APPENDIX

1.1. *Simulation details*

The R code chunk below was used to generate the scenario with probit link for y and normal distribution for z_2, **with coefficient of z_2 set to -0.85**:

```
## set seed and sample size
set.seed(0)
n=1000

## observed confounders
z1 <- runif(n)
z4 <- runif(n)

# unobserved confounder
z2 <- rnorm(n)

## instrumental variable
z3 <- rbinom(n,1,0.5)

## non-linearities
f1   <- function(x) cos(pi*2*x) + sin(pi*x)
f2   <- function(x) x + exp(-30*(x-0.5)^2)

## treatment assignment
beta <- -0.85
prob.treated <-plogis(-0.5 + f1(z1) beta*z2 + 3*z3 + 1.3*z4)
x <- rbinom(n, 1, prob.treated)

## potential outcomes
p0 <- plogis(-3.5 + f2(z1) + 2*z2 -0.8*z4)
p1 <- plogis( 0.5 + f2(z1) + 2*z2 -0.8*z4)

y0 <- rbinom(n, 1, p0)
y1 <- rbinom(n, 1, p1)

## observed outcomes
y <- y0
y[x==1] <- y1[x==1]
```

To allow z_2 to be Student's t with four degrees of freedom, χ^2 with one degree of freedom and uniform[-3, 3], and the parameter of the unobserved confounder to have different impacts in the treatment equation, the above R code can be easily modified by replacing $\mathrm{z2 <- rnorm(n)}$ with $\mathrm{z2 <- rt(n, df=2)}$, $\mathrm{z2 <- rchisq(n, df=1)}$ or $\mathrm{z2 <- runif(n, -3, 3)}$ and replacing $\mathrm{beta <- -0.85}$ with $\mathrm{beta <- -1.5}$, $\mathrm{beta <- 0}$, $\mathrm{beta <- 0.85}$, or $\mathrm{beta <- 1.5}$.

1.2. *Further simulation results*

Results for additional simulation settings (where the value of coefficient of the unobserved confounder in the treatment equation has been set to 0 and -1.5) are reported in Tables 1 and 2. When the coefficient is set to 0 (i.e. no unobserved confounding problem), then, as expected, the univariate model and matching perform the best with the former being more efficient than the latter. Although the copula models (Gaussian and Frank copulae) show a poorer performance, the magnitudes of their bias and RMSE are comparable. When the problem of unobserved confounding becomes more severe (the coefficient is set to -1.5), then copula models still perform predictably well whereas the univariate and matching approaches deteriorate as compared to the case where the confounding issue is less severe. Though we do not report the results here, we observed similar patterns when setting the value of the coefficient of z_2 to 0.85 and 1.5.