

→ <sup>(Estimated)</sup> VARIANCES OF NON-LINEAR FUNCTIONS OF <sup>(Estimated)</sup> PARAMETERS  $\approx$

$$V(f(B)) \approx \begin{bmatrix} \frac{\partial f(B)}{\partial \beta_0} \\ \frac{\partial f(B)}{\partial \beta_1} \\ \vdots \\ \frac{\partial f(B)}{\partial \beta_k} \end{bmatrix}' V(B) \begin{bmatrix} f_0 \\ f_1 \\ f_2 \\ \vdots \\ f_k \end{bmatrix}$$

→ ESTIMATED  $V\left(\frac{\partial \hat{p}}{\partial x_j}\right)$  FROM LOGIT MODEL:

$$\begin{aligned} \frac{\partial \hat{p}}{\partial x_j} &= \frac{e^{x\beta}}{1+e^{x\beta}} \cdot \frac{1}{1+e^{x\beta}} \cdot \beta_j \equiv f(B) \\ &= \hat{p} \cdot (1-\hat{p}) \cdot \beta_j \end{aligned}$$

$$V(f(B)) = \begin{bmatrix} f_0 \\ f_1 \\ \vdots \\ f_k \end{bmatrix}' V(B) \begin{bmatrix} f_0 \\ f_1 \\ \vdots \\ f_k \end{bmatrix} = \begin{bmatrix} \frac{e^{x\beta}(1-e^{x\beta})}{(1+e^{x\beta})^3} \cdot x_j \beta_j \\ + \frac{e^{x\beta}}{1+e^{x\beta}} \cdot \frac{\partial \beta_j}{\partial \beta_k} \end{bmatrix}' V(B) \begin{bmatrix} \cdot \\ \cdot \\ \cdot \\ \cdot \end{bmatrix}$$

→ ... FROM PROBIT MODEL:

$$\frac{\partial \hat{p}}{\partial x_j} = \phi(x\beta) \cdot \beta_j \equiv f(B)$$

$$V[f(B)] = \begin{bmatrix} f_0 \\ f_1 \\ \vdots \\ f_k \end{bmatrix}' V(B) \begin{bmatrix} f_0 \\ f_1 \\ \vdots \\ f_k \end{bmatrix} = \begin{bmatrix} \frac{\partial \phi(x\beta)}{\partial \beta_k} \cdot \beta_j \\ + \phi(x\beta) \cdot \frac{\partial \beta_j}{\partial \beta_k} \end{bmatrix}' V(B) \begin{bmatrix} \cdot \\ \cdot \\ \cdot \\ \cdot \end{bmatrix}$$