Consequences of Regge behaviour

In Susy LFHQCD we obtain for the nucleon ($\tau = 3$) FF the beautiful result:

$$F(t) = \frac{1}{B(2, 1-\alpha_0)}\, B(2, 1-\alpha(t)) \tag{1}$$

where $\alpha(t) = \alpha_0 - \alpha'\, t$.

For vector current: $\alpha_0 = \frac{1}{2}$, for axial current $\alpha_0 = 0$, for both currents : $\alpha' = \frac{1}{4\lambda}$

From that we can deduce that the distribution function $q(x)$ can be expressed in a parametrization invariant way as:

$$q(x) = \frac{1}{B(2, 1-\alpha_0)}\; (1 - w(x))\; w(x)^{-\alpha(t)}\, w'(x) \tag{2}$$

For small x we assume $w(x) = C\, x + O(x^2)$ This yields for the small x dependence:

$$q(x) \sim \frac{1}{B(2, 1-\alpha_0)}\, (Cx)^{-\alpha(t)}\, C = \frac{1}{B(2, 1-\alpha_0)}\, C^{1-\alpha_0-\alpha' t}\, x^{-\alpha_0-\alpha' t} \tag{3}$$

For small x Regge behaviour suggests :

$$q(x,t) \sim \beta_R(t) \left(\frac{x_0}{x}\right)^{\alpha(t)} \tag{4}$$

where $x_0 < 1$ is the value of x where Regge behaviour sets in. x is conventionally identified with the Bjorken $x = \frac{Q^2}{s+m^2+Q^2}$ Comparing the two expressions we obtain for the Regge residue the condition:

$$\beta_R(t) \left(\frac{x_0}{x}\right)^{-\alpha_0-\alpha' t} = \frac{1}{B(2, 1-\alpha_0)}\, C^{1-\alpha_0-\alpha' t}\, x^{-\alpha_0-\alpha' t} \tag{5}$$

$$\beta_R(t) = \frac{1}{B(2, 1-\alpha_0)}\, C^{1-\alpha_0} x^{-\alpha_0} e^{-\log(C\, x_0)\, t/(4\lambda)} \tag{6}$$

For the vector current we obtain

$$\beta_V(t) = \frac{3}{4}\left(\frac{C_V}{x_0}\right)^{1/2} \exp[-\log(C_V\, x_0)\, t/(4\lambda)] \tag{7}$$

For the axial current:

$$\beta_V(t) = 2C_A\, \exp[-\log(C_A\, x_0)\, t/(4\lambda)] \tag{8}$$

If we assume that the Regge residues at $t = 0$ are approximatly equal, then we have:

$$C_A \approx \frac{3}{8}\sqrt{\frac{C_V}{x_0}} \tag{9}$$

As a rough estimate for the t-dependence of the residue we assume that is similart to that of a FF, that is we assume that $C_V x_0 = e^{-n}$ with n in the range $2 \ldots 4$, that is $x_0 \approx e^{-n}/C_V$ Then $C_A \approx \frac{3}{8} C_V e^{n/2}$

For the standard form we have: $w'(0, a) = e^{-a}$ and hence we expect wery roughly:

$$a_A = a_V - n/2 + 0.98 \tag{10}$$

That is we expect a_A to be near zero or even negative.