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Structural Changes and the Index of Economic Well-being: Empirical Evidence from the Iranian Economy[1]

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Abstract
It is a well-established empirical fact that economic growth and development brings about major changes in sectorial output, employment, and consumption structure. In the context of economic development discussion, structural change refers to the change in key components of macroeconomic indicators, including national production and expenditure, exports and imports, population, and the sectorial composition of labor.
Considering the importance of human capital for economic growth and development, the most important of the above factors is the labor market and the sectorial composition of employment. Another important dimension of economic development is economic well-being. In this study, we formulated and calculated two indicators called the Coefficient of Structural Change of Iran (CSCI) and the Index of Economic Well-Being of Iran (IEWBI), and then used the vector autoregressive (VAR) modeling method and the software EViews v.10 to analyze the impact of structural changes of Iranian economy on IEWBI. The results indicate the positive effect of structural changes and therefore development policies on the economic well-being of Iran when the weighting scheme of IEWBI was biased in favor of the consumption flow dimension, and the negative effect in other cases.

1. Introduction

It is impossible to achieve economic development and its dividends for economic and social welfare without any structural change. It is a well-established empirical fact that economic growth and development involves and requires major changes in sectorial output, employment and consumption structure (For example, see (1) and (2)), which together are referred to as

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"structural change" (3). Although long-term economic growth may seem a stable process, from a historical perspective, the decline of agriculture and the expansion of industrial and service sectors always lead to a major evolution of the economic landscape. One way to accurately quantify structural changes is to monitor the shift in the relative importance of these three sectors (agriculture, production, and services) in the course of economic growth and development. However, structural change can be viewed as a broader concept encompassing changes in production and employment structures within and across all sectors of the economy as well as the emergence of new sectors and the disappearance of old ones (4).

Structural change is a dynamic process that affects almost all real variables of the economy, including employment, welfare, production, etc. (For example see (5), (6), (7) and (8)). This concept can be defined as the change in the relative weight of key components of macroeconomic indicators, such as national production and expenditure, exports and imports, population, and employment in agriculture, industry, and service sectors (9). Considering the importance of human capital for economic growth and development, the one of most important of the above factors is the sectorial composition of employment. Since employment is one of the major concerns of economic policymakers in Iran and this country is crossing a turning point in terms of the demographic window, in this study, the sectorial composition of employment is analyzed as a structural variable. The goal of this study is to determine whether structural changes in the Iranian economy have improved the economic well-being of Iranian citizens. To answer this question, first, two indicators called the Coefficient of Structural Change of Iran (CSCI) and the Index of Economic Well-Being of Iran (IEWBI) are calculated and then the impacts of structural changes of the Iranian economy on IEWBI are analyzed with the help of the software EViews v.10 and a vector autoregression (VAR) model.

The rest of this paper is organized as follows: after this introduction, section 2 reviews the subject literature, section 3 and 4 introduces and calculates the above-said indicators of Iran's economy, section 5 explains the research methodology, section 6 report empirical results and the final section report the concludes of the paper.

2. Review of literature

The past studies, especially those conducted in Iran, have been mostly focused on the economic growth and its overall impact on poverty, inequality and social welfare, but Less attention to the effect of structural changes on the economic well-being. Therefore, the current study fills this gap in the literature.

Khaledi and Sadr al-Ashrafi (2005) investigated the mutual relationship between agricultural growth and income distribution in rural areas of Iran from 1971 to 2001 using linear and nonlinear models. This study showed that slow and unsteady growth of Iran's agricultural sector has not been able to reduce income inequality in rural areas. This study reported a direct relationship between the indicator of income inequality in rural areas and the growth rate of the agricultural sector (10).

Ciarli et al. (2008) analyzed the concurrent effect of structural changes in production and consumption on long-term economic growth and income distribution. The model of this study uses numerical simulation to examine the relationship between structural changes, production organization, income distribution, and final demand, which are considered as structural variables affecting economic growth. This study showed that structural changes in production and consumption play an important role in long-term economic growth (11).

Schneider and Winkler (2010) tried to model the changes in welfare with a range of factors and found that, among these factors, the cyclical changes in macro variables such as economic growth, unemployment, and inflation have a significant effect on welfare (12).

Kahya (2012) examined the effect of structural changes on income distribution and poverty in Malaysia, Indonesia, Thailand, and the Philippines. After investigating the Gini index and the sectorial composition of value-added, he showed that the transition from agriculture to service sector did not affect income distribution, but the transition from industry to services increased the income inequality. The shift from the agricultural sector to the industrial sector and the transition from the service sector to the industrial sector were found to lead to a reduction in income inequality. The lowest and highest inequalities were observed in industry and services, respectively. Income inequality in agriculture was higher than in industry, which contradicts Kuznets' hypothesis that income inequality is lower in agriculture than in non-agriculture sectors (13).

Shahikitash et al. (2014) estimations showed that unemployment, inflation, and Gini index were inversely correlated with cardinal welfare (14).

Farahmand et al. (2013) investigated the relationship between the growth of agriculture, industry and service sectors and welfare and poverty of Iranian households in different provinces of the country from 2000 to 2007. This study found that although the growth of agriculture, industry and service sectors has improved the welfare of the country, in most provinces, it has also increased inequality among households. It was also reported that, on average, the service sector has grown faster than the other two sectors (15).

Alonso-Carrera and Raurich (2018) presented a two-sector growth model. For economic calibration, they defined two sectors, agricultural and non-agricultural, and used their model to estimate structural change based on the relative income difference of the two sectors as well as labor mobility costs. They argued that since wages of different sectors are not equal, production factors are misallocated. During the transition, this misallocation of production factors is eliminated by the structural change in the sectorial composition of employment and thus the structural change in the sectorial composition of GDP. They concluded that the process of structural change is closely related to the process of relative wage convergence (16).

Alvarez-Cuadrado et al. (2018) which was conducted in the United States, it was reported that from 1960 to 2005, the decline in the labor income share in the manufacturing sector has been greater than that in the service sector. They argued that this difference can be attributed to the capital bias of technical change and the capital-labor substitution in the manufacturing sector. When two sectors have different substitution elasticity, the more elastic sector absorbs the cheaper factor. In the end, they concluded that sectoral differences in productivity growth are among the main drivers of structural change (17).

Mahinizadeh et al. (2019) investigated the effect of structural change on economic welfare in Iran with computable general equilibrium models (CGE) approach. For this purpose, the share of employment in the main economic sectors including agriculture, industry and services has been used as a structural variable and using the computable general equilibrium model, the impact of structural changes in Iran's economy on economic well-being is measured by measuring the Hicksian Equivalent Variations. In this regard, four scenarios are defined that the results of all scenarios indicate the negative impact of structural changes in employment on economic well-being. Also, the results of the research indicate the effect of service sector spillovers on the industry sector (18).

Mahinizadeh et al. (2019) used the Composite Index of Economic Well-Being Approach to analyze the Economic Welfare in Iran. The results show that, compared to the base weighting scheme (uniform weight of 0.25 for all four dimensions), giving a higher weight to the consumption flow or wealth stock dimensions results in IEWBI showing higher growth rates. Conversely, biasing the weighting scheme toward the income distribution dimension results in lower IEWBI growth rates and producing such bias toward the economic security dimension leads to IEWBI exhibiting a negative growth rate (19).

3. Calculation of Index of Economic Well-Being of Iran (IEWBI)

According to Sharpe (20), there are five major indicators of economic and social well-being at the national and international levels:

Measure the Economic Welfare (MEW) introduced by William Nordhaus and James Tobin in the early 1970s.

Genuine Progress Indicator (GPI) introduced by the San Francisco-based think tank Redefining Progress.

Index of Economic Well-Being (IEWB) developed by the Centre for the Study of Living Standards (CSLS)

Index of Social Health (ISH) developed by Marc Miringoff of the Institute for Innovation in Social Policy of Fordham University.
Index of Living Standards (ILS) introduced by Christopher Sarlo of the Fraser Institute.

The above indicators and a few others (e.g. Sen welfare function and human development indices) are the most commonly used composite measures of economic and social well-being in research. Sharpe (1999) ranked the major composite indicators of welfare in terms of robustness and reported that IEWB earns the highest place in this ranking (20). The results of this ranking are presented in Table (1).

Table 1. Evaluation of composite indicators of economic and social well-being

Ranking criteria \ Composite indexes of well-being	MEW	GPI	IEWB	ISH	ILS
Public policy purpose	4	4	4	4	4
Grounded in well-established theory	3	1	4	1	0
Possibility of disaggregation	4	4	4	4	4
Availability of consistent time series	4	4	4	4	4
Composite index and components reliable and valid	2	1	2	3	2
Usefulness to policymakers	1	2	3	3	1
Average ranking	3	2.8	3.5	3.2	2.5

Source: Sharpe, 1999

The prominent features of this index include the ability to analyze welfare in detail and in general, a strong theoretical foundation, and usefulness for policymaking. Considering these features of IEWB, this study uses this index, although with minor adjustments, to analyze Iran’s economic well-being.

IEWB was first developed in 1998 by Centre for the Study of Living Standards (CSLS) in Canada. IEWB defines the economic well-being as a function of average consumption flows, wealth or accumulation of stocks of productive resources, income inequality, and economic security. Each of these factors is given a weight by a specific method. The additive formulation of IEWB assumes that the weight assigned to one dimension does not depend on the weight given to another (21).

As mentioned, considering the superiority of IEWB over other indicators of welfare, all evaluations of this study are based on this indicator. The general formulation of IEWB of Iran (IEWBI) is:

$$IEWBI = CF + WS + ID + ES \qquad (1)$$

Where CF is consumption flow, WS is wealth stock, ID is income distribution, and ES is economic security. The extended form of the above formulation is presented below:

$$
\begin{aligned}
IEWBI = {} & \omega_1 \left\{ \left[APC\,(IEI) + GC \right] (ILE) \right\} \\
& + \omega_2 \left\{ \left[K + RD + FDI - ED + HC + NR \right] \right\} \\
& + \omega_3 \left[\xi \{PI\} + (1-\xi) \{II\} \right] \\
& + \omega_4 \left[\lambda_1 \{RUE\} + \lambda_2 \{RILL\} + \lambda_3 \{RSPP\} + \lambda_4 \{RINF\} \right]
\end{aligned}
\qquad (2)
$$

Where $\{\bullet\}$: Linear scaling of $\bullet$; for example $\{PI\}$ is the linear scaling of *PI*.

APC: per capita Adjusted Private Consumption (private consumption minus consumption expenditure on durable goods), consumption flow is adjusted by the index of life expectancy and the square root of family size as a measure of income equalization index;

IEI: Index of Equivalent Income (square root of family size (For example see (22)), scaled to the base year (1966 = 1));

GC: per capita Government Consumption;

ILE: Index of Life Expectancy (scaled to the base year (1966 = 1));

K: per capita capital Stock (approximated base on per-capita fixed capital accumulation);

RD: per capita expenditure on Research and Development (share of the research budget from per capita GDP is the representative of per capita R&D expenditure);

FDI: per capita net inflows of Foreign Direct Investment;

ED: per capita social costs of Environmental Degradation (approximated base on per capita carbon dioxide emission);

HC: per capita stock of Human Capital (approximated base on per capita government expenditure on education);

NR: Per Capita stock of Natural Resource Wealth (approximated base on per capita government oil revenue);

PI: Poverty Intensity (income ratio of the tenth income decile to the first income decile);

II: Inequality index (Gini coefficient is used as the measure);

RUE: Risk from Unemployment (approximated based on per-capita weekly wage and service compensation);

RILL: Risk from Illness (substituted by the share of expenditure on healthcare from the total private expenditure);

RSPP: Risk from Single Parenthood Poverty (approximated by multiplying the rate of divorce by the unemployment rate of women);

RINF: Risk from Inflation (considered equal to the percentage changes of inflation rate);

ω_i : Weight of *i*-th dimension in the formulation of IEWBI;

ξ : Weight of poverty intensity in the overall income distribution;

$(1-\xi)$: Weight of inequality index in the overall income distribution.

Economic theories do not provide exact relative weights for Gini index and poverty intensity, but the studies conducted in accordance with Rawls and Utilitarian consensus have given a three times higher weight to poverty intensity than to the Gini index (23). Accordingly, in this study, the Gini index and Poverty intensity are given weights of 0.25 and 0.75, respectively.

λ_i : Weight of *i*-th component in the formulation of economic security, for which we have:

$$\sum_{i=1}^{4} \lambda_i = 1 \qquad (3)$$

To make sure that IEWBI is realistic, all stages of development including definition, selection, scaling, and weighting of parameters are performed according to the principles of development of composite indicators (For more detailed information, see Salzman (24)). For each dimension of well-being, variables are selected based on whether valid and relevant data can be extracted from the national accounts system and statistical center of Iran or other credible statistical sources. Since different variables and dimensions of well-being are expressed in different units, the index cannot be computed by simply summing the dimensions with each other. This problem is resolved by the use of Linear Scaling Technique (LST). LST is a method for linear scaling of values to the range of [0,1]. This technique has been used in many well-known indicators, including the UNDP's Human Development Index, Heritage Foundation's Index of Economic Freedom, Cato Institute's Economic Freedom Index, etc. (25).

In the formulation of IEWB, its four dimensions are given different coefficients to represent their relative importance in the index. In the past studies, these coefficients have been set based on the views of experts in this area such as Salzman (24) and Osberg (26). Following the approach of Sharpe and Osberg (27), in this study, the coefficients of IEWBI are set as shown in Table 2, (For similar cases, see (28), (29), (23), (30), (31), (27) and (24)).

The results suggest that giving consumption flow a higher weight results in IEWBI showing higher growth rates compared to the base state (when all dimensions have a weight of 0.25). Also, giving a higher weight to economic security causes IEWBI to show negative growth rates.

Table 2. IEWBI calculates based on different weighting schemes

Index ID	Weights of [CF,WS,ID,ES] in the index formulation	Long-term growth
IEWBI1	[0.25, 0.25, 0.25, 0.25]	0.83
IEWBI2	[0.4, 0.1, 0.25, 0.25]	1.08
IEWBI3	[0.1, 0.1, 0.1, 0.7]	-0.22

Figure (1) illustrates the trends of IEWBI with different weighting schemes.

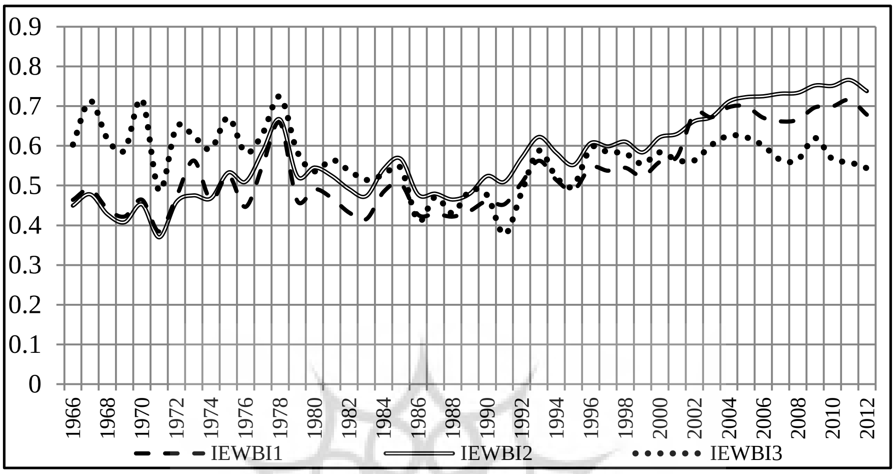

Figure 1. Trends of IEWBI with different weighting schemes over the study period

4. Calculation of Coefficient of Structural Change of Iran (CSCI)

Since employment and human resources in general have a central place in economic discussions, and this issue is one of the major concerns of Iranian policymakers and this country is crossing a turning point in terms of the demographic window, and on other hand since the goal of this study is to determine whether structural changes in the Iranian economy have improved the economic well-being of Iranian citizens, and also the employment has a direct impact on the level of welfare and living of people, in this study, the sectorial composition of employment is considered as structural variable.

To measure the Coefficient of Structural Change of Iran (CSCI), we utilize the model used in the annual report of the Australian Productivity Commission (32), (also see (33) and (34)). This report analyzes the relationship between microeconomic reforms and the rate of structural changes in employment. These reforms include changes in labor productivity, changes in total demand in each sector, and changes in exports and imports. In the present study, the degree of structural change in employment is measured with a rate or coefficient of structural change. The coefficient of structural change in Iran is defined as follows:

$$CSCI = \frac{1}{2}\left\{\sum_{i=1}^{n}\left|X_{i,t} - X_{i,t-1}\right|\right\} \tag{4}$$

Where $X_{i,t}$ and $X_{i,t-1}$ are the share of sector i from the total employment at the end of the period (t) and the beginning of the period (t-1). If you simply sum the differences of employment shares of different sectors, positive and negative values will cancel each other out. Therefore, we sum the absolute values of these differences (For further reading, see (35) and (32)).

If there is a large change in the sectorial composition, the coefficient of structural change will be large, and in the absence of such change, this coefficient will be small. The zero value for this coefficient means there has been no structural change in the sectorial composition of employment. The coefficient of structural change in employment only measures the net employment shifts between sectors and does not include all increases and decreases in the employment of a sector over a period (34).

Figure (2) illustrates the trends of the coefficient of structural change of Iran, which have been calculated using the employment statistics of the agriculture, industry and service sectors from 1966 to 2002. As can be seen, during this period, there have been very small structural changes in Iran’s employment structure, and the value of the coefficient ranges from 0.14% to 2.68% (2.68% seems to be an anomaly and is related to 1976). The results show mild structural changes with a steady upward trend from 1966 to 1974, followed by relatively large structural changes in 1976, which can be attributed to the first oil shock and the boom in oil revenues and its significant impact on the economy of that period. This sudden boom has reduced the share of agriculture and increased the share of industry and services, thus leading to relatively large structural changes. As can be seen, from 1978 to 1989, the coefficient of structural change in employment has been small, which is because during this period the country has experienced a revolution, followed by a devastating war as well as economic sanctions, which have left little to no room for economic reform. As a result, there has been no noticeable change in the sectorial composition of employment during these years.

There is a similar trend from 1989 to 1997, when the Iranian economy continued to suffer from sanctions, as well as severe inflation and post-war instability. From 1997 to 2005, which coincided with the second and third plans of economic, cultural and social development, there have been some changes in the sectorial composition and structural changes have emerged with an almost stable trend.

As shown in Figure (2), from 2005 to 2011, there have been many fluctuations in the coefficient of structural change. This signifies a high rate of structural change over these years, and somewhat reflects the abnormality of structural changes in the Iranian economy, because the examination of changes in the sectorial composition of employment reveals a shift in the labor force from the agricultural sector to the service sector, not to the industry, which means the service sector is expanding before the industry matures.

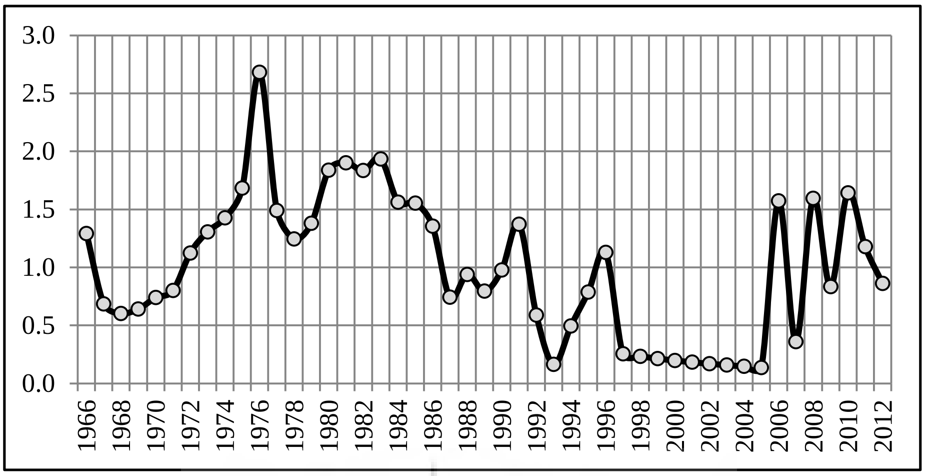

Figure 2. Trend of the coefficient of structural change of Iran from 1966 to 2012

5. Research method

The vector autoregression (VAR) model is a statistical model not an economic one and is therefore based on statistical theory and assumptions (36). When analyzing the behavior of multiple time series variables, we need to consider the mutual relations of these variables in the form of a simultaneous equation system.

According to Christopher A. Sims (1980), if there is indeed a simultaneity relation between a set of model variables, all variables must be treated as the same and it is not correct to judge which variable is endogenous and which is exogenous in advance. To address this issue, he has introduced the VAR model (37).

A VAR model has two features, first, the model length or degree (p), which represents the number of lags entering the model, and second, the number of variables that are simultaneously determined in the model (m). The general form of a VAR (p) model with m variables is as follows:

$$\mathbf{Y}_t = \mathbf{A}_0 + \mathbf{A}_1\mathbf{Y}_{t-1} + \mathbf{A}_2\mathbf{Y}_{t-2} + \cdots + \mathbf{A}_p\mathbf{Y}_{t-p} + \boldsymbol{\varepsilon}_t \qquad (5)$$

where:

$$\begin{aligned}
&\mathbf{Y}_t' = (Y_{1t} \quad Y_{2t} \quad \dots \quad Y_{mt}),\\
&\mathbf{A}_0' = (\alpha_{10} \quad \alpha_{20} \quad \cdots \quad \alpha_{m0}),\\
&\mathbf{Y}_{t-j}' = (Y_{1t-j} \quad Y_{2t-j} \quad \cdots \quad Y_{mt-j}) \qquad j = 1, 2, \dots, p,\\
&\mathbf{A}_j = \begin{pmatrix} \alpha_{11.j} & \alpha_{12.j} & \dots & \alpha_{1m.j} \\ \alpha_{21.j} & \alpha_{22.j} & \cdots & \alpha_{2m.j} \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_{m1.j} & \alpha_{m2.j} & \cdots & \alpha_{mm.j} \end{pmatrix} \qquad j = 1, 2, \dots, p
\end{aligned} \tag{6}$$

Accordingly, the VAR models estimated in this study to analyze the impact of structural changes of the Iranian economy on IEWBI are as follows:

$$\begin{aligned}
&IEWBI_t^{\kappa} = \alpha_{10} + \sum_{i=1}^{p} \alpha_{1i} IEWBI_{t-i}^{\kappa} + \sum_{i=1}^{p} \beta_{1i} CSCI_{t-i} + \varepsilon_{1t}\\
&CSCI_t = \alpha_{20} + \sum_{i=1}^{p} \alpha_{2i} CSCI_{t-i} + \sum_{i=1}^{p} \beta_{2i} IEWBI_{t-i}^{\kappa} + \varepsilon_{2t}\\
&, \quad \kappa = 1, 2, 3, 4
\end{aligned} \tag{7}$$

In the above relationships, κ determines which of the weight schemes of Table (2) is used to compute IEWBI, and $\kappa = 4$ represents the case where the average of IEWBI values computed with the three weight schemes is used.

The dynamic behavior of the VAR model is examined with two measures: impulse response function (IRF) and variance decomposition. The first measure involves examining the response of endogenous variables after generating shocks in exogenous variables. According to Lütkepohl and Reimers, IRF is a useful tool for gaining and assessing information about the interactions between variables in auto-regression models (38). The other measure, variance decomposition, examines the percentage contribution of shocks of variables to the forecast error variance. In other words, forecast error variance decomposition allows us to determine the extent to which changes in one variable (time series) are affected by its own shocks and the extent to which they are affected by the shocks of other variables within the system.

6. Empirical results

6.1. Test of stationarity of variables

The unit root test is one of the most widely used tests for detecting the stationarity of a time series. This test is necessary because other analyses of time series are based on the assumption of stationarity of these series. A time series is said to be stationary when its mean, variance, and autocorrelation coefficients remain constant over time. Analysis of nonstationary time series may lead to the problem of spurious regression. In this study, the stationarity of variables is investigated using Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests, the results of which are presented in Tables (4), (5), and (6), respectively.

The results of unit root tests show the stationarity of all research variables. If the model variables are stationary, then there will be a balanced state for those. Otherwise, when the variables are nonstationary, the discussion enters the domain of co-integration (36). Since the variables of this study are all stationary, there is no need for the tests of co-integration and long-term correlation.

Table 3. Results of the Augmented Dickey-Fuller (ADF) unit root test

Variable	ADF statistic		MacKinnon critical value			Interoperation of test results
			1%	5%	10%	
IEWBI[1]	With intercept	-1.854	-3.581	-2.927	-2.601	nonstationary
	With intercept and trend	-3.316	-4.171	-3.511	-3.185	stationary
	Without intercept and trend	0.211	-2.616	-1.948	-1.612	nonstationary
IEWBI[2]	With intercept	-1.265	-3.581	-2.927	-2.601	nonstationary
	With intercept and trend	-3.236	-4.171	-3.511	-3.185	stationary
	Without intercept and trend	0.689	-2.616	-1.948	-1.612	nonstationary
IEWBI[3]	With intercept	-3.957	-3.581	-2.927	-2.601	stationary
	With intercept and trend	-4.018	-4.171	-3.511	-3.185	stationary
	Without intercept and trend	-0.702	-2.616	-1.948	-1.612	nonstationary
AIEWBI	With intercept	-2.426	-3.581	-2.927	-2.601	nonstationary
	With intercept and trend	-3.483	-4.171	-3.511	-3.185	stationary
	Without intercept and trend	0.794	-2.616	-1.948	-1.612	nonstationary
CSCI	With intercept	-1.927	-3.585	-2.928	-2.602	nonstationary
	With intercept and trend	-3.348	-4.171	-3.511	-3.185	stationary
	Without intercept and trend	-0.893	-2.616	-1.948	-1.612	nonstationary

Source: Research findings

Table 4. Results of the Phillips-Perron (PP) unit root test

Variable	PP statistic		MacKinnon critical value			Interoperation of test results
			1%	5%	10%	
IEWBI1	With intercept	-1.553	-3.581	-2.927	-2.601	nonstationary
	With intercept and trend	-3.277	-4.171	-3.511	-3.185	stationary
	Without intercept and trend	0.405	-2.616	-1.948	-1.612	stationary
IEWBI2	With intercept	-1.001	-3.581	-2.927	-2.601	nonstationary
	With intercept and trend	-3.275	-4.171	-3.511	-3.185	stationary
	Without intercept and trend	1.118	-2.616	-1.948	-1.612	nonstationary
IEWBI3	With intercept	-4.227	-3.581	-2.927	-2.601	stationary
	With intercept and trend	-4.366	-4.171	-3.511	-3.185	stationary
	Without intercept and trend	-0.449	-2.616	-1.948	-1.612	nonstationary
AIEWBI	With intercept	-2.338	-3.581	-2.927	-2.601	nonstationary
	With intercept and trend	-3.621	-4.171	-3.511	-3.185	stationary
	Without intercept and trend	0.534	-2.616	-1.948	-1.612	nonstationary
CSCI	With intercept	-2.924	-3.581	-2.927	-2.601	stationary
	With intercept and trend	-3.152	-4.171	-3.511	-3.185	nonstationary
	Without intercept and trend	-1.453	-2.616	-1.948	-1.612	nonstationary

Source: Research findings

Table 5. Results of Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root test

Variable	KPSS statistic		MacKinnon critical value			Interoperation of test results
			1%	5%	10%	
IEWBI1	With intercept	0.645	0.739	0.463	0.347	stationary
	With intercept and trend	0.180	0.216	0.146	0.119	stationary
IEWBI2	With intercept	0.756	0.739	0.463	0.347	nonstationary
	With intercept and trend	0.134	0.216	0.146	0.119	stationary
IEWBI3	With intercept	0.217	0.739	0.463	0.347	stationary
	With intercept and trend	0.166	0.216	0.146	0.119	stationary
AIEWBI	With intercept	0.541	0.739	0.463	0.347	stationary
	With intercept and trend	0.168	0.216	0.146	0.119	stationary
CSCI	With intercept	0.309	0.739	0.463	0.347	stationary
	With intercept and trend	0.108	0.216	0.146	0.119	stationary

Source: Research findings

6.2. Determination of optimal lag length

Before estimating the VAR model, the lengths of lags in the model must be determined. The optimal lag order can be determined based on Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn Information Criterion (HQ).

Since the number of observations (or sample size) in this study is less than 100 and SIC provides more accurate results for such limited data, we obtain the optimal lag with this criterion. The results of different tests for determining the optimal lag of the models are summarized in Table 6. As shown in this table, based on SIC, the optimal lag for models VAR_1, VAR_2, and VAR_4 is 1, and for VAR_3 it is 2.

Table 6. Optimal lag order for the research models according to different criteria

Model	LR	FPE	AIC	SC	HQ	Optimal lag length
VAR1	3	3	3	1	3	1
VAR2	3	3	3	1	3	1
VAR3	3	3	3	2	3	2
VAR4	3	4	4	1	3	1

Source: Research findings

6.3. Test of stability of VAR models

To ensure that the results of the estimated VAR models are reliable, the stability of these models should be examined with the AR Root test, which assesses the inverse roots of AR characteristic polynomial.

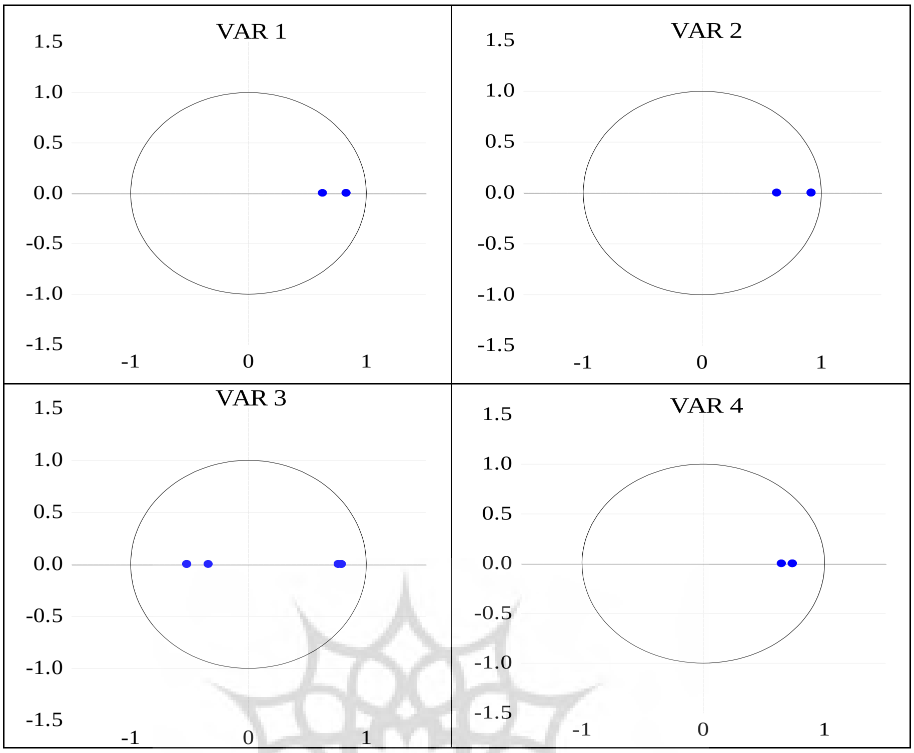

Figure 3. Stability test of research models

If the points fall within a circle with unit radius, then the VAR model is stable. If the model is unstable, IRF and variance composition analyses will be incorrect. Overall, there will be an $m \times p$ number of roots, where m is the number of endogenous variables and p is the number of lags. The results of this test for the research models are illustrated in Figure (3). As can be seen, all of the roots for all of the models are in the circle with unit radius, which means the estimated VAR models are stable.

6.4. Results of the estimated models

Results of VAR models are often interpreted with the help of IRF and variance decomposition and with less attention to criteria such as the significance of coefficients according to t-statistic. This is because, in VAR models, explanatory variables are usually highly correlated, and thus t-statistic cannot be a reliable measure of the suitability of coefficients (Souri, 2015). Therefore, here, the effects of the shocks of CSCI on IEWBI are analyzed exclusively by IRF and forecast error variance decomposition.

6.5. Analysis of IRF and forecast error variance decomposition

IRFs demonstrate how the variables of the VAR model respond to shocks. These shocks are random changes that are introduced to the model through u_{1t}, u_{2t}, …, and u_{mt}. Any shock that is introduced to a variable also affects other variables (36). IRFs allow us to analyze the behavior of target variables when shocks are applied to other variables. There, in this study, we use IRFs to observe the response of economic well-being index to the shocks of structural changes in the economy. Using forecast error variance decomposition, it is possible to determine how much of the variations of a variable are affected by its own components and how much of them are affected by the components of other variables in that system. In other words, forecast error variance decomposition helps us determine what percentage of changes in the dependent variable (here, IEWBI) is explained by the shocks from each variable (here, the shocks from CSCI). Figure (4) shows the IRFs (the response of IEWBI with different weighting schemes to a shock with a magnitude of one standard deviation in CSCI). In this figure, the dotted curves represent 95% confidence intervals, the vertical axis represents deviations from the initial equilibrium values, and the horizontal axis represents the time in years.

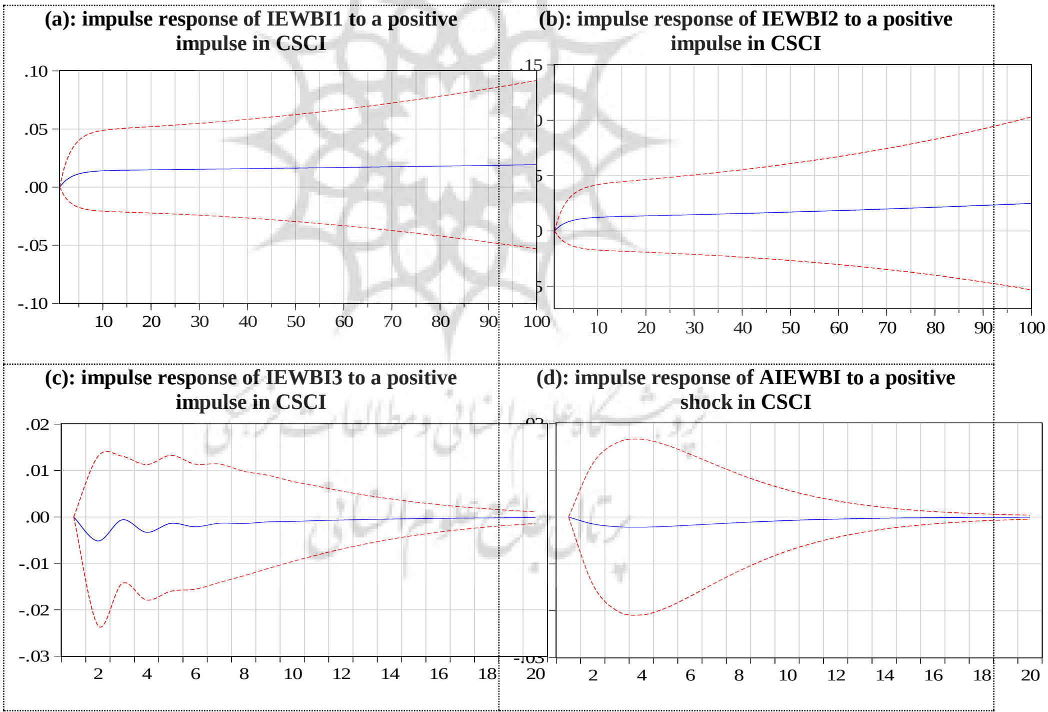

Figure 4. Impulse response functions

Figure (4-a) shows the response of IEWBI with the uniform weighting scheme ($IEWBI^1$) to one standard deviation shock in CSCI. According to Figure (4-a), the structural changes of the Iranian economy have a positive and lasting effect on $IEWBI^1$. In other words, a unit standard deviation shock in CSCI will increase the economic well-being index of Iran in the coming years. Figure (4-b) illustrates the response of $IEWBI^2$ (the index with a higher weight assigned to consumption flow) to the same shock. This figure shows that the structural changes in the Iranian economy have a positive and lasting effect on the economic well-being index if we define this index with a higher weight given to the consumption flow (as is the case in $IEWBI^2$). According to the Figure (4-a) and Figure (4-b), the impact of one standard deviation shock in CSCI has more effect on $IEWBI^2$ than on $IEWBI^1$ in Iranian economy, and it can be said that the positive effect of structural change coefficient on $IEWBI^1$ is due to structural change effect on consumption dimension.

Figure (4-c) displays the impulse response of $IEWBI^3$ (the index with a higher weight assigned to economic security) to one standard deviation shock in CSCI. This figure shows the inverse and transient effect of structural changes on the well-being index with a higher weight given to economic security. The results show that this effect is almost neutralized after about 20 periods after introducing the shock. In this case, the inverse effect of structural changes on the well-being index can be attributed to the downward trend of almost all components of the economic security dimension (all except RINF) during the studied period. The results obtained for the economic security dimension show that RSPP (Risk from Single Parenthood Poverty) with the highest long-term negative growth rate (-3.71) has had the greatest negative impact on the economic security dimension and hence $IEWBI^3$. After RSPP, RILL (Risk from Illness) and RUE (Risk from Unemployment) with long-term growth rates of respectively -0.35 and -0.15 have had the next most powerful impacts on this dimension. On the contrary, RINF (risk from inflation) with a long-term growth rate of 1.18% has had a positive and reinforcing effect on the economic security dimension and $IEWBI^3$. According to these results, from 1966 to 2012, the economic security index has experienced a long-term change of -92%. These results suggest that if we assign a higher weight to the economic security dimension of IEWBI, then structural changes and development policies in Iran have had an adverse effect on the economic well-being of the country. Figure (4-d) shows the response of AIEWBI (the average of three IEWBIs with different weighting schemes) to the same shock in CSCI. In this case, too, structural changes in the Iranian economy have had an inverse and transient effect on economic well-being index. According to results this effect is almost neutralized after about 17 periods.

It is worth noting that the results are consistent with the realities of Iranian economy. Growth of the economy, as well as the adoption of supportive policies, such as the payment of subsidies by policymakers, has led to the expansion of the consumer basket over time, and therefore people have been encouraged to consume more over the past decades. So if assuming that the increase in well-being results from increased physical consumption, it is reasonable to expect an increase in economic well-being. In other words, it can be concluded that from this perspective, structural changes and development policies have had a positive effect on the economic well-being of society. On the other hand, in the Iranian economy, the economic security dimension due to its components has deteriorated over the past decades. Then from this perspective, structural changes and development policies in Iran have had an adverse effect on the economic well-being of the country.

The results of the variance decomposition analysis of IEWBI in the estimated VAR models for 30 periods are presented in Table 7. The S.E. column of this table shows the forecast errors for different periods. Since the forecast error for each period is calculated based on the error of the previous period, it increases over time.

According to Table (7-a), the percentage change in $IEWBI^1$ that is explained by CSCI has decreased from about 4.42% at the beginning of the period to 0.34% at the end of the 30th period, which demonstrates the impact of the structural changes of the Iranian economy on the economic well-being index. The lowest explanatory power is related to the case in which IEWBI has been defined with a higher weight given to the consumption flow dimension, where, according to Table (7-b), the shock in structural changes has at most managed to explain 2.36% of changes in $IEWBI^2$ (in the first period). According to Table (7-c), when a higher weight is assigned to the economic security dimension of the index ($IEWBI^3$), then structural changes account for about

Table 7. Results of the variance decomposition of IEWBIs

Period	a) variance decomposition of IEWBI1			Period	b) variance decomposition of IEWBI2		
	IEWBI1	CSCI	S.E.		IEWBI2	CSCI	S.E.
1	95.58012	4.419878	0.058886	1	97.64176	2.358237	0.045985
3	97.69716	2.302837	0.099713	3	99.03716	0.962844	0.078782
6	98.79037	1.20963	0.139145	6	99.34925	0.650748	0.111421
9	99.16895	0.831054	0.169768	9	99.2558	0.744197	0.137375
12	99.34669	0.653309	0.196037	12	99.14295	0.857052	0.160065
15	99.44992	0.55008	0.219589	15	99.05715	0.942849	0.180778
18	99.51808	0.481921	0.241245	18	98.9951	1.004898	0.200166
21	99.56675	0.433255	0.261488	21	98.94947	1.050528	0.21862
24	99.60333	0.396671	0.280631	24	98.9149	1.085096	0.23639
27	99.63186	0.36814	0.298893	27	98.88795	1.112054	0.253654
30	99.65474	0.345263	0.316433	30	98.86638	1.133615	0.270541
Period	c) variance decomposition of IEWBI3			Period	d) variance decomposition of AIEWBI		
	IEWBI3	CSCI	S.E.		AIEWBI	CSCI	S.E.
1	94.62886	5.371135	0.061797	1	93.49835	6.501652	0.053376
3	93.08341	6.916594	0.069615	3	92.30645	7.693547	0.073376
6	92.29146	7.708537	0.072162	6	91.54362	8.456381	0.079721
9	92.11229	7.887705	0.072503	9	91.33788	8.662125	0.080783
12	92.06042	7.93958	0.072539	12	91.29237	8.707633	0.080965
15	92.0481	7.951898	0.072544	15	91.28342	8.716577	0.080995
18	92.04537	7.95463	0.072546	18	91.28178	8.718217	0.081
21	92.04482	7.955177	0.072547	21	91.28149	8.718506	0.081001
24	92.04473	7.955273	0.072547	24	91.28144	8.718555	0.081001
27	92.04471	7.955285	0.072547	27	91.28144	8.718563	0.081001
30	92.04471	7.955286	0.072547	30	91.28144	8.718565	0.081001

Source: Research findings

5.37% of the changes in the index in the first period, and this rate increases to about 8% at the end of the 30th period. If we use the average of these three indexes (AIEWBI) in the VAR model, then structural changes explain 6.5% of changes in the index in the first period and about 8.72% of these changes at the end of the 30th period (Table (7-d)).

The important thing is that the results reported in Table 7 provide strong evidence that some of the changes in the index of economic well-being of Iran are explained by the shocks in structural changes in the Iranian economy, which demonstrates the impact of structural changes and hence development policies on **Iranian economic welfare.**

7. Conclusion Remarks

This study aimed to answer the question that whether structural changes in the Iranian economy improves the economic welfare of this country? To answer this question, we formulated and calculated two indicators called the Coefficient of Structural Change of Iran (CSCI) and the Index of Economic Well-Being of Iran (IEWBI), and then used the vector autoregressive (VAR) model to analyze the impact of structural changes of Iranian economy on IEWBI and its different dimensions. It was found that the IEWBI with the weighting scheme where the consumption flow dimension is given a higher weight produces higher growth rates than the one with the uniform weighting scheme, where all dimensions have a weight of 0.25. On the contrary, the IEWBI with the weighting scheme where the economic security dimension is given a higher weight produces relatively lower (in this case negative) growth rates. Calculations of CSCI revealed that structural changes in the Iranian economy have been modest and volatile, and had ranged from 0.14% to 2.68%.

After calculating the IEWBI and CSCI time series, the VAR model was used to investigate how structural changes have affected the index of economic well-being over the years. The plotted diagrams of impulse response function (IRF) demonstrated that the shocks in CSCI have indeed had an effect on IEWBI. It was found that the said shocks have a lasting positive impact on $IEWBI^1$ and $IEWBI^2$. The IRF diagrams plotted for the other two definitions of IEWBI showed the negative and transient effect of the shocks in CSCI on these indexes.

In other words, these results suggested that structural changes and development policies have been detrimental to economic well-being. It should be noted that results are consistent with the realities of Iranian economy, because, assuming that improvements in well-being result from increased physical consumption, it is reasonable to expect an increase in economic well-being during last decades. Also, if assuming that well-being affected more by security dimension, it is reasonable to expect decrease in economic well-being. Hence, it can be concluded from this perspective that structural changes and development policies have had a positive effect on the economic well-being when consumption flow considered as the most prominent dimension of economic well-being, and when higher weight assigned to economic security, the effect is negative.

The results of variance decomposition analysis provide strong evidence that some of the changes in the index of economic well-being of Iran can be explained by the shocks in structural changes in the Iranian economy, which means the economic well-being in Iran has indeed been affected by the structural changes and development policies.

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تغییرات ساختاری و شاخص رفاه اقتصادی: شواهد تجربی از اقتصاد ایران

چکیده

این یک واقعیت تجربی ثابت شده است که رشد و توسعه اقتصادی با تغییرات قابل توجه در ستاده بخشی، اشتغال و ساختار مصرف مرتبط است. در مباحث توسعه اقتصادی، تغییر ساختاری تغییر وزن نسبی اجزای مهم شاخص‌های کلان اقتصاد، مانند اشتغال، تولید و مخارج ملی، صادرات و واردات، جمعیت و ... در بخش‌های سه‌گانه کشاورزی، صنعت و خدمات می‌باشد. در این میان، با توجه به اهمیت و نقش سرمایه انسانی در رشد و توسعه اقتصادی، مهم‌ترین حوزه، حوزۀ بازار کار و سهم اشتغال بخش‌های عمدۀ اقتصادی است. بعد مهم دیگر توسعه اقتصادی، رفاه اقتصادی است. در پژوهش حاضر پس از برآورد ضریب تغییرات ساختاری اقتصاد ایران (CSCI) و نیز شاخص رفاه اقتصادی ایران (IEWBI)، با استفاده از مدل خودرگرسیونی برداری (VAR) و نیز نسخه دهم بسته نرم‌افزاری ایویوز، تأثیر تغییرات ساختاری اقتصاد ایران بر شاخص رفاه اقتصادی، مورد بررسی قرار گرفته است. نتایج حاکی از تأثیر تغییرات ساختاری و لذا سیاست‌های توسعه‌ای بر شاخص رفاه اقتصادی ایران است. این تأثیر با اختصاص جدول وزنی تورش‌دار به‌سمت بعد جریان مصرف مثبت و در دیگر حالات منفی می‌باشد.

کلمات کلیدی: ایران، شاخص رفاه اقتصادی، تغییرات ساختاری، مدل خودرگرسیون برداری.