

VC-Portfolio Selection under Probabilistic, Possibilistic, and Credibilistic Risk

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Extended abstract. This paper views a venture capitalist's (VC's) portfolio selection problem under three types of uncertainties corresponding to probabilistic, possibilistic, and credibilistic risks. A VC faces such a complex situation, when several potential target companies are under analysis and some are handled in probabilistic terms while others call for a possibilistic or a credibilistic treatment. A possibilistic instead of probabilistic treatment is suitable for cases, where uncertainty is very high. This can be due to lack of available statistical information, because investment targets are often privately owned small companies with limited public information, possibly totally without past sales, without market values, there don't exist comparable firms to allow comparables-based valuations, and their value largely depends on intangibles and their strategic future actions. Credibilistic approach also has similar benefits over a probabilistic approach and certain computational benefits over a possibilistic approach.

The total value of a VC investment is defined to consist of two parts (cf. Smit and Trigeorgis, 2006): (i) the base value of a target, which depends primarily on its operating assets and (ii) the value of strategic growth opportunities, which in turn depend largely on the combined strategic capital of the target and the VC and the inherent flexibility of strategic future actions. We present a real options approach for such venture capitalist setup: standard NPV methods are applicable to value the base (i) and real options methods are applicable to value the growth opportunities (ii). In our approach some targets' strategic parts are valued probabilistically using Datar-Mathews real options method (Datar and Mathews, 2004) and some targets' strategic parts are valued possibilistically using the fuzzy real options method (Collan et al 2009), and some are handled using credibilistic extension of the fuzzy payment method (Collan et al 2012). The applied methods are selected for their intuitivity and practicality; other real options methods are can be used accordingly.

The approach of the paper first builds on the 2-component portfolio selection problem of Georgescu and Kinnunen (2012a), applied to mergers and acquisitions by Kinnunen and Georgescu (2013), corresponding to a situation in which some return rates on investments are described by random variables, while others by fuzzy numbers. We add the credibilistic risk to get a 3-component portfolio selection problem (Georgescu and Kinnunen, 2012b) and we apply the approach to venture

capital portfolio selection. This paper unifies Markowitz probabilistic model and possibilistic and credibilistic portfolio selection models resulting in the optimal solution of a 3-component portfolio problem faced by a VC. The portfolio can include one or all three types of components. The paper discusses the added value and the usefulness of the two-component approach for a VC, presents a simulation analysis with a calculation example to demonstrate the practicality of the approach.

Keywords: portfolio selection; venture capital; risk theory; fuzzy numbers; credibility theory; possibility theory; probability theory

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