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Functional Income Distribution in Turkey: A Cointegration and VECM Analysis

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Abstract: This study analyzes the patterns of functional income distribution in Turkey. Cointegration, vector error correction model (VECM), and impulse response procedures are applied on a quarterly data set covering the period 1987Q1-2005Q4. The main finding of the paper is that the functional income components, i.e., wage income, non-wage agricultural earnings, and operating surplus are cointegrated and, thus, can not drift too far apart. This suggests that, contrary to the general belief, distribution of functional income has not significantly changed within the last two decades in Turkey.

JEL Classification Codes: D30.
Key Words: Functional income distribution, cointegration, VECM.

1. Introduction

The concept of income distribution is probably one of the most puzzling issues of any given society living on earth. Many poor nations already suffer from the presence of drastic income inequalities. On the other hand, many other nations produce tremendous wealth but alongside tremendous poverty. It seems that neither, as a nation, staying poor nor getting rich solves the problem of income inequality.

As Stewart (2000) points out, there are several key issues with regard to income distribution. First, a nation needs to deal with the question of "what to distribute?" This demands making a decision about distributable goods, taking into consideration the distinction between household income and functional income distributions in the society. The second question that needs to be answered is "distribution among whom?" In this case the issue of income distribution among groups, households, or individuals needs to be

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dealt with as target subjects can differ enormously within various societies. The third key issue is determining the unit in which income inequality needs to be diminished to a reasonable level. The unit may be local, national, or, if possible, international.

Personal income distribution is the share of total income received by individuals or households, which may or may not be earned from productive activities. Functional income distribution, on the other hand, is the distribution of income between groups, depending on their supply of factors of production in the form of land, labor, capital, and entrepreneurial ability. Though functional income distribution can offer important clues in dealing with the distribution of income in general, recent studies pay little attention to the long run behavior of functional income distribution. Also, the general tendency to assume that the functional income distribution is highly stable is unfounded, since it may be stable in one society but not in the other.

This study primarily aims to analyze the long-run behavior of functional income distribution in Turkey. In particular, the possible relationship between returns and factors of production is investigated by utilizing cointegration and vector error correction model (VECM) procedures. If a cointegration relationship can be found, this will indicate that there are no fundamental distortions of income distribution among the suppliers of factors of production. The detailed short-run properties of the relationship among variables can be obtained from the VECM application.

Applied research dealing with the long-run properties of the functional income distribution in Turkey is quite limited. Further, a vast majority of the studies are based on simple data analysis procedures. The Turkish Statistical Institute (TURKSTAT) occasionally reports earning differences between wage and non-wage earnings, partially reflecting a truncated functional income distribution. Based on these reports, Ensari (1997) shows that in 1973, 1987, and 1994, respectively, 28.3, 27.0, and 31.5 percent of the income went to the wage earners, and 71.7, 73.0, and 68.5 percent of the income went to the non-wage earners in Turkey. In 2003, the institute also reported some comparable statistics with regard to 1994 and 2002 income distributions. According to this report, functional income distribution more closely approached equality in 2002 compared to 1994. The report states that the wage-earners' share of the income was 38.7 percent in 2002 and the entrepreneurs' share was 34.5 percent in the same year, compared to 42.4 percent in 1994. Kuştepeli and Halaç (2004) report that between 1994 and 2002, within the total entrepreneur income, non-wage agricultural earnings went down from 39.3 percent to 38.2 percent in real terms. Boratav and Yeldan (2001) argue that "the share of agricultural income [was] almost reduced by half in the course of the last three decades." They also show that, on average, in 1980s the wage earners' share of national income was about 10 percent lower than their share were in 1970s and 1990s.

The data from various other nations also indicate that functional income distributions have considerable potential to fluctuate, rather than being stable or constant over time. Zweimüller (2000) presents functional income distribution figures for the USA, UK, Germany, and France from the early 1960s up about to the mid-1990s. For the US it appears that labor share has diminished within the past decades. For the UK the labor share seems to have remained relatively stable over time. However, in Germany and France the labor share increased until the early 1980s, and decreased sharply thereafter, implying a substantial variability in distribution. Jalava (2001) explains that in Finland "new technology has resulted in a shift in the functional income distribution in favor of capital," compared to labor whose share, on average, decreased from 64.4 percent to 55.6 percent between the periods 1975-90 and 1995-99, respectively. Pernia and Knowles (1998) state that financial shocks hitting a number of South-eastern and East Asian economies in 1997 altered functional income distribution in favor of non-wage earners. Heinz and Carsten (2005) find that in Germany, through technological progress, functional income distribution becomes more equal as labor becomes more skilled. Kauppinen (2001) investigates the behavior of wage patterns in EU member countries, US and Japan. He concludes that in all of these countries "the share of wage income has decreased and capital income increased" considerably.

The purpose of this article is to analyze the patterns of long-run functional income distribution in order to bring some clarification to the ongoing 'distribution controversy' observed almost every part of the society in Turkey. The controversy may never end, but we can at least see what the numbers are really showing us. Unit root, cointegration, vector error correction model (VECM), and impulse response procedures are utilized. Especially since the work of Blanchflower *et al.* (1996), the microeconomic fundamentals of sharing have been explored extensively. In this particular study the authors present three models. In one of the models, they extend the framework of Baily (1974) and Azariadis (1975) which allows a firm to be risk-averse. This indicates that the firm and the workers intentionally select sharing the risk of demand fluctuations, which further implies that wages and profits move together. We build our work on this framework to determine whether the parties share in the good times and the bad times. Given that the cointegrated series tend to move together, without drifting too far apart, it would be wise to use cointegration analysis in order to see the possible long-run relationships between the various functional income components.

The following section introduces the data. Section three presents the methodology and reports the empirical results. Finally, section four concludes the paper.

2. Data

The quarterly data covering the period 1987Q1-2005Q4 comes from the Central Bank of the Republic of Turkey (CBRT) electronic data delivery system. The functional income components analyzed in this study are wage payments (W), non-wage agricultural earnings (AE), and operating surplus, which comprises rent, interest and profit gains. This latter component will be labeled as CE. The variables were transformed into real values by using the consumer price index (CPI).

Figure 1: Functional income distribution (in log form): wage income (W), non-wage agricultural earnings (AE), and operating surplus (CE).

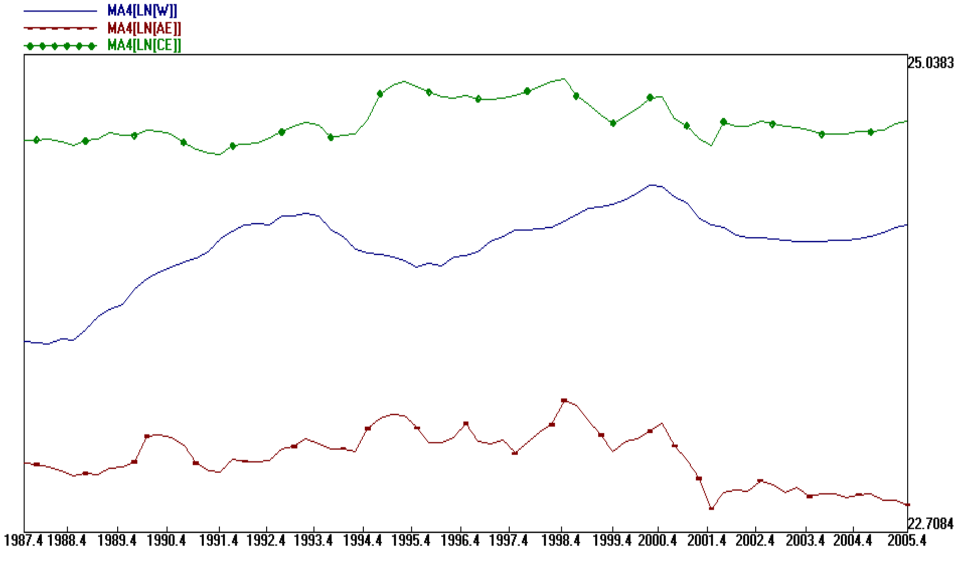


Figure 1 presents the behavior of three functional income components, W, AE, and CE, measured in real terms. Since the data is quarterly, reflecting severe seasonal variations especially in AE, we smoothed the data by moving the average procedure to get a better picture of the numbers. The figure shows that operating surplus was higher in most of the second half of 1990s, compared to before and after, but was relatively constant in the long run. Contrary to the general belief in Turkey, however, we see that on average real income obtained by labor suppliers increased in the long run. It seems that, compared to the other periods in the figure, in 1993 and 2000 the wage-earners share was the highest. Non-wage agricultural earnings remained stable until 2000Q4 and decreased thereafter. It seems that the downward trend is persistent in non-wage agricultural earnings.

3.1 Unit root and cointegration tests

Since many macroeconomic series appear to be nonstationary, as Nelson and Plosser (1982) affirm, we first need to check for the stationarity of the series. Several unit root tests exist to check for stationarity of the series. In order to proceed for the cointegration analysis, one must establish that the variables possess the same order of integration. A variable is called integrated order of d, I(d), if it has to be differenced d times to become stationary (Kennedy, 1996: 253). We apply the Augmented Dickey-Fuller (ADF) (1981) test to examine the stationarity characteristics of the series. Table 1 reports the ADF unit-root test results below:

Table 1: Augmented Dickey-Fuller (ADF) unit-root test results

Variables	Form	Constant, No Trend	Constant, Trend
W	Level	-2.4120 (3)	-1.5774 (3)
	First Difference	-3.7422* (3)	-4.0491* (3)
AE	Level	-1.6208 (4)	-2.0285 (4)
	First Difference	-4.8658* (5)	-5.0007* (5)
CE	Level	-2.2741 (4)	-2.2467 (4)
	First Difference	-5.5661* (5)	-5.5801* (5)

All variables are in log forms. Lag lengths, determined by AIC, are in parenthesis. An asterisk denotes 1% significance level. Critical values are from Davidson and MacKinnon (1993).

The results presented in Table 1 suggest, at 1% significance level, that the null hypothesis of a unit root (i.e., nonstationarity) is accepted when the series W, AE, and CE are in levels, but it is rejected when they are in first differences. Further, given the test results, it seems that the series also exhibit stationarity around a deterministic linear time trend. However, testing the trend pattern of the series by utilizing the test equation $zt = \mu + \beta t + \rho zt-1 + \varepsilon t$ does not confirm the presence of a deterministic trend, as we estimate $\beta=0$ and $\rho=1$.

The presence of cointegration suggests that there is a long-run equilibrium relationship between the series. In our case functional income components are cointegrated if they are each I(1) and there exists a linear combination of them being I(0). To test for cointegration, we apply the Johansen-Juselius (1990) methodology.

The Johansen-Juselius, (JJ), procedure utilizes two test statistics to determine the number of cointegrating vectors. These are trace and maximum eigenvalue test statistics. Utilizing the $\lambda trace = T \sum j=r+1,n \ln(1-\lambda j)$ equation, the trace test statistic, for the null, hypothesizes that there are at most r number of cointegrating vectors. In the equation T represents the number of observations, and λjs shows the estimated values of the characteristic roots, in assuming that the series are I(1). Using the $\lambda max = -T \ln(1-\lambda r+1)$ relationship, the maximum eigenvalue test statistic constructs the null hypothesis as at most r cointegrating vectors, and the alternative hypothesis as r+1 cointegrating vectors.

Table 2 reports the results of Johansen-Juselius cointegration tests for the series. Special critical values for the test statistics are obtained from Johansen and Juselius (1990).

Table 2: JJ cointegration test results

	$r = 0$	C. Values	$r \leq 1$	C. Values	$r \leq 2$	C. Values
λ_{trace}	32.7	28.4 (5%)	4.4	15.6 (10%)	0.7	6.7 (%10)
λ_{max}	28.3	19.0 (5%)	3.7	12.8 (10%)	0.7	6.7 (%10)

According to the AIC and SC criteria optimum lag length is selected to be 9. The model includes three seasonal dummies. No restrictions on the constant term are imposed.

In Table 2 results of trace, λtrace, and maximal eigenvalue, λmax, test statistics are presented. The results indicate that there is exactly one cointegrating vector in the model. This means that a single vector uniquely defines the cointegration space (Harris and Sollis, 2003: 152). As Enders (2004: 372) states, "cointegrated variables share the same stochastic trends and so cannot drift too far apart." This suggests the existence of a long-run relationship between the series.

3.2 Error correction model

Cointegrated series have an error correction representation. Engle and Granger (Granger, 1983; Engle and Granger, 1987) reveal that, if the series are cointegrated, then the possibility of the estimated regression being spurious due to tribulations such as omitted variable bias, autocorrelation, and endogeneity is ruled out. Since our series are cointegrated, we can further proceed to determine the direction of causality, in Granger's sense, among the variables. For this purpose various vector error correction models can be specified. Observing the short-run properties of the series, by utilizing such models, may provide very useful insights especially for policy makers.

Relying on the presence of a cointegrating vector, the subsequent vector error correction model (VECM) can be written as follows:

$$\Delta lnW_t = \alpha_1 + \sum^a \Phi_1(i)\Delta lnAE_{t-i} + \sum^a \Omega_1(i)\Delta lnCE_{t-i} + \sum^a \gamma_1(i)\Delta lnW_{t-i} + \psi_1 ECT_{t-1} + \varepsilon_{1t}$$

(8)

$$\Delta lnAE_t = \alpha_2 + \sum^b \Phi_2(i)\Delta lnW_{t-i} + \sum^b \Omega_2(i)\Delta lnCE_{t-i} + \sum^b \gamma_2(i)\Delta lnAE_{t-i} + \psi_2 ECT_{t-1} + \varepsilon_{2t}$$

(9)

$$\Delta lnCE_t = \alpha_3 + \sum^c \Phi_3(i)\Delta lnW_{t-i} + \sum^c \Omega_3(i)\Delta lnAE_{t-i} + \sum^c \gamma_3(i)\Delta lnCE_{t-i} + \psi_3 ECT_{t-1} + \varepsilon_{3t}$$

(10)

where Δ is the first-difference operator, ECT is the error correction term coming from the long-run cointegrating relationship, i.e. residuals, and the terms a, b, c, are lag lengths. In this parsimonious VEC model, the lag lengths could be equal to zero for the variables that are not also dependent variables. The coefficients of ECTt-1, ψ1,…,ψ3, capture the adjustments of ΔlnWt, ΔlnAEt, and ΔlnCEt towards long-run equilibrium. The short-run causality relationships can be tested through the coefficients of each explanatory variable. For example, in order to see whether CE Granger-causes W in Equation (8) we can test the null hypothesis of different lag-length parameters being equal to zero, i.e., H0: $\Omega 1 = \Omega 2 = \ldots = \Omega a = 0$.

The vector error correction model (VECM) estimation results obtained from equations (8)-(10) are given in Table 3. A set of necessary standard diagnostic tests was conducted during the process of estimation to rule out any discrepancies.

Table 3: Results from the vector error correction model (VECM)

Regressors	Coefficient (Eq. 8)	Coefficient (Eq. 9)	Coefficient (Eq. 10)
ECT_{t-1}	-0.03669*	-0.04141	-0.08260**
ΔlnW_t		0.30167***	0.30681*
$\Delta lnAE_t$			0.38478*
$\Delta lnCE_t$	0.29817*	1.0325*	
ΔlnW_{t-1}	0.81220*	-0.08832	-0.35706*
$\Delta lnAE_{t-1}$	0.02327	0.39156*	-0.26270*
$\Delta lnCE_{t-1}$	-0.27938*	0.30322***	0.61828*
Constant	0.00009	0.00020	-0.00005
* = 1% ** = 5% *** = 10%	R^2: 0.6351 DW:2.09 RESET-PV: 0.30	R^2: 0.5412 DW: 2.05 RESET-PV: 0.29	R^2: 0.6265 DW: 2.10 RESET-PV: 0.64

In estimating equations (8)-(10), as explained in Hendry (1995), we first used four lags of the explanatory variables, i.e. estimated unrestricted ECM, and then sequentially removed the insignificant variables obtaining a final parsimonious VEC specification. In such specification the variables that impose significant present-period pressure on the regressand are included into the equations without lags.

The results presented in Table 3 show that the ECT coefficients of equations (8) and (10) are significant and have negative signs implying that the series can not drift too far apart and convergence is achieved in the long run. More specifically, each ECT coefficient indicates that a deviation from the long-run equilibrium value in one period is corrected in the next period by the size of that coefficient. For equations (8) and (10) the corrections are around four percent and eight percent, respectively. The ECT coefficient of equation (9) has a negative sign but it is not significant.

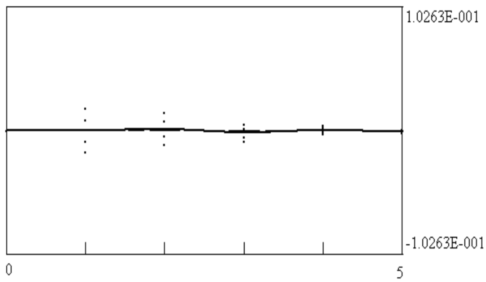
In the short run, it can be observed that fluctuation-type relationships exist in general. Further, almost all adjustments take place within the same or following time periods, implying that the system settles down quickly.

3.3 Impulse response analysis

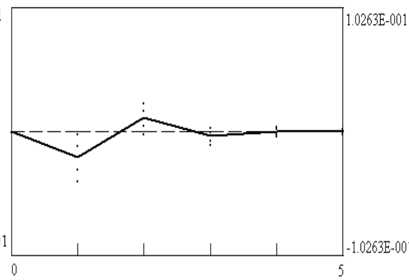
Since shocks to a particular variable can generate variations both in itself and in other variables, we employ the orthogonalized methodology of Sims (1980) to determine impulse responses. In this approach it is possible to trace out the time path of the various shocks on the variables. The general representation of this procedure is widely available and can be found in the seminal works of Sims (1980), Bernanke (1986), and Sims (1986).

As Enders (2004: 270) states, there is a controversy about whether the series in a VAR need to be stationary. Some researchers argue that differencing the variables to make them stationary leads to the loss of a significant portion of information related to the co-movements in the data. Many other researchers, however, do not agree with this argument. Since we have already determined that the variables contain a unit root, we have chosen to use stationary series in obtaining impulse responses. Results obtained from the variance decomposition procedure are given in Figure 2 below. The dots indicate plus and minus 1 and 2 times the standard error bands.

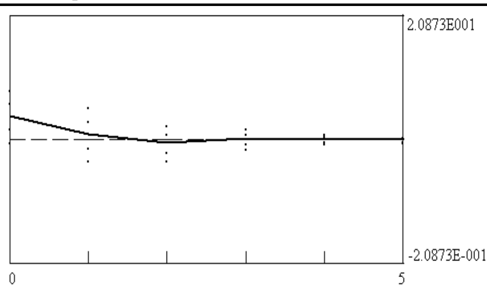
Figure 2: Impulse responses to innovations



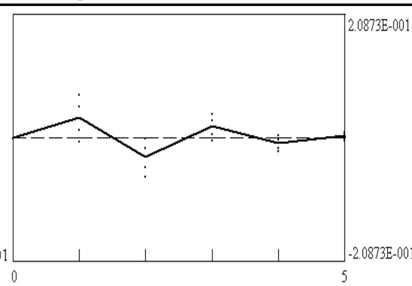
2-i. Response of LnW to a unit shock in LnAE



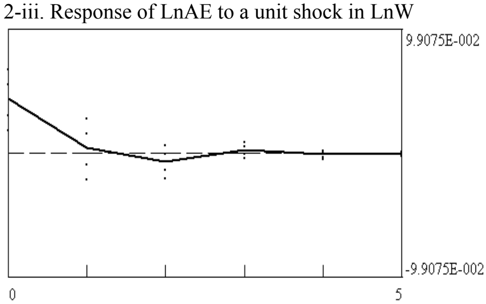
2-ii. Response of LnW to a unit shock in LnCE



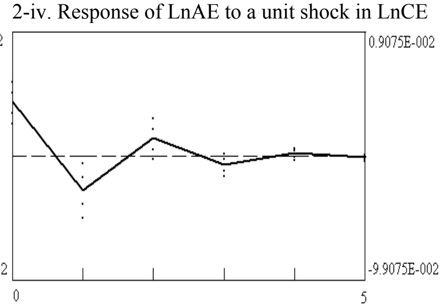
2-iii. Response of LnAE to a unit shock in LnW



2-iv. Response of LnAE to a unit shock in LnCE



2-v. Response of LnCE to a unit shock in LnW



2-vi. Response of LnCE to a unit shock in LnAE

In the first panel in Figure 2 we see that response of wage income to an unanticipated change in non-wage agricultural earnings is neutral, i.e., irresponsive. In 2-ii the initial response of wage income to a unit shock in operating surplus is negative and significant one quarter after the shock then becomes positive and dies out. In 2-iii the response of non-wage agricultural earnings to a shock in wage income is positive in the first period but the reaction can not be considered as significant. Panel 2-iv shows that the response of non-wage agricultural earnings to an operating surplus shock is initially positive and becomes negative and significant in the second period and then increases and dies out. In 2-v, the response of operating surplus to a shock in wage income is positive and significant but dies out within one quarter. Finally, panel 2-vi shows that the initial response of operating surplus to a shock in non-wage agricultural earnings is negative and significant in the first quarter, then becomes positive and dies out. Overall, from Figure 2 we see that the short-run equilibrium adjustment process is quite fast.

4. Conclusion

There is a widespread belief in Turkey that especially after 1980s inequality in functional income distribution has increased dramatically on behalf of operating surplus earners, making them better off, and the reverse is true for wage earners and agricultural earnings.

In order to see whether this argument has a solid ground, we applied cointegration, VECM, and impulse response analyses on three major components of the functional income, i.e., wage income, non-wage agricultural earnings, and operating surplus. Unit root tests show that these series were non-stationary in levels, but were stationary after first differencing. The cointegration test results indicate that the three functional income components are cointegrated, implying that the series cannot drift too far apart. The vector error correction (VEC) estimates further establish presence of a causal relationship among the variables. Impulse response analysis also indicates that the series are responsive to the various corresponding shocks.

Our findings do not support Boratav and Yeldan (2001) who argue that the share of agricultural income and wage income has diminished drastically in Turkey within the last several decades. In contrast to their findings, which were obtained from simple data analysis procedures, our results show that compared to the operating surplus earners the wage income earners have been better off within the last two decades. Overall, the relationship between the series was relatively stable, as Turkish Statistical Institute's sporadic reports imply, and cannot be considered as drifting too far apart. To the best of our knowledge, there is no applied research on this subject in Turkey with which to further compare our findings, and thus, we urge researchers to do more applied work in this area.

In short, this paper, contrary to the general belief, which is not based on applied research, finds that the distribution of income going to the major input suppliers for production has not significantly changed within the last two decades in Turkey. It should be noted, however, that these results do not, *per se*, effectively address personal income distribution.

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