

**Inferences and Effect Sizes for Direct, Indirect, and Total Effects in Continuous-Time  
Mediation Models (Supplementary Materials)**

Ivan Jacob Agaloos Pesigan<sup>1</sup>, Michael A. Russell<sup>1, 2</sup>, and Sy-Miin Chow<sup>3</sup>

<sup>1</sup>Edna Bennett Pierce Prevention Research Center, The Pennsylvania State University

<sup>2</sup>Department of Biobehavioral Health, The Pennsylvania State University

<sup>3</sup>Department of Human Development and Family Studies, The Pennsylvania State University

**Author Note**

Ivan Jacob Agaloos Pesigan  <https://orcid.org/0000-0003-4818-8420>; Michael A. Russell  <https://orcid.org/0000-0002-3956-604X>; Sy-Miin Chow  <https://orcid.org/0000-0003-1938-027X>.

This research was made possible by the Prevention and Methodology Training Program (PAMT) funded by a T32 training grant (T32 DA017629 Multiple Principal Investigators: Jennifer Maggs & Stephanie Lanza) from the National Institute on Drug Abuse (NIDA), the National Institutes of Health Intensive Longitudinal Health Behavior Cooperative Agreement Program (U24AA027684), National Science Foundation (Grant DUE-2417294), the National Center for Advancing Translational Sciences (UL1TR002014-06), and the National Institute of Diabetes, Digestive & Kidney Diseases (U01DK135126).

Computations for this research were performed on the Pennsylvania State University's Institute for Computational and Data Sciences' Roar supercomputer using SLURM for job scheduling (Yoo et al., 2003), GNU Parallel to run the simulations in parallel (Tange, 2021), and Apptainer to ensure a reproducible software stack (Kurtzer et al., 2017, 2021).

Some of the data and ideas in the manuscript were presented at the Society for Prevention Research Conference in May 2024 and the International Meeting of Psychometric Society in July 2024.

Correspondence concerning this article should be addressed to Ivan Jacob Agaloos Pesigan, Edna Bennett Pierce Prevention Research Center, College of Health and Human Development, The Pennsylvania State University, 320 Biobehavioral Health Building, University Park, PA 16802 or by email (ijapesigan@psu.edu).

**Inferences and Effect Sizes for Direct, Indirect, and Total Effects in Continuous-Time  
Mediation Models (Supplementary Materials)**

**Links**

**Research Compendium**

The data and materials for this study are available on OSF (<https://osf.io/qwnmf>) and GitHub (<https://github.com/jeksterslab/manCTMed>, <https://jeksterslab.github.io/manCTMed/index.html>).

**cTMed R Package**

Source code and documentation for the **cTMed** R package are available on GitHub (<https://github.com/jeksterslab/cTMed>, <https://jeksterslab.github.io/cTMed/index.html>).

**Illustration 1**

<https://jeksterslab.github.io/manCTMed/articles/fig-example-1.html>

**Illustration 2**

<https://jeksterslab.github.io/manCTMed/articles/fig-example-2.html>

**Illustration 3**

<https://jeksterslab.github.io/manCTMed/articles/fig-example-3.html>

**Single Replication from the Simulation Study**

<https://jeksterslab.github.io/manCTMed/articles/replication.html>

**Containers for Reproducibility**

<https://jeksterslab.github.io/manCTMed/articles/containers.html>

**Figures**

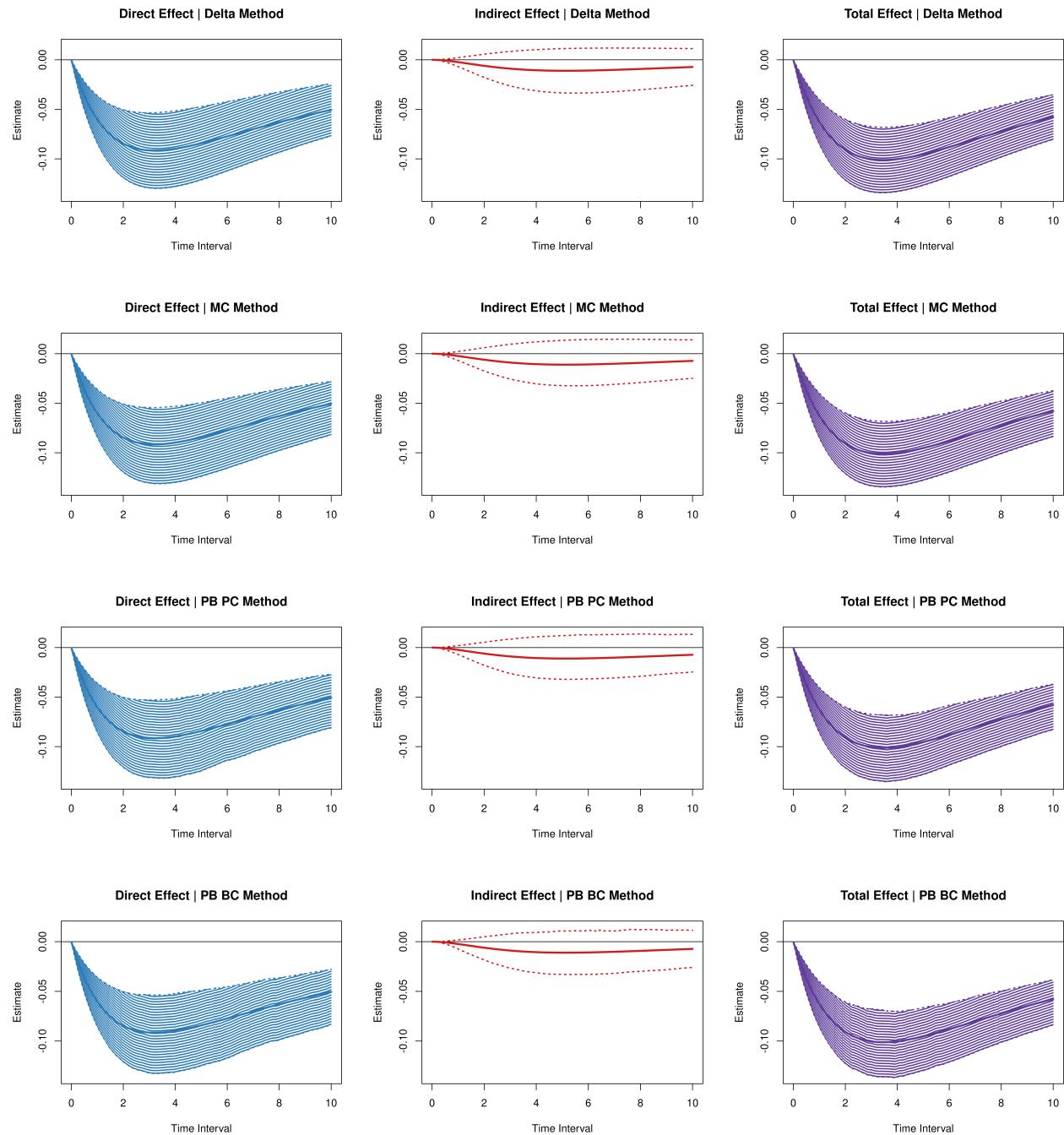
**List of Figures**

1	Regions of Significance for the Direct, Indirect, and Total Effects (Conflict → Knowledge → Competence) . . . . .	4
2	Regions of Significance for the Standardized Direct, Indirect, and Total Effects (Conflict → Knowledge → Competence) . . . . .	5
3	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 1 to 25   Moderate Coupling   Unstandardized) . . . . .	6
4	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 25 to 30   Moderate Coupling   Unstandardized) . . . . .	7
5	Monte Carlo Simulation Study Statistical Power (Moderate Coupling   Unstandardized) . . . . .	8
6	Monte Carlo Simulation Study Type I Error Rate (Moderate Coupling   Unstandardized) . . . . .	9

7	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 1 to 25   Moderate Coupling   Standardized) . . . . .	10
8	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 25 to 30   Moderate Coupling   Standardized) . . . . .	11
9	Monte Carlo Simulation Study Statistical Power (Moderate Coupling   Standardized) . . . . .	12
10	Monte Carlo Simulation Study Type I Error Rate (Moderate Coupling   Standardized) . . . . .	13
11	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 1 to 25   Strong Coupling   Unstandardized) . . . . .	14
12	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 25 to 30   Strong Coupling   Unstandardized) . . . . .	15
13	Monte Carlo Simulation Study Statistical Power (Strong Coupling   Unstandardized) . . . . .	16
14	Monte Carlo Simulation Study Type I Error Rate (Strong Coupling   Unstandardized) . . . . .	17
15	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 1 to 25   Strong Coupling   Standardized) . . . . .	18
16	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 25 to 30   Strong Coupling   Standardized) . . . . .	19
17	Monte Carlo Simulation Study Statistical Power (Strong Coupling   Standardized) . . . . .	20
18	Monte Carlo Simulation Study Type I Error Rate (Strong Coupling   Standardized) . . . . .	21
19	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 1 to 25   Weak Coupling   Unstandardized) . . . . .	22
20	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 25 to 30   Weak Coupling   Unstandardized) . . . . .	23
21	Monte Carlo Simulation Study Statistical Power (Weak Coupling   Unstandardized) . . . . .	24
22	Monte Carlo Simulation Study Type I Error Rate (Weak Coupling   Unstandardized) . . . . .	25
23	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 1 to 25   Weak Coupling   Standardized) . . . . .	26
24	Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$ from 25 to 30   Weak Coupling   Standardized) . . . . .	27
25	Monte Carlo Simulation Study Statistical Power (Weak Coupling   Standardized) . . . . .	28
26	Monte Carlo Simulation Study Type I Error Rate (Weak Coupling   Standardized) . . . . .	29

**Figure 1**

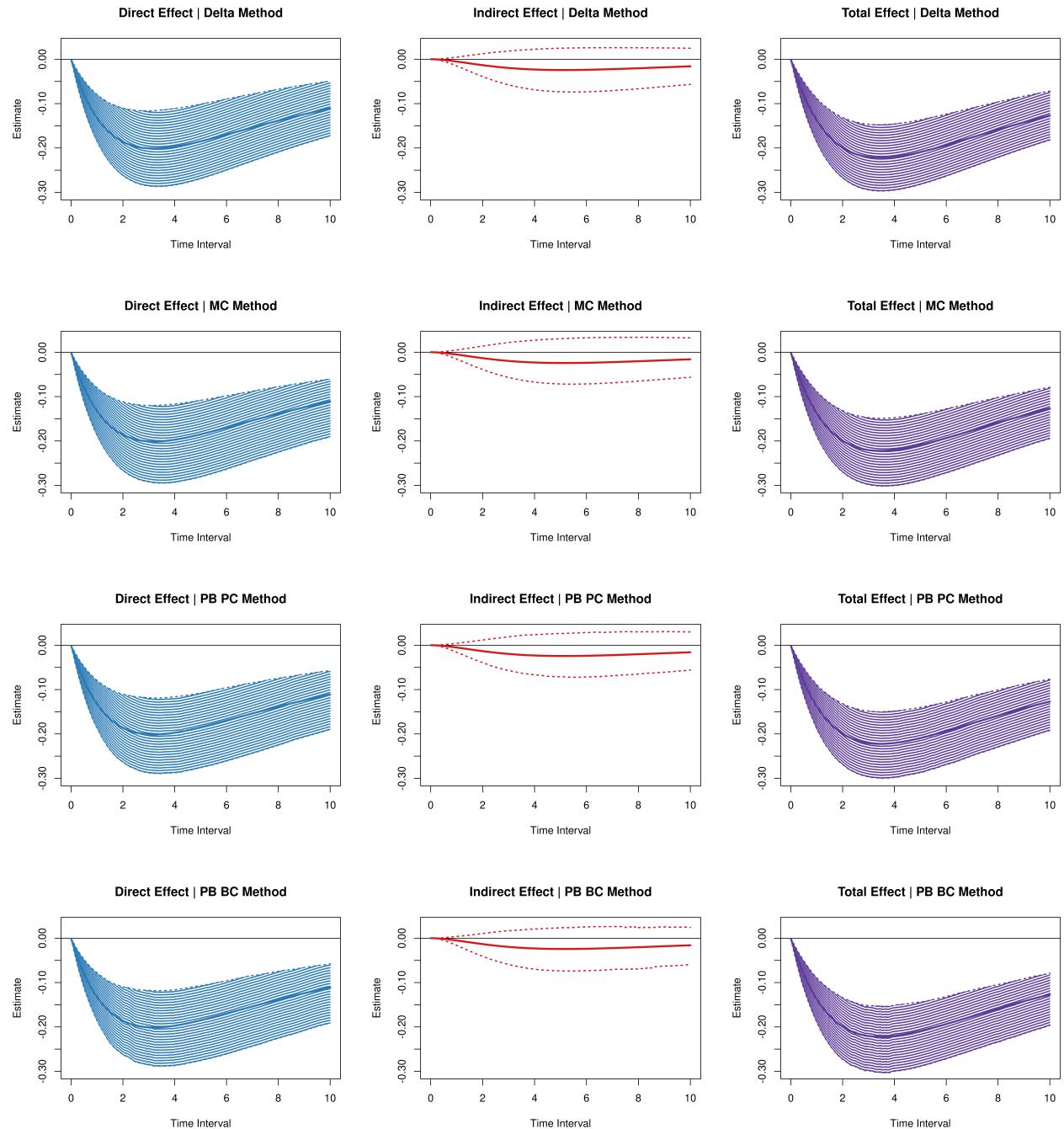
*Regions of Significance for the Direct, Indirect, and Total Effects (Conflict → Knowledge → Competence)*



*Note:* The shaded areas represent regions of significance, that is, instances where the 95% CIs did not contain zero for a given time interval.

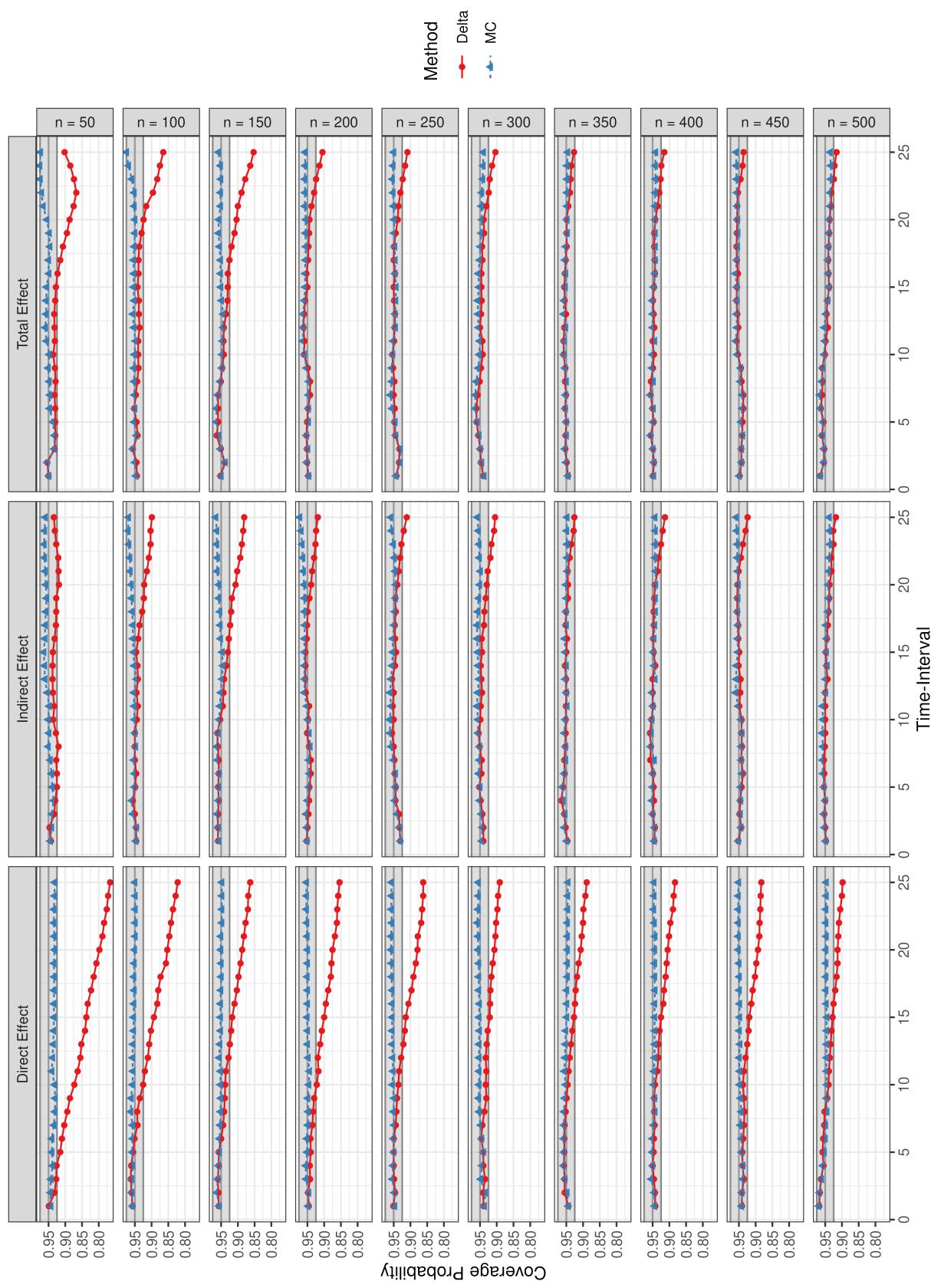
**Figure 2**

*Regions of Significance for the Standardized Direct, Indirect, and Total Effects (Conflict → Knowledge → Competence)*

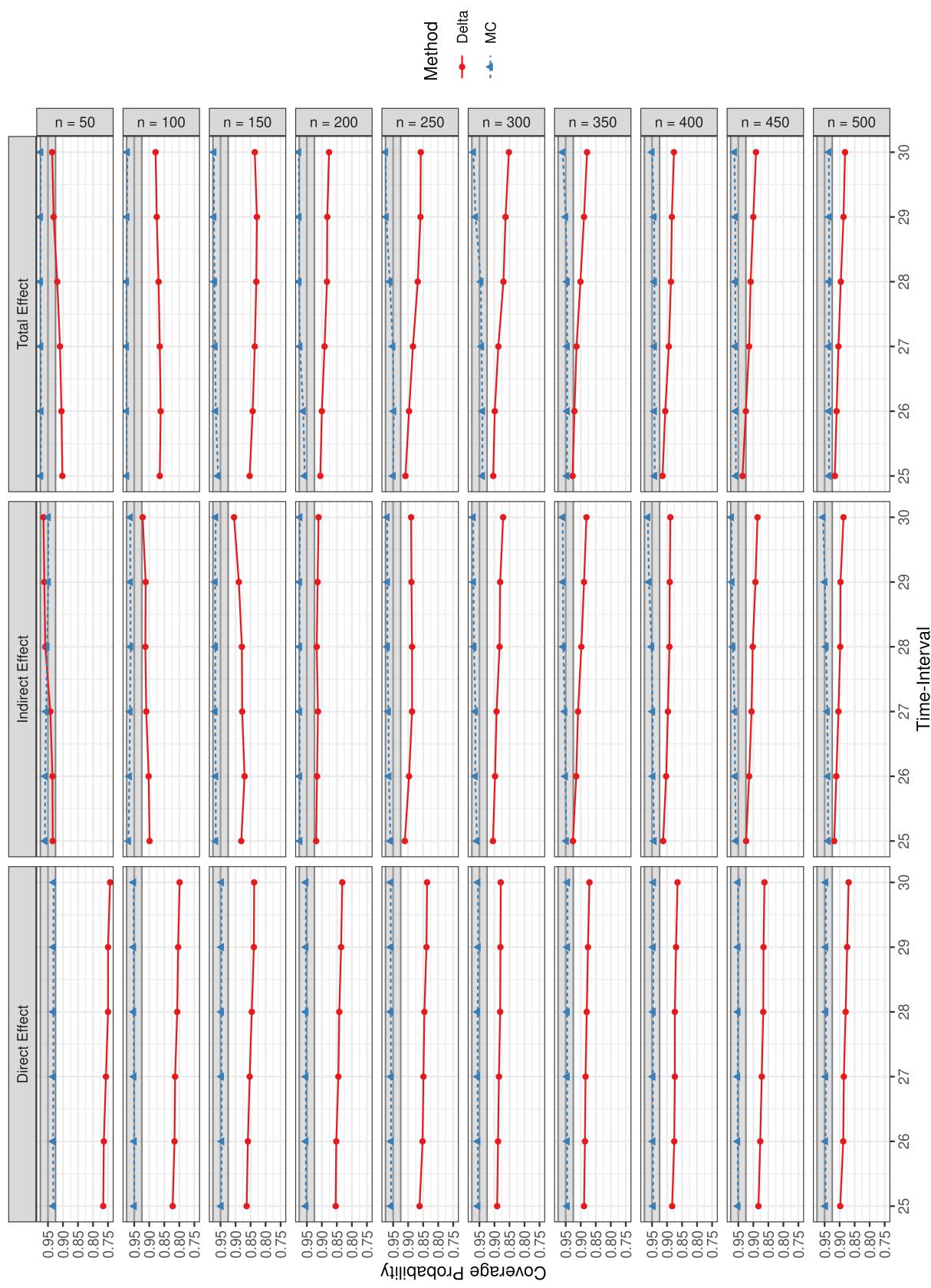


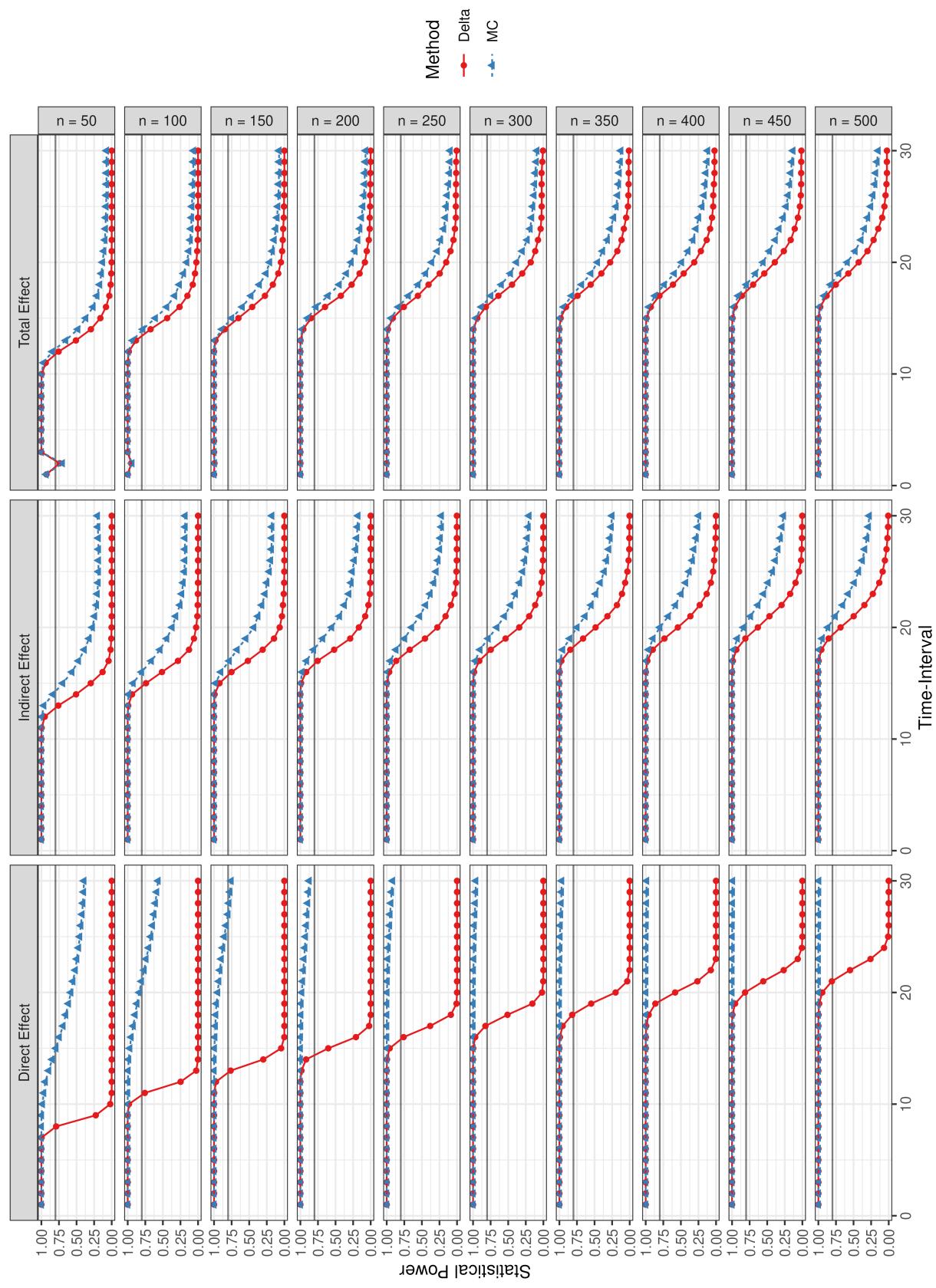
*Note:* The shaded areas represent regions of significance, that is, instances where the 95% CIs did not contain zero for a given time interval.

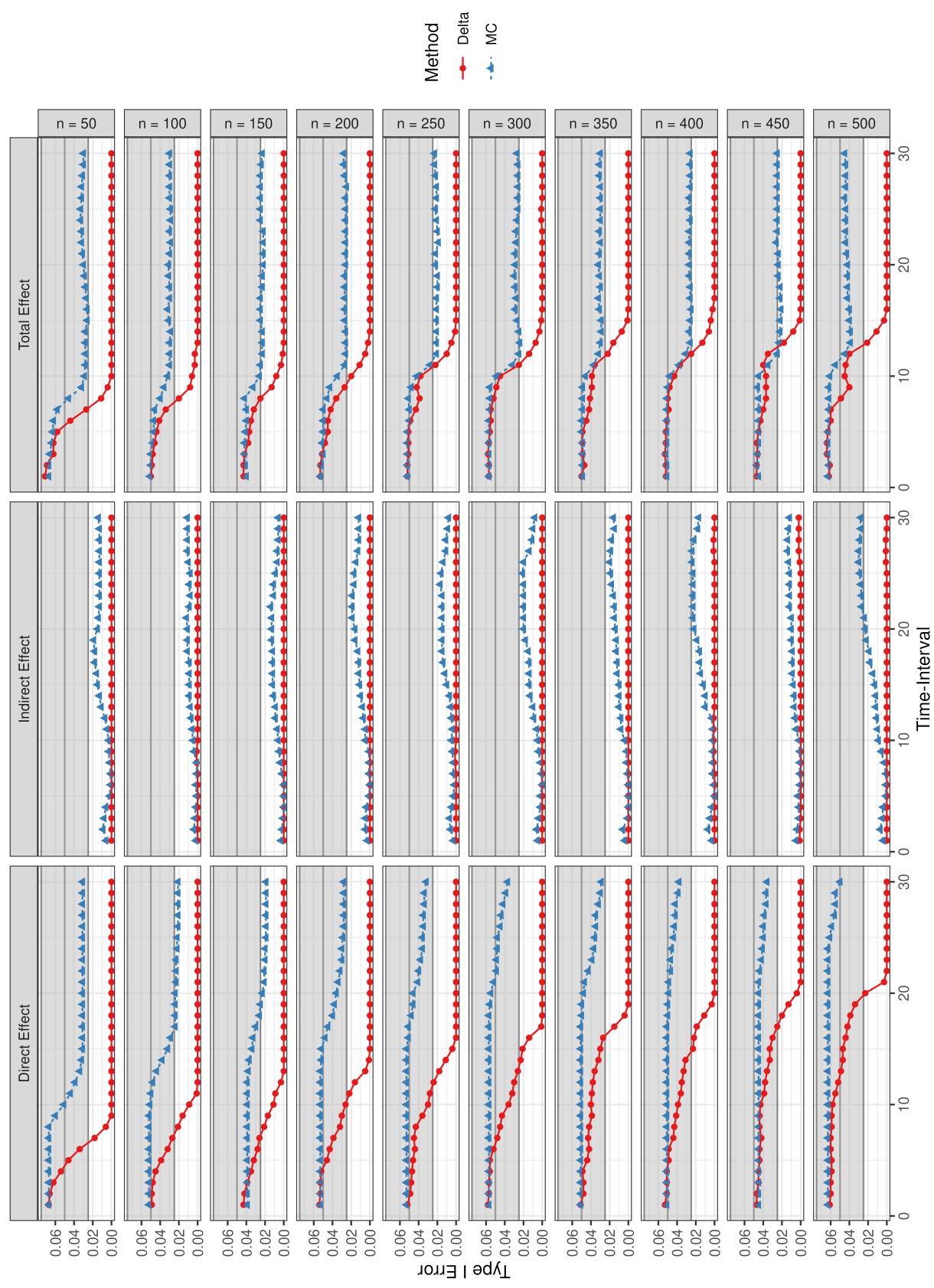
**Figure 3**  
*Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 1 to 25 / Moderate Coupling / Unstandardized)*



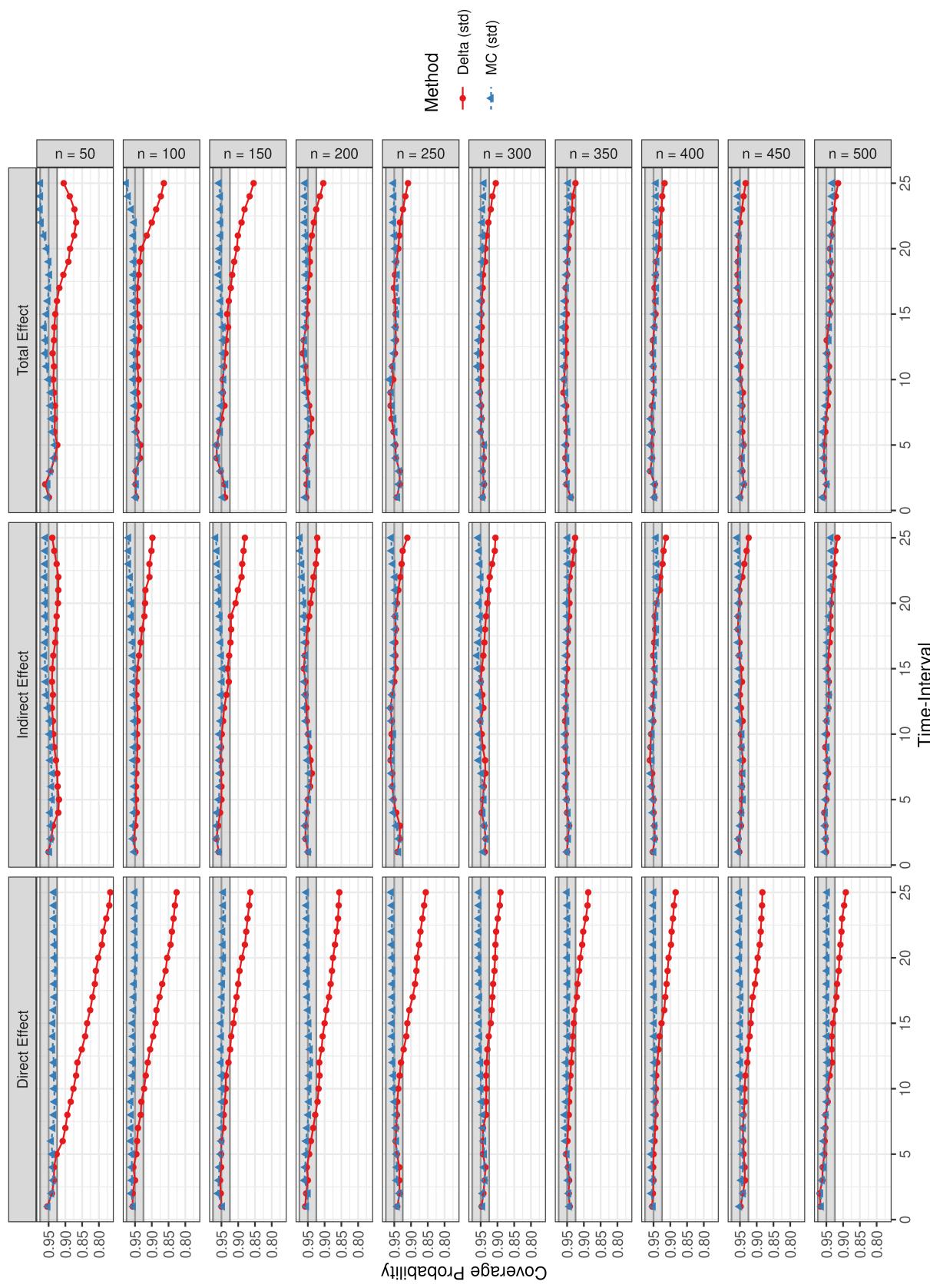
**Figure 4**  
Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 25 to 30 / Moderate Coupling / Unstandardized)



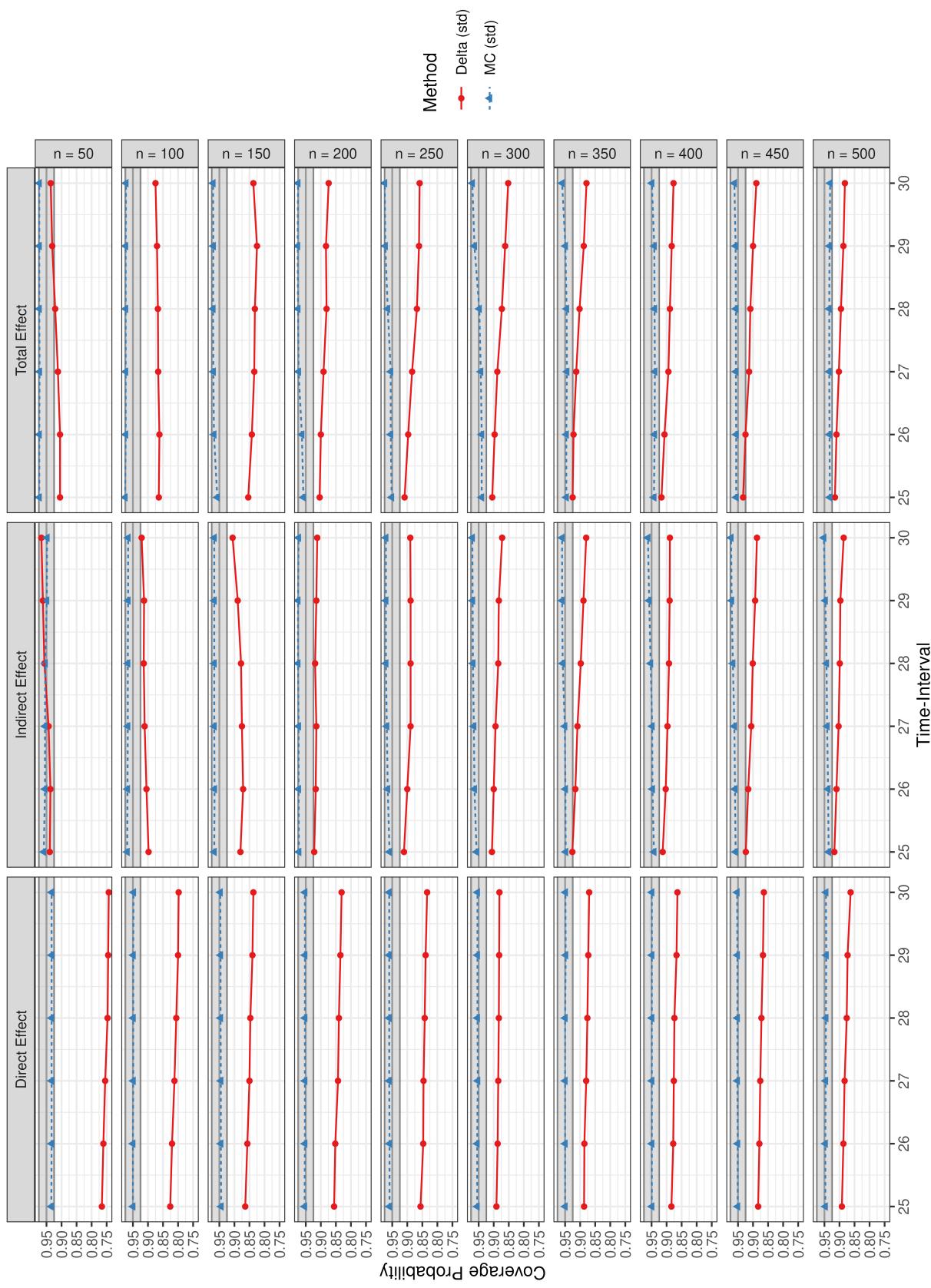




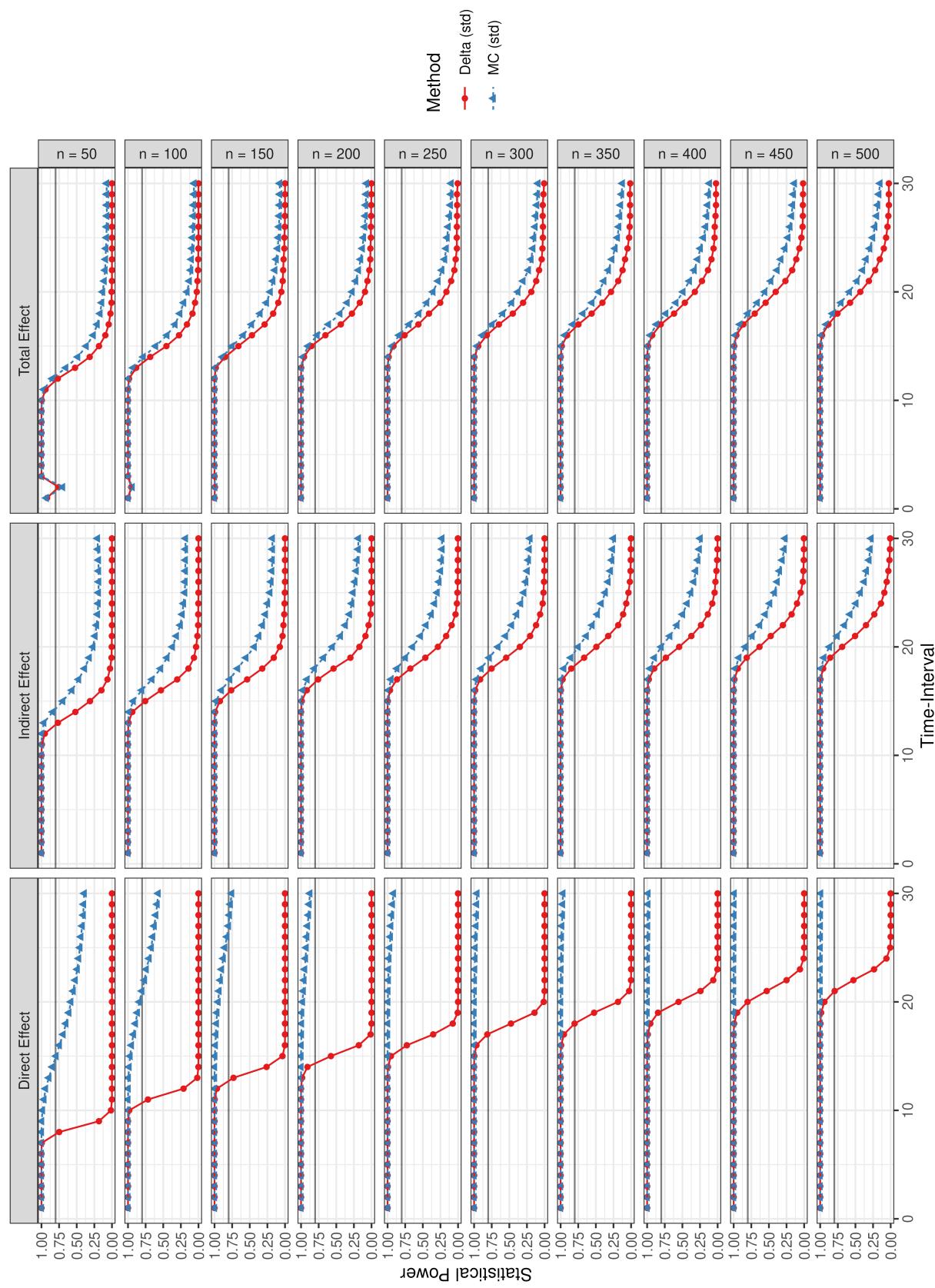
**Figure 7**  
*Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 1 to 25 / Moderate Coupling / Standardized)*



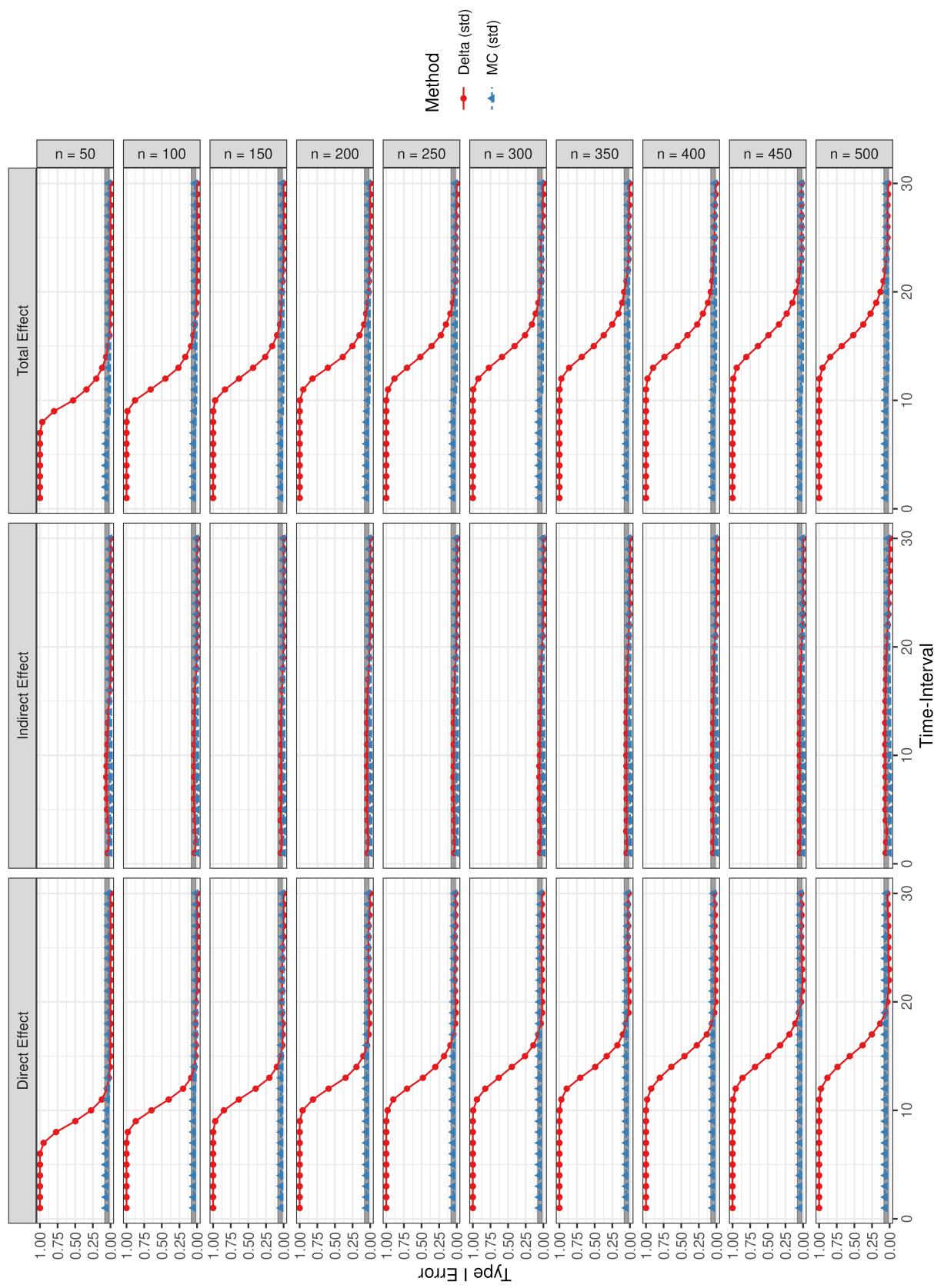
**Figure 8**  
*Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 25 to 30 / Moderate Coupling / Standardized)*



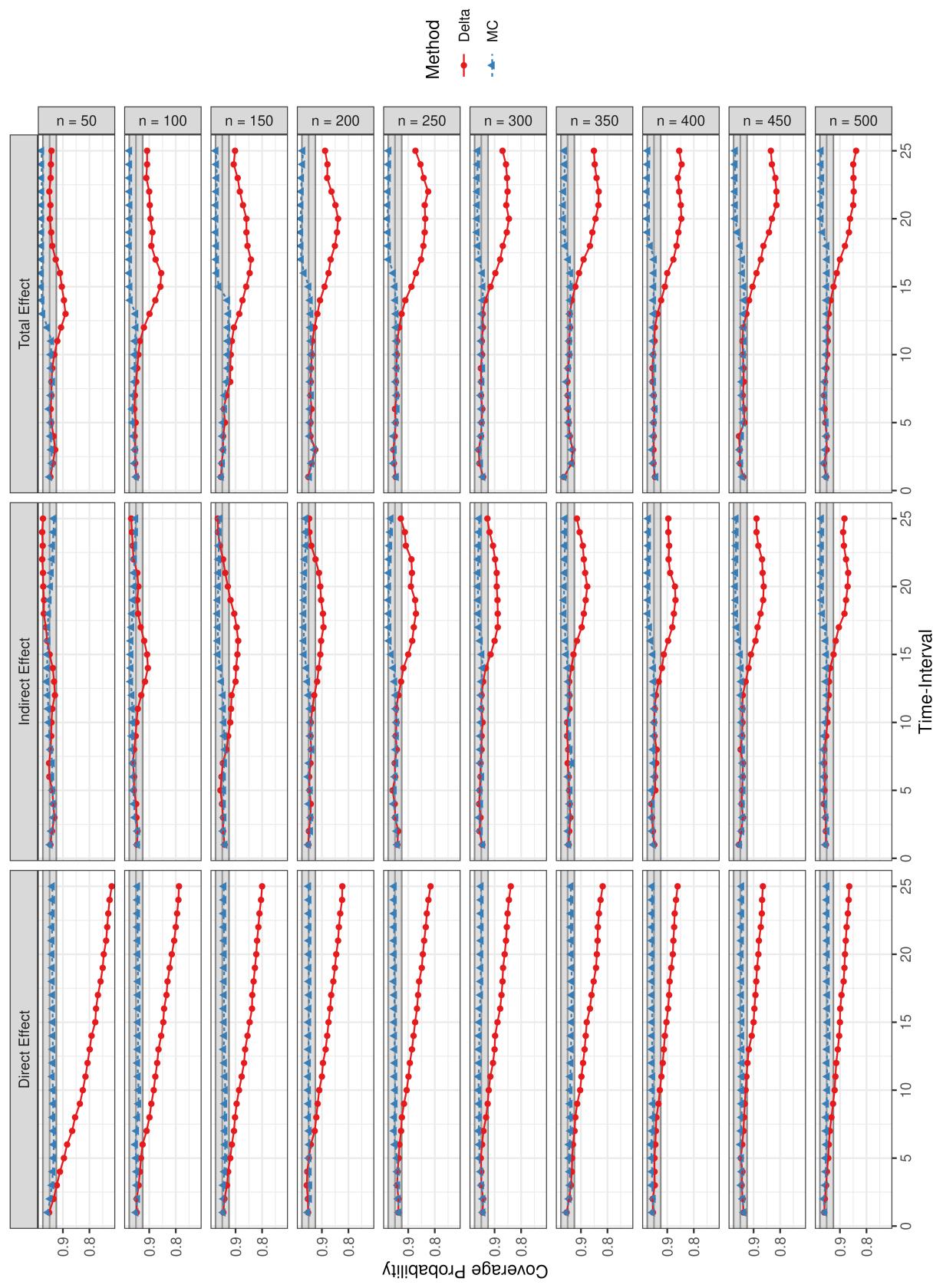
**Figure 9**  
*Monte Carlo Simulation Study Statistical Power (Moderate Coupling / Standardized)*



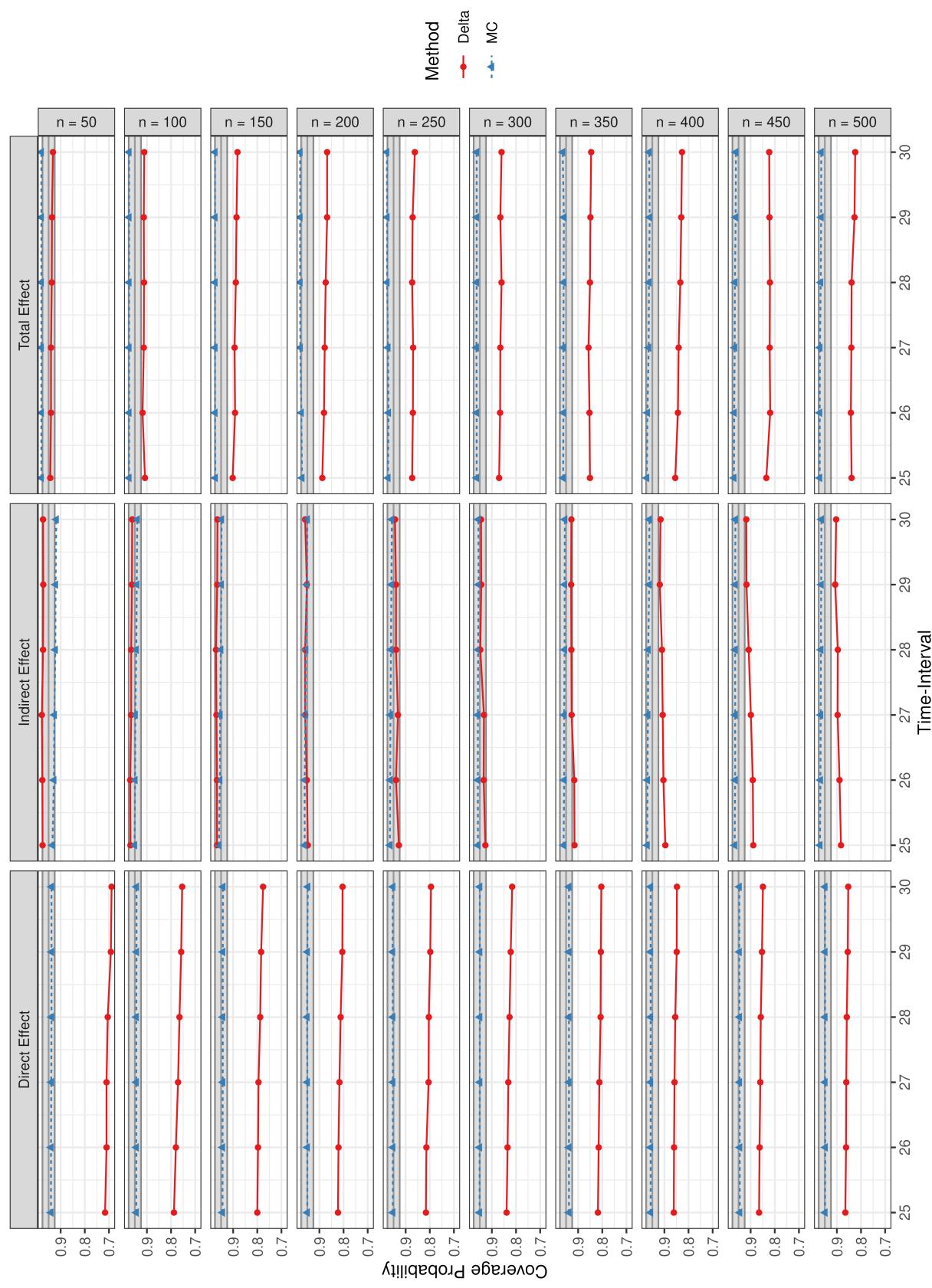
**Figure 10**  
*Monte Carlo Simulation Study Type I Error Rate (Moderate Coupling / Standardized)*



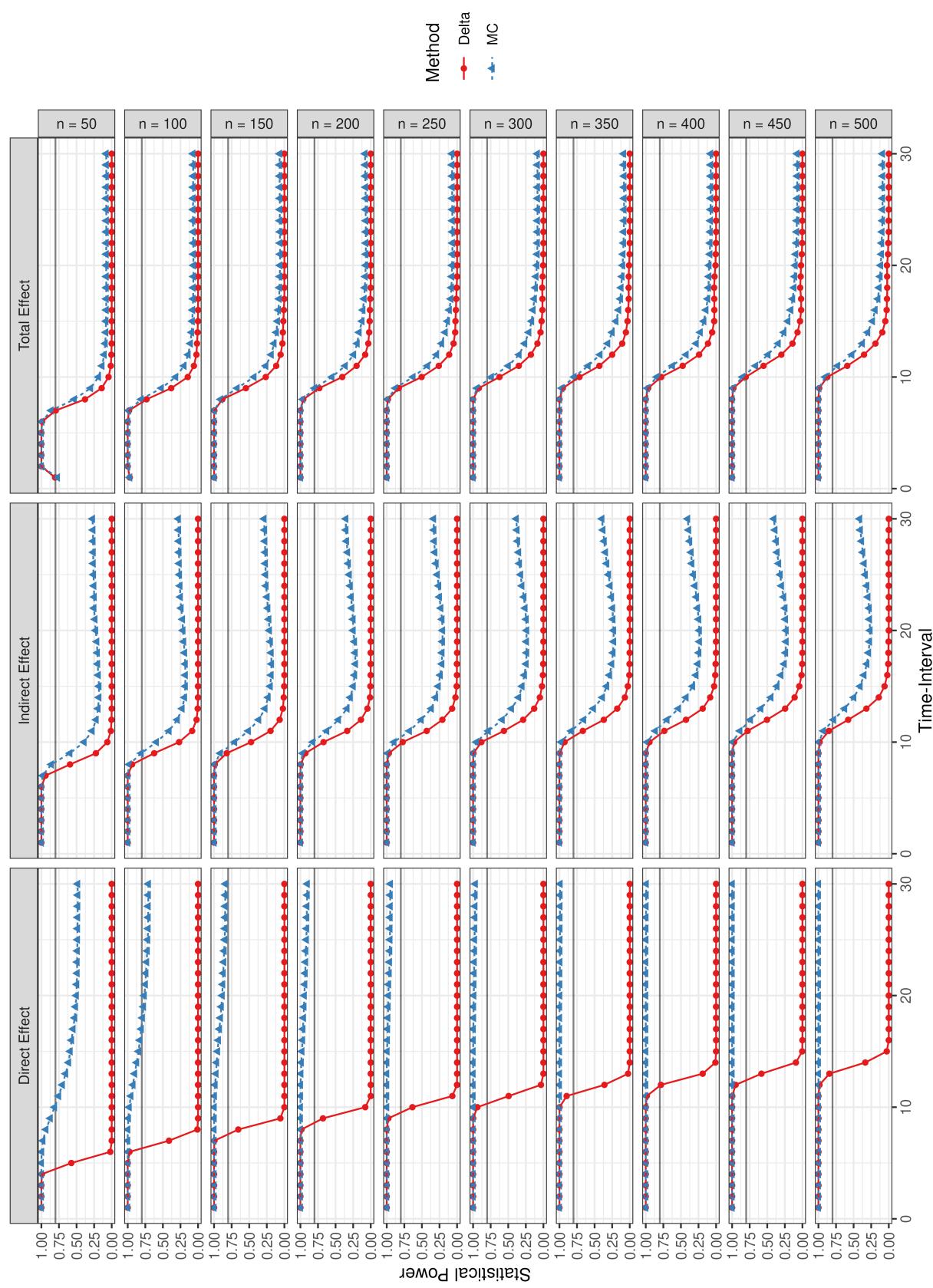
**Figure 11**  
*Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 1 to 25 / Strong Coupling / Unstandardized)*



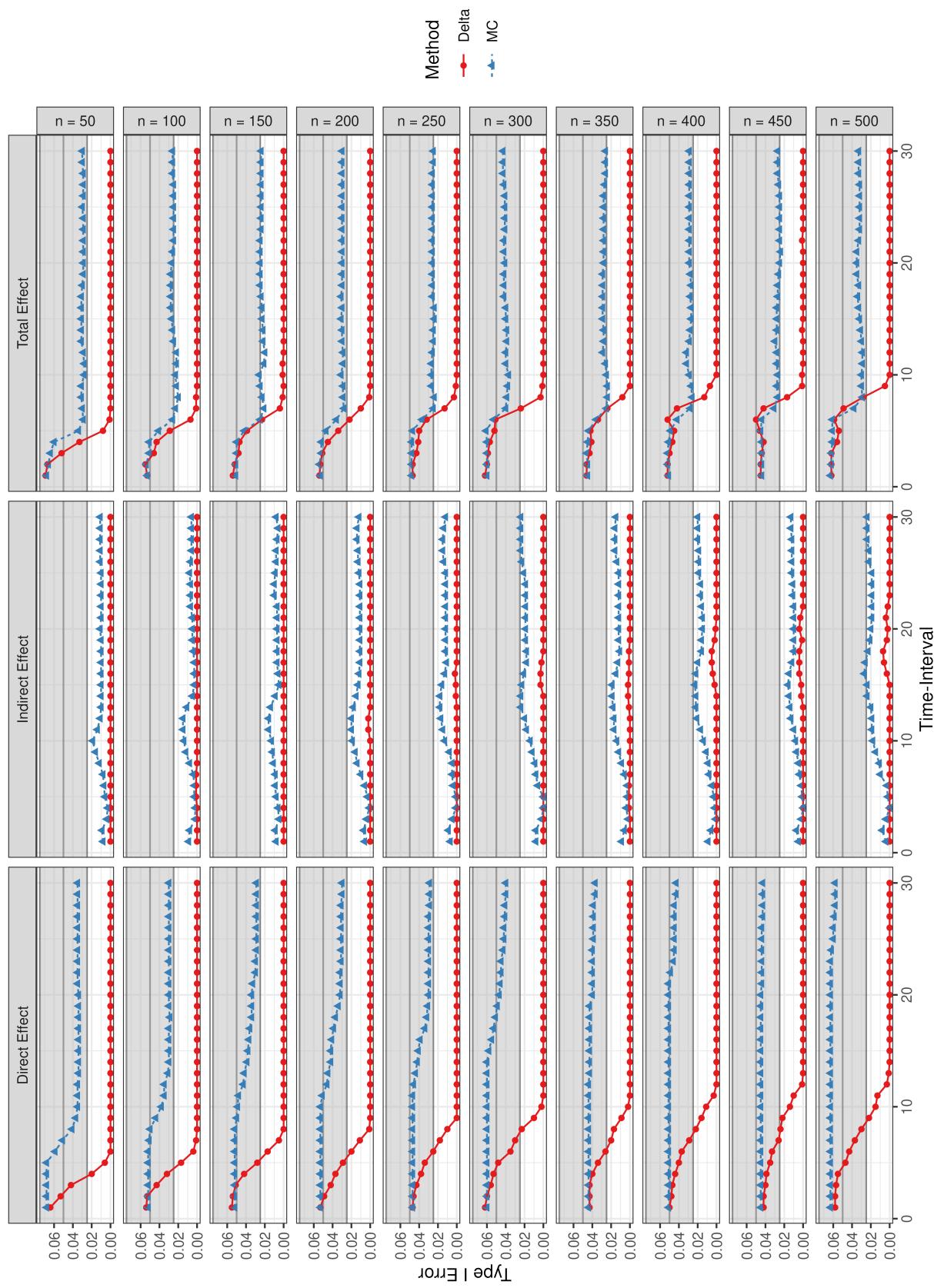
**Figure 12**  
Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 25 to 30 / Strong Coupling / Unstandardized)



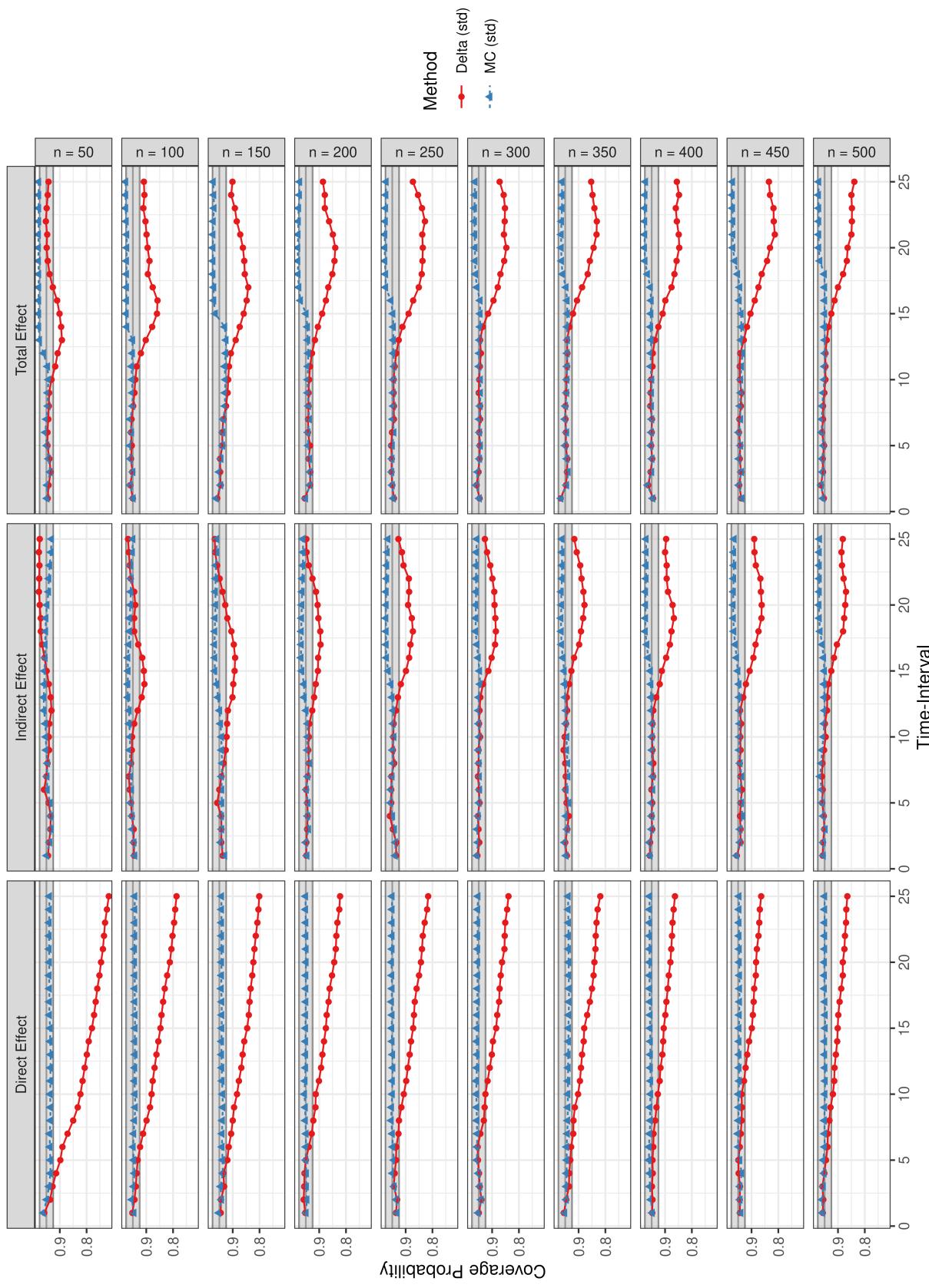
**Figure 13**  
*Monte Carlo Simulation Study Statistical Power (Strong Coupling / Unstandardized)*



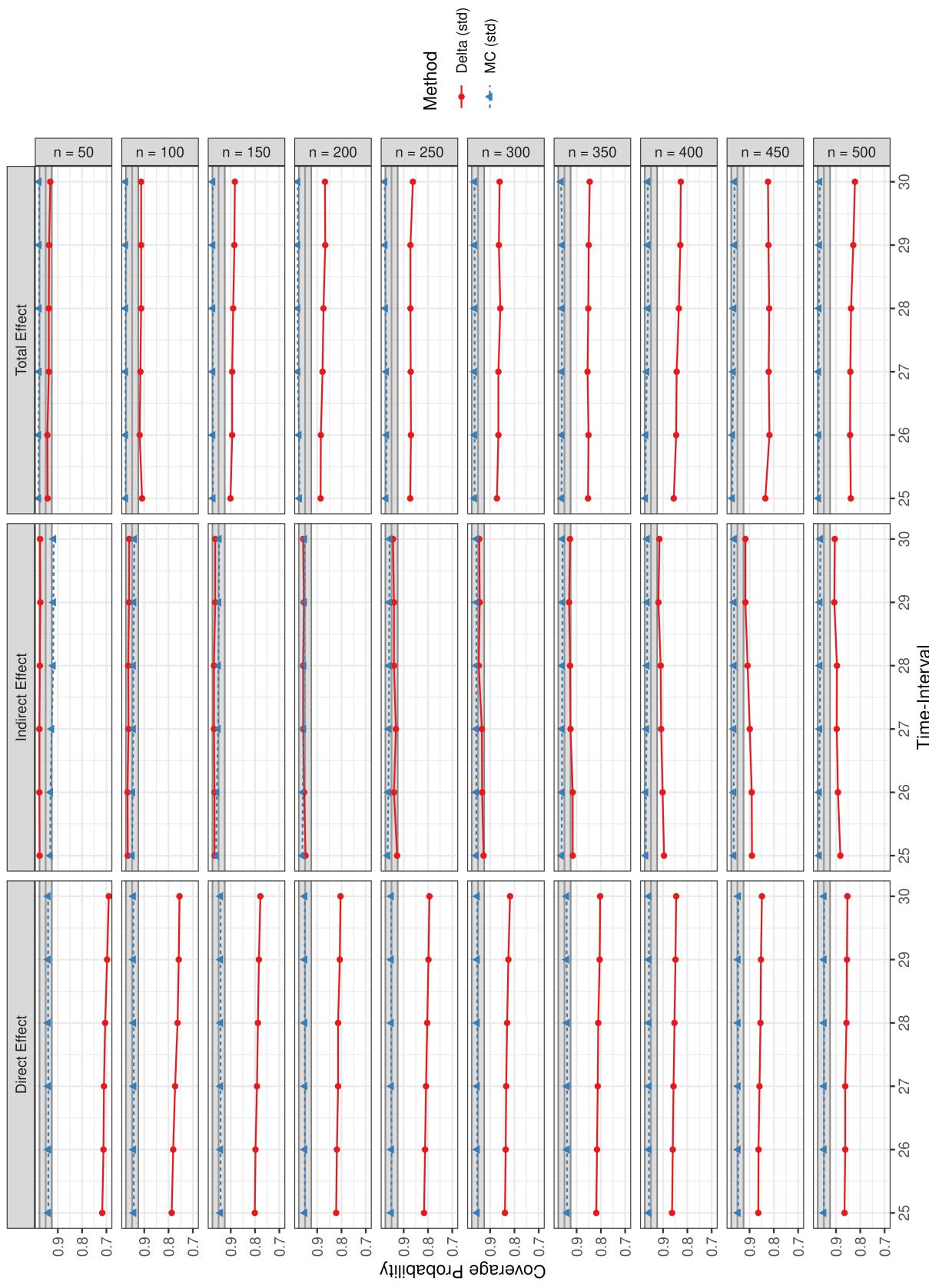
**Figure 14**  
*Monte Carlo Simulation Study Type I Error Rate (Strong Coupling / Unstandardized)*



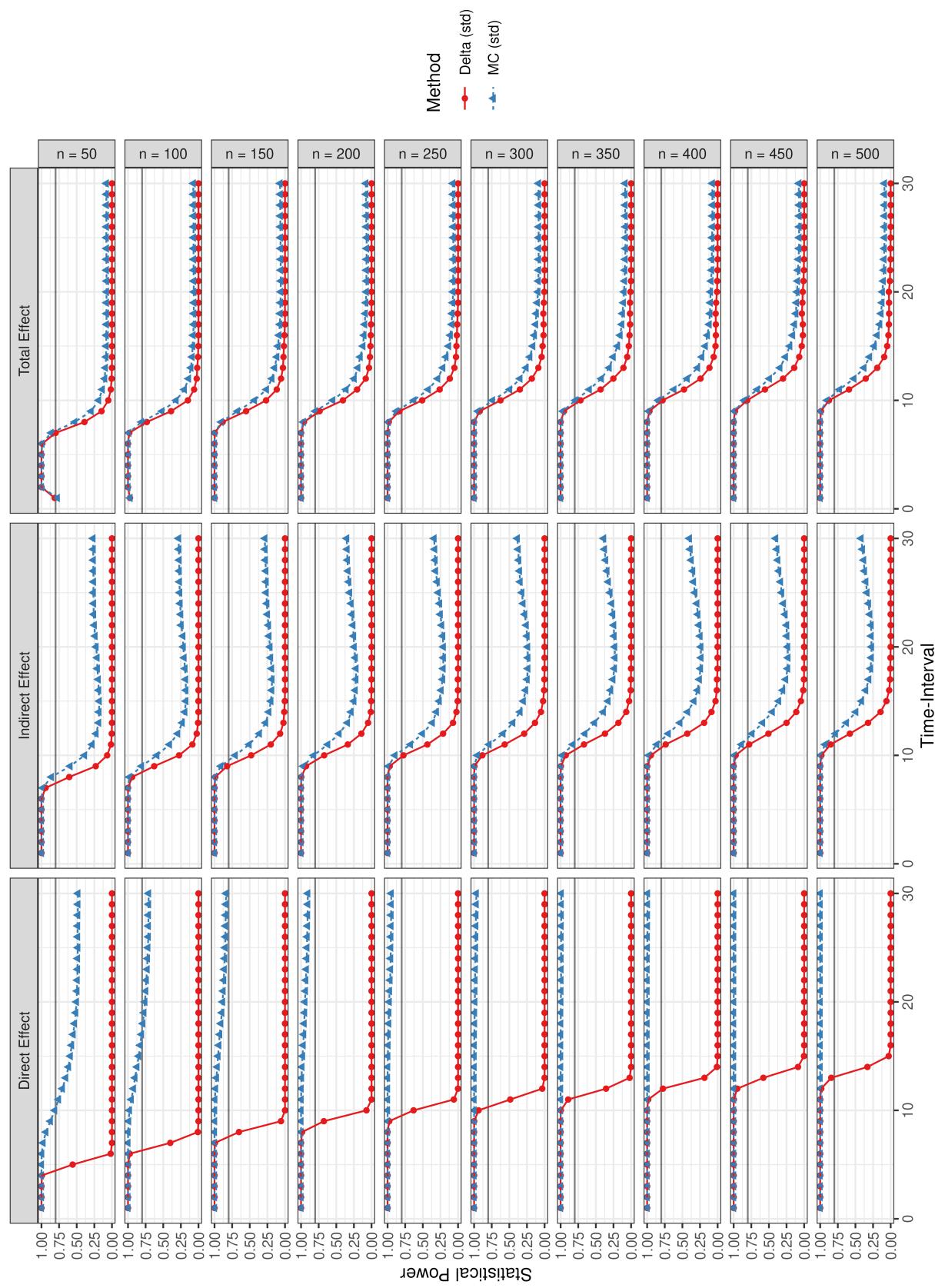
**Figure 15**  
*Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 1 to 25 / Strong Coupling / Standardized)*



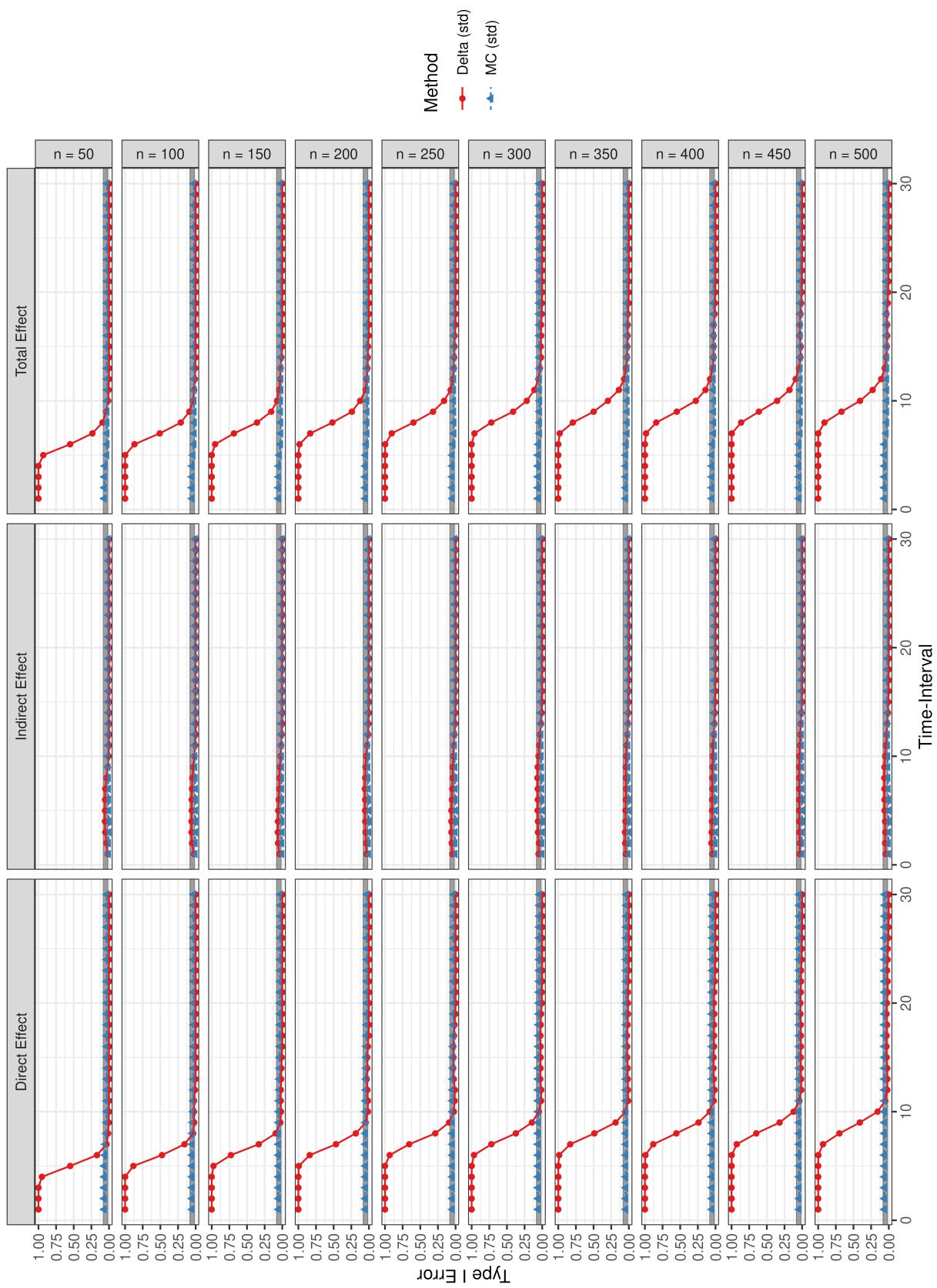
**Figure 16**  
*Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 25 to 30 / Strong Coupling / Standardized)*



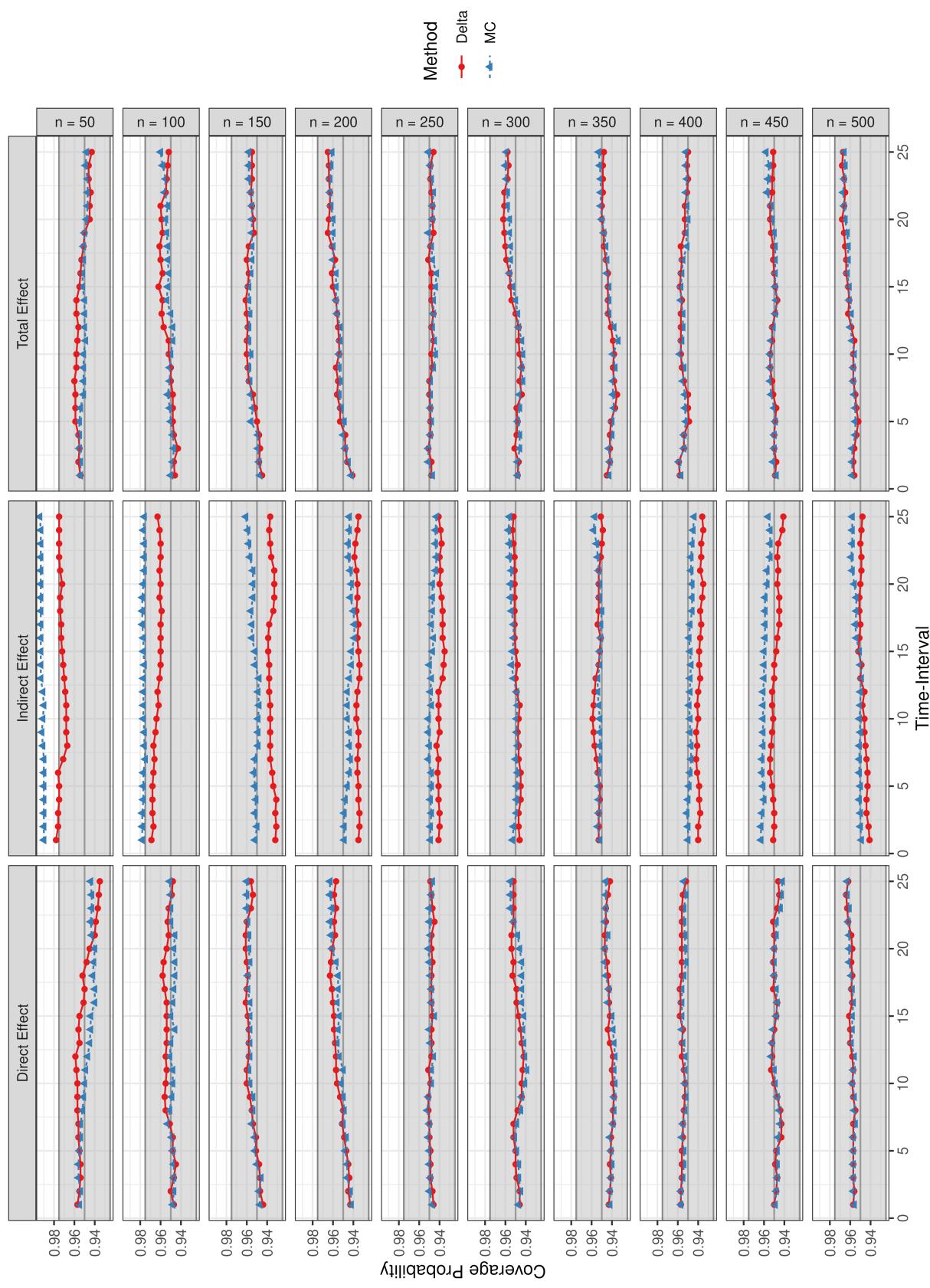
**Figure 17**  
Monte Carlo Simulation Study Statistical Power (Strong Coupling / Standardized)



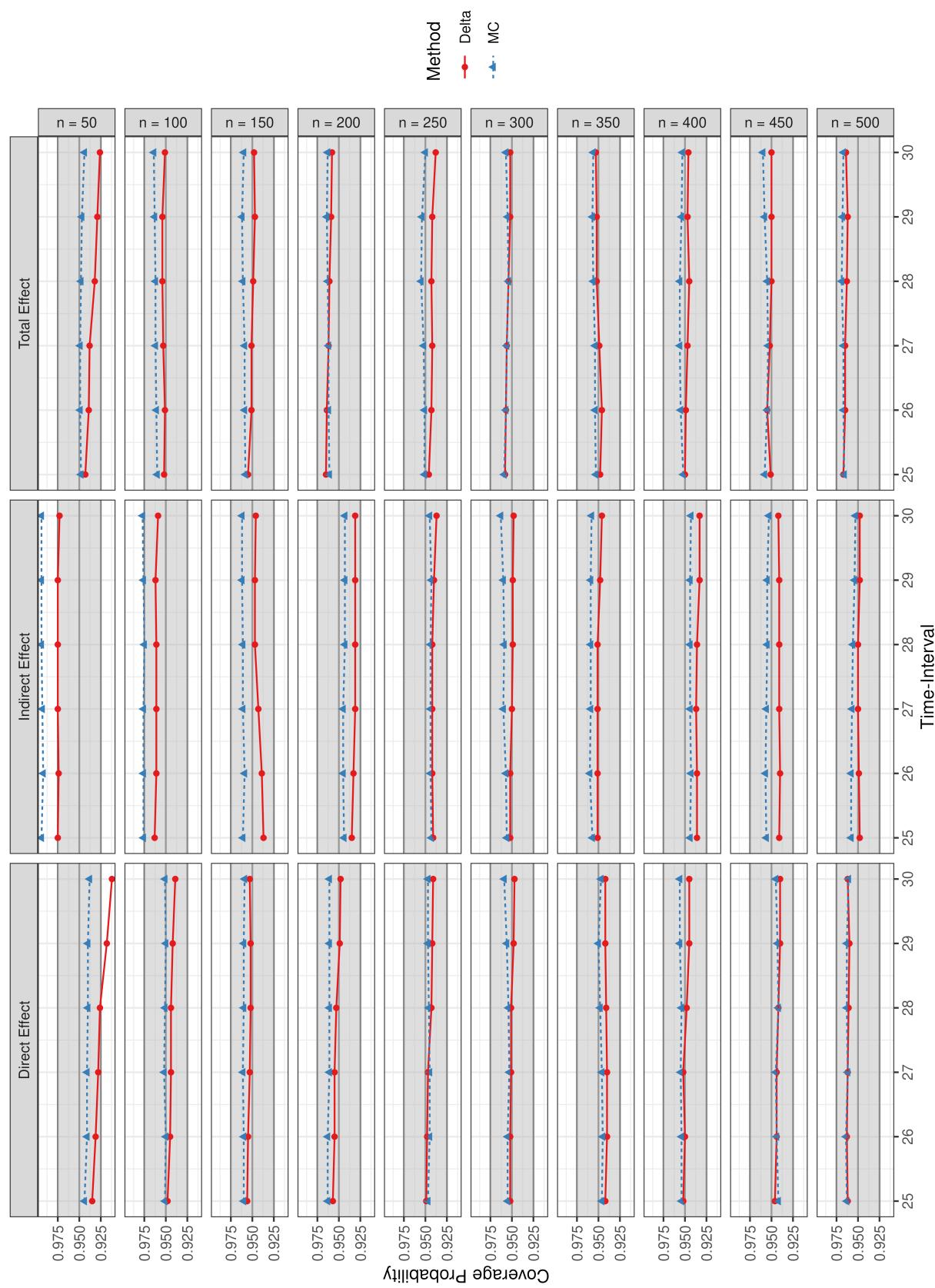
**Figure 18**  
*Monte Carlo Simulation Study Type I Error Rate (Strong Coupling / Standardized)*



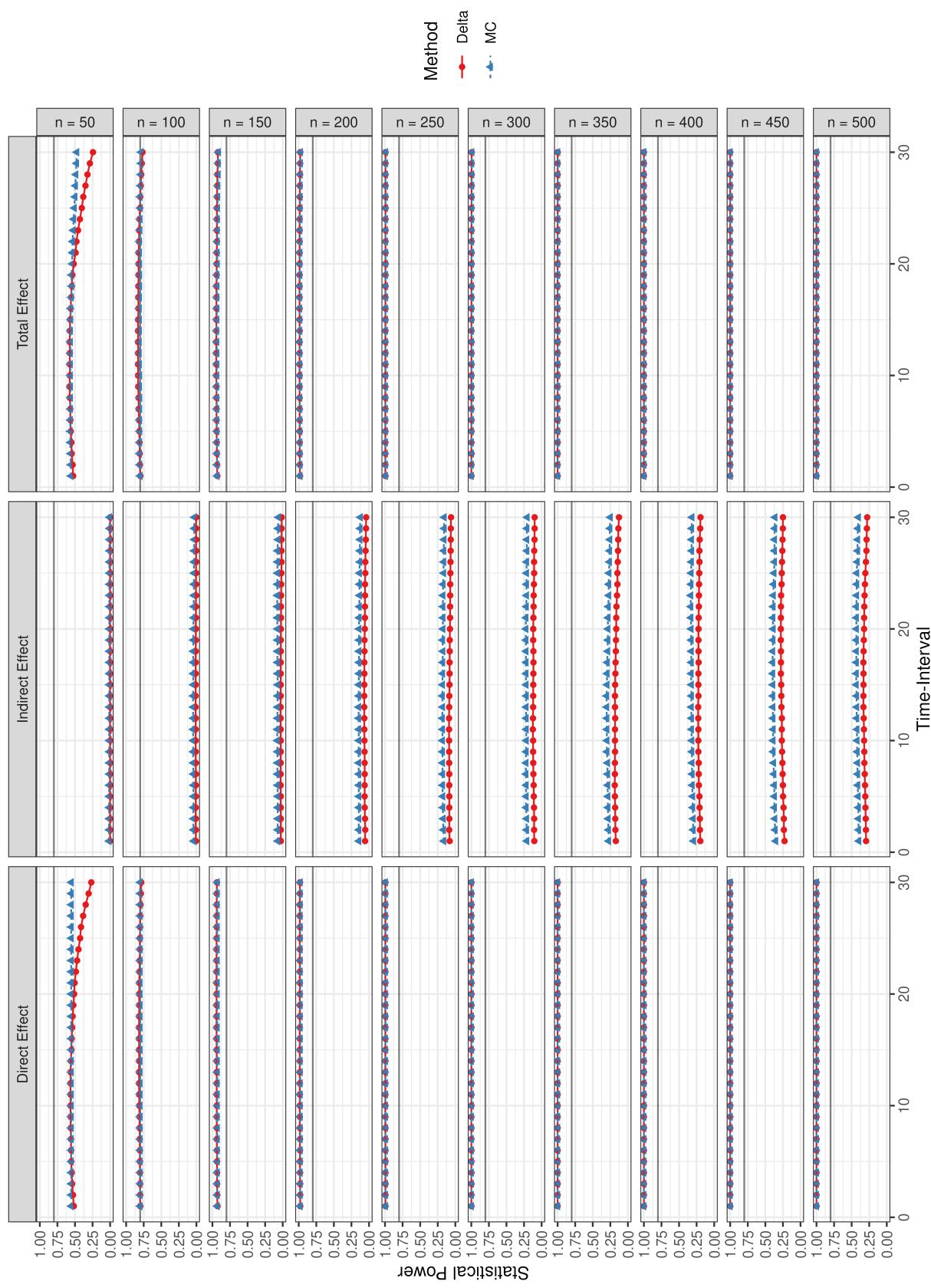
**Figure 19**  
*Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 1 to 25 / Weak Coupling / Unstandardized)*



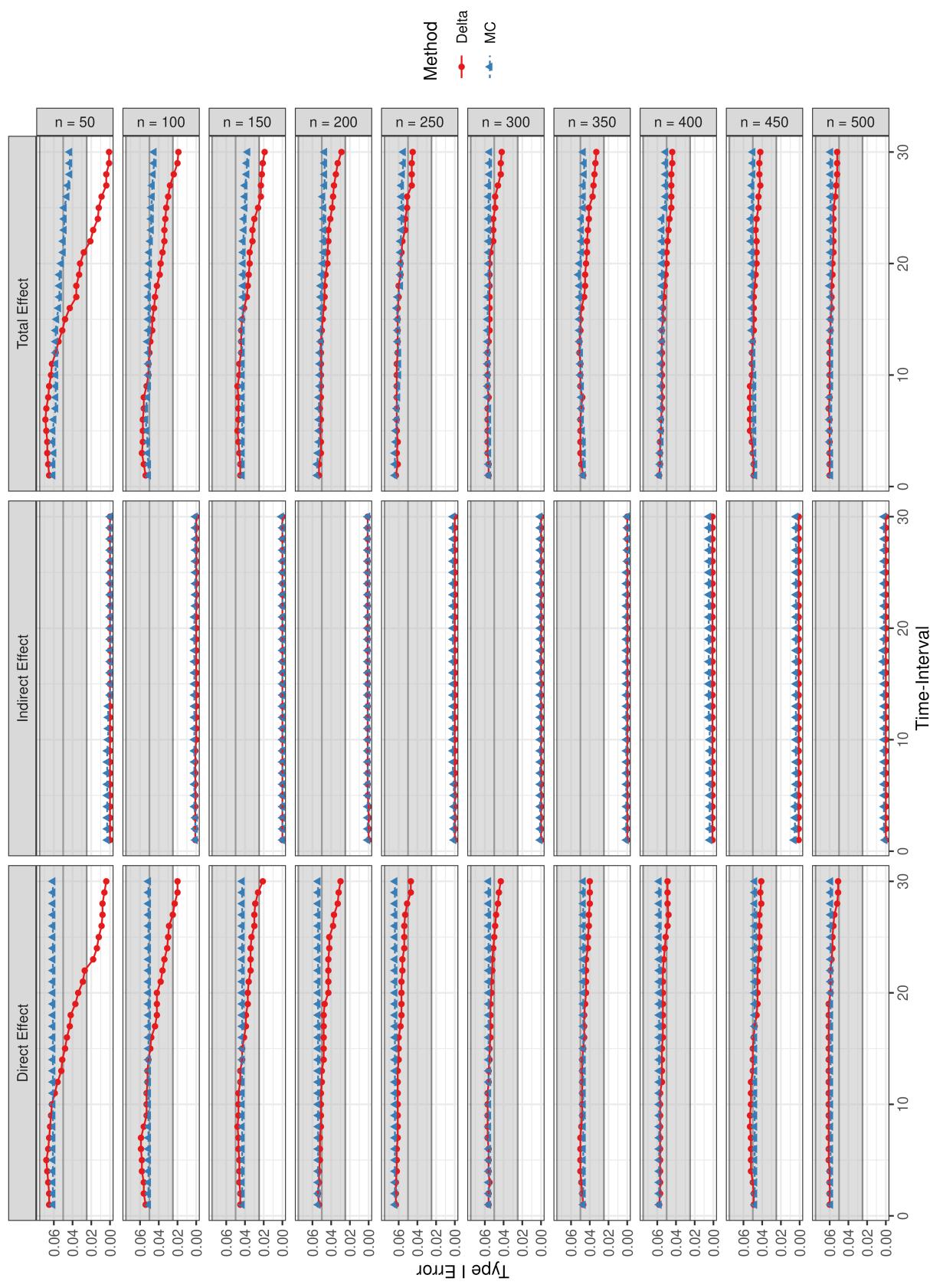
**Figure 20**  
*Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 25 to 30 / Weak Coupling / Unstandardized)*



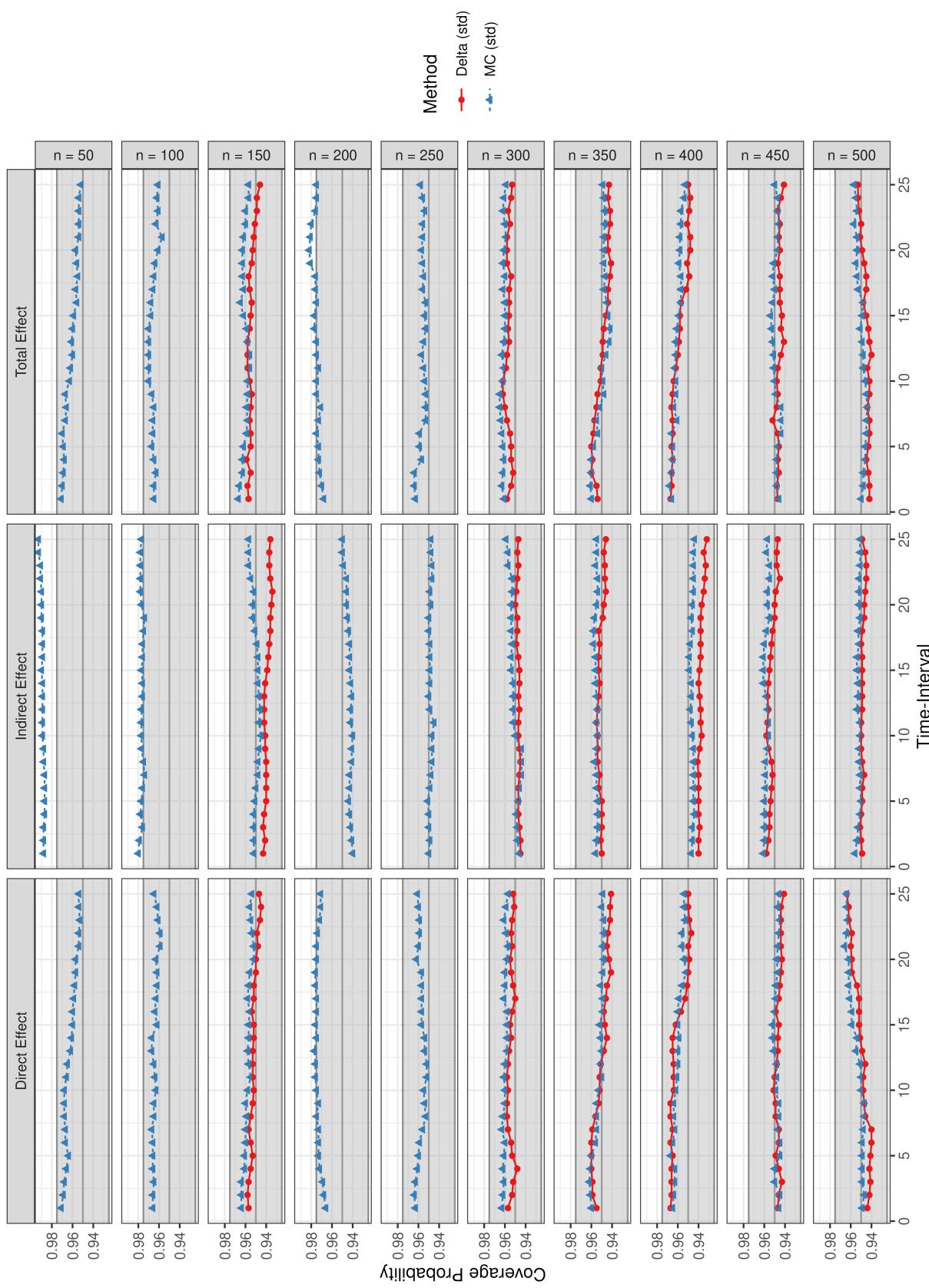
**Figure 21**  
*Monte Carlo Simulation Study Statistical Power (Weak Coupling / Unstandardized)*



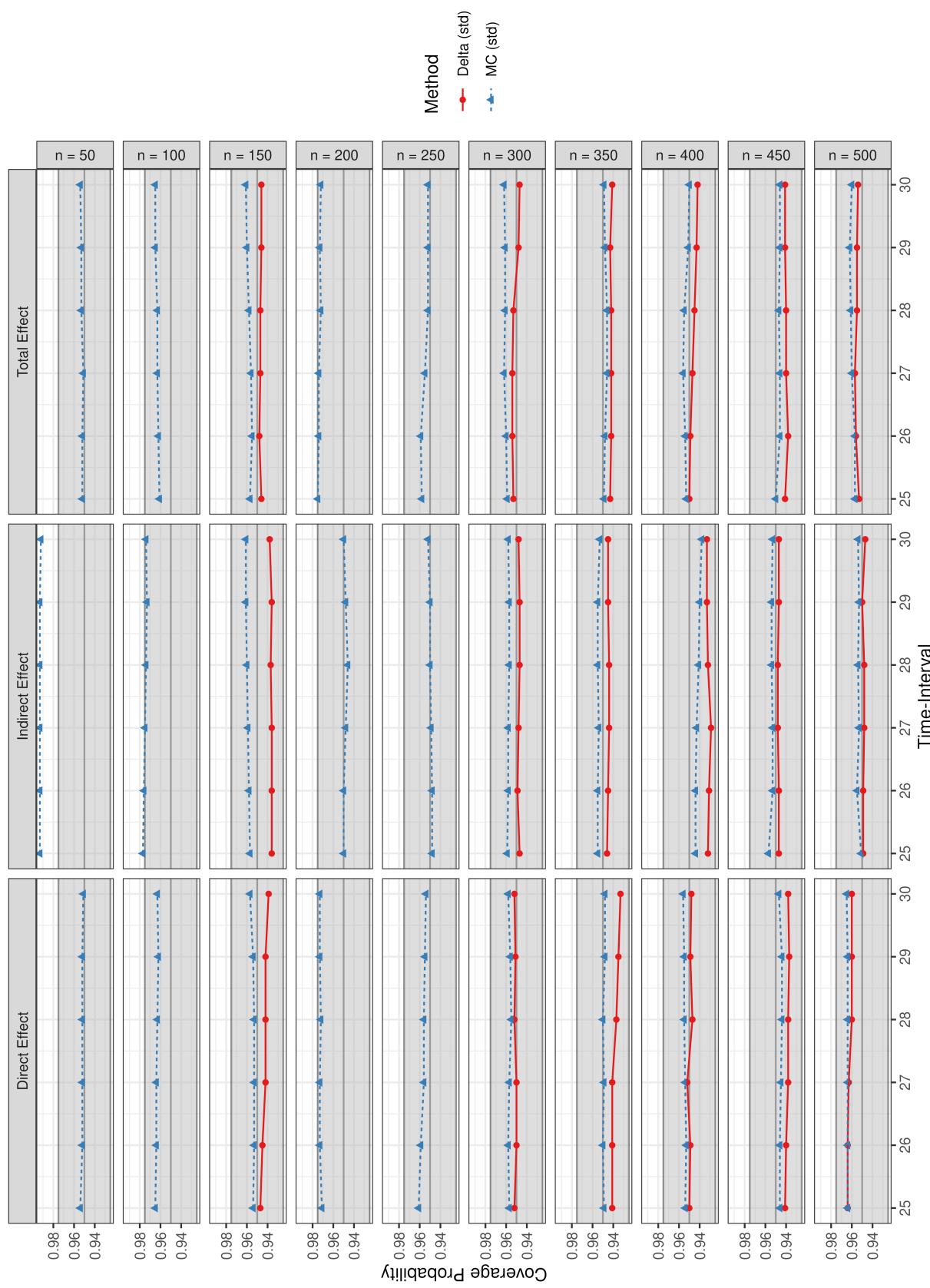
**Figure 22**  
*Monte Carlo Simulation Study Type I Error Rate (Weak Coupling / Unstandardized)*



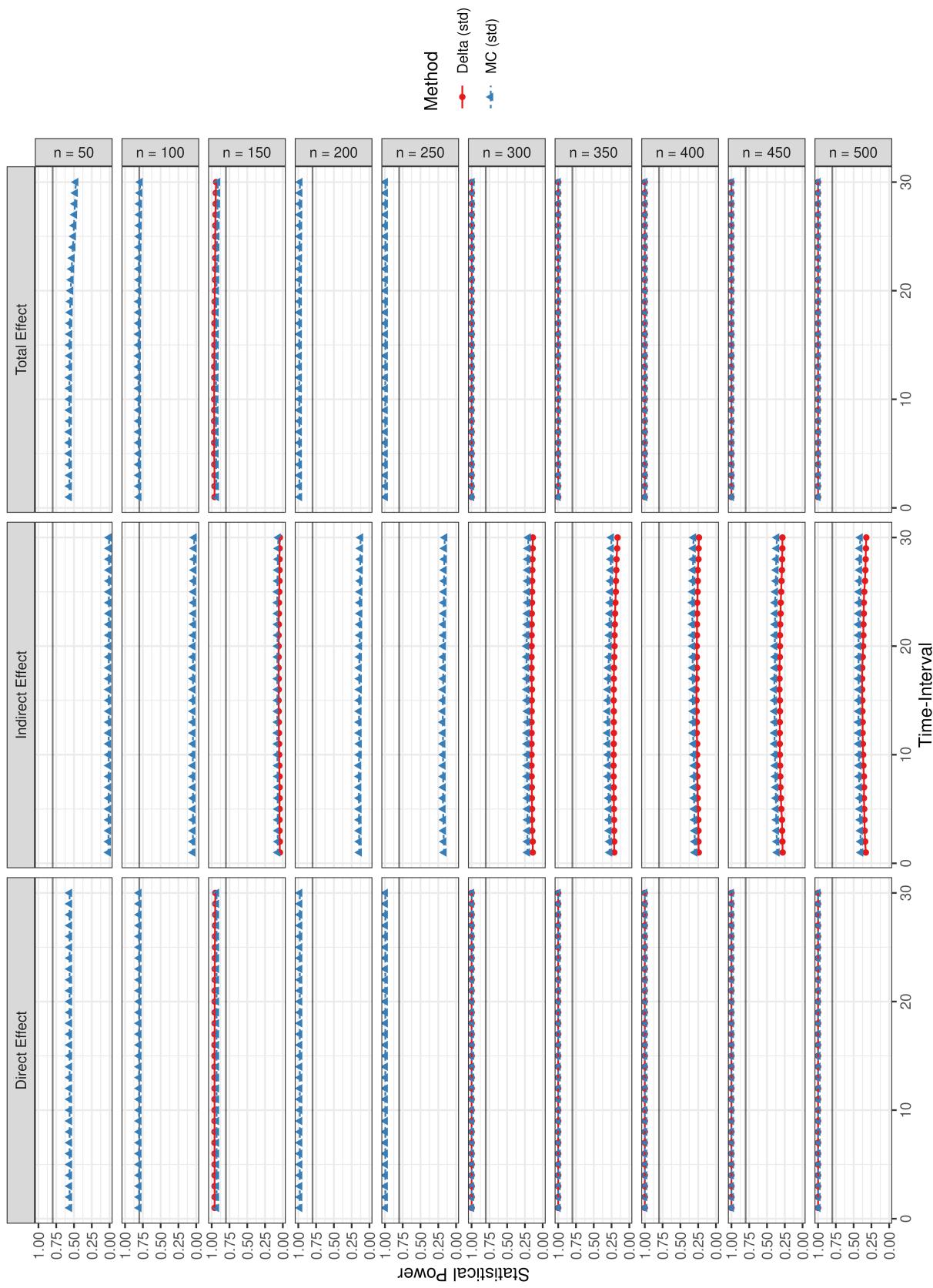
**Figure 23** Monte Carlo Simulation Study Coverage Probabilities ( $\Delta$  from 1 to 25 / Weak Coupling / Standardized)



**Figure 24**  
Monte Carlo Simulation Study Coverage Probabilities ( $\Delta t$  from 25 to 30 / Weak Coupling / Standardized)



**Figure 25**  
*Monte Carlo Simulation Study Statistical Power (Weak Coupling / Standardized)*



**Figure 26**  
Monte Carlo Simulation Study Type I Error Rate (Weak Coupling / Standardized)

