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Article

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Estimating the growth effects of services sector: a cointegration analysis for Pakistan

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Abstract

This article empirically tests the hypothesis of Pugno (Struct Change Econ Dyn 17:99–115, 2006) that both business- and household-related services contribute in the economic growth of the country in the case of Pakistan over the period of 1960–2014. To accomplish the task, the study uses Johansen–Juselius cointegration test and autoregressive distributed lag bounds test to test the long-run relationship between the services sector and the economic growth of Pakistan. The tests reveal that the services sector has a long-run relationship with the economic growth of Pakistan. Furthermore, the estimation of cointegrating vector shows that the services sector positively contributes in the economic growth of Pakistan.

Keywords: Services sector, Economic growth, Pakistan, ARDL

1 Background

The important works of Kuznets (1957), Chenery (1979), Kuznets (1966, 1971), Rostow (1971), Chenery and Syrquin (1975), Baumol et al. (1989) and Echevarria (1997) on economic growth argue that growth of gross domestic product (GDP) is connected with variations in the share of services and the sectoral composition of GDP. Therefore, services sector has caught the attention of economists all around the world due to its increasing share in GDP and employment over the last decades. A plethora of research has covered the issue of rise in services sector across the world economies from many angles and different vantage points.

Over the last two decades, the emergence of economics of transport and tourism, economics of infrastructure and economics of financial sector development well recognizes the role of services in explaining the economic growth of economies. Particularly, Munnell (1992), Gramlich (1994) and Pradhan and Bagchi (2013) point out that the deficit of infrastructure may hurt the economic growth of emerging economies. Similarly, Roubini and Sala-i-Martin (1992), Levine (1997), Levine and Zervos (1998), Levine et al. (2000) and Jalil et al. (2010) document that the financial sector is one of the important determinants of economic growth of developing and developed countries. Therefore, we may say that the role of services sector in affecting the level and growth of

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output is implicitly recognized in the recent literature on economic growth. However, the role of services is not well researched in Pakistan.

Services sector has shown marked improvement in Pakistan as the share of services in GDP of Pakistan is 53.5 % in 2011–2012 and growth rate of this sector was 4.5 % in 2010–2011, and it accounts for one-third of total employment. Importantly, the services sector is further expected to emerge in the near future. Sundrum (1990) Illeris (1996) and Qin (2006) document that it is a natural process for a developing economy to evolve into a services-oriented economy. Furthermore, Pakistani government has a special eye on the services sector by promoting the policies on the development of infrastructure on Pakistan and financial sector development.

On the other hand, an important work of Baumol (1967) points out that increasing share of services sector in the GDP has a negative effect on the economic growth in the framework of unbalanced growth model. The unbalanced growth model postulates that the growth of services sector may decrease the overall improvement in the productivity of an economy, which ultimately leads to decrease in the economic growth of the economy (Qin 2006). The economy of Pakistan witnessed a miracle growth in GDP from 2000 to 2006. Indeed, the services sector was the major contributor in this miraculous economic growth. But suddenly that miracle evaporated and economy of Pakistan witnessed a free fall from 8 % annual growth in 2006 to 2 % growth in 2011 and 2012. It is argued that the economic growth of Pakistan was demand driven and that demand-driven growth ever remains shaky (Baumol 1967; Baumol et al. 1985).

With the increasing share of services sector in the presence of contradictory theoretical arguments, there is an imperative need to test the role of services sector in the case of Pakistani economy. The objective of this study is to test the Pugno (2006) hypothesis that services sector, irrespective of household or business, has a positive effect on the economic activities of an economy in the case of Pakistan over the period of 1960–2014. We argue that, despite the importance of services sector over the last two decades, there is no scientific study available in the literature on the economy of Pakistan. Therefore, this article will contribute in this way.

The findings of this paper suggest that the measure of services sector enters significantly positive in the growth regression of Pakistan. This implies that the services sector has a positive impact on the economic activities of Pakistan. To check the robustness of this finding, we take several business- and household-related service variables. All these variables confirm the previous results that the services-related variable enters significantly positive in the growth regression whether these are related to business or household activities like education- and health-related expenditure.

The study proceeds as follows: Section 2 sets the analytical framework; Sect. 3 covers the estimation strategies; variable construction and data sources are discussed in Sect. 4; Sect. 5 gives the empirical results; and Sect. 6 concludes the study.

2 Analytical setting

GDP is determined as the value added of agriculture, industrial and services sector. Therefore, consider the following production function-type relationship among GDP, agriculture, industry and services sector.

$$\mathrm{GDP}_t = F(\mathrm{AGR}_t, \mathrm{IND}_t, \mathrm{SER}_t) \tag{1}$$

where AGR_t is the output of agricultural sector, IND_t is industrial output and SER_t is the output of the services sector. Taking total differentiation for the linearization gives:

$$\mathrm{dGDP}_t = F_\mathrm{A}\mathrm{dAGR}_t + F_\mathrm{I}\mathrm{dIND}_t + F_\mathrm{S}\mathrm{dSER}_t \tag{2}$$

where F_A, F_I and F_S are the partial derivatives of agricultural, industrial and services sector, respectively. Dividing Eq. 2 by GDP will give the economic growth:

$$\frac{\mathrm{dGDP}}{\mathrm{GDP}} = \frac{F_\mathrm{A}}{\mathrm{GDP}}\mathrm{dAGR}_t + \frac{F_\mathrm{I}}{\mathrm{GDP}}\mathrm{dIND}_t + \frac{F_\mathrm{S}}{\mathrm{GDP}}\mathrm{dSER}_t \tag{3}$$

Then, Eq. 3 can be augmented with sector output for getting the elasticities:

$$\frac{\mathrm{dGDP}}{\mathrm{GDP}} = \frac{F_\mathrm{A}}{\mathrm{GDP}}\mathrm{dAGR}_t\frac{\mathrm{AGR}_t}{\mathrm{AGR}_t} + \frac{F_\mathrm{I}}{\mathrm{GDP}}\mathrm{dIND}_t\frac{\mathrm{IND}_t}{\mathrm{IND}_t} + \frac{F_\mathrm{S}}{\mathrm{GDP}}\mathrm{dSER}_t\frac{\mathrm{SER}_t}{\mathrm{SER}_t} \tag{4}$$

By rearranging

$$\frac{\mathrm{dGDP}}{\mathrm{GDP}} = \frac{\partial F}{\partial \mathrm{AGR}_t}.\frac{\mathrm{AGR}_t}{\mathrm{GDP}_t}.\frac{\mathrm{dAGR}_t}{\mathrm{AGR}_t} + \frac{\partial F}{\partial \mathrm{IND}_t}.\frac{\mathrm{IND}_t}{\mathrm{GDP}_t}.\frac{\mathrm{dIND}_t}{\mathrm{IND}_t} + \frac{\partial F}{\partial \mathrm{SER}_t}.\frac{\mathrm{SER}_t}{\mathrm{GDP}_t}.\frac{\mathrm{dSER}_t}{\mathrm{SER}_t} \tag{5}$$

By simplification

$$\frac{\mathrm{dGDP}}{\mathrm{GDP}} = \alpha_\mathrm{A}.\frac{\mathrm{dAGR}_t}{\mathrm{AGR}_t} + \alpha_\mathrm{I}.\frac{\mathrm{dIND}_t}{\mathrm{IND}_t} + \alpha_\mathrm{S}.\frac{\mathrm{dSER}_t}{\mathrm{SER}_t} \tag{6}$$

where α_A, α_I and α_S are sectoral output elasticities of agriculture, industry and services. So, the specification of Eq. 6 leads to model with variables $\frac{\mathrm{dGDP}}{\mathrm{GDP}}$, $.\frac{\mathrm{dAGR}_t}{\mathrm{AGR}_t}$, $.\frac{\mathrm{dIND}_t}{\mathrm{IND}_t}$ and $\frac{\mathrm{dSER}_t}{\mathrm{SER}_t}$.

Alternatively, Eq. 4 can be re arranged in share terms instead of elasticities. If we assume that there is perfect competition in the economy, then marginal product theory postulates that every sector will be compensated according to its marginal product. Therefore, $F_\mathrm{A} = w_\mathrm{A}$, $F_\mathrm{I} = w_\mathrm{I}$ and $F_\mathrm{S} = w_\mathrm{S}$ and Eq. 5 can be rewritten as:

$$\frac{\mathrm{dGDP}}{\mathrm{GDP}} = w_{\mathrm{A}t}.\frac{\mathrm{AGR}_t}{\mathrm{GDP}_t}.\frac{\mathrm{dAGR}_t}{\mathrm{AGR}_t} + w_{\mathrm{I}t}.\frac{\mathrm{IND}_t}{\mathrm{GDP}_t}.\frac{\mathrm{dIND}_t}{\mathrm{IND}_t} + w_{\mathrm{S}t}.\frac{\mathrm{SER}_t}{\mathrm{GDP}_t}.\frac{\mathrm{dSER}_t}{\mathrm{SER}_t} \tag{7}$$

And

$$\frac{\mathrm{dGDP}}{\mathrm{GDP}} = W_{\mathrm{A}t}.\frac{\mathrm{dAGR}_t}{\mathrm{AGR}_t} + W_{\mathrm{I}t}..\frac{\mathrm{dIND}_t}{\mathrm{IND}_t} + W_{\mathrm{S}t}..\frac{\mathrm{dSER}_t}{\mathrm{SER}_t} \tag{8}$$

where $W_{\mathrm{A}t}$, $W_{\mathrm{I}t}$ and $W_{\mathrm{S}t}$ are the shares of agriculture, industry and services sector in the total output. This implies that services sector has a pivotal role in explaining the GDP. Since the economy of Pakistan is in transition from developing economy and services sector has a lion's share in the GDP, the present study estimates the reduced-form bivariate model to examine the long-run effects of services sector on the aggregate real GDP. Following the estimable specification of Singh (2010):

$$\ln gdp = \beta_0 + \beta_1 \ln ser_t + u_t \tag{9}$$

ln *gdp* is the natural log real GDP and *lser* is the natural log of services share.

Since there is a theoretical controversy about the effect of services on the output of the economy, there is a need of testing the result of Eq. 9. For this purpose, we put a number of control variables for checking the robustness of the sign and significance of the services variable. The empirical investigation based on the production function suggests a number of variables effecting economic growth, for example physical capital stock (Lucas 1988), trade openness (Grossman and Helpman 1991; Lucas 1988; Young 1991) and inflation (Sidrauski 1967; Faria 2001). Therefore, the present article takes these factors in Eq. 9 as a control variable.

Furthermore, it is generally argued that the business services like wholesale and retail trade, finance and insurance, transport, storage and communication are effective in flourishing the economic growth and the household services are recognized as a burden for the growth of the economy. However, this puzzle is reconciled by Pugno (2006) in an endogenous growth model by considering that education, health care and cultural services, which form a large fraction of household services, contribute to human capital formation and hence to growth. Therefore, we shall include the share of different subsectors in the growth regression.

3 Estimation strategy

The time-series analysis suggests that the researchers should test the long-run relationship among the variables under consideration in case of non-stationary data series. The econometricians propose a number of cointegration techniques for test the long-run relationships among variables. The present study uses, Johansen (1988, 1991) and Johansen and Juselius (1990) bivariate cointegration tests to examine the long-run relationship between natural log of real GDP and natural log of share of services. Since this estimator is extensively discussed in the literature of theoretical and applied literature, we are not going to discuss here. Johansen (1988, 1991) and Johansen and Juselius (1990) are referred for further details.

However, this estimator can be applied in the case when the data series have the same order of integration. Therefore, testing the time properties of data series is a natural starting point in our case. A number of tests are discussed in the literature for this purpose. The present study uses augmented Dickey–Fuller (ADF) and Phillips–Perron tests to find out the order of integration of both the series. If the series have same order of integration, then we can use Johansen (1988, 1991) and Johansen and Juselius (1990) of cointegration.

If there exists cointegration relationship, then it implies that there is a long-run relationship between both variables. This further implies that there exists Granger causality between both variables in at least one direction. The error correction mechanism (ECM) was introduced by Sargan (1964) and then popularized by Engle and Granger (1987). This mechanism is used for correcting short-run disequilibrium in the long run and testing for long- and short-run causality among cointegrated data series. We specify the ECM for our bivariate model as follows:

$$\Delta \ln gdp_t = a_0 + \sum_{i=1}^{m} a_{1i} \Delta \ln gdp_{t-i} + \sum_{i=1}^{n} a_{2i} \Delta \ln ser_{t-i} + \lambda ECM_{t-1} \tag{10}$$

$$\Delta \ln ser_t = b_0 + \sum_{i=1}^{m} b_{1i} \Delta \ln ser_{t-i} + \sum_{i=1}^{n} b_{2i} \Delta \ln gdp_{t-i} + \theta ECM_{t-1} \tag{11}$$

In Eq. 10, ln *ser* causes ln *gdp* if either λ is statistically significant (the long-run causality) or the all a are jointly significant (short-run causality). Similarly, in Eq. 11, ln *gdp* causes ln *ser* if either θ is statistically significant (the long-run causality) or all b are jointly significant (short-run causality).

As a test of robustness, we also use the autoregressive distributed lag models (ARDL) bounds testing procedure proposed by Pesaran et al. (2001). Mah (2000) argues that Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990) approaches of cointegration are not reliable in the case of small sample size. Furthermore, Kremers et al. (1992) notes no cointegration can be established among the $I(1)$ variables in the case of small sample size. Therefore, researchers use ARDL due to its various advantages over other cointegration techniques for testing the existence of a linear long-run relationship between the series.

The time-series literature prefers ARDL modeling among other techniques due to several advantages. For example, Pesaran and Shin (1999) argue that small sample properties of ARDL approach are far superior to the Johansen and Juselius cointegration technique. Furthermore, ARDL modeling technique does not impose the restrictive assumption that all under consideration variables should have the same order of integration, but it can be applied irrespective of whether the variable are $I(0)$, $I(1)$ or fractionally cointegrated (Pesaran and Pesaran 1997). The endogeneity is less a problem in ARDL framework because it is free of residual correlation. Pesaran and Shin (1999) have shown that the ARDL method can distinguish between dependent and explanatory variables, and the estimation is possible even when the explanatory variables are endogenous (Pesaran and Pesaran 1997; Pesaran et al. 2001). Therefore, the ARDL modeling is adopted in this study, and it involves estimating the following regression:

$$\begin{aligned}\Delta \ln gdp_t = \gamma_0 &+ \sum_{i=1}^{p} \gamma_{1i} \Delta \ln gdp_{t-i} + \sum_{i=1}^{p} \gamma_{2i} \Delta \ln ser_{t-i} + \sum_{i=1}^{p} \gamma_{2i} \Delta Z_{t-i} + \lambda_1 \ln gdp_{t-1} \\ &+ \lambda_2 \ln ser_{t-1} + \lambda_3 \ln Z_{t-1} + v_t \end{aligned} \tag{12}$$

where γ_0 is drift component and v_t white noise. Furthermore, the terms with summation signs represent the error correction dynamics, while the second part of the equation with λ_i corresponds to long-run relationship. The null hypothesis in the equation is H_0: $\lambda_1 = \lambda_2 = \lambda_3 = 0$. This means the nonexistence of long-run relationship, while the alternative is H_1: $\lambda_1 \neq 0, \lambda_2 \neq 0, \lambda_3 \neq 0$.

The calculated F statistics value is compared with two sets of critical values, which are given by the Pesaran et al. (2001).

The cointegration analysis establishes only the relationship among the variables, which does not provide the direction of the causality. More clearly whether growth of services has an impact on the economic growth or vice versa is still not established. In order to ascertain the direction of causality, Granger casualty test has been employed. As ARDL can be applied irrespective of the order of integration (Pesaran et al. 2001), Granger

causality tests are applicable irrespective of the orders of integration of the underlying variables if it has been established that there exists a long-run equilibrium relationship between the underlying series (Groenewold and Tang 2007). However, in the presence of a long-run relationship, Granger causality test requires the inclusion of a lagged error correction term within a vector error correction model (VECM) in order to capture the short-run deviations of the series from their long-run equilibrium relationship (Narayan and Smyth 2004; Feridun et al. 2009). In vector error correction mechanism, the following regression will be specified for the Granger causality analysis

$$\Delta \ln gdp_t = \alpha_0 + \psi_{11}^{p}(L)\Delta \ln gdp_t + \psi_{12}^{q}(L)\Delta \ln ser_t + \delta_1 \mathrm{ECT}_{t-1} + \mu_{1t} \tag{13}$$

$$\Delta \ln ser_t = \alpha_1 + \psi_{21}^{p}(L)\Delta \ln ser_t + \psi_{22}^{q}(L)\Delta \ln gdp_t + \delta_2 \mathrm{ECT}_{t-1} + \mu_{2t} \tag{14}$$

where $\psi_{ij}^{p}(L) = \sum_{n=1}^{P_{ij}} \psi_{ijn} L^1$ and $\psi_{ij}^{q}(L) = \sum_{n=1}^{Q_{ij}} \psi_{ijn} L^1$ where L are the lag operator, which implies that $(L)\ \Delta\ln\ gdp_t = \Delta\ln\ gdp_{t-1}$. ECT_{t-1} denotes the one-period lagged error correction term, and μ_{1t} and μ_{2t} represent serially independent random errors with mean zero and finite covariance matrix (Narayan and Smyth 2004). In Eq. 13, $\Delta\ln\ gdp_t$ is regressed on its own lagged values and the lagged values of $\Delta\ln\ ser_t$, whereas the opposite is the case in Eq. 14. In both equations, ECT_{t-1} captures the speed of adjustment of the variables in response to a deviation from their long-run equilibrium path. The significance of the differenced explanatory variables based on F statistics indicates the existence of short-term causal effects, whereas the significance of ECT_{t-1} based on t statistics indicates the existence of a long-term relationship.

4 Variable construction and data

Our base model is a bivariate model in which we shall regress the share of services on the real GDP. However, the result may be skeptical in the presence of puzzle that the share of service in the GDP is moving in the opposite direction while the growth rate of real GDP and growth rate of value added are moving in the same direction. Therefore, to test the robustness of the estimated models, we shall incorporate a number of alternative variables for measuring the different levels of services and control variables.

We follow the conventions and measure the economic through real GDP. Even the economic development is measured by the per capita GDP by Lucas (1988). Lucas (1988) argues that the problem of economic development is simply the problem of levels and rate of growth of per capita income. Therefore, the empirical research relies on the data of real GDP for measuring the economic growth and economic development despite the contradiction of Streeten (1994) on the statement of Lucas (1988). We also follow Lucas (1988) by taking the level of real GDP for measuring the economic growth.

The other major variable is share of value-added services in GDP. We also take several sub-sectors of services to test the robustness of our model. More importantly, we are interested to test the Baumol (1967) and Pugno (2006) controversy that whether the business services or household services are important for the economic growth. For this purpose, we take that data of share of wholesale and retail trade (*wrt*), finance and insurance (*fi*) and transport storage and communication (*tc*) in the value-added services. Then, the household services are measured through the share of expenditure on education (*edu*) and share of expenditure on health (*hlt*) as Pugno (2006) suggested.

The variables are capital, trade openness and inflation, which usually enter in the growth regression. Since the data on the capital stock are not available for the economy of Pakistan, the researchers estimate the capital through various methodologies by taking the various rates of depreciation of capital based on the assumptions about the economies. We will use the perpetual inventory flow method by using the 4 % rates of geometric decay (Jalil et al. 2010). We use Nehru and Dhareshwar (1993) for calculating the initial value of capital stock. If $K(0)$ is the initial stock in period zero and δ is the rate of depreciation, then the capital stock series (cap) will be generated as $K_{t+1} = I_t + (1 - \delta)K_t$. While the value of I_t in the first period is estimated through a linear regression of the log of investment against time, the fitted value of initial investment is used to calculate initial capital stock using the following equation: $K_t = I_t/I_t(g + \delta)$. Here, g is the rate of growth of GDP. Trade openness (open) is the ratio of value of exports plus value of imports to real GDP, and inflation (cpi) is measured by the natural log of consumer price index.

All data are taken from 1960 to 2014. The major sources of the data are the various issues of economic survey of Pakistan and the Handbook of Statistics (SBP 2010). Furthermore, we divide the sample into two parts to test the robustness of the results. We take the sample from 1973 to 2014. We have a justification that East Pakistan was separated into Bangladesh in 1971. Therefore, there may be a structural break in the data set. Furthermore, we are using the ARDL that provides the consistent results in the case of sample size. Therefore, our implied methodologies allow us for using the different sample sizes.

5 Empirical results

Testing the stationary properties of a data is a natural start of an empirical analysis in a time-series data setting. For this purpose, we use two most popular methodologies: ADF and PP. The results are presented in Table 1.

It is evident from the table the both tests are giving contradictory results in different equations. Several variables appear to be stationary even at levels, and some others are stationary at first difference. However, it is clear that none of the variables is stationary at second difference. We have mentioned about ARDL cointegration technique. This can be applied irrespective of $I(0)$ or $I(1)$. But, Perron (1989) notes that the power of conventional unit root tests decreases in the presence of structural break. Therefore, the result of ADF test may mislead due to the fact the under consideration variables may contain structural breaks. We may allow exogenous structural break in ADF tests to avoid this problem. For this purpose, Zivot and Andrews (1992) and Perron (1997) propose determining the break point 'endogenously' from the data. The researchers frequently use the Clemente–Montanes–Reyes (CMR hereafter) (1998) unit root tests. The major advantage of CMR unit root test is that they do not require an a priori knowledge of the structural break dates. This test allows two structural breaks in the mean of the series with the null hypothesis that the series has a unit root with structural break(s) against the alternative hypothesis that they are stationary with break(s). Two models are estimated under the CMR unit root tests. First, an additive outliers (AO) model captures a sudden change in the mean of a series. Second, an innovational outliers (IO) model allows for a gradual shift in the mean of the series. In this thesis, both models will be used. As evident from Table 2, the structural breaks suggested by CMR unit root tests are significant at 5 % level of significance.

Table 1 Unit root tests without structural breaks

	τ_u	τ_t	τ		τ_u	τ_t	τ	Method
ln *gdp*	−0.420	−1.690	6.030[a]	Δln *gdp*	−4.680[a]	−4.650[a]	NA	PP[b]
	−0.400	−1.770	2.130		−4.700[a]	−4.640[a]	7.319[a]	ADF[c]
lser	−1.787	−1.290	5.040[a]	Δ*lser*	−3.600[a]	−4.523[a]	NA	PP
	0.891	−1.740	2.130		−3.610[a]	−3.750[a]	−4.850[a]	ADF
lwrt	−1.440	−2.060	2.950	Δ*lwrt*	−3.690[a]	−3.720[a]	−2.610	PP
	−1.540	−1.990	4.060[a]		−3.650[a]	−3.670[a]	NA	ADF
fi	0.620	−2.660	4.500[a]	Δ*fi*	−3.650[a]	−3.740[a]	NA	PP
	1.010	−2.770	2.900		−3.690[a]	−3.760[a]	−2.090	ADF
tc	−2.420	−0.890	12.510[a]	Δ*tc*	−4.620[a]	−5.070[a]	−NA	PP
	−2.400	−0.860	14.260[a]		−4.640[a]	−5.060[a]	NA	ADF
edu	−0.420	−1.690	6.030[a]	Δ*edu*	−4.680[a]	−4.650[a]	NA	PP
	−0.400	−1.770	7.130[a]		−4.700[a]	−4.640[a]	NA	ADF
hlt	−2.850	−2.840	−0.250	Δ*hlt*	−7.180[a]	−7.150[a]	−7.360[a]	PP
	−2.770	−2.750	−0.200		−6.220[a]	−6.130[a]	−6.310[a]	ADF
lcap	−2.100	−1.980	0.000	Δ*lcap*	−4.510[a]	−4.380[a]	−4.610[a]	PP
	−2.420	−4.300[a]	−0.120		−4.490[a]	NA	−4.560[a]	ADF
lopen	−2.850	−2.840	−0.250	Δ*lopen*	−7.180[a]	−7.150[a]	−7.360[a]	PP
	−2.770	−2.750	−0.200		−6.220[a]	−6.130[a]	−6.310[a]	ADF
lcpi	−1.780	−4.290[a]	5.040[a]	Δ*lcpi*	−3.600[a]	NA	NA	PP
	0.890	−2.740	3.130		−3.610[a]	−3.750[a]	NA	ADF

τ_u is the model with an intercept and without trend;τ_t represents with an intercept and trend; and τ is without an intercept and trend

[a] Implies that the data series is stationary

[b] PP is an abbreviation of Phillips and Perron test for unit root

[c] Abbreviation of augmented Dickey–Fuller test for unit root

Table 2 Unit test with two structural breaks

	Innovative outliers				Additive outliers			
	t stat	TB1	TB2	Decision	*t* stat	TB1	TB2	Decision
ln *gdp*	−4.864	1997*	1996*	*I*(1)	−4.89	2000*	1997*	*I*(1)
lser	−3.53	2001*	1997*	*I*(1)	−4.18	1994*	1997*	*I*(1)
lwrt	−4.345	2001*	2003*	*I*(1)	3.769	1998*	2003*	*I*(1)
fi	−4.284	2000*	2004*	*I*(1)	7.684	2001*	2005*	*I*(1)
tc	−5.889	1997*	2000*	*I*(1)	6.817	1999*	2005*	*I*(1)
edu	−7.864	2001*	2003*	*I*(1)	4.556	1997*	2003*	*I*(1)
hlt	−4.738	2000*	2005*	*I*(1)	6.100	1989*	1998*	*I*(1)
lcap	−5.821	1986*	2004*	*I*(1)	4.290	1997*	2003*	*I*(1)
lopen	−4.781	1997*	2002*	*I*(1)	5.716	2001*	2006*	*I*(1)
lcpi	−7.031	2001*	2006*	*I*(1)	7.479	1998*	2001*	*I*(1)

***, **, * indicates significance at 1 %, 5 % and * 10 %, respectively

Though CMR unit root tests suggest that all series are $I(1)$, we can easily apply Johansen cointegration. However, due to the contradiction among ADF, PP and CMR results in the case of ln *gdp*, ln *ser* and several other variables, the authors prefer ARDL approach over Johansen cointegration approach for detailed analysis of long-run relationship. However, we shall start with Johansen cointegration for testing the bivariate model by estimating Eqs. 10 and 11. The results are presented in Table 3.

Table 3 Test of cointegration of bivariate model

Null hypothesis	Alternative hypothesis	Trace statistics	Critical value (0.05)
Johansen cointegration test			
$r = 0$	$r = 1$	17.1302	13.1994
$r \leq 1$	$r = 2$	0.272	03.8410

Model	*F* stats Imposing one lag length	*F* stats Optimal lag length	
		F stats	Lag length
ARDL cointegration test[a]			
ln *gdp* = *f*(*lser*)	7.0360	6.5865	2
ln *gdp* = *f*(*lwrt*)	6.2550	6.2550	1
ln *gdp* = *f*(*lfi*)	7.1071	10.5041	3
ln *gdp* = *f*(*ltc*)	5.7146	5.3793	2
ln *gdp* = *f*(*ledu*)	4.5189	7.2515	2
ln *gdp* = *f*(*lhlt*)	5.0984	5.9894	3
ln *gdp* = *f*(*lser*, *lcap*, *lopen*, *lcpi*)	6.3286	5.5003	2

[a] The calculated values are compared with critical values of Pesaran et al. (2001)

The comparison of calculated trace statistics value with the critical value at 5 % level of significance clearly indicates that the null hypothesis of zero cointegration vectors is rejected while the null hypothesis of one cointegrating vector is accepted. Thus, we can conclude that ln *gdp* and ln *ser* are cointegrated. That is, there is a long-run relationship between real GDP and services sector of Pakistan.

Furthermore, as mentioned earlier for the robustness purposes we also use ARDL cointegration technique. The results of ARDL cointegration test are mentioned in the lower panel of Table 3. The choosing of lag length is an important task here. We follow two strategies. First, following Ang (2010), we impose one lag length keeping the small sample of the data. It is important to mention here that the any autoregressive model is sensitive to the number of lags. Therefore, as a second strategy we use the optimal lag length based on the Akaike information criteria (AIC). We estimated seven different models for testing the long-run relationship among the variables; six out of seven models are bivariate models which contain single measure of services sector of the right-hand side, while the seventh model is regressed with some other control variables to test the robustness of the sign and significance of services sector. It is evident from the result that all models show strong evidence of long-run relationship among the variables.

We have established the long-run association among the variables through the cointegration analysis. But, yet we are not sure that which variable is causing the other variable. For this purpose, we estimate Eqs. 13 and 14 for the Granger causality test. The results are presented in Table 4.

Table 4 Granger causality test

Null hypothesis	*F* statistics	Prob
ln *ser* does not Granger cause ln *gdp*	4.1964	0.0484
ln *gdp* does not Granger cause ln *ser*	0.4492	0.4239

Table 5 Long-run estimates through ARDL

Regressor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
ln *gdp* is dependent variable							
lser	0.6769***	NA	NA	NA	NA	NA	0.3062***
	(0.2395)	NA	NA	NA	NA	NA	(0.1188)
lwrt	NA	0.3885**	NA	NA	NA	NA	NA
	NA	(0.1948)	NA	NA	NA	NA	NA
fi	NA	NA	0.6295***	NA	NA	NA	NA
	NA	NA	(0.2659)	NA	NA	NA	NA
tc	NA	NA	NA	0.5261***	NA	NA	NA
	NA	NA	NA	(0.2111)	NA	NA	NA
edu	NA	NA	NA	NA	0.8060***	NA	NA
	NA	NA	NA	NA	(0.2163)	NA	NA
hlt	NA	NA	NA	NA	NA	−0.3579	NA
	NA	NA	NA	NA	NA	(0.2993)	NA
lcap	NA	NA	NA	NA	NA	NA	0.3615**
	NA	NA	NA	NA	NA	NA	(0.1698)
lopen	NA	NA	NA	NA	NA	NA	0.3706***
	NA	NA	NA	NA	NA	NA	(0.1562)
lcpi	NA	NA	NA	NA	NA	NA	−0.7459*
	NA	NA	NA	NA	NA	NA	(0.4287)
ECM_{t-1}	−0.3702**	−0.1656***	−0.3626**	−0.3839***	−0.7519*	−0.2030*	−0.5176***
	(0.1611)	(0.0686)	(0.1768)	(0.1024)	(0.4187)	(0.1201)	(0.1785)
Diagnostics test							
Functional form	0.7361	0.8789	0.7119	0.1358	0.1965	0.5814	0.2763
Normality	0.7901	0.4840	0.4236	0.6873	0.5111	0.3191	0.5782
Heteroscedasticity	0.2660	0.4599	0.7574	0.8706	0.7383	0.2651	0.5002
Serial correlation	0.1175	0. 7799	0.1442	0. 0927	0. 3799	0.8890	0.1568
CUSUM	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CUSUMSQ	Stable	Stable	Stable	Stable	Stable	Stable	Stable

Standard errors of the coefficients in parenthesis indicates the significance levels

***, **, * indicates significance at 1 %, 5 % and * 10 %, respectively

The null hypothesis ln *ser* does not Granger cause ln *gdp* is rejected at 5 % level of significance which implies that the services sector may be a pivotal determinant of the real GDP in Pakistan. While the acceptance of null hypothesis ln *gdp* does not Granger cause ln *ser* implies that the causality does not run other way.

After establishing a long-run relationship and direction of causality, the next task is to estimate the error correction model for the long-run elasticities and error correction term. For this purpose, we use the ARDL estimators. The results are presented in Table 5. The table contains only the long-run estimates, while the short-run estimates are not presented keeping brevity in mind.[1]

It is evident from model 1 that the variable ln *ser*, which is a measure of share of value-added services in the GDP of Pakistan, enters significantly positive in the regression, which implies that the services sector has a positive impact on the economic activities of Pakistan. This finding is in line with that by Sundrum (1990), Illeris (1996), Qin (2006) and Pugno (2006) that it is a natural process for a developing economy to evolve into

[1] However, the short-run results are available from corresponding author on request.

a services-oriented economy. However, the findings of the present study are sharply in contrast to Baumol (1967) and Baumol et al. (1985), which points out the services-led growth is a demand-driven growth and demand-driven economic growth always remains shaky in its nature. However, Fixler and Siegel (1999), Greenhalg and Gregory (2001), Oulton(2001) and Baumol (2001) recognize that the business-related services lead toward the economic growth of an economy, while the household services are the burden on an economy.

To test this preposition, we take several business- and household-related service variables. It is evident that from model 2 to model 6 the services-related variable enters significantly positive in the growth regression whether it is related to business or household activities like education- and health-related expenditure. In this way, our findings are in line with the theoretical model of Pugno (2006), which reconciles the puzzle through the endogenous growth model. Furthermore, there are several factors that may affect the business activities of a country, for example physical capital, trade openness and inflation. We also incorporate these variables to test the robustness of the sign and significance of services variable. The model 7 shows that the sign and significance level of services remain robust and do not alter the results. The measure of capital stock, trade openness and inflation enters in the regression according to the a priori expectation.

In addition, to testing the robustness of our model we re-estimated all seven models with a shorter sample size. We take the sample from 1973 to 2014, keeping the fact in view that East Pakistan was separated in 1971 and there may be some aggregation bias in pre-1971 data. Since we are using ARDL technique for estimating the error correction model, this methodology allows us to get super consistent results even in a short span of time. As expected, our findings do not alter in the shorter span of time.[2]

The ECM term of the each model is presented in Table 5. The term is correct in sign, which is negative and significant in all cases. The negative sign implies that any disequilibrium in the short run will be converging to the long-run equilibrium. However, the magnitude of the ECM term varies from case to case. Specifically, it varies from −0.1656 to −0.7519. The magnitudes of the ECM term show the speed of adjustment of a shock in short run, which will be adjusted in the long run. More clearly, −0.1656 implies that any exogenous shock in the economic growth will be adjusted in approximately 5 and half years.

Further to test the health of our estimated model, we pass through our regression through various statistical tests. Our estimated models pass through model. The reported p values in Table 5 show that the null hypotheses of correct functional form, normal distribution of error, homoscedastic errors and no serial correlation are accepted for all almost every model except model 4. In addition, we test the stability of the models through well popular by using Brown et al. (1975) stability test as suggested by Pesaran et al. (2001). This test is well known as cumulative (CUSUM) and cumulative sum of squares (CUSUMSQ). The calculated values of CUSUM and CUSUMSQ statistics are well within the critical bounds at 5 % level of significance.[3] It implies that the coefficients in the error correction model are stable.

[2] We are not presenting the results here for saving the space of article.

[3] However, we do not present here the 14 graphs of CUSUM and CUSUMSQ keeping brevity in mind.

6 Conclusion

This article empirically tests the hypothesis of Pugno (2006) that the services sector, whether it is business related or household related, positively related to the economic growth of a country. We test this hypothesis in the case of Pakistan. According to our understanding, Pakistan is a good candidate in this context, since the economy of Pakistan witnessed a miracle growth in GDP from 2000 to 2006. Indeed, according to the annual reports of State Bank of Pakistan, the services sector was the major contributor in this miraculous economic growth. But suddenly that miracle evaporated and economy of Pakistan witnessed a free fall from 8 % annual growth in 2006 to 2 % growth in 2011 and 2012.

For this purpose, we estimate the bivariate model of Singh (2010) under the ARDL framework over the period of 1960–2014. We also use the Johansen cointegration for the robustness of the results, because augmented Dickey–Fuller test and Phillips–Perron tests give contradictory results about the order or integration. Then, we allow the structural breaks in the data series and apply the Clemente–Montanes–Reyes unit root test. This test shows that all the series have the same order of integration and are stationary at first difference. Therefore, in the presence contradictory evidences on the order of integration we use two different cointegration methodologies. However, we rely on ARDL for the estimation of error correction model as it can be applied irrespective of $I(0)$ or $I(1)$.

Our findings are in line with Pugno (2006) that the services sector contributes in the economic growth of a country regardless of the fact that whether these services are business related or household related. Therefore, the findings of the study suggest that the promotion of services sector may improve the growth of Pakistani economy. Therefore, the policy makers should concentrate on the household- or business-related services. But it is important to mention here that Pakistan should adopt a gradual policy for the transition from industrialization era to the post-industrialization as done by China over the last three decades. Otherwise, if we rely exclusively on the services sectors for the economic growth, as we have done in the first half of the decade 2000, then our growth will vulnerable to any external or internal shock.

Authors' contributions

AJ, SM and SS proposed the methodology and provided policy implications. SM was in charge of data collection and conducted data analysis. AJ and SS wrote the paper. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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