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Nonlinearity and smoothing in venture capital performance data

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ABSTRACT

Performance indices for illiquid investments are known to suffer from returns smoothing, and the purpose of this paper is to investigate the presence and nature of such smoothing in the context of venture capital. We find that while the standard techniques may or may not indicate the presence of smoothing, significant evidence of smoothing exists when a nonlinear regime-dependent model is specified. Further, the model suggests the presence of regime-specific responsiveness of venture capital returns whereby different weights are placed on newly arrived information in different regimes.

1. Introduction

Benchmarking performance in the venture capital (VC) industry requires the construction of an overall index of the general movements in the value of an extremely heterogeneous group of assets. Further, the value of these assets is known only intermittently – i.e. at rounds of investment or points of exit – such that estimated, and often self-reported, values are frequently relied upon. In many respects, the issues present when constructing a venture investment index are similar to the problems faced in the context of creating real estate indices (see Fisher et al., 1994; Geltner, 1991, 1993). In fact, these issues are common among a broad range of illiquid investments — including real estate, hedge funds, private equity, and VC.

The problems associated with benchmarking VC performance may mean that index smoothing, which has been found to be an issue for real estate indices, may also be relevant for venture indices. The concept of return smoothing can be traced back to Dimson (1979), and a small number of papers have considered smoothing in the context of VC, and more generally, private equity (see e.g. Cumming and MacIntosh, 2007; Cumming et al., 2010, in press; Woodward, 2009; Woodward and Hall, 2003). This paper differs from previous contributions in that we employ a regime-switching model, which is closer in spirit to that adopted in the smoothing papers in the hedge fund literature (see Bollen and Pool, 2008; Bollen and Whaley, 2009; Getmansky et al., 2004). We view smoothing as a mechanism that converts true returns into reported returns, where the two may differ because of the use of appraisals, stale data, misreporting, or conservatism in marking to market; indeed there may be other explanations and the ones listed may not be mutually exclusive.[1] We note that while appraisal seems to be a key feature of private equity data (Cumming et al., 2010, in press), it does not appear relevant to VC data (Woodward, 2009).

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[1] For instance, the issues of smoothing are possibly related to partial exits, which are very common in VC and private equity sale transaction; see e.g. Cumming and MacIntosh (2003). We are grateful to the referees for this suggestion.

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Regime switching is a useful mechanism for capturing different market conditions, and it has found widespread use in modelling economic and financial time series. Bollen and Pool (2008), for instance, use the manager's reluctance to report losses as the behavioural trigger that creates the different regimes. We are not so precise in our regime delineation but allow for regimes in both the dynamics of true returns and also in fund manager smoothing conversion. Further, based on the literature which suggests that fundamentals are autocorrelated (see e.g. Pesaran and Timmermann, 1995, 2002), our model does not assume that the true returns are a white-noise process (as might be assumed in an efficient market).

While a small number of VC indices are available for analysis, we focus on the Sand Hill VC index data.[2] This choice is motivated by the fact that the Sand Hill index is available monthly, which makes it better suited to the relatively complicated econometric models that are the focus of our analysis.[3] It is worth noting that if we were to include an investigation of private equity returns, the same analysis could be applied and there are, again, a good range of data options described in Cumming et al. (2010).

We apply the double threshold autoregressive (TAR–TAR) model – which was originally proposed by Lizieri et al. (in press) for real estate returns – to the VC returns. This is a threshold-type model whose flexibility, unlike the conventional linear model, allows us to distinguish between differences in smoothing "behaviour" in different market conditions, as well as switches in the true unobserved returns. In particular, we argue that this model is directly applicable to modelling VC returns, where distinct regimes exist that directly impact on the valuation process (see Cochrane, 2005; Korteweg and Sorensen, 2010; McKenzie and Janeway, 2011). This is an important issue as smoothing in returns implies that the historical estimate of volatility will underestimate the "true" volatility. The model used in this paper has the potential to produce a more accurate picture of venture performance with direct implications for tactical asset allocation and risk management.[4]

The contribution of our paper goes beyond applying an existing model to a new dataset. We improve upon the algorithm of estimation and testing of TAR–TAR models used in Lizieri et al. (in press). Our new procedure significantly increases the convergence speed and this is our main methodological contribution. We also extend the theoretical analysis of systematic dynamics which concerns the mean path of the target time-series. By investigating regime-specific responsiveness of VC returns, we advance our understanding of this relatively new econometric model as well as of VC returns themselves.

The rest of the paper is organised as follows. Section 2 reviews the main econometric model in the current context, and considers issues related to its implementation. Section 3 describes the data used throughout the paper, and presents some summary statistics. Then in Section 4 we report and discuss our empirical results. Section 5 shows the results of the test for the existence of regimes which provide further support of our estimation results. Finally, in Section 6, we conclude and suggest further areas of research.

2. A model of index smoothing

2.1. Economic identification and the TAR–TAR model

Smoothing generally refers to the case where the current reported return is based on past returns, simply because the latest performance data do not become immediately available at the time of valuation. The most obvious example of an event that values the venture funded entity is when the General Partner (GP) is able to exit the investment. This typically takes place as a result of the firm going public, being bought out or going bankrupt, in which case valuing the firm is a fairly easy task. In addition to these exit valuations, there are a number of other events over the firm's life which can be used to establish the worth of the firm. Recall that venture funded firms typically receive their funding over a number of 'rounds', where each round is usually contingent on some milestone being reached (proof of concept, successful trials, development of prototype, bringing product to market, etc.). At each milestone, further funding is provided in exchange for a proportion of the firm's ownership, in which case a 'market' value for the firm is established. These transaction events provide an arm's-length valuation of the firm and form the basis of the index construction.

Consequently, a suitable econometric model for VC returns would explain (i) how the information is converted into reported returns; and (ii) the underlying unobservable returns on VC. In this paper, we apply the double Threshold Autoregressive or TAR–TAR model, proposed by Lizieri et al. (in press), to model VC return. This model can be thought of as an extension to the Threshold Autoregressive or TAR model (Tong, 1978, 1990). It comprises two processes as follows.

$$\text{Smoothing process}: \quad r_t^* = \alpha_t r_{t-1}^* + (1-\alpha_t) r_t, \tag{1}$$

$$\text{Returns process}: \quad r_t = \gamma_t + \phi_t r_{t-1} + \varepsilon_t \quad \varepsilon_t \sim iid\left(0, \sigma_\varepsilon^2\right). \tag{2}$$

[2] Cambridge Associates (CA) produces a database that records the performance of VC tranches of different vintages at a quarterly frequency. Dow Jones recently introduced quarterly VC indices, which are based on the Sand Hill methodology. Thomson's VentureXpert provides extensive databases based on quarterly data drawn from individual VC funds.

[3] We wish to emphasise that our results are in no way a criticism of the Sand Hill data as smoothing may feature in any illiquid asset index. Indeed, the Sand Hill method is uniquely designed to overcome the self-reporting problem insomuch as VentureSource (who collect the data behind the index) reports all rounds of investment for venture companies and reports the value associated with a given round of investment for some rounds (reported prices are sourced from a combination of investee companies, general partners and limited partners). Sand Hill estimates missing values, which are corrected for the bias in reported values. There are no valuations provided for dates between rounds of investment or exits. Thus, where smoothing in the Sand Hill data exists, it may be because of choice of the time of the investment or choosing not to provide a valuation. We are grateful to the referees for their clarification of this issue.

[4] The role of alternative investments, including VC, in tactical asset allocation is discussed in Cumming et al. (in press).