A PROOF OF LEMMA 1

We can write the conditional probability as

\[ P \left( Y_{x_0} = 1 \mid X = x \right) = \frac{P \left( Y_{x_0} = 1, X = x \right)}{P \left( X = x \right)} . \]

We first show the identifiability of the numerator.

\[
P \left( Y_{x_0} = 1, X = x \right) = P \left( Y_{x_0} = 1, A_k = a_k, X_k = x_k, D_{k+1} = d_{k+1} \right)
= \sum_{c_k \leq x_k} P \left( Y_{x_0} = 1, A_k = a_k, (X_k)_k = x_k, (X_k)_{a_k} = c_k, D_{k+1} = d_{k+1} \right)
= \sum_{c_k \leq x_k} P \left( Y_{x_0} = 1, A_k = a_k, C_k = c_k, D_{k+1} = d_{k+1} \right)
= \sum_{(c_k,c_{k+1}) \leq (x_k,x_{k+1})} P \left( Y_{x_0} = 1, A_k = a_k, C_k = c_k, (X_{k+1})_{a_k,a_{k+1}} = c_{k+1}, D_{k+2} = d_{k+2} \right)
\]

where for ease of presentation we use \( C_l = c_l \) to denote \( ((X_l)_{a_l}, (X_l)_{a_l,c_{l-1}+1}, x_{0_l}) = (x_l, c_l) \) for \( k \leq l \leq p \) and \( x_l \geq c_l \), and \( c_l = x_{0_l}^l \) if \( l \in S \). The second equality holds because of the consistency and the monotonicity assumptions.
Recursively, by the consistency and the composition, we have

\[
P \left( Y_{x_S}^0 = 1, X = x \right) \\
= P \left( Y_{x_S}^0 = 1, A_k = a_k, D_k = d_k \right) \\
= \sum_{c_k, p \geq d_k} P \left( Y_{x_S}^0 = 1, A_k = a_k, C_k = c_k, \cdots, C_p = c_p \right) \\
= \sum_{c_k, p \geq d_k} P \left( Y_{a_k, c_{k:p}} = 1, A_k = a_k, C_k = c_k, \cdots, C_p = c_p \right) \\
= \sum_{c_k, p \geq d_k} P \left( Y_{a_k, c_{k:p}} = 1, C_k = c_k, \cdots, C_p = c_p \mid A_k = a_k \right) \times P(A_k = a_k), \\
= \sum_{c_k, p \geq d_k} P \left( Y_{a_k, c_{k:p}} = 1 \mid A_k = a_k \right) \times \prod_{l=k}^p P \left( C_l = c_l \mid A_k = a_k \right) \times P(A_k = a_k),
\]

where the last equality holds as the potential outcomes \( C_{k:p} = (C_k, \cdots, C_p) \) are conditionally independent given \( A_k \). By the no confounding assumption, the first factor can be identified by

\[
P \left( Y_{a_k, c_{k:p}} = 1 \mid A_k = a_k \right) = P(Y = 1 \mid A_k = a_k, X_k = c_k, \cdots, X_p = c_p).
\]

Next, we consider the identifiability of \( P(C_l = c_l \mid A_k = a_k) \) for \( l = k + 1, \ldots, p \). For \( l \in S \), we have

\[
P \left( C_l = c_l \mid A_k = a_k \right) = P \left( (X_l)_{a_l} = x_l, (X_l)_{a_k, c_{k:l-1}, x_S^0} = c_l \mid A_k = a_k \right)
\]

\[
= 1_{c_l = x_l} \cdot P \left( (X_l)_{a_l} = x_l, (X_l)_{a_k, c_{k:l-1}, x_S^0} = x_l^1 \mid A_k = a_k \right)
\]

\[
= 1_{c_l = x_l} \cdot P \left( (X_l)_{a_l} = x_l \mid A_k = a_k \right)
\]

\[
= 1_{c_l = x_l} \cdot P \left( (X_l)_{a_l} = x_l \mid A_k = a_k \right)
\]

where the second equality holds by the definition of \( c_l \) and the third equality holds by the consistency.

For \( l \notin S \), we have the following three cases according to the values of \((x_l, c_l)\):

- \((x_l, c_l) = (0, 0)\): for this case, we have

\[
P \left( C_l = c_l \mid A_k = a_k \right)
\]

\[
= P \left( (X_l)_{a_l} = 0, (X_l)_{a_k, c_{k:l-1}, x_S^0} = 0 \mid A_k = a_k \right)
\]

\[
= P \left( (X_l)_{a_l} = 0 \mid A_k = a_k \right)
\]

\[
= P \left( (X_l)_{a_l} = 0 \mid A_k = a_k \right)
\]

where the second and the third equalities hold because of the monotonicity and no confounding assumptions, respectively;

- For the case of \((x_l, c_l) = (1, 1)\), we have

\[
P \left( C_l = c_l \mid A_k = a_k \right)
\]

\[
= P \left( (X_l)_{a_l} = 1, (X_l)_{a_k, c_{k:l-1}, x_S^0} = 1 \mid A_k = a_k \right)
\]

\[
= P \left( (X_l)_{a_k, c_{k:l-1}, x_S^0} = 1 \mid A_k = a_k \right)
\]

\[
= P \left( (X_l)_{a_k, c_{k:l-1}, x_S^0} = 1 \mid A_k = a_k \right)
\]

where the second and the third equalities hold because of the monotonicity and no confounding assumptions, respectively;
For the case of \((x_i, c_i) = (1, 0)\), we have
\[
P(C_l = c_l \mid A_k = a_k) = \begin{cases} \frac{P(Y = 1 \mid A_k = a_k, D_k = d_k)}{P(D_k = d_k \mid A_k = a_k)} & \text{if } i \in \{k, \ldots, p\} \\
\prod_{i=0}^{p} P(C_l = c_l \mid A_k = a_k) & \text{if } i \notin \{k, \ldots, p\} \end{cases}
\]

Summarizing the identification equations for the three cases, we get
\[
\prod_{i=1}^{p} \begin{cases} \prod_{i=0}^{p} P(C_l = c_l \mid A_k = a_k) \\
(1 - x_i) \times P(X_i = 0 \mid A_i = a_i) + x_i (1 - c_i) \times P(X_i = 1 \mid A_i = a_i) \\
+ x_i (1 - 1 - c_i) \times P(X_i = 1 \mid A_k = a_k, X_{k-1} = c_{k-1}) \end{cases} \times \prod_{i \in S} P(X_i = x_i \mid A_i = a_i)
\times 1_{x_S = c_S}.
\]

From the above results, the identification formula of \(P(Y_{x_S} = 1 \mid X = x)\) can be derived as follows
\[
P(Y_{x_S} = 1 \mid X = x) = \frac{P(Y_{x_S} = 1, X = x)}{P(X = x)} = \sum_{c_k, p \geq d_k} \begin{cases} \prod_{i=0}^{p} P(C_l = c_l \mid A_k = a_k) \\
(1 - x_i) \times P(X_i = 0 \mid A_i = a_i) + x_i (1 - c_i) \times P(X_i = 1 \mid A_i = a_i) \\
+ x_i (1 - 1 - c_i) \times P(X_i = 1 \mid A_k = a_k, X_{k-1} = c_{k-1}) \end{cases} \times \prod_{i \in S} P(X_i = x_i \mid A_i = a_i)
\times 1_{x_S = c_S} \
\times \prod_{i \in \{k, \ldots, p\} \setminus S} \begin{cases} \prod_{i=0}^{p} P(C_l = c_l \mid A_k = a_k) \\
(1 - x_i) \times P(X_i = 0 \mid A_i = a_i) + x_i (1 - c_i) \times P(X_i = 1 \mid A_i = a_i) \\
+ x_i (1 - 1 - c_i) \times P(X_i = 1 \mid A_k = a_k, X_{k-1} = c_{k-1}) \end{cases} \times \prod_{i \in S} P(X_i = x_i \mid A_i = a_i)
\times 1_{x_S = c_S}.
\]

where the last equality holds because
\[
(1 - x_i) \times \frac{P(X_i = 0 \mid A_i = a_i)}{P(X_i = x_i \mid A_i = a_i)} = \begin{cases} 0, & \text{if } x_i = 1; \\
1 - x_i, & \text{if } x_i = 0; \end{cases}
\]

and
\[
x_i (1 - c_i) \times \frac{P(X_i = 1 \mid A_i = a_i)}{P(X_i = x_i \mid A_i = a_i)} = \begin{cases} x_i (1 - c_i), & \text{if } x_i = 1; \\
0, & \text{if } x_i = 0. \end{cases}
\]

### B PROOF OF LEMMA 2

We write the conditional probability as
\[
P(Y_{x_S} = 1 \mid X = x) = \frac{P(Y_{x_S} = 1, X = x)}{P(X = x)},
\]
and we first show the identifiability of the numerator above.

\[
P \left( Y_{x_l} = 1, X = x \right)
= P \left( Y_{x_l} = 1, A_k = a_k, X_k = x_k, D_{k+1} = d_{k+1} \right)
= \sum_{c_k \geq x_k} P \left( Y_{x_l} = 1, A_k = a_k, (X_k)_{a_k} = x_k, (X_k)_{a_k} = c_k, D_{k+1} = d_{k+1} \right)
= \sum_{c_k \geq x_k} P \left( Y_{x_l} = 1, A_k = a_k, C_k = c_k, D_{k+1} = d_{k+1} \right)
= \sum_{(c_k, c_{k+1}) \geq (x_k, x_{k+1})} P \left( Y_{x_l} = 1, A_k = a_k, C_k = c_k, (X_{k+1})_{a_k} = x_{k+1}, (X_{k+1})_{a_k} = c_{k+1}, D_{k+2} = d_{k+2} \right)
= \sum_{c_{k+1} \geq x_{k+1}} P \left( Y_{x_l} = 1, A_k = a_k, C_k = c_k, C_{k+1} = c_{k+1}, D_{k+2} = d_{k+2} \right),
\]

where \( C_l = c_l \) denotes \((X_l)_{a_l}, (X_l)_{a_{l-1}, x_l^1}\) = \((x_l, c_l)\) for any \( k \leq l \leq p \) satisfying \( x_l \leq c_l \) and \( c_l = x_l^1 \) if \( l \in S \). The second equality holds because of the consistency and Assumption 2(a).

Recursively, by the consistency and the composition, we have

\[
P \left( Y_{x_l} = 1, X = x \right)
= P \left( Y_{x_l} = 1, A_k = a_k, D_k = d_k \right)
= \sum_{c_k \geq x_k} P \left( Y_{x_l} = 1, A_k = a_k, C_k = c_k, \cdots, C_p = c_p \right)
= \sum_{c_k \geq x_k} P \left( Y_{a_k, c_{k:p}} = 1, A_k = a_k, C_k = c_k, \cdots, C_p = c_p \right)
= \sum_{c_k \geq x_k} P \left( Y_{a_k, c_{k:p}} = 1, C_k = c_k, \cdots, C_p = c_p \mid A_k = a_k \right) \times P(A_k = a_k),
= \sum_{c_k \geq x_k} P \left( Y_{a_k, c_{k:p}} = 1 \mid A_k = a_k \right) \times \prod_{l=k}^p P \left( C_l = c_l \mid A_k = a_k \right) \times P(A_k = a_k),
\]

where the last equality holds because of the conditional independencies between the potential outcomes \( C_{k:p} = (C_k, \cdots, C_p) \) given \( A_k \). By the no confounding assumption, the first factor above can be identified by

\[
P \left( Y_{a_k, c_{k:p}} = 1 \mid A_k = a_k \right)
= P \left( Y = 1 \mid A_k = a_k, X_k = c_k, \cdots, X_p = c_p \right).
\]

Next, we consider the identifiability of \( P(C_l = c_l \mid A_k = a_k) \) for \( l = k + 1, \ldots, p \).

For \( l \in S \), we have

\[
P \left( C_l = c_l \mid A_k = a_k \right)
= P \left( (X_l)_{a_l} = x_l, (X_l)_{a_{l-1}, x_l^1} = c_l \mid A_k = a_k \right)
= 1_{c_l = x_l} \cdot P \left( (X_l)_{a_l} = x_l, (X_l)_{a_{l-1}, x_l^1} = x_l^1 \mid A_k = a_k \right)
= 1_{c_l = x_l} \cdot P \left( (X_l)_{a_l} = x_l \mid A_k = a_k \right)
= 1_{c_l = x_l} \cdot P \left( X_l = x_l \mid A_k = a_k \right),
\]
where the second equality holds by the definition of $c_l$ and the third equality holds by the consistency.

For $l \notin S$, according to the value of $(x_l, c_l)$ we discuss it for three cases.

- For the case of $(x_l, c_l) = (0, 0)$, we have

  \[
  P(C_l = c_l \mid A_k = a_k) = P\left((X_l)_{a_l} = 0, (X_l)_{a_k, c_k:1-1, x_l} = 0 \mid A_k = a_k\right) = P\left((X_l)_{a_k, c_k:1-1, x_l} = 0 \mid A_k = a_k\right) = P\left(X_l = 0 \mid A_k = a_k, X_{k:l-1} = c_{k:l-1}\right),
  \]

  where the second and the third equalities hold because of the monotonicity and no confounding assumptions, respectively;

- For the case of $(x_l, c_l) = (1, 1)$, we have

  \[
  P(C_l = c_l \mid A_k = a_k) = P\left((X_l)_{a_l} = 1, (X_l)_{a_k, c_k:1-1, x_l} = 1 \mid A_k = a_k\right) = P\left((X_l)_{a_k} = 1 \mid A_k = a_k\right) = P\left(X_l = 1 \mid A_l = a_l\right);
  \]

- For the case of $(x_l, c_l) = (0, 1)$, we have

  \[
  P(C_l = c_l \mid A_k = a_k) = P\left((X_l)_{a_l} = 0, (X_l)_{a_k, c_k:1-1, x_l} = 1 \mid A_k = a_k\right) = P\left((X_l)_{a_k} = 1 \mid A_k = a_k\right) = P\left(X_l = 0 \mid A_k = a_k, X_{k:l-1} = c_{k:l-1}\right).
  \]

Summarizing the identification equations for the three cases, we get

\[
\prod_{l=k}^{p} P(C_l = c_l \mid A_k = a_k) = 1_{x,S=c_S} \times \prod_{i \in \{k, \ldots, p\}\setminus S} \left\{(1 - x_i)c_i \times P(X_i = 0 \mid A_i = a_i) + x_i \times P(X_i = 1 \mid A_i = a_i) \right\} \times \prod_{i \in S} P(X_i = x_i \mid A_i = a_i).
\]
From the above results, the identification formula of \( P \left( Y_{x_k^i} = 1 \mid X = x \right) \) can be derived as follows

\[
P \left( Y_{x_k^i} = 1 \mid X = x \right) = \frac{P \left( Y_{x_k^i} = 1, X = x \right)}{P(X = x)}
\]

\[
= \sum_{c_k, p \geq d_k} \left[ \frac{P \left( Y_{a_k, c_k, p} = 1 \mid A_k = a_k \right)}{P(D_k = d_k \mid A_k = a_k)} \times \prod_{l=k}^{p} P(C_l = c_l \mid A_k = a_k) \right]
\]

\[
= \sum_{c_k, p \geq d_k} \left\{ 1_{x = e_S} \times \frac{P \left( Y = 1 \mid A_k = a_k, D_k = c_k \right)}{P(D_k = d_k \mid A_k = a_k)} \times \prod_{i \in \{k, \ldots, p\} \setminus S^-} \left( x_i - c_i \times P(X_i = 0 \mid A_i = a_i) + x_i \times P(X_i = 1 \mid A_i = a_i) \right) \right\}
\]

\[
+ (1 - x_i)(-1)^{c_i} \times P \left( X_i = 0 \mid A_k = a_k, X_{k; i - 1} = c_{k; i - 1} \right)
\]

\[
= \sum_{c_k, p \geq d_k} \left\{ 1_{x = e_S} \times P(Y = 1 \mid A_k = a_k, D_k = c_k) \times \prod_{i \in \{k, \ldots, p\} \setminus S^-} \left[ x_i + c_i - x_i c_i + (1 - x_i)(-1)^{c_i} \right] \times \frac{P(X_i = 0 \mid A_k = a_k, X_{k; i - 1} = c_{k; i - 1})}{P(X_i = 1 \mid A_i = a_i)} \right\},
\]

where the last equality holds because

\[
(1 - x_i)c_i \times \frac{P(X_i = 0 \mid A_i = a_i)}{P(X_i = x_i \mid A_i = a_i)} = \begin{cases} 0, & \text{if } x_i = 1; \\ (1 - x_i)c_i, & \text{if } x_i = 0; \end{cases}
\]

and

\[
x_i \times \frac{P(X_i = 1 \mid A_i = a_i)}{P(X_i = x_i \mid A_i = a_i)} = \begin{cases} x_i, & \text{if } x_i = 1; \\ 0, & \text{if } x_i = 0. \end{cases}
\]

**C PROOF OF THEOREM 1**

The conclusion follows directly from Lemma 1, Lemma 2 and the definition of CCCE.

**D PROOF OF COROLLARY 1**

For any subset \( X' \subseteq X \), we have

\[
\text{CCCE} (X_S \Rightarrow Y \mid X' = x') = P \left( Y_{x_k^i} = 1 \mid X' = x' \right) - P \left( Y_{x_k^i} = 1 \mid X' = x' \right)
\]

\[
= \sum_{x: x' \geq x'} \left[ P \left( Y_{x_k^i} = 1 \mid X = x \right) - P \left( Y_{x_k^i} = 1 \mid X = x \right) \right] \times P(X = x \mid X' = x')
\]

\[
= \sum_{x: x' \geq x'} \text{CCCE} (X_S \Rightarrow Y \mid X = x) \times P(X = x \mid X' = x').
\]

Hence, \( \text{CCCE} (X_S \Rightarrow Y \mid X' = x') \) is identifiable if and only if \( \text{CCCE} (X_S \Rightarrow Y \mid X = x) \) is identifiable, and its identification formula can be obtained by Theorem 1.
E PROOF OF THEOREM 2

E.1 CCCE($X_S \Rightarrow Y \mid X = x, Y = 1$)

For $Y = 1$, we have

$$CCCE(X_S \Rightarrow Y \mid X = x, Y = 1) = E(Y_{x_S^1} - Y_{x_S^0} \mid X = x, Y = 1)$$

$$= 1 - P(Y_{x_S^1} = 1 \mid X = x, Y = 1) = 1 - \frac{P(Y_{x_S^0} = 1, X = x, Y = 1)}{P(X = x, Y = 1)}.$$

By consistency, composition and Assumption 2(a), we have

$$P \left( Y_{x_S^0} = 1, X = x, Y = 1 \right)$$

$$= \sum_{c_k \leq d_k} P \left( Y_{x_S^0} = 1, Y_x = 1, (A_k)_{x_S^0} = a_k, (D_k)_{a_k,x_S^0} = c_k, X = x \right)$$

$$= \sum_{c_k \leq d_k} P \left( Y_{a_k,x_S^0,c_k} = 1, Y_x = 1, (A_k)_{x_S^0} = a_k, (D_k)_{a_k,x_S^0} = c_k, X = x \right)$$

$$= \sum_{c_k \leq d_k} P \left( Y_{a_k,x_S^0,c_k} = 1, (D_k)_{a_k,x_S^0} = c_k, X = x \right)$$

$$= \sum_{c_k \geq d_k} P \left( Y_{x_S^0} = 1, (D_k)_{a_k,x_S^0} = c_k, X = x \right),$$

where $k = \min S$. Hence, we have

$$CCCE(X_S \Rightarrow Y \mid X = x, Y = 1) = 1 - \frac{P(Y_{x_S^0} = 1, X = x, Y = 1)}{P(X = x, Y = 1)}$$

$$= 1 - \frac{P(Y_{x_S^0} = 1, X = x)}{P(X = x, Y = 1)} = 1 - \frac{P(Y_{x_S^0} = 1 \mid X = x)}{P(Y = 1 \mid X = x)}.$$

E.2 CCCE($X_S \Rightarrow Y \mid X = x, Y = 0$)

For $Y = 0$, we have

$$CCCE(X_S \Rightarrow Y \mid X = x, Y = 0) = E(Y_{x_S^1} - Y_{x_S^0} \mid X = x, Y = 0)$$

$$= P(Y_{x_S^1} = 1 \mid X = x, Y = 0) - 0 = 1 - P(Y_{x_S^0} = 0 \mid X = x, Y = 0)$$

$$= 1 - \frac{P(Y_{x_S^0} = 0, X = x, Y = 0)}{P(X = x, Y = 0)}.$$

By consistency, composition and Assumption 2(a), we have

$$P \left( Y_{x_S^0} = 0, X = x, Y = 0 \right)$$

$$= \sum_{c_k \geq d_k} P \left( Y_{x_S^0} = 0, Y_x = 0, (A_k)_{x_S^0} = a_k, (D_k)_{a_k,x_S^0} = c_k, X = x \right)$$

$$= \sum_{c_k \geq d_k} P \left( Y_{a_k,x_S^0,c_k} = 0, Y_x = 0, (A_k)_{x_S^0} = a_k, (D_k)_{a_k,x_S^0} = c_k, X = x \right)$$

$$= \sum_{c_k \geq d_k} P \left( Y_{a_k,x_S^0,c_k} = 0, (A_k)_{x_S^0} = a_k, (D_k)_{a_k,x_S^0} = c_k, X = x \right)$$

$$= \sum_{c_k \geq d_k} P \left( Y_{x_S^0} = 0, (D_k)_{a_k,x_S^0} = c_k, X = x \right),$$

$$= P \left( Y_{x_S^0} = 0, X = x \right).$$
where \( k = \min S \). Hence, we have

\[
\text{CCCE}(X_S \Rightarrow Y \mid X = x, Y = 0) = 1 - \frac{P(Y_{x_k^b} = 0, X = x, Y = 0)}{P(X = x, Y = 0)} = 1 - \frac{P(Y_{x_k^b} = 0, X = x)}{P(Y = 0 \mid X = x)}
\]

\[
= 1 - \frac{P(Y_{x_k^b} = 0, X = x)}{P(Y = 0 \mid X = x)}.
\]

### F PROOF OF LEMMA 3

Using the notations in this lemma, we have

\[
P(Y_{x_k^b} = 1, X = x, Y = y, Z = z)
\]

\[
= \sum_{x^*} P(Y_{x_k^b} = 1, X_{x_k^b} = x^*, X = x, Y = y, Z = z)
\]

\[
= \sum_{x^*} P(Y_{x_k^b} = 1, X_{x_k^b} = x^*, X = x, Y = y, Z = z)
\]

\[
= \sum_{x^*} P(Y_{x_k^b} = 1, X_{x_k^b} = x^*, Z = z \mid X = x, Y = y) \times P(X = x, Y = y)
\]

\[
= \sum_{x^*} P(Y_{x_k^b} = 1, X_{x_k^b} = x^*, Z = z \mid X = x, Y = y) \times P(X = x, Y = y)
\]

\[
= \sum_{x^*} P(Y_{x_k^b} = 1, X_{x_k^b} = x^* \mid X = x, Y = y) \times P(X = x, Y = y, Z = z),
\]

where the second and the fourth equalities hold because of the composition and Assumption 1(c), respectively. Hence, we have

\[
P(Y_{x_k^b} = 1 \mid X = x, Y = y, Z = z) = \frac{P(Y_{x_k^b} = 1, X = x, Y = y, Z = z)}{P(X = x, Y = y, Z = z)}
\]

\[
= \sum_{x^*} P(Y_{x_k^b} = 1, X_{x_k^b} = x^* \mid X = x, Y = y)
\]

\[
= P(Y_{x_k^b} = 1 \mid X = x, Y = y).
\]

### G PROOF OF COROLLARY 3

The conclusion follows directly from Lemma 3 and the definition of CCCE.

### H PROOF OF THEOREM 3

For any subset \( W \subseteq (X, Y, Z) \), we have

\[
\text{CCCE}(X_S \Rightarrow Y \mid W = w)
\]

\[
= P(Y_{x_k^b} = 1 \mid W = w) - P(Y_{x_k^b} = 1 \mid W = w)
\]

\[
= \sum_{(x, y, z) : (x, y, z) \subseteq w} P(X = x, Y = y, Z = z \mid W) \times \left[ P(Y_{x_k^b} = 1 \mid X = x, Y = y, Z = z) \right]
\]

\[
- P(Y_{x_k^b} = 1 \mid X = x, Y = y, Z = z)
\]

\[
= \sum_{(x, y, z) : (x, y, z) \subseteq w} \text{CCCE}(X_S \Rightarrow Y \mid X = x, Y = y, Z = z) \times P(X = x, Y = y, Z = z \mid W)
\]

\[
= \sum_{(x, y, z) : (x, y, z) \subseteq w} \text{CCCE}(X_S \Rightarrow Y \mid X = x, Y = y) \times P(X = x, Y = y, Z = z \mid W),
\]

where the last equality holds because of Corollary 3. Hence, \( \text{CCCE}(X_S \Rightarrow Y \mid W = w) \) is identifiable if and only if \( \text{CCCE}(X_S \Rightarrow Y \mid X = x, Y = y) \) is identifiable for any \( (x, y, z) \subseteq w \), and under Assumption 1 and Assumption 2, the identification equations are given by Theorem 2.