Table 1

Standardized Bias of Average Treatment Effect Estimates, with $\gamma_{11} = 0$ and A Random Quadratic Effect, Stratified by the Number of Measurement Occasions (T), Reliability of Slope (R_{slp}), Missing Data Mechanism, and Mean Growth Pattern

Missing	Mean	$T = 3$						$T = 4$							
Data	Growth	$R_{slp} = 0.5$			$R_{slp} = 0.8$			$R_{slp} = 0.5$				$R_{slp} = 0.8$			
Mechanism	Pattern	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	QG-ASR	SLG	QG-AIF	QG-ASF	QG-ASR
NM	SameSmallQ	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02
	DiffSmallQ	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.05	-0.05	-0.05	-0.05	0.01	0.01	0.01	0.01
	SameLargeQ	-0.02	-0.02	-0.02	-0.03	-0.03	-0.03	-0.05	-0.05	-0.05	-0.05	0.01	0.01	0.01	0.01
	DiffLargeQ	0.02	0.02	0.02	0.01	0.01	0.01	-0.01	-0.01	-0.01	-0.01	0.05	0.05	0.05	0.05
Same MCAR	SameSmallQ	-0.04	-0.03	-0.04	0.01	0.01	0.01	-0.02	-0.02	-0.02	-0.02	-0.01	0.00	0.00	0.00
	DiffSmallQ	0.12	0.16	0.00	0.14	0.26	0.02	0.16	0.19	0.02	0.02	0.21	0.29	0.02	0.02
	SameLargeQ	-0.04	-0.03	-0.03	-0.02	0.00	0.00	0.01	0.02	0.01	0.01	0.02	0.02	0.00	0.01
	DiffLargeQ	0.17	0.35	0.03	0.14	**0.46**	0.00	0.2	0.37	0.01	0.01	0.2	**0.55**	-0.01	-0.01
Diff MCAR	SameSmallQ	**-0.47**	-0.01	-0.02	**-0.55**	0.01	0.01	**-0.55**	-0.01	-0.01	-0.01	**-0.77**	-0.04	-0.04	-0.04
	DiffSmallQ	-0.38	0.14	0.01	**-0.46**	0.18	-0.01	**-0.47**	0.15	0.01	0.01	**-0.63**	0.2	-0.01	-0.01
	SameLargeQ	**-0.53**	0.02	0.01	**-0.52**	0.03	0.04	**-0.76**	0.01	0.01	0.01	**-0.84**	0.00	0.00	0.00
	DiffLargeQ	**-0.46**	0.23	-0.01	**-0.42**	0.37	0.02	**-0.67**	0.26	-0.01	-0.01	**-0.72**	**0.42**	-0.01	-0.01
Same MAR	SameSmallQ	-0.01	-0.01	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02	0.00	0.00	0.00	0.00
	DiffSmallQ	0.13	0.17	0.02	0.11	0.25	0.01	0.11	0.14	-0.04	-0.04	0.2	0.3	0.01	0.01
	SameLargeQ	-0.01	-0.02	-0.02	0.02	0.03	0.03	-0.01	-0.01	-0.01	-0.01	0.00	0.01	0.01	0.01
	DiffLargeQ	0.11	0.31	0.00	0.1	**0.49**	0.01	0.18	0.33	0.00	0.00	0.19	**0.56**	0.00	0.00
Diff MAR	SameSmallQ	-0.27	0.02	0.05	-0.26	-0.05	-0.01	**-0.51**	-0.03	-0.03	-0.02	**-0.64**	-0.11	-0.12	-0.01
	DiffSmallQ	-0.19	0.16	0.06	-0.13	0.16	0.00	**-0.44**	0.09	-0.04	-0.02	**-0.46**	0.12	-0.11	-0.01
	SameLargeQ	-0.21	0.03	0.05	-0.11	-0.07	-0.04	**-0.54**	-0.04	-0.03	-0.02	**-0.43**	-0.1	-0.11	0.00
	DiffLargeQ	-0.13	0.26	0.03	0.01	0.35	-0.01	-0.36	0.28	0.00	0.02	-0.26	0.34	-0.13	-0.03

Note: SLG = straight-line growth model; QG-AIF = quadratic growth model with fixed and arm-invariant quadratic effect; QG-ASF = quadratic growth model with fixed and arm-specific quadratic effects; QG-ASR = quadratic growth model with random and arm-specific quadratic effects; Same = same missing data rates across study arms; Diff = higher missing data rates in the control arm than the treatment arm; standardized bias is expressed as bias in standard error units (with standardized bias of 0.4 or greater in boldface); positive (or negative) bias indicates the ATE estimate is larger (or smaller) than 0.

Table 2

% Relative Bias of Average Treatment Effect Estimates, with $\gamma_{11} = 1$ and A Random Quadratic Effect, Stratified by the Number of Measurement Occasions (T), Reliability of Slope (R_{slp}), Missing Data Mechanism, and Mean Growth Pattern

Missing	Mean	$T = 3$						$T = 4$							
Data	Growth	$R_{slp} = 0.5$			$R_{slp} = 0.8$			$R_{slp} = 0.5$				$R_{slp} = 0.8$			
Mechanism	Pattern	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	QG-ASR	SLG	QG-AIF	QG-ASF	QG-ASR
NM	SameSmallQ	2.0	2.0	2.0	-0.2	-0.2	-0.2	-1.1	-1.1	-1.1	-1.1	-0.3	-0.3	-0.3	-0.3
	DiffSmallQ	-0.3	-0.3	-0.3	-1.6	-1.6	-1.6	1.2	1.2	1.2	1.2	-1.0	-1.0	-1.0	-1.0
	SameLargeQ	-2.0	-2.0	-2.0	-0.1	-0.1	-0.1	-2.6	-2.6	-2.6	-2.6	0.0	0.0	0.0	0.0
	DiffLargeQ	-1.8	-1.8	-1.8	-0.6	-0.6	-0.6	-0.2	-0.2	-0.2	-0.2	-0.7	-0.7	-0.7	-0.7
Same MCAR	SameSmallQ	8.5	**12.9**	0.4	8.6	**15.8**	0.4	**14.2**	**15.8**	1.9	2.2	**12.1**	**17.0**	-1.1	-0.8
	DiffSmallQ	**17.7**	**25.9**	0.9	**14.7**	**30.1**	-0.1	**22.0**	**26.4**	-0.6	-0.5	**23.6**	**35.2**	0.1	0.1
	SameLargeQ	**13.3**	**27.1**	2.3	9.6	**31.0**	1.2	**14.0**	**24.9**	-2.2	-2.2	**13.6**	**35.8**	0.3	0.0
	DiffLargeQ	**21.5**	**48.7**	2.5	**14.7**	**53.1**	0.5	**31.3**	**54.3**	1.7	1.6	**22.9**	**64.1**	-1.0	-1.3
Diff MCAR	SameSmallQ	**-24.1**	7.6	-1.3	**-19.6**	**12.1**	1.1	**-25.9**	**11.3**	1.6	1.7	**-28.4**	**12.4**	-0.2	-0.2
	DiffSmallQ	**-17.9**	**18.4**	0.7	**-18.9**	**18.8**	-2.2	**-24.5**	**18.0**	-0.9	-0.9	**-24.0**	**24.5**	-0.1	-0.2
	SameLargeQ	**-25.5**	**18.5**	0.8	**-19.7**	**21.8**	0.4	**-37.8**	**18.6**	-0.3	-0.3	**-31.0**	**24.7**	0.5	0.5
	DiffLargeQ	**-18.7**	**34.2**	1.5	**-14**	**38.1**	1.3	**-29.8**	**36.7**	0.3	0.4	**-24.8**	**45.8**	0.4	0.3
Same MAR	SameSmallQ	**10.7**	**14.7**	1.7	7.4	**15.4**	0.0	**14.0**	**15.0**	1.5	1.7	**13.1**	**17.8**	0.2	0.2
	DiffSmallQ	**16.1**	**25.0**	0.6	**12.7**	**29.4**	0.1	**26.1**	**29.9**	2.6	2.4	**22.4**	**32.7**	-2.5	-2.6
	SameLargeQ	8.8	**24.2**	0.3	5.4	**28.5**	-1.1	**15.2**	**26.2**	-1.1	-1.0	**15**	**36.5**	0.7	0.7
	DiffLargeQ	**13.7**	**42.9**	-2.0	**12.2**	**49.3**	-0.4	**31.0**	**54.3**	1.7	1.5	**22.1**	**64.3**	-0.9	-0.8
Diff MAR	SameSmallQ	**-11.5**	9.1	1.7	-5.5	9.4	-0.6	**-22.7**	**10.2**	0.6	1.3	**-22.4**	8.1	-5.2	-0.6
	DiffSmallQ	-6.1	**18.6**	1.5	1.3	**21.7**	-0.2	**-15.4**	**20.2**	0.2	0.9	**-12.3**	**22.2**	-4.5	0.2
	SameLargeQ	-3.6	**21.4**	4.5	0.1	**19.6**	-2.0	**-20.6**	**18.8**	-0.8	-0.4	**-10.9**	**21.4**	-5.7	-1.0
	DiffLargeQ	-1.3	**36.4**	1.5	7.1	**41.4**	-0.1	**-11.3**	**37.3**	-2.4	-1.6	-0.9	**46.7**	-4.5	0.0

Note: SLG = straight-line growth model; QG-AIF = quadratic growth model with fixed and arm-invariant quadratic effect; QG-ASF = quadratic growth model with fixed and arm-specific quadratic effects; QG-ASR = quadratic growth model with random and arm-specific quadratic effects; Same = same missing data rates across study arms; Diff = higher missing data rates in the control arm than the treatment arm; relative bias is expressed as the ratio of absolute bias to the true value in percentage format (with relative bias of 10% or greater in boldface); positive (or negative) bias indicates the absolute value of the ATE estimate is larger (or smaller) than the absolute value of the true parameter.

Table 3

% Relative Bias for Estimating the Variance of Random Slope σ^2_{u1}, When $\gamma_{11} = 1$ and the Reliability of Slope $R_{slp} = 0.5$, Stratified by the Number of Measurement Occasions (T), Type of Quadratic Effect (Fixed or Random), Missing Data Mechanism, and Mean Growth Pattern

Missing	Mean	$T = 3$						$T = 4$							
Data	Growth	Fixed Q			Random Q			Fixed Q				Random Q			
Mechanism	Pattern	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	QG-ASR	SLG	QG-AIF	QG-ASF	QG-ASR
NM	StraightL	1.2	1.2	1.3				-0.3	-0.3	-0.3	0.0				
	SameSmallQ	**-118.9**	-1.4	0.1	**-143.8**	**-24.8**	**-23.2**	**-64.2**	-0.6	0.1	0.1	**-77.2**	**-13.5**	**-12.7**	-0.1
	DiffSmallQ	**-152.7**	-7.0	-1.1	**-174**	**-28.4**	**-22.7**	**-81.9**	-4.0	-0.9	-0.9	**-93.5**	**-15.3**	**-12.1**	0.2
	SameLargeQ	**-481.5**	-6.7	-0.6	**-502.8**	**-28.6**	**-22.7**	**-256.3**	-3.4	-0.3	0.0	**-268.8**	**-14.9**	**-11.8**	0.4
	DiffLargeQ	**-608.9**	**-23.6**	0.0	**-633.5**	**-46.9**	**-23.4**	**-324.3**	**-12.1**	0.3	0.3	**-337.7**	**-25.2**	**-12.7**	-0.2
Same MCAR	StraightL	-0.1	-0.2	-0.1				0.5	0.4	0.4	0.7				
	SameSmallQ	**-109**	-1.5	0.0	**-139.5**	**-23.5**	**-22.3**	**-46.7**	0.8	1.2	1.5	**-57.7**	-4.1	-3.3	-0.5
	DiffSmallQ	**-140.8**	-5.9	-0.3	**-171.3**	**-29.3**	**-23.9**	**-61.4**	-1.7	0.8	0.9	**-71.6**	-5.8	-3.1	-0.4
	SameLargeQ	**-451.8**	-5.1	0.1	**-490.7**	**-30.1**	**-24.4**	**-216.7**	-3.4	-1.1	-1.0	**-230.7**	-5.9	-3.3	-0.4
	DiffLargeQ	**-574.7**	**-21.3**	1.2	**-616**	**-47.2**	**-24.8**	**-279.4**	-9.6	-0.5	-0.3	**-299**	**-13.2**	-3.0	-0.3
Diff MCAR	StraightL	0.1	0.2	0.2				0.8	0.8	0.9	0.6				
	SameSmallQ	**-121.8**	-1.9	-0.5	**-149.3**	**-25.7**	**-24.2**	**-60.4**	-1.2	-0.5	-0.3	**-70.1**	-7.3	-6.5	0.8
	DiffSmallQ	**-156.9**	-5.0	0.2	**-184.4**	**-28.5**	**-23**	**-80**	-2.7	-0.1	0.2	**-90.7**	-9.8	-7.1	0.1
	SameLargeQ	**-483.5**	-5.9	-0.7	**-513.7**	**-29.1**	**-23.3**	**-248.3**	-2.8	-0.4	0.1	**-262.6**	-9.2	-6.6	0.9
	DiffLargeQ	**-624.6**	**-21.2**	0.3	**-654.9**	**-45.5**	**-22.6**	**-323.9**	-9.9	0.0	0.3	**-342.3**	**-19**	-8.2	-1.2
Same MAR	StraightL	2.4	2.5	2.2				1.0	0.9	0.8	1.7				
	SameSmallQ	**-123.7**	0.1	1.2	**-189.8**	**-31.3**	**-30.4**	**-16**	2.7	3.2	4.1	**-29.8**	-3.2	-2.7	1.4
	DiffSmallQ	**-164.1**	-5.7	0.4	**-234.4**	**-36.7**	**-30.4**	**-34.6**	-0.1	2.5	3.3	**-44.8**	-4.1	-0.9	3.2
	SameLargeQ	**-517.6**	-4.6	1.7	**-609.3**	**-35.8**	**-29.9**	**-213.7**	-0.3	2.4	3.2	**-248.6**	-4.0	-1.0	3.3
	DiffLargeQ	**-640.6**	**-23.8**	2.7	**-737.4**	**-58.1**	**-30.9**	**-286**	-8.1	2.5	2.8	**-328.1**	**-14.7**	-2.3	2.1
Diff MAR	StraightL	1.5	1.1	0.7				2.6	2.6	2.4	2.9				
	SameSmallQ	**-137.3**	-1.6	1.0	**-185.5**	**-28.7**	**-27.1**	**-52**	-1.1	0.9	1.2	**-66.1**	-8.0	-6.1	2.3
	DiffSmallQ	**-179.3**	-6.7	1.5	**-233.2**	**-35.4**	**-28.6**	**-75.3**	-4.9	0.6	1.1	**-90.5**	**-11.7**	-5.9	2.4
	SameLargeQ	**-530.2**	-4.8	3.6	**-600**	**-36.4**	**-29.7**	**-263.6**	-3.9	1.7	1.8	**-291.8**	**-11.8**	-6.4	1.8
	DiffLargeQ	**-675.7**	**-27.7**	-0.3	**-743**	**-54.7**	**-28.7**	**-348.8**	**-14.3**	1.7	1.9	**-378.1**	**-24.4**	-7.4	0.9

Note: SLG = straight-line growth model; QG-AIF = quadratic growth model with fixed and arm-invariant quadratic effect; QG-ASF = quadratic growth model with fixed and arm-specific quadratic effects; QG-ASR = quadratic growth model with random and arm-specific quadratic effects; Fixed Q = true population quadratic effect is fixed within a study arm; Random Q = true population quadratic effect is random within a study arm; Same = same missing data rates across study arms; Diff = higher missing data rates in the control arm than the treatment arm; the relative bias is expressed as the ratio of absolute bias to the true value in percentage format (with relative bias of 10% or greater in boldface).

Table 4

% Relative Bias for Estimating the Level-1 Residual Variance σ_e^2, When $\gamma_{11} = 1$ and the Reliability of Slope $R_{slp} = 0.5$, Stratified by the Number of Measurement Occasions (T), Type of Quadratic Effect (Fixed or Random), Missing Data Mechanism, and Mean Growth Pattern

Missing	Mean	$T = 3$						$T = 4$							
Data	Growth	Fixed Q			Random Q			Fixed Q				Random Q			
Mechanism	Pattern	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	QG-ASR	SLG	QG-AIF	QG-ASF	QG-ASR
NM	StraightL	-0.5	-0.5	-0.5				-0.1	-0.1	-0.1	-0.3				
	SameSmallQ	**119**	1.5	0.1	**143.8**	**24.8**	**23.2**	**64.4**	0.9	0.1	0.2	**76.9**	**13.2**	**12.4**	-0.2
	DiffSmallQ	**151.6**	5.8	0.0	**174.4**	**28.8**	**23.1**	**81.5**	3.5	0.4	0.4	**94**	**15.8**	**12.5**	0.3
	SameLargeQ	**481**	6.2	0.1	**503.6**	**29.4**	**23.5**	**255.9**	3	-0.1	-0.4	**269.1**	**15.3**	**12.1**	0.0
	DiffLargeQ	**608.9**	**23.6**	0.1	**633.6**	**47**	**23.5**	**324.7**	**12.5**	0.1	0.2	**337.8**	**25.3**	**12.7**	0.2
Same MCAR	StraightL	0.0	0.1	0.0				-0.1	-0.1	-0.1	-0.1				
	SameSmallQ	**112.5**	1.7	0.2	**147.7**	**32.9**	**31.7**	**56.9**	0.5	-0.2	-0.3	**73.9**	**15.8**	**15**	0.6
	DiffSmallQ	**143.4**	5	-0.6	**177.6**	**36.6**	**31.2**	**72.5**	2.7	-0.2	-0.4	**89.3**	**17.7**	**14.8**	0.4
	SameLargeQ	**457.7**	5.8	0.3	**497**	**37.9**	**32.3**	**236.2**	3.1	0.3	0.4	**253.9**	**17.7**	**14.9**	0.3
	DiffLargeQ	**581.6**	**23.1**	0.0	**621.4**	**54.1**	**32.1**	**300.1**	**10.8**	-0.6	-0.3	**322.3**	**26.2**	**14.8**	0.2
Diff MCAR	StraightL	0.2	0.3	0.2				0.1	0.1	0.1	0.4				
	SameSmallQ	**121.6**	1.6	0.1	**151.8**	**30.2**	**28.7**	**63.1**	0.5	-0.2	-0.3	**77.2**	**14**	**13.2**	-0.7
	DiffSmallQ	**156.9**	5.7	0.3	**186.6**	**33.8**	**28.3**	**81.9**	2.4	-0.5	-0.9	**96.4**	**16**	**13.1**	-0.6
	SameLargeQ	**483**	4.8	-0.5	**515.5**	**34**	**28.3**	**254.3**	2.9	0.1	-0.4	**271**	**16.7**	**13.8**	-0.5
	DiffLargeQ	**624.5**	**21.9**	-0.4	**656.5**	**51.1**	**28.2**	**328.9**	**11.1**	-0.3	-0.5	**347.7**	**25.8**	**14.2**	0.5
Same MAR	StraightL	0.0	0.1	0.3				0.0	0.1	0.1	-0.1				
	SameSmallQ	**133.5**	1.7	0.4	**187**	**34.8**	**33.6**	**58.7**	0.4	-0.2	-0.3	**73.6**	**15.1**	**14.4**	0.4
	DiffSmallQ	**171**	6.8	0.8	**226.8**	**38.8**	**32.9**	**76.2**	2.9	0.0	-0.1	**90.3**	**17**	**14**	0.0
	SameLargeQ	**514.9**	6.1	0.0	**591**	**39.5**	**33.7**	**253.1**	3	0.0	0.1	**276.5**	**17.1**	**14**	0.2
	DiffLargeQ	**637.9**	**25.6**	0.5	**716.4**	**59.4**	**33.8**	**320.8**	**11.4**	-0.4	-0.2	**348.5**	**26.5**	**14.2**	-0.1
Diff MAR	StraightL	0.1	0.4	0.5				-0.1	-0.1	0.0	0.0				
	SameSmallQ	**138.2**	2	0.3	**179.1**	**29.9**	**28.8**	**66.2**	0.4	-0.4	-0.6	**80.7**	**14.1**	**13.2**	-0.5
	DiffSmallQ	**177.9**	6.1	-0.1	**223.2**	**35.1**	**29.4**	**87**	3	-0.2	-0.4	**101.8**	**16.7**	**13.1**	-0.4
	SameLargeQ	**525.3**	6.2	-0.2	**583**	**35.4**	**29.8**	**271**	3.1	-0.1	0.0	**291.7**	**16.7**	**13.4**	0.0
	DiffLargeQ	**665.6**	**24.1**	0.1	**725.2**	**53**	**29.3**	**350.8**	**11.9**	-0.4	-0.4	**372**	**26.6**	**13.6**	0.2

Note: SLG = straight-line growth model; QG-AIF = quadratic growth model with fixed and arm-invariant quadratic effect; QG-ASF = quadratic growth model with fixed and arm-specific quadratic effects; QG-ASR = quadratic growth model with random and arm-specific quadratic effects; Fixed Q = true population quadratic effect is fixed within a study arm; Random Q = true population quadratic effect is random within a study arm; Same = same missing data rates across study arms; Diff = higher missing data rates in the control arm than the treatment arm; the relative bias is expressed as the ratio of absolute bias to the true value in percentage format (with relative bias of 10% or greater in boldface).

Table 5

% Relative Bias for Estimating the Effect Size of Average Treatment Effect $ES_{\gamma_{11}}$, When $\gamma_{11} = 1$ and the Reliability of Slope $R_{slp} = 0.5$, Stratified by the Number of Measurement Occasions (T), Type of Quadratic Effect (Fixed or Random), Missing Data Mechanism, and Mean Growth Pattern

Missing	Mean	$T = 3$						$T = 4$							
Data	Growth	Fixed Q			Random Q			Fixed Q				Random Q			
Mechanism	Pattern	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	QG-ASR	SLG	QG-AIF	QG-ASF	QG-ASR
NM	StraightL	-1.5	-1.5	-1.5				1.3	1.3	1.3	1.3				
	SameSmallQ	-0.6	-0.6	-0.6	2.8	2.8	2.8	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	DiffSmallQ	1.6	1.6	1.6	0.5	0.5	0.5	1.4	1.4	1.4	1.4	2.1	2.1	2.1	2.1
	SameLargeQ	1.7	1.7	1.7	-1.3	-1.3	-1.3	1.6	1.6	1.6	1.6	-2.0	-2.0	-2.0	-2.0
	DiffLargeQ	1.9	1.9	1.9	-0.9	-0.9	-0.9	2.4	2.4	2.4	2.4	0.7	0.7	0.7	0.7
Same MCAR	StraightL	2.5	2.5	2.5				3.1	3	2.0	1.9				
	SameSmallQ	**11.5**	**17.1**	2.6	8.4	**12.4**	0.1	**12.2**	**17.6**	3.8	4	**11.9**	**14.6**	1.1	4
	DiffSmallQ	**20.8**	**31**	3.2	**18**	**25.8**	1.1	**21.4**	**29.8**	1.5	1.8	**18.8**	**24.7**	-1.7	1
	SameLargeQ	**13.3**	**31.2**	3.8	**13.7**	**26.7**	2.2	**11.6**	**29.2**	1.5	1.4	9.8	**23.2**	-3.2	-0.5
	DiffLargeQ	**18.6**	**52.3**	-0.2	**22.1**	**48.6**	2.9	**23.3**	**53.5**	-0.1	-0.1	**26.1**	**51.5**	0.5	3.3
Diff MCAR	StraightL	3.1	3.2	3.2				-0.6	-0.4	-0.4	-0.4				
	SameSmallQ	**-22.8**	**11.2**	1.1	**-23.2**	7.9	-1	**-26.7**	**12.4**	2.5	2.6	**-25.7**	**11**	1.5	3.2
	DiffSmallQ	**-18.8**	**20.3**	1	**-16.9**	**18.4**	1	**-20.3**	**24**	4.4	4.4	**-24.2**	**17.6**	-1	0.6
	SameLargeQ	**-23.2**	**23.1**	4.2	**-24.2**	**18.7**	1.1	**-38.2**	**20.7**	1.6	1.4	**-37.6**	**17.9**	-0.6	1
	DiffLargeQ	**-18.8**	**38.1**	2.2	**-17.7**	**33.7**	1.4	**-29**	**40**	2.5	2.5	**-29.3**	**35.9**	0.3	1.9
Same MAR	StraightL	2.1	2.1	2.2				3.7	3.8	4.3	4.2				
	SameSmallQ	**11.2**	**17.6**	3.4	**13.8**	**15.9**	3.1	5.3	**16.6**	2.7	2.5	6	**14.1**	1	3.2
	DiffSmallQ	**18.1**	**29.6**	1.9	**20.7**	**26.7**	2.3	**12.2**	**26.7**	-0.8	-1	**16.4**	**28.1**	1.7	3.6
	SameLargeQ	**11.1**	**27.7**	0.3	**16.2**	**25.3**	1.5	8	**28.2**	0.6	0.8	**10.4**	**24.3**	-2.2	-0.1
	DiffLargeQ	**20.8**	**53.3**	1.7	**22.1**	**44.7**	-0.6	**22.7**	**56.7**	3.2	3.3	**26.6**	**51.7**	0.6	2.7
Diff MAR	StraightL	1.2	1.7	2.5				-1.8	-1.7	-1.3	-1.4				
	SameSmallQ	**-12.4**	**11.7**	1.2	-8.3	**10.4**	2.9	**-26.5**	**10.8**	0.4	0.5	**-23.3**	**10.3**	0.6	2.4
	DiffSmallQ	-5	**23**	1.8	-2.2	**20**	2.5	**-17.8**	**22.9**	1.5	1.4	**-15.7**	**20.4**	0.1	1.8
	SameLargeQ	-2.6	**23.4**	2.3	2.6	**23.5**	6.2	**-21.2**	**22.4**	1.1	0.9	**-18.5**	**19**	-0.7	0.7
	DiffLargeQ	5.4	**44.6**	3.9	5.1	**38.6**	3	**-10.6**	**42.6**	0.3	0.0	-8.1	**38**	-2.3	-0.5

Note: SLG = straight-line growth model; QG-AIF = quadratic growth model with fixed and arm-invariant quadratic effect; QG-ASF = quadratic growth model with fixed and arm-specific quadratic effects; QG-ASR = quadratic growth model with random and arm-specific quadratic effects; Fixed Q = true population quadratic effect is fixed within a study arm; Random Q = true population quadratic effect is random within a study arm; Same = same missing data rates across study arms; Diff = higher missing data rates in the control arm than the treatment arm; the relative bias is expressed as the ratio of absolute bias to the true value in percentage format (with relative bias of 10% or greater in boldface); positive (or negative) bias indicates the absolute value of the effect size estimate is larger (or smaller) than the absolute value of the true parameter.

Table 6

Coverage Probability of Estimating Average Treatment Effect, with $\gamma_{11} = 1$ and the Reliability of Slope $R_{slp} = 0.5$, Stratified by the Number of Measurement Occasions (T), Reliability of Slope (R_{slp}), Missing Data Mechanism, and Mean Growth Pattern

Missing	Mean	$T = 3$						$T = 4$							
Data	Growth	Fixed Q			Random Q			Fixed Q				Random Q			
Mechanism	Pattern	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	SLG	QG-AIF	QG-ASF	QG-ASR	SLG	QG-AIF	QG-ASF	QG-ASR
NM	StraightL	0.951	0.951	0.951				0.946	0.946	0.946	0.946				
	SameSmallQ	0.955	0.955	0.955	0.95	0.95	0.95	0.946	0.946	0.946	0.946	0.946	0.946	0.946	0.946
	DiffSmallQ	0.953	0.953	0.953	0.949	0.949	0.949	0.955	0.955	0.955	0.955	0.954	0.954	0.954	0.954
	SameLargeQ	0.958	0.958	0.958	0.958	0.958	0.958	0.95	0.95	0.95	0.95	0.948	0.948	0.948	0.948
	DiffLargeQ	0.948	0.948	0.948	0.951	0.951	0.951	0.95	0.95	0.95	0.95	0.948	0.948	0.948	0.948
Same MCAR	StraightL	0.951	0.951	0.947				0.949	0.949	0.953	0.953				
	SameSmallQ	0.95	0.948	0.954	0.951	0.944	0.957	0.947	0.944	0.952	0.954	0.945	0.941	0.962	0.948
	DiffSmallQ	0.94	**0.923**	0.947	0.947	0.937	0.961	0.94	0.93	0.954	0.956	0.94	0.937	0.965	0.953
	SameLargeQ	0.947	**0.914**	0.951	0.94	0.925	0.958	0.943	0.928	0.946	0.947	0.945	0.93	0.969	0.954
	DiffLargeQ	0.943	**0.867**	0.944	0.945	**0.885**	0.96	0.937	**0.866**	0.951	0.949	0.93	**0.862**	0.958	0.947
Diff MCAR	StraightL	0.957	0.958	0.955				0.954	0.954	0.954	0.954				
	SameSmallQ	0.934	0.951	0.955	0.935	0.95	0.961	**0.912**	0.939	0.945	0.946	**0.919**	0.941	0.953	0.943
	DiffSmallQ	0.938	0.938	0.95	0.942	0.941	0.962	0.938	0.928	0.953	0.953	0.93	0.94	0.958	0.95
	SameLargeQ	0.932	0.945	0.957	0.927	0.939	0.963	**0.899**	0.932	0.948	0.946	**0.904**	0.93	0.957	0.946
	DiffLargeQ	0.934	**0.9**	0.954	0.938	**0.906**	0.952	**0.915**	**0.893**	0.944	0.944	0.927	**0.907**	0.958	0.954
Same MAR	StraightL	0.948	0.949	0.946				0.95	0.952	0.953	0.952				
	SameSmallQ	0.949	0.944	0.953	0.95	0.947	0.96	0.949	0.945	0.951	0.954	0.953	0.954	0.966	0.957
	DiffSmallQ	0.939	**0.924**	0.952	0.945	0.936	0.962	0.944	0.935	0.955	0.955	0.945	0.936	0.963	0.949
	SameLargeQ	0.946	0.927	0.951	0.946	0.934	0.955	0.942	0.925	0.945	0.946	0.947	0.932	0.964	0.953
	DiffLargeQ	0.937	**0.866**	0.949	0.944	**0.9**	0.96	0.931	**0.854**	0.955	0.955	**0.924**	**0.851**	0.954	0.942
Diff MAR	StraightL	0.946	0.946	0.946				0.944	0.943	0.947	0.944				
	SameSmallQ	0.941	0.944	0.948	0.938	0.941	0.95	0.929	0.948	0.951	0.949	0.936	0.942	0.956	0.949
	DiffSmallQ	0.951	0.939	0.955	0.946	0.94	0.956	0.947	0.941	0.956	0.959	0.94	0.929	0.949	0.94
	SameLargeQ	0.952	0.935	0.952	0.951	0.931	0.956	0.933	0.939	0.954	0.951	0.939	0.938	0.96	0.953
	DiffLargeQ	0.946	**0.889**	0.947	0.955	**0.914**	0.961	0.949	**0.895**	0.956	0.955	0.951	**0.902**	0.962	0.956

Note: SLG = straight-line growth model; QG-AIF = quadratic growth model with fixed and arm-invariant quadratic effect; QG-ASF = quadratic growth model with fixed and arm-specific quadratic effects; QG-ASR = quadratic growth model with random and arm-specific quadratic effects; Fixed Q = true population quadratic effect is fixed within a study arm; Random Q = true population quadratic effect is random within a study arm; Same = same missing data rates across study arms; Diff = higher missing data rates in the control arm than the treatment arm; Coverage Probability = the proportion of the 95% confidence intervals covering the true ATE value (with values outside the range [0.925, 0.975] in boldface).

Table 7

% Relative Bias of Average Treatment Effect Estimates Given Unequally Spaced Measurements, with $\gamma_{11} = 1$, Reliability of Slope (R_{slp}) = 0.5, and Large Quadratic Effects That Were Random and Unequal between the Two Arms (Mean Response Pattern = DiffLargeQ with A Random Quadratic Effect), Stratified by the Missing Data Mechanism and Number of Measurement Occasions (T)

Missing Data Mechanism	T	% Relative Bias			
		SLG	QG-AIF	QG-ASF	QG-ASR
NM	3	**35.2**	**35.2**	0.0	
	4	**21.9**	**21.9**	-0.7	-0.7
Same MCAR	3	**53.9**	**64.0**	0.0	
	4	**43.5**	**48.8**	-0.2	-0.3
Same MAR	3	**50.5**	**62.9**	-1.3	
	4	**43.4**	**49.7**	0.4	0.5
Diff MCAR	3	**11.4**	**53.0**	-2.7	
	4	-0.9	**38.6**	-1.5	-1.5
Diff MAR	3	**33.1**	**55.3**	-3.3	
	4	7.6	**43.4**	0.4	1.4

Note: Within each simulation condition, a single dataset with a sample size $N = 100,000$ was generated and analyzed; for three-wave data, measurement time was set to -3, 1.5, and 3; for four-wave data, measurement time was set to -3, -2.5, 1.2, and 3; SLG = straight-line growth model; QG-AIF = quadratic growth model with fixed and arm-invariant quadratic effect; QG-ASF = quadratic growth model with fixed and arm-specific quadratic effects; QG-ASR = quadratic growth model with random and arm-specific quadratic effects; Same = same missing data rates across study arms; Diff = higher missing data rates in the control arm than the treatment arm; relative bias is expressed as the ratio of absolute bias to the true value in percentage format (with relative bias of 10% or greater in boldface).

Figure 1

Type I error rates for detecting the average treatment effect, given a fixed quadratic effect, $R_{slp} = 0.8$, and $T = 3$. Error rates are presented for varying sample sizes (n = 50, 100, 200), missing data mechanisms (NM, SameMCAR, DiffMCAR, SameMAR or DiffMAR), and mean growth patterns (StraightL, SameSmallQ, DiffSmallQ, SameLargeQ, or DiffLargeQ). The dashed horizontal line is a reference line representing a Type I error rate of 0.05.

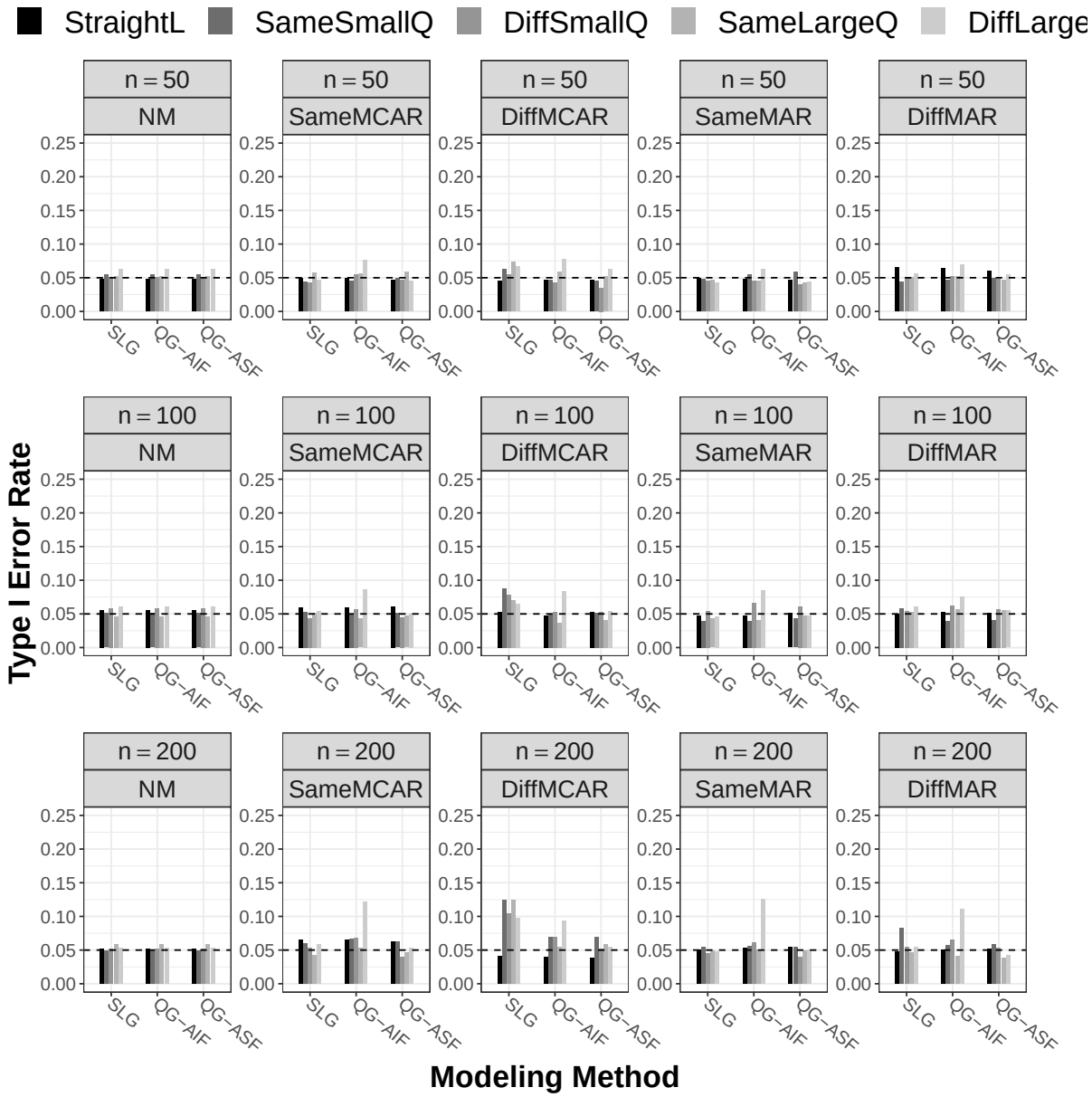

Figure 2

Type I error rates for detecting the average treatment effect, given a random quadratic effect, $R_{slp} = 0.8$, and $T = 3$. Error rates are presented for varying sample sizes (n = 50, 100, 200), missing data mechanisms (NM, SameMCAR, DiffMCAR, SameMAR or DiffMAR), and mean growth patterns (SameSmallQ, DiffSmallQ, SameLargeQ, or DiffLargeQ). The dashed horizontal line is a reference line representing a Type I error rate of 0.05.

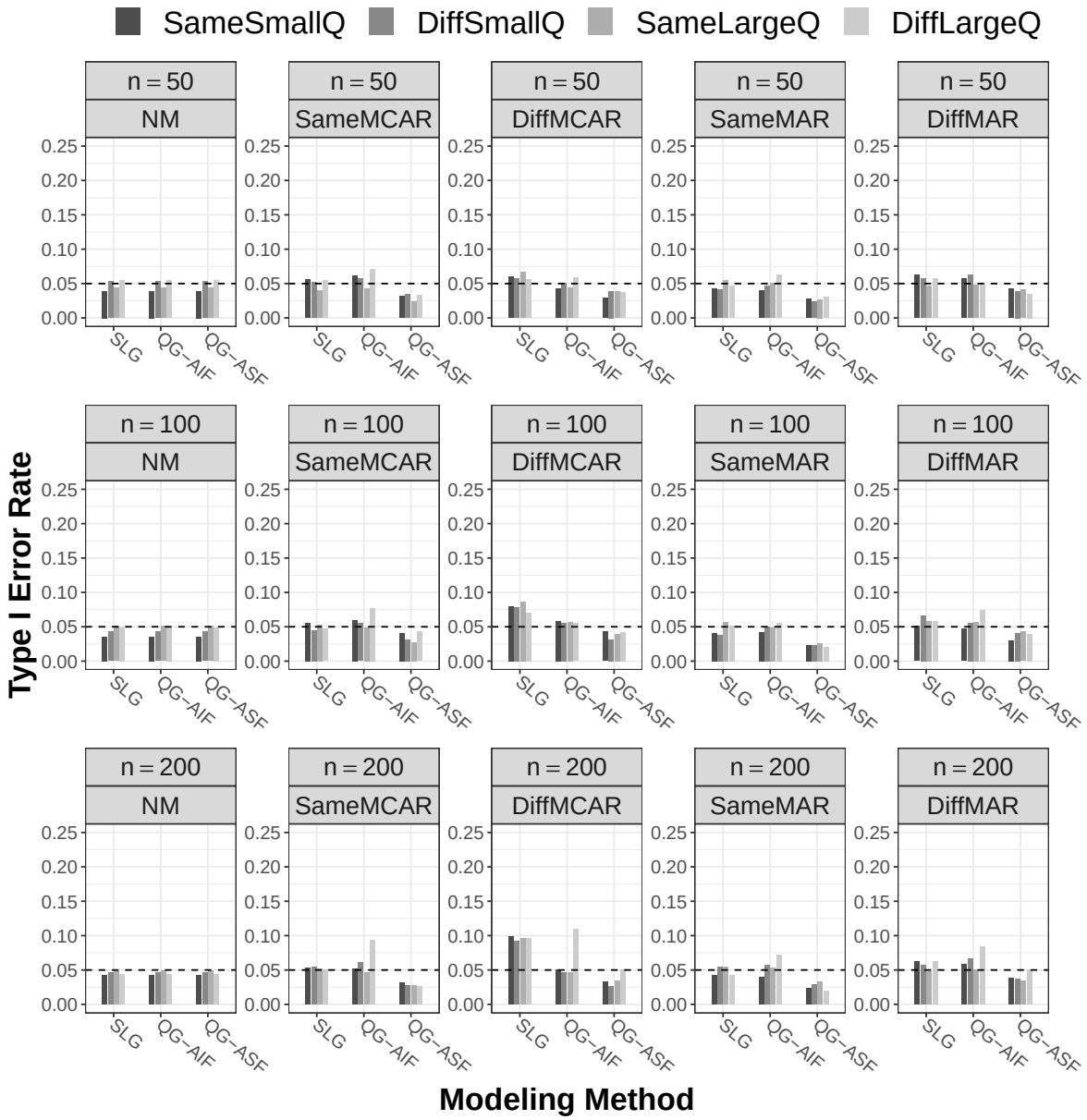

Figure 3

Type I error rates for detecting the average treatment effect, given a fixed quadratic effect, $R_{slp} = 0.5$, and $T = 3$. Error rates are presented for varying sample sizes (n = 50, 100, 200), missing data mechanisms (NM, SameMCAR, DiffMCAR, SameMAR or DiffMAR), and mean growth patterns (StraightL, SameSmallQ, DiffSmallQ, SameLargeQ, or DiffLargeQ). The dashed horizontal line is a reference line representing a Type I error rate of 0.05.

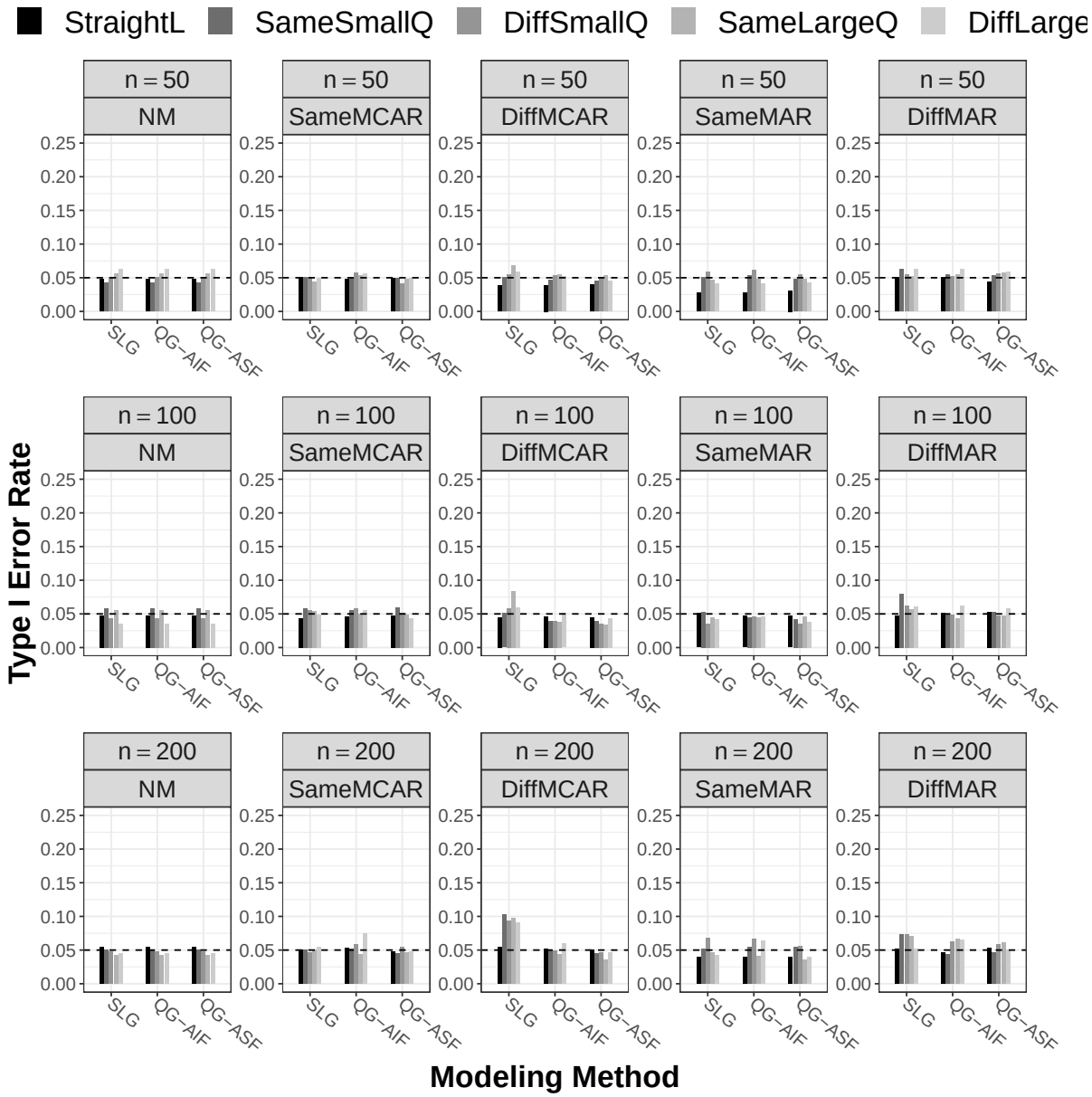

Figure 4

Type I error rates for detecting the average treatment effect, given a random quadratic effect, $R_{slp} = 0.5$, and $T = 3$. Error rates are presented for varying sample sizes (n = 50, 100, 200), missing data mechanisms (NM, SameMCAR, DiffMCAR, SameMAR or DiffMAR), and mean growth patterns (SameSmallQ, DiffSmallQ, SameLargeQ, or DiffLargeQ). The dashed horizontal line is a reference line representing a Type I error rate of 0.05.

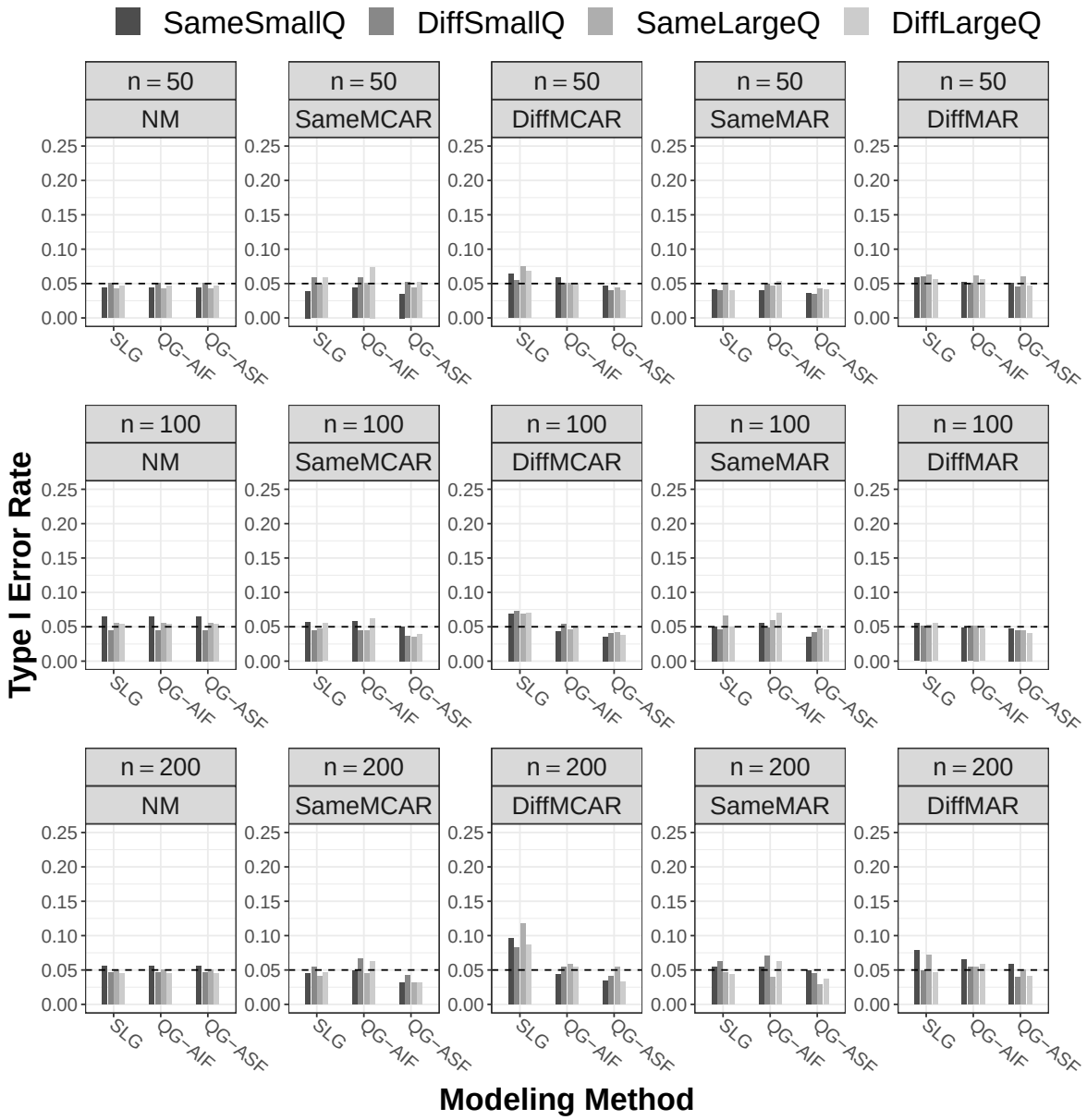

Figure 5

Type I error rates for detecting the average treatment effect, given a fixed quadratic effect, $R_{slp} = 0.5$, and $T = 4$. Error rates are presented for varying sample sizes (n = 50, 100, 200), missing data mechanisms (NM, SameMCAR, DiffMCAR, SameMAR or DiffMAR), and mean growth patterns (StraightL, SameSmallQ, DiffSmallQ, SameLargeQ, or DiffLargeQ). The dashed horizontal line is a reference line representing a Type I error rate of 0.05.

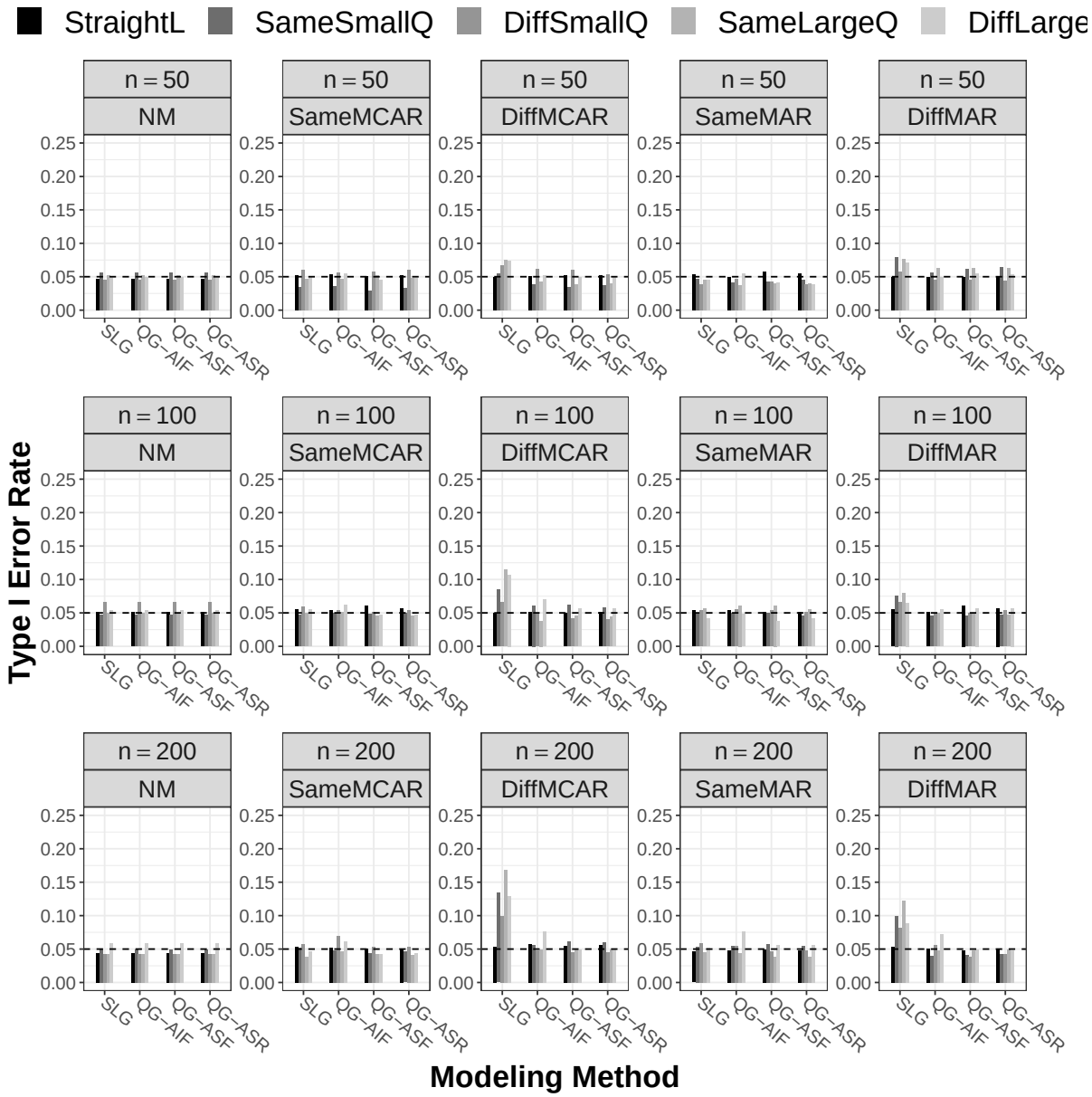

Figure 6

Type I error rates for detecting the average treatment effect, given a random quadratic effect, $R_{slp} = 0.5$, and $T = 4$. Error rates are presented for varying sample sizes (n = 50, 100, 200), missing data mechanisms (NM, SameMCAR, DiffMCAR, SameMAR or DiffMAR), and mean growth patterns (SameSmallQ, DiffSmallQ, SameLargeQ, or DiffLargeQ). The dashed horizontal line is a reference line representing a Type I error rate of 0.05.