Deriving Polytropic EOS + ideal gas

Polytropic EOS: $P = K \rho^{\Gamma}$

Ideal gas: $P = \frac{k_B}{\mu m_p} \rho T \Rightarrow T = \frac{\mu m_p}{k_B} \frac{P}{\rho}$

$P = K \rho^{\Gamma}$

$T = \frac{\mu m_p}{k_B} K \rho^{\Gamma - 1} \Rightarrow T \propto \rho^{\Gamma - 1}$

$T_0 = C \rho_0^{\Gamma - 1}$

$T(r) = C \rho(r)^{\Gamma - 1}$

$$\frac{T(r)}{T_0} = \left(\frac{P(r)}{\rho_0} \right)^{\Gamma - 1}$$

$$T(r) = T_0 \left(\frac{P(r)}{P_0} \right)^{\Gamma - 1}$$