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Stelios Arvanitis, Alexandros Louka

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Stable Limits for the Gaussian QMLE in the Non-Stationary GARCH(1,1) Model

Stelios Arvanitis*

Alexandros Louka

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Address: Dept. of Economics, AUEB, Patision str. 76, Athens P.O. Box 10434, GREECE.

Abstract

We derive the limit theory of the Gaussian QMLE in the non-stationary GARCH(1,1) model when the squared innovation process lies in the domain of attraction of a stable law. Analogously to the stationary case, when the stability parameter lies in $(1, 2]$, we find regularly varying rates and stable limits for the QMLE of the ARCH and GARCH parameters.

Keywords: Martingale Limit Theorem, Domain of Attraction, Stable Distribution, Slowly Varying Sequence, Non-Stationarity, Gaussian QMLE, Regularly Varying Rate.

JEL: C13, C22.

1 Introduction

We derive the limit theory of the Gaussian QMLE in the non-stationary GARCH(1,1) model when the squared innovation process lies in the domain of attraction (DoA) of a p -stable law for $p \in (1, 2]$. Our interest stems from the empirical fact that distributions of financial asset returns exhibit fat tail behavior. This renders plausible the consideration of heavy-tailed distributions for the innovation process of GARCH-type models in financial applications. In the stationary versions of such cases, \sqrt{n} -consistency and possibly asymptotic normality can break down for the Gaussian QMLE (see for example [Hall and Yao \(2003\)](#); [Mikosch and Straumann \(2006\)](#); [Arvanitis and Louka \(2017\)](#)). Hence the question of whether this holds under non-stationarity arises naturally, and can be important for the determination of the asymptotic validity of inferential procedures based on the QMLE.

For the non-stationary GARCH(1,1), when the innovations fourth moments exist (hence $p = 2$), [Jensen and Rahbek \(2004a\)](#) and [Francq and Zakoian \(2012\)](#) establish standard limit theories for the ARCH and GARCH parameters QMLE. In the non-stationary ARCH(1) case

*Corresponding Author-Email address: stelios@aueb.gr.

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