Plan Efficiency Evaluation in Health Insurance Exchanges

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Abstract

Objectives. To help individuals identify plans of potentially lesser value on health insurance exchanges (HIX) and inform a discussion with payers regarding plan efficiency based on competitive landscape.
Study Design. We propose a methodology based on linear regression to identify inefficient (dominated) plans in the exchanges based on plans' attributes. We identify the excess premium by which certain plans are less competitive than others based on an analysis of plans' features such as premiums and deductibles. We assign each health payer a letter grade based on the percentage of efficient (non-dominated) plans in its HIX portfolio.
Data Sources. We use HIX plan information in Pennsylvania and Massachusetts.
Principal Findings. Our approach documents wide variations in payers' competitiveness and the role of the health payer (name) in driving premiums.
Conclusions. Our methodology provides a novel way to analyze HIX offerings. Payers should articulate more clearly the value proposition of plans labeled "inefficient" or "dominated" in our approach.
Keywords. Health Insurance Exchanges, health plans, efficiency evaluation.

The establishment of the Health Insurance Marketplace through the Affordable Care Act has opened an important channel for individuals to obtain health coverage[1]. While the wide range of plans available on exchanges during the 2015 open enrollment period suggests a robust health insurance market, the existing literature suggests that extensive choice can be overwhelming for customers and lead to greater procrastination before making a choice and/or dissatisfaction afterward; specifically, although psychological benefits of provision of choice do exist, people are more satisfied when they are given a more limited number of options, which they can compare more easily in order to reach an informed decision[2]. In the context of health insurance exchanges, states have been advised to align themselves on Massachusetts in offering only a reasonable but limited set of choices[3]. Too much choice can inhibit consumers and reduce the satisfaction they derive from their decision; further, consumers are highly price sensitive when shopping on exchanges[4].

The objective of this paper is to provide an analytical methodology to help individuals narrow down plan choices by identifying plans that are *dominated* by competitors' offerings in terms of premium, metal level, maximum out of pocket payment and plan type (such as HMO, POS, EPO or PPO). If a customer makes her plan choice based on the features above, it is not in her best interest to select a dominated plan, but a customer who analyzes alone the many plans available on the exchanges may not realize it and thus may make a less-than-optimal decision for herself. Our approach also provides payers with a novel way to analyze their own plans in the HIX landscape. The high-level goal of this methodology is to contribute to a wider discussion on making plans offered on the exchanges as compelling as possible for health exchange customers. We illustrate our methodology using a federal-run exchange (Pennsylvania) and a state-run exchange (Massachusetts).

Methodology and data sources

The following factors should be considered when comparing marketplace plans: (a) *Plan metal level:* Catastrophic (for individuals under the age of 30 with hardship exemptions) Bronze, Silver, Gold, Platinum, in increasing order of actuarial value, (b) *Monthly premium*, (c) *Out-of-pocket costs* – including deductible, copayments, co-insurance – up to the out-of-pocket maximum, (d) *Type of insurance plan and provider network*: HMO, POS, EPO or PPO, because each type has different limitations on usage of in-network versus out-of-network doctors and referrals for specialty care, and (e) *Benefits*: although all marketplace plans have the same essential health benefits, cover pre-existing conditions and offer free preventive services, some plans offer additional benefits.

Intuitively, a plan that has less choice (is of a "worse" type, offering less choice) and higher premium than another plan should have a better metal level or a lower maximum out of pocket to justify the higher

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[1] Kaiser Family Foundation. Summary of the Affordable Care Act, 2011.
https://kaiserfamilyfoundation.files.wordpress.com/2011/04/8061-021.pdf

[2] Sheena S. Iyengar and Mark R. Lepper, When choice is demotivating: Can one desire too much of a good thing? *Journal of Personality and Social Psychology*, 79(6), Dec 2000, 995-1006.

[3] Rosemarie Day and Pamela Nadash, New state insurance exchanges should follow the example of Massachusetts by simplifying choices among health plans, *Health Affairs*, Vol31(5), 2012, 982-989.

[4] Sanjay B. Saxena and Nate Holobinko, Why less choice is more in health insurance exchanges, *Harvard Business Review*, October 2013.

premium. If it does not, the plan is said to be, in our terminology, "inefficient" or "dominated." We do not compare plans issued by the same payer because we assume that those plans are priced in a consistent fashion, i.e., a single decision-maker prices plans rationally, with a more desirable plan always priced higher.

Our objective is to identify "dominated" plans in this framework and quantify their excess premium, i.e., the amount by which their premium should be decreased to be made efficient in this framework or the amount that the payer must take great care in justifying to convince potential enrollees' of the plan's value proposition. We quantify the excess premium in two different ways: by re-running a regression with, as explanatory variables, either plans by non-dominated payers that are assigned a good letter grade, such as B or above (Method 1), or plans that are rarely dominated by other plans, with the precise threshold percentage set by the analyst (Method 2).

Our methodology consists in the following steps:

1. We identify inefficient plans using an algorithm that – for plans issued by different payers – compares types (HMO, POS, EPO or PPO), premiums, metal levels and maximum out of pockets.
2. We run a regression explaining plan premiums using plan features including payer's name, and check whether payer's name is a significant variable. If it is, we assign a letter grade to each payer using Step 3. Otherwise, we go to Step 4.
3. (**Method 1 only**) (Step a) For each payer, we compute the *percentage of non-dominated plans* offered on the exchange. We cluster payers of similar percentages and assign each cluster a letter grade. (Step b) We rerun the regression of Step 1 with the payers graded B or higher only. We then compute the estimated premium that a plan by a payer ranked strictly below B should have had in this model and compare it to the premiums of a plan with the same attributes offered by a payer ranked B or higher. The excess premium for a plan by a payer graded strictly below B is the *smallest difference* between its plan's premium and the premium of a similar plan offered by a high-graded payer, when positive.
4. (**Method 2 only**) Re-run the regression using only plans that are rarely dominated by other plans, with the threshold percentage being set by the analyst. Then, compute what the premiums of dominated plans should have been based on their features for them to be non-dominated. The decrease in premium that the payer should consider – or the part of the premium that he should more clearly justify – is the *smallest difference* between the premium that a non-dominated or efficient plan should have given the plan features and the regression results.

Algorithm to select efficient plans

When selecting efficient plans, we take four factors into consideration: premium, level, type, and out-of-pocket maximum. We assume throughout that plans from the same company are priced appropriately based on their characteristics, i.e., there is no inefficient plan within the pool offered by a given company. Hence, we only compare plans from different payers. Our goal is to identify those plans that have higher premiums with worse benefits. We label a plan P as "inefficient" when we can find another plan Q such that P's type (such as HMO or PPO) is the same or worse than Q's, P's premium is higher than Q's, and either P's metal level is worse than Q's or its metal level is the same but its out-of-pocket maximum is higher than or equal to Q's. If no such Plan Q can be found for a given plan P, Plan P is said to be "efficient". We perform those checks using the MATLAB computer programming software.

Rank payers by efficiency ratio

To investigate whether some payers are more efficient (offer more efficient plans) than others, we rank payers according to the percentage of efficient plans in their HIX portfolio. The higher the percentage is, the less likely it is that a payer's plans are dominated. Based on those percentages, we use a three-level grading scale: A/B/C, to group payers, when appropriate (when payer's name is a significant variable).

Linear regression – plan evaluation

We use linear regression to determine the weights of attributes of plans in the marketplace. The dependent variable is premium. The independent variables include numeric variables: deductible, out-of-pocket maximum; categorical (dummy) variables: company, metal level (bronze, etc.), type (HMO, etc.). We also run individual regression models for each plan level – bronze, silver, gold ad platinum – using stepwise variable selection.

Results

Data visualization in the Pennsylvania Health Insurance Exchange

Figure 1 shows the distribution of plans based on metal level, premium and deductible.
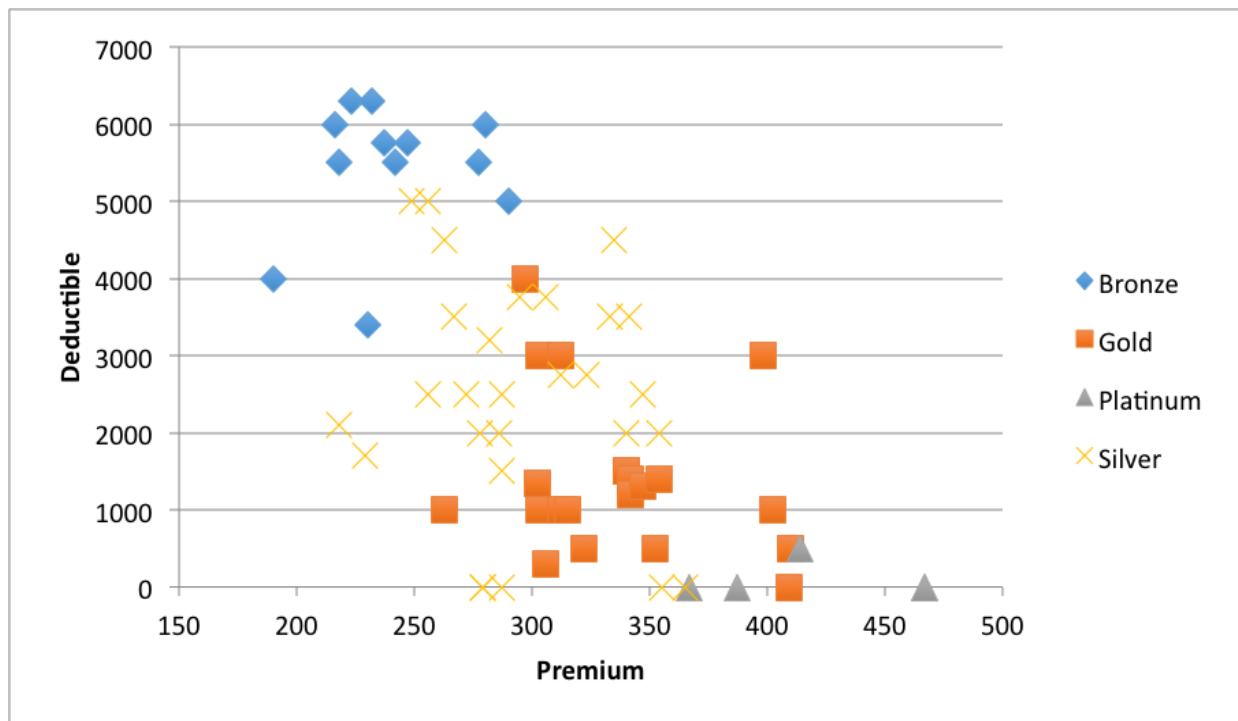

Figure 1 Plans in a (premium, deductible) plane according to metal level, PA HIX

Plan efficiency evaluation results in the Pennsylvania HIX

We run a regression model both with and without stepwise variable selection, to remove non-significant variables. Our next step is to include all Company variables, Level variables, and Deductible then rerun the regression model. Among all the independent variables left in the model, all have p-values smaller than 0.05 (significant) except "Keystone payer" and "Deductible". A summary of the regression models, including R-square values and variables included, is presented in Table 1.

Table 1 Summary of regression models – PA & MA

PA			
	No. of observ.	R-square	Variables
All variables	66	0.9273	all
Stepwise selection	66	0.9263	all companies, all levels, deductible
Bronze only	12	0.8109	Assurant, CBC, OOP_Max
Silver only	28	0.8501	Aetna, Assurant, CBC, Deductible
Gold only	21	0.7816	Geisinger, Assurant, CBC
Platinum only	5	1	Geisinger, HMO, Deductible
MA			
	No. of observ.	R-square	Variables
Model with all variables	106	0.8402	all
Stepwise selection	106	0.8402	all
Bronze only	14	0.4675	MA_BCBS, OOP_Max
Silver only	20	0.6077	Fallon, Harvard, MA_BCBS, United
Gold only	48	0.6803	Fallon, Harvard, MA_BCBS, Tufts, United
Platinum only	24	0.7408	Fallon, Harvard, MA_BCBS, Tufts, United

Next, we look at the individual regression models for each metal level. Since there are few plan observations at the bronze and platinum levels, we only investigate the cases of the silver and gold plans. The regression results illustrate that the identity of the payer is the most important attribute driving plan premiums. Results of all regression models on the PA data (for the 18015 zip code and an adult in her late thirties) are summarized in Table 2. Highmark and Geisinger have the highest percentage of absolutely efficient plans.

Table 2 Summary of inefficient plans & ranks of companies- PA

Company name	Aetna	Assurant	CBC	Geisinger	Highmark	Keystone
Company sum of dominated times	85	38	109	8	6	64
Number of plans in each company	10	6	11	11	16	12
Number of comparisons	560	360	605	605	800	648
Percent of dominated by others	15.2%	10.6%	18.0%	1.3%	0.8%	9.9%
Number of absolutely efficient plans	0	0	0	3	10	0
Percent of absolutely efficient plans	0.0%	0.0%	0.0%	27.3%	62.5%	0.0%
Rank	5	4	6	2	1	3
Grade	C	B	C	A	A	B

We also run Method 2, with a threshold percentage of plan being dominated by at most 10% other plans. There are 44 such plans. The R-square is 0.9068. The highest excess premium is $53 (for a monthly premium of $323), achieved for Aetna Silver $5 copay 2750 OAMC. (2750 is the deductible for the plan and OAMC stands for Open-Access Managed Choice.) In fact, the four plans with the highest excess premium are Aetna plans. This may not mean that they are overpriced, but Aetna should make sure that its plans' value proposition is well understood. The most underpriced plan is Capital Blue Cross Healthy Benefits PPO 5500.50, which has a monthly premium of $277 although the model estimates the premium at $296, and the second most underpriced plan is Keystone Healthy Benefits Value HMO 1000.0 (monthly premium $315, estimated premium $325).[5]

Plan efficiency evaluation results in Massachusetts Health Insurance Exchanges

We use data obtained for the 02142 zipcode for an adult in her late thirties. Only 1 plan offered is PPO, and 7 plans are EPO; however, these 7 EPO plans are all from United Health Care, and all United Health Care plans are EPO plans. As a result, we exclude "Type" in the regression model since it is already captured in the "Company" ("Payer") variable.

Compared to Pennsylvania plans, Massachusetts plans have far fewer deductible levels. We run a regression model to identify the factors attributed to plan premiums. The R-square of this model is 0.8402, which is very good. All variables except the payer Tufts and Out-of-pocket maximum are significant at the 5% level. The residual plots (not shown here) suggest that this model fits quite well. Specifically, the QQ plot is almost a straight line, and the residuals follow a Normal distribution. We also apply stepwise variable selection to MA plans but all variables are selected by the program, leading back to the original model.

We also apply regression models to plans at each metal level. More plans are offered in the 02142 Massachusetts zip code than in the 18015 Pennsylvania zip code, so the results are more convincing. Also

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[5] Tengjiao Xiao and Aurélie Thiele, Analytical methods for plan efficiency evaluation in the health insurance exchanges, Technical Report, Department of Industrial and Systems Engineering, Lehigh University, March 2015.

note that the MA plans studied here tend to have higher metal levels, where silver is the dominant metal level in PA and gold is dominant in MA. The regression results shown in Table 1 indicate that the payer is still the most important attribute in plan premiums. Therefore, it is meaningful to compare plans from different companies and rank companies based on plan efficiency.

We apply the algorithm to all MA plans. Key results are summarized in Table 3. Companies in MA are ranked and given grades in the same fashion as companies in PA. Plans provided by United HealthCare, Boston Medical Center and Minuteman Health are best-performing in our framework.

Table 3 Summary of inefficient plans & ranks of companies - MA

Company name	Ambetter	BMC	Fallon	Harvard Pilgrim	MA_BCBS	Minu-teman	NHP	Tufts	Uni-ted
Company sum of dominated times	71	9	602	231	243	14	39	90	2
Number of plans in each company	9	7	27	13	10	9	9	13	7
Number of comparisons	855	679	2079	1183	940	855	855	1183	679
Percent of dominated by others (%)	8.3	1.33	29.0	19.5	25.9	1.6	4.6	7.61	0.3
Number of absolutely efficient plans	1	3	0	1	1	4	1	2	5
Percent of absolutely efficient plans (%)	11.1	42.9	0.0	7.7	10.0	44.4	11.1	15.4	71.4
Rank	6	2	9	7	8	3	4	5	1
Grade	B	A	C	C	C	A	B	B	A

Recommendations for other states and health policy makers

To extend our methodology to other states besides MA and PA, analysts should first identify any unique characteristics of plans in the state once they have obtained the summary statistics of plan premium and benefits. For example, the types of MA plans (HMO, PPO and EPO) are different from the PA plans (HMO, PPO and POS), and it turns out that we can discard the Type variable in the MA regression model. The second step is to utilize regression models to decide whether a payer (name) is the most important indicator of inefficiency/efficiency. If it is, then we feel justified in assigning grades to payers; otherwise, we have to implement a different method (Method 2) to compute premiums.

Health payers with offerings less compelling (as quantified by this framework) than their competitors may wish to discuss internally the assumptions that led their analysts to pricing the plan higher than what the regression model recommends, potential ways to realize savings in order to decrease premiums, or a stronger positioning of their plan to justify the apparent inefficiency using a different quantitative metric.

We now illustrate possible recommendations to health insurance companies using the Capital Blue Cross (CBC) payer in Pennsylvania. CBC has a total of eleven plans but zero absolutely efficient plan, and is thus given the grade of C. In order to give suggestions to CBC regarding the size in premium reduction that would make its plans more competitive in our model, we first conduct regression on plans from payers graded A or B (Highmark, Geisinger, Keystone, and Assurant) since they are the "aspirational peers" of payers ranked C. Then we apply the regression results to CBC plans in order to get approximate premiums for plans with such characteristics offered by A or B payers. Based on 45 plans from grade A and grade B companies, the R-squared of the model is 0.8919 and the adjusted R-squared is 0.8602, both of which are very high. Although the F statistic is significant, some of the variables are not very significant at the individual level. As a result, we apply stepwise variable selection on the model. After the stepwise variable selection, the Type variables and Deductible are excluded from the model. We include the selected variables and run the regression model again. The R-square drops down slightly to 0.8896 but the adjusted R-square goes up to 0.8687.

Our next step is to apply the regression coefficients to CBC plans. Table 4 shows the estimated premiums of each CBC plan if they were plans from grade A and B companies. (Those estimated premiums are all smaller than the actual ones.) This gives CBC an estimate of the premium decreases they should achieve in order to stay competitive in the market. Alternatively, this is a measure of how much CBC feels they will attract sicker patients due to their name recognition.

The estimated premiums give us ranges of premiums for efficient plans with same benefits. Out of the eleven plans, two CBC plans' premiums (highlighted in green) are within the ranges determined by efficient plans, solely because they have lower premiums than Assurant's corresponding plans. The reason could be that Assurant is only slightly better than CBC (rank 4th vs. 6th) in spite of being ranked B instead of C, so that occasionally CBC plans are more efficient than Assurant's.

Table 4 Estimated premiums – CBC Healthy Benefits (HB), PA, Method 1. Well-priced plans are in bold.

Plan	Level	Type	Deductible	OOP Max	Prem.	Est_Pre _Highm	Est_Pre _ Geis.	Est_Pre_ Keyst.	Est_Pre _Assu.
PPO 5500.50	**Bronze**	**PPO**	**5500**	**6350**	**277**	**220.86**	**202.67**	**220.73**	**289.44**
PPO 3000.0	Gold	PPO	3000	6350	398	321.54	303.35	321.42	390.12
PPO 1000.0	Gold	PPO	1000	6350	402	321.54	303.35	321.42	390.12
PPO 500.0	Gold	PPO	500	6350	410	321.54	303.35	321.42	390.12
PPO 0.0.10	Platinum	PPO	0	6350	467	389.63	371.44	389.51	458.21
PPO 4500.50	**Silver**	**PPO**	**4500**	**6350**	**335**	**269.29**	**251.11**	**269.17**	**337.87**
PPO 3500.0	Silver	PPO	3500	6350	341	269.29	251.11	269.17	337.87
PPO 2500.0	Silver	PPO	2500	6350	347	269.29	251.11	269.17	337.87
PPO 2000.0	Silver	PPO	2000	6350	354	269.29	251.11	269.17	337.87
PPO 0.50	Silver	PPO	0	6350	355	269.29	251.11	269.17	337.87
PPO 0.0	Silver	PPO	0	6350	365	269.29	251.11	269.17	337.87

We calculated the estimated premiums for Aetna plans (grade C) in a similar fashion. We notice that Aetna plans are always more expensive than plans from Highmark, Geisinger and Keystone with the same benefits. However, they are always cheaper than the corresponding Assurant plans as well. This is not surprising because their ranks are even closer (rank 4th vs. 5th). As a result, it is more likely that Aetna has more efficient plans than Assurant compared to CBC.

Conclusions

This paper investigates the important drivers of plan premiums in the health exchanges, with examples drawn from the Pennsylvania and Massachusetts health insurance marketplaces. We proposed a simple algorithm to identify "efficient" plans and assign letter grades to payers, and used linear regression results to identify the premium amount by which certain plans may be unattractive to customers. Alternatively, some plans may be underpricing their competitors to generate market share. This work can provide a framework for informed discussions between policy-makers and payers active on public health exchanges.

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