A dynamic leverage stochastic volatility model

Hoang Nguyen

joint with **Trong-Nghia Nguyen**, **Minh-Ngoc Tran**
University of Sydney Business School

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Dynamic Leverage Stochastic Volatility

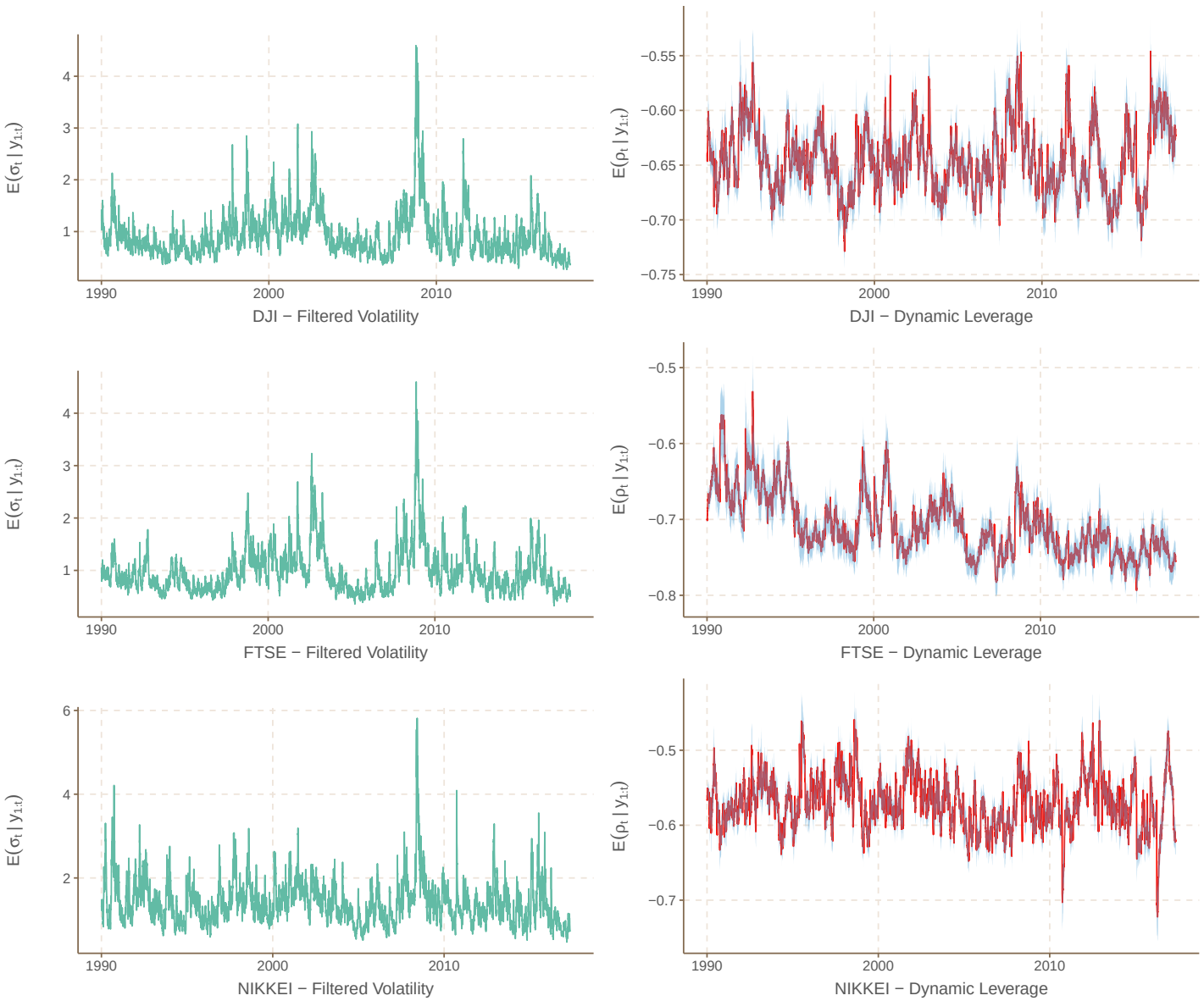
- Leverage effect of financial returns is the phenomenon that negative returns tend to increase the volatility process (Black, 1976). Moreover, time varying leverage has been documented in several studies, see Bandi and Renò (2012), Yu (2012), (Veraart and Veraart, 2012), Bretó (2014), among others.
- DLSV = LSV + GAS.

$$
\begin{aligned}
y_t &= \exp(0.5 h_t)\epsilon_t, \\
h_t &= \mu_h(1-\phi) + \phi h_{t-1} + \sigma_\eta \eta_t, \text{ where } Cor(\eta_t, \epsilon_{t-1}) = \rho_t = \Lambda(f_t) \\
f_t &= \omega(1-b) + a s_{t-1} + b f_{t-1}, \\
s_{t-1} &= \frac{\partial \log p(y_{t-1}|f_{t-1})}{\partial f_{t-1}} \\
&= \frac{1}{2}(\epsilon_{t-1}^2 - 1)\sigma_\eta \left(\epsilon_{t-2} - \frac{\rho_{t-1}}{\sqrt{1-\rho_{t-1}^2}} \zeta_{t-1} \right) \frac{2\exp(f_{t-1})}{(\exp(f_{t-1})+1)^2}.
\end{aligned}
$$

where $\epsilon_t \sim N(0,1)$ and $\eta_t \sim N(0,1)$ for $t = 1, \ldots, T$.

- We employ the Annealing Sequential Monte Carlo (ASMC) algorithm of Tran et al. (2014) and Duan and Fulop (2015) for posterior approximation.

A DLSV model


E(σt | y1:t)
DJI − Filtered Volatility
E(ρt | y1:t)
DJI − Dynamic Leverage
FTSE − Filtered Volatility
FTSE − Dynamic Leverage
NIKKEI − Filtered Volatility
NIKKEI − Dynamic Leverage
1990
2000
2010

The impact of the temporal return innovations on the leverage effect

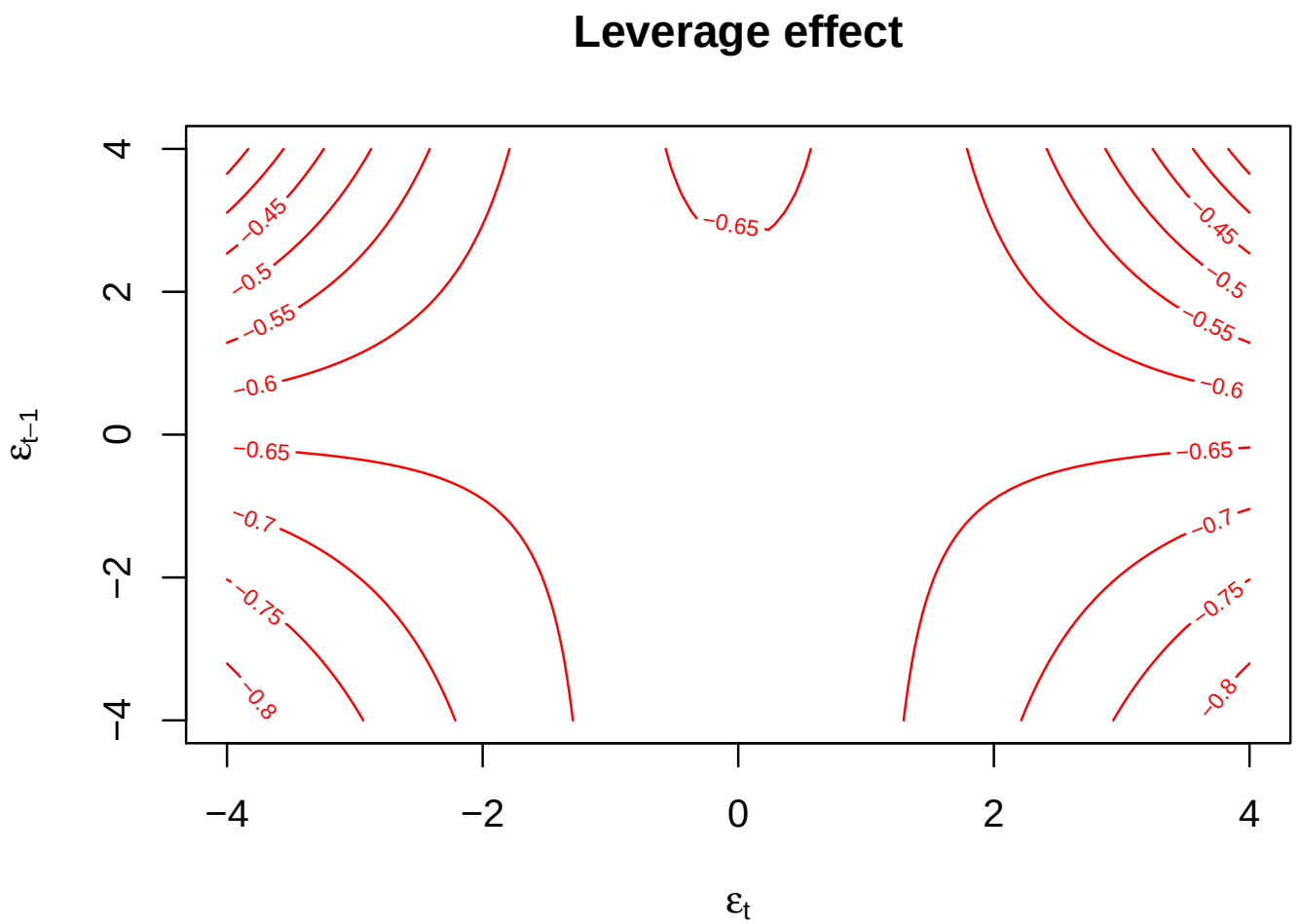


Figure: The contour plot shows the impact of the temporal return innovations $(\epsilon_t, \epsilon_{t-1})$ on the dynamic leverage correlation ρ_{t+1} for the DJI data. The current GAS process f_t is assumed to stay at its long term mean ω and $\zeta_t = 0$.

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