$$\operatorname{tr} B_3 = (1 - \gamma_2)\frac{\phi_2}{1 + \beta_{21}n_{1a}^*} + s_{2a}$$

$$\det B_3 = (1 - \gamma_2)\frac{\phi_2}{1 + \beta_{21}n_{1a}^*}s_{2a} - \gamma_2\frac{\phi_2}{1 + \beta_{21}n_{1a}^*}\frac{\pi_2}{1 + \alpha_{21}n_{1a}^*}.$$