age, marital status, number of children per household, the percent of the African-American population, the percent of the population with Hispanic origin, employment status, family income, sex, and

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<sup>10</sup> Appendix 2 includes a brief discussion of allowed price trends in Massachusetts.

educational attainment.

### *Provider Information*

The Occupational Employment Statistics (OES) data, posted by the United States Bureau of Labor Statistics, identify workers through a standard occupational classification system, and includes health care and technical workers. These data construct estimates of worker salaries and employment numbers, based on voluntary information provided by individuals.

One primary weakness of the OES data is that the survey data does not encompass self-employed individuals. We find, however, that over two thousand individuals are employed as pediatricians in Massachusetts and approximately 200,000 total individuals are employed as healthcare practitioners in the Massachusetts (include table here of basic numbers). Admittedly, the Massachusetts Health insurance reform may have affected the percentage of self-employed healthcare practitioners in Massachusetts relative to other states. Despite this weakness of the analysis, we believe that the provider analysis provides insight into a plausible mechanism that explains shifts in observed reimbursement patterns.

## **5. Methods**

We use a difference-in-differences estimation strategy to identify the effect of the Massachusetts health insurance reform on reimbursement. The outcome of interest is the allowed amount for a specific health service type: well-adult visits, well-infant visits, or appendectomies. Each service corresponds to a group of CPT codes. A particular CPT code indicates the specifics of the service that took place (for example, a separate CPT code is used if the appendectomy was performed after the appendix burst). To allow for differences in the conditions under which a procedure occurred, we estimate all models with CPT-specific fixed effects.

The allowed amounts for procedures performed in other northeastern states are used as a control. These states include Maine, Vermont, New Hampshire, Connecticut, Rhode Island, New York, Pennsylvania, New Jersey, Maryland, Delaware, and Washington D.C. Washington D.C. is omitted from the appendectomy analysis due to the small number performed in the D.C. area.

Models of the following specification are estimated using ordinary least squares:

$$\begin{aligned}
\ln(\text{Price}_{pst}) = & \alpha_0 + \beta_1 MA_s + \beta_2 * \text{PostReform}_t + \beta_3 MA_s \times \text{Post Reform}_t \\
& + \beta_4 \text{Implementation}_t + \beta_5 MA_s \times \text{Implementation}_t + X'_{st}\beta + \omega_s + \lambda_t + \psi_p \\
& + \pi_{st} + \epsilon_{pst}
\end{aligned}
\tag{5}$$

The subscript  $p$  denotes CPT codes,  $s$  denotes states and  $t$  denotes years.  $\ln(\text{Price}_{pst})$  is the natural log of the allowed amount for the procedure grouping in question.  $MA_s$  is a binary variable which takes on the value of 1 if the procedure was performed in Massachusetts and takes on a value of 0 if the procedure was performed in a different northeastern state.  $\text{Post Reform}_t$  is a binary variable that takes on the value 1 for the years after the reform (2008 and 2009) and takes on the value 0 for years prior to the reform (2005 and 2006), A separate dummy for 2007,  $\text{Implementation}_t$ , is used to capture the effect of the reform immediately after implementation, before all actors in the market have time to adjust. This dummy is also interacted with the post period. The differences-in-differences estimators,  $\beta_3$  and  $\beta_5$ , are the coefficients on the interaction between the two post period indicators and the dummy for Massachusetts.  $\beta_{5s}$  provides the estimated effect of the health care reform on the allowed price of the procedures before the market has time to totally adjust and  $\beta_3$  provides the estimated effect of the health care reform on the allowed price of the procedures after the market has time to totally adjust.  $X'_{st}$  is a matrix of control variables from the Zipcode.com and ACS data. Additionally,  $\omega_s$  is a set of state fixed effects,  $\lambda_t$  is a set of year fixed effects,  $\psi_p$  is a set of CPT code fixed effects,  $\pi_{st}$  is a state specific time trend, and  $\epsilon_{pst}$  is a set of robust standard errors clustered at the state-CPT-year level. Additional specifications include state by CPT, and year by CPT fixed effects.

The difference-in-differences approach compares changes in the price of procedures in Massachusetts to changes in the price of procedures in similar states that did not pass a reform. The first difference across time removes any time-invariant state level characteristics that could

influence prices. The second difference across states removes an approximation of the baseline effect that would have occurred had Massachusetts not passed the reform.<sup>11</sup>

## 6. Results

### *Appendectomy*

Estimates show that the reform did not differentially change the prices of appendectomies in Massachusetts. There was no effect in the implementation period as well as no effect once the implementation period was over. Table 3A reports the regression results: the first row reports the difference-in-differences estimate for the post-implementation period. The fourth row reports the estimate for during the implementation period. Each column shows a regression with a different set of controls and fixed effects which are noted in the bottom portion of the table. All coefficient estimates other than the difference-in-differences estimate are suppressed.<sup>12</sup> The largest effect found on reimbursements for appendectomy price is approximately 3.6 percent, however, none of the estimates are statistically significant at conventional levels, and in many cases the estimate has a lower magnitude than its standard error, which makes a strong case for the average effect of the estimates being effectively zero given the number of observations. These results are in line with the demand elasticity for appendectomies not changing substantially as a result of the reform.

### *Well-Infant Visits*

The results for well-infant visit reimbursements are reported in Table 3B. The layout of Table 3B is identical to that of Table 3A, the only difference being the dependent variable in the

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<sup>11</sup> This approximation is valid to the extent that the control states are similar to Massachusetts.

<sup>12</sup> Full regression results which include covariates as control variables are available upon request.

regressions. Reimbursement for well-infant visits did exhibit a statistically significant increase during the implementation period; all of the estimates showed approximately a 4 percent increase in reimbursement. This result is robust to the inclusion of several different groups of fixed effects, and hardly changes at all once demographic controls are added. The increase in reimbursement is consistent with an increase in the number of parents taking their children for well-infant visits immediately after they get insurance. Once the implementation period is over, we find a very small negative effect (8 tenths of a percent) of the reform on prices once all controls and fixed effects are included.

### *Well-Adult Visits*

The regression results for well-adult visits are reported in Table 3C, which shares the same layout as Tables 3A and B. We find no effect of the reform on prices at conventional levels during the implementation period, and also no effect of the reform at conventional levels after the implementation period once all controls and fixed effects are included in the estimation.

## **7. Provider Capacity**

The above estimates show a temporary increase in the price of care for well-infant visits during the implementation period, followed by a price level that is statistically indistinguishable from the pre-reform period during the post reform period. These results are consistent with parents having a decrease in demand elasticity post reform, followed shortly by either physicians realizing the average infant is healthier and lowering prices, an expansion in provider capacity which lowering prices, or both. We cannot determine how much of the dampening effect on prices came from a healthier patient mix and how much of the effect came from attempts to increase provider capacity. However, we can present evidence that at least part of the decrease

is due to physician influx.

To explore this question we conduct a simple analysis of the impact of the reform on the supply of physicians. We estimate an equation similar to those used for the reimbursement analysis on the state supply of physicians and pediatricians:

$$\ln(\text{Number of Physicians}_{st}) = \alpha_0 + \beta_1 * MA + \sum_{t=2003}^{2008} \beta_2 * MA \times \lambda_t + X'_{st}\beta + \omega_s + \lambda_t + \epsilon_{st} \quad (6)$$

The left hand side variable  $\ln(\text{Number of Physicians}_{st})$  is the natural log of the number of physicians in a given state in a given year. We estimate equation 6 for all physicians and for only pediatricians. The above estimating equation does not specifically capture the effect of the Massachusetts health reform. We instead report Massachusetts by year interaction effects, which show percent changes in the number of doctors choosing to practice in Massachusetts over time.

Table 4 reports the Massachusetts state by year interaction effects, where the year 2005 is the omitted year. Estimates show that the supply of physicians in Massachusetts was relatively stable over this time frame relative to other states, whereas the supply of pediatricians increased dramatically. These results are suggestive that the changing supply of pediatricians played a role in the previously reported effects of the reform on well-infant visits. An increase in pediatricians after 2006 would have in part counteracted upward pressure on reimbursement that the newly insured exerted. This does not say anything about the magnitude of the effect of provider capacity increases on the price.

## 8. Insurer Entry



There is a third, competing explanation for why the reimbursement changed after the policy was implemented. Since the reform mandated that individuals purchase insurance, it is possible that the reform spurred entry into the health insurance market on the supply side. The number of health insurers in the market affects average provider reimbursement rates. A post-implementation influx of health insurance providers would cause reimbursement rates to increase as insurance company market power is diluted by new entrants. However, this does not appear to be the case empirically. We include a depiction of the yearly changes in the number of health insurers from 2001 to 2009 - the rate of entry of newly licensed health insurers post-2006 does not deviate significantly from the mean entry rate of approximately 2.5 entrants per year (Figure 2).

While Figure 2 depicts average entry rates of health insurers, we are unable to determine the change in the number of covered lives as a result of health insurer market entry and the total number of health insurers in the market. The number of enrollees covered by each health insurer would provide some sort of indication of the market power wielded by each insurer – large insurers hold more leverage than smaller insurers during negotiation and would drive allowed prices down further than a negotiation with a smaller insurer. Along the same vein, we are able to observe rates of entry but cannot observe mergers, and thus an increase of negotiation power, of existing firms.

## **9. Refinement – Triple Differences**

The results from the difference-in-differences estimation that we attribute to an increase in the reform may be biased by unobserved factors. Bias in the estimates may occur because of unobservable features of the health care market may change at the same time as the reform.

We further refine our estimates by using a difference-in-differences-in-differences or triple difference estimation strategy. The triple difference takes the difference between the difference-in-

differences estimate for well-infant or well-adult exams and the difference-indifferences estimate for appendectomies. Because demand for appendectomies is extremely inelastic (Manning et al., 1987) and we do not expect it to change as a result of the health reform, the third difference removes the effect of unobservable characteristics of the health care market in general such as the cost of nursing staff, medical supplies, or facilities. Because appendectomies are performed by a different specialty than well-infant visits, the triple difference does not remove the effect of the increase in provider capacity.

The primary advantage of an aggregated triple-differences estimation strategy is that the triple-differences can control for state-specific differences in market trends. Previous research (Kolstad and Kowalski, 2012; Miller, 2012) estimates the effect of the Massachusetts health care reform on county-specific outcomes. Geographic granularity is extremely valuable for the examination of health insurance take-up rates or emergency room visits, but cannot address the possibility of a change in the landscape of health services and insurance provision. Above, we directly estimate the effect of the Massachusetts Health insurance reform on plausible mechanisms for observed reimbursement changes, namely shifts in health services and insurance provider accessibility. The triple-differences estimation technique controls for additional mechanisms that affect state-specific provider reimbursement, such as such as increased nurse wages or the average quality of insurance purchased.

The triple difference estimates for well-infant visits are presented in Table 5A. Table 5A follows the same format as Tables 3A, B and C. Once again, the estimates show an increase in reimbursement during the implementation period and no effect of the reform once the implementation period is over. The triple differences estimate of the effect of the implementation period on reimbursement of approximately 2 percent is smaller in magnitude than the difference

in differences estimate of approximately 4 percent.

The triple differences estimates for well-adult visits are presented in Table 5B. Table 5B has the same format as Table 5A. Once all controls and fixed effects are included in the estimating equation, we find no effect of the reform in either the implementation period or post period on reimbursement at conventional levels.

## 10. Conclusion

The Massachusetts reform greatly increased the number of people in Massachusetts covered by health insurance. The above analysis shows that the increase in insurance coverage was accompanied by sizable increases in reimbursement for procedures that gained a larger patient base with the introduction of the insurance mandate. These increases in reimbursement were temporary: they were eventually offset by either decreases in the cost of provision as healthier individuals entered the market, increases in provider capacity or both.

Our results have broader implications for the remainder of the United States, as additional portions of the Affordable Care Act come into effect. A nationwide individual mandate would likely have similar effects to the mandate seen in Massachusetts. Specifically, the price of many procedures with relatively elastic demand before the Affordable Care Act should be expected to rise during the period while the individual mandate provisions are coming into effect.

We can get a rough estimate of how large such an impact may be using the Medical Expenditure Panel Survey (MEPS) data. In 2009, the average amount paid by public insurance to physicians per person for an office visit in the United States was 69 dollars. We can approximately calculate the additional amount of money paid to physicians if the average change in price of an office procedure is 2 percent, all else equal.

If we consider the non-Massachusetts, non-Medicare or Medicaid U.S. infant population, roughly 19 million individuals, and assume an average of 3 well care visits per infant during the implementation year, a similar health insurance mandate would create around 200 million dollars in additional office visit costs through increased reimbursement. This does not consider other elastic procedures that may also see increases in prices and potential differences in the number of well care visits by demographic. Despite the imprecision of the estimate, the magnitude of this one year price increase underscores the importance of having a firm grasp of the price effects when considering health insurance mandates such as the Affordable Care Act.

This is especially important given that at least part of the price offset once the reform was fully enacted is due to increases in provider capacity. Increasing physician supply in one state is relatively easy compared to doing so for the country, as the cost of incenting physicians to move across state lines is much less than the cost of incenting physicians to move across international borders.

As a final note, it is also important to remember that the full effects of the Massachusetts reforms are still being measured. Our study, along with others in the literature provides estimates that are informative for the short to medium run. It is unclear how the reform will affect health care prices, access to care, and health service quality in the long run as slow-moving market factors such as the supply of new doctors and hospitals adjust to the program changes.

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Figure 1: Market Demand for Health Care

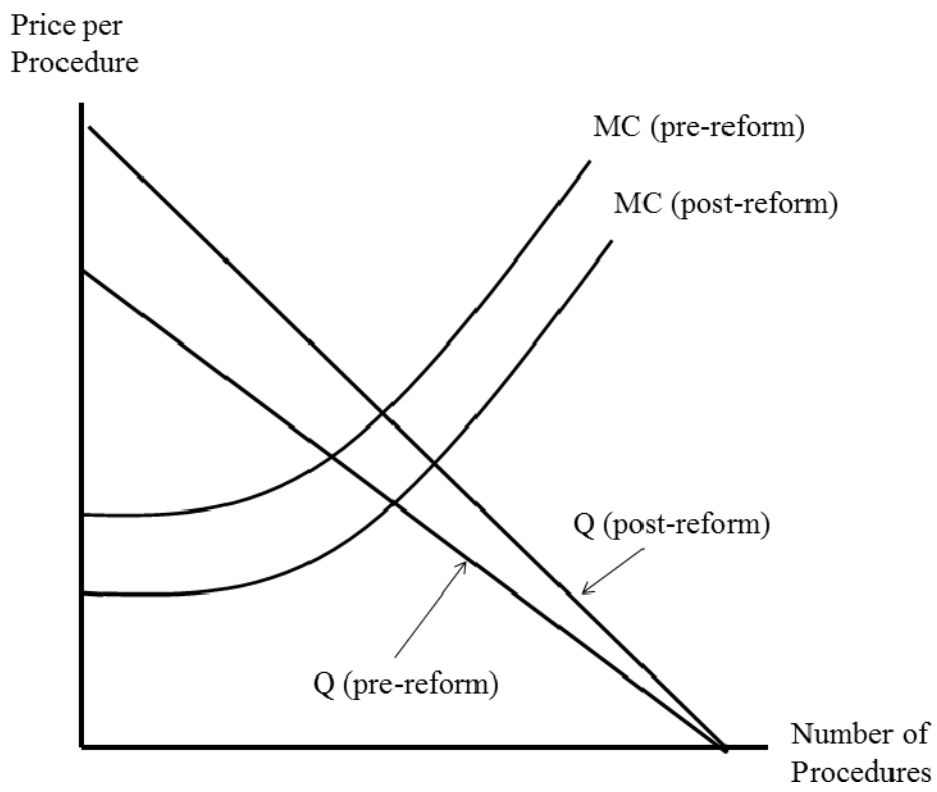
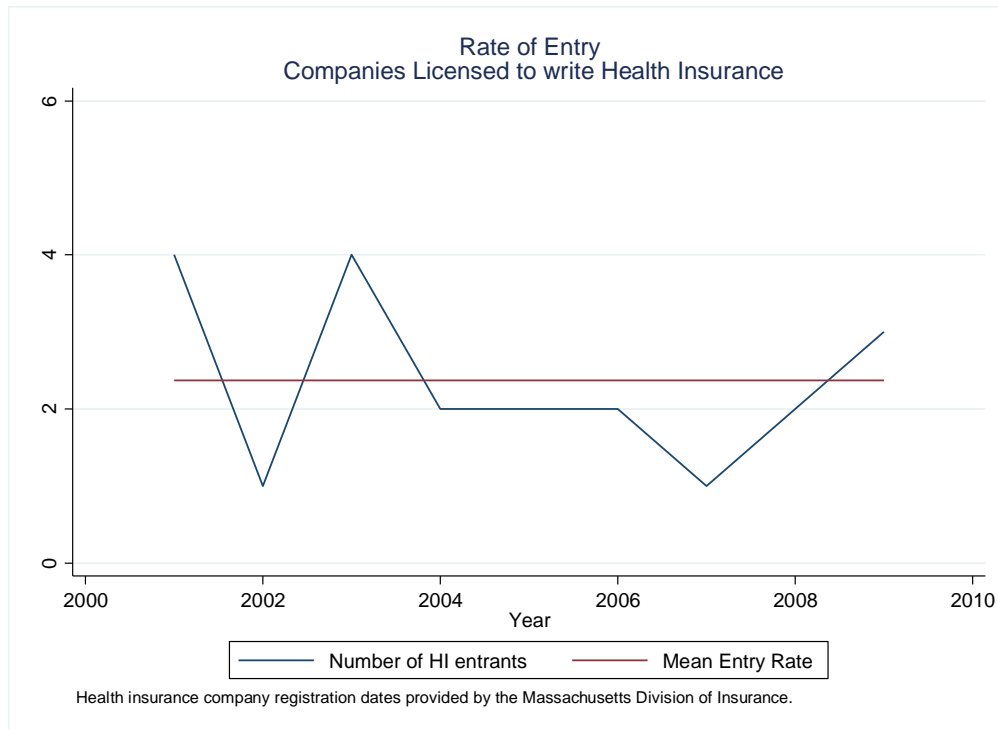




Figure 2: The Rate of Entry of New Health Insurers into the Massachusetts Health Insurance Market



**Table 1: CPT codes**

Procedure	CPT	Description	Allowed Price	
			Mean	Std. Dev.
Well-Adult Exam	99385	Age 18-44 New Patient	123.73	38.27
	99386	Age 45-64 New Patient	142.13	41.53
	99395	Age 18-44 Established Patient	102.13	30.23
	99396	Age 45-64 Established Patient	113.91	32.93
Well - Infant Exam	99381	Age <1 year New Patient	98.00	31.70
	99391	Age <1 year Established Patient	76.87	25.08
Appendectomy	44950	Laparoscopic	861.00	1,125.78
	44960	Open	1,096.47	1,577.23
	44970	Open with Perforated Appendicitis	1,104.73	2,157.35

**Table 2: Demographic Summary Statistics**

Variable	All States	Northeastern States	Massachusetts
White	0.80 (0.13)	0.82 (0.11)	0.84 (0.01)
Black	0.10 (0.11)	0.10 (0.08)	0.06 (0.00)
Female	0.51 (0.01)	0.52 (0.01)	0.52 (0.00)
Percent Employed	0.63 (0.04)	0.64 (0.03)	0.64 (0.01)
Percent Married	0.54 (0.05)	0.53 (0.03)	0.50 (0.02)
Hispanic Origin	0.08 (0.09)	0.07 (0.05)	0.07 (0.00)
Percent with High School Degree	0.40 (0.04)	0.39 (0.03)	0.35 (0.01)
Percent with Some College	0.23 (0.03)	0.21 (0.02)	0.20 (0.01)
Percent with College Degree	0.25 (0.05)	0.29 (0.04)	0.35 (0.01)
Age	46.15 (1.22)	46.92 (0.69)	46.54 (0.13)
ln(Population)	7.94 (0.83)	8.28 (0.65)	8.83 (0.02)
ln(House Value)	11.38 (0.42)	11.74 (0.28)	12.11 (0.17)
People per Household	2.2 (0.79)	2.5 (0.51)	2.5 (0.60)
Number of Children per Household	0.66 (0.08)	0.65 (0.05)	0.65 (0.03)
Houses per zipcode	3217 (2302)	3846 (1721)	4668 (841)
Income	33247 (12691)	44630 (9616)	49568 (8742)
N	255	55	5

Notes: State demographic data was calculated using the publicly available American Community Survey and the proprietary Zip-codes.com database. Numbers are weighted by state population.

**Table 3A: Reform Effects on Appendectomy Prices**

Appendectomies: ln(Allowed Price)	(1)	(2)	(3)	(4)
MA x Post Health Reform	0.034	0.036	0.035	0.036
Std. Error	0.045	0.08	0.045	0.043
t-statistic	0.75	0.21	0.78	0.84
MA x Implementation Period	-0.01	0.057	0.075	0.069
Std. Error	0.026	0.27	0.154	0.149
t-statistic	0.38	0.21	0.49	0.47
Demographics	No	Yes	Yes	Yes
Procedure FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
State Specific Trends	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Procedure x State FE	No	No	Yes	Yes
Procedure x Year FE	No	No	No	Yes
Observation	49592	48130	48130	48130
R-Squared	0.02	0.02	0.02	0.02

Standard errors are clustered by state-year-procedure. Demographics come from Zipcode.com and the ACS. \*\*\*, \*\*, and \* denote statistical significance at the 1, 5 and 10 percent levels

**Table 3B: Reform Effects on Well-Infant Visit Prices**

Well Infant Visits: ln(Allowed Price)	(1)	(2)	(3)	(4)
MA x Post Health Reform	-0.006	-0.008	-0.007	-0.008*
Std. Error	0.02	0.012	0.007	0.006
t-statistic	0.31	0.65	1.08	1.34
MA x Implementation Period	0.044***	0.040***	0.039***	0.039***
Std. Error	0.009	0.006	0.006	0.003
t-statistic	4.71	7.18	11.72	11.88
Demographics	No	Yes	Yes	Yes
Procedure FE	Yes	Yes	Yes	Yes
State Specific Trends	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Procedure x State FE	No	No	Yes	Yes
Procedure x Year FE	No	No	No	Yes
Observation	2,476,171	1,702,783	1,702,783	1,702,783
R-Squared	0.34	0.36	0.36	0.36

Standard errors are clustered by state-year-procedure. Demographics come from Zipcode.com and the ACS. \*\*\*, \*\*, and \* denote statistical significance and the 1, 5 and 10 percent levels

**Table 3C: Reform Effects on Well-Adult Visit Prices**

Well Adult Visits: ln(Allowed Price)	(1)	(2)	(3)	(4)
MA x Post Health Reform	-0.002	0.007	0.007	0.006
Std. Error	0.017	0.012	0.011	0.011
t-statistic	0.09	0.57	0.62	0.62
MA x Implementation Period	0.037***	-0.009	-0.009	-0.009
Std. Error	0.014	0.012	0.009	0.009
t-statistic	3.61	0.75	0.98	0.98
Demographics	No	Yes	Yes	Yes
Procedure FE	Yes	Yes	Yes	Yes
State Specific Trends	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Procedure x State FE	No	No	Yes	Yes
Procedure x Year FE	No	No	No	Yes
Observation	11,303,645	8,469,844	8,469,844	8,469,844
R-Squared	0.32	0.31	0.31	0.32

Standard errors are clustered by state-year-procedure. Demographics come from Zipcode.com and the ACS. \*\*\*, \*\*, and \* denote statistical significance and the 1, 5 and 10 percent levels

**Table 4: Physician Supply in Massachusetts, Yearly and DD Estimates**

ln(number of physicians)	(1) All Fields	(2) All Fields	(3) Pediatricians	(4) Pediatricians
MA x 2006	-0.074 (0.272)		0.182 (0.225)	
MA x 2007	0.032 (0.273)		0.388* (0.233)	
MA x 2008	0.021 (0.270)		0.497** (0.251)	
MA x 2009	0.052 (0.273)		0.437** (0.211)	
MA x Post Health Reform		0.0726 (0.177)		0.349** (0.142)
Demographics	No	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observation	11,872	11,872	474	474
R-Squared	0.30	0.30	0.55	0.55

Standard errors are clustered by state-year-procedure. Demographics come from Zipcode.com and the ACS. \*\*\*, \*\*, and \* denote statistical significance and the 1, 5 and 10 percent levels

**Table 5A: Reform Effects on Well-Infant Visit Prices (Triple Difference)**

	(1)	(2)	(3)	(4)
MA x Post Health Reform x Well-Infant	-0.003*	0.01	0.005	0.005
Std. Error	0.019	0.016	0.007	0.007
t-statistic	0.14	0.63	0.78	0.78
MA x Implementation Period	0.015***	0.016***	0.023***	0.023***
Std. Error	0.037	0.032	0.013	0.013
t-statistic	0.42	0.49	1.72	1.71
Demographics	No	Yes	Yes	Yes
Procedure FE	Yes	Yes	Yes	Yes
State Specific Trends	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Procedure x State FE	No	No	Yes	Yes
Procedure x Year FE	No	No	No	Yes
Observation	2,524,301	1,750,913	1,750,913	1,750,913
R-Squared	0.60	0.65	0.65	0.65

Standard errors are clustered by state-year-procedure. Demographics come from Zipcode.com and the ACS. \*\*\*, \*\*, and \* denote statistical significance and the 1, 5 and 10 percent levels



**Table 5B: Reform Effects on Well-Adult Visit Prices (Triple Difference)**

	(1)	(2)	(3)	(4)
MA x Post Health Reform x Well-Adult	0.005	0.037	0.035	0.035
Std. Error	0.058	0.076	0.076	0.076
t-statistic	0.08	0.49	0.46	0.46
MA x Implementation Period	0.052	0.054**	0.044	0.044
Std. Error	0.042	0.041	0.038	0.038
t-statistic	1.25	1.34	1.14	1.14
Demographics	No	Yes	Yes	Yes
Procedure FE	Yes	Yes	Yes	Yes
State Specific Trends	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Procedure x State FE	No	No	Yes	Yes
Procedure x Year FE	No	No	No	Yes
Observation	11,280,363	8,466,662	8,466,662	8,466,662
R-Squared	0.38	0.40	0.40	0.40

Standard errors are clustered by state-year-procedure. Demographics come from Zipcode.com and the ACS. \*\*\*, \*\*, and \* denote statistical significance and the 1, 5 and 10 percent levels respectively.

## Appendix 1: Minimum Credible Coverage Requirements

In order to qualify as a credible insurance plan, insurance in Massachusetts must cover at least the following:<sup>13</sup>

- Ambulatory patient services, including outpatient day surgery and related anesthesia
- Diagnostic imaging procedures, including x-rays
- Emergency services
- Hospitalization, including at a minimum, inpatient acute care services which are generally provided by an acute care hospital for covered benefits in accordance with the member's subscriber certificate plan description
- Maternity and newborn care
- Medical/surgical care, including preventative and primary care
- Mental health and substance abuse services
- Prescription drugs
- Radiation therapy and chemotherapy

