$$\tilde{u}_B(y) \equiv \sup_{c \geq 0} \left(u_B(c) - yc \right) = u_B(I_{u_B}(y)) - yI_{u_B}(y),$$
$$\tilde{u}_A(y) \equiv \sup_{c \geq 0} \left(u_A(c) - yc \right) = u_A(I_{u_A}(y)) - yI_{u_B}(y),$$