Fiscal Decentralisation, Provincial Economic Growth and Spillover Effects: A Spatial Panel Data Analysis

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This study examines the spatial dependence, direct and indirect effects of fiscal decentralisation on the provincial economic growth of Pakistan. Due to spatial dependence, spatial econometric technique is applied on the augmented growth of Mankiw, *et al.* (1992) by incorporating the fiscal decentralisation variable in the theoretical framework. The empirical analysis is based on the spatial panel data set, which is used from 1990 to 2011 of provinces. Model is selected on basis of specific to general and general to specific approach, and decided two-way fixed effects Spatial Durbin model (SDM) is appropriate for our data. We have estimated the SDM by maximum likelihood (bias corrected and random effect) estimation technique, otherwise, if we applied OLS and ignore the spillover effect which makes our estimated parameters biased and inconsistent. Results show that revenue decentralisation has positive, while expenditure decentralisation has negative effect to provincial economic growth. Spillover effects are found to be significant in case of revenue decentralisation and insignificant in case of expenditure. Negative and insignificant spillover effect of expenditure decentralisation is due to weak institutions, lack of intra governmental competition, and absence of political vision which may increase the level of corruption and less accountability.

On the basis of econometric analysis, it may be suggested that federal government should transfer the resources to provinces as determined in the 18th amendment, and it is the responsibility of provincial government to train their officials in the area of professional ethics, technical and administrative skills by different programmes.

JEL Classification: C31, C33, H3, H50
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1. INTRODUCTION

Fiscal decentralisation is the transfer of fiscal responsibilities from central to sub-central governments in devolving its functions of taxes and expenditures. It is considered as a sign of efficiency from few decades. Owing to this approach the local governments can independently figure out their problems, rather consulting to federal government [Oates (1972, 1999)]. This is the basic logic behind the Tiebout hypothesis (1956).

Pakistan has a federal government structure, in which the resources are distributed among the provinces which have a significant impact on income, and living standard of the people. The NFC (National Finance Commission) award is considered as a step toward

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federalism [Mustafa (2011)], which makes mechanism to distribute resources from center to the provinces, and Provinces Finance Commission (PFC) for distribution of resources from provinces to district level. The 7th NFC award is the gesture of hope and sacrifice which strengthen federation, and realising the people that other provinces are equally caring about their development [Mustafa (2011)]. In this award provinces are granted more financial resources not based on population only but also on the regional backwardness.

Fiscal Share of Provinces, by 1995–2010

Provinces	Ratio of Revenue and Expenditure to Total Share	1995	2000	2005	2010
Punjab	Rev	0.13115	0.14463	0.1504	0.15876
	Exp	0.13253	0.13325	0.12939	0.15264
Sindh	Rev	0.06516	0.07906	0.07059	0.07241
	Exp	0.06754	0.07284	0.8399	0.08554
KPK	Rev	0.04499	0.05027	0.04347	0.04157
	Exp	0.04803	0.04871	0.0229	0.04465
Balochistan	Rev	0.02587	0.02621	0.02846	0.02956
	Exp	0.02322	0.02297	0.01778	0.01923

Punjab has more revenue and expenditure share than any other provinces, which have an upward trend from 1995 to 2010. In addition 18th amendment has been done to bridge the gap between provinces and federation disparities. In this amendment provinces are given more autonomy, and financial resources are devolved by some more extent, which will strengthen the process of decentralisation in Pakistan.

Fiscal decentralisation results in stronger intergovernmental competition due to spatial dependence one region's government policy may affect the other regions [Crowley and Sobel (2011)]. Moreover, each province provides the local public good in his jurisdiction. The public goods benefit to those citizen in which province they are located, but may also have favourable spillover to the other provinces. Therefore, the spillover effects among the provinces motivate us to check the direct and spillover effect of fiscal decentralisation on provincial economic growth in Pakistan.

Objective of this study is to answer the following questions:

(1) Is spatial dependence (spatial interaction effect) exist among the provinces of Pakistan?
(2) What is the direct and indirect (spillover) effects of fiscal decentralisation on provincial economic growth (real per capita income).
(3) Are these effects (direct and spillover) exist, significantly or not?

This study is organised as: Section 2, reviews theoretical and empirical literature on decentralisation and economic growth in case of spatial and non-spatial econometrics. Section 3, discusses the empirical model, econometrics methodology and data. Section 4, empirically examines the role of fiscal decentralisation, and provinces economic growth and discusses the findings. Section 5 concludes the results, gives policy implementation, limitation and way forward of the study.

2. REVIEW OF LITERATURE

Empirical Review of Decentralisation and Economic Growth

On the relationship between fiscal decentralisation and economic growth from cross country level to group of countries, there is extensive literature. World is divided into two groups, high income industrialised countries and developing countries, and different empirical studies in both group found different results.

Zhang and Zou (1998) used methodology of Barro (1990), Lvine and Renelt (1992) and Davoodi and Zou (1998) to find the relationship between decentralisation and economic growth for China, they estimated panel data fixed effect model of 28 provinces (from 1980-1992) by using the estimation technique generalised least square. They find negative and significant impact of the fiscal decentralisation on the economic growth.

Jin, *et al*. (2005) re-examine the study of Zhang and Zou (1998) including the variable of volatility, they extended the empirical methodology of Zhang and Zou (1998) by including (data from 1982 to 1992 of 29 provinces of China) the variable of dummy that capture the effect of a national macroeconomics fluctuations. They conclude that the fiscal decentralisation promotes economic growth of Chinese provinces.

Xie, *et al*. (1999) used the theoretical model for decentralisation that is elaborated in Davoodi and Zou (1998) for 50 American states (from time period 1948-1994), empirically they applied time series methodology by OLS estimation. They concluded that existing expenditure share for local and state governments in USA are consistent with the objective of maximising the growth of the economy, the effect of decentralisation is highly insignificant.

Lin and Liu (2000) used the methodology of Mankiw, *et al*. (1992) and they specify a model of growth of Solow (1956). They used data of 28 provinces of China for the time period 1970-1993, their empirically analysis based on provinces panel data, with two way (provinces and time dummies) fixed effects. They found, the fiscal decentralisation contributes economic growth in China, significantly, which is consistent with the hypothesis that fiscal decentralisation can enhance economic efficiency.

Zhang and Zou (2001) developed a new model with accordance Barro (1990) and Zhang and Zou (1998) that connects the different public spending categories in the diverse government levels with the economic growth of the region. They selected 28 provinces of China (from 1987-1993) and 16 major states of India (from1970-1994). In empirical analysis, they applied provincial fixed effect model (in case of China) and regression analysis based on panel data, with estimation a five year forward-moving average of real per capita income growth (in case of India). They concluded, in case of China, as in Zhang and Zou (1998), a negative and significant association between province economic growth and fiscal decentralisation. However, in case of India, they found a positive and significant association between fiscal decentralisation and economic growth.

Behnisch, *et al*. (2003) conducted a study in Germany (from time period 1950-1990), but they did not make any reference to their theoretical model. They applied linear and time series regression analysis (further details are not available). The analysis shows an inverse significance of state expenditure, and therefore, indicates polices among state level governments as part of cooperative federalism is not efficient with regard of productivity growth.

Vazquez and McNab (2003) used panel data set (from 1972-1997) for 52 transitional countries. They examined direct and indirect relationship among fiscal decentralisation and economic growth and macroeconomic stability. They concluded that decentralisation leads to reduce the rate of inflation, and positively effect on economic growth through its positive impact on macroeconomic stability.

Desai, *et al.* (2003) used the regression analysis of (80 Russian) regions and average data with time specific effects as a base of simultaneous regression models. They applied three stage least squares (3SLS) and OLS with panel-corrected standard error estimation. They do not mention the reference of any theoretical pattern. Thus, the proxy for sub-national (tax retention) fiscal autonomy has a positive impact on the output regaining of regions since the break-up of the Soviet Union.

Feld, *et al.* (2004) used the methodology of neoclassical growth model of Mankiw, *et al.* (1992) on panel data for the 26 Swiss cantons from 1980 to 1998. In their empirical study the effect of diverse instruments of fiscal federalism on economic performance measured by GDP per capita. The results concluded that matching grants have a negative impact on economic performance, while tax competition is not least harmful to economic performance, competition among the different sub-national governments enhance efficiency.

Akai, *et al.* (2004) provided the theory (from Barro (1990) analytical framework) that describes how to decentralisation effect economic growth under different structure of regional complementary. They estimated panel data model with time and state fixed effects of fifty states of USA over the period of 1992-1997, which support the theoretical specification of the production function, by using the technique of maximum likelihood estimation. They observed the "hump-shaped" association between fiscal decentralisation and economic growth.

Jin and Zou (2005) applied the methodology of Barro (1990) and Davoodi and Zou (1998) in a panel dataset for 30 provinces in China to examine the association between fiscal decentralisation and economic growth over two stages of fiscal decentralisation in China: first, 1979–1993 under the fiscal contract system, and second, 1994–1999 under the tax assignment system. In their empirical analysis, they estimated the coefficients with fixed-effects with correction for panel heteroskedasticity and panel serial correlation. They concluded, for time period 1979 to 1993, results suggest, that revenue decentralisation encourage revenue mobilisation from local sources, expenditure centralisation enhance growth, because the central government spends more efficiently than the provinces, and for second time period from 1994 to 1999, results suggest that at a certain level of expenditure decentralisation, more revenue centralisation promotes economic growth in China.

Carrion-i-Silvestre, *et al.* (2006) analysed the influence of the Spanish fiscal decentralisation on economic growth at aggregate and regional level. They followed the methodology of Xie, *et al.* (1999) based on Davoodi and Zou (1998), take the data set of aggregate and regional level of 17 Autonomous Communities from 1980 to 1998 and 1991 to 1996 respectively. On their panel data estimation they conclude that the Spanish decentralisation process has a positive effect on both aggregate and regional economic growth.

Akai and Sakata (2007) used same theoretical model applied by Xie, *et al*. (1999), based on the pattern of Davoodi and Zou (1998). They applied OLS and Fixed Effect Model with time dummies, on the panel data of 50 states of USA (from 1992 to 1997), their estimated coefficients on fiscal decentralisation is significant and have a positive effect on economic growth.

Rodríguez-Pose, *et al.* (2009), used the regression model based on methodology of Levineand Renelt (1992) to investigate the significance of fiscal decentralisation in sixteen Central and Eastern European countries. They applied panel data approach with dynamic effects over the 1990–2004 period of time, findings says expenditure decentralisation has a negative effect on economic growth due to the weak institution structure in many of countries and in case of decentralisation of revenues, they investigated that if revenues are decentralised at sub-national level their own revenue source behave better to local public demands and promote economic efficiency.

Empirical Review in Case of Pakistan

Malik, *et al*. (2006) investigated the positive association between fiscal decentralisation and economic growth, they use time series data from 1972 to 2005 and Ordinary Least Square estimation method is applied.

Iqbal (2013) analysed the effect of fiscal decentralisation on economic growth and macroeconomic stability by using the endogenous growth model. In his analysis time series data is used from 1972-2010 and Generalise Method of Moment technique is applied. It is concluded by him that revenue and expenditure decentralisation has positive and negative effect on economic growth respectively. The reason of negative effect of expenditure decentralisation is weak institution and administrative framework at provinces level.

Decentralisation, Economic Growth, Spillover Effects and Spatial Econometrics

Spatial econometrics is the advancement in econometrics literature which captures the spatial effect due to spatial autocorrelation [Yang and Zheng (2010)].

Yamoah (2007) used the growth model of Carlino and Mills (1987) to check the effect of decentralisation on economic growth in three thousand counties of forty six states of USA. In her study she take cross sectional data, and result indicate that fiscal decentralisation have negative effect on economic growth, spatial spillovers in county government decision making does not investigate and this limitation is acknowledge by her, and give way forward of new research in the area of spatial econometrics.

Tosun and Yilmaz (2010) applied the panel data (1976-2001) and cross-sectional spatial regression analysis in 67 and 81 provinces in Turkey respectively. In cross sectional regression analysis there exists spatial correlation among the contiguous provinces (spatial effect incorporate in regression analysis due to this reason) and the model of spatial dependence account for any direct effect of spatial neighbour and spillover effects, hence, it is concluded that decentralisation contracting positive effect on economic growth through greater degree of competition among the provinces government.

Hammond and Tosun (2011) investigated the impact of fiscal decentralisation on economic growth in counties of USA. Their sample size divide into metropolitan counties and non-metropolitan counties (period from 1970 to 2000). Since they use county-level data then spatial spill-overs across counties exist, and these spill-over effects which imply that growth shocks to one county may be transferred feedback effect to other counties nearby, and will basis the residual variance in an OLS regression to be non-spherical. To correct this problem they used spatial error model in order to distinguish between metropolitan and nonmetropolitan impacts. They estimates that 10 percent increase in revenue centralisation in metropolitan counties causes the decrease in long rune per capita income growth of 0.28 percent, and no correlation between decentralisation and non-metropolitan economic growth exist. This recommends that metropolitan fiscal decentralisation benefits long-run income growth. It also advises that generating revenue in a decentralised way makes the county a more attractive. Therefore, they examine significant positive spillover growth shocks to other counties, which suggests that counties whose neighbour grow faster than expected, to grow faster than expected.

Zheng, *et al.* (2013) took 21 province data (from time period 1994-2006) to investigate the supply of healthcare expenditures, which causes to slow down economic growth from last two decades. They use spatial panel data econometrics and find that the supply of healthcare resources is negatively related to the degree of decentralisation. It is credited to the presence of strategic alternatives (spillover) in healthcare spending across city governments.

Conclusion

Effect of decentralisation on economic growth is diverse in different regions. This difference exist on some extent due to misspecification of the model, because regional governments are interlinked on base of strategies and boarders, the act of one government have feedback effect (spillover effect) to another. If spatial dependence and spillover effect are not account for then they could lead to biased and inconsistent parameter estimates [LeSage (1998)]. In case of Pakistan there is not conducted the study of fiscal decentralisation and its effect on economic growth at provinces level, where provinces effect their neighbours significantly.

3. DATA AND ECONOMETRICS METHODOLOGY

Due to spatial dependence, spatial panel data econometric will be applied on the modified theoretical framework of Mankiw, *et al.* (1992) by incorporating the decentralisation variable. Estimation is performed by employing maximum likelihood technique instead of OLS method to obtain unbiased and consistent parameters in the presence of spillover effect. Therefore, specified Spatial Durbin Model (SDM) is:

$$y_{ti} = \delta \sum_{j=1}^{N} W_{ij} y_{jt} + \alpha + x_{ti}\beta + \sum_{j=1}^{N} W_{ij} x_{jt}\theta + \mu_i(optional) + \tau_t(optional) + \varepsilon_{ti} \quad \dots \quad (1)$$

or in matrix form

$$y_t = \delta WY_t + \alpha + X_t\beta + WX_t\theta + \mu_i + \tau_t + \varepsilon_t \qquad \dots \qquad \dots \qquad \dots \qquad \dots \quad (1a)$$

Where, *W* is weight matrix, and is coefficients of spatial interaction effect of dependent and independent variables, respectively.

W Matrix and Normalising *W* Matrix

W representing an $n \times n$ spatial weight matrix (in case of cross sectional data) of binary numbers, in which one is assign for neighbour, and zero is assign to prevent a region to the neighbor of itself [LeSage and Pace (2009)], in our case study (of Pakistan) we have four regions (Punjab, Sind, KPK and Balochistan). Where each column represent one region, 1st for Punjab, 2nd for Sindh, 3rd for KPK and 4th for Balochistan.

$$W = \begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix} \qquad W_{RN} = \begin{bmatrix} 0 & 0.33 & 0.33 & 0.33 \\ 0.5 & 0 & 0 & 0.5 \\ 0.5 & 0 & 0 & 0.5 \\ 0.33 & 0.33 & 0.33 & 0 \end{bmatrix}$$

As another way, *W* might be normalised in such a way that the elements of each column sum to one. There is a point that the column elements of a spatial *W* matrix show the impact of a particular unit on all other units, while the row elements of spatial *W* matrix display the on a specific unit by all other units. Therefore, column normalisation has the effect, the impact of each region on all other regions is equalised, while row normalisation (W_{RN}) has the effect, the impact of a particular region on all other regions [Elhorst (2014)].

Data Description and Variable Construction

Data which used in this study is at provinces level (from 1990 to 2011) of Pakistan.

Table 3.1

Data Description

Variable	Definition
Dependent Variable (y)	*Real per capita income of provinces (base = 1999-00)*
Revenue Decentralisation (rd)	$\dfrac{Provinces\ Revenue}{Total\ Revenue\ (including\ federal)}$
Expenditure Decentralisation (ed)	$\dfrac{Provinces\ Expenditure}{Total\ Revenue\ (including\ federal)}$
Human Capital (h)	*Per capita health and education expenditure of provinces*
Capital (k)	*Per capita capital expenditure of provinces*

Data of provincial GDP is estimated and disaggregated by Shaheen Malik (Research Analyst at unit SASEP) for World Bank. He used three traditional approaches (to estimate GDP), production, expenditure, and income. More specifically, where detail provincial data were available, i.e. agriculture, mining and quarrying, whole sale and retail trade and manufacturing, sectorial value added were estimated using the production approach. The expenditure approach was used to compute value added of construction, electricity and gas distribution, ownership of dwellings, defence subsectors and public admiration. Moreover, the income approach was applied to value added to transport, communication and storage, banking and insurance, and services sub-sectors. The

analysis of estimation has been applied to facilitate the economic assessment for two provinces reports: Development Issue and Prospect of Balochistan and Public Expenditure Review for Khyber Pakhtunkhwa.

We are also using the education and health expenditures as proxy of human capital and the capital expenditure of provincial governments as a proxy for capital, data on variables are taken from annual Pakistan Statistical Year Book. For transforming the data into per unit form, provinces population has been used, which is collected from the Labour Force Survey, published by Pakistan Bureau of Statistics (PBS). In addition, data of provincial revenue and expenditure is also taken from annual Pakistan Statistical Year Book, and the calculation of decentralisation (revenue and expenditure) variables, obtain by the ratio of provinces revenue and expenditure to total revenues and expenditures of the provincial government (including federal) respectively [Oates (1972)].

4. EMPIRICAL RESULTS

In this section, we empirically analyse the different spatial econometrics models, by using the spatial panel data that explain the provincial economics performance and decentralisation in Pakistan (from 1990 to 2011). The dependent variable is real per capita income and explanatory variables are decentralisation (revenue or expenditure), capital and human capital. All variables are in log form, so our specified SDM is equation (1 or 1a), which we can convert to non-spatial models easily by eliminating the spatial interaction effects, with spatial effect or/and time period fixed effects, and estimation is done in Matlab software.

Results of Revenue Decentralisation

Table 4.1.1

Estimation Results of Revenue Decentralisation Using Panel Data Models
without Spatial Interaction Effects

Determinants	(1) Pooled OLS	(2) Spatial fixed Effects	(3) Time-period Fixed Effects	(4) Spatial and Time-period Fixed Effects
Log(rd)	0.085	–0.032	0.162	0.144
	(1.407)	(–0.260)	(2.638)	(1.065)
Log(h)	0.062	0.039	0.025	0.045
	(1.176)	(0.817)	(0.325)	(0.655)
Log(k)	0.222	0.186	0.332	0.180
	(7.165)	(6.39)	(5.57)	(2.558)
Intercept	8.637			
	(27.58)			
	0.111	0.081	0.092	0.071
	0.428	0.578	0.517	0.631
LogL	–24.905	–12.118	–17.758	–6.499
LM Spatial lag	5.669	4.96	7.684	14.565
LM Spatial error	3.517	5.596	12.650	17.140
Robust LM Spatial lag	2.346	0.009	7.386	8.557
Robust LM Spatial error	0.194	0.638	12.352	11.13

Note: t-value in parentheses.

Table 4.1.1 accounts the estimation results of revenue decentralisation on economic growth when adopting a non-spatial panel data model. To check which specific effect should include in model (spatial or/and time), we use likelihood ratio test. Therefore, the null hypothesis, the spatial fixed effects are jointly non-significant, the result (*LR*=25.57, with 4 degrees of freedom [df],) indicate that null hypothesis is rejected and we should extend our model by including spatial specific effects. Similarly, the hypothesis that the spatial and time period fixed effects are jointly insignificant must be rejected (LR=37.00, 25 df). Results of these tests justify the extension of the model with spatial and time period fixed effects that is also known as the two ways fixed effects model [Baltagi (2008)].

Therefore, inclusion of spatial and time-period fixed effects, our next step is to determine whether the spatial lag model or the spatial error model is more suitable. For the inclusion of spatial interaction effects we are using classic LM tests, and both the hypothesis of no spatially serial correlated error term and the hypothesis of no spatially lagged dependent variable must be significant at 5 percent and 1 percent level of significance. When using the robust LM tests, the hypothesis of no spatially lagged dependent variable may not be rejected at 5 percent as well as 1 percent significance. However, hypothesis of no spatially serial correlated error term must still be rejected at 5 percent and 1 percent level of significance.

Up to now, our test results point to the spatial error specification of the two-way fixed effect model because LM spatial error test is more significant than LM spatial lag test. But there is ambiguity to selection of the model because both tests reject their null hypotheses in favour of their alternatives. Nevertheless, if a non-spatial model on the basis of robust LM tests is rejected in favour of spatial error model or the spatial lag model, we should be careful to select one of these two models [Elhorst (2014)]. The LeSage and Pace (2009) recommend to consider the spatial Durbin model when this situation exist. The first hypothesis whether the spatial Durbin model can be simplified to the spatial lag model, and the second examines whether it simplified to the spatial error model [Elhorst (2014)]. The test statistics of both models follow Chi squared distribution with *K* degree of freedom.

The spatial Durbin model best describes the data if both hypotheses and are rejected. On the other hand, if the first hypothesis not able to be rejected, the spatial lag model then best specify the data, the robust LM tests also specify the spatial lag model. Similarly, if second hypothesis can't be rejected, the spatial error model the best describes the data, provided that robust LM tests also specify the spatial error model. Therefore, one of these conditions is not satisfied, i.e. if the robust LM tests point to another model than the LR/Wald test, the Spatial Durbin model should be adopted [Elhorst (2014)]. Because, this (SDM) model generalises both the spatial lag and the spatial error model. In model specification criteria, the spatial econometric literature is divided regarding to apply specific-to-general or general-to-specific approach [Elhorst (2014)].

Table 4.1.2

Estimation Results of Revenue Decentralisation: Spatial Durbin Model
Specification with Spatial and Time-period Specific Effects

Determinants	(1) Spatial and Time-period Fixed effects	(2) Spatial and Time-period Fixed effects bias-corrected	(3) Random Spatial effects, fixed time-period effects
W*log(y)	−0.913	−0.769	−0.673
	(−10.69)	(−7.659)	(−6.47)
Log(rd)	0.744	0.741	0.724
	(9.110)	(7.570)	(8.30)
Log(h)	0.072	0.074	0.076
	(1.691)	(1.433)	(1.503)
Log(k)	0.162	0.168	0.163
	(3.608)	(3.112)	(3.137)
W*Log(rd)	2.264	2.49	2.493
	(8.896)	(8.235)	(8.634)
W*Log(h)	0.147	0.159	0.173
	(1.520)	(1.367)	(1.508)
W*Log(k)	0.598	0.655	0.557
	(4.282)	(3.936)	(3.636)
Phi			0.209
			(2.039)
	0.013	0.018	0.018
	0.929	0.919	0.870
Corrected R^2	0.537	0.562	0.436
LogL	39.518	39.518	NA
Wald Test Spatial lag	84.276	72.322	81.10
	(p=0.0000)	(p=0.0000)	(p=0.0000)
LR Test Spatial lag	64.027	64.027	NA
	(p=0.0000)	(p=0.0000)	
Wald Test Spatial error	33.993	35.356	43.522
	(p=0.0000)	(p=0.0000)	(p=0.0000)
LR Test Spatial lag error	46.774	46.774	NA
	(p=0.0000)	(p=0.0000)	

Note: t-value in parenthesis. Hausman test-statistic, degrees of freedom and probability = 2.987, 7, 0.8862.

In above testing procedure we mix both approaches. Firstly, we estimate non-spatial model to test it's against spatial lag and spatial error model (specific to general approach). In case of non-spatial model is rejected then spatial Durbin model is estimated, and this can test to simplified to the spatial lag or spatial error model (general to specific approach). If both approaches identify same model either spatial lag or spatial error model, it is safe to select this one which model describes best to data. In other hand that is the best to adopt more general model (SDM), when non-spatial model is specified in favour of spatial lag or spatial error model and spatial Durbin model not identify it. The results which we are obtained by estimating the Spatial Durbin Model (SDM) are reported in Table 4.1.2. The first column indicates the results when model is estimated by using direct approach and the second column shows the bias corrected coefficient. These

results show that the difference between parameters estimate of independent variable (*X*) and are small through bias corrected estimation. But on another hand, the coefficient of the independent variables (*WX*) and the spatially lagged dependent variables (*WY*) seem quite sensitive to bias correction procedure [Elhorst (2014)].

We have estimated three models (SDM) by different technique (in three columns), first we check which model specification is the best our data set, either fixed effect model is appropriated or random effect. Hausman's specification test can use to test the random effects against fixed effects model. The results (*h*=2.987, 7 df, p > 0.05 and 0.10) indicate that random effects model does not rejected against fixed effect.

The Wald test (43.52, p=0.000) indicate that the hypothesis whether spatial Durbin model (SDM) can be simplified to the spatial error model (SEM), must be rejected, similarly the hypothesis that SDM can be simplified to SAR model, must be rejected (Wald test: 81.10, p=0.0000). This indicates that both the SEM and the SAR must be rejected in favour of the spatial Durbin model.

In this study we concentrate on decentralisation variable as a direct and indirect effect. The coefficient of revenue decentralisation in the non-spatial model is insignificant but has an expected sign. In the two-way fixed effects form of this model (the last column of Table 4.1.1), higher revenue decentralisation increase regional income positively but effect again is insignificant. In other way, we have discussed (specification procedure of model) that spatial and time period specific effects are not correlate to explanatory variables, and these effects are consider as random (reason to specifying random effect model). However, due to spatial interaction (both in dependent and independent variables) the specification of spatial Durbin random effects model is found to be more appropriate, and the elasticity's in non-spatial and two-way fixed effect SDM consider as biased (due to acceptance of the null hypothesis of Hausman test). In the third column of the estimation results of SDM, the elasticity of revenue decentralisation is 0.724 which is significantly overestimated as we compare it to non-spatial fixed effects models. Whereas, the coefficient estimates in the non-spatial model represent the marginal effect of a change in revenue decentralisation on provincial per capita income (economic growth) but the coefficients of spatial Durbin model (SDM) do not.

Table 4.1.3

Direct and Indirect (Spillover) Effects Estimates Based on the Parameter Estimates of the Spatial Durbin Model Reported in Table 4.1.2.

Determinants	(1) Spatial and Time-Period Fixed Effects	(2) Spatial and Time-Period Fixed Effects Bias-corrected	(3) Random Spatial Effects, Fixed Time-period Effects
Direct Effect Log(*rd*)	0.087	0.145	0.203
	(0.810)	(1.269)	(2.027)
Indirect Effect Log(*rd*)	1.495	1.70	1.732
	(7.264)	(6.928)	(7.087)
Total Effect Log(*rd*)	1.583	1.845	1.935
	(7.970)	(7.052)	(6.914)

Notes: t-values in parentheses. Direct and indirect (spillover) effects: (I-)$^{-1}$ are calculated.

For this reason, we should use the direct and indirect effects of estimates and these effects are reported in above Table 4.1.3. The logic that the direct effects of the independent variables are different from their parameter estimates is due to feedback, which arises in response of impacts passing through neighbouring provinces and back to the provinces themselves. These feedback effects are relatively due to parameter of spatial lagged dependent variable [W*log(y)] that turns out to be negative and significant, and partially in result of the parameter of the spatially lagged of the independent variable itself. The coefficient of latter turns out to be positive and significant for the revenue decentralisation [W*log (rd)].The direct and indirect (spillover) effects estimates are obtained by computing $(I-)^{-1}$.

In random effects spatial Durbin model (column (3) of Table 4.1.2) the direct effect of the revenue decentralisation variable appears to be 0.724. This means that the revenue decentralisation elasticity is 0.144 in the non-spatial model that is underestimating by 80 percent. Since, the direct effect of the revenue decentralisation is 0.237 and its coefficient estimate is 0.724 its feedback amount represents the direct effect. Therefore, this feedback effects turn out relatively small. In another hand, the indirect (spillover) effects in non-spatial model are equate to zero, the indirect effect of due to change in the explanatory variables in the spatial Durbin model appears to be 853.2 percent of the direct effect in case of revenue decentralisation, and this indirect effect is statistically significant on base of t-statistics which calculated from a set of 1000 simulation parameter values. In other words, if the revenue decentralisation in a particular provinces changes, not only per capita income of that province itself, but also in that of its neighbouring provinces will change. Now move to the estimation results of expenditure decentralisation.

Results of Expenditure Decentralisation

Table 4.2.1

Estimation Results of Expenditure Decentralisation Using Panel Data Models without Spatial Interaction Effects

Determinants	(1) Pooled OLS	(2) Spatial fixed Effects	(3) Time-period Fixed Effects	(4) Spatial and Time-Period Fixed Effects
Log(*ed*)	0.088 (1.389)	−0.246 (0.1641)	0.141 (2.179)	−0.434 (−1.711)
Log(*h*)	0.067 (1.220)	−1.080 (0.873)	0.009 (0.127)	0.092 (1.278)
Log(*k*)	0.230 (7.04)	0.174 (5.706)	0.348 (5.438)	0.130 (1.733)
Intercept	8.576 (27.26)			
	0.111	0.079	0.095	0.069
	0.428	0.584	0.505	0.639
LogL	−24.930	−11.553	−18.829	−5.591
LM Spatial Lag	5.533	5.815	6.423	13.501
LM Spatial Error	3.409	5.409	9.731	14.636
Robust LM Spatial Lag	2.315	0.538	16.366	3.281
Robust LM Spatial Error	0.191	0.132	19.674	4.416

Note: t-value in parentheses.

Table 4.2.1 accounts the estimation results (of expenditure decentralisation), when adopting a non-spatial panel data model. To check which specific effects should include in model (spatial or/and time), we again use likelihood ratio test as we have used in case of revenue decentralisation. Thus, the null hypothesis, the spatial and time period fixed effects are jointly non-significant is rejected because *LR*=38.68 (with 25 df,) and we extend our model by including spatial and time specific effects.

Our next step is to check the spatial interaction effects for specification of the model. The procedure of the selection of the model is also the same as we have discussed (in case of revenue decentralisation). For inclusion of spatial interaction effects, both hypotheses, no spatially serial correlated error term and the hypothesis of no spatially lagged dependent variable are significant at 5 percent and 1 percent level of significance because statistics of LM spatial lag and LM spatial error (see in fourth column of Table 4.2.1**)** are greater than the critical value (which is *Chi (1) .01 value* = 6.64). Therefore, we have applied both techniques specific to general and general to specific (as in revenue decentralisation is applied), and conclude that our specify model is Spatial Durbin Model (SDM).

Table 4.2.2

Estimation Results of Expenditure Decentralisation: Spatial Durbin Model
Specification with Spatial and Time-Period Specific Effects

Determinants	(1) Spatial and Time-period Fixed Effects	(2) Spatial and Time-period Fixed Effects Bias-corrected	(3) Random Spatial Effects, Fixed Time-period Effects
W*log(y)	–0.864	–0.683	–0.706
	(–8.894)	(–5.992)	(–6.377)
Log(ed)	–0.482	–0.473	0.531
	(-1.906)	(-1.550)	(5.283)
Log(h)	0.202	0.202	0.073
	(2.841)	(2.356)	(0.952)
Log(k)	0.131	0.134	0.397
	(1.505)	(1.280)	(5.782)
W*Log(ed)	–0.540	–0.484	1.509
	(–0.824)	(–0.611)	(4.387)
W*Log(h)	0.331	0.339	0.113
	(2.051)	(1.738)	(0.640)
W*Log(k)	0.183	0.179	0.603
	(0.855)	(0.696)	(3.709)
Phi			0.996
			(2.753)
	0.042	0.047	0.047
	0.824	0.796	0.675
Corrected R^2	0.132	0.140	0.428
LogL	8.980	8.979	NA
Wald Test Spatial Lag	10.301	7.098	38.995
	(p=0.0162)	(p=0.0688)	(p=0.0000)
LR Test Spatial Lag	6.846	6.846	NA
	(p=0.0769)	(p=0.0769)	
Wald Test Spatial Error	2.871	2.974	18.720 (p=0.0000)
	(p=0.4120)	(p=0.3956)	
LR Test Spatial Lag Error	1.1596	1.159	NA
	(p=0.7627)	(p= 0.7627)	

In Table 4.2.2 we again estimate three models (SDM) in case of expenditure decentralisation by different specification and technique (see column of Table 4.2.2). We check first, which model specification is the best describes our data set, either fixed effect model is appropriated or random effect. For this we apply the Hausman's specification test to check either random effects model is appropriate or fixed effects. The result (h=16.18, 7 df, p < 0.05) indicate that random effects model is rejected in favor of fixed effects, as a result we ignore the third column. Expenditure decentralisation in specification of random effect model, positively affect the real per capita income of the provinces, but these results are biased due to misspecification of the model, in other hand, the correct specification of the model, expenditure decentralisation effect negatively to provinces economic growth.

The coefficient of expenditure decentralisation in the non-spatial (two-way fixed effects) model (see the last column of Table 4.2.1) show the negative association to provinces income, it indicates that if higher expenditure are decentralised it will decrease the regional income, but this effect is insignificant. However, due to spatial interaction (both in dependent and independent variables) the spatial Durbin fixed effects model is found to be more appropriate, and the elasticity in non-spatial and random effects SDM consider are biased (due to reject the null hypothesis of Hausman test).

We are using bias corrected estimates for interpretation and the reason to chosen the bias correction estimates have been given in section of revenue decentralisation. In the second column of the estimation results of SDM, the elasticity of expenditure decentralisation is –0.472 which is insignificant, it is overestimate if we compare it to the elasticity coefficient of non-spatial two way-fixed effects model.

Table 4.2.3

Direct and Indirect (Spillover) Effects Estimates Based on the Parameter
Estimates of the Spatial Durbin Model Reported in Table 4.2.2

Determinants	(1) Spatial and Time-period Fixed Effects	(2) Spatial and Time-period Fixed Effects Bias-corrected	(3) Random Spatial Effects, Fixed Time-period Effects
Direct Effect Log(*ed*)	–0.440	–0.423	0.216
	(–1.731)	(–1.506)	(2.89)
Indirect Effect Log(*ed*)	–0.132	–0.133	0.989
	(–0.267)	(–0.232)	4.036)
Total Effect Log(*ed*)	– 0.572	–0.556	1.206
	(–1.234)	(–0.930)	(4.578)

Notes: t-values in parentheses. Direct and indirect (spillover) effects: $(I-)^{-1}$ are calculated.

In addition to find the direct and indirect effects we only concern the expenditure decentralisation variable. In expenditure decentralisation, the direct (feedback) and indirect effects (see Table 4.2.3) are not exist, because the t-value are insignificant respectively. The reason of insignificant direct and spillover effects is weak institutions and less administrative and political autonomy among the government of the provinces, and that is also a reason of negative effect of expenditure decentralisation [Rodríguez-Pose, *et al.* (2009) and Iqbal (2013)].

5. CONCLUSION AND POLICY RECOMMENDATIONS

Given study analysed the spatial (correlation) interaction effects, the effect of fiscal decentralisation on the provinces economic growth, and also analysed the direct and spillover effects. The estimated result in case of revenue decentralisation showed that there exist spatial interaction effects, positive effect of revenue decentralisation on provincial economic growth and found significant direct (feedback) and indirect (spillover) effects, due to heterogeneous governments in the provinces[1] (from 1990 to 2011), because revenue decentralisation generates positive externalities[2] and further in case of human capital and capital labour ratio have positive association to provincial economic growth respectively. On the other hand, the result indicates (in case of expenditure decentralisation) that there exist spatial interaction effects, but has negative association with the provincial economic growth. In addition there exist no direct (feedback) and indirect (spillover) effects due to weak institutions[3] and lack of intra governmental competition which may increase the level of corruption, less accountability and lack of political vision of the people. In expenditure decentralisation human capital and capital labour ratio have positive association to provincial economic growth. The coefficient of spatial lag of dependent variable has negative association to economic growth (due to boarder effect), when one province income increase it may affect the income of other provinces negatively because investment and business activity move to that province which is economically grow and in this case economic growth in other provinces may fall.

There are few policy implications which construct from this study:

(1) As our empirical results reveal that revenue decentralisation have positive direct and spillover effect on economic growth due to competition among the provincial government in given circumstances. Because by giving discretion to provincial government (in revenue generation) will increase the pace of economic growth in their region. Unfortunately, in 18th constitutional amendment many funds are move to provincial government but they are still in control of federal government. The Punjab government complaint against the federal government in Supreme Court that federal government is unwilling to handover its share.[4] 18th amendment gives the more autonomy to the provinces, which will leads to competition among the sub-national governments and this competition will leads to positive spillover. Therefore, it is the responsibility of federal government to move the resources to provinces, as determined under 18th amendment.

(2) In case of expenditure decentralisation, it will be only effective when provinces have strong institutions, in which they have more administrative and accountability authority which leads to transparency, as a result, expenditure decentralisation can contribute positively to economic growth. Hence, Provinces government should take steps to teach and giving the training to

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[1]Not concern either there is democratic or dictatorship in centre.

[2] Iqbal, *et al*. (2013) "Decentralisation of revenue generation responsibilities generates positive externalities which increase the per capita income of the country".

[3] Findings of Rodríguez-Pose, *et al.* (2009) and Iqbal (2013).

[4]*Dawn News* (02/April/2015) News link: http://www.dawn.com/news/1173391.

public officials in professional ethics, technical and administrative skills by different programs in order to get the significant positive impact of expenditure decentralisation on their economic growth.

Limitation and Way Forward of the Study

Due to unavailability of data we are not able to extend our study at district level, in which more spatial variation can be captured and results would be become more versatile. In this study we used fiscal decentralisation as a proxy of decentralisation by ignoring the political and administrative decentralisation. In addition, data of provincial GDP is not collected officially at the provincial government[5] level, which is again an issue of reliability of data.

The research can be extended to find the spatial effect of fiscal decentralisation on health sector, poverty and income inequality.

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[5]*Dawn News* (04/Aug/2013) News link: http://www.dawn.com/news/1033968.

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