

**Additional file 2 — Exact expressions of the condensed monomials in Section 4.2**

With the initial values of the power variables  $\{P_{s_n,t_1}^{k,0}, P_{s_n,t_2}^{k,0}, P_{r_n}^{k,0}\}$  and the considered posynomials in Section 4.2  $\{g_{d_{un},t_1}^{k,0}, g'_{d_{un},t_2}, g_{d_{un},t_2}^{k,0}, g_{r_n}^{k,0}\}$ , the exact expressions of the condensed monomials in Section 4.2 can be denoted as follows:

$$\tilde{g}_{d_{un},t_1}^k = \left(g_{d_{un},t_1}^{k,0}\right)^{\frac{\sigma^2}{g_{d_{un},t_1}^{k,0}}} \prod_{n'} \left(\frac{P_{s_{n'},t_1}^k}{P_{s_{n'},t_1}^{k,0}} g_{d_{un},t_1}^{k,0}\right)^{\frac{P_{s_{n'},t_1}^{k,0} G_{s_{n'},d_{un}}^k}{g_{d_{un},t_1}^{k,0}}},$$

$$\tilde{g}'_{d_{un},t_2}{}^k = \left(g'_{d_{un},t_2}\right)^{\frac{\sigma^2}{g_{d_{un},t_2}^{k,0}}} \prod_{n'} \left(\frac{P_{s_{n'},t_2}^k}{P_{s_{n'},t_2}^{k,0}} g'_{d_{un},t_2}\right)^{\frac{P_{s_{n'},t_2}^{k,0} G_{s_{n'},d_{un}}^k}{g_{d_{un},t_2}^{k,0}}} \prod_{n' \neq n} \left(\frac{P_{r_{n'}}^k}{P_{r_{n'}}^{k,0}} g'_{d_{un},t_2}\right)^{\frac{P_{r_{n'}}^{k,0} G_{r_{n'},d_{un}}^k}{g_{d_{un},t_2}^{k,0}}}$$

$$\tilde{g}_{d_{un},t_2}^k = \left(g_{d_{un},t_2}^{k,0}\right)^{\frac{\sigma^2}{g_{d_{un},t_2}^{k,0}}} \prod_{n' \neq n} \left(\frac{P_{s_{n'},t_2}^k}{P_{s_{n'},t_2}^{k,0}} g_{d_{un},t_2}^{k,0}\right)^{\frac{P_{s_{n'},t_2}^{k,0} G_{s_{n'},d_{un}}^k}{g_{d_{un},t_2}^{k,0}}} \prod_{n'} \left(\frac{P_{r_{n'}}^k}{P_{r_{n'}}^{k,0}} g_{d_{un},t_2}^{k,0}\right)^{\frac{P_{r_{n'}}^{k,0} G_{r_{n'},d_{un}}^k}{g_{d_{un},t_2}^{k,0}}}$$

$$\tilde{g}_{r_n}^k = \left(g_{r_n}^{k,0}\right)^{\frac{\sigma^2}{g_{r_n}^{k,0}}} \prod_{n'} \left(\frac{P_{s_{n'},t_1}^k}{P_{s_{n'},t_1}^{k,0}} g_{r_n}^{k,0}\right)^{\frac{P_{s_{n'},t_1}^{k,0} G_{s_{n'},r_n}^k}{g_{r_n}^{k,0}}},$$