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Full Length Research Paper

The nexus between labor reallocation and sectoral productivities in Pakistan: 1980 to 2007

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This paper empirically studies the labor allocation between rural and urban sectors due to economic growth in one of the least developed economies, Pakistan. The paper adopts a time-series analysis from 1980 to 2007, to study the causal impact of sectoral productivities on labor reallocation among sectors. The results indicate that labor productivity in manufacturing induces labor mobility from agriculture to manufacturing. The results also support the view that improvement in labor productivity in the agricultural sector pushes labor allocation to non-agricultural sectors.

Key words: Labor reallocation, sectoral productivity, exports, Pakistan.

INTRODUCTION

During the process of economic growth, the demand for manufactured commodities and services increases sharply in the beginning, this reallocates the resources such as labor and other inputs from agriculture to manufacturing and services sectors. After sometime with the saturation in the demand for manufacturing commodities and with the maturity of the manufacturing sector, the services sector grows faster than the industrial sector. This is because the industry uses services more intensively than agriculture and it absorbs resources released from other sectors.

The neoclassical view holds that sectoral composition is a relatively unimportant byproduct of growth, while other groups of economists argue that economic growth depends on changes in sectoral composition. Thus, there is no simple and straightforward conclusion about the interaction between sectoral composition and economic growth.

Various studies on structural changes and economic growth show different mechanisms behind the reallocation of labor among sectors. Lewis (1954) and Fei and Ranis (1964) argued that the growth of manufacturing sector is a basis for labor migration from agricultural sector to manufacturing sector, while Nurkse (1953) and Rostow (1960) viewed labor migration from agriculture as a result of agriculture productivity growth. Matsuyama (1992) and Eswaran and Kotwal (1993) have argued that the two views depend on the extent to which domestic economy is integrated with the global economy. They found that, if an economy is not strongly integrated with the global economy, then agricultural productivity causes labor migration from agriculture to other sectors. Though several studies attempted to examine the above phenomenon using descriptive and calibration methods, empirical studies using econometric methods are scanty. The objective of this paper, therefore, is to analyze the process of labor reallocation across agriculture, manufacturing and service sectors in one of the least developed economy, Pakistan. Author hopes that the present study will provide important insights into the labor reallocation process from agriculture to other sectors in the early stage of development.

The reminder of this paper is organized as follows. The review of relevant theoretical and empirical literatures concerning labor reallocation across sectors. A description of the data used in this study and explains the pattern of economic changes in Pakistan during the study period. The methodology adopted followed by a detailed discussion of the estimation results. Finally, the paper ends with a summary of the findings of this study.

JEL classifications: O10, O53.

LABOR REALLOCATION ACROSS SECTORS

Theory and empirics

The evidence from now developed economies support the phenomenon of the so called "Petty-Clark's Law" which quarrels that the centre of gravity in economic activities shifts from the primary to the secondary sector and further to the tertiary sector as the average per capita income continues to rise (Hayami and Godo, 2005). There are two views about such structural changes and their relationship with economic growth. The neoclassical view holds that sectoral composition is a relatively unimportant byproduct of growth. The other group of economist including Kuznets (1971), Rostow (1971) and Chenery and Syrquin (1975) is of the view that economic growth depends on changes in sectoral composition. Echevarria (1997) established a dynamic equilibrium model, which is basically a Solow model of sustained growth with three consumption goods, to analyze how sectoral changes and economic growth are interrelated. Echevarria (1997) found that sectoral composition explains an important part of the variation in growth and correlation between the share of industry and national income is hump-shaped implying that in the early stage of economic development the manufacturing has a large share in national income but at more advanced stages of development manufacturing share decreases. Chenery and Syrquin (1975) explained that the pattern of structural change can differ from country to country depending on the social objectives and the choice of policy, natural resource endowments, country size, and disparities in the access to external capital, and changes in uniform factors over time. The literature dealing with structural changes and economic growth (Hoffmann, 1958; Kuznets, 1971) suggests that structural change and economic growth are very closely interrelated but that the pattern of change can be different for different economies. Since economic growth can be decomposed into the growth of various sectors, it is important to know what factors cause the reallocation of resources particularly labor from agricultural to nonagricultural sector during the process of economic development. There are various studies representing different views among development economists about the migration of labor from agricultural sector to non-agricultural sector.

The issue of labor migration from agriculture was first discussed by Lewis (1954) through a dual economy model. Later, Fei and Ranis (1964) advocated that agriculture and modern manufacturing sectors not only differ in the use of technologies (labor and capital) but also in institutions. The agriculture sector has a classical (pre-capitalist) economy where wage rates are equal to the average product of labor. Because of the custom of income sharing and mutual help within tribes and villages, disguised unemployment is present in agriculture sector in developing countries. Therefore, the marginal products of labor in agriculture are very low if not zero. Thus, the agricultural sector is typically characterized by low wages, an abundance of labor, and low productivity through a labor intensive production process. On the other hand, modern manufacturing sector follows the neoclassical model, where wage rates are equal to the marginal product of labor. Thus, the modern manufacturing sector is typically characterized by higher wage rates than the agricultural sector, higher marginal productivity, and demand for more workers initially. Moreover, as manufacturing sector is assumed to use a production process that is capital intensive, investment and capital formation in the manufacturing sector are possible over time through reinvestment of capitalists' profits in the capital stock. Improvement in the marginal productivity of labor in the agricultural sector is assumed to be of low priority as developing nation's investment hypothetically goes towards the physical capital stock in the manufacturing sector. Thus, if some labor is absolute surplus in the agricultural sector, it could be moved into another sector without decreasing agricultural output.

Another group of economists including Rosenstein-Rodan (1943), Rostow (1960) and Hayami and Ruttan (1985) had argued that economic growth emanates from agricultural productivity growth. Their argument is based on the assumption that technical progress would enhance total factor productivity growth in agriculture, which is characterized by lower marginal productivity of labor and thus lower real wages, and which in turn release the labor from agriculture to non-agricultural sectors leading to economic growth.

Martin and Mitra's (2001) study based on panel data of approximately 50 countries suggests that technical progress is faster in agriculture than in manufacturing. They also found evidence of convergence in the levels and growth rates of total factor productivity (TFP) in agriculture suggesting a relatively rapid international dissemination of innovation. From these findings, one can conclude that a large agriculture sector is an advantage if productivity growth is rapid.

Matsuyama (1992) clarified issues concerning the nexus between sectoral composition and economic growth by considering a two-sector model. He considered learning by doing in manufacturing as the basis for industrial development. He found that if a two-sector economy is open for trade with the free mobility of resources (particularly labor) and has an initial comparative advantage in agriculture, which means that more resources will be allocated to agriculture, then there is a negative relationship between rising agricultural productivity, manufacturing employment and economic growth due to less learning by doing in manufacturing. In the closed economy case, however, he found a positive relation between agricultural productivity and economic growth since an increase in agricultural productivity

Table 1. Structural changes in pakistan, 1980 to 2007.

Year	GDP per capita (in constant 2000 US $)	Value added million US $			Value added as percentage of GDP		
		Agriculture	Manufacturing	Services	Agriculture	Manufacturing	Services
1980	330.25	781.04	315.50	1187.02	29.52	15.93	45.56
2007	634.50	2017.08	1785.93	4997.80	19.39	19.47	53.41

Table 2. Labor shares (%), manufacturing exports share (%), and labor productivities (constant 2000 us$) of different sectors, 1980 to 2007.

Year	LA	LM	LS	ALP	MLP	MEx	SLP
1980	52.7	20.3	26.8	433.5	565.6	48.2	1612.0
2007	42.0	21.3	36.6	720.1	1407.0	81.3	2291.5

expands learning by doing via manufacturing.

Many studies have proposed models to study this resource reallocation phenomenon based on these mechanisms using calibration method but Kawabata (2006) is perhaps the only study which empirically investigated the long run relationship using data from Indonesia, Korea, Malaysia, Philippines, and Thailand. He observed that agricultural productivity Granger causes the labor share in agriculture in Indonesia, Thailand, and Philippines; while in Korea and Malaysia manufacturing exports does so. These findings suggest that agricultural productivity growth is a more important factor for labor migration in the early stage of economic development and countries with a comparative advantage in agriculture show a high relative contribution of agriculture in labor migration from agriculture even if the country is a high income one.

Therefore, the hypotheses to be tested in this paper are:

1. Agricultural productivity growth is the most important factor for labor migration from agriculture to non-agricultural sector in one of the least developed economy, Pakistan;
2. Labor productivity in manufacturing causes the increase in share of manufacturing in merchandise exports.

DATA AND DESCRIPTIVE ANALYSIS

Empirical analysis is conducted using 28 years' (1980 to 2007) data collected from World Bank Development Indicators on five annual macroeconomic variables; that is, labor share in agriculture (LA), agricultural labor productivity (ALP), manufacturing labor productivity (MLP), manufacturing share in merchandise exports (MEx) and services labor productivity (SLP). The labor share in agriculture (LA) was calculated by taking the ratio of agriculture employment and total employment and it is used as a proxy for structural change. The labor productivity of each sector (or sectoral productivities) was calculated by dividing the value added (constant 2000 US$) by that sector with the employment in that sector. The manufacturing share in merchandise exports is defined as the manufacturing exports as a percentage of total merchandise exports, and it is directly given in World Bank Development Indicators.

Table 1 shows that in Pakistan, GDP per capita (constant 2000 international $) has increased from $327.43 in year 1980 to $634.50 in year 2007 at an average annual growth rate of 2.11%. The sectoral value in all sectors has increased in nominal terms but in relative terms the agriculture share has decreased from 29.52% in year 1980 to 19.39% in year 2007, the manufacturing sector share has slightly increased from 15.93% in year 1980 to 19.47% in year 2007, while the services sector share has risen from 45.56 to 53.42% from 1980 to 2007.

Table 2 presents the data of employment in the three sectors during 1980 to 2007. The labor share of agriculture has decreased from 52.7 to 42.0%, while the same has increased from 26.8 to 36.6% in the services sector. The labor share in the manufacturing sector in year 2007 is almost the same as it was in 1980. The productivity per worker (constant 2000 US$) has increased in all sectors from year 1980 to 2007, but the change is more prominent in the manufacturing sector where the productivity per worker more than doubled during study period. The manufacturing exports had also increased during this time.

METHODOLOGY

Pre test of Stationarity and lag length

Economic activities can rarely be assumed independent across time and past events can influence the future and lags in behaviors are prevalent. Thus, in using time series, we have to test either variables are independent of time or not. If not, then series is not a stationary series. Since a non-stationary process or a unit root process does not guarantee asymptotic properties for time series analysis, the existence of a unit root must be examined beforehand. There are three models which have been frequently used to test the non-Stationarity in time series data:

1. without drift and deterministic time trend:

$$\Delta Y_t = \beta Y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + u_{1t} \quad (1)$$

2. with drift:

$$\Delta Y_t = \alpha_0 + \beta Y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + u_{2t} \quad (2)$$

3. with both drift and deterministic time trend:

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \beta Y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + u_{3t} \quad (3)$$

Where, $\Delta Y_t = Y_t - Y_{t-1}$
p = Number of lags in the dependent variable.
u_{1t}, u_{2t} and u_{3t} are stochastic error terms.

The pioneering method for testing a unit root in time series was developed by Dickey and Fuller (DF). The basic objective is to test the null hypothesis that β=1 in equations (1) to (3); The Augmented Dickey Fuller (ADF) test uses the following hypothesis:

H_0: $\beta = 0$; Vs H_a: $\beta < 0$

The variable is said to be stationary when we reject the null hypothesis in favor of alternate hypothesis. If we do not reject the null hypothesis it implies that time series is non-stationary at the level which requires first or higher order differencing to make it stationary. Recent methods for testing unit root in time series include Phillips-Perron (PP) method which is based on a more comprehensive theory of unit root non-Stationarity. This test is similar to the ADF test but this incorporates an automatic correction to the DF procedure to allow for auto-correlated residuals. The test usually gives the same conclusions as the ADF test, and the calculation of the test statistics is complex. In this paper, author used both Augmented Dickey Fuller (ADF) test and the Phillips-Perron (PP) tests on levels and first differences.

The appropriate lag length is also important as too many lags reduce the power of the test due to the estimation of additional parameters and a loss of degrees of freedom. In contrast, too few lags may not capture the dynamics of the actual error correction process resulting in poor estimates of coefficients and its standard errors. This paper employs the multivariate forms of the Akaike Information Criterion (AIC) and the Schwartz Bayesian Criterion (SBC) to determine lag lengths.

Co-integration tests

If two or more time series are non-stationary but a linear combination of them is stationary, then the series are said to be co-integrated and these series move together over time which guarantees that the variables are bound in a long run relationship. Examination of the dynamic relations between variables may be undertaken through either Engle and Granger (1987) or Johansen and Juselius (1990) protocols. While Engle and Granger's (1987) two-step error correction model may be used in a multivariate context, the Johansen and Juselius (1990) Vector Error Correction Model (VECM) yields more efficient estimators of co-integrating vectors. This is because the Johansen and Juselius (1990) VECM is a full information maximum likelihood estimation model, which allows for testing co-integration in a whole system of equations in one step without requiring a specific variable to be normalized. This allows researchers to avoid carrying over the errors from the first-into the second-step, unlike as in the case of Engle and Granger's (1987) methodology. Prior assumptions of endogeneity or exogeneity of variables can also be avoided. Johansen and Juselius (1990) method is explained as follows:

$$Y_t = A_0 + \sum_{j=1}^{p} A_j Y_{t-j} + \varepsilon_t \quad (4)$$

Where A_0 is a (n × 1) vector of constants, Y_t is a (n × 1) vector of non-stationary (1) variables, p is the number of lags, A_j is a (n × n) matrix of coefficients and ε_t is assumed to be a (n × 1) vector of Gaussian error terms. The above vector autoregressive process was reformulated and turned into a VECM in order to use Johansen-Juselius test as under:

$$Y_t = A_0 + \sum_{j=1}^{p-1} \Gamma_j \Delta Y_{t-j} + \Pi Y_{t-p} + \varepsilon_t \quad (5)$$

Where, $\Gamma_j = -\sum_{i=j+1}^{p} A_i$, $\Pi = -I + \sum_{i=j+1}^{p} A_i$, **I** is a (n × n) identity matrix, and Δ is the difference operator. The Trace and the Maximum Eigen Value tests were used to find the number of characteristic roots that were insignificantly different from unity.

Tests for causality

The Granger causality test augmented with a lagged Error Correction Term was also conducted in the final stage. If a long run relationship exists among the variables specified, there must be Granger causality in at least one direction. To avoid misleading conclusions in the presence of co-integration, Granger causality is not conducted at first difference through Vector Auto Regression (VAR) method. The inclusion of an additional variable the error correction term to VAR method, would also help in capturing the long run relationship among the variables.

EMPIRICAL RESULTS

It is compulsory to test the economic time series for Stationarity before proceeding for examining co-integration and long-run relationship. In the present study, author employed the Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) test on the variables in levels and first differences and results are presented in Table 3. Both

Table 3. Unit root test.

Variable	Augmented Dickey-Fuller test statistics				Phillips-Perron test statistics			
	Without trend		With trend		Without trend		With trend	
	Level	First difference	Level	First difference	Level	First difference	Level	First difference
LA	-1.346	-7.888**	-1.721	-7.754**	-1.035	-8.385**	-1.649	-8.266**
ALP	-1.054	-6.364**	-2.303	-6.081**	-1.046	-6.517**	-2.280	-6.522**
MLP	-1.361	-5.520**	-2.359	-5.462**	-1.345	-5.543**	-2.364	-5.490**
SLP	-2.564	-6.999**	-2.382	-7.342**	-2.068	-6.649**	-2.740	-6.803**
MEx	-2.537	-5.029**	-1.669	-6.061**	-2.689	-5.101**	-1.300	-6.986**

* and ** show significance at 5 and 1% respectively.

Table 4. Lags under different criteria.

Lag	Selection order criteria				
	LR	FPE	AIC	HQIC	SBIC
0	N/A	7.9e+08	40.367	40.448	40.700*
1	117.390	4.3e+07	39.549	40.278	42.298
2	135.090*	3.4e+08*	38.003*	39.371*	43.157

*Lag order selected by criteria.

Table 5. Johansen co-integration test.

Hypothesized number of cointegrating vectors	Trace		Max-Eigen	
	Statistic	5% critical value	Statistic	5% critical value
None	183.058*	124.24	64.817*	45.28
At Most 1	118.241*	94.15	31.314	39.37
At Most 2	66.927	68.52	31.159	33.46
At Most 3	35.768	47.21	20.854	27.07

* Significant at 5%.

tests revealed that the hypothesis that variables follow the non-stationary process could be rejected in the first difference at the 1% level of significance. These results suggest that all variables used in this study are integrated of order one.

The results of unit root test showed that all variables used in this study were integrated of the same order. Thus, Johansen and Juselius (1990) technique was applied to explore the existence of long-run relationships among variables. The first step in multivariate co-integration analyses is to find an appropriate lag length. Based on the results of LR, LPE, AIC, SBC, and HQ lag selection criteria, as shown in Table 4, the study used two lags.

The next step involves determining the co-integrating rank. By testing for co-integration rank we will be able to determine the number of co-integrating relations. Table 5 reports λ_{trace} and λ_{max} values and their critical values at 5%. When the results obtained from the λ_{trace} and λ_{max} tests yield different conclusions, λ_{trace} statistic is preferred. This is supported by Cheung and Lai (1993) who found that the λ_{trace} test shows more robustness to both skewness and excess kurtosis in the residuals than that of the λ_{max} test. The results for the λ_{trace} test with the selected lag lengths indicate that there is no more than one cointegrating relationship at 5% level. We thus conclude that there is one cointegrating vector (that is, r = 1).

Table 7 shows the results of the Granger causality based on VECM given in Table 6. The results revealed that change in agricultural productivity Granger causes labor migration from agriculture sector to non-agriculture sector. This finding is consistent with the finding of Kawabata (2006) with respect to Indonesia, Thailand and Philippines.

This finding suggests that agricultural productivity growth is a more important factor for labor migration in

Table 6. Results of vector error correction model.

	Equations in VECM				
	D(LA)	**D(ALP)**	**D(MLP)**	**D(MEx)**	**D(SLP)**
D(LA(-1))	-2.04** (-2.20)	45.82 (1.04)	-18.04 (-0.53)	-0.50 (-0.22)	-84.12** (-2.11)
D(LA(-2))	-1.74* (-1.91)	37.44 (0.70)	-0.24 (-0.01)	-1.39 (-0.62)	-96.80 (-1.48)
D(ALP(-1))	-0.05** (-2.15)	0.95* (1.72)	-0.16 (-0.19)	0.05 (0.82)	-2.20** (-2.25)
D(ALP(-2))	-0.01** (-2.45)	0.32 (0.69)	0.93 (1.29)	0.01 (0.28)	-1.46 (-1.05)
D(MLP(-1))	0.03 (1.20)	-0.59 (-1.61)	0.32 (0.58)	0.04 (1.04)	1.30** (1.99)
D(MLP(-2))	0.04 (0.68)	-0.662* (-1.70)	0.18 (0.30)	0.02 (0.53)	2.23*** (3.22)
D(MEx(-1))	-0.31*** (-2.83)	3.09 (1.15)	0.98 (0.24)	-0.27 (-0.99)	13.85*** (2.89)
D(MEx(-2))	-0.17 (-1.44)	4.32 (1.56)	0.12 (0.03)	-0.43 (-1.50)	6.31* (1.88)
D(SLP(-1))	-0.01 (-0.56)	-0.11 (-0.44)	-0.07 (-0.19)	0.02 (0.67)	1.18* (1.90)
D(SLP(-2))	0.02 (0.76)	-0.34 (-1.29)	0.00 (-0.01)	0.04 (1.31)	1.06** (2.21)
Error(-1)	-0.51** (-2.23)	-0.49** (-2.23)	-0.33 (-0.75)	0.63 (0.76)	-0.64** (-2.30)
Intercept	-3.02*** (-2.87)	66.67*** (2.61)	-0.62 (-0.02)	-1.83 (-0.70)	-94.93** (-2.09)

Numbers in brackets are t-ratios. *, **, and *** show significance at 10, 5 and 1% respectively.

Table 7. Granger causality based on VECM.

Effect	Cause				
	D(LA)	**D(ALP)**	**D(MLP)**	**D(MEx)**	**D(SLP)**
D(LA)	---	9.358***	3.373	2.987	3.158
D(ALP)	2.407	---	6.134**	3.417	2.383
D(MLP)	0.304	2.471	---	0.059	0.038
D(MEx)	0.381	0.687	1.536	---	2.901
D(SLP)	2.094	2.673	15.890***	9.362***	---

*, **, and *** show significance at 10, 5 and 1% respectively.

the early stages of economic development. The finding also support the view of Rosenstein-Rodan (1943), Rostow (1960) and Hayami and Ruttan (1985) that technical progress that can enhance total factor productivity in the agriculture sector can release the labor which enables labor migration into non-agricultural sector fuelling economic growth.

Thus, this result shows that economic growth depends on changes in sectoral composition in Pakistan.

In addition, the results of the VECM and Granger causality show, that change in agricultural labor share or labor productivity in agriculture sector does not Granger causes the change in labor productivity in services sector. However, change in labor productivity in manufacturing sector and manufacturing exports do so. This supports the Eswaran and Kotwal (1993) view that industry uses services more intensively than agriculture. The change in labor productivity in services sector does not Granger causes the change in labor productivity in manufacturing sector or manufacturing exports share. This suggests that services sector is passive but manufacturing labor productivity seems to be the engine of the economic growth stimulating labor productivity in both agricultural and services sectors.

Moreover, the results of the VECM and the Granger causality show that none of the factors such as labor share in agriculture, labor productivity in agriculture or services sectors, and manufacturing exports share Granger causes the change in labor productivity in manufacturing. This may suggests that the manufacturing productivity in Pakistan is not determined from these variables but from exogenous variables such as technology. On the other hand, an increase in labor productivity in manufacturing does not cause any increase in manufacturing share in merchandise exports suggesting that either the products produced in Pakistan are not of export quality or that mostly manufacturing is agriculture based and is consumed domestically.

Conclusion

This study focused on the nexus between sectoral composition and economic growth and the forces behind the reallocation of resources, particularly labor across sectors in a low income and not well integrated with the global economy, Pakistan. The results show that economic growth depends on sectoral composition. With respect to the mechanism behind the reallocation of labor among sectors, this study supports the arguments of Lewis (1954) and Fei and Ranis (1964) that labor productivity in manufacturing stimulates labor productivity in agriculture to induce labor migration from agriculture in Pakistan. Equally, the results of this study support the arguments of Rosenstein-Rodan (1943), Rostow (1960) and Hayami and Ruttan (1985) that improvement in agricultural productivity is the important factor contributing to labor migration from agriculture. Therefore, the policy conclusion is that Government of Pakistan should tailor reform measures to improve labor productivity in both agricultural and manufacturing sectors.

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