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NEW EVIDENCE ON THE LINK BETWEEN INCOME INEQUALITY AND MISERY INDEX: A NONLINEAR TIME SERIES ANALYSIS

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ABSTRACT

This paper investigates the relationship between the misery index and income inequality by estimating a nonlinear time series model in Iran from 1972 to 2011. Misery index, defined as the sum of the unemployment rate plus the annual rate of inflation. We showed that the dynamics of the mentioned relationship can be well approximated by a class of smooth transition autoregressive (STAR) models using the level of misery index as a transition variable. The findings indicated that by increasing misery index upper its threshold value, as counted 49.52, a strongly positive link is existed between two variables. However, any significant relationship was not confirmed for misery index in lower than 49.52.

Keywords: Unemployment rate, Inflation rate, Misery index, Income inequality, Gini coefficient, Smooth transition autoregressive models (STAR).

JEL Codes:C22, D33, E31, E24

1. INTRODUCTION

Reducing income inequality may be one of a few goals that all policymakers agree to. Yet, we seem to have a little knowledge about the inequality. A major determinant of the distribution of income in a country is traditionally assumed to be the level of development: as predicted by the so-called Kuznets hypothesis (Kuznets, 1955) countries shift from relative equality to inequality and back to greater equality as they move through the development stages. A large number of multi country empirical studies have shown however that the Kuznets hypothesis explains only a very limited part of the inter-country variation in income distribution (Bulir and Gulde, 1995). Some of multi -country studies include inflation and unemployment among the explanatory variables for income inequality or poverty indicators to improve significantly the explanation of the cross-country differences in income distribution (Milanovic, 1994; Tanzi, 1998; Chu *et al.*, 2000), but do not have a specific interest in studying the relationship between inflation and income distribution or poverty rates. Few studies are concerned specifically with this question, most of them using time-series data for the United States(see, Mocan (1999)Johnson and Shipp

(1999), Romer and Romer (1998), Cole and Towe (1996), Powers (1995), Cutler and Katz (1991), Blank and Blinder (1986), Blinder and Esaki (1978)). The results from all these studies are noticeably mixed –some authors find inflation to be a regressive tax, others find it to be a progressive tax, and others find it to be unrelated to income distribution –so that the literature seems to have generated inflation -inequality puzzle. Galli and Hoeven (2001) argued to solve this puzzle by assuming a non -monotonic relationship between inflation and inequality. Particularly, they suggested the use of a U-shaped relationship between income inequality and inflation, with inequality decreasing as inflation moves from high to low rates, and increasing as inflation is further reduced from low to lower rates.

The relationship between unemployment and income distribution has given rise to numerous studies in recent years (see Cysne and Turchick (2012), Gupta and Dutta (2011), Saunders (2002), Sen (1997), Beladi (1990)). The problem has been traditionally tackled from a macro-economic perspective, as part of studies focusing on expansion and recession cycles and their effects on inequality and poverty. High and persistent unemployment has presented a major challenge for the welfare state from two directions. First, it has eroded the funding base and second, it has increased the demands on welfare programs because of the consequences for poverty and inequality resulting from high unemployment. There is strong evidence that unemployment increases the risk of poverty and contributes to inequality, and that it also gives rise to a series of debilitating social effects on unemployed people themselves, their families and the communities in which they live.

From the literature, it is clear that both unemployment and inflation rates explain the change in income inequality via positive and negative effects; however it does not provide clear evidence of those catalysts which have strong effects on and can exert the most influence on inequality. In other words, what is the net effect on inequality? In addition, if these two variables are included into the model, it may lead to the occurrence of the multi co linearity problem. Furthermore, if we include the variables separately, we will lose valuable information and cause the misspecification problems. Thus, to avoid these mis-specification problems, we are motivated to take both unemployment and inflation rates together.

In this study, we employ the misery index, which is the unemployment rate plus the inflation rate to examine their effects on income inequality in Iran from 1972 to 2011. There are two advantages of using the misery index. First, it is able to examine both unemployment and inflation effects on inequality with no multi co linearity problem. Second, it is able to examine the net effect of unemployment and inflation on inequality variable. Moreover, we apply a different methodology to investigate the relationship. Indeed, we employ the class of smooth transition autoregressive (STAR) models. It has long been recognized that both the dynamic behavior of economic variables as well as many relationships between economic variables are inherently nonlinear. Both theoretical and empirical researchers have stressed the importance of such nonlinearities – an illustrative example being provided by the business cycle literature.

The remainder of the paper is organized as follows. After the introduction, data, model and methodology are discussed in section 2. The results of the study are elaborated in section 3. The conclusion and proposed suggestion are presented in the last part.

2. DATA & METHODOLOGY

In this research, annual data for misery index and earning equality in Iran during 1972-2011 have been used. Inflation, unemployment rates and Gini coefficient statistics have been taken from the central bank of Iran.

We primarily employ the exponential STAR model; the smooth transition autoregressive (STAR) model is defined as follows:

$$y_t = \acute{\phi}_1 x_t\big(1 - G(s_t;\gamma,c)\big) + \acute{\phi}_2 x_t G(s_t;\gamma,c) + \varepsilon_t, \qquad t = 1,\dots,T, \qquad (1)$$

Where x_t is a vector consisting of lagged endogenous and exogenous variables, $x_t = (1,\acute{\tilde{x}}_t)$ with $\tilde{x}_t = (y_{t-1},\dots,y_{t-p}, z_{1t},\dots,z_{kt})$ and $\phi_i = (\phi_{i,0},\phi_{i,1},\dots,\phi_{i,m}), i = 1,2,\ with\ m = p + k.$ the ε_t's are assumed to be a martingale difference sequence with respect to the history of time series, which is denoted as $\Omega_{t-1} = \{y_{t-1}, y_{t-2},\dots, y_{1-(p-1)}, y_{1-p}\}$, that is, $E[\varepsilon_t|\Omega_{t-1}] = 0.$ $G(s_t;\gamma,c)$ represents the so called *transition function*, which is a continuous function and usually is bounded between 0 to 1. Besides, s_t and γ and c are, respectively, transition variable, smoothness and location parameters. The transition variable s_t can be a lagged endogenous variable($s_t = y_{t-d}\ for\ certain\ integer\ d > 0$), an exogenous variable($s_t = z_t$), or a (possibly nonlinear) function of lagged endogenous and exogenous variables($s_t = h(\tilde{x}_t)$ for some function h(.)). Another possibility is to take s_t equal to a (function of a) linear time trend($s_t = t$), which gives rise to a model with smoothly changing parameters, see Lin and Teräsvirta (1994). Written out in more detail, the STAR model thus is given by,

$$y_t(\phi_{1,0} + \phi_{1,1}y_{t-1} + \dots + \phi_{1,p}y_{t-p})\big(1 - G(s_t;\gamma,c)\big)(\phi_{2,0} + \phi_{2,1}y_{t-1} + \dots \phi_{2,p}y_{t-p})G(s_t;\gamma,c) + \varepsilon_t \qquad (2)$$

The STAR model can be interpreted as a regime-switching model that allows for two or three regimes, associated with the extreme values of the transition function, $G(s_t;\gamma,c) = 0$ and $G(s_t;\gamma,c) = 1$, whereas the transition from one regime to the other is gradual. The regime that occurs at time t can be determined by the observable variable s_t and the associated value of $G(s_t;\gamma,c)$.

A popular choice for $G(s_t;\gamma,c)$ is the logistic function

$$G(s_t;\gamma,c) = \frac{1}{1 + exp\{-\gamma(s_t - c)\}} \qquad \gamma > 0, \qquad (3)$$

Where s_t is a transition variable and γ(>0) is a parameter defining the smoothness of the transition.

3. RESULTS

The Augmented Dickey-Fuller (ADF), Kwiatkowski-Phillips-Schmidt-Shin (KPSS) and Phillips-Perron (PP) unit root tests have been performed to investigate the degree of integration and have been found that two variables were stationary. Unit roots tests results reported in Table (1).

Table-1. Results of unit root tests

Tests	Variables	Statistic Values	Lag Length
At level of variables			
ADF	Misery index	-4.02*	0
PP	Misery index	-3.87*	7
KPSS	Misery index	0.21*	0
ADF	Gini coefficient	-3.12**	4
PP	Gini coefficient	-2.94**	0
KPSS	Gini coefficient	0.60**	9

Note: * and ** Signifies rejection of the unit root hypothesis at the 1% and 5% levels, respectively.

We first search for the length of the transition variable zt that best fits the specification. The optimal lags order lengths of variables are determined by information criteria such as AIC and SBC. As a preliminary test, we first conduct the F tests of linearity against the STAR alternatives. With reference to the test, the linearity hypothesis is rejected and nonlinearity dynamics is strongly suggested. In regard to thestatisticsofF2, F3andF4, LSTR1 model as Optimized model has been specified. Besides, the level of misery index as transition variable is suggested.

The model performs well in terms of the goodness of fit and statistically significant coefficient estimates. Furthermore, there is no evidence of remaining autocorrelations in residuals.

The estimation result suggests that in low regimewithmisery indexless than49.52, there is no significant relationshipbetweenthisindexand income inequality. However, it seems clear that in upper regime, an increase to misery index lead to remarkable inequality by 0.49 coefficient. In addition, $\gamma = 8.83$ is expressed the smoothness of changing in regimes. Furthermore, there is no evidence of remaining autocorrelations in residuals.

4. CONCLUSION

In this paper we proposed a nonlinear methodology to trace the impact of Economic discomfort on income inequality in Iran. Economic discomfort, defined as the sum of the unemployment rate plus the annual rate of inflation. We show that the STAR models, the parsimonious parametric nonlinear time series models, offer a very convenient framework in examining the relationship between the mentioned variables. Based on the estimated model, after increasing misery index more than its threshold value, a high income inequality has observed. Even so, any link between two variables was not confirmed in low value of the misery variable.

This finding may shed some light for policymakers in formulating policy to reduce observed earnings inequality based on the misery index.

Table-2. Testing linearity against STR models

Transition Variable	F	F4	F3	F2	Suggested Model
Misery(t)*	7.3513e-04	1.6642e-04	9.3733e-01	2.7960e-01	LSTR1
Misery(t-1)	3.3321e-01	5.1310e-01	2.3957e-01	2.2585e-01	Linear
Misery(t-2)	3.6423e-02	3.3852e-02	6.1142e-01	9.7978e-02	LSTR1
Misery(t-3)	4.2948e-01	4.8657e-01	1.5691e-01	7.9492e-01	Linear
Trend	3.8700e-02	9.7567e-02	1.9196e-02	7.6413e-01	LSTR2

The resulting final specification and the estimates for the model show in table (3).

Table-3. Result of estimation

Linear Part				
Variable	Start	Estimate	SD	t-stat
CONST	0.063	0.046	0.067	0.689
Gini(t-1)	0.984	0.969	0.189	5.108
Gini(t-2)	-0.458	-0.499	0.290	-1.718
Gini(t-3)	0.343	0.417	0.209	1.989
Misery(t)	0.0001	0.0003	0.0007	0.457
Misery(t-1)	-0.0008	-0.0006	0.0005	-1.214
Misery(t-2)	0.0008	0.0009	0.0005	1.672
Misery(t-3)	-0.0006	-0.0007	0.0005	-1.466
Nonlinear Part				
Variable	Start	Estimate	SD	t-stat
CONST	-31.26	-56.17	5.14	-0.096
Gini(t-1)	-25.33	-20.72	2.44	-0.906
Gini(t-2)	-13.046	-8.19	0.000	-0.000
Gini(t-3)	36.87	24.07	0.000	0.000
Misery(t)	-8.29	-5.44	0.000	-3.011
Misery(t-1)	13.52	8.09	0.000	0.000
Misery(t-2)	3.21	2.77	0.000	2.017
Misery(t-3)	5.69	3.16	0.000	2.130
Gamma	6.615	8.830	8.136	2.085
C1	54.237	49.529	13.116	3.776

$G(z_t;\hat{\gamma}) = 1 - exp\{-8.83 Misery_t{}^2\}, R^2 = 0.84$

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