对于参与市场的策略型发电商 i，其在两个市场中的投标决策问题即可转化为 MPEC 问题，目标函数为最大化自身效益，约束条件为自身报价约束和两个市场最优性条件。该 MPEC 问题及其对偶变量可以表示为

$$\min\sum_{t=1}^{T}(\sum_{k=1}^{K}\lambda_{i,k}P_{i,t,k}-\pi_{i,t}^{1}\sum_{k=1}^{K}P_{i,t,k}^{1}-\pi_{i,t}^{2}\sum_{k=1}^{K}P_{i,t,k}^{2})$$

$$0=\alpha_{i,0}^{1}<\alpha_{i,1}^{1}<\alpha_{i,2}^{1}<\ldots<\alpha_{i,K}^{1}:\omega_{i,k}^{\alpha,1}$$

$$0=\alpha_{i,0}^{2}<\alpha_{i,1}^{2}<\alpha_{i,2}^{2}<\ldots<\alpha_{i,K}^{2}:\omega_{i,k}^{\alpha,2}$$

$$P_{i,t}=\sum_{k=1}^{K}P_{i,t,k}:\rho_{i,t}^{G}$$

$$0\le P_{i,t,k}\le\overline{P}_{i,k}:\omega_{i,t,k}^{G\min,0},\omega_{i,t,k}^{G\max,0}$$

$$P_{r,t}=\sum_{i\in X_r}\sum_{k=1}^{K}P_{i,t,k}^{2}-\sum_{j\in Y_r}\sum_{k=1}^{K}D_{j,t,k}^{2}:\rho_{r,t}^{2}$$

$$-\sum_{l\in Z_r}\overline{P}_{l}^{Ex}\le P_{r,t}\le\sum_{l\in Z_r}\overline{P}_{l}^{Ex}:\omega_{r,t}^{l\min,2},\omega_{r,t}^{l\max,2}$$

$$0\le P_{i,t,k}^{2}\le\overline{P}_{i,k}^{2}:\omega_{i,t,k}^{G\min,2},\omega_{i,t,k}^{G\max,2}$$

$$0\le D_{j,t,k}^{2}\le\overline{D}_{j,k}^{2}:\omega_{j,t,k}^{D\min,2},\omega_{j,t,k}^{D\max,2}$$

$$\alpha_{i,k}^{2}-\pi_{r,t}^{2}+\zeta_{i,t,k}^{G2,\max}-\zeta_{i,t,k}^{G2,\min}=0:\gamma_{i,t,k}^{G,2}$$

$$-\beta_{j,k}^{2}+\pi_{r,t}^{2}+\zeta_{j,t,k}^{D2,\max}-\zeta_{j,t,k}^{D2,\min}=0:\gamma_{j,t,k}^{D,2}$$

$$\pi_{r,t}^{2}-\tau_{r,t}^{Ex,\min}+\tau_{r,t}^{Ex,\max}=0:\gamma_{r,t}^{Ex}$$

$$\tau_{r,t}^{Ex,\min},\tau_{r,t}^{Ex,\max}\ge 0:\gamma_{r,t}^{Ex,\min},\gamma_{r,t}^{Ex,\max}$$

$$\zeta_{i,t,k}^{G2,\max},\zeta_{i,t,k}^{G2,\min}\ge 0:\gamma_{i,t,k}^{G2,\min},\gamma_{i,t,k}^{G2\quad ax}$$

$$\zeta_{j,t,k}^{D2,\max},\zeta_{j,t,k}^{D2,\min}\ge 0:\gamma_{j,t,k}^{D2,\min},\gamma_{j,t,k}^{D2\quad ax}$$

$$\sum_{t=1}^{T}(\sum_{i=1}^{I}\sum_{k=1}^{K}\alpha_{i,k}^{2}P_{i,t,k}^{2}-\sum_{j=1}^{J}\sum_{k=1}^{K}\beta_{j,k}^{2}D_{j,t,k}^{2})-\sum_{t=1}^{T}\sum_{r}\tau_{r}^{Ex,\min}\sum_{l\in Z_r}\overline{P}_{l,t}^{Ex}-\sum_{t=1}^{T}\sum_{r}\tau_{r,t}^{Ex,\max}\sum_{l\in Z_r}\overline{P}_{l,t}^{Ex}$$

$$-\sum_{t=1}^{T}\sum_{i=1}^{I}\sum_{k=1}^{K}\zeta_{i,t,k}^{G2,\max}\overline{P}_{i,k}^{2}-\sum_{t=1}^{T}\sum_{j=1}^{J}\sum_{k=1}^{K}\zeta_{j,t,k}^{D2,\max}\overline{D}_{j,k}^{2}=0:\gamma^{DT,2}$$

$$P_{i,t}=\sum_{k=1}^{K}P_{i,t,k}^{1}+\sum_{k=1}^{K}P_{i,t,k}^{2}:\rho_{i,t}^{G'}$$

$$D_{j,t}=\sum_{k=1}^{K}D_{i,t,k}^{1}+\sum_{k=1}^{K}D_{i,t,k}^{2}:\rho_{j,t}^{D'}$$

$$\sum_{i\in\Psi_n}P_{i,t}-\sum_{j\in\Phi_n}D_{j,t}=\sum_{l\in O_n}P_{l,t}-\sum_{l\in I_n}P_{l,t}+\sum_{l\in Co_n}P_{l,t}^{Ex}-\sum_{l\in Ci_n}P_{l,t}^{Ex}:\rho_{n,t}^{1}$$

$$0\le P_{i,t,k}^{1}\le\overline{P}_{i,k}^{1}:\omega_{i,t,k}^{G\min,1},\omega_{i,t,k}^{G\max,1}$$

$$0\le D_{j,t,k}^{1}\le\overline{D}_{j,k}^{1}:\omega_{j,t,k}^{D\min,1},\omega_{j,t,k}^{D\max,1}$$

$$-P_{i}^{rp}\le P_{i,t}-P_{i,t+1}\le P_{i}^{rp}:\omega_{i,t}^{rp\min},\omega_{i,t}^{rp\max}$$

$$P_{l,t}=\sum_{n=1}^{N}G_{l-n}(\sum_{i\in\Psi_n}P_{i,t}-\sum_{j\in\Phi_n}D_{j,t}):\rho_{l,t}^{L}$$

$$-\overline{P}_l\le P_{l,t}\le\overline{P}_l:\omega_{l,t}^{L\min},\omega_{l,t}^{L\max}$$

$$\alpha_{i,k}^{1}-\chi_{i,t}^{G}-\zeta_{i,t,k}^{G1,\min}+\zeta_{i,t,k}^{G1,\max}=0:\gamma_{i,t,k}^{G,1}$$

$$-\beta_{j,k}^{1}-\chi_{j,t}^{D}-\zeta_{i,t,k}^{D1,\min}+\zeta_{i,t,k}^{D1,\max}=0:\gamma_{j,t,k}^{D,1}$$

$$\chi_{i,t}^{G}-\pi_{n,t}^{1}-\sum_{l=1}^{L}\vartheta_{l,t}G_{l-n}-\eta_{i,t}^{\min}+\eta_{i,t}^{\max}+\eta_{i,t-1}^{\min}-\eta_{i,t-1}^{\max}=0,i\in\Psi_n:\gamma_{i,t}^{G}$$

$$\chi_{j,t}^{D}+\pi_{n,t}^{1}+\sum_{l=1}^{L}\vartheta_{l,t}G_{l-n}=0,j\in\Phi_n:\gamma_{j,t}^{D}$$

$$\vartheta_{l,t}+\pi_{x,t}^{1}-\pi_{y,t}^{1}-\tau_{l,t}^{\min}+\tau_{l,t}^{\max}=0,l\in O_x,l\in I_y:\gamma_{l,t}^{L}$$

$$\zeta_{i,t,k}^{G1,\min},\zeta_{i,t,k}^{G1,\max}\ge0:\gamma_{i,t,k}^{G1,\min},\gamma_{i,t,k}^{G1,\max}$$

$$\zeta_{j,t,k}^{D1,\min},\zeta_{j,t,k}^{D1,\max}\ge0:\gamma_{j,t,k}^{D1,\min},\gamma_{j,t,k}^{D1,\max}$$

$$\eta_{i,t}^{\min},\eta_{i,t}^{\max}\ge0:\gamma_{i,t}^{rp,\min},\gamma_{i,t}^{rp,\max}$$

$$\tau_{l,t}^{\min},\tau_{l,t}^{\max}\ge0:\gamma_{l,t}^{L,\min},\gamma_{l,t}^{L,\max}$$

$$\sum_{t=1}^{T}(\sum_{i=1}^{I}\sum_{k=1}^{K}\alpha_{i,k}^{1}P_{i,t,k}^{1}-\sum_{j=1}^{J}\sum_{k=1}^{K}\beta_{j,k}^{1}D_{j,t,k}^{1})+\sum_{t=1}^{T}\sum_{n=1}^{N}\pi_{n,t}^{1}(\sum_{l\in Co_n}P_{l,t}^{Ex}-\sum_{l\in Ci_n}P_{l,t}^{Ex})$$
$$-\sum_{t=1}^{T}\sum_{i=1}^{I}\sum_{k=1}^{K}\zeta_{i,t,k}^{G1,\max}\overline{P}_{i,k}^{1}-\sum_{t=1}^{T}\sum_{j=1}^{J}\sum_{k=1}^{K}\zeta_{j,t,k}^{D1,\max}\overline{D}_{j,k}^{1}-\sum_{t=1}^{T}\sum_{i=1}^{I}\eta_{i,t}^{\min}P_i^{rp}-\sum_{t=1}^{T}\sum_{i=1}^{I}\eta_{i,t}^{\max}P_i^{rp}$$
$$-\sum_{t=1}^{T}\sum_{l=1}^{L}\tau_{l,t}^{\min}\overline{P}_l-\sum_{t=1}^{T}\sum_{l=1}^{L}\tau_{l,t}^{\max}\overline{P}_l=0:\gamma^{DT,1}$$

对于每一个市场参与者（市场主体），可以建立其优化决策模型的拉格朗日函数，并列写其 KKT 条件：

（原始可行）：

$$0=\alpha_{i,0}^{1}<\alpha_{i,1}^{1}<\alpha_{i,2}^{1}<...<\alpha_{i,K}^{1}$$

$$0=\alpha_{i,0}^{2}<\alpha_{i,1}^{2}<\alpha_{i,2}^{2}<...<\alpha_{i,K}^{2}$$

$$\beta_{j,1}^{1}>\beta_{j,2}^{1}>...>\beta_{j,K}^{1}>\beta_{j,0}^{1}=0$$

$$\beta_{j,1}^{2}>\beta_{j,2}^{2}>...>\beta_{j,K}^{2}>\beta_{j,0}^{2}=0$$

$$P_{r,t}=\sum_{i\in X_r}\sum_{k=1}^{K}P_{i,t,k}^{2}-\sum_{j\in Y_r}\sum_{k=1}^{K}D_{j,t,k}^{2}$$

$$-\sum_{l\in Z_r}\overline{P}_l^{Ex}\le P_{r,t}\le\sum_{l\in Z_r}\overline{P}_l^{Ex}$$

$$0\le P_{i,t,k}^{2}\le\overline{P}_{i,k}^{2}$$

$$0\le D_{j,t,k}^{2}\le\overline{D}_{j,k}^{2}$$

$$\alpha_{i,k}^{2}-\pi_{r,t}^{2}+\zeta_{i,t,k}^{G2,\max}-\zeta_{i,t,k}^{G2,\min}=0$$

$$-\beta_{j,k}^{2}+\pi_{r,t}^{2}+\zeta_{j,t,k}^{D2,\max}-\zeta_{j,t,k}^{D2,\min}=0$$

$$\pi_{r,t}^{2}-\tau_{r,t}^{Ex,\min}+\tau_{r,t}^{Ex,\max}=0$$

$$\tau_{r,t}^{Ex,\min},\tau_{r,t}^{Ex,\max}\geq 0$$

$$\zeta_{i,t,k}^{G2,\max},\zeta_{i,t,k}^{G2,\min}\geq 0$$

$$\zeta_{j,t,k}^{D2,\max},\zeta_{j,t,k}^{D2,\min}\geq 0$$

$$\sum_{t=1}^{T}(\sum_{i=1}^{I}\sum_{k=1}^{K}\alpha_{i,k}^{2}P_{i,t,k}^{2}-\sum_{j=1}^{J}\sum_{k=1}^{K}\beta_{j,k}^{2}D_{j,t,k}^{2})-\sum_{t=1}^{T}\sum_{r}\tau_{r}^{Ex,\min}\sum_{l\in Z_r}\overline{P}_{l,t}^{Ex}-\sum_{t=1}^{T}\sum_{r}\tau_{r,t}^{Ex,\max}\sum_{l\in Z_r}\overline{P}_{l,t}^{Ex}$$

$$-\sum_{t=1}^{T}\sum_{i=1}^{I}\sum_{k=1}^{K}\zeta_{i,t,k}^{G,\max}\overline{P}_{i,k}^{2}-\sum_{t=1}^{T}\sum_{j=1}^{J}\sum_{k=1}^{K}\zeta_{j,t,k}^{D,\max}\overline{D}_{j,k}^{2}=0$$

$$P_{i,t}=\sum_{k=1}^{K}P_{i,t,k}^{1}+\sum_{k=1}^{K}P_{i,t,k}^{2}$$

$$D_{j,t}=\sum_{k=1}^{K}D_{i,t,k}^{1}+\sum_{k=1}^{K}D_{i,t,k}^{2}$$

$$\sum_{i\in\Psi_n}P_{i,t}-\sum_{j\in\Phi_n}D_{j,t}=\sum_{l\in O_n}P_{l,t}-\sum_{l\in I_n}P_{l,t}+\sum_{l\in Co_n}P_{l,t}^{Ex}-\sum_{l\in Ci_n}P_{l,t}^{Ex}$$

$$0\leq P_{i,t,k}^{1}\leq\overline{P}_{i,k}^{1}$$

$$0\leq D_{j,t,k}^{1}\leq\overline{D}_{j,k}^{1}$$

$$-P_{i}^{rp}\leq P_{i,t}-P_{i,t+1}\leq P_{i}^{rp}$$

$$P_{l,t}=\sum_{n=1}^{N}G_{l-n}(\sum_{i\in\Psi_n}P_{i,t}-\sum_{j\in\Phi_n}D_{j,t})$$

$$-\overline{P}_{l}\leq P_{l,t}\leq\overline{P}_{l}$$

$$\alpha_{i,k}^{1}-\chi_{i,t}^{G}-\zeta_{i,t,k}^{G1,\min}+\zeta_{i,t,k}^{G1,\max}=0$$

$$-\beta_{j,k}^{1}-\chi_{j,t}^{D}-\zeta_{i,t,k}^{D1,\min}+\zeta_{i,t,k}^{D1,\max}=0$$

$$\chi_{i,t}^{G}-\pi_{n,t}^{1}-\sum_{l=1}^{L}\vartheta_{l,t}G_{l-n}-\eta_{i,t}^{\min}+\eta_{i,t}^{\max}+\eta_{i,t-1}^{\min}-\eta_{i,t-1}^{\max}=0,i\in\Psi_n$$

$$\chi_{j,t}^{D}+\pi_{n,t}^{1}+\sum_{l=1}^{L}\vartheta_{l,t}G_{l-n}=0,j\in\Phi_n$$

$$\vartheta_{l,t}+\pi_{x,t}^{1}-\pi_{y,t}^{1}-\tau_{l,t}^{\min}+\tau_{l,t}^{\max}=0,l\in O_x,l\in I_y$$

$$\zeta_{i,t,k}^{G1,\min},\zeta_{i,t,k}^{G1,\max}\geq 0$$

$$\zeta_{j,t,k}^{D1,\min},\zeta_{j,t,k}^{D1,\max}\geq 0$$

$$\eta_{i,t}^{\min},\eta_{i,t}^{\max}\geq 0$$

$$\tau_{l,t}^{\min},\tau_{l,t}^{\max}\geq 0$$

$$\sum_{t=1}^{T}(\sum_{i=1}^{I}\sum_{k=1}^{K}\alpha_{i,k}^{1}P_{i,t,k}^{1}-\sum_{j=1}^{J}\sum_{k=1}^{K}\beta_{j,k}^{1}D_{j,t,k}^{1})+\sum_{t=1}^{T}\sum_{n=1}^{N}\pi_{n,t}^{1}(\sum_{l\in Co_n}P_{l,t}^{Ex}-\sum_{l\in Ci_n}P_{l,t}^{Ex})$$
$$-\sum_{t=1}^{T}\sum_{i=1}^{I}\sum_{k=1}^{K}\zeta_{i,t,k}^{G1,\max}\overline{P}_{i,k}^{1}-\sum_{t=1}^{T}\sum_{j=1}^{J}\sum_{k=1}^{K}\zeta_{j,t,k}^{D1,\max}\overline{D}_{j,k}^{1}-\sum_{t=1}^{T}\sum_{i=1}^{I}\eta_{i,t}^{\min}P_{i}^{rp}-\sum_{t=1}^{T}\sum_{i=1}^{I}\eta_{i,t}^{\max}P_{i}^{rp}$$
$$-\sum_{t=1}^{T}\sum_{l=1}^{L}\tau_{l,t}^{\min}\overline{P}_{l}-\sum_{t=1}^{T}\sum_{l=1}^{L}\tau_{l,t}^{\max}\overline{P}_{l}=0$$

（对偶可行）：

$$\frac{\partial L}{\partial P_{i,t,k}}=\lambda_{i,k}-\rho_{i,t}^{G}-\omega_{i,t,k}^{G\min,0}+\omega_{i,t,k}^{G\max,0}=0$$
$$\frac{\partial L}{\partial P_{i,t,k}^{1}}=-\pi_{i,t}^{1}-\rho_{i,t}^{G'}-\omega_{i,t,k}^{G\min,1}+\omega_{i,t,k}^{G\max,1}+\alpha_{i,k}^{1}\gamma^{DT,1}=0$$
$$\frac{\partial L}{\partial P_{i,t,k}^{2}}=-\pi_{i,t}^{2}-\rho_{r,t}^{2}-\rho_{i,t}^{G'}-\omega_{i,t,k}^{G\min,2}+\omega_{i,t,k}^{G\max,2}+\alpha_{i,k}^{2}\gamma^{DT,2}=0$$
$$\frac{\partial L}{\partial \alpha_{i,k}^{1}}=-\omega_{i,k}^{\alpha,1}+\omega_{i,k-1}^{\alpha,1}+\sum_{t=1}^{T}\gamma_{i,t,k}^{G,1}+\gamma^{DT,1}\sum_{t=1}^{T}P_{i,t,k}^{1}=0$$
$$\frac{\partial L}{\partial \alpha_{i,k}^{2}}=-\omega_{i,k}^{\alpha,2}+\omega_{i,k-1}^{\alpha,2}+\sum_{t=1}^{T}\gamma_{i,t,k}^{G,2}+\gamma^{DT,2}\sum_{t=1}^{T}P_{i,t,k}^{2}=0$$
$$\frac{\partial L}{\partial D_{j,t,k}}=-\mu_{j,k}-\rho_{j,t}^{D}-\omega_{j,t,k}^{D\min,0}+\omega_{j,t,k}^{D\max,0}=0$$
$$\frac{\partial L}{\partial D_{j,t,k}^{1}}=\pi_{j,t}^{1}-\rho_{i,t}^{D'}-\omega_{i,t,k}^{D\min,1}+\omega_{i,t,k}^{G\max,1}-\beta_{i,k}^{1}\gamma^{DT,1}=0$$
$$\frac{\partial L}{\partial D_{j,t,k}^{2}}=\pi_{i,t}^{2}+\rho_{r,t}^{2}-\rho_{i,t}^{D'}-\omega_{j,t,k}^{D\min,2}+\omega_{j,t,k}^{D\max,2}-\beta_{j,k}^{2}\gamma^{DT,2}=0$$
$$\frac{\partial L}{\partial \beta_{j,k}^{1}}=\omega_{j,k}^{\beta,1}-\omega_{j,k-1}^{\beta,1}-\sum_{t=1}^{T}\gamma_{j,t,k}^{D,1}-\gamma^{DT,1}\sum_{t=1}^{T}D_{j,t,k}^{1}=0$$
$$\frac{\partial L}{\partial \beta_{j,k}^{2}}=\omega_{j,k}^{\beta,2}+\omega_{j,k-1}^{\beta,2}-\sum_{t=1}^{T}\gamma_{j,t,k}^{D,2}-\gamma^{DT,2}\sum_{t=1}^{T}D_{j,t,k}^{2}=0$$
$$\frac{\partial L}{\partial \pi_{n,t}^{1}}=-\sum_{k=1}^{K}P_{i,t,k}^{1}-\sum_{k=1}^{K}\gamma_{i,t,k}^{G}+\sum_{l=O_n}\gamma_{l,t}^{L}-\sum_{l=I_n}\gamma_{l,t}^{L}+\gamma^{DT,1}(\sum_{l\in Co_n}P_{l,t}^{Ex}-\sum_{l\in Ci_n}P_{l,t}^{Ex})=0,i\in\Psi_n$$
$$\frac{\partial L}{\partial \pi_{n,t}^{1}}=\sum_{k=1}^{K}D_{j,t,k}^{1}-\sum_{k=1}^{K}\gamma_{j,t,k}^{D}+\sum_{l=O_n}\gamma_{l,t}^{L}-\sum_{l=I_n}\gamma_{l,t}^{L}+\gamma^{DT,1}(\sum_{l\in Co_n}P_{l,t}^{Ex}-\sum_{l\in Ci_n}P_{l,t}^{Ex})=0,j\in\Phi_n$$
$$\frac{\partial L}{\partial \pi_{r,t}^{2}}=-\sum_{k=1}^{K}P_{i,t,k}^{2}-\sum_{k=1}^{K}\gamma_{i,t,k}^{G,2}+\gamma_{r,t}^{Ex}=0,i\in\Psi_r$$
$$\frac{\partial L}{\partial \pi_{r,t}^{2}}=\sum_{k=1}^{K}D_{j,t,k}^{2}+\sum_{k=1}^{K}\gamma_{j,t,k}^{D,2}+\gamma_{r,t}^{Ex}=0,i\in\Phi_r$$
$$\frac{\partial L}{\partial P_{i,t}}=\rho_{i,t}^{G}+\rho_{i,t}^{G'}+\rho_{n,t}^{1}+\omega_{i,t}^{rp\min}-\omega_{i,t}^{rp\max}-\sum_{l\in O_n or l\in I_n}\rho_{l,t}^{L}G_{l-n}=0$$

$$\frac{\partial L}{\partial D_{j,t}} = \rho_{j,t}^{D} + \rho_{j,t}^{D'} - \rho_{n,t}^{1} + \sum_{l \in O_n or l \in I_n} \rho_{l,t}^{L} G_{l-n} = 0$$

$$\frac{\partial L}{\partial P_{r,t}} = \rho_{r,t}^{2} - \omega_{r,t}^{l\min,2} + \omega_{r,t}^{l\max,2} = 0$$

$$\frac{\partial L}{\partial \zeta_{i,t,k}^{G2,\max}} = \gamma_{i,t,k}^{G,2} - \gamma_{i,t,k}^{G2,\max} - \gamma^{DT,2} \overline{P}_{i,k}^{2} = 0$$

$$\frac{\partial L}{\partial \zeta_{i,t,k}^{G2,\min}} = -\gamma_{i,t,k}^{G,2} - \gamma_{i,t,k}^{G2,\min} = 0$$

$$\frac{\partial L}{\partial \zeta_{j,t,k}^{D2,\max}} = \gamma_{j,t,k}^{D,2} - \gamma_{j,t,k}^{D2,\max} - \gamma^{DT,2} P\overline{D}_{j,k}^{2} = 0$$

$$\frac{\partial L}{\partial \zeta_{j,t,k}^{D2,\min}} = -\gamma_{j,t,k}^{D,2} - \gamma_{j,t,k}^{D2,\min} = 0$$

$$\frac{\partial L}{\partial \tau_{r,t}^{Ex,\max}} = \gamma_{r,t}^{Ex} - \gamma_{r,t}^{Ex,\max} - \gamma^{DT,2} \sum_{l \in Z_r} \overline{P}_{l,t}^{Ex} = 0$$

$$\frac{\partial L}{\partial \tau_{r,t}^{Ex,\min}} = -\gamma_{r,t}^{Ex} - \gamma_{r,t}^{Ex,\min} - \gamma^{DT,2} \sum_{l \in Z_r} \overline{P}_{l,t}^{Ex} = 0$$

$$\frac{\partial L}{\partial P_{l,t}} = \rho_{,}^{L} + \rho_{,}^{1} - \rho_{y,t}^{1} - \omega_{l,t}^{L\min} + \omega_{l,t}^{L\max} = 0, l \in O_x, l \in I_y$$

$$\frac{\partial L}{\partial \chi_{i,t}^{G}} = -\sum_{k=1}^{K} \gamma_{i,t,k}^{G,1} + \gamma_{i,t}^{G} = 0$$

$$\frac{\partial L}{\partial \chi_{j,t}^{D}} = -\sum_{k=1}^{K} \gamma_{j,t,k}^{D,1} + \gamma_{j,t}^{D} = 0$$

$$\frac{\partial L}{\partial \zeta_{i,t,k}^{G1,\min}} = -\gamma_{i,t,k}^{G,1} - \gamma_{i,t,k}^{G1,\min} = 0$$

$$\frac{\partial L}{\partial \zeta_{i,t,k}^{G1,\max}} = \gamma_{i,t,k}^{G,1} - \gamma_{i,t,k}^{G1,\max} - \gamma^{DT,1} \overline{P}_{i,k}^{1} = 0$$

$$\frac{\partial L}{\partial \zeta_{j,t,k}^{D1,\min}} = -\gamma_{j,t,k}^{D,1} - \gamma_{j,t,k}^{D1,\min} = 0$$

$$\frac{\partial L}{\partial \zeta_{j,t,k}^{D1,\max}} = \gamma_{j,t,k}^{D,1} - \gamma_{j,t,k}^{D1,\max} - \gamma^{DT,1} \overline{D}_{j,k}^{1} = 0$$

$$\frac{\partial L}{\partial \eta_{i,t}^{\min}} = -\gamma_{i,t}^{G} + \gamma_{i,t-1}^{G} - \gamma_{i,t}^{rp,\min} - \gamma^{DT,1} P_{i}^{rp} = 0$$

$$\frac{\partial L}{\partial \eta_{i,t}^{\max}} = \gamma_{i,t}^{G} - \gamma_{i,t-1}^{G} - \gamma_{i,t}^{rp,\max} - \gamma^{DT,1} P_{i}^{rp} = 0$$

$$\frac{\partial L}{\partial \vartheta_{l,t}} = \sum_{n=1}^{N} G_{l-n} \left(\sum_{j \in \Phi_n} \gamma_{j,t}^{D} - \sum_{i \in \Psi_n} \gamma_{i,t}^{G} \right) + \gamma_{l,t}^{L} = 0$$

$$\frac{\partial L}{\partial \tau_{l,t}^{\min}} = -\gamma_{l,t}^{L} - \gamma_{i,t}^{rp,\min} - \gamma^{DT,1}\overline{P}_l = 0$$

$$\frac{\partial L}{\partial \tau_{l,t}^{\max}} = \gamma_{l,t}^{L} - \gamma_{i,t}^{rp,\max} - \gamma^{DT,1}\overline{P}_l = 0$$

（互补松弛条件）：

$$\alpha_{i,k-1}^{1} \le \alpha_{i,k-1}^{1} \perp \omega_{i,k}^{\alpha,1} \ge 0$$

$$\alpha_{i,k-1}^{2} \le \alpha_{i,k-1}^{2} \perp \omega_{i,k}^{\alpha,2} \ge 0$$

$$\beta_{i,k-1}^{1} \ge \beta_{i,k-1}^{1} \perp \omega_{i,k}^{\beta,1} \ge 0$$

$$\beta_{i,k-1}^{2} \ge \beta_{i,k-1}^{2} \perp \omega_{i,k}^{\beta,2} \ge 0$$

$$0 \le P_{i,t,k} \perp \omega_{i,t,k}^{G\min,0} \ge 0$$

$$P_{i,t,k} \le \overline{P}_{i,k} \perp \omega_{i,t,k}^{G\max,0} \ge 0$$

$$-\sum_{l\in Z_r} \overline{P}_l^{Ex} \le P_{r,t} \perp \omega_{r,t}^{l\min,2} \ge 0$$

$$P_{r,t} \le \sum_{l\in Z_r} \overline{P}_l^{Ex} \perp \omega_{r,t}^{l\max,2} \ge 0$$

$$0 \le P_{i,t,k}^{2} \perp \omega_{i,t,k}^{G\min,2} \ge 0$$

$$P_{i,t,k}^{2} \le \overline{P}_{i,k}^{2} \perp \omega_{i,t,k}^{G\max,2} \ge 0$$

$$0 \le D_{j,t,k}^{2} \perp \omega_{j,t,k}^{D\min,2} \ge 0$$

$$D_{j,t,k}^{2} \le \overline{D}_{j,k}^{2} \perp \omega_{j,t,k}^{D\max,2} \ge 0$$

$$\tau_{r,t}^{Ex,\min} \ge 0 \perp \gamma_{r,t}^{Ex,\min} \ge 0$$

$$\tau_{r,t}^{Ex,\max} \ge 0 \perp \gamma_{r,t}^{Ex,\max} \ge 0$$

$$\zeta_{i,t,k}^{G2,\min} \ge 0 \perp \gamma_{i,t,k}^{G2,\min} \ge 0$$

$$\zeta_{i,t,k}^{G2,\max} \ge 0 \perp \gamma_{i,t,k}^{G2,\max} \ge 0$$

$$\zeta_{j,t,k}^{D2,\min} \ge 0 \perp \gamma_{j,t,k}^{D2,\min} \ge 0$$

$$\zeta_{j,t,k}^{D2,\max} \ge 0 \perp \gamma_{j,t,k}^{D2,\max} \ge 0$$

$$0 \le P_{i,t,k}^{1} \perp \omega_{i,t,k}^{G\min,1} \ge 0$$

$$P_{i,t,k}^{1} \le \overline{P}_{i,k}^{1} \perp \omega_{i,t,k}^{G\max,1} \ge 0$$

$$0 \le D_{j,t,k}^{1} \perp \omega_{j,t,k}^{D\min,1} \ge 0$$

$$D_{j,t,k}^{1} \le \overline{D}_{j,k}^{1} \perp \omega_{j,t,k}^{D\max,1} \ge 0$$

$$-P_i^{rp} \le P_{i,t} - P_{i,t+1} \perp \omega_{i,t}^{rp\min} \ge 0$$

$$P_{i,t} - P_{i,t+1} \le P_i^{rp} \perp \omega_{i,t}^{rp\max} \ge 0$$

$$-\overline{P}_l \le P_{l,t} \perp \omega_{l,t}^{L\min} \ge 0$$

$$P_{l,t} \le \overline{P}_l \perp \omega_{l,t}^{L\max} \ge 0$$

$$\zeta_{i,t,k}^{G1,\min} \ge 0 \perp \gamma_{i,t,k}^{G1,\min} \ge 0$$

$$\zeta_{i,t,k}^{G1,\max} \ge 0 \perp \gamma_{i,t,k}^{G1,\max} \ge 0$$

$$\zeta_{j,t,k}^{D1,\min} \geq 0 \perp \gamma_{j,t,k}^{D1,\min} \geq 0$$
$$\zeta_{j,t,k}^{D1,\max} \geq 0 \perp \gamma_{j,t,k}^{D1,\max} \geq 0$$
$$\eta_{i,t}^{\min} \geq 0 \perp \gamma_{i,t}^{rp,\min} \geq 0$$
$$\eta_{i,t}^{\max} \geq 0 \perp \gamma_{i,t}^{rp,\max} \geq 0$$
$$\tau_{l,t}^{\min} \geq 0 \perp \gamma_{l,t}^{L,\min} \geq 0$$
$$\tau_{l,t}^{\max} \geq 0 \perp \gamma_{l,t}^{L,\max} \geq 0$$