Syrovatka V. N., Kudryavtsev O. E. (Rostov branch of the Russian Customs Academy, Rostov-on-Don, Russia). **Managing expected losses in multi-stage R&D using compound options in Lévy models.**

Let the efficacy process X_t of a drug under development in a multi-stage R&D follow a compound Poisson process with intensity λ and identically distributed jumps of size u and $-u$ (with probabilities p_u and p_d, respectively). Let $V_i(t, x, h_i)$ be the price of a compound call option (option to buy an option) on stage $i+1$ of R&D with current efficacy x at time t and target drug efficacy h_i, if exceeded, the next stage is launched, subject to commercial viability. This paper examines the expected losses when deciding to launch the next phase of the project, which can be managed by changing the barriers h_i. In particular, the following theorem has been proven.

Theorem 1. Let i_0 be the number of the current stage, and the product satisfies the efficacy and commercial viability condition $V_{i_0}(T_{i_0}, X_{T_{i_0}}, h_{i_0}) > 0$ provided that the efficacy has the level $X_{T_{i_0}} = k_0 u$. Denote $p_{i_0,k_0,i}$ as the probability for success at stage i conditioned on $X_{T_{i_0}} = k_0 u$, and $L_{i_0,k_0,i}$ as the expected sunk costs on condition that the stage i is the terminal for a product that has reached stage $i-1$ with the efficacy $X_{T_{i_0}} = k_0 u$. Then for $i > i_0$

$$L_{i_0,k_0,i} = -\rho_{i_0,k_0,i} \sum_{j=0}^{i-1} \frac{K_j}{(1+r)^{T_j - T_{i_0}}}, \rho_{i_0,k_0,i} = p_{i_0,k_0,i_0+1} \cdot \ldots \cdot p_{i_0,k_0,i-1} \cdot (1 - p_{i_0,k_0,i}),$$

where $\rho_{i_0,k_0,i}$ is the conditional probability that stage i is terminal for a product that has reached stage $i-1$ conditioned on $X_{T_{i_0}} = k_0 u$.