Nonlinearity and Cross-Country Dependence of Income Inequality

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Introduction

- In this study we show that the process of income inequality consists of two equilibriums identifiable by high inequality, high variance and low inequality, low variance using a newly developed Gaussian Mixture Autoregressive Model (GMAR) by Kalliovirta, Meitz, and Saikkonen (2012, 2014).
- Results also indicate that changes in the top 1% income share in the US have driven the level of income inequality in other developed economies during the last 100 years.

Results of the univariate GMAR model

We assume that the top 1% income share series y_t is generated by

$$y_t = \sum_{m=1}^{M} s_{t,m}(\varphi_{m,0} + \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \sigma_m \varepsilon_t),$$

where unobservable random variables $s_{t,m}$ indicate the regimes $m = 1,...,M$ ($M = 2$ or 3). Parameters $\varphi_{m,0}$, φ_1, φ_2, and σ_m fulfill restrictions: $\varphi(z) = 1 - \varphi_1 z - \varphi_2 z^2 \neq 0$ for $|z| \leq 1$ and $\sigma_m > 0$.

Table 1: Univariate estimation results of the top 1% income share

	Australia	Canada	Finland	France	Japan	USA
Regime 1						
autocorrelation	0.90	0.95	0.94	1.11	1.33	1.14
	(0.04)	(0.03)	(0.03)	(0.11)	(0.08)	(0.10)
mean	4.8	9.6	4.9	8.4	8.1	8.2
	(0.1)	(0.8)	(0.5)	(0.4)	(0.3)	(0.3)
variance	0.01	1.4	0.5	0.6	0.6	0.2
	(0.01)	(0.7)	(0.3)	(0.3)	(0.2)	(0.1)
Regime 2						
autocorrelation				-0.16	-0.42	-0.24
				(0.12)	(0.09)	(0.10)
mean	6.0	14.3	7.9	15.5	16.7	15.1
	(0.4)	(4.4)	(1.6)	(2.2)	(1.5)	(1.2)
variance	0.3	15.2	4.5	11.3	12.7	6.6
	(0.1)	(9.6)	(2.1)	(5.8)	(5.2)	(2.5)
Regime 3						
mean	9.1					
	(1.0)					
variance	2.9					
	(1.3)					

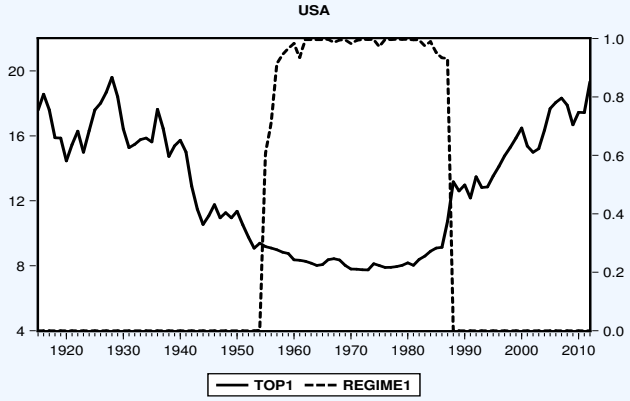

Figure 1. Top 1% income share and the time-dependent mixing weights based on the univariate GMAR model for the USA .

Results of the multivariate GMAR model

We assume that the 6 dimensional 1% income share series $\boldsymbol{y_t}$ is generated by

$$\boldsymbol{y_t} = \sum_{m=1}^{3} s_{t,m}\left(\phi_{m,0} + A_1 \boldsymbol{y_{t-1}} + A_2 \boldsymbol{y_{t-2}} + \Omega_m^{1/2} \boldsymbol{\varepsilon_t}\right),$$

where unobservable random variables $s_{t,m}$ indicate the regimes $m = 1,...,3$ and $\boldsymbol{\varepsilon_t}$ are i.i.d. N($\mathbf{0}$,I_6) random vectors. The random variables $\boldsymbol{\varepsilon_t}$ and $s_{t,m}$ are independent given $\{\boldsymbol{y_{t-j}}, j > 0\}$. Parameters $\phi_{m,0}$, A_1, A_2, and Ω_m fulfill the following conditions: $\det A(z) \neq 0$ for $|z| \leq 1$ with $A(z) = I_6 - A_1 z - A_2 z^2$ and covariance matrix Ω_m is positive definite.

Table 2: Multivariate estimation results of the top 1% income share, 1921-2009

	Australia	Canada	Finland	France	Japan	USA
y_{t-1}	0.93	1.00	0.91	0.88	1.22	1.21
	(0.04)	(0.11)	(0.03)	(0.03)	(0.09)	(0.10)
y_{t-2}	-	-0.15	-	-	-0.33	-0.28
		(0.10)			(0.08)	(0.10)
USA_{t-1}	0.02	0.11	0.07	0.06	0.13	
	(0.04)	(0.05)	(0.04)	(0.02)	(0.03)	

- Country-related regime specific means and variances are roughly similar with those found in the univariate models.
- The covariance matrix in low variance regime, Ω_1 is diagonal whereas in the high variance regime covariance matrix Ω_2 has nonzero elements off diagonal. The latter indicates that country specific error terms are correlated in this regime, and that shocks in one country will affect the future values of inequality in other countries.
- Impulse response analysis supports the idea that income inequality in the U.S. affects income inequality in other developed countries.

Conclusions

- Because increase in the mean share of top 1% income in the high inequality, high variance regime is higher than any conceivable short to medium term growth of GDP, shift to this regime is more harmful for the bottom 99% income earners.
- Larger fluctuations in the top 1% income share in the high inequality regime also translate to larger stochastic fluctuation in the GDP per capita, because stochastic parts of income inequality and GDP per capita have been found to have an *equilibrium* relation (Herzer and Vollmer 2013; Malinen 2012).
- The responses of sovereign nations on the costs associated to income inequality are diminished by the dependence of it on the level of income inequality in the U.S.

References

Herzer, D. and S. Vollmer (2013). Rising top incomes do not raise the tide. *Journal of Policy Modelling*, 35(): 504–519.

Kalliovirta, L., Meitz, M., and P. Saikkonen (2014). A Gaussian mixture vector autoregressive model for multivariate time series. Working paper.

Kalliovirta, L., Meitz, M., and P. Saikkonen (2012). A Gaussian mixture autoregressive model for univariate time series. HECER discussion paper 352.

Malinen, T. (2012). Estimating the long-run relationship between income inequality and economic development. *Empirical Economics*, 42(1), 209-33.