The frequency dependence of the sideband shift is determined by the variables in Eq. (3) and the evolution equations for the sidebands. The sidebands experience a frequency difference of $\delta \tau$ from the center frequency, which yields the relation $\delta \tau = \frac{1}{\Delta n} \left( n_2 a^2 + \frac{1}{2} n_3 a^4 \right)$, where $n_2$ and $n_3$ are the nonlinear coefficients for the sidebands.

In the case of infinite small nonlinearity ($\tau = 0$), the XPM coupling coefficient $\eta$ is determined by the values of $\Lambda$, $\Delta n$, and $\alpha$. The total gain $G$ is given by $G = G_{\text{tot}} - G_{\text{SD}}$, where $G_{\text{tot}}$ is the total gain $G_{\text{tot}} = G_{\text{XPM}} + G_{\text{Raman}}$.

In backward-pumped scheme (c), the sideband frequency shift is observed in the absence of MI, whereas in forward-pumped scheme (b), the sideband frequency shift is observed in the presence of MI. The sideband frequency shift is determined by the values of $\Lambda$, $\Delta n$, and $\alpha$, where $\Lambda$ is the nonlinear coefficient for the sidebands, $\Delta n$ is the nonlinear coefficient for the sidebands, and $\alpha$ is the two-wave coupling coefficient.