

$$\begin{aligned}
\left(\frac{\partial x}{\partial T}\right)_v &= \frac{-\left(\frac{dv'}{dT}\right)(v'' - v') - (v - v')\left(\left(\frac{dv''}{dT}\right) - \left(\frac{dv'}{dT}\right)\right)}{(v'' - v')^2} \\
&= \frac{\left(\frac{dv'}{dT}\right) + x\left(\left(\frac{dv''}{dT}\right) - \left(\frac{dv'}{dT}\right)\right)}{(v' - v'')} \\
&= \frac{x\left(\frac{dv''}{dT}\right) + (1 - x)\left(\frac{dv'}{dT}\right)}{(v' - v'')}
\end{aligned}$$


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$$\begin{aligned}
\left(\frac{\partial x}{\partial p}\right)_h &= \frac{-\left(\frac{dh'}{dp}\right)(h'' - h') - (h - h')\left(\left(\frac{dh''}{dp}\right) - \left(\frac{dh'}{dp}\right)\right)}{(h'' - h')^2} \\
&= \frac{\left(\frac{dh'}{dp}\right) + x\left(\left(\frac{dh''}{dp}\right) - \left(\frac{dh'}{dp}\right)\right)}{(h' - h'')} \\
&= \frac{x\left(\frac{dh''}{dp}\right) + (1 - x)\left(\frac{dh'}{dp}\right)}{(h' - h'')}
\end{aligned}$$


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$$\begin{aligned}
\left(\frac{\partial x}{\partial p}\right)_s &= \frac{-\left(\frac{ds'}{dp}\right)(s'' - s') - (s - s')\left(\left(\frac{ds''}{dp}\right) - \left(\frac{ds'}{dp}\right)\right)}{(s'' - s')^2} \\
&= \frac{\left(\frac{ds'}{dp}\right) + x\left(\left(\frac{ds''}{dp}\right) - \left(\frac{ds'}{dp}\right)\right)}{(s' - s'')} \\
&= \frac{x\left(\frac{ds''}{dp}\right) + (1 - x)\left(\frac{ds'}{dp}\right)}{(s' - s'')}
\end{aligned}$$


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