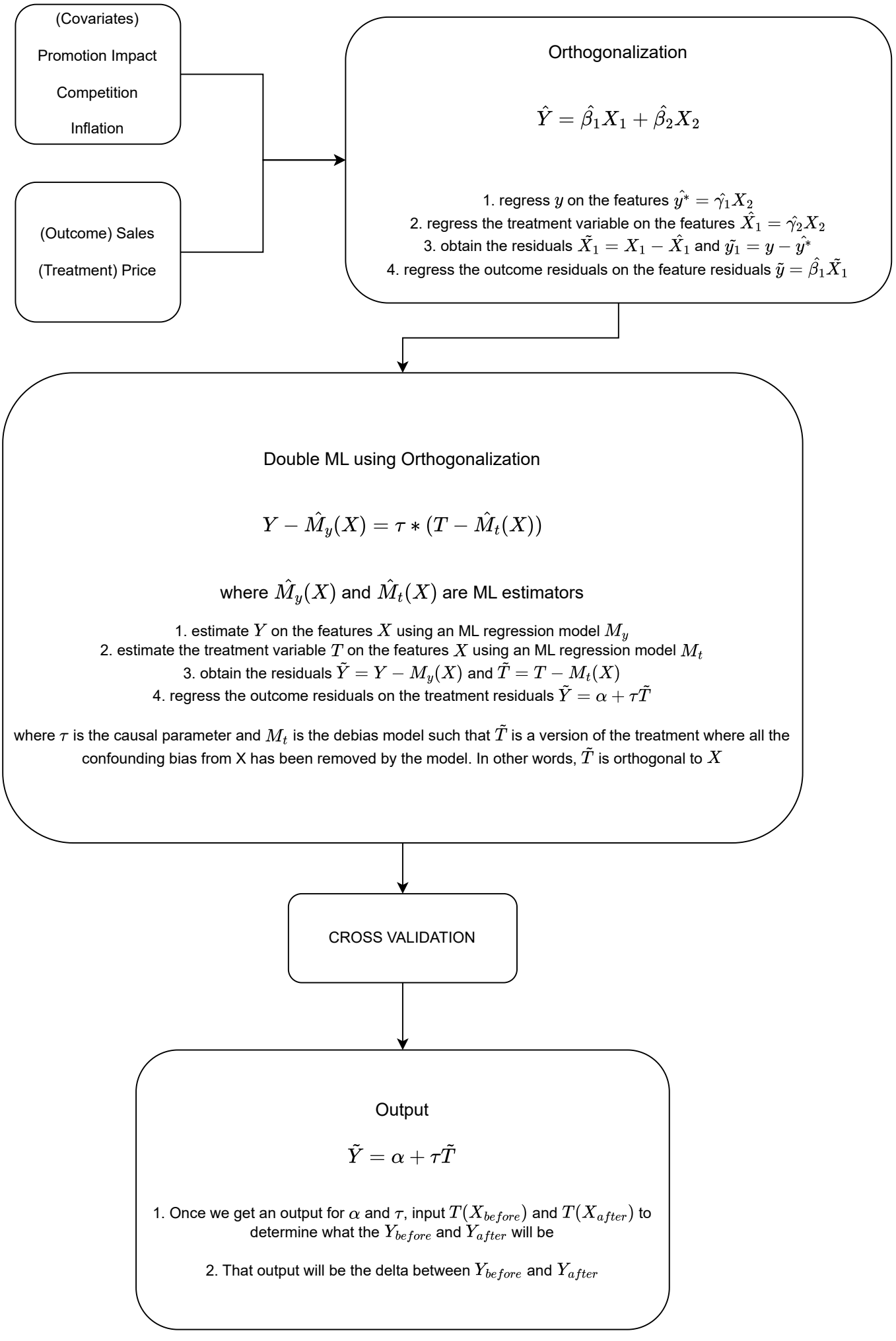
(Covariates)
Promotion Impact
Competition
Inflation
(Outcome) Sales
(Treatment) Price
Orthogonalization
$\hat{Y} = \hat{\beta}_1 X_1 + \hat{\beta}_2 X_2$
1. regress y on the features $\hat{y^*} = \hat{\gamma_1} X_2$
2. regress the treatment variable on the features $\hat{X_1} = \hat{\gamma_2} X_2$
3. obtain the residuals $\tilde{X_1} = X_1 - \hat{X_1}$ and $\tilde{y_1} = y - \hat{y^*}$
4. regress the outcome residuals on the feature residuals $\tilde{y} = \hat{\beta}_1 \tilde{X_1}$
Double ML using Orthogonalization
$Y - \hat{M}_y(X) = \tau * (T - \hat{M}_t(X))$
where $\hat{M}_y(X)$ and $\hat{M}_t(X)$ are ML estimators
1. estimate Y on the features X using an ML regression model M_y
2. estimate the treatment variable T on the features X using an ML regression model M_t
3. obtain the residuals $\tilde{Y} = Y - M_y(X)$ and $\tilde{T} = T - M_t(X)$
4. regress the outcome residuals on the treatment residuals $\tilde{Y} = \alpha + \tau \tilde{T}$
where τ is the causal parameter and M_t is the debias model such that $\tilde{T}$ is a version of the treatment where all the confounding bias from X has been removed by the model. In other words, $\tilde{T}$ is orthogonal to X
CROSS VALIDATION
Output
$\tilde{Y} = \alpha + \tau \tilde{T}$
1. Once we get an output for α and τ, input $T(X_{before})$ and $T(X_{after})$ to determine what the Y_{before} and Y_{after} will be
2. That output will be the delta between Y_{before} and Y_{after}