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Impact of Infrastructure and Agroclimate on the Location of Rural Bank Branches in Pakistan: A Preliminary Assessment

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Rural financial institutions play an important role in development and growth of the agricultural sector. In developing economies some rural areas are adequately served by financial institutions, while others have little or no access to these institutions. This uneven pattern of geographic location of rural bank branches has been attributed largely to regional differences in agroclimatic conditions and infrastructural endowments. We have estimated several alternative specifications which can be helpful in understanding the spatial distribution of commercial bank branches across the rural areas. Our results indicate that the location of rural bank branches is significantly influenced by infrastructural endowments and agroclimatic environment.

1. INTRODUCTION

Rural financial institutions play a vital role in the development and growth of the agricultural sector. In the context of developing economies, however, it has been observed that while some rural areas are adequately served by financial institutions, others have little or no access to these institutions. In the development literature, this uneven pattern of geographic location of rural bank branches has been attributed largely to regional differences in agroclimatic conditions and infrastructural endowments.[1] The basic premise is that banks locate their branches where the agroclimate and infrastructure are favourable to their operations. Financial institutions find it more profitable to locate in environments where a good agroclimate leads to a

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Authors' Note: This paper is part of a larger study being undertaken at PIDE. The results reported in this paper are only exploratory at this stage. We are extremely grateful to Mr Akhtiar Hussain Shah, Staff Economist, PIDE, for his hard work on data compilation, tabulation, and manipulation. We are also very thankful to Mr Masood Ashfaq Ahmed for his help with computer work. The excellent typing of Mr Dildar Ali is also appreciated. However, only the authors are responsible for any errors and omissions.

[1]There are several studies which have emphasised that agroclimatic conditions and infrastructural endowments play a prominent role in the geographic location of rural bank branches in developing economies. See, for example, Binswanger (1980), Bapna, Binswanger and Quizon (1984), Binswanger and Rosenzweig (1986), Binswanger and McIntyre (1987), Binswanger, Yang, Bowers and Mundlak (1987), and Binswanger and Khandkar (1993). Another strand of literature, the classical location theory, also underlines the importance of infrastructure in the geographic location of businesses. See, for instance, Friedman and Alonso (1964), Isard (1956) and Losch (1954).

substantial demand for agricultural investment and high repayment capacity. In view of the fact that better agroclimate directly enhances both agricultural productivity and the demand for private agricultural investment, agroclimatic opportunities of a region play a pivotal role in the location decision of banks. Similarly, better infrastructure can facilitate the emergence and growth of financial institutions in a particular area by increasing the profitability of banks through reduction in the cost of financial intermediation. Moreover, government expenditure on physical infrastructure influences the private production and investment decisions in agriculture, leads to better agricultural productivity, and increases the rate of return to private agricultural investment. These factors are essential ingredients for the viability of financial institutions in the rural areas.

The present paper aims to explore the impact of infrastructure and agroclimate on the geographic location of rural bank branches in Pakistan. The paper is organised as follows. Section 2 presents the model which is used to assess quantitatively the influence of infrastructural endowments and agroclimatic environment on the location of financial institutions across the rural landscape. Section 3 describes data and the variables. Section 4 reports preliminary estimation results while Section 5 offers some concluding remarks.

2. MODEL SPECIFICATION

Banks are assumed to locate in a district with good agroclimate and infrastructure i.e.

$$CB_j = CB_j(R_{rj}, AC_{pj}, E_j)$$

where

CB_j = Number of banks operating in district j;
R_{rj} = Level of the rth infrastructure variable (say road length) in district j;
AC_{pj} = Level of Pth agroclimate variable in district j; and
E_j = Error term.

3. DATA AND VARIABLES

We have chosen three alternative variables to represent infrastructural endowments of a region. These are Irrigated Area, Road Length, and number of Primary Schools. Annual Rainfall is the only variable available to capture agroclimatic environment.[2] Dependent variable is the number of rural branches of Agricultural

[2]Our choice of variables representing infrastructural endowments and agroclimatic environment has obviously been dictated by data availability. Several other variables can be considered as explanatory variables in these two categories. For example, rural electrification and communications etc. can be used to represent infrastructural endowments. Similarly, soil moisture and temperature can be used to capture agroclimatic environment. However, consistent data on these variables are not yet available

Development Bank of Pakistan (ADBP) and National Bank of Pakistan (NBP) established at the district level.

District level data on Irrigated Area, Road Length, number of Primary Schools, and Rainfall are collected from various issues of Provincial Development Statistics published by Governments of Punjab, Sindh, NWFP and Balochistan. District level data on the number of rural bank branches are obtained from unpublished reports of the State Bank of Pakistan and the Agricultural Development Bank of Pakistan.

4. PRELIMINARY ESTIMATIONS

In this section, we report preliminary regression results. Besides estimating equations on all Pakistan basis, we also provide separate estimations for the provinces of Punjab and Sindh for comparative purposes. In Table 1, six equations are estimated by ordinary least squares (OLS) using cross section data for 97 districts of Pakistan for the year 1992-93. In Tables 2–5, we replicate this exercise for the provinces of Punjab, Sindh, NWFP and Balochistan using respectively cross section data for 34 districts of Punjab, 17 districts of Sindh, 20 districts of NWFP, and 26 districts of Balochistan.

Table 1

Effects of Infrastructure and Agroclimate on Location of Rural Bank Branches in 97 Districts of Pakistan

	Dependent Variable	Explanatory Variables	R^{-2}	D.W.	F
(1)	CB =	5.139 + 0.003 IA + 0.009 RF (6.56)*** (4.00)*** (3.97)***	0.23	1.49	15.64
(2)	CB =	1.839 + 0.007 RL + 0.006 RF (1.82)* (6.82)*** (2.66)**	0.37	1.42	29.28
(3)	CB =	2.990 + 0.007 PS + 0.006 RF (3.63)*** (11.69)*** (1.55)*	0.63	1.71	84.36
(4)	CB =	1.858 + 0.0005 IA + 0.002 RL + 0.007 PS (2.46)** (1.02) (1.36)* (8.91)***	0.64	1.83	57.29
(5)	CB =	1.950 + 0.001 IA + 0.006 RL + 0.006 RF (1.95)* (1.72)* (4.88)*** (2.90)**	0.38	1.59	20.91
(6)	CB =	1.622 + 0.001 IA + 0.001 RL + 0.006 PS + 0.003 RF (2.13)* (1.29)* (1.20)* (8.32)*** (1.67)*	0.64	1.90	44.50

Note: IA = Irrigated Area.
RL = Road Length.
PS = Primary Schools.
RF = Rainfall.
CB = Number of National Bank and Agricultural Development Bank Branches.
* = Indicates coefficient is significant at 10 percent level.
** = Indicates coefficient is significant at 5 percent level.
*** = Indicates coefficient is significant at 1 percent level.

Let us first focus on Table 1. Equation (1) explains the number of rural bank branches as a function of total irrigated area (IA), and annual rainfall (RF). Both rainfall and irrigated area have a positive and significant impact on the dependent variable. In Equation (2), number of bank branches is regressed on road length (RL) and rainfall. In this equation, both the explanatory variables have a positive and significant effect on the dependent variable. This equation explains 37 percent of the variation in the dependent variable. Equation (3) uses number of primary schools in the district (PS) as a proxy for infrastructure. In this equation, both rainfall and number of primary schools positively influence the dependent variable with significant co-efficients. This equation explains 63 percent of the variation in the dependent variable. Equation (4) is restricted to the estimation of the impact of infrastructure variables only on the dependent variable. The three explanatory variables in this equation—road length, irrigated area, and the number of primary schools—positively influence the dependent variable. However, irrigated area turns out to be insignificant. This equation explains 64 percent of the variation in the dependent variable. In Equation (5), besides using rainfall as an agroclimatic variable, we use irrigated area and road length as variables representing infrastructure. Here all the variables have a positive and significant impact on the dependent variable. In addition to using rainfall as an explanatory variable, Equation (6) combines all the three infrastructure variables to assess their relative impact on the dependent variable. All the explanatory variables positively influence the dependent variable. The co-efficient of number of primary schools is significant at 1 percent level while the other co-efficients are significant at 10 percent level. This equation explains 64 percent of the variation in the dependent variable.

Let us now consider the estimation results for the province of Punjab (see Table 2). In addition to rainfall, Equations (1)–(3) respectively use irrigated area, road length, and number of primary schools as regressors. In each of these equations, the explanatory variables positively and significantly influence the dependent variable. These equations respectively explain 36 percent, 58 percent, and 62 percent of the variation in the dependent variable. In Equation (4), both road length and number of primary schools positively affect the dependent variable while irrigated area inversely affects the dependent variable. This equation explains 61 percent of the variation in the dependent variable. In Equation (5), the explanatory variables are irrigated area, road length, and rainfall. All the three explanatory variables have positive co-efficients. However, irrigated area turns out to be insignificant in this equation. Equation (6) differs from Equation (5) in that we add number of primary schools as an explanatory variable. In this equation, road length, number of primary schools, and rainfall positively and significantly affect the dependent variable. The co-efficient of irrigated area is negative but insignificant. This equation explains 62 percent of the variation in the dependent variable.

Table 2

Effects of Infrastructure and Agroclimate on Location of Rural Bank Branches in 34 Districts of Punjab

	Dependent Variable	Explanatory Variables	R^{-2}	D.W.	F
(1)	CB =	4.499 + 0.013 IA + 0.010 RF (2.36)** (3.17)*** (2.63)**	0.36	1.71	10.30
(2)	CB =	–2.166 + 0.12 RL + 0.007 RF (–0.98) (5.69)*** (2.38)**	0.58	1.67	24.28
(3)	CB =	0.004 + 0.008 PS + 0.004 RF (0.002) (6.20)*** (1.27)*	0.62	2.07	28.10
(4)	CB =	–1.181 – 0.003 IA + 0.004 RL + 0.007 PS (–0.55) (–0.64) (1.13)* (2.91)**	0.61	2.07	18.14
(5)	CB =	–2.093 + 0.003 IA + 0.011 RL + 0.007 RF (–0.94) (0.61) (4.10)*** (2.35)**	0.58	1.71	15.98
(6)	CB =	–1.619 – 0.002 IA + 0.005 RL + 0.006 PS + 0.005 RF (–0.76) (–0.40) (1.37)* (2.14)* (1.41)*	0.62	1.98	14.56

Note: IA = Irrigated Area.
RL = Road Length.
PS = Primary Schools.
RF = Rainfall.
CB = Number of National Bank and Agricultural Development Bank Branches.
* = Indicates coefficient is significant at 10 percent level.
** = Indicates coefficient is significant at 5 percent level.
*** = Indicates coefficient is significant at 1 percent level.

Table 3 reports estimation results for the province of Sindh. As in the preceding cases, Equations (1)–(3) respectively combine irrigated area, road length, and number of primary schools with rainfall. In Equation (1), rainfall has a positive and significant effect while irrigated area has a negative but insignificant effect on the dependent variable. In Equation (2), both the explanatory variables have positive signs. However, none of these variables is significant. In Equation (3), both rainfall and number of primary schools positively affect the dependent variable. This equation explains 37 percent of the variation in the dependent variable. Equation (4) uses irrigated area, road length and, and number of primary school as regressors. In this equation, both road length and number of primary schools have a positive and significant impact on the dependent variable. However, irrigated area inversely affects the number of bank branches. This equation explains 49 percent of the variation in the dependent variable. In Equation (5), besides using rainfall as an agroclimatic variable, we use irrigated area and road length as variables representing infrastructure. Road length has a positive and significant effect on the dependent variable. However, both rainfall and irrigated area

Table 3

Effects of Infrastructure and Agroclimate on Location of Rural Bank Branches in 17 Districts of Sindh

	Dependent Variable	Explanatory Variables	R^{-2}	D.W.	F
(1)	CB =	3.763 – 0.0002 IA + 0.016 RF	0.17	1.73	2.61
		(4.29)*** (–0.30) (1.68)*			
(2)	CB =	3.295 + 0.002 RL + 0.002 RF	0.22	1.63	3.32
		(3.73)*** (1.06) (0.125)			
(3)	CB =	5.967 + 0.005 PS + 0.010 RF	0.37	1.97	5.71
		(2.74)** (2.98)** (0.67)			
(4)	CB =	5.921 – 0.003 IA + 0.010 RL + 0.005 PS	0.49	1.79	6.03
		(2.97)** (–2.02)* (2.13)* (2.96)**			
(5)	CB =	3.268 – 0.001 IA + 0.006 RL – 0.002 RF	0.33	1.51	3.65
		(3.98)*** (–1.81)* (2.11)* (–0.19)			
(6)	CB =	5.976 – 0.004 IA + 0.011 RL + 0.005 PS – 0.011 RF	0.45	1.75	4.25
		(2.88)** (–1.98)* (1.59)* (2.62)** (–0.36)			

Note: IA = Irrigated Area.
RL = Road Length.
PS = Primary Schools.
RF = Rainfall.
BC = Number of National Bank and Agricultural Development Bank Branches.
* = Indicates coefficient is significant at 10 percent level.
** = Indicates coefficient is significant at 5 percent level.
*** = Indicates coefficient is significant at 1 percent level.

negatively influence the dependent variable. This equation explains 33 percent of the variation in the dependent variable. In Equation (6), co-efficients of road length and number of primary schools have positive signs while rainfall and irrigated area have negative co-efficients. With the exception of rainfall, all the explanatory variables are significant. This equation explains 45 percent of the variation in the dependent variable.

Tables 4 and 5 respectively report the estimation results for the provinces of NWFP and Balochistan. From Table 4, it is clear that road length and number of primary schools positively and significantly influence the dependent variable in all the six equations. However, irrigated area inversely affects the dependent variable in these equations. While rainfall positively affects the dependent variable in all the equations, its co-efficient is significant in only 1 equation. In the case of Balochistan (see Table 5), both irrigated area and number of primary schools have positive and significant co-efficients in all the equations. Similarly, both road length and rainfall

Table 4

Effects of Infrastructure and Agroclimate on Location of Rural Bank Branches in 20 Districts of NWFP

	Dependent Variable	Explanatory Variables	R^{-2}	D.W.	F
(1)	CB =	6.158 – 0.018 IA + 0.004 (2.33)** (–0.34) (1.33)*	0.25	1.78	0.99
(2)	CB =	I.618 + 0.011 RL + 0.002 RF (0.87) (2.81)** (0.57)	0.31	1.8	5.32
(3)	CB =	0.033 + 0.010 PS + 0.002 RF (0.14) (2.53)** (0.86)*	0.27	1.80	4.47
(4)	CB =	1.061 – 0.070 IA + 0.007 RL + 0.009 PS (0.45) (–1.66)* (2.13)* (2.17)*	0.27	1.80	4.47
(5)	CB =	2.968 – 0.038 IA + 0.011 RL + 0.001 RF (1.20)* (–0.84) (2.89)** (0.44)	0.30	2.00	3.73
(6)	CB =	1.023 + 0.069 IA + 0.007 RL + 0.009 PS + 0.0003 RF (2.13)* (1.29) (1.20)* (8.32)*** (1.67)*	0.42	2.08	4.42

Note: IA = Irrigated Area.
RL = Road Length.
PS = Primary Schools.
RF = Rainfall.
CB = Number of National Bank and Agricultural Development Bank Branches.
* = Indicates coefficient is significant at 10 percent level.
** = Indicates coefficient is significant at 5 percent level.
*** = Indicates coefficient is significant at 1 percent level.

positively influence the dependent variable. However, while the co-efficients of rainfall are significant in 3 equations, the co-efficients of road length are insignificant in all the equations.

Before we conclude this section, it is instructive to compare the results for the provinces of Punjab, Sindh, NWFP, and Balochistan. Our results point out that both road length and number of primary schools have a significant impact on the number of bank branches in the provinces of Punjab, Sindh, and NWFP. However, in the case of Balochistan, road length does not seem to have a significant impact on the dependent variable. On the other hand, while rainfall appears to be an important determinant of the number of rural bank branches in the case of Punjab and Balochistan, its effect on the dependent variable is not conclusive in the case of Sindh and NWFP.

Table 5

Effects of Infrastructure and Agroclimate on Location of Rural Bank Branches in 26 Districts of Balochistan

	Dependent Variable	Explanatory Variables	R^{-2}	D.W.	F
(1)	CB =	1.853 + 0.017 IA + 0.008 RF	0.33	1.93	3.14
		(4.80)*** (1.93)* (3.14)***			
(2)	CB =	I.985 + 0.0003 RL + 0.008 RF	0.23	2.69	4.71
		(4.00)*** (0.46) (2.81)**			
(3)	CB =	1.887 + 0.009 PS + 0.002 RF	0.32	2.44	6.92
		(4.80)*** (1.84)* (0.59)			
(4)	CB =	1.701 + 0.015 IA + 0.0001 RL + 0.010 PS	0.37	2.39	5.80
		(3.72)*** (1.72) (0.17)* (3.31)**			
(5)	CB =	1.719 + 0.017 IA + 0.0003 RL + 0.008 RF	0.31	2.85	4.69
		(3.58)*** (1.90)* (0.48) (2.86)**			
(6)	CB =	1.653 + 0.016 IA + 0.0001 RL + 0.008 PS + 0.003 RF	0.35	2.59	4.38
		(3.54)*** (1.74)* (0.17) (1.58)* (0.71)			

Note: IA = Irrigated Area.
RL = Road Length.
PS = Primary Schools.
RF = Rainfall.
CB = Number of National Bank and Agricultural Development Bank Branches.
* = Indicates coefficient is significant at 10 percent level.
** = Indicates coefficient is significant at 5 percent level.
*** = Indicates coefficient is significant at 1 percent level.

5. CONCLUDING REMARKS

This study has attempted to quantify the role of infrastructural endowments and agroclimatic environment in the geographic location of rural bank branches in Pakistan. We have estimated several alternative specifications which can be helpful in understanding the spatial distribution of commercial bank branches across the rural landscape. Our results indicate that the location of rural bank branches is significantly influenced by infrastructural endowments. In other words, regions endowed with better infrastructure appear to have a greater access to financial institutions. Our results also highlight the importance of agroclimatic environment in the geographic location of rural bank branches. These results point out that policies designed to promote access to financial institutions in the rural areas need to be adopted in tandem with greater efforts to provide better infrastructure in regions with a favourable agroclimatic environment.

This study is planned to be extended in at least two directions. First, variables representing infrastructure will be made endogenous in the model as governments also allocate their infrastructure investments in response to the agroclimatic potential of the districts. Second, the joint impact of infrastructure and agroclimate on private

agricultural investment and output will be examined. In summary, the broader study will quantify the inter-relationships among the investment decisions of government, financial institutions and farmers, and their combined effects on agricultural investment and output.

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Comments

I compliment the authors for having attempted a paper on a subject which is so important for policy formulation in the country. The paper focuses on assessing the influence of agro-climate and infrastructure on the location of rural bank branches of the National Bank of Pakistan (NBP) and the Agricultural Development Bank of Pakistan (ADBP). Agroclimate and infrastructure have been assumed to be represented by four factors, i.e., rainfall, irrigated area, roads, and primary schools. It has estimated six linear multiple regression equations with different combinations of the variables using them as regressors and bank branches as a regressand. My comments would centre around three points: (1) Identification of factors influencing rural branches of NBP and ADBP; (2) partial coverage of rural credit by NBP and ADBP; and (3) technical aspects of the model. Elaboration of these points, I am sure, would squarely cover all relevant aspects of the paper.

First, different factors, environment and Government/State Bank policies have been operative in the selection of location of rural branches of NBP and ADBP. Therefore these need separate consideration. Unlike ADBP, NBP does not have exclusive rural branches. They cover all sorts of transactions and some of its designated branches cover rural credit as a light part of their overall business. NBP has been designated as Government treasury. Its branches had, therefore, been extended even upto Tehsil/sub-Tehsil level and also in some non-banking areas. Generally, the location has been guided by the feasibility of bank branch. It is to be ultimately approved by State Bank of Pakistan which not often allows concentration of too many bank branches in an area, particularly so in an area of nationalised commercial banks. The economic and financial viability is also kept in view. The factors which influence the branches, feasibility and ultimately its location, generally include urbanisation, industrial growth, commercialisation, growth of shopping areas, marketing facilities, transport and communications access etc.

ADBP is basically a specialised agricultural lending institution, and demand for loans is a major factor influencing its location. Since its lending requires back-up support of revenue authorities in pledging and mortgaging process, its bank branches have been established even upto Tehsil/sub-Tehsil level. The demand for loans is heavily influenced by cropping intensity, agricultural transactions etc.

Common to both the NBP and the ADBP have also been factors like availability of collateral, security considerations, and political influences.

Secondly, the four explanatory factors which the study has selected to explain the pattern of location of rural branches of NBP and ADBP, have never been the real consideration but they have, however, some remote relationship with real factors. The commercial banks other than NBP as well as Federal Bank for Cooperatives and

Provincial Cooperative Banks have also been advancing agriculture credit through Cooperative Societies. Their exclusion from the study has influenced its findings.

Thirdly, in most of the research being conducted by local Pakistani economists including the present paper is heavily relying on the use of OLS based linear multiple regression. There are also other alternate modelling techniques which should also be used for getting better results. In this particular case, there was no need to have 6 equations which if at all were required should have been in the unrecorded background while preparing the paper and in fact the last equation i.e. 6th was adequate to cater to the paper requirements. There was need for calculating adjusted R^2 in place of a routine R^2; that could have improved the fit. The coefficient of the "constant" when viewed in all equations is fairly significant and R^2 is found too low while its highest value found is 0.64 in a few equations. This implies that the real factors have not been included on the regressors' side. It is not out of place to point out that low R^2 is defended in the case of cross sectional data but it would involve considerably high margin of risk in predictability strength of the model. Further instability in the regression coefficients from one equation to the other means that no attention has been paid to any possible influence of multi-colinearity and heteroscedastisity.

The reader of the paper finds it difficult to fully comprehend the nature of the explanatory factors as the data have not been appended to it. There is a strong need to select at least two periods, in case the time series data are not available, to assess the behavioural relationship. Since this paper, as its footnote indicates, will be part of a big study being undertaken at PIDE, these observations need to be kept in view to get plausible and consistent results. The rural bank branches of a commercial bank or a specialised agricultural institution have been established under uniform government policies and State Bank of Pakistan's rules. Given that, some Provinces having similar agro-climate and infrastructure should not have different patterns of location of branches unless some deviation emanates from political factors. The different findings of the Study for different Provinces as well as for the country as a whole, in effect, emerge from the fact that proper specification of the explanatory factors and use of suitable modelling techniques are wanting.

This paper is a good attempt and I hope that next time the authors would come up with its better version when they complete their planned larger study.

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