

Risk Transfer Formula for Individual and Small Group Markets Under the Affordable Care Act

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Abstract: The Affordable Care Act provides for a program of risk adjustment in the individual and small group health insurance markets in 2014 as Marketplaces are implemented and new market reforms take effect. The purpose of risk adjustment is to lessen or eliminate the influence of risk selection on the premiums that plans charge. The risk adjustment methodology includes the risk adjustment model and the risk transfer formula.

This article is the third of three in this issue of the *Medicare & Medicaid Research Review* that describe the ACA risk adjustment methodology and focuses on the risk transfer formula. In our first companion article, we discussed the key issues and choices in developing the methodology. In our second companion paper, we described the risk adjustment model that is used to calculate risk scores. In this article we present the risk transfer formula. We first describe how the plan risk score is combined with factors for

the plan allowable premium rating, actuarial value, induced demand, geographic cost, and the statewide average premium in a formula that calculates transfers among plans. We then show how each plan factor is determined, as well as how the factors relate to each other in the risk transfer formula. The goal of risk transfers is to offset the effects of risk selection on plan costs while preserving premium differences due to factors such as actuarial value differences. Illustrative numerical simulations show the risk transfer formula operating as anticipated in hypothetical scenarios.

Keywords: risk adjustment, Affordable Care Act, ACA, risk transfers, risk transfer formula, allowable rating factors, risk equalization, balanced risk transfers, risk scores, health insurance marketplaces

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Introduction

Beginning in 2014, individuals and small businesses are able to purchase private health insurance through competitive Marketplaces. Issuers must follow certain rules to participate in the markets, for example, in regard to the premiums they can charge enrollees, and also not being allowed to refuse insurance to anyone or vary enrollee premiums based on their health. Enrollees in individual market health plans through the Marketplaces may be eligible to receive premium tax credits to make health insurance more affordable and financial assistance to cover cost sharing for health care services.

This article is the third in a series of three related articles in this issue of the *Medicare & Medicaid Research Review* that describe the Department of Health and Human Services (HHS)-developed risk adjustment methodology for the individual and small group markets established by the Affordable Care Act (ACA) of 2010. The risk adjustment methodology consists of a *risk adjustment model* and a *risk transfer formula*. The risk adjustment model uses an individual's demographics and diagnoses to determine a risk score, which is a relative measure of how costly that individual is anticipated to be. The transfer formula averages all individual risk scores in a risk adjustment covered plan, makes certain adjustments, and calculates the funds transferred between plans. Risk transfers are intended to offset the effects of risk selection on plan costs while preserving premium differences due to factors such as actuarial value differences. This article describes the payment transfer formula. See our companion article (Kautter *et al.*, 2014) for a description of the risk adjustment model.

Another companion article (Kautter *et al.*, 2014) discusses the key issues and choices in developing the ACA risk adjustment methodology.¹

HHS will use this risk adjustment methodology when operating risk adjustment on behalf of a state. For 2014, the HHS methodology will be used in all states except one (Massachusetts), and it will apply to all non-grandfathered plans both inside and outside of the Marketplaces in the individual and small-group markets in each state. Payment transfers will be determined separately for the individual and small group markets unless a state elects to merge them. Payment transfers will occur among platinum, gold, silver, and bronze plans as a single risk adjustment pool and as a separate risk adjustment pool among catastrophic plans. Payment transfers for 2014 will be calculated retrospectively, in 2015, using data for 2014 made available by plans subject to risk adjustment.

This article is organized as follows. We begin by describing the risk transfer formula, starting with the concepts behind the formula. Then we explain the details of the formula's components and how these components are calculated. Finally, we present selected examples of hypothetical plans subject to risk adjustment to illustrate how risk transfers would be calculated and their hypothetical impact on premiums.

In the Appendix to this article, we provide a mathematical derivation of the risk transfer formula.

The Transfer Formula

The transfer formula is the part of the ACA risk adjustment methodology that is used to determine the dollar flows from low- to high-risk plans. The plan liability risk score, described in

a companion article, is a crucial component of the transfer formula. But the transfer formula also incorporates several other factors into its calculation of transfers, as described below. A plan's transfer payment or charge cannot be determined from just its own information; instead, every plan's transfer depends on the risk scores and other information of all plans in the state's individual or small group market risk pool.

Overview of Transfer Formula

The purpose of the risk transfers is to offset variations in plan actuarial risk due to risk selection, beyond the premiums plans are able to collect. Conceptually, the risk transfer formula measures the difference between two plan premium estimates: 1) premium with risk selection,² minus 2) premium without risk selection.³ Transfers are intended to bridge the gap between these two premium estimates; that is, they are to account for health risk differences while preserving permissible premium differences. If the difference between the two premium estimates is positive, a plan receives a transfer payment. If the difference is negative, a plan is "charged" and owes transfer funds.

The two premium estimates are based on the product of a specified set of plan cost factors, expressed relative to the state average product of those cost factors, and multiplied by the state average premium. In addition to the risk score included in the first premium estimate, four other cost factors are modeled in this transfer payment formula: 1) the plan's metal level actuarial value (AV), 2) allowable rating factor (ARF), 3) the induced demand factor associated with the plan's metal level (IDF), and 4) a geographic cost factor (GCF).

¹ For general background on risk adjustment, risk transfers ("risk equalization"), and risk selection, see van de Ven and Ellis (2000), van de Ven and Schut (2011), Van de Ven (2011), and Breyer, Bundorf, and Pauly (2012).

² By "premium with risk selection," we mean premiums that reflect the actual risk of each plan's enrollees.

³ By "premium without risk selection" we mean premiums that reflect enrollees of average risk given a plan's allowable rating factors (age profile of its enrollees).

With these adjustments, the formula for plan *i*'s transfer T_i is:

$$T_i = \left[\frac{PLRS_i \cdot IDF_i \cdot GCF_i}{\sum_i (s_i \cdot PLRS_i \cdot IDF_i \cdot GCF_i)} - \frac{AV_i \cdot ARF_i \cdot IDF_i \cdot GCF_i}{\sum_i (s_i \cdot AV_i \cdot ARF_i \cdot IDF_i \cdot GCF_i)} \right] \bar{P}_s \quad (1)$$

The first term in the transfer formula (within the square brackets) estimates the premium with risk selection, relative to the market (statewide) average. Its numerator is the product of three terms:

- 1) a plan liability risk score (PLRS), which reflects the plan's actuarial value as well as the plan's enrollee health status risk (including health risk due to age) as described in the companion article on the risk adjustment model;⁴
- 2) an induced demand factor (IDF), which reflects the anticipated induced demand associated with the plan's cost sharing (metal) level; and
- 3) a geographic cost factor (GCF), which reflects the medical cost structure in the geographic location of the plan's enrollees.

The second term in the transfer formula estimates the premium without risk selection, relative to the market (statewide) average. Its numerator is the product of four terms:

- 1) the actuarial value (AV) associated with the plan's metal level;
- 2) the plan's allowable rating factor (ARF), which reflects the relative premium plans are permitted to charge given the allowable rating factors of its enrollees;

⁴ The risk score is also multiplicatively adjusted for induced demand associated with individual enrollee income-based ACA cost sharing reductions.

- 3) the induced demand factor (IDF) associated with the plan's metal level; and
- 4) the geographic cost factor (GCF) of the plan's enrollees.

The denominators of the first and second terms in the transfer equation express the plan's required revenues and allowable revenues, respectively, relative to the market (statewide) average, weighted by plan enrollment market shares (denoted by "s" in the formula). Transfers are converted from relative factors into dollar amounts by multiplying them by the statewide enrollment-weighted market average plan premium \bar{P}_s .

Transfer Formula in Depth

The risk transfer formula assumes a multiplicative relationship among the various cost factors. Other things being equal, a 10 percent increase in the cost of doing business in a rating area increases plan liabilities and premiums by 10 percent, a 10 percent increase in risk increases plan liabilities by 10 percent, etc. If Plan A's actuarial value is 25 percent higher than Plan B's AV, and Plan A's geographic cost factor is 40 percent higher than Plan B's GCF, then Plan A's costs would be expected to be 75 percent greater than Plan B's costs ($1.25 \times 1.40 - 1.00 = 1.75$).

More formally, a plan's expected costs would be proportional to the product $PLRS \cdot IDF \cdot GCF$. Below is the formula showing how plan *i*'s estimated premium with risk selection is calculated:

$$\left[\frac{PLRS_i \cdot IDF_i \cdot GCF_i}{\sum_i (s_i \cdot PLRS_i \cdot IDF_i \cdot GCF_i)} \right] \bar{P}_s \quad (2)$$

where

\bar{P}_s = Statewide market average premium,

$PLRS_i$ = plan *i*'s plan liability risk score,

IDF_i = plan *i*'s induced demand factor,

GCF_i = plan *i*'s geographic cost factor,

s_i = plan *i*'s share of marketwide enrollment,

and the denominator is summed across all plans in the risk pool in the market in the State.

Conceptually, this expression calculates the plan's expected costs (PLRS*IDF*GCF) relative to the marketwide average costs. The denominator normalizes the product of the plan cost factors to the market average product of these cost factors. This normalized product of the plan cost factors provides an estimate of how a plan's liability differs from the market average due to underlying differences in its cost factors, including risk selection, induced demand and geographic cost differences. It is multiplied by the statewide market average premium (\bar{P}_s) to provide an estimate of plan premiums including risk selection.

The key factor in this premium estimate is the plan liability risk score, which is calculated from the HHS-HCC risk adjustment model (the model is described in our companion article). The PLRS is a relative measure of plan liability based on the health status of the plan's enrollees. This risk score measure incorporates each plan's metal level actuarial value, so it takes into account the fact that higher-AV plans will incur greater costs due to their more generous benefit designs. Because of this, the premium expression does not include a separate AV adjustment factor. The risk score also includes estimated health costs due to age, so this premium estimate does not include a separate allowable rating factor.

The other expression in the risk transfer formula simulates how much premium revenue the plan would be expected to collect. This expression is shown below:

$$\left[\frac{AV_i \cdot ARF_i \cdot IDF_i \cdot GCF_i}{\sum_i (s_i \cdot AV_i \cdot ARF_i \cdot IDF_i \cdot GCF_i)} \right] \bar{P}_s \quad (3)$$

where notation is as defined above, plus ARF_i is the plan's allowable rating factor. The ARF reflects the impact of the age composition of each plan's

enrollees on the premiums it would collect from enrollees, given applicable rating constraints.

This term estimates the amount of premium revenue that a plan can be expected to collect from its enrollees if the plan premium were based solely on age, actuarial value, induced demand, and geographic cost differences. Plans with higher actuarial value, induced demand, or geographic area costs would be expected to charge higher premiums to cover these costs. The ARF adjustment captures the fact that plans with higher allowable rating factors will be able to collect higher premiums, though these premiums are restricted by applicable rating rules. Note that the right hand (premium without risk selection) term does not include a plan's risk score, because health status risk is not an allowable rating factor under the ACA. This term reflects the premium that the plan could collect from enrollees if they were of average risk, but taking into account their age, geographic location, the actuarial value of their coverage, and the induced demand associated with that level of coverage.

The statewide market average premium acts as a common scaling factor for both terms in the transfer formula, which are expressed as relatives to the statewide market average. With competition among plans for enrollees, the statewide average premium should also reflect the statewide cost level. The statewide premium is therefore simultaneously a premium and a cost scaling factor. The statewide average premium embeds an average level of efficiency. All plans receive a risk payment or charge appropriate for a plan with average efficiency, rather than a higher or lower payment or charge reflecting their own cost structure (differences in efficiency will be reflected in plans' own premiums, however).

Two other reasons that the risk transfers are scaled by the state average premium, as opposed to, for example, their own premium, are:

1. This minimizes issuers' ability to manipulate their transfers by adjusting their own plan premiums.
2. Scaling all risk transfers to the same premium obviates any further adjustment of payments and charges to ensure that risk transfers for the entire market sum to zero.

Structured as shown above, the risk transfer formula calculates T_i , the payment or (if negative) charge to plan i for each member-month of enrollment. The total risk transfer for each plan is calculated by multiplying T_i by the plan's total member-months. The transfer formula is self-normalizing with respect to any of its factors except the plan market share s and the statewide average premium \bar{P}_s . Because all of the other factors appear in both the numerator and denominator of the transfer formula terms within brackets, any of them may be multiplied by a constant and the calculated transfers will be unchanged.

For the purposes of the transfer formula, a health plan that is offered in more than one geographic rating area is treated as multiple plans, one for each rating area. The risk score, geographic cost factor, and other elements of the transfer formula interact multiplicatively. For this reason, multi-rating-area plans must be treated as separate "plan segments," one per rating area, to calculate transfers correctly. Once transfers have been calculated for each plan segment, they can be re-aggregated to the plan or issuer level.

Components of the Transfer Formula

In this section we provide additional details on the calculation of components of the transfer formula.⁵

⁵ More information on each of the components of the transfer formula, and on the calculation of transfers, is available in (Patient Protection and Affordable Care Act, 2012a, 2012b, 2013a, 2013b; DHHS, 2013).

Adjustment to the Plan Liability Risk Score (PLRS) for Family Rating Rules

The risk transfer formula is based on individuals (including children) rather than families as the unit of enrollment. However, the PLRS includes an adjustment to account for the family rating rules (Patient Protection and Affordable Care Act, 2012a), which cap (at 3) the number of children who can count toward the buildup of family rates. When the plan average PLRS is calculated, *all* plan enrollees are counted in the numerator, but only *billable* plan enrollees (parents and up to the three oldest children) are counted in the denominator. This creates a weighted average plan PLRS that takes into account the fact that families with non-billable children impose more risk per billable member-month than families in which every member-month is billable, all else being equal.

Actuarial Value (AV)

The actuarial value adjustment in the risk transfer formula accounts for relative differences in plan liability due to differences in the percentage of enrollees' expenditures that the plan covers.⁶ Without an AV adjustment, low-risk, low-AV plans would tend to pay higher charges than appropriate (because their claims expense would not be scaled down by their low AV), and high-risk, high-AV plans would receive lower payments than are necessary to compensate for their excess risk (because their payments would not be scaled up by their high AV). Concomitantly, high-risk, low-AV plans would tend to receive higher payments than appropriate and low-risk, high AV plans would pay lower charges than appropriate.

⁶ Recall that the AV adjustment is implicitly made in the plan liability risk score in the left hand side of the transfer formula and is explicitly made as a separate component in the right hand side of the transfer formula.

The AV adjustment is based on the metal level actuarial value associated with each plan type.⁷ The metal level is assigned based on entering each plan's cost sharing parameters into the Department of Health and Human Services' AV calculator (DHHS, 2013). The AV calculator returns an actuarial value, and from this value each plan is assigned a metal level. This provides a simple and straightforward way to capture the impact of benefit design on plan liability. Exhibit 1 shows the metal level AVs. So for example, all bronze plans are assigned an AV adjustment factor of 0.6 in the risk transfer formula.^{8,9}

Induced demand reflects differences in enrollee spending patterns attributable to differences in the generosity of plan benefits (cost sharing). Risk adjustment should not compensate issuers for plan liability attributed to variation in benefit design. For this reason, the risk transfer formula includes an induced demand adjustment to the plan revenue requirement and allowable premium revenue sides of the equation. The HHS AV calculator includes an induced demand factor for each metal level based on the claims of plans grouped into the metal level actuarial value tiers (DHHS, 2013). The same set of induced demand factors are used for the values of IDF_i in the payment transfer formula, as shown in Exhibit 2.

Exhibit 1. Actuarial Value Adjustment Used for Each Metal Level

Metal Level	AV Adjustment
Catastrophic	0.570
Bronze	0.600
Silver	0.700
Gold	0.800
Platinum	0.900

SOURCE: DHHS (2013).

Exhibit 2. Induced Demand Adjustment for Each Metal Level

Metal Level	Induced Demand Adjustment
Catastrophic	1.00
Bronze	1.00
Silver	1.03
Gold	1.08
Platinum	1.15

SOURCE: Patient Protection and Affordable Care Act (2013a).

Allowable Rating Factor (ARF)

The allowable rating factor (ARF) adjustment in the risk transfer formula accounts only for age rating. The risk score is adjusted for family rating requirements as described above, and geographic rating areas receive a separate adjustment described below. Tobacco use and wellness discounts are not included in the ARF (Patient Protection and Affordable Care Act, 2012b).¹⁰

Age rating allows issuers to be partially compensated for risk variation based on enrollee age. Under the Market Reform Rule (Patient Protection and Affordable Care Act, 2012a), each state has a standard age curve that all plans are required to use in that state. (A federal age rating curve operates in states that do not designate their own curve.) The 3:1 age rating restriction applies

⁷ The AV adjustment is consistent between the two terms of the transfer formula; both the plan liability risk score in the first term and the explicit AV adjustment in the second term are based on the plan's metal level.

⁸ A plan actuarial value of 1.0 indicates that the plan covers all enrollee medical expenses; i.e., there is no enrollee cost sharing. An actuarial value of 0.90 indicates that the plan covers 90 percent of the enrollee medical expenses of a standard population on average, while 10 percent is paid by enrollees through cost sharing and, similarly, for other actuarial value levels.

⁹ A plan's calculated AV must be within a de minimus range of plus or minus 0.02 from a metal level nominal value (0.60–bronze, 0.70–silver, 0.80–gold, 0.90–platinum). If the plan's AV is not within 0.02 of a metal level, the plan must modify its cost sharing design to be within the de minimus range of a metal AV.

¹⁰ Tobacco rating and wellness discounts are discretionary and are not included in the ARF to maintain issuer flexibility regarding these rating adjustments.

to adults only (defined as age 21 or greater). Each plan's ARF is calculated as the enrollment-weighted average of age factors across all of the plan's enrollees.

The federal age rating curve is presented in Exhibit 3. For example, a 21-year-old enrollee has an ARF of 1.000, while the maximum rating (for people age 64 and older) is 3.000, conforming to the 3:1 maximum adult age rating restriction. Plan-level average ARF values enable comparisons of premium-generating capacity across plans; for example, a plan whose ARF is 2.00 would be able to collect 25 percent more premium revenue through age rating than a plan with an ARF equal to 1.60. The ARF can be modified to conform to state variation in rating rules (e.g., a 2:1 rather than 3:1 age rating restriction with associated age rating curve).

Geographic Cost Factor (GCF)

The risk transfer methodology includes an adjustment for geographic cost variation

because there are many costs, such as input prices and medical care utilization rates, that vary geographically and are likely to affect premiums. Without geographic cost adjustment, risk transfers would tend to subsidize high-risk plans in low-cost areas and low-risk plans in high-cost areas at the expense of low-risk plans in low-cost areas and high-risk plans in high-cost areas. Other things equal, low-risk plans pay charges and high-risk plans receive payments. If these transfers are scaled to statewide average costs, in low-cost areas low-risk plans would pay more than is appropriate for an area where costs are lower than average, and high-risk plans would receive more than necessary to compensate for their excess risk. The reverse would be true in an area where costs are higher than the state average.

A GCF is calculated for each rating area. For the metal level risk pools these factors are calculated based on the observed average silver plan premiums in a geographic area relative to the

Exhibit 3. Federal Age Rating Curve

Age	Premium Ratio	Age	Premium Ratio	Age	Premium Ratio
21	1.000	36	1.230	51	1.865
22	1.000	37	1.238	52	1.952
23	1.000	38	1.246	53	2.040
24	1.000	39	1.262	54	2.135
25	1.004	40	1.278	55	2.230
26	1.024	41	1.302	56	2.333
27	1.048	42	1.325	57	2.437
28	1.087	43	1.357	58	2.548
29	1.119	44	1.397	59	2.603
30	1.135	45	1.444	60	2.714
31	1.159	46	1.500	61	2.810
32	1.183	47	1.563	62	2.873
33	1.198	48	1.635	63	2.952
34	1.214	49	1.706	64 and Older	3.000
35	1.222	50	1.786	—	—

SOURCE: Patient Protection and Affordable Care Act, (2012a).

state-wide average silver plan premium.¹¹ When the silver plan premiums are used to calculate the adjustment they are standardized for age rating to isolate geographic cost differences embedded in premiums. Premiums are not standardized for risk score because observed premiums reflect payment transfers, which offset enrollee health status risk variation. Differences in the average premium revenue of silver plans across rating areas will reflect differences in the cost of doing business, but not differences in risk, actuarial value, or differences in use of services that are induced by differing levels of coverage.

The enrollment-weighted statewide average of plan GCF values equals 1.0, so deviations from 1.0 can be interpreted as the percentage by which any geographic area's costs deviate from the state average. In other words, a GCF equal to 1.15 indicates that the plan operates in a geographic area where costs are, on average, 15 percent higher than the statewide average. If a plan enrolls members in multiple rating areas, it will be decomposed into "plan segments" with enrollment (and any other characteristics necessary for the transfer calculation that vary by area) specific to each applicable rating area. These plan segments will be used in the calculation of payment transfers, which will then be aggregated to the plan and issuer level for execution.¹²

Numerical Simulations of Hypothetical Risk Transfer Scenarios

To illustrate how the risk transfer methodology works and impacts premiums, in this section we

present several simplified scenarios of risk transfers among hypothetical health insurance plans. Exhibit 4 shows the simulation of six scenarios that illustrate the role of each of the factors in the risk transfer formula. We begin with a very simple scenario, then progress to scenarios of increasing complexity, employing more of the factors in the transfer formula.¹³

In each scenario, we focus on the calculation of transfers (if applicable) and on the estimated premiums plans charge their enrollees (incorporating transfers if applicable). Scenarios 1 and 3 do not include transfers so that the effect of transfers on premiums relative to a baseline case without them can be assessed. We focus on the impact of transfers on estimated premiums because the goal of HHS risk adjustment is to remove the effect of health status but not other factors on plan premiums. In all six scenarios, only two plans constitute the entire statewide market (risk pool), and each plan has half of the total market. The parameter values for the simulations are chosen for illustrative purposes. They are intended to be generally realistic, but are purely hypothetical and are not intended to be indicative of any actual or expected transfers or premiums.

Scenario 1: Plans with Equal Coverage, No Risk Transfers

Scenario 1 compares two "silver" plans (actuarial value = 0.7 by Exhibit 1) whose enrollees differ in health status risk and, therefore, cost. Plan 1's enrollee risk scores, gross medical care costs, and plan liability¹⁴ are all double those of Plan 2. In other words, Plan 1's enrollees are less healthy and, therefore, have higher health care

¹¹ The GCF for the catastrophic risk pool is calculated using catastrophic plan premiums.

¹² Plans offered in multiple areas must be decomposed into plan segments because the transfer formula factors interact multiplicatively, and the sum across rating areas of the product of a plan's factors in each rating area is not equal to the product of the average of a plan's factors across areas.

¹³ In Scenarios 1–5, for simplicity, we assume no induced demand or geographic cost differences, hence $IDF=GCF=1$. In Scenarios 1–4, we assume no difference in plan enrollee age mix, hence $ARF=1$.

¹⁴ In the examples in Exhibit 4, plan liability is the plan's gross medical care costs multiplied by its actuarial value.

Exhibit 4. Simulations of Hypothetical Risk Adjustment Scenarios

	1		2		3		4		5		6	
	Plans with Equal Coverage, No Risk Transfers		Plans with Equal Coverage, with Risk Transfers		Plans with Unequal Coverage, No Risk Transfers		Plans with Unequal Coverage, with Risk Transfers		Scenario 4 with Unequal Plan Enrollee Age Mix		Scenario 5 with Induced Demand and Geographic Cost Differences	
	Plan	Silver-1	Plan	Silver-1	Plan	Silver	Plan	Silver	Plan	Silver	Plan	Silver
	Silver-2	Silver-2	Silver-1	Silver-2	Plan	Silver	Plan	Silver	Plan	Silver	Plan	Silver
Plan Characteristics:												
Risk Score	1.33	0.67	1.33	0.67	1.39	0.61	1.39	0.61	1.39	0.61	1.39	0.61
Allowable Rating Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.50	1.00	1.50	1.00
Actuarial Value	0.70	0.70	0.70	0.70	0.80	0.70	0.80	0.70	0.80	0.70	0.80	0.70
Induced Demand Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.08	1.03
Geographic Cost Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.05	0.95
Market Share	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Gross Medical Care Cost (\$)	666.67	333.33	666.67	333.33	666.67	333.33	666.67	333.33	666.67	333.33	756.00	326.17
Plan Liability (\$)	466.67	233.33	466.67	233.33	533.33	233.33	533.33	233.33	533.33	233.33	604.80	228.32
Risk Transfer (\$)	0.00	0.00	116.67	-116.67	0.00	0.00	124.44	-124.44	49.12	-49.12	50.62	-50.62
Average Premium (\$)	466.67	233.33	350.00	350.00	533.33	233.33	408.89	357.78	484.21	282.46	554.18	278.94
Market Average:												
Plan Liability or Premium (\$)	350.00	—	350.00	—	383.33	—	383.33	—	383.33	—	416.56	—
Risk Score	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Ratio Two Plans:												
Gross Medical Care Cost	2.00	—	2.00	—	2.00	—	2.00	—	2.00	—	2.32	—
Premiums	2.00	—	1.00	—	2.29	—	1.14	—	1.71	—	1.99	—
Premium ratio in terms of transfer formula factors	—	—	—	—	=2*(0.8/0.7)	—	=0.8/0.7	—	=1.5*(0.8/0.7)	—	=1.5* (0.8/0.7)*	—
											(1.08/1.03)*	
											(1.05/0.95)	

(Continued)

Exhibit 4 Continued. Simulations of Hypothetical Risk Adjustment Scenarios

NOTES: 1. Gross medical care costs, plan liability, risk transfers, and premiums are all expressed on a per member per month (PMPM) basis.

2. Risk scores are plan liability risk scores.

3. The market average premium equals the market average plan liability because plans are assumed to break even and transfers sum to zero across plans (see text).

4. Scenarios 1–5 assume no induced demand or geographic cost differences.

5. Plan Gold's age-mix (ARF-) standardized premium in Scenario 5 is \$322.81 and in Scenario 6 is \$369.45. All other average premiums are equivalent to age-mix standardized premiums because the plan ARF is 1.00. The age-mix standardized premium is the premium charged to a 21 to 24 year old enrollee (ARF=1).

6. Despite the change in plan liabilities in Scenario 6, risk scores are not recalculated because risk scores do not reflect induced demand or geographic cost differences.

7. Calculations for the table used more precision than the two decimal places that are shown in the table, hence calculations using displayed results may not exactly equal values shown in the table.

SOURCE: Authors' calculations.

expenditures. To cover their costs, plans charge enrollees average premiums¹⁵ equal to their average liability for enrollee medical costs.¹⁶ Plan 1 charges an average monthly premium of its plan liability of \$466.67 and Plan 2 charges an average monthly premium of its plan liability of \$233.33. The plan with sicker enrollees (Plan 1) charges double the premium of the plan with healthier enrollees (Plan 2).

Scenario 2: Plans with Equal Coverage, with Risk Transfers

We now introduce risk adjustment into Scenario 1 and calculate risk transfers according to the transfer formula. We first describe how Plan 1's transfer is calculated. As discussed above, a plan's transfer is its required revenue (given its enrollee health status mix) minus its allowable revenues (given its enrollee age mix).

Plan 1's required revenue, from the first term in the transfer formula, is its adjusted plan liability risk score or "adjusted PLRS" (i.e., $PLRS \times IDF \times GCF$) relative to the market average adjusted PLRS, multiplied by the market average premium. Noting that IDF and GCF are each equal to 1.0 in this example, in Scenario 2 (Exhibit 4), Plan 1's required revenue is its risk score, 1.33, multiplied by the market average plan liability (medical claims cost net of enrollee cost

¹⁵ In Scenarios 1–4, the average premium equals the age-mix-adjusted premium (the average premium divided by the ARF) because the ARF=1. Hence, the average premiums are directly comparable between the two plans. The age-mix standardized premium is interpreted as the premium paid by an enrollee with an allowable rating factor of 1.0, or a 21–24 year old (Exhibit 3). Although the primary reason a plan ARF of 1.0 was chosen for the simulations was equality of average and age-standardized premiums, it is not unrealistic. The average age of 2019 ACA individual market adult enrollees has been projected as 40 (ARF=1.278 from Exhibit 3), and 19 percent of enrollees are projected to be children (ARF= 0.635 from Exhibit 3) (Trish, Damico, Claxton, Levitt, & Garfield, 2011). Thus, a projection of the market average ARF is $0.81 \times 1.278 + 0.19 \times 0.635 = 1.156$, not very different from 1.0.

¹⁶ This simplified example implicitly assumes that administrative costs and profit are proportionate to medical expense. We also assume that plans have no market power in pricing; that is, that plans "price to cost."

sharing) is \$350, and since premiums are the only source of plan revenue and must cover costs on a market-average basis (transfers sum to zero across plans), the market average plan premium is also \$350. Therefore, Plan 1's required revenue is $1.33 \times \$350 = \466.67 .¹⁷

Plan 1's allowable revenue in this example, from the second term in the transfer formula, is its adjusted allowable rating factor, or "adjusted ARF" (i.e., $ARF \times AV \times IDF \times GCF$), relative to the market average adjusted ARF, multiplied by the market average premium. Noting that Plan 1's ARF, IDF, and GCF are each equal to 1.0 in this example, Plan 1's adjusted ARF is its AV, 0.7, as is the market average adjusted ARF (because the AV of Plan 2 is also 0.7). Thus, Plan 1's adjusted ARF relative to the market average is 1.0, and its allowable revenue is 1.0 multiplied by the market average premium of \$350, or \$350.

Plan 1's transfer is its required revenue minus its allowable revenue, or $\$466.67 - \$350 = \$116.67$, which is a transfer payment paid to Plan 1. By a similar calculation, Plan 2's risk transfer is $-\$116.67$, which is a transfer charge paid by Plan 2. Transfers are budget neutral and sum to zero.

In setting their premiums, as compared to Scenario 1, Plans 1 and 2 must now account for the impact of their risk transfers on their costs. Plan 1 would receive a transfer payment of \$116.67, so its premium is its plan medical cost liability of \$466.67 minus its transfer of \$116.67, or \$350. Plan 2 would pay a transfer charge of \$116.67, so its premium is its plan liability of \$233.33 plus its \$116.67 transfer, or \$350. With risk transfers, both Plan 1 enrolling a sicker

population and Plan 2 enrolling a healthier population have the same post-transfer costs and charge their enrollees the same premium of \$350. In Scenario 2, risk transfers have achieved the goal of removing the effect of health status on premiums that occurs in Scenario 1.

Scenario 3: Plans with Unequal Coverage, No Risk Transfers

In Scenario 1 and Scenario 2, the two plans offer the same level of coverage of enrollee medical expenses. In Scenario 3, a Silver Plan offers silver coverage with actuarial value 0.7. The competing plan is a Gold Plan with a higher actuarial value of 0.8. The Gold Plan experiences adverse selection, perhaps caused by its lower required cost sharing, and has a higher risk score than the Silver Plan. Without risk adjustment, each plan charges a premium equal to its average plan liability. Plan Gold charges an average monthly premium of \$533.33. This premium is higher than the premium Plan Silver-1 charges in Scenario 1, even though gross medical care costs are identical, because the Gold Plan in Scenario 3 covers a larger portion of gross medical expenses. Plan Silver in Scenario 3 charges the same \$233.33 premium as Plan Silver-2 in Scenario 1. The Gold Plan in Scenario 3 charges a higher premium than the Silver Plan in Scenario 3, both because the Gold Plan has a sicker and more expensive enrollee mix and a higher actuarial value.

Scenario 4: Plans with Unequal Coverage with Risk Transfers

We now introduce risk adjustment into Scenario 3 and calculate risk transfers according to the transfer equation. We first describe how Plan Gold's transfer is calculated. A plan's transfer is its required revenue (given its enrollee health status mix) minus its allowable revenues (given its enrollee age mix).

¹⁷ The calculations in Exhibit 4 use more precision than the rounded numbers shown in the text limited to two decimal places. For example, the risk score of Plan 1 in Exhibit 4 is actually $4/3$, not exactly 1.33. For this reason, calculations using the numbers shown in the text do not always exactly equal the results displayed in Exhibit 4.

By the same logic as in Scenario 2, Plan Gold's required revenue is its risk score multiplied by the market average premium, or $1.39 \times \$383.33 = \533.33 . Although Plan Gold's enrollees incur the same medical care expense as Plan Silver-1's enrollees in Scenario 2, Plan Gold's (plan liability) risk score is higher than Plan Silver-1's in Scenario 2 because of Plan Gold's higher actuarial value (0.8 vs. 0.7). Plan Gold's higher actuarial value also raises the market average plan liability/premium in Scenarios 3 and 4 compared to Scenarios 1 and 2.

Plan Gold's allowable revenue, the right hand term in the transfer formula, is its adjusted allowable rating factor (ARF) relative to the market average adjusted ARF, multiplied by the market average premium. Plan Gold's ARF is 1.0, its actuarial value (AV) is 0.8, and all other adjustment factors (induced demand and geographic cost) are 1.0. Plan Gold's adjusted ARF is, therefore, 0.8. By the same logic, the adjusted ARF of Plan Silver is 0.7. Because the Gold and Silver Plans each have half the market, the market average adjusted ARF is 0.75. Thus, Plan Gold's adjusted ARF relative to the market average is $0.80/0.75$, and its allowable revenue is this ratio multiplied by the market average premium of $\$383.33$, or $\$408.89$.

Plan Gold's transfer is its required revenue minus its allowable revenue, or $\$533.33 - \$408.89 = \$124.44$, which is a transfer payment paid to Plan Gold. By a similar calculation, Plan Silver's risk transfer is $-\$124.44$, which is a transfer charge paid by Plan Silver. Transfers are budget neutral and sum to zero.

In setting their premiums, as compared to Scenario 3, Plans Gold and Silver must now account for the impact of their risk transfers on their costs. Plan Gold receives a transfer of $\$124.44$, so its premium is its plan medical cost liability of $\$533.33$ minus its transfer of $\$124.44$, or

$\$408.89$. Plan Silver pays a transfer of $\$124.44$, so its premium is its plan liability of $\$233.33$ plus its $\$124.44$ transfer, or $\$357.78$.

The premium difference of Plans Gold and Silver with risk transfers (Scenario 4), as compared to without risk transfers (Scenario 3), has been narrowed, but not eliminated. Plan Gold/Plan Silver premiums are $\$408.89/\357.78 with risk transfers (Scenario 4) versus $\$533.33/\233.33 without risk transfers (Scenario 3). Risk transfers offset the adverse selection of the sicker enrollee mix of the more generous Plan Gold. But Plan Gold's premium remains higher than Plan Silver's to reflect the lower enrollee cost sharing of Plan Gold. Risk adjustment does not eliminate the plan premium difference as in Scenario 2, nor should it be expected to. The purpose of risk adjustment is to bring the difference in premiums of competing products into line with the difference in the value of the coverage they offer without being distorted by differences in the average risk of their enrollees. The ratio of Plans' Gold/Silver premiums in Scenario 4 with risk adjustment ($\$408.989/\$357.78 = 1.143$) reflects the ratio of their actuarial values ($0.8/0.7 = 1.143$). In Scenario 3, without risk adjustment, the ratio of their premiums ($\$533.33/\$233.33 = 2.29$) is substantially higher than the ratio of their actuarial values (1.143). Risk adjustment, therefore, achieves its intended purpose.¹⁸

¹⁸ It is interesting to note that, if in Scenario 4, there were no risk selection, Plan Gold and Plan Silver's enrollee total medical care costs would be $\$500$ each. Plan Gold's premium would reflect its liability for these costs according to its AV, or $0.8 \times \$500 = \400 , and similarly Plan Silver's premium would be $\$500 \times 0.7 = \350 . Market average plan liability would be $\$375$. Scenario 4's premiums are slightly higher than these premiums without risk selection. The reason is that adverse selection—the interaction of Plan Gold's more expensive population (higher risk score) with its higher AV—raises the market average plan liability from $\$375$ to $\$383.33$ (Exhibit 4). Scenario 4's Plan Silver premium is higher by $\$7.78$, $\$357.78$ versus $\$350$, and Plan Gold's premium is higher by $\$8.89$, $\$408.89$ versus $\$400$, so that plans' premium revenue covers the extra plan liability. The premiums are higher according to the ratio of Plan Gold's to Plan Silver's AVs ($\$8.89/\$7.78 = 0.8/0.7$).

Scenario 5: Scenario 4 with Unequal Plan Enrollee Age Mix

In the previous scenarios, enrollees of the two plans have the same age mix, so that the plans' allowable rating factors are equal (assumed to be ARF=1.0). In Scenario 5, we specify that Plan Gold has an older age mix than Plan Silver, such that Plan Gold's ARF is 1.5 instead of 1.0. This means that, other things equal, Plan Gold can charge 50 percent higher average premiums than Plan Silver. Although a plan's ARF depends on its enrollee distribution across all age categories, for individual enrollees, according to the federal age rating curve in Exhibit 3, a 21 to 24 year old enrollee has an ARF of 1.0 and a 46 year old enrollee has an ARF of 1.5. How does the difference in enrollee allowable rating factors affect the transfers and premiums calculated in Scenario 4?

First, consider Plan Gold's transfer. Plan Gold's required revenue calculation is the same as in Scenario 4, and its required revenue is \$533.33. Plan Gold's allowable revenue calculation is different. The numerator of the right hand side of the transfer formula is now Plan Gold's ARF of 1.5 adjusted by its AV of 0.8, or 1.2. The denominator of the right hand side, the market average adjusted ARF, is now the average of Plan Gold's adjusted ARF of 1.2 and Plan Silver's adjusted ARF of 0.7, or 0.95. Plan Gold's allowable revenue is numerator (1.2) divided by denominator (0.95), multiplied by the market average premium of \$383.33, or \$484.21.

Plan Gold's transfer is its required revenue minus its allowable revenue, which is \$533.33 minus \$484.21, or \$49.12, a transfer payment paid to Plan Gold. By a similar calculation, Plan Silver's risk transfer is -\$49.12, a transfer charge paid by Plan Silver. Transfers are budget neutral and sum to zero. Plan Gold's average premium is its plan liability (net claims cost) of \$533.33 minus its

transfer of \$49.12, or \$484.21. Plan Silver's average premium is its plan liability of \$233.33 minus its transfer of -\$49.12, or \$282.46.¹⁹

The older age mix of Plan Gold enrollees allowing Plan Gold to charge a 50 percent higher average premium has reduced transfer payments and has widened the average premium difference between Plans Gold and Silver. Scenario 4's transfer of \$124.44 from Plan Silver to Plan Gold has fallen to \$49.12 in Scenario 5. Scenario 4's Plan Gold/Plan Silver average premiums of \$408.89/\$357.78 become average premiums of \$484.21/\$282.46 in Scenario 5. Scenario 5's plan premiums are closer to Scenario 3's premiums—without risk adjustment—of \$533.33/\$233.33. This is because in Scenario 5, the higher risk score of Plan Gold is substantially related to the higher average age of its enrollees. As a result, Plan Gold in Scenario 5 recovers a substantial part of its higher costs from enrollees in the form of higher age-rated premiums. Risk transfers compensate for the health status of Plan Gold enrollees only to the extent that the associated costs are not recoverable from the allowable age-rated premiums.

In Scenario 5, Plan Gold with less-healthy enrollees charges an average premium 1.71 times as large as Plan Silver with a healthier enrollee mix (\$484.21 versus \$282.46). This might seem to violate the goal of premiums independent of health status. But Plan Gold's higher premium is "justified" by (i) Plan Gold's older enrollee age mix, allowing a 1.5:1 average premium ratio for the same coverage; and (ii) the greater actuarial value of Plan

¹⁹ Note that Plan Silver's Scenario 5 transfer and premium have changed significantly from Scenario 4 even though none of Plan Silver's plan characteristics have changed. This illustrates the important point that ACA risk transfers depend on the characteristics of all plans in the market, not just the characteristics of a specific plan. In this case, Plan Silver's transfer and premium change because of a shift in Plan Gold's enrollment to an older age mix, which reduces Plan Gold's uncompensated risk selection and requires a smaller transfer from Plan Silver.

Gold, which allows a 0.8:0.7 premium ratio for the same person. Putting these two factors together accounts for the 1.71:1 average premium ratio of Plan Gold versus Plan Silver: $(1.5) \times (0.8/0.7) = 1.71$. Importantly, the sicker enrollee mix (higher risk score) of Plan Gold does not contribute to its greater average premium. Risk transfers remove the effect of health status differences on premiums, while retaining the effects of allowable age rating and actuarial value differences.

We have compared average premiums between Plans Gold and Silver. But from the point of view of enrollees, the premium for a specific age category is the relevant premium. To standardize for age mix, we divide each plan's average premium by its ARF. The Gold Plan's age-standardized premium is \$484.21 divided by 1.5, or \$322.81. The Silver Plan's age-standardized premium is \$282.46 divided by 1.0, or \$282.46. These standardized premiums are charged to enrollees with an ARF of 1.0, or 21 to 24 year olds (Exhibit 3).²⁰ Plan Gold and Plan Silver charge an enrollee of the same age a considerably more similar premium than is indicated by their average premiums. The ratio of Plan Gold to Plan Silver's age-standardized premiums ($\$322.81/\282.46) reflects the gold to silver actuarial value ratio (0.8/0.7), but not the older age mix of Plan Gold's enrollees. Plan Gold's age-standardized premium in Scenario 5 is lower than in Scenario 4 ($\$322.81$ versus $\$408.89$), although its average premium is higher ($\$484.21$ versus $\$408.89$).

Scenario 6: Scenario 5 with Induced Demand and Geographic Cost Differences

In the previous scenarios, we assume that there is no induced demand and one statewide geographic rating area so that the induced demand and

geographic cost factors (IDF and GCF) equal one. In Scenario 6, we illustrate the role of the IDF and the GCF in the transfer formula by modifying Scenario 5 to allow induced demand and multiple geographic rating areas. Plan Gold is expected to experience greater induced demand than Plan Silver because Plan Gold's enrollee cost sharing (one minus its actuarial value) is lower than Plan Silver's. From Exhibit 2, the IDF for Plan Gold is 1.08 and for Plan Silver is 1.03. Also, we stipulate that Plan Gold's enrollees reside in an area with higher medical costs than Plan Silver's enrollees, such that Plan Gold's GCF is 1.05 compared to Plan Silver's GCF of 0.95. In other words, medical costs in Plan Gold's rating area are about 11 percent higher ($1.05/0.95$) than in Plan Silver's rating area.

With these changes, Plan Gold's gross medical care cost rises to \$756 ($\666.67 from Scenario 5 multiplied by 1.08 for induced demand and 1.05 for relative rating area costs), and Plan Silver's falls to \$326.17 ($\333.33 from Scenario 5 multiplied by 1.03 for induced demand and 0.95 for relative rating area costs).²¹ The transfer calculations for the two plans are similar to Scenario 5, except that the risk score²² and the allowable rating factor are now adjusted by (i.e., multiplied by) the plan IDF and GCF, in addition to the plan AV, and the market average premium rises to \$416.56. The result is that Plan Gold's transfer is \$50.62 and its average premium is \$554.18, and Plan Silver's transfer is $-\$50.62$ and its average premium is \$278.94.

²⁰ If the hypothetical state of our simulation is employing the federal age rating curve, the plan premium for any age group other than age 21–24 is its age-standardized premium multiplied by the premium ratio for the desired age category from Exhibit 3.

²¹ In this hypothetical, didactic example, the IDF and GCF affect the absolute level of the two plans' costs, so the IDF's and GCF's absolute levels affect transfers and premiums. In actual ACA risk adjustment operations, plans' assigned IDFs and GCFs will not affect their costs, and these factors may be rescaled arbitrarily without affecting calculated transfers because, as discussed above, the transfer formula is self-normalizing.

²² We do not recalculate the risk scores in Scenario 6 to reflect the change in plan liability from Scenario 5 because the risk scores do not reflect induced demand or geographic area costs. These factors are captured by the separate IDF and GCF terms in the transfer formula. We recalculate the risk scores in Scenario 3 because the risk scores do reflect plan actuarial value, which changes from Scenario 2 to Scenario 3.

Transfers are quite similar to the transfers in Scenario 5, although slightly larger. In this example, the presence of induced demand (8 percent for Plan Gold and 3 percent for Plan Silver) and geographic cost differences (11 percent higher for Plan Gold relative to Plan Silver) has only a minor effect on transfers (\$1.50 or about a 3 percent increase). The effect of induced demand and geographic cost differences on transfers tends to be limited by the fact that they affect both the required revenue and allowable premium revenue sides of the risk transfer formula.²³

Nevertheless, the increase in Plan Gold's medical care costs, because of induced demand and higher relative geographic area costs, substantially raises its average premium, from \$484.21 in Scenario 5 to \$554.18 in Scenario 6. Plan Gold's average premium is now 1.99 times larger than Plan Silver's average premium. In addition to the enrollee age mix and plan actuarial value factors creating a 1.71 premium ratio between Plans Gold and Silver as in Scenario 5, the induced demand and geographic cost factors in Scenario 6 create an additional $(1.08/1.03) \times (1.05/0.95) = 1.16$ premium differential. The total differential is $1.71 \times (1.16) = 1.99$ times larger simulated average premium charged by Plan Gold than Plan Silver in Scenario 6.

Plan Gold's average premium standardized for its older age mix (ARF=1.5) is \$369.45 in Scenario 6. This standardized premium is higher than in Scenario 5 (\$322.81) reflecting the induced demand and higher geographic costs in Scenario 6, but considerably lower than its Scenario 6 average premium, reflecting the older enrollees who are charged more and raise its average premium. Plan

Silver's Scenario 6 premium is quite similar to its Scenario 5 premium, as its induced demand and geographic cost factors have offsetting effects on its medical costs, and its transfer is little changed.

Conclusions

As discussed in our companion overview article, the key program goal of the ACA risk adjustment methodology developed by HHS is to compensate health insurance plans for differences in enrollee health mix so that plan premiums reflect differences in scope of coverage and other plan factors, but not differences in health status. Our companion article on the empirical risk adjustment model discusses how we use demographic and diagnostic information from plan enrollees and plan actuarial value (metal tier) to determine a risk score that reflects expected plan liability for enrollee medical expenditures. This article discusses how we combine that risk score with factors for a plan's allowable premium rating, actuarial value, induced demand, geographic costs, market share, and the statewide average premium in a formula to calculate transfer payments and charges among plans. How each factor is determined is described, as well as how the transfers relate to each other in the transfer formula.

Throughout we emphasize how the development of the risk transfer factors and formula is guided by the goals and key issues of ACA risk adjustment. The goal of ACA risk adjustment is to lessen or eliminate the influence of risk selection on the premiums that plans charge, while not affecting the influence of other factors. Key issues for ACA risk adjustment are that risk transfers must be balanced (i.e., must sum to zero across all plans), that health status is not an allowable rating factor, and that plan premiums for adults must not vary by age by more than a three to one ratio.

²³ From the point of view of the numerators of the transfer formula, the IDF and GCF act like "multipliers," scaling the size of the transfer up or down to reflect plan induced demand or area cost levels. However, the IDF and GCF also affect the denominators of the transfer formula, so their overall impact cannot be characterized as that of a "multiplier." The effects of the IDF and the GCF are not necessarily always as small as in Scenario 6.

The basic concept that we develop for ACA risk transfers is that a plan's transfer is the difference between its estimated premium given its risk selection of enrollees (as measured by its risk score) and its estimated premium in the absence of risk selection.²⁴ The aim of ACA risk adjustment is to foster the development of markets where health plans compete on quality, efficiency, and value, not on risk selection; moreover, the objective is to preserve consumer choice in plan generosity to lessen the likelihood of market dynamics in which more generous plans are eliminated from the market by their adverse selection of health risks. ACA risk adjustment explicitly accounts not only for the health status risk of enrollees, expected to be greater in more generous plans, but also for the greater liability of generous plans for their enrollees' costs. Other things being equal, the aim of ACA risk adjustment is that enrollees in more generous plans would pay higher premiums in return for the higher actuarial value and induced demand in their plans, but not for the sicker average health status expected for enrollees in these plans.

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²⁴ For other perspectives on plan payment and enrollee premium policy in regulated competitive or employer-sponsored insurance markets, including with heterogeneous consumer preferences for health insurance and imperfect competition, see Glazer and McGuire (2011), Bundorf, Levin, and Mahoney (2012), McGuire *et al.* (2013), Ericson and Starc (2012), Glazer, McGuire, and Shi (2014), and Geruso (2013).

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Appendix

Derivations of the Risk Transfer Formula

As described in the main body of this paper, the risk transfer formula was designed to achieve two main objectives:

1. to compensate for the costs of health risk variations, but not other cost variations, across plans, and
2. to generate a set of risk transfer payments and charges that balance to zero across the market as a whole.

In this mathematical appendix, we demonstrate how the transfer formula can be derived from these objectives.

We show this derivation using two sets of assumptions. First, we consider a simplified model of an insurance marketplace in which the only source of cost variation across plans arises from differences in actuarial value. This basic setup illustrates how risk transfers that achieve the two objectives can be calculated from observable information. Second, we develop a more sophisticated formula that takes other variation in plan characteristics into account. Specifically, we allow variation in induced demand, geographic costs, and allowable rating factors. This more complete model produces the risk transfer formula that will be implemented for risk adjustment under the ACA.

A1. Simple Scenario: Actuarial Value (AV) Variation Only

Consider a market containing N plans, numbered 1, 2, ..., N . In this simple derivation, we make the following assumptions:

1. All plans are identical except for their actuarial values (AV). AV measures the proportion of enrollees' total medical expenditures paid by the plan. This variation, plus enrollee health status

variation, constitute the only reasons why one plan's costs differ from another's costs.

2. Plans "price to cost." This assumption captures the idea that in a competitive market, premiums approximate the cost of providing insurance.²⁵

In addition, we define the following notation:

- T_i = transfer payment per member-month for plan i ; negative values of T_i indicate a charge imposed on plan i .
- P_i = premium charged by plan i (including transfer payment)
- PL_i = average medical expenditure liability for plan i ; health status of enrollees is reflected in this liability
- AV_i = actuarial value of plan i in a standard population
- C_i = total medical expenditure costs per enrollee for plan i reflecting enrollee health status variation across plans.
- \bar{P} = the market average premium
- \bar{PL} = the market average plan liability
- $PLRS_i$ = Plan liability risk score for plan i
- s_i = enrollment market share of plan i .

The values of T_i , P_i , PL_i , C_i , \bar{P} , and \bar{PL} are measured on a per member-month basis.

Plan liability can be expressed as a function of C_i , total expenditures per enrollee, and the plan's cost sharing design (deductibles, coinsurance, copays, out of pocket maximums) as summarized in its actuarial value.²⁶

$$PL_i = f(AV_i, C_i) \quad (A1)$$

²⁵ Note that these costs can be defined to include administrative and loading costs as well as a normal rate of return or profit.

²⁶ In the simple case where a plan's cost sharing is a single coinsurance rate with no deductible, $f(AV_i, C_i) = AV_i * C_i$, where AV_i is the plan's actuarial value and C_i is average total cost per enrollee. With more complex cost sharing designs, AV_i can be thought of as a vector of plan cost sharing parameters and C_i as a vector of individual enrollee medical costs, which jointly determine a plan's liability for enrollee medical costs.

The price-to-cost assumption implies that plan premium will be equal to plan liability, less any transfer payment received.

$$P_i = PL_i - T_i \quad (A2)$$

Rearranging (A2) we have:

$$P_i + T_i = PL_i \quad (A3)$$

Multiplying this expression by the plan's market share and summing across all N plans in the market, we get the following expression:

$$\sum P_i s_i + \sum T_i s_i = \sum PL_i s_i \quad (A4)$$

Next, we impose our second criterion for the risk transfer payments, which is that they must sum to zero across the entire market. That is:

$$\sum T_i s_i = 0 \quad (A5)$$

As a result, equation (A4) becomes:

$$\bar{P} \equiv \sum P_i s_i = \sum PL_i s_i \equiv \bar{PL} \quad (A6)$$

This expression has an intuitive interpretation, which is that the average of all premium revenue collected by plans in the market will equal the average of all plan liability in the market. Equivalently, the total premium revenue in the market will equal total plan liability. We note that the left side of equation (A6) is the market average premium, \bar{P} , and the right side is the market average plan liability, \bar{PL} .

Our first criterion is that plan premiums should reflect only cost variations other than health status risks. In this simple model with only two cost factors, plan premiums should reflect plan AV differences, but not enrollee health status differences. Our specific criterion is that the ratio of any two plans' premiums (here, plan 1 and plan i) should equal the ratio of their actuarial values:

$$\frac{P_1}{P_i} = \frac{AV_1}{AV_i} \quad (A7)$$

Equation A7 can be rearranged to show the premium for plan i as

$$P_i = \frac{P_1 \cdot AV_i}{AV_1} \quad (A8)$$

We can substitute equation (A8) into the expression for the state average premium, as shown in equation (A6) above:

$$\bar{P} = \sum P_i s_i = \sum \frac{P_1 \cdot AV_i}{AV_1} s_i \quad (A9)$$

And solving for P_1 , we obtain:

$$P_1 = \frac{\bar{P} \cdot AV_1}{\sum AV_i s_i} \quad (A10)$$

We also need to define the plan liability risk score. As described in our companion article on the empirical risk adjustment model, the plan liability risk score expresses each plan's average estimated liability relative to the average estimated liability across all plans offered in the market. This liability is a function of enrollee health risks as well as plan benefit design—specifically, actuarial value. Plan i's plan liability in dollar terms is $f(AV_i, C_i)$ and the market average plan liability is $\bar{PL} = \sum s_i \cdot f(AV_i, C_i)$. So we can express Plan i's plan liability risk score as

$$PLRS_i = \frac{PL_i}{\bar{PL}} = \left[\frac{f(AV_i, C_i)}{\sum [s_i \cdot f(AV_i, C_i)]} \right] \quad (A11)$$

Rearranging terms, it is also possible to define Plan i's plan liability in terms of the state-wide average premium:

$$PL_i = PLRS_i \cdot \bar{PL} \quad (A11a)$$

Now we return to equation (A2), writing it for Plan 1 and rearranging terms:

$$T_1 = PL_1 - P_1 \quad (A12)$$

Substituting equation (A11a) and equation (A6), this becomes

$$T_1 = PLRS_1 \cdot \bar{P} - P_1 \quad (A13)$$

and substituting the expression for P_1 in equation (A10),

$$T_1 = \text{PLRS}_1 \cdot \bar{P} - \frac{\bar{P} \cdot AV_1}{\sum AV_i s_i} \quad (\text{A14})$$

Factoring out the state average premium \bar{P} on the right hand side yields the final form of the risk transfer formula:

$$T_1 = \left[\text{PLRS}_1 - \frac{AV_1}{\sum AV_i s_i} \right] \bar{P} \quad (\text{A15})$$

Here we can see how the risk transfer formula works. In this simple version, risk transfers are determined by the difference between plan liability risk score (which is already expressed relative to the market average) and the plan's actuarial value relative to the mean AV in the market.

A2. Transfer Formula Including All Adjustments

The basic derivation presented above can be extended to include other determinants of plan costs and premiums. Specifically, we now include variation in levels of induced demand, geographic costs, and allowable rating factors in setting premiums. To begin, we define the following additional notation:

- There are M age bands, indexed as $j=1,2,\dots,M$.
- P_{i,A_j} = plan i 's premium charged to enrollees in age band j
- $\%E_{i,A_j}$ = the proportion of plan i 's enrollment in age band j
- R_j = the ratio of the premium charged in age band j to the premium charged in age band 1 (the youngest age band). Because plans are constrained by the state-prescribed age rating curve, these premium ratios will be likewise constrained. Under the federal default age rating curve,²⁷ the

youngest (least costly) adult age band will have $R_1 = 1$; the oldest age band (M) will have $R_M = 3$.

- ARF_i = the allowable rating factor for plan i
- IDF_i = the induced demand factor for plan i
- GCF_i = the geographic cost factor for plan i .

As before, we begin with the assumption that plans "price to cost;" that is, they set premiums such that their premium revenue including transfers (left hand side of equation A16, below) is equal to their expected cost. For plan i , this means

$$T_i + P_i = f(AV_i, C_i) \cdot \text{IDF}_i \cdot \text{GCF}_i \quad (\text{A16})$$

Expected cost is modeled as a function of total expenditure per enrollee reflecting health status variation (C_i), plan actuarial value (AV_i), the induced demand factor (IDF_i) appropriate for Plan i 's metal level, and the geographic cost factor (GCF_i), which reflects local cost variations.

Multiplying equation (A16) by plan i 's market share (s_i) and summing over all plans in the market, we get

$$\sum T_i s_i + \sum P_i s_i = \sum f(AV_i, C_i) \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i \quad (\text{A17})$$

As before, we stipulate that the sum of transfer payments in the market must equal zero, so equation (A17) reduces to

$$\bar{P} \equiv \sum P_i s_i = \sum f(AV_i, C_i) \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i \equiv \bar{PL} \quad (\text{A18})$$

which indicates that the average of all premiums collected in the market will equal the average plan liability, including adjustments for induced demand and geographic cost variation. The left hand side of equation (A18) is the market average premium (\bar{P}), and the right hand side is the market average plan liability (\bar{PL}).

Next we focus on plan premiums. The plan average premium is an enrollment-weighted average of all age-band premiums, as shown:

²⁷ States may prescribe maximum premium differences by age to be less than a 3:1 ratio, but state age rating curves may not exceed a 3:1 premium ratio.

$$P_1 = P_{1,A1}(\%E_{1,A1}) + P_{1,A2}(\%E_{1,A2}) + P_{1,A3}(\%E_{1,A3}) + \dots + P_{1,AM}(\%E_{1,AM}) \quad (A19)$$

This equation shows that plan 1's average premium (P_1) is equal to an enrollment-weighted average of its age-band premiums $P_{1,A1}$ through $P_{1,AM}$. We define a premium ratio $R_j \equiv P_{1,Aj} / P_{1,A1}$, which is the ratio of age band j 's premium to the lowest premium (age band 1).²⁸ Using this ratio notation, equation (A19) can be rewritten as

$$P_1 = P_{1,A1} \left[R_1(\%E_{1,A1}) + R_2(\%E_{1,A2}) + R_3(\%E_{1,A3}) + \dots + R_M(\%E_{1,AM}) \right] \quad (A20)$$

We next define the allowable rating factor for plan 1 as the enrollment-weighted average of these R_j premium ratios,

$$ARF_1 = R_1(\%E_{1,A1}) + R_2(\%E_{1,A2}) + R_3(\%E_{1,A3}) + \dots + R_M(\%E_{1,AM}) \quad (A21)$$

which allows us to simplify equation (A20) as:

$$P_1 = P_{1,A1} \cdot ARF_1 \quad (A22)$$

Generalizing equation (A22) to any plan i , we can express the market average premium \bar{P} in terms of plan premiums:

$$\bar{P} = \sum P_i s_i = \sum P_{i,A1} \cdot ARF_i \cdot s_i \quad (A23)$$

As before, we impose the condition that plan premiums should reflect cost differences across plans except the cost variation due to enrollee health status. Our specific criterion is expressed in terms of the ratio of premiums across plans for any given age band:

$$\frac{P_{1,A1}}{P_{i,A1}} = \frac{AV_1 \cdot IDF_1 \cdot GCF_1}{AV_i \cdot IDF_i \cdot GCF_i} \quad (A24)$$

²⁸ This ratio is shown for plan 1. However, because plans must use the state-prescribed age rating curve, the ratio R_j will be the same for all plans.

Equation (A24) shows that the ratio of Plan 1's premium charged to the youngest age band ($j=1$) to Plan i 's premium to the same age group should be proportional to the product of each plan's AV, induced demand factor (IDF) and geographic cost factor (GCF). So, for example, if Plan i 's AV*IDF*GCF is equal to the market average, but the product of Plan 1's cost factors is 30% higher, then Plan 1's premium also should be 30% higher.

We can rearrange equation (A24) in terms of $P_{i,A1}$:

$$P_{i,A1} = \frac{P_{1,A1} \cdot AV_i \cdot IDF_i \cdot GCF_i}{AV_1 \cdot IDF_1 \cdot GCF_1} \quad (A25)$$

We substitute this expression into equation (A23) to yield

$$\bar{P} = \sum \frac{P_{1,A1} \cdot AV_i \cdot IDF_i \cdot GCF_i}{AV_1 \cdot IDF_1 \cdot GCF_1} \cdot ARF_i \cdot s_i \quad (A26)$$

and then solve for $P_{i,A1}$:

$$P_{i,A1} = \frac{\bar{P} \cdot AV_1 \cdot IDF_1 \cdot GCF_1}{\sum AV_i \cdot ARF_i \cdot IDF_i \cdot GCF_i \cdot s_i} \quad (A27)$$

We now return to the original expression for the risk transfer amount, in equation (A16), show it in terms of plan 1 instead of plan i , and isolate T_1 :

$$T_1 = f(AV_1, C_1) \cdot IDF_1 \cdot GCF_1 - P_1 \quad (A28)$$

We use the definition of plan liability risk score,

$$PLRS_1 = \frac{f(AV_1, C_1)}{\sum f(AV_i, C_i) \cdot s_i} \text{ and rewrite this equation as:}$$

$$T_1 = PLRS_1 \cdot IDF_1 \cdot GCF_1 \cdot \sum f(AV_i, C_i) s_i - P_1 \quad (A29)$$

Next we use equation (A22) to express Plan 1's average premium in terms of its lowest age band premium and its ARF,

$$T_1 = PLRS_1 \cdot IDF_1 \cdot GCF_1 \cdot \sum f(AV_i, C_i) s_i - P_{1,A1} \cdot ARF_1 \quad (A30)$$

and then substitute the expression for $P_{1,A1}$ from equation (A27):

$$T_1 = \text{PLRS}_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1 \cdot \sum f(AV_i, C_i) s_i - \frac{\bar{P} \cdot AV_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1 \cdot \text{ARF}_1}{\sum AV_i \cdot \text{ARF}_i \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i} \quad (\text{A31})$$

The rest of this derivation is algebraic manipulation. We multiply the first term in equation (A31) by \bar{P}/\bar{P} :

$$T_1 = \frac{\bar{P}}{\bar{P}} \text{PLRS}_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1 \cdot \sum f(AV_i, C_i) s_i - \frac{\bar{P} \cdot AV_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1 \cdot \text{ARF}_1}{\sum AV_i \cdot \text{ARF}_i \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i} \quad (\text{A32})$$

and then use the result from equation (A18) to obtain

$$T_1 = \frac{\bar{P} \cdot \text{PLRS}_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1 \cdot \sum f(AV_i, C_i) \cdot s_i}{\sum f(AV_i, C_i) \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i} - \frac{\bar{P} \cdot AV_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1 \cdot \text{ARF}_1}{\sum AV_i \cdot \text{ARF}_i \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i} \quad (\text{A33})$$

and continue to rearrange terms:

$$T_1 = \frac{\bar{P} \cdot \text{PLRS}_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1}{\left[\frac{\sum f(AV_i, C_i) \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i}{\sum f(AV_i, C_i) s_i} \right]} - \frac{\bar{P} \cdot AV_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1 \cdot \text{ARF}_1}{\sum AV_i \cdot \text{ARF}_i \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i} \quad (\text{A34})$$

which, using the definition of PLRS, can be expressed as

$$T_1 = \frac{\bar{P} \cdot \text{PLRS}_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1}{\sum \text{PLRS}_i \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i} - \frac{\bar{P} \cdot AV_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1 \cdot \text{ARF}_1}{\sum AV_i \cdot \text{ARF}_i \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i} \quad (\text{A35})$$

and, finally,

$$T_1 = \left[\frac{\text{PLRS}_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1}{\sum \text{PLRS}_i \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i} - \frac{AV_1 \cdot \text{IDF}_1 \cdot \text{GCF}_1 \cdot \text{ARF}_1}{\sum AV_i \cdot \text{ARF}_i \cdot \text{IDF}_i \cdot \text{GCF}_i \cdot s_i} \right] \cdot \bar{P} \quad (\text{A36})$$

which shows the final form of the risk transfer formula.