We also get $\boldsymbol{p}^{\mathrm{st}(k)}=\boldsymbol{M}^{(2)}\boldsymbol{p}^{\mathrm{st}(k-2)}+\boldsymbol{M}^{(1)}\boldsymbol{p}^{\mathrm{st}(k-1)}$ for further orders of $k\geq 2$. Then, the equilibrium payoff is given by

$$\begin{aligned}
u^{\mathrm{st}(0)} &= \boldsymbol{p}^{\mathrm{st}(0)}\cdot\boldsymbol{u}=u^{\mathrm{st}}, && \text{(A44)}\\
u^{\mathrm{st}(1)} &= \boldsymbol{p}^{\mathrm{st}(1)}\cdot\boldsymbol{u}=0, && \text{(A45)}\\
u^{\mathrm{st}(2)} &= \boldsymbol{p}^{\mathrm{st}(2)}\cdot\boldsymbol{u}=(\boldsymbol{u}\cdot\boldsymbol{1}_z)(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\cdot\boldsymbol{p}^*), && \text{(A46)}\\
u^{\mathrm{st}(3)} &= \boldsymbol{p}^{\mathrm{st}(3)}\cdot\boldsymbol{u}=(\boldsymbol{M}^{(2)}\boldsymbol{p}^{\mathrm{st}(1)}+\boldsymbol{M}^{(1)}\boldsymbol{p}^{\mathrm{st}(2)})\cdot\boldsymbol{u}=(\boldsymbol{u}\cdot\boldsymbol{1}_z)(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\cdot\boldsymbol{p}^{\mathrm{st}(1)}) && \text{(A47)}\\
&= (\boldsymbol{u}\cdot\boldsymbol{1}_z)\left\{(\boldsymbol{\delta}\cdot\boldsymbol{p}^*)(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\circ\boldsymbol{y}^*\cdot\boldsymbol{1}_x)+(\boldsymbol{\epsilon}\cdot\boldsymbol{p}^*)(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\circ\boldsymbol{x}^*\cdot\boldsymbol{1}_y)\right\}, && \text{(A48)}\\
u^{\mathrm{st}(4)} &= \boldsymbol{p}^{\mathrm{st}(4)}\cdot\boldsymbol{u}=(\boldsymbol{M}^{(2)}\boldsymbol{p}^{\mathrm{st}(2)}+\boldsymbol{M}^{(1)}\boldsymbol{p}^{\mathrm{st}(3)})\cdot\boldsymbol{u}=(\boldsymbol{u}\cdot\boldsymbol{1}_z)(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\cdot\boldsymbol{p}^{\mathrm{st}(2)}) && \text{(A49)}\\
&= (\boldsymbol{u}\cdot\boldsymbol{1}_z)[(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\cdot\boldsymbol{p}^*)(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\cdot\boldsymbol{1}_z)\\
&\qquad +\{(\boldsymbol{\delta}\cdot\boldsymbol{p}^*)(\boldsymbol{\delta}\circ\boldsymbol{y}^*\cdot\boldsymbol{1}_x)+(\boldsymbol{\epsilon}\cdot\boldsymbol{p}^*)(\boldsymbol{\delta}\circ\boldsymbol{x}^*\cdot\boldsymbol{1}_y)\}(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\circ\boldsymbol{y}^*\cdot\boldsymbol{1}_x)\\
&\qquad +\{(\boldsymbol{\delta}\cdot\boldsymbol{p}^*)(\boldsymbol{\epsilon}\circ\boldsymbol{y}^*\cdot\boldsymbol{1}_x)+(\boldsymbol{\epsilon}\cdot\boldsymbol{p}^*)(\boldsymbol{\epsilon}\circ\boldsymbol{x}^*\cdot\boldsymbol{1}_y)\}(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\circ\boldsymbol{x}^*\cdot\boldsymbol{1}_y)]. && \text{(A50)}
\end{aligned}$$

Here, we used

$$\begin{aligned}
\boldsymbol{M}^{(1)\mathrm{T}}\boldsymbol{u} &= \underbrace{(\boldsymbol{y}^*\circ\boldsymbol{1}_x\cdot\boldsymbol{u})}_{=0}\boldsymbol{\delta}+\underbrace{(\boldsymbol{x}^*\circ\boldsymbol{1}_y\cdot\boldsymbol{u})}_{=0}\boldsymbol{\epsilon}=\boldsymbol{0}, && \text{(A51)}\\
\boldsymbol{M}^{(2)\mathrm{T}}\boldsymbol{u} &= (\boldsymbol{u}\cdot\boldsymbol{1}_z)\boldsymbol{\delta}\circ\boldsymbol{\epsilon}. && \text{(A52)}
\end{aligned}$$

Then, the gradient of this payoff is given by

$$\begin{aligned}
\frac{\partial u^{\mathrm{st}(1)}}{\partial\boldsymbol{\delta}} &= \boldsymbol{0}, && \text{(A53)}\\
\frac{\partial u^{\mathrm{st}(2)}}{\partial\boldsymbol{\delta}} &= (\boldsymbol{u}\cdot\boldsymbol{1}_z)\boldsymbol{\epsilon}\circ\boldsymbol{p}^*, && \text{(A54)}\\
\frac{\partial u^{\mathrm{st}(3)}}{\partial\boldsymbol{\delta}} &= (\boldsymbol{u}\cdot\boldsymbol{1}_z)\{(\boldsymbol{\delta}\cdot\boldsymbol{p}^*)\boldsymbol{\epsilon}\circ\boldsymbol{y}^*\circ\boldsymbol{1}_x+(\boldsymbol{\epsilon}\cdot\boldsymbol{p}^*)\boldsymbol{\epsilon}\circ\boldsymbol{x}^*\circ\boldsymbol{1}_y+(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\circ\boldsymbol{y}^*\cdot\boldsymbol{1}_x)\boldsymbol{p}^*\}, && \text{(A55)}\\
\frac{\partial u^{\mathrm{st}(4)}}{\partial\boldsymbol{\delta}} &= (\boldsymbol{u}\cdot\boldsymbol{1}_z)[(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\cdot\boldsymbol{p}^*)(\boldsymbol{\epsilon}\circ\boldsymbol{1}_z)+(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\cdot\boldsymbol{1}_z)(\boldsymbol{\epsilon}\circ\boldsymbol{p}^*)\\
&\qquad +\{(\boldsymbol{\delta}\cdot\boldsymbol{p}^*)(\boldsymbol{\delta}\circ\boldsymbol{y}^*\cdot\boldsymbol{1}_x)+(\boldsymbol{\epsilon}\cdot\boldsymbol{p}^*)(\boldsymbol{\delta}\circ\boldsymbol{x}^*\cdot\boldsymbol{1}_y)\}(\boldsymbol{\epsilon}\circ\boldsymbol{y}^*\circ\boldsymbol{1}_x)\\
&\qquad +\{(\boldsymbol{\delta}\cdot\boldsymbol{p}^*)(\boldsymbol{\epsilon}\circ\boldsymbol{y}^*\cdot\boldsymbol{1}_x)+(\boldsymbol{\epsilon}\cdot\boldsymbol{p}^*)(\boldsymbol{\epsilon}\circ\boldsymbol{x}^*\cdot\boldsymbol{1}_y)\}(\boldsymbol{\epsilon}\circ\boldsymbol{x}^*\circ\boldsymbol{1}_y)\\
&\qquad +(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\circ\boldsymbol{y}^*\cdot\boldsymbol{1}_x)\{(\boldsymbol{\delta}\cdot\boldsymbol{p}^*)\boldsymbol{y}^*\circ\boldsymbol{1}_x+(\boldsymbol{\epsilon}\cdot\boldsymbol{p}^*)\boldsymbol{x}^*\circ\boldsymbol{1}_y+(\boldsymbol{\delta}\circ\boldsymbol{y}^*\cdot\boldsymbol{1}_x)\boldsymbol{p}^*\}\\
&\qquad +(\boldsymbol{\delta}\circ\boldsymbol{\epsilon}\circ\boldsymbol{x}^*\cdot\boldsymbol{1}_y)(\boldsymbol{\epsilon}\circ\boldsymbol{y}^*\cdot\boldsymbol{1}_x)\boldsymbol{p}^*]. && \text{(A56)}
\end{aligned}$$

The learning dynamics (of continualized MMGA) in two-action one-memory games are given by

$$\begin{aligned}
\dot{\boldsymbol{\delta}} &= +(x^*\boldsymbol{1}+\boldsymbol{\delta})\circ(\tilde{x}^*\boldsymbol{1}-\boldsymbol{\delta})\circ\frac{\partial u^{\mathrm{st}}}{\partial\boldsymbol{\delta}}, && \text{(A57)}\\
\dot{\boldsymbol{\epsilon}} &= -(y^*\boldsymbol{1}+\boldsymbol{\epsilon})\circ(\tilde{y}^*\boldsymbol{1}-\boldsymbol{\epsilon})\circ\frac{\partial u^{\mathrm{st}}}{\partial\boldsymbol{\epsilon}}. && \text{(A58)}
\end{aligned}$$