























































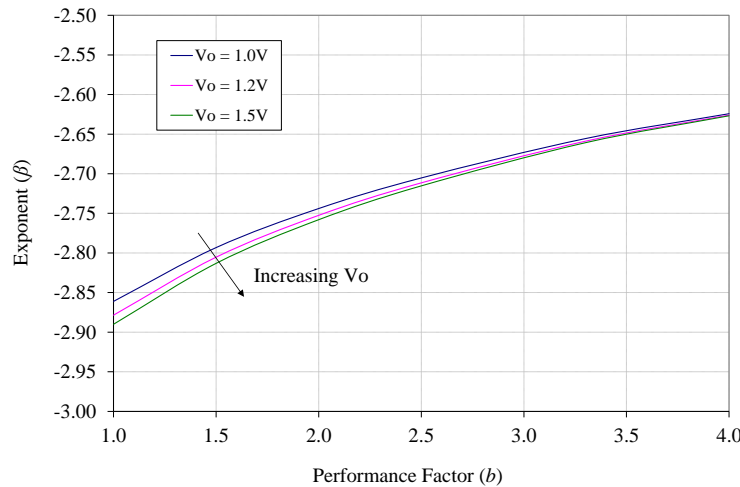
and

$$b = \frac{R_{P0} C_{P0}}{R_{N0} C_{N0}} . \quad (14)$$

In eqn. (14),  $b$  represents a relative performance factor for  $S_H$  and  $S_L$ . If both devices exhibit the same  $RC$  product (e.g., are both NMOS), then  $b$  equals one. More typically,  $S_H$  is a PMOS and  $S_L$  is a NMOS, so  $b$  is closer to three. Furthermore, it can be shown empirically that  $f_{opt}$  fits the power law

$$f_{opt} = kV_{in}^{\beta} , \quad (15)$$

assuming both  $\beta$  and  $k$  are functions of  $b$  and  $V_o$ , and given  $V_{in} > 2V_o$ . Figure 18 shows how the exponent  $\beta$  varies as a function of  $b$  for various  $V_o$ .



**Figure 18 – Exponent  $\beta$  vs. relative performance factor ( $b$ )**

What can be concluded from eqn. (15) and Figure 18 is that  $f_{opt}$  increases very rapidly with decreasing  $V_{in}$ . For example, if  $b = 3$  and  $V_o = 1.0$  V, then  $\beta = -2.67$ . Therefore, a buck converter with a  $V_{in}$  of 1.8 V should be able to switch 15.3 times faster than a buck converter with a  $V_{in}$  of 5.0 V with equal power loss in both cases. This leads to less energy storage in the filter elements ( $L$  and  $C$ ) for a given dynamic and static response.