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RESEARCH ARTICLE

Estimating Premium Sensitivity for Children's Public Health Insurance Coverage: Selection but No Death Spiral

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Objective. To estimate the effect of premium increases on the probability that near-poor and moderate-income children disenroll from public coverage.

Data Sources. Enrollment, eligibility, and claims data for Georgia's PeachCare for Kids™ (CHIP) program for multiple years.

Study Design. We exploited policy-induced variation in premiums generated by cross-sectional differences and changes over time in enrollee age, family size, and income to estimate the duration of enrollment as a function of the effective (per child) premium. We classify children as being of low, medium, or high illness severity.

Principal Findings. A dollar increase in the per-child premium is associated with a slight increase in a typical child's monthly probability of exiting coverage from 7.70 to 7.83 percent. Children with low illness severity have a significantly higher monthly baseline probability of exiting than children with medium or high illness severity, but the enrollment response to premium increases is similar across all three groups.

Conclusions. Success in achieving coverage gains through public programs is tempered by persistent problems in maintaining enrollment, which is modestly affected by premium increases. Retention is subject to adverse selection problems, but premium increases do not appear to significantly magnify the selection problem in this case.

Key Words. CHIP, cost sharing, public policy, child health

Since its introduction in 1999, Georgia's Children's Health Insurance Program (CHIP), PeachCare for Kids™ (PCK), has been very successful in expanding health insurance coverage for Georgia's low-income children, those at risk of being otherwise uninsured. At any given time, between 8 and 10 percent of Georgia's children are enrolled in this program. Nationally, empirical evidence suggests that state program characteristics are partially determinative of the relative success of CHIP in reducing the number of uninsured children within each state (Sommers 2005; Wolfe and Scrivner

2005; Marton 2007) and keeping children enrolled (Wachino and Weiss 2009).

A key program characteristic is the choice of whether and at what level to impose CHIP premiums. Our study provides a unique insight into the effect of the marginal premium on the duration of CHIP enrollment episodes. Most of the prior studies rely exclusively on premium variation generated by the time-dependent implementation of a new premium (extensive margin) or a (generally) smaller premium change equally applicable to all families (intensive margin). In contrast, we exploit policy-induced variation in premiums generated by cross-sectional differences and changes over time in enrollee age, family size, and income to estimate the duration of enrollment as a function of the effective (per child) premium (i.e., a dose response). Thus, the effect we estimate is the "per dollar" effect of a premium increase based on a much broader range of premium changes along the intensive margin than is typical in the literature.

An estimate of such price responsiveness is useful information for policy makers thinking about how families might respond to changes in the cost of coverage under the Affordable Care Act (ACA). The success of the ACA in expanding coverage to moderate-income families through subsidized coverage will rest on a complete understanding of how such families, many of whom are similar to CHIP families with respect to income, respond over time to incremental changes in their relative price for coverage based on underlying premiums and the premium tax credits that are intended to facilitate coverage.

Our analysis is also strengthened by our ability to link enrollment and claims data to control for child health status. We use these findings to simulate enrollment changes if premiums are increased by $5, $10, or $15 per child per month. We find a high baseline probability of exiting coverage for all children, but especially for healthy (low illness severity) children, consistent with a standard adverse selection story. The baseline probability is only marginally

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affected by premium increases, and such effects are comparable for both healthy children and those with medium or high illness severity, implying that a "death spiral" is unlikely in the program.

BACKGROUND

Literature

As of January 2013, all but 18 states charge premiums for some or all of the children enrolled in their CHIP programs. Policy makers frequently alter premiums by either changing the income thresholds for the categories of children subject to premiums or by raising or lowering the level of premiums required within these eligibility categories (Ross, Horn, and Marks 2008). Most states have exempted children in the lowest income eligibility class from premiums, however, where premiums are in effect, monthly premiums for a child in the lowest income eligibility class range from $4 to $15. Monthly premiums for a child in families with incomes above 200 percent of the Federal Poverty Line (FPL) range as high as $100 (Heberlein et al. 2013).

There is an extensive body of literature that analyzes the responsiveness of families to premiums in the employer-sponsored insurance market. When provided significant subsidies for coverage, low take-up among previously uninsured individuals suggests inelastic demand (Cutler 2002; Gruber and Washington 2005). This is compared with significant movement across plans among the already insured in the face of a relative price change (Cutler and Reber 1998; Royalty and Solomon 1999). Among the self-employed, Heim and Lurie (2009) find the take-up elasticity is significantly smaller than the response to incremental changes in the after-tax price for insurance. Thus, there is evidence from the private market that the response to any premiums among those not currently purchasing coverage may be quite different (much weaker) than the "dose response" to a change in premiums.

Turning to public coverage, several "extensive margin" studies have examined the coverage impact of the introduction of a premium or eligibility changes that expose enrollees to a premium. Marton (2007) analyzes the effect of the imposition of a new CHIP premium in Kentucky and finds that the duration of enrollment episodes is significantly reduced by the new $20 per family per month premium. Marton and Talbert (2010) also examine CHIP data in Kentucky and show that children with chronic health conditions are less likely to exit than healthy children. With respect to Georgia's PeachCare for Kids™ (PCK) program, Ketsche et al. (2007) study the effect of the

transition from nonpremium to premium status on the enrollment of 6-year-olds. The authors find that most of the children enrolled in Medicaid at their 6th birthday, who are expected to transition to PCK and begin paying premiums, either recertify and find that they are still eligible for Medicaid or disenroll from public coverage. Wisconsin children enrolled in BadgerCare experienced the reverse situation in which the premiums originally imposed for children with incomes between 150 and 200 percent of the FPL were eliminated. Analysis of this removal of premiums finds that exit rates fell by approximately one-fifth as result of this policy change (Leininger et al. 2011).

Other studies have evaluated incremental "intensive margin" changes to CHIP premiums and the associated impact on retention of those enrolled. For example, Shenkman et al. (2002) demonstrate that even small CHIP premium reductions in Florida reduce disenrollment, albeit only slightly, and increase the likelihood that a previously disenrolled child will be reenrolled. Boylston-Herndon et al. (2008) find that increasing premiums in Florida reduces the duration of enrollment episodes and that the effect is stronger for lower income (<150 percent of the FPL) enrollees; children with chronic health conditions are less sensitive to these premium changes. Notably, even after the premium increase in Florida was rescinded, enrollment episodes for lower income CHIP children did not return to prior lengths. Morrisey et al. (2012) find that an increase of $50 in the annual premium combined with some increases in cost sharing reduces the likelihood of reenrollment by 6 percent among Alabama CHIP enrollees. Marton, Ketsche, and Zhou (2010) look at changes along both margins by comparing the response to the imposition of a new premium in Kentucky with increases in an existing premium in Georgia; the authors find a larger response to a newly imposed rather than an increased premium, even when the magnitude of the premium change is substantial.

Most of the studies mentioned above use premium variation generated by the imposition of a new premium, or a change in an existing premium at a point in time, to estimate the enrollee response to premium changes. In contrast, given relatively recent policy changes in Georgia, there is significant policy-induced variation in premiums among PCK enrollees over time, by family size, and across incremental levels of income when measured as a percentage of the FPL. As discussed below, PCK monthly family premiums can vary from $0 to $70, which is close to the $100 maximum mentioned above. This allows us to create an effective (per child) premium for each family and estimate a "dose response" of coverage duration that is based on a much broader

range of premium changes along the intensive margin than is typically possible in the literature.

PeachCare for Kids™ Premium Policy

Since the inception of the program, premiums for PCK have been in place for children older than 6. Premiums are only charged for the first two children in the family so that children in larger families have effective (per child) premiums that are significantly lower than otherwise similar children in families with one or two children. Prior to July 2003, premiums of $7.50 for one and $15 for two or more children in the same family applied to all enrollees. In July of 2003, the premium for one child at all income levels was increased from $7.50 to $10. In addition, family premiums were scaled by two income levels such that a premium of $15 applied for two or more children for families below 150 percent of the FPL, but a premium of $20 applied for two or more children for families with incomes above 150 percent of the FPL. This represented an increase of $5 (33 percent increase) for families in this higher income category of eligibility. Premiums were increased more significantly for these higher income families in July of 2004 when premiums ranging from $20/$40 to $35/$70 based on a sliding scale were imposed.

Table 1 summarizes these changes in premiums over time. For children in families with two or more children and incomes below 150 percent of the FPL, there has been no change in premiums at all, while for children in families with two children and incomes at the upper bounds of eligibility, premiums increased almost fivefold over these 2 years.

Table 1: A History of Premiums for PeachCare Enrollees Age 6 and Older

	Before July 2003		*July 2003–June 2004*		*After June 2004*	
FPL (%)	*One Child*	*Family Cap*	*One Child*	*Family Cap*	*One Child*	*Family Cap*
100–150	$7.50	$15	$10	$15	$10	$15
151–160	$7.50	$15	$10	$20	$20	$40
161–170	$7.50	$15	$10	$20	$22	$44
171–180	$7.50	$15	$10	$20	$24	$48
181–190	$7.50	$15	$10	$20	$26	$52
191–200	$7.50	$15	$10	$20	$28	$56
201–210	$7.50	$15	$10	$20	$29	$58
211–220	$7.50	$15	$10	$20	$31	$62
221–230	$7.50	$15	$10	$20	$33	$66
231–235	$7.50	$15	$10	$20	$35	$70

DATA

We use data obtained from the Georgia Medicaid/PCK eligibility, enrollment, and claims databases from January 2003 to May of 2006 for this study. This time frame allows us to observe families and children enrolled during periods of time before and after the various premium changes shown in Table 1. These data reflect: (i) the information submitted by families at the time of their application for PCK regarding the child/children for whom coverage is sought and the family of the applicant; (ii) enrollment information contained in the Medicaid/PCK enrollment database for all enrollees; and (iii) health care utilization information contained in the Medicaid/PCK claims database for all enrollees. One key characteristic of the application/eligibility data is the ability to reconstruct family income used to determine eligibility and hence applicable effective (per child) premiums over time.[1] In addition, both the application/eligibility and enrollment data allow us to control for basic family demographic information for each child such as age, sex, race/ethnicity, citizenship status and familial characteristics such as age and sex of primary parent/guardian and county of residence. The addition of these variables also allows us to control for differences between the age and gender of the primary parent and/or the citizenship status of the child that could impact their response to premium changes.

There are a total of 663,024 episodes of PCK coverage for children enrolled at any point during the study period.[2] We make several exclusions before starting the analysis. First, we drop episodes with missing information on demographics, family income, or premiums; this exclusion drops a small percentage of episodes (5.5 percent). Next, we drop approximately 47,000 episodes with a discrepancy between the spell length given in the application/eligibility database and the enrollment database (7.1 percent). We also drop roughly 89,000 episodes (13.5 percent) where reported family income fell outside the PCK program income range for at least 1 month during the episode, as those below 100 percent of the FPL should be enrolled in Medicaid and not subject to premiums and those above 235 percent of the FPL should not be eligible for public coverage.[3] To focus on children and families who could face a premium at some point during the study period (starting at age 3 if enrollment continues to the 6th birthday), we dropped another approximately 70,000 episodes (10.5 percent) in which the enrollees are aged 3 or under at the start of the episodes or those over age 18 at the start of their episode. Finally, we exclude roughly 105,000 "left-censored" episodes (15.8 percent). These

episodes were already underway as of January 2003 and we cannot determine how many previous months of coverage these children had.[4]

After making these sample restrictions, our final analysis file includes 315,415 enrollment episodes generated by 200,412 unique children in 130,633 families. Within our sample, about 37 percent of the episodes are "right censored" in that the child is either still enrolled at the end of the study period or the child ages out of coverage so that we cannot observe when the child would have dropped coverage as a function of their effective (per child) premium.

We then examine the extent to which the episodes in our study sample represent the spectrum of income groups in which premiums within the PCK program apply. Table 2 shows that about 37 percent of the episodes are associated with incomes above 150 percent of the FPL where exogenous premium changes are significant and affect all children, regardless of family size. Children in families with no enrolled siblings in the 101–150 percent of the FPL income eligibility category also experienced an exogenous premium increase during the study period. Therefore, even among this large cohort of lower income enrollees, many would experience changes in the absolute premium during their episode of coverage.

Sample Means

Table 3 provides sample means for our entire sample of episodes. To assure ourselves that our sample includes children that actually experience a change in their effective (per child) premium, we compare actual family premiums and effective premiums in the first and last month of each episode. We find that actual premiums and effective premiums are constant in the first and last

Table 2: Distribution of Episodes by Initial Income Eligibility Category

FPL (%)	*Episodes (%)*
101–150	62.53
151–160	9.17
161–170	7.26
171–180	5.84
181–190	4.67
191–200	3.59
201–210	2.98
211–220	2.18
221–230	1.36
231–235	0.42

month for about 80 percent of the observed episodes. Among children experiencing a change, about 64 percent experienced an increase in effective premiums, while the remaining group of almost 36 percent experienced a decline in their effective premium. This measure may understate the extent to which effective (per child) premiums vary, as it is possible for some children to have a premium change within an episode even if the first and last month premiums are constant.

We use the Chronic Illness and Disability Payment System + Rx (CDPS + Rx) to construct measures of enrollee health status (Kronick et al. 2000). The CDPS + Rx system was originally developed for state Medicaid programs to use with claims data to better adjust payments for beneficiaries with disabilities and is based on demographic information, more than 15,000

Table 3: Descriptive Statistics for our PeachCare Sample of Episodes

Variable	*All Children*
Number of children	200,412
Number of episodes	315,415
Number of exits	198,198
Avg. episode length (months)	8.17
Average exit probability (%)	7.70
Other episode characteristics	
Avg. effective premium $ (first month)*	7.15
Avg. effective premium $ (all months)*	10.22
Avg. effective premium $ (last month)*	10.56
Avg. actual payment (first month)	12.09
Avg. actual payment (all months)	17.05
Avg. federal poverty level (FPL)	146.84
% from Medicaid	15.48
Demographics	
Avg. age (first month)	10.73
% Female	49.26
% White	43.63
% Hispanic	7.91
% African American	41.28
% Other race	7.18
% Citizen	99.18
% Born to teen mother	0.03
% Parent over 40 (first month)	28.53
% Mother primary parent	75.23
% Low CDPS + Rx score	39.60
% Medium CDPS + Rx score	39.49
% High CDPS + Rx score	20.91

*Effective premiums are adjusted for family size based on the number of children in the family in the premium paying PeachCare eligibility category.

ICD-9 codes, and National Drug Code (NDC) codes (Kronick, Bella, and Gilmer 2009). It has been used in recent literature as a measure of health status (Thomas et al. 2005; Macias et al. 2006; Weir, Aweh, and Clark 2008; Clark, Samnaliev, and McGovern 2009; Gilmer et al. 2009), including two studies using the same sort of Georgia public health insurance claims data (Landers, Snyder, and Zhou 2013; Landers and Zhou 2014) that we use in this article.

There are multiple advantages of using the CDPS+Rx system over other risk adjustment systems to account for differences in illness severity among the CHIP population. First, it was developed specifically for low-income populations. Second, separate weights are created for Temporary Assistance to Needy Families (TANF) adults, TANF children, and the Supplemental Security Income (SSI—older adults and the disabled) populations (Weir, Aweh, and Clark 2008). Thus, the CDPS+Rx system can be applied to a study focused on CHIP children whose health status is generally comparable to the TANF population.[5]

We categorize enrollees into our sample via their CDPS+Rx risk score into three categories: low, medium, and high severity. Low illness severity is defined as a score at or below the 25th percentile and high illness severity is defined as a score at or above the 75th percentile. Medium illness severity is defined as the scores in between. Table 3 shows that 40 percent of the episodes in our sample are generated by a child with low illness severity, 39 percent by a child with medium illness severity, and 21 percent by a child with a high illness severity.

Analytic Methods

We empirically model the duration of a child's enrollment in PCK as a function of the effective (per child) premium and family income, allowing those characteristics to vary over time. We assume that in each month, families compare the expected utility net of any monetary (i.e., premiums) or nonpecuniary costs (i.e., stigma) of remaining in PCK with the net expected utility associated with exiting. Our formal proportional hazard model can be stated as follows:

$$H(t) = \exp(X_{1t}'\beta_1) * \exp(t\alpha_1 + t^2\alpha_2) \quad (1)$$

As in Marton, Ketsche, and Zhou (2010), we are estimating the impact of the observable characteristics parametrically using the standard proportional hazard functional form ($\exp(X_{1t}'\beta_1)$). Rather than modeling the baseline hazard in the standard way (Weibull distribution), we include a quadratic in time on the right-hand side of our model ($\exp(t\alpha_{j1} + t^2\alpha_{j2})$). While our approach to

modeling the baseline hazard is still a parametric one, it does provide more flexibility than the Weibull distribution.[6] In addition, we include as controls on the right-hand side of our model indicators for spikes in the underlying hazard. These spikes occur in the first 3 months of enrollment, December of each year, and in July 2005.[7]

The effective premium is the premium from the schedule shown in Table 1 divided by the number of children in a family enrolled in a premium paying category of PCK for a given month. We control for observable demographic characteristics as of the date of enrollment (child age, gender, race/ethnicity, and citizenship status, primary parent age and gender, and the child's public health district of residence). We also include an indicator for whether this episode was initiated as a result of a transfer from Medicaid and separate indicators for low or medium illness severity.

We estimate the model separately for children with low, medium, and high illness severity to examine the extent to which families with these different groups of children respond differentially to premium changes. We then use these results to simulate how premium changes of different sizes would differentially impact a hypothetical cohort of 100,000 children with different illness severity levels.

RESULTS

For each set of regression results, Table 4 gives the hazard coefficient for each variable, the standard error, the p-value associated with the hypothesis test that the hazard is equal to 1 (i.e., the variable in question has no impact on the duration of enrollment), and the absolute value associated with each variable. Hazard ratios are relative probabilities, which is why we also report the absolute values. For example, the hazard ratio associated with the African American indicator in the full sample regression says that African American children are 29 percent more likely to exit in a given month than white children. To know whether this is a big effect, we need a reference. We use as a reference the average monthly exit probability for the entire sample, 7.70 percent. Thus, for African American children, the absolute effect says that the monthly probability of an exit is 9.89 percent (7.70*1.285 = 9.89) or 29 percent higher than the average monthly exit probability of 7.70 percent.

Our key variable of interest is the effective (per child) premium associated with each child's coverage. As the premium is in dollar increments, the coefficient on the effective premium variable represents the incremental

Table 4: Primary Hazard Model Results

	All Children				*Low CDPS + Rx Score*				*Medium CDPS + Rx Score*				*High CDPS + Rx Score*			
Variable	*Hazard*	*SE*	*p-value*	*Abs. Value (%)*	*Hazard*	*SE*	*p-value*	*Abs. Value (%)*	*Hazard*	*SE*	*p-value*	*Abs. Value (%)*	*Hazard*	*SE*	*p-value*	*Abs. Value (%)*
Effective premium	1.017	0.000	.000	7.83	1.018	0.001	.000	9.09	1.018	0.001	.000	7.30	1.014	0.001	.000	6.76
FPL_151_160	0.885	0.007	.000	6.81	0.909	0.012	.000	8.12	0.890	0.012	.000	6.38	0.858	0.016	.000	5.73
FPL_161_170	0.869	0.008	.000	6.69	0.888	0.013	.000	7.93	0.867	0.013	.000	6.21	0.867	0.018	.000	5.78
FPL_171_180	0.853	0.009	.000	6.56	0.875	0.014	.000	7.81	0.852	0.014	.000	6.11	0.844	0.020	.000	5.63
FPL_181_190	0.794	0.009	.000	6.11	0.816	0.014	.000	7.29	0.807	0.015	.000	5.78	0.751	0.021	.000	5.01
FPL_191_200	0.758	0.010	.000	5.83	0.802	0.016	.000	7.16	0.736	0.016	.000	5.27	0.735	0.022	.000	4.91
FPL_201_210	0.755	0.011	.000	5.81	0.781	0.017	.000	6.97	0.768	0.018	.000	5.50	0.704	0.024	.000	4.69
FPL_211_220	0.746	0.013	.000	5.74	0.770	0.020	.000	6.88	0.744	0.020	.000	5.33	0.736	0.029	.000	4.91
FPL_221_230	0.754	0.016	.000	5.80	0.764	0.026	.000	6.82	0.774	0.026	.000	5.55	0.722	0.036	.000	4.82
FPL_231_235	0.686	0.032	.000	5.28	0.716	0.052	.000	6.39	0.703	0.052	.000	5.04	0.618	0.068	.000	4.12
From Medicaid	0.870	0.006	.000	6.70	0.911	0.010	.000	8.13	0.872	0.010	.000	6.25	0.824	0.011	.000	5.50
Female	1.003	0.005	.510	7.72	0.997	0.007	.653	8.90	0.981	0.007	.011	7.04	1.065	0.011	.000	7.11
Hispanic	0.778	0.008	.000	5.99	0.770	0.011	.000	6.88	0.779	0.014	.000	5.58	0.817	0.020	.000	5.45
African American	1.285	0.007	.000	9.89	1.267	0.011	.000	11.32	1.296	0.012	.000	9.29	1.302	0.017	.000	8.69
Other race	0.902	0.009	.000	6.95	0.889	0.013	.000	7.94	0.903	0.015	.000	6.47	0.950	0.022	.028	6.34
Age 4–6	0.547	0.005	.000	4.21	0.751	0.010	.000	6.71	0.437	0.006	.000	3.13	0.565	0.011	.000	3.77
Age 7–12	0.883	0.005	.000	6.79	0.966	0.008	.000	8.63	0.839	0.007	.000	6.01	0.880	0.010	.000	5.87
Citizen	1.950	0.064	.000	15.01	1.979	0.091	.000	17.68	1.805	0.095	.000	12.94	2.325	0.223	.000	15.51
CDPS + Rx – low	1.235	0.008	.000	9.51	N.A.								N.A.			

Continued

Table 4. *Continued*

	All Children				*Low CDPS + Rx Score*				*Medium CDPS + Rx Score*				*High CDPS + Rx Score*			
Variable	*Hazard*	*SE*	*p-value*	*Abs. Value (%)*	*Hazard*	*SE*	*p-value*	*Abs. Value (%)*	*Hazard*	*SE*	*p-value*	*Abs. Value (%)*	*Hazard*	*SE*	*p-value*	*Abs. Value (%)*
CDPS + Rx – medium	1.074	0.007	.000	8.27	N.A.								N.A.			
Number of episodes	315,415				124,920				124,548				65,947			
Number of exits	198,198				83,728				74,927				39,543			
Avg. episode length (months)	8.17				7.50				8.39				8.99			
Avg. exit probability (%)	7.70				8.93				7.17				6.67			

Note. We are also controlling for the child's public health district of residence as of the first month of their enrollment episode, the child's age 6 premium, a flag for their 6th birthday month, a flag for having a teen mother, a flag for the primary parent being the mother, a flag for the primary parent being over 40 years old, linear and quadratic time trends, and spikes in the exit rate during the first 3 months of each episode, during the end of each calendar year, and in July 2005, but these coefficients are not reported above.

increase in the probability of disenrolling associated with a one-dollar change in the effective premium. For all children together, a single dollar increase in the effective (per child) premium is associated with an increase in their probability of exiting from 7.70 percent to 7.83 percent each month.

For children with high or medium illness severity, the average exit probabilities are significantly lower than for the low severity cohort (8.99 and 8.39 vs. 7.50 percent—bottom of Table 4), but as shown by the effective premium coefficient at the top of Table 4, the effect of a dollar increase in premiums on their exit rate is fairly similar to that of low illness severity children. If premiums were to increase by one dollar, the exit probability for children with high illness severity would increase from 6.67 to 6.76 percent and for children with medium severity the increase would be from 7.17 to 7.30 percent, whereas among low-severity children, the increase would be from 8.93 to 9.09 percent. This suggests that families with children in poor health do not respond much differently than families with children in medium or good health to premium changes, despite their different baseline probabilities of exit. The simulation results we present in Table 5 also help with the interpretation of these findings.

With respect to our other covariates in the full sample regression, we note that a very small number of qualified noncitizens are enrolled in PCK and being a citizen increases the probability of exiting significantly compared to noncitizen children. The probability of exiting also varies by race/ethnicity as it is lower than average for Hispanic children and higher than average for African American children. Children beginning a PCK episode by transferring from Medicaid are less likely to exit than children that had no public health insurance coverage in the previous month. The FPL indicators should be compared to the 101–150 percent

Table 5: Simulation Results for Premium Increases

	All Children	*Low CDPS + Rx Score*	*Medium CDPS + Rx Score*	*High CDPS + Rx Score*
Enrollment loss after 1 year	61,748	67,458	59,044	56,330
Loss based on a premium increase of				
$5 PMPM (31% increase)	63,731	69,401	61,068	57,944
%	3.21	2.88	3.43	2.87
$10 PMPM (62% increase)	65,717	71,330	63,103	59,570
%	6.43	5.74	6.87	5.75
$15 PMPM (93% increase)	67,701	73,240	65,142	61,207
%	9.64	8.57	10.33	8.66

of the FPL eligibility category. Their coefficients suggest that as family income increases, children are less likely to exit PCK, everything else (including effective premium levels) equal.

Premium Increase Simulation

We use our model to simulate the effect of increasing premiums by $5, $10, and $15 on the enrollment of a cohort of children over a year. This helps translate the impact of a one dollar per child per month change predicted by the hazard model into a more easily interpretable effect that reflects a range of potentially real premium policy changes. This simulation quantifies the effect of a premium increase on total enrollment for a given cohort of children assuming all other characteristics of the population remain unchanged. We model enrollment for a single calendar year under the baseline risk of disenrollment and then predict how disenrollment would change with a five-, ten-, and fifteen-dollar increase in absolute premiums. Such changes in premiums would translate into changes in the effective per child premium based on current family sizes and enrollment of between $2.80 and $8.50.

The simulations in Table 5 show more clearly the implications of a premium increase on changes in total enrollment in CHIP. The baseline estimates show the level of attrition in a cohort of 100,000 children in 1 year under assumptions that reflect the mean effective premiums and demographics for children enrolled between 2003 and 2006. The baseline probability of exiting results in a decline in a single cohort of PCK enrollment of over 60 percent of the children (61,748) within a single year, such that after one full year, only 38,252 children of the original cohort remain enrolled. In contrast, if premiums were further increased by $5 per member per month, disenrollment would increase to almost 64,000 from the original cohort, or an increase of about 3 percent in the number disenrolled. If premiums increased by $15 per member per month, disenrollment would go up to over 67,000 children. That is, almost 6,000 additional children would disenroll by year's end, leaving total enrollment at 32,299 [= 100,000 − 61,748 (due to normal attrition) − 5,953 (due to the premium increase)].

When we consider only low illness severity children, baseline disenrollment is even higher such that annual enrollment loss of 67,458 would result in only 32,542 children remaining enrolled at year's end. In contrast, children with medium or high illness severity disenroll at a lower rate such that an annual enrollment loss of 59,044 children would result in 40,956 children

remaining enrolled at year's end among those with medium illness severity. For children with a high illness severity, we see an annual enrollment loss of 56,330 children, resulting in 43,670 remaining at year's end. These baseline differences lead to our conclusion that adverse selection is a significant determinant of CHIP enrollment.

However, when we consider the responsiveness of each illness group to a premium increase, children in each group behave similarly. Among low illness severity children, a premium increase of $15 per member per month increases disenrollment by 5,782 children (73,240–67,458 baseline) or 9 percent, while among children with medium illness severity, the increase in premium increases disenrollment by 6,098 children or 10 percent. For children with high illness severity, the premium increase increases disenrollment by 4,877 children or 9 percent. The similarity in these effects leads to our conclusion that a premium-related death spiral is unlikely in the range of premiums normally considered for low-income public programs.

DISCUSSION

Our simulation results suggest a small but significant response to premium changes. The relative percentage changes in premiums and disenrollment suggest an inelastic demand as the percentage decrease in enrollment is smaller than the percentage increase in premiums. Our results agree with the low estimates of the elasticity of take-up (or percent increase in families buying private coverage with the percent decrease in premium) of employer-sponsored coverage from the academic literature.

While our study is the first to examine a "dose response" of coverage duration to premium changes in a public insurance program, our simulation results (3–9 percent enrollment loss for $5 to $15 increases in premiums) are comparable to the magnitude of responses found by other studies examining incremental "intensive margin" changes to CHIP premiums. These studies also find small reductions in disenrollment and small increases in the likelihood that a previously disenrolled child will reenroll when existing premiums are changed (Shenkman et al. 2002; Morrisey et al. 2012). The magnitude of our responses is much lower in comparison to studies done on the "extensive margin" that have found a doubling of disenrollment rates following a premium introduction (Marton 2007) and even 20 percent increases in enrollment following a premium removal (Leininger et al. 2011).

Baseline disenrollment is high for all children and is made slightly worse as premiums increase. The difference in baseline disenrollment trends for children with low illness severity compared to those with medium or high illness severity provides strong evidence that PCK retention is subject to adverse selection. This finding is consistent with the previous research done in Florida and Kentucky (Shenkman et al. 2002; Marton and Talbert 2010). However, the similarity in response to a change in premium suggests that, at least for children and for premiums in the range of our analysis, small to moderate increases are not likely to make the selection problem worse. Our findings differ from those of Boylston-Herndon et al. (2008), who study intensive margin changes and find children with chronic health conditions less sensitive to the changes in premiums.

The propensity to exit coverage before the end of the eligibility period may be at least partially attributable to the continuous open enrollment for this public program. While highly subsidized families in the ACA-related marketplaces may have similar incomes and be subject to comparable fluctuations in income that could influence disenrollment, the marketplace plans will have incentives that differ in two substantive ways: First, enrollment is closed during much of the year. Second, such families will face the individual mandate tax penalties, which increase the cost of disenrollment. Therefore, while our study is informative and suggests the potential for attrition, it will be important to monitor disenrollment trends for adults gaining such coverage.

While the final rule on Medicaid Cost-sharing Requirements released on July 5, 2013 (42 C.F.R. 447.52-447.54), does not allow premiums for individuals under 150 percent FPL, at least two states are proposing to institute premiums for their adult expansion populations above 50 percent of the FPL on a trial basis through 1115 waiver authority (i.e., Iowa and Pennsylvania). High disenrollment rates among similarly situated children suggest that such programs for adults could lead to unstable and cyclical coverage. Both states are proposing to allow individuals to reduce or eliminate their monthly premiums if they participate in health and wellness appointments. As states attempt to introduce individual responsibility into their Medicaid programs and align adult benefit packages with national standards for coverage, cost-sharing arrangements will likely continue to be tools states seek to use to transform public programs and make them competitive with the private market. Future research on the impact of premiums and other forms of cost sharing on poorer populations and, in particular, for families will be important.

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NOTES

1. Families report their income when they apply for coverage and at their annual recertification. In addition, families are expected to report any changes in income and family size when they occur within the enrollment period.
2. We define a PCK spell as one or more consecutive months of PCK coverage. We know if a child was enrolled in Medicaid or had no public coverage in the month prior to the start of their PCK spell and control for that in our hazard analysis. We also know if the PCK spell ends because the child transitions to Medicaid coverage or no public coverage. The reason we create "pure" PCK spells that do not include Medicaid coverage is because there are no premiums in the Medicaid program. For further discussion of CHIP spells, see Marton (2007).
3. The vast majority of these 89,000 episodes had income below the PCK program income range floor of 100 percent of the FPL (i.e., the poverty line). Given that children in families with income below the poverty line are not subject to public insurance premiums, we felt as though dropping them would be the appropriate thing to do, rather than assigning them a premium equal to the PCK minimum or making some other ad hoc assumption.
4. See Table S1 for a summary of these sample restrictions.
5. One potential concern associated with this approach is that children with short enrollment spells have less information to contribute to the calculation of their CDPS+Rx risk score. A general rule of thumb is that one needs at least 6 months of enrollment data to get accurate risk scores. We use enrollment data from both PCK and Medicaid over our 41-month timeframe to calculate risk scores. Thus, if a child had a 3-month PCK spell and then a 12-month Medicaid spell, we base his or her risk score on information from all 15 months. Under this approach, only 11,309 spells (3.59 percent) of the total of 315,415 have a CDPS+Rx risk score based on less than 6 months of enrollment data. Therefore, any issues associated with short spells should not cause major problems in our analysis.

6. We also estimated our primary specification using the Weibull distribution and found that the results were essentially unchanged.
7. A common concern associated with survival analysis is the presence of nonrandom censoring. Our relatively long time frame mitigates this concern to some degree, as over 60 percent of our episodes are not censored. We also control for a wider set of covariates than is typical in the literature to move as close as we can to having truly noninformative censoring.

REFERENCES

Boylston-Herndon, J., W. Vogel, R. L. Bucciarelli, and E. A. Shenkman. 2008. "The Effect of Premium Changes on SCHIP Enrollment Duration." *Health Services Research* 43 (2): 458–77.

Clark, R. E., M. Samnaliev, and M. P. McGovern. 2009. "Impact of Substance Disorders on Medical Expenditures for Medicaid Beneficiaries with Behavioral Health Disorders." *Psychiatric Services* 60 (1): 35–42.

Cutler, D. 2002. *Employee Costs and the Decline in Health Insurance.* Working Paper 9036. Cambridge, MA: National Bureau of Economic Research.

Cutler, D., and S. Reber. 1998. "Paying for Health Insurance: The Trade Off Between Competition and Adverse Selection." *Quarterly Journal of Economics* 113: 433–66.

Gilmer, T. P., V. D. Ojeda, C. Barrio, D. Fuentes, P. Garcia, N. M. Lanouette, and K. C. Lee. 2009. "Adherence to Antipsychotics among Latinos and Asians with Schizophrenia and Limited English Proficiency." *Psychiatric Services* 60 (2): 175–82.

Gruber, J., and E. Washington. 2005. "Subsidies to Employees' Health Insurance Premiums and the Health Insurance Market." *Journal of Health Economics* 24 (2): 253–76.

Heberlein, M., T. Brooks, J. Alker, A. Artiga, and J. Stephens. 2013. Getting into Gear for 2014: Findings from a 50 State Survey of Eligibility, Renewal, and Cost-Sharing Policies in Medicaid and CHIP, 2012-2013. Kaiser Commission on Medicaid and the Uninsured [accessed on July 3, 2014]. Available at http://kaiserfamilyfoundation.files.wordpress.com/2013/05/8401.pdf

Heim, B. T., and I. Z. Lurie. 2009. "Do Increased Premium Subsidies Affect How Much Health Insurance Is Purchased? Evidence from the Self-Employed." *Journal of Health Economics* 28 (6): 1197–210.

Ketsche, P., E. K. Adams, A. Snyder, M. Zhou, K. Minyard, and R. Kellenberg. 2007. "Discontinuity of Coverage for Medicaid and S-CHIP Children at a Transitional Birthday." *Health Services Research* 42 (6 Pt 2): 2410–23.

Kronick, R., M. Bella, and T. Gilmer. 2009. "The Faces of Medicaid III: Refining the Portrait of People with Multiple Chronic Conditions." In *The Faces of Medicaid*, edited by L. Martin, pp 1–30. Hamilton, NJ: Center for Health Care Strategies Inc.

Kronick, R., T. Gilmer, T. Dreyfus, and L. Lee. 2000. "Improving Health-Based Payment for Medicaid Beneficiaries: CDPS." *Health Care Financing Review* 21 (3): 29–64.

Landers, G., and M. Zhou. 2014. "The Impact of Medicaid Peer Support Utilization on Cost." *Medicare and Medicaid Research Review* 4 (1): E1–17.

Landers, G., A. Snyder, and M. Zhou. 2013. "Comparing Preventive Visits of Children in foster Care with other Children in Medicaid." *Journal of Health Care for the Poor and Underserved* 24 (2): 802–12.

Leininger, L. J., D. Friedsam, L. Dague, S. Mok, E. Hynes, A. Bergum, and T. DeLeire. 2011. "Wisconsin's BadgerCare Plus Reform: Impact on Low-Income Families' Enrollment and Retention in Public Coverage." *Health Services Research* 46 (1 Pt 2): 336–47.

Macias, C., C. F. Rodican, W. A. Hargreaves, D. R. Jones, P. J. Barreira, and Q. Wang. 2006. "Supported Employment Outcomes of a Randomized Controlled Trial of ACT and Clubhouse Models." *Psychiatric Services* 57 (10): 1406–15.

Marton, J. 2007. "The Impact of the Introduction of Premiums into a SCHIP Program." *Journal of Policy Analysis and Management* 26 (2): 237–55.

Marton, J., and J. C. Talbert. 2010. "SCHIP Premiums, Health Status, and the Insurance Coverage of Children." *Inquiry* 47 (3): 199–214.

Marton, J., P. Ketsche, and M. Zhou. 2010. "SCHIP Premiums, Enrollment, and Expenditures: A Two State, Competing Risk Analysis." *Health Economics* 19 (7): 772–91.

Morrisey, M. A., J. Blackburn, B. Sen, D. Becker, M. L. Kilgore, C. Caldwell, and N. Menachemi. 2012. "The Effects of Premium Changes on ALL Kids, Alabama's CHIP Program." *Medicare and Medicaid Research Review* 2 (3): E1–16.

Ross, D. C., A. Horn, and C. Marks. 2008.Health Coverage for Children and Families in Medicaid and SCHIP: State Efforts Face New Hurdles. Kaiser Commission on Medicaid and the Uninsured [accessed on July 3, 2014]. Available at http://www.kff.org/medicaid/upload/7740_ES.pdf

Royalty, A., and N. Solomon. 1999. "Health Plan Choice: Price Elasticities in a Managed Competition Setting." *The Journal of Human Resources* 34 (1): 1–42.

Shenkman, E., B. Vogel, J. Boyett, and R. Naff. 2002. "Disenrollment and Re-Enrollment Patterns in SCHIP." *Health Care Financing Review* 23 (5): 47–63.

Sommers, B. D. 2005. "The Impact of Program Structure on Children's Disenrollment from Medicaid and SCHIP." *Health Affairs* 24 (6): 1611–8.

Thomas, M. R., J. A. Waxmonsky, P. A. Gabow, G. Flanders-McGinnis, R. Socherman, and K. Rost. 2005. "Prevalence of Psychiatric Disorders and Costs of Care among Adult Enrollees in a Medicaid HMO." *Psychiatric Services* 56 (11): 1394–401.

Wachino, V., and A. M. Weiss. 2009. Maximizing Kids' Enrollment in Medicaid and SCHIP: What Works in Reaching, Enrolling, and Retaining Eligible Children. National Academy for State Health Policy [accessed on July 3, 2014]. Available at http://nashp.org/sites/default/files/Max_Enroll_Report_FINAL.pdf?q=files/Max_Enroll_Report_FINAL.pdf

Weir, S., G. Aweh, and R. E. Clark. 2008. "Case Selection for a Medicaid Chronic Care Management Program." *Health Care Financing Review* 30 (1): 61–74.

Wolfe, B., and S. Scrivner. 2005. "The Devil May Be in the Details: How the Characteristics of SCHIP Programs Affect Take-Up." *Journal of Policy Analysis and Management* 24 (3): 499–522.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.
Table S1. PeachCare Sample Restriction Summary.