Appendix A

Measuring Cooperation

In this calculation, *G*represents the symbiotic unit of public hospitals, *M* represents the symbiotic unit of private hospitals, V_G represents the quantity parameter of public hospitals, and V_M represents the quantity parameter of private hospitals. Changes in outpatient visits, inpatient admissions, and surgical servicesfor both types of hospitals are considered quantity parameters.

The degree of symbiosis between public and private hospitals is defined as follows:

$$\vartheta_{G_M} = \frac{dV_G/V_G}{dV_M/V_M} \tag{1}$$

Similarly, the degree of symbiosis between private and public hospitals is defined as:

$$\vartheta_{MG} = \frac{dV_M/V_M}{dV_G/V_G} \tag{2}$$

A significant linear relationship exists between the quantity parameters of outpatient visits, inpatient admissions, and surgical services for both public and private hospitals. Therefore, the following is assumed:

$$V_G = \alpha + \beta V_M^t \tag{3}$$

$$V_M = \lambda + \mu V_G^t \tag{4}$$

Where parameters α, β, λ, and μ are determined using regression models. By substituting Equations (3) and (4) into Equations (1) and (2), the degree of symbiosis between public and private hospitals can be calculated. Furthermore, the symbiotic coefficients of the main quantity parameters of public and private hospitals can be solved, reflecting the degree of mutual influence between them, as shown in Equations (5) and (6):

$$\vartheta_G = \frac{|\vartheta_{GM}^t|}{|\vartheta_{GM}^t| + |\vartheta_{MG}^t|} \tag{5}$$

$$\vartheta_M = \frac{|\vartheta_{MG}^t|}{|\vartheta_{MG}^t| + |\vartheta_{GM}^t|} \tag{6}$$

Where $\vartheta_G + \vartheta_M = 1$. Based on the value of ϑ_G, the mutual influence between public and private hospitals can be determined, as shown in Supplementry Table S1.

Supplementary Table S1. Mutual influence between public and private hospitals

Determination	Main features
$\vartheta_G = 0$	No impact of private hospitals on public hospitals.
$\vartheta_G = 1$	No impact of public hospitals on private hospitals.
$0 < \vartheta_G < 1/2$	The influence of private hospitals on public hospitals is less than the influence of public hospitals on private hospitals.
$1/2 < \vartheta_G < 1$	The influence of public hospitals on private hospitals is less than the influence of private hospitals on public hospitals.
$\vartheta_G = 1/2$	The influence of public hospitals on private hospitals is less than the influence of private hospitals on public hospitals.

In conjunction with previous research, we consider that when ϑ_G is closer to 0.5, the influence of public and private hospitals on each other is equal, suggesting a mode of reciprocal symbiosis. When $0 < \vartheta_G < 1/2$or $1/2 < \vartheta_G < 1$, the influence of public and private hospitals on each other is unequal, indicating a mode of biased symbiosis. We used the degree of cooperative symbiosis to represent the degree of cooperative symbiosis between public and private hospitals in the outpatient, inpatient, and surgical service domains, as shown in equations (7)–(9):

$$\text{Outpatient cooperation degree} = ||\text{Outpatient symbiosis coefficient} - 0.5| - 0.5| \quad (7)$$

$$\text{Inpatient cooperation degree} = ||\text{Inpatient symbiosis coefficient} - 0.5| - 0.5| \quad (8)$$

$$\text{Surgical cooperation degree} = ||\text{Surgical symbiosis coefficient} - 0.5| - 0.5| \quad (9)$$

Appendix B

Competitive Intensity Measurement

Based on the outpatient, inpatient, and surgical service volumes of public and private hospitals, their market shares were calculated as the sum of the squares, namely, the HHI. Subtracting market concentration from 1 yielded the competitive market intensity between public and private hospitals. As outpatient, inpatient, and surgical service volumes were selected as proxies for the market shares of public and private hospitals in this study, the HHI values ranged from 0.5 to 1, and the competitive intensity values ranged from 0 to 0.5. A higher HHI represents lower market competition, indicating a lower competitive intensity, whereas a lower HHI represents higher market competition, indicating a higher competitive intensity.

Drawing from previous studies, we adopted the outpatient, inpatient, and surgical service volumes of public and private hospitals from the yearbooks as proxies for market share. Specifically, as shown in Equations (10)–(12),

$$\begin{aligned}\text{Outpatient competition intensity} = 1 - (&\text{Market share of public hospitals in outpatient services}^2 \\ &+ \text{Market share of private hospitals in outpatient services}^2)\end{aligned} \quad (10)$$

$$\begin{aligned}\text{Inpatient competition intensity} = 1 - (&\text{Market share of public hospitals in inpatient services}^2 \\ &+ \text{Market share of private hospitals in inpatient services}^2)\end{aligned} \quad (11)$$

$$\begin{aligned}\text{Surgical competition intensity} = 1 - (&\text{Market share of surgeries in public hospitals}^2 \\ &+ \text{Market share of surgeries in private hospitals}^2)\end{aligned} \quad (12)$$