The Optimal Spread and Offering Price for Underwritten Securities

Appendix: Comparative statics

The net proceeds maximization theory yields comparative statics for the optimal spread for both unseasoned and seasoned securities, the optimal offering price, the net proceeds, and the expected initial return for underwritten securities. The comparative statics ignore the possibilities that price uncertainty is a function of the new share ratio and the underwriting fee is a function of price uncertainty.

A.1. Comparative statics for the optimal spread for unseasoned securities

The theory yields comparative statics for the optimal spread for unseasoned securities. The change in the optimal spread for unseasoned securities with respect to a change in price uncertainty is

$$s_s^* = \frac{(1-\Delta)u\exp(sN^{-1}(u)-.5s^{\,2})(n(N^{-1}(u)-s\,)+N(N^{-1}(u)-s\,)(N^{-1}(u)-s\,))}{((1-\Delta)u\exp(sN^{-1}(u)-.5s^{\,2})+\Delta N(N^{-1}(u)-s\,))^2}\,, \qquad \text{(A1)}$$

where *n(x)* is the standard normal density function. The sign of Eq. (17) is positive for reasonable parameter values.[1] Therefore, the optimal spread for unseasoned securities increases as price uncertainty increases.

The change in the optimal spread for unseasoned securities with respect to a change in the new share ratio is

$$s_\Delta^* = \frac{N(N^{-1}(u)-s\,)(N(N^{-1}(u)-s\,)-u\exp(sN^{-1}(u)-.5s^{\,2}))}{((1-\Delta)u\exp(sN^{-1}(u)-.5s^{\,2})+\Delta N(N^{-1}(u)-s\,))^2}\,, \qquad \text{(A2)}$$

which is negative. Therefore, the optimal spread for unseasoned securities increases as the new share ratio decreases.

The change in the optimal spread for unseasoned securities with respect to a change in the underwriting fee is

[1] For example, when the underwriting fee is 20% of the spread and the new share ratio is 30%, the change in the optimal spread for unseasoned securities with respect to a change in price uncertainty becomes negative when price uncertainty exceeds about 700%.

$$s_u^* = \frac{(1-\Delta)\exp(sN^{-1}(u)-.5s^2)\begin{pmatrix}-u\exp(sN^{-1}(u)-.5s^2)\\ +N(N^{-1}(u)-s)+\left(\dfrac{usN(N^{-1}(u)-s)}{n(N^{-1}(u))}\right)\end{pmatrix}}{((1-\Delta)u\exp(sN^{-1}(u)-.5s^2)+\Delta N(N^{-1}(u)-s))^2}, \quad \text{(A3)}$$

which is positive for reasonable parameter values. Therefore, the optimal spread for unseasoned securities increases as the underwriting fee increases.

A.2. Comparative statics for the optimal spread for seasoned securities

The theory yields comparative statics for the optimal spread for seasoned securities. The change in the optimal spread for seasoned securities with respect to a change in price uncertainty is

$$s_s^{0*} = \frac{(1-\Delta)(u+\Delta(1-(N(.5s)-N(-.5s))))n(.5s)}{(u-\Delta(N(.5s)-N(-.5s)))^2}, \quad \text{(A4)}$$

which is positive. Therefore, the optimal spread for seasoned securities increases as price uncertainty increases.

The change in the optimal spread for seasoned securities with respect to a change in the new share ratio is

$$s_\Delta^{0*} = \frac{-(N(.5s)-N(-.5s))(u-(N(.5s)-N(-.5s)))}{(u-\Delta(N(.5s)-N(-.5s)))^2}, \quad \text{(A5)}$$

which is negative for reasonable parameter values. Therefore, the optimal spread for seasoned securities increases as the new share ratio decreases.

The change in the optimal spread for seasoned securities with respect to a change in the underwriting fee is

$$s_u^{0*} = \frac{-(1-\Delta)(N(.5s)-N(-.5s))}{(u-\Delta(N(.5s)-N(-.5s)))^2}, \quad \text{(A6)}$$

which is negative. Therefore, the optimal spread for seasoned securities increases as the underwriting fee decreases.

A.3. Comparative statics for the optimal offering price

The theory yields comparative statics for the optimal offering price for unseasoned and seasoned securities implicitly defined in Eq. (5) when the spread and the offering price are set sequentially. The change in the optimal offering price with respect to a change in price uncertainty is

$$\Omega_s^* = \frac{-\Omega^* n(-d_1)}{N(-d_1)}, \tag{A7}$$

which is negative. Therefore, the optimal offering price increases as price uncertainty decreases.

The change in the optimal offering price with respect to a change in the new share ratio is

$$\Omega_\Delta^* = \frac{\Omega^*((1-s)\Omega^* N(-d_2) - \hat{V}N(-d_1))}{(1-\Delta)\hat{V}N(-d_1)}, \tag{A8}$$

whose sign is indeterminate. Therefore, the change in the optimal offering price as the new share ratio changes is indeterminate.

The change in the optimal offering price with respect to a change in the underwriting fee is

$$\Omega_u^* = \frac{s(\Omega^*)^2}{(1-\Delta)\hat{V}N(-d_1)}, \tag{A9}$$

which is positive. Therefore, the optimal offering price increases as the underwriting fee increases.

The change in the optimal offering price with respect to a change in the spread is

$$\Omega_s^* = \frac{(\Omega^*)^2(u - \Delta N(-d_2))}{(1-\Delta)\hat{V}N(-d_1)}, \tag{A10}$$

which is positive when the new share ratio equals zero. Therefore, the optimal offering price increases as the spread increases for non-equity offerings and purely secondary equity offerings. When the new share ratio does not equal zero, the change in the optimal offering price as the spread changes is indeterminate.

A.4. Comparative statics for the net proceeds

The theory yields comparative statics for the net proceeds when the offering price and the spread are set sequentially. The change in the net proceeds with respect to a change in price uncertainty is

$$B_s^* = \frac{-(1-s)\Omega^* n(-d_1)}{N(-d_1)}, \tag{A11}$$

which is negative. Therefore, the net proceeds increase as price uncertainty decreases.

The change in the net proceeds with respect to a change in the new share ratio is

$$B_{\Delta}^{*} = \frac{(1-s)\Omega^{*}((1-s)\Omega^{*}N(-d_2) - \hat{V}N(-d_1))}{(1-\Delta)\hat{V}N(-d_1)}, \tag{A12}$$

which is indeterminate. Therefore, the change in the net proceeds as the new share ratio changes is indeterminate.

The change in the net proceeds with respect to a change in the underwriting fee is

$$B_{u}^{*} = \frac{(1-s)s(\Omega^{*})^{2}}{(1-\Delta)\hat{V}N(-d_1)}, \tag{A13}$$

which is positive. Therefore, the net proceeds increase as the underwriting fee increases.

The change in the net proceeds with respect to a change in the spread is

$$B_{s}^{*} = -\Omega^{*} + \frac{(1-s)(\Omega^{*})^{2}(u-\Delta N(-d_2))}{(1-\Delta)\hat{V}N(-d_1)}, \tag{A14}$$

whose sign is indeterminate. Therefore, the change in the net proceeds as the spread changes is indeterminate.

A.5. Comparative statics for the expected initial return

The theory yields comparative statics for the expected initial return when the spread and the offering price are set sequentially. The change in the expected initial return with respect to a change in price uncertainty is

$$E(I^{*})_{s} = \frac{(1-\Delta)\hat{V}n(-d_1)}{\Omega^{*}N(-d_1)}, \tag{A15}$$

which is positive. Therefore, the expected initial return increases as price uncertainty increases.

The change in the expected initial return with respect to a change in the new share ratio is

$$E(I^{*})_{\Delta} = (1-s)\left(1 - \frac{N(-d_2)}{N(-d_1)}\right), \tag{A16}$$

which is negative. Therefore, the expected initial return increases as the new share ratio decreases.

The change in the expected initial return with respect to a change in the underwriting fee is,

$$E(I^{*})_{u} = \frac{-s}{N(-d_1)}, \tag{A17}$$

which is negative. Therefore, the expected initial return increases as the underwriting fee decreases.

The change in the expected initial return with respect to a change in the spread is

$$E(I^*)_s = \frac{-u + \Delta(N(-d_2) - N(-d_1))}{N(-d_1)}, \tag{A18}$$

which is negative when the new share ratio equals zero. Therefore, the expected initial return increases as the spread decreases for non-equity offerings and purely secondary equity offerings. When the new share ratio does not equal zero, the change in the expected initial return as the spread changes is indeterminate.