© *Pakistan Journal of Economic Studies*
https://journals.iub.edu.pk/index.php/pjes
Vol. 4, No. 2, December 2021, Pages: 205-236

ISSN 2708-1486 (E)
ISSN 2708-1478 (P)

Vertical Fiscal Imbalance, Economic Growth and Decentralization

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Abstract

Irrespective of the degree of tax and expenditure decentralization, every federation and unitary state face the problem of Vertical Fiscal Imbalance (VFI). The transfer dependency of subnational governments led them to substitute central transfers over their own revenue effort and this is historically evident in Pakistan. The contribution of provincial own revenues to the provincial expenditures is not much decent, which led to higher magnitude of VFIs. This paper is an empirical investigation of VFI, and its determinants. Based on a strongly balanced panel data at provincial (subnational) level from 1971 to 2021, we studied the effect of economic growth, tax decentralization, expenditure decentralization, and Eighteenth Amendment to the Constitution on VFIs. One of the key distinctions of this paper is modelling economic growth using per capita energy consumption which includes electricity, natural gas and set of petroleum products. Economic growth proxied through per capita energy consumption has negative association with VFI which means a corrective effect on VFI. Similarly, tax decentralization is also negatively associated with VFI, which obviously means corrective effect and less transfer dependency on federal government. To the contrary a positive association between expenditure decentralization and VFI is indicative that increase in government size/budget outlay are broadly financed through federal transfers thereby creating larger vertical fiscal imbalances. This also give policy prescription for future, that tax decentralization has disproportionality higher benefits compared to expenditure decentralization in terms of magnitude of VFIs. Based on different model specifications, we found that Eighteenth Amendment to the Constitution has both corrective and expansionary effect on VFIs.

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Key Words: Vertical Fiscal Imbalance (VFI), Subnational governments, Fiscal decentralization, Tax decentralization, Expenditure decentralization, devolution, Eighteenth Amendment, Fiscal federalism, Balanced panel data
JEL Codes: C33, H11, H60, H62, H70, H71, H72, H74

1 Introduction

Several studies have established the dependence of subnational tiers on transfers from their respective upper level of governments. (Ruggeri, Wart, Robertson, & Howard, 1993) for Canada, (Stein, 1999) for Latin America, (Chelliah, 2005) for India, (Dollery , 2002) for Australia, (Guo, 2008) for China, (Meloni, 2016) for Argentina noted fiscal dependence of subnational governments over their immediate upper tier of government. Similarly, the federal system of Pakistan is characterized by the federal transfers system to provinces which form major source of provincial revenues receipts.

In most federations by virtue of the constitutional arrangements, most revenue sources rest with central/federal government whereas subnational/provincial governments are endowed with major expenditure on provision of public goods (Bird & Tarasov, 2004), so the design of fiscal operations are based on transfers system. Scholars have long been debating on various aspects of decentralization, transfers system and their impact on common well-being and economic growth. Empirical evidence suggest that the transfer dependent subnational governments have less flexibility to increase their own tax base and revenue (Rodden, 2005).

In many developing countries including Pakistan, transfer dependency results in lack of responsiveness on part of subnational governments for increasing their own tax base and collection. The final figures of fiscal year 2018-19 show that percentage of own revenues in provincial resource pool ranges between a lowest 6.1 per cent3 to a highest of 20.5 per cent. The

[3] As per Annual Budget Statements 2020-21 of respective provinces, whereby the final statistics of 2018-19 are provided with a time lag, the percentage of own revenues to

state of provincial revenues in Pakistan has been disappointing compared to what ought to be. In a book on tax reforms in Pakistan (Bahl, Cyan, & Wallace, 2015) the tax authorities confirms that the provincial revenue potential is much higher compared to so far exploited. The empirical literature suggests that higher VFIs are associated with fiscal indiscipline and low tax effort at subnational and local level. Like Pakistan, most of the state governments in India are dependent on transfers and grants. Regarding the states' own revenues (Kurian & Gupta, 2004) categorized Indian states into four groups [A(high), B (medium), C (low) and D (poor)]4 according to own tax revenues as percentage of total revenues and most of the states are classified under the last category of poor performing states5. So, per this classification all provinces in Pakistan lie under D category of poor performing states. Whereas this ratio is much better in advanced countries, as noted by (Blöchliger & Petzold, 2009) that on average the subnational governments in OECD countries finance half or more than half of their expenditures through their own source taxes for which they exercise autonomy of setting up the base and rates of taxes. Similarly, most US states finance their expenditure from their own revenues to an extent of 75 per cent and just 25 per cent is financed from federal transfers (Sorens, 2016).

1.1 Pakistan's context

Both Pakistan and India have inherited legacy of well-designed system of intergovernmental public finances. The colonial administration legislated the Government of India Act, 1935 first comprehensive written statute (Khan H. , 2009). The Act provided detailed schedule6 of the taxes, revenues,

provincial resource pools are as follows; Sindh (20.5 per cent), Punjab (16.6 per cent), Balochistan (6.9 per cent) and Khyber Pakhtunkhwa (6.1 per cent).

[4] Group A-High performer 60 % and above, Group B– Medium performer with 50-59%, Low performer with 40-49%, Group D poor performer with less than 40 percent of own revenues as percentage of total revenues.

[5] Group A (Haryana, Karnataka, Maharashtra, Tamil Nadu, Kerala), Group B (Andhra Pradesh, Gujrat, Punjab), Group C (Rajasthan, Uttar Pradesh, West Bengal, Madhya Pradesh), Group D (Arunachal Pradesh, Assam, Bihar, Chhattisgarh, J&K, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Goa, Himachal Pradesh, and Uttaranchal).

[6] Seventh Schedule, Section 100, 104 of the (Govenment of India, 1935).

expenditures responsibilities of central and state government in India. The first constituent assembly of Pakistan adopted the Government of India Act, 1935 as the Interim Constitution of Pakistan. Later Pakistan had first Federal Constitution in 1956, and then the second Constitution of 1962 which made it a unitary state with Presidential system. Despite having high degree of centralization, the Constitution of Pakistan, 1973 reestablished the federal spirit, and more recently the Eighteenth Amendment to the Constitution of Pakistan, 1973 back in 2010 addressed the long overdue demands of devolution of powers and finances to the provinces.

In most cases globally, the taxation powers, roles are responsibilities are explicit part of constitutional arrangements. Similarly in Pakistan, the Article 70(4) and the Schedule 4 of the Constitution laid down framework of taxation powers and functional responsibilities of federal (central) and the provincial (subnational/state) governments in Pakistan. The system of federal transfers of divisible pool, straight transfers and grants are administered through Article 160, Article 161, and Article 164 of the Constitution of Pakistan, 1973 (Pakistan, Natioanl Assembly of, 1973).

The **Error! Reference source not found.**comprehends the intergovernmental fiscal system of divisible pool taxes, straight transfers, and grants to the provinces. The scope and powers of federal tax collection are explicitly defined in Schedule IV of the Constitution and the residuary taxation powers[7] rest with the provinces. Under the Article 160 of the Constitution of Pakistan, the tax collected by the Federal government, the divisible pool taxes – see Table 1 are first distributed among federal and provincial government vertically i.e., presently this vertical sharing ratio is 42.5:57.5 (federal: cumulative share of provinces) and then the provincial share is horizontally divided among them according to a criterion of multiple indicators as prescribed by the National Finance Commission (NFC) Award

[7] Residuary powers mean, powers which are not classified in federal list will automatically deemed as provincial powers

2010[8]. Historically state of Pakistan and its fiscal system have been centralized, and horizontal distribution was based on population until 2010 the 18th amendment to the Constitution of Pakistan.

Table 1

Federal and Provincial Taxes

Taxes	Federal (Divisible Pool)	Provincial (subnational own taxes)
Direct Taxes	○ Tax on income, other than agricultural income ○ Taxes on corporations ○ Taxes on capital value of the assets, not including taxes on immovable property	○ Agriculture income tax ○ Property tax ○ Capita Gain
Indirect Taxes	○ Duties of customs (including export duties) ○ Duties of excise, including duties on salt, but not including duties on alcoholic liquors, opium, ad other narcotics. ○ Taxes on sales and purchase of goods, imported, exported, produced, manufactured, or consumed [except sales tax on services.] ○ Taxes on mineral oil, natural gas, and minerals for use in generation of nuclear energy. ○ Tax and duties on production capacity of any plant, machinery, undertaking, establishment, or installation. ○ Terminal taxes on goods or passengers carried by railway, sea or air, taxes on their fares and freights	○ Excise Duty on Alcohol/Liquor/Narcotics ○ Stamp Duty ○ Mutation Fee ○ Registration Fee ○ Motor Vehicle Tax ○ Sales tax on services (devolved after 18th Amendment in 2010) ○ Tax on Professions ○ Motor Vehicle Tax

Source: Author's compilation from Schedule 4 of the Constitution of Pakistan, 1973 and Fiscal System of Pakistan.

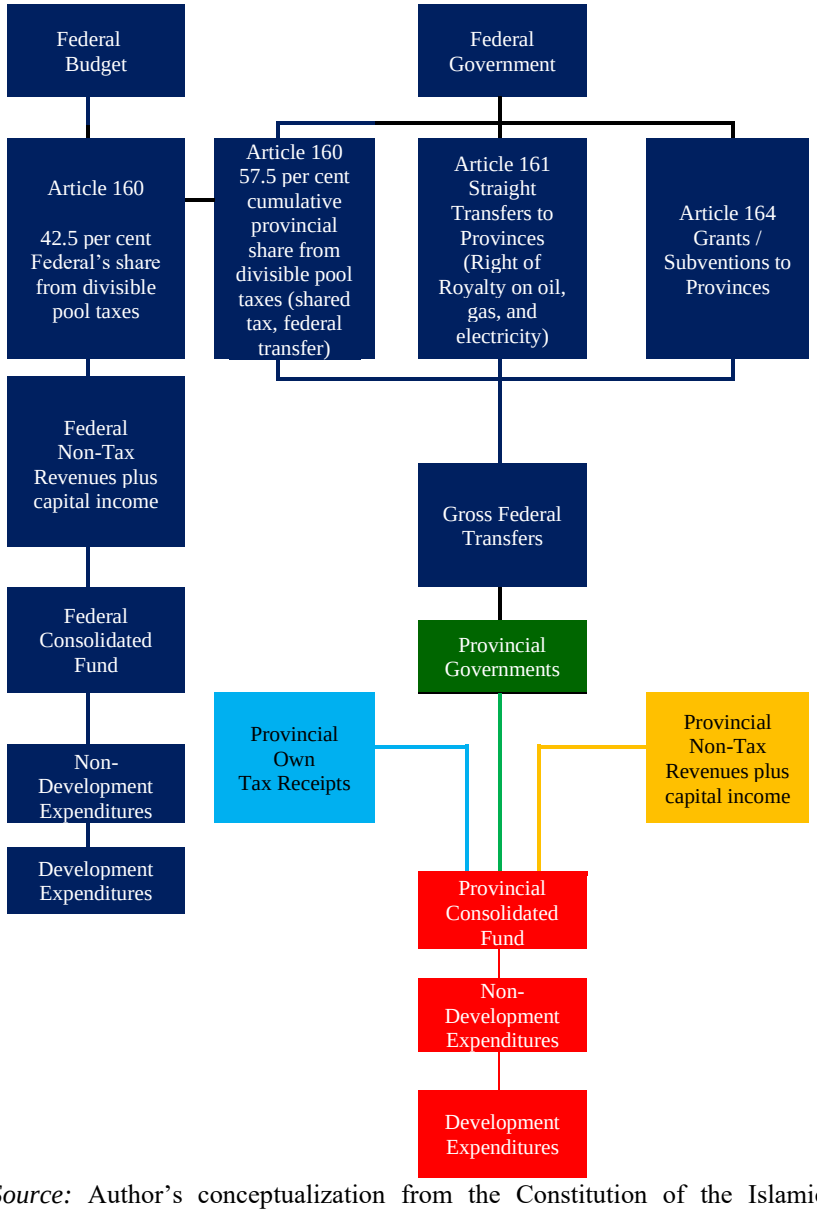
[8] Population (82 per cent), Poverty and Backwardness (10.3 per cent), Revenue Collection and Generation (5 per cent) and Inverse Population Density (2.7 per cent). Till 2010, the horizontal distribution was based on population as the sole criterion of distribution.

The right of royalty of provinces on production of oil, gas and hydroelectric profits is acknowledged in the Article 161 of the Constitution. The royalty on production of oil and gas and hydroelectric profits, gas development surcharge, and excise duty on gas are credited to the provinces under Article 161. Other than divisible taxes under Article 160 and straight transfers under Article 161, the Federal government transfers annual grant-in-aid to the provinces in form of financial support and assistance to provinces through development and non-development grants under Article 164 of the Constitution. These are non-formula-based grants.

The fiscal transfers under three accounting heads divisible taxes, royalties and grants constitute the gross federal transfers to the provinces see figure 1.

Which after addition of provincial own revenues, non-tax revenues, capital income and loans become the Provincial Consolidated Fund. Out of provincial resource pool, first non-development expenditures are met, being non-discretionary in nature and then with the leftover budget development priorities are fulfilled.

Figure 1
The Intergovernmental Fiscal System of Pakistan[9]



Source: Author's conceptualization from the Constitution of the Islamic Republic of Pakistan (Pakistan, Natioanl Assembly of, 1973) and fiscal system of Federal and Provincial governments.

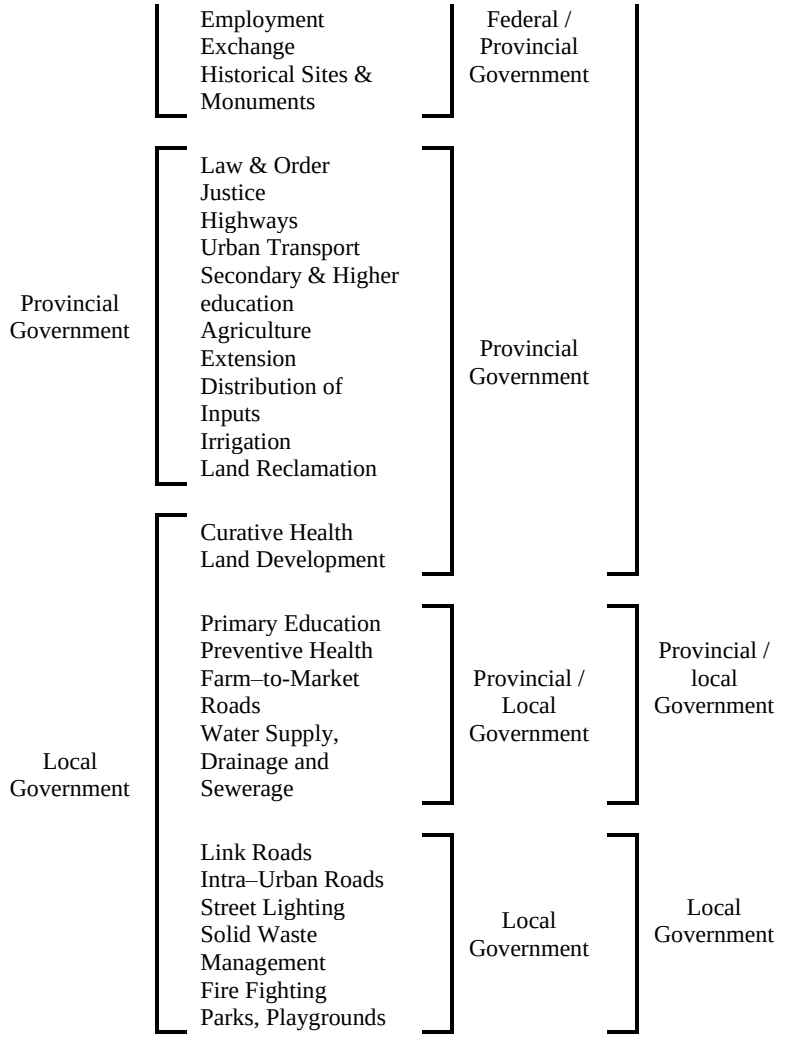
[9] *Note: The distinctive color scheme is indicative of the direction and flow of the resources.*

The details of federal and provincial expenditures responsibilities are provided in figure 2.

Figure 2

Pre & Post 18th Amendment Legislative and Actual Functional Responsibilities

Legislative Functional Allocation Pre 18th Amendment	Functions and Services	Actual Functional Allocation Pre 18th Amendment 1973–2010	Legislative and Actual Functional Allocation Post 18th Amendment
Federal Government	Defence External Affairs Post and telegraph Telephones Radio and TV Currency Foreign Exchange Foreign Aid Institutes for Research Nuclear Energy Ports and Aerodromes Shipping Air Service Stock Exchange National Highway Geological Surveys Censuses Meteorological Surveys Railways Mineral oil and Natural gas Industries	Federal Government	Federal Government
Federal / Provincial Government	Population Planning Electricity (Except Karachi Electric) Curriculum Development Syllabus Planning Centers of Excellence Tourism Social Welfare		Provincial Government
	Vocational/Technical Training		



Source:(Khan, Asim Bashir, 2015), updated according to recent developments.

The objective of this paper is to develop a comprehensive empirical framework to investigate the link between the VFIs, economic growth, tax, and expenditure decentralization. The state of Pakistan has been over-centralized for most of her history, and provinces with insufficient tax devolution and low provincial tax collection have always been in a persistent state of dependency over Federal transfers, and this reliance has not over even after the

Eighteenth Amendment[10], although provincial tax collection and administration has improved.

This paper provides empirical investigation of problem of VFI at subnational level in Pakistan using strongly balanced panel data from 1971 to 2021. It is important to note that almost the entire research on subject of VFI is either on national level, cross country comparison and if at subnational level are based on unbalanced panel because the boundaries of states and subnational governments are not consistent over time. However, in case of Pakistan we do have this advantage of constructing a strongly balanced panel due to consistent boundaries of provinces from 1971 to date.

Pakistan is a federation with three tiers of government federal provincial and local. The federation consists of four provinces[11], the federating units. The scope of this paper is explicitly restricted to the study of finances, VFI and allied empirical problems of federation and provinces. The local governments and their system in Pakistan have undergone too many changes, systems[12], and experiments, making it difficult to compile a consistent time series data of the indicators.

Since this area of research is evolving thus far, therefore the scope of this paper is purely empirical. The federalism literature on VFI provide empirical studies like, effect of VFI on decentralization design, tax policies etc. on country level. This is the first study that uses a balanced panel data of subnational governments (provinces) from 1971-2021 to provide empirical evidence on relationship between VFI and economic growth, decentralization, and Eighteenth Amendment.

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[10] The National Assembly of Pakistan passed Eighteenth Amendment to the Constitution on 8th April 2010.

[11] Punjab, Sindh, Khyber Pakhtunkhwa and Baluchistan. The other territories Azad Jammu and Kashmir and Gilgit Baltistan are directly controlled by federal government and are not part of tax sharing arrangement under the scope of National Finance Commission and Article 160 of the Constitution of Pakistan, 1973.

[12] [Basic Democracy Order, 1959], [Local Government Ordinance, 1979], [Local Government Ordinance, 2001] and [Local Government Act, 2013]

2 Literature Review

The inbuilt VFIs in federations are settled through fiscal transfers. The transfers act as a policy instrument for safeguarding the subnational governments against idiosyncratic shocks to their fiscal capacity (Lockwood, 1999). This means the subnational tiers broadly have two sources of revenues, own-source revenues[13] (OSR) and fiscal transfers from central government sometimes referred to as shared taxes. This at time leads subnational government to be overly dependent on fiscal transfers as noted by (Hines & Thaler, 1995) because an addition in grants leads to larger government spending, and the government often use the Flypaper effect argument, that an increase in income from federal transfers, is going to disproportionately increase subnational capacity to provide public goods, compared to an increase in per capita income spent on private goods (Knight, 2002).

2.1 Theoretical Considerations

The outpouring literature of fiscal federalism on the VFI has different contexts ranging from thorough discussions on definitions and computational aspects, to empirical investigations. In the literature of fiscal federalism, there is no universally accepted definition of VFI, nor an approach for measurement of VFI. Regarding definition and accurate measurement of VFI, there exist no consensus (Sharma, 2012). Literature about VFI has historically been evolved over past fifty years. But most of the studies have defined the concept of VFI in terms of transfer dependency i.e., revenue dependence of state/provinces on central/federal government.

The pioneering study on the subject is of (Hunter, 1974) summarizes a positive perspective on VFI with accounting relationships. This laid down the foundation and a reference point for future studies. A critique and rejoinder on the study of (Hunter, 1974) was published by (G. Thimmaiah, 1976) primarily making

[13] Own-source revenue at subnational level means, the revenue for which the subnational governments have full autonomy of defining tax base, setting of tax rates, administering the collection mechanism.

normative arguments about the definitions of the different variables and defined VFI in terms of transfers dependency. There are two important hypothetical situations, first $\mathrm{VFI} = 0$ suggests that the state/province can meet its entire expenditure from its own revenues and second $\mathrm{VFI} = 1$ which explains that state/province is fully dependent on transfers/loans and its own revenues are zero. Practically the VFI can never be either zero or one, so, the value of VFI is positive and should necessary lie in between $0 < VFI < 1$.

(Hettich & Winer, 1986) provides detailed commentary on the paper of (Hunter, 1974) and (G. Thimmaiah, 1976) a rejoinder and largely complimentary, but they maintained that a meaningful analysis of VFI should have both short-run and long-run dynamics with simultaneously study of positive and normative approach. With context specification, different authors have used and suggested different measures and computational aspects of VFI (Karpowicz, 2012), (Eyraud & Lusinyan, 2013) and (Aldasoro & Seiferling, 2014) have used one of the most commonly used measure of vertical imbalance $VFI = 1 - \left[\frac{r^{own}}{s^{own}}\right]$ contextualizing the subnational own revenues and expenditures.

With some further modification (Collins, 2002) proposed slightly different specification for analysis of VFI in case of Australia. (Ebel & Yilmaz, 2002) used the accounting specification $VFI = \frac{R^*}{E^*}$ for a comparative analysis of VFI between various unitary[14] and federal countries15. Where $R^*$is level of government's own-source revenue, not including transfers from other levels of government and E^* is level of government's own-purpose expenditures, not including transfers to other levels of government.

[14] Albania, Azerbaijan, Belarus, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Iceland, Kazakhstan, Latvia, Lithuania, Mauritius, Moldova, Mongolia, Norway, Poland, Slovak Republic, Slovenia, and United Kingdom.

[15] Australia, Austria, Bolivia, Mexico, Switzerland, and United States.

The similar accounting framework of transfer dependency with contextualization of control of subnational government over resources is used by (Ahmad & Craig, 1997) and (Osterkamp & Eller, 2003). The debate on accounting evidence and measurement of VFI has been well comprehended in a survey article by (Sharma, 2012).

The theoretical models and developments in the literature of federalism provides explanations for heterogeneous preferences across different levels of governments (Oates, 1972). The same phenomenon is theorized based on theory of competing jurisdictions over use of public finances (Breton, 1987) and (Salmon, 1987). Against the theory of Leviathan hypothesis of increasing government size (Brennan and Buchanan, 1980) has empirically teste the same.

The literature about vertical fiscal imbalance is very confined and broadly restrictive on certain specific dimensions. (Scialà and Liberati, 2013) developed a very theoretical model of vertical structure of public sector in context of economic openness, based on utility functions of central and local governments and then optimized their respective utility or welfare functions as per their preferences.

2.2 Empirical Evidence

Not only the theoretical development on this subject is very much confined to certain specific dimensions, but the empirical literature too is evolving as of now. Much of the empirical literature in this context is about decentralization and its link with size of government (Marlow, 1988), (Wu & Lin, 2012) and (Cantarero & Perez, 2012). However, about linkage of VFI and economic growth, an empirical study by (Cevik, 2014) on an unbalanced data of 858 municipalities of Moldova, concluded the negative relationship between economic growth and VFI and the same effect for tax decentralization. Similarly, based on country level unbalanced data there are two very important studies, (Aldasoro & Seiferling, 2014) studied empirical relationship between VFI and public debt and concluded that VFIs and accumulation of debt are positively associated. On the other hand,

(Eyraud & Lusinyan, 2013) finds out the effect of VFI on fiscal performance of governments and concluded that larger VFIs has a negative effect on fiscal performance of a government.

3 Data and Methodology

3.1 Data Overview

The foundation of this paper is based on a very exclusive strongly balanced panel data of public finance data of provinces/subnational governments in Pakistan, and that too for a period from 1971 to 2021. As elucidated above the objective of this paper to examine the effect of economic growth and decentralization on vertical fiscal imbalances at disaggregated and subnational level which is one of the novel merits of this paper.

The data of provincial Gross Domestic Product (GDP) from 1970-71 to 2020-21 is the biggest challenges for this research. Pakistan Bureau of Statistics (PBS) is endowed with responsibility of collecting and publishing the data of national income accounts in Pakistan, but it doesn't publicize the data of provincial (subnational) and quarterly national income accounts. To overcome this limitation, some scholars have empirically attempted to estimate the series of provincial GDPs.

First of all, (Bengaliwala, 1995) produced the provincial estimates of GDP from 1971-72 to 1989-90 on base year prices of 1980-81, later (Bengali & Sadaqat, 2005) extended this research with the same methodology up to 1999-2000 and with the same base year 1980-81. Second empirical study is of (Arby, 2008) about estimation the series of provincial GDP from 1971-72 to 2004-05. Third study on this subject is of (Pasha, 2015), estimating the series of provincial GDP from 1999-00 to 2014-15 with 2005-06 as the base year. More recently (Group, The World Bank , 2017) published the estimates of provincial GDP in its report 'Sindh: Public Expenditure Review' from 2005-06 to 2014-15 at base year 1999-2000 prices.

Albeit these studies do provide us with estimates of provincial GDP, but with different base years and for different time periods, which do not correspond to the time frame of this

paper 1971-2021. A further in-depth analysis of above mentioned studies reveals that, the methodologies and results of these studies differ significantly, for example as per estimated series of provincial GDPs in (Bengaliwala, 1995), (Bengali & Sadaqat, 2005) Punjab is the richest province with highest per capita GDP, whereas (Arby, 2008) and (Pasha, 2015) estimates conclude Sindh with highest per capita GDP.

The absence of actual data for regional GDPs, and approximated estimates with different methodology warrant us to avoid extending the existing approximated series. This resultantly implies to use a proxy that should not only corresponds with but better represent the economic activity and wellbeing of individual. Above all, the proxy under consideration should also overcome the limitations of base year and issue of changes in prices over time.

The empirical behaviour of per capita energy consumption and per capita income are alike. Several researches and studies have empirically established the direct association between per capita energy consumption and per capita income; (Chima & Freed, 2005) for US, (Dhungel, 2008) for Nepal concluded that increase in per capita energy consumption lead to economic growth. For a panel of 10 Latin American countries16 (Campo & Sarmiento, 2013) established two-way causality between energy consumption and GDP. Similarly, for a group of 75 net energy-importing countries (Esen & Bayrak, 2017) established that there exist positive and statistically significant long run relationship between energy consumption and GDP growth.

Therefore, first we considered series of per capita electricity consumption in KWh, which is also considered by (Cevik, 2014) for his study on municipalities in Moldova. But in case of Pakistan, we know there are glaring differences in per capita electricity consumption across provinces and most importantly there are many places deprived of power in every province. This necessitated us to incorporate some exhaustive

[16] Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela.

measure of energy consumption which is more representative. Consequently, we considered total per capita energy consumption (from all sources), as proxy for per capita income and economic growth. The total energy consumption includes three broad categories electricity, gas, and petroleum products, further divided into many sub-categories. The province wise consumption of electricity, gas [Natural Gas, Liquefied Petroleum Gas (LPG), and Compressed Natural Gas (CNG)] and petroleum products [Aviation Fuels, Motor Spirit (MS), High Octane Blending Component (HOBC), High Speed Diesel (HSD), Furnace Oil (FO), and Kerosene], under each sub-category summed up on a standard conversion metric based on energy value or energy intensity, and then the per capita energy consumption is calculated using this comparable value of cumulative energy consumption for each province over time. Using the per capita energy consumption, will overcome the problem of estimating regional GDP, rebasing to latest year, and splicing. Considering per capita total energy consumption is my novel contribution to the body of knowledge.

This paper is based on secondary data from various sources, publications and institutions which Annual Budget Statements, Public Sector Development Programmes, Annual Development Programme, Annual Budgets Volumes of Federal and Provincial Governments, National Finance Commission Reports, Parliamentary Debates, Pakistan Economic Survey, Pakistan Statistical Yearbook, Data and Record of Ministry of Petroleum and Natural Resources, Pakistan Energy Data Book, Pakistan Energy Yearbook, CBR/FBR Yearbook, Fiscal Policy Statement, Debt Policy Statement, various issues and Pakistan Bureau of Statistics (PBS), Population and Housing Census Pakistan 1961, 1972, 1981, 1998 and 2017.

Table 2
Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
VFI1 (Index variable %)	204	84.2	9.6	57.5	97.9
VFI2 (Index variable %)	204	57.9	17.4	4.9	97.3
Electricity consumption per capita (KWh)	204	273.1	138.4	14.0	625.1
Energy consumption per capita (KOE)	204	217.6	127.9	25.1	442.7
Energy consumption growth (%)	204	6.5	16.1	-43.0	134.7
Total revenue/total expenditure (%)	204	7.0	5.7	0.1	32.2
Own source revenue/total revenue (%)	204	17.7	10.8	1.4	70.1
Per capita own source revenue/total revenue (%)	204	607.5	953.6	2.4	5949.1
Subnational expenditures/consolidated expenditures (%)	204	11.4	8.1	1.1	40.5
Revenue expenditure /total expenditure (%)	204	59.2	15.2	4.4	98.0
Per capita expenditures	204	5136.6	6933.2	30.5	33018.3
Eighteenth Amendment Dummy variable	204	0.22	0.4	0	1

Source: Author's calculations based on data from the Ministry of Finance, Pakistan Bureau of Statistics, Ministry of Petroleum and Natural Resource, Provincial Finance Departments, Pakistan.

There are significant trends of variations across subnational governments. Electricity consumption per capita which is proxy of income per capita ranges between a minimum of 14.0 KWh and maximum of 625.1 KWh, similarly energy consumption per capita varies from 25.1 KOE to a maximum of 442.7 KOE.

Subnational revenue effort is measured by own source revenues as percentage of total revenues ranges between 1.4% to 70.1%. Another approach of measuring revenue effort is calculating own source revenues as percentage of total expenditures and this ranges from 0.1% to 32.1%.

3.2 Methodology

Since the dependent and independent are stationary at level, and $T > N$, we used the (Pesaran, 2015) test for cross-sectional dependence for large panels, and the same stands valid in case where $T > N$[17]. We reject the null hypothesis of weak cross-sectional dependence except in case of Model 2&3. We tested multicollinearity among the independent variables and found evidence to the contrary – for details see Variance Inflation Factor (VIFs) provided in Annexure-1. So, we used linear panel regression models with fixed and random effect, whichever is applicable, the results of Hausman specification test are provided along with.

$$VFI_{i,t} = \alpha Elec_{i,t} + \beta Rev_{i,t} + \gamma Exp_{i,t} + \delta Dum + \eta_i + v_t + \varepsilon_{i,t} \quad (1)$$

$$VFI_{i,t} = \alpha Ener_{i,t} + \beta Rev_{i,t} + \gamma Exp_{i,t} + \delta Dum + \eta_i + v_t + \varepsilon_{i,t} \quad (2)$$

Since there is no consensus over universally accepted definition of VFI, so to make our analysis more exhaustive, we considered two different definitions of VFI as dependent variable. We considered $VFI_{i,t}$ vertical fiscal imbalance used by (Karpowicz, 2012), (Eyraud & Lusinyan, 2013) and (Aldasoro & Seiferling, 2014). -- see Table 3: Model 1, 1a, 2 & 3.

$$VFI_{1\ i,t} = 1 - \left[\frac{r^{own}}{s^{own}}\right]$$

The second definition of VFI used by Osterkamp and Eller, 2003 – see Table 4: Model 4, & 4a.

$$VFI_{2\ i,t} = \frac{gross\ transfers}{total\ expenditures}$$

Whereas independent variables include per capita electricity consumption as proxy for per capita income. Electricity consumption per capita is not only a famous proxy for economic activity but for revenue generation capacity too. Seventh National

[17] Badi H. Baltagi in correspondence with the author.

Finance Commission, 2010 in Pakistan also considered the same for revenue generation in multi factor distribution formula18.

To account for revenue effort and revenue decentralization at subnational level, we consider provincial (subnational) revenues as percentage of total revenues [Model 1, 1a] – see Table 3 and per capita own source revenues [Model 2, 3, 4 & 4a] – see Table 4. Expenditure decentralization is modelled using subnational expenditures as percentage of consolidated subnational & federal government expenditures (OECD, 2011) Model 1, 1a], and per capita expenditures [Model 2, 3, 4 & 4a] – see Table 4. Whereas η_i and v_t are unobserved province specific, time effects respectively and $\varepsilon_{i,t}$ is idiosyncratic error term which signifies the assumption of zero mean and constant variance.

Table 3

Data for models-different specifications/proxies for different independent variables with same dependent variables

Variable	Details of variable	Model 1 & 1a	Model 2
Dependent variable	Mean response/dependent variable	VFI= [1-(subnational own revenues/subnational expenditures)]	VFI= [1-(subnational own revenues/subnational expenditures)]
Independent variables	Electricity consumption per capita	Electricity consumption in KWh	Per capita total energy consumption (electricity, gas, petroleum products etc. horizontally summed up in TOEs)
Independent variables	Revenue effort	Subnational revenues as percentage of total revenues (%)	Per capita own source revenue (tax plus non-tax) in PKR
Independent variables	Expenditure Decentralization	Subnational expenditures as percentage of consolidated subnational & central government expenditures	Per capita expenditure in PKR
Dummy variable	18th amendment to the Constitution of	D=0, from 1971 to 2010	D=0, from 1971 to 2010

[18] The distribution of National Finance Commission in Pakistan has historically been based on single population-based criterion, which is one of the biggest structural rigidities. After Seventh NFC Award in 2010, Pakistan moved to multi factor distribution.

	Pakistan (the devolution amendment effective from July 1, 2011)	D=1, from 2011 to 2021	D=1, from 2011 to 2021

Source: Author's tabulation

Table 4
Data for models-different specifications/proxies for dependent variables with same set of independent variables

Variable	Model 3	Model 4 & 4a
Mean response/dependent variable	VFI_1= [1- (subnational own revenues/subnational expenditures)]	VFI_2= gross transfers/total expenditures
Energy consumption growth	Per capita total energy consumption (electricity, gas, petroleum products etc. horizontally summed up in KOEs)	Per capita total energy consumption (electricity, gas, petroleum products etc. horizontally summed up in KOEs)
Revenue effort	Per capita own source revenue (PKR)	Per capita own source revenue (PKR)
Expenditure Decentralization	Per capita expenditure (PKR)	Per capita expenditure (PKR)
Dummy variable		
18th amendment to the Constitution of Pakistan (the devolution amendment effective from July 1, 2011)	D=0, from 1971 to 2010 D=1, from 2011 to 2021	D=0, from 1971 to 2010 D=1, from 2011 to 2021

Source: Author's tabulation

4 Results and Discussion

We empirically modelled VFI and is determinants using two different definitions VFI as dependent variables, and for independent variables, we used different constructions, definitions as available in literature. As the literature suggest, for a model of federalism, it is important to account for both sides of budget, tax

decentralization and expenditure decentralization. We considered both types of decentralization and its proxies in model specifications. To come up with complete and comprehensive empirical evidence, we considered using different definitions of dependent and independent variables and found our results consistent.

The per capita electricity consumption proxied for per capita income is negatively associated with average VFI which implies a corrective effect [Model 1], increase in per capita income or years of higher economic growth will result in higher subnational tax collection and lower reliance on federal transfers. But the coefficient of electricity consumption lacks statistical significance, and this is due to the fact many districts and villages across Pakistan are deprived of electricity. We tested the same model with a time restriction 1981-2021, because in 1976 Tarbella Dam, the largest energy project of Pakistan was commissioned, and the power supply and transmission were extended to KP and Balochistan in years to come. We found statistically significant negative relationship between average VFI and electricity consumption for a reduced sample [Model 1a], the same relationship is concluded by (Cevik, 2014).

Similarly, when we add per capita total energy consumption to the model [Model 2, 3, 4 & 4a] with different definitions of independent variables, we found significant improvement in the size of coefficient and statistical significance. Subnational revenue effort measured by ratio of own revenues to the total revenues, and per capita revenues have negative association with VFI which signifies a corrective effect and less dependence on gross federal transfers.

Table 5
Determinants of VFI-with different proxies for independent variables

Dependent variable VFI-1	Model 1 FE 1971-2021	Model 1a FE 1981-2021	Model 2 FE 1971-2021
Electricity consumption per capita	-0.779	-5.156**	
	(1.457)	(1.108)	
Total energy consumption per capita			-2.871*
			(1.096)
Provincial own revenues/total revenue	-0.782***	-0.885***	
	(0.125)	(0.0746)	
Per capita subnational own revenue			-14.16***
			(2.235)
Provincial expenditures/consolidated expenditures	0.370**	0.312**	
	(0.0892)	(0.0740)	
Per capita expenditures			15.31***
			(2.143)
18th Amendment to the Constitution (Devolution) Structural change	-2.536***	-1.438	-1.904**
	(0.229)	(0.751)	(0.581)
F-Statistic	201.02	251.50	387.08
Prob	0.0000	0.0000	0.0000
Hausman statistic	37.64	50.34	93.11
Prob	0.0000	0.0000	0.0046
CD: Pesaran (2015)	6.201	3.759	-0.009
H0: Errors are CD	0.000	0.000	0.993
R-squared	0.804	0.869	0.888
Observations	204	160	204
Number of ids	4	4	4

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Note: ***, **, and * specify the statistical significance at the levels of 1, 5, and 10 percent, respectively. The regressions include constant terms but have not been displayed in the table.

Table 6
Determinants of VFI - with different definitions of VFI

Dependent Variables VFI-1 & VFI-2	Mode1-3 VFI-1 RE	Mode-4 VFI-2 RE	Mode-4a VFI-2 RE Punjab & Sindh only
Energy consumption growth	-0.0220**	-0.0118	-0.0670***
	(0.0105)	(0.0357)	(0.0105)
Tax revenue/total expenditures	-0.844***	-1.337***	-1.531***
	(0.200)	(0.0642)	(0.144)
Revenue expenditures/total expenditures	-0.0924	0.608***	0.635***
	(0.130)	(0.0456)	(0.0916)
18th Amendment to the Constitution (devolution) Structural change	4.481***	17.24***	20.78***
	(1.120)	(2.364)	(1.445)
Wald Stats	92.42	195.72	137.07
Prob	0.0000	0.0000	0.0000
Hausman statistic	5.66	1.60	0.01
Prob	0.2258	0.8090	1.0000
CD: Pesaran (2015)	1.432	7.905	2.692
H0: Errors are CD	0.152	0.000	0.0041
R-squared	0.305	0.478	0.5851
Observations	204	204	102
Number of ids	4	4	2

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1
Note: ***, **, and * specify the statistical significance at the levels of 1, 5, and 10 percent, respectively. The regressions include constant terms but have not been displayed in the table.

Both definitions of the expenditure decentralization proxied through subnational expenditure as percentage of consolidated expenditures, and per capita expenditures are positively associated with VFI [Model 1, 1a, 2, 4, 4a]. As we have discussed above that the magnitude of expenditure decentralization in Pakistan has been disproportionately higher than the tax decentralization. And most of the significant taxes

endowed with Federal government in all respect i.e., right to set up tax base, tax rate, and administration of tax collection.

GST on goods and services was a subnational subject under Government of India Act, 1935 and Federal government took control of GST in 1948 and then onwards it's been a federal tax and part of divisible pool.

More recently, the Eighteenth Amendment to the Constitution in 2010 successfully attempted to address this structural rigidity and devolve GST on services to the provinces. As of now GST on services is single largest tax of own revenues of each province. Consequently 2010 the year of the Eighteenth Amendment is an important structural break, although it's been only 10 so far, so we modelled this intervention as dummy variable. In Model 1, 2 with fixed effect, we found that the Amendment is negatively associated with VFI, which is obviously due to increase in tax revenues of provinces. On the other hand, Model 4, 4a with random effect, whereby we used direct transfer dependency definition of VFI as dependent variable, we found that Eighteenth Amendment dummy shows a positive relationship with VFI. Even after the Amendment, greater devolution of powers and autonomy to provinces, the non-development expenditures are rising disproportionately compared to development spending and transfer dependency on federal government is more or less, same as before the Amendment.

The situation created another complicated moral hazard problem for provinces, that devolved GST is the single largest source of their revenues which is up to or more than fifty per cent. So, provincial reforms interventions for many other small taxes like Agricultural Income Tax, Urban Immovable Property Tax, Land Revenue, Stamp Duties, etc. are very much sluggish.

5 Summary and Conclusion

System of multi-tiered federalism and finances necessarily involves vertical fiscal imbalances due to mismatch between level and magnitude of tax and expenditure decentralization. Due to lower tax base and revenue generations at provincial/subnational governments tend to remain over reliant on transfers from federal

government. The theoretical models of federalism are more focused on Flypaper effect, government size, Leviathan hypothesis, compensation hypothesis. The vertical imbalances and dimensions of vertical structure are less debated both in theory and empirics. The theoretical model of economic openness and vertical structure of governments concludes that each level of government sets up its priority to optimize its utility function, whereas economic openness leads to reduction in tariffs thereby reducing tax pool of central government and resultantly causing a reduction in subnational shares in transfers. There may be two propositions either government will keep on expanding or in other will reduce its size. The relationship between economic growth, tax decentralization and VFI are empirically established by (Cevik, 2014) study on Moldova.

In this paper we have developed a novel empirical model of determinants of VFI based on balance panel of subnational governments in Pakistan for a period of 1971-2021. Since the data of provincial GDPs is not publicized by the Government of Pakistan, we proxied per capita income by per capita energy consumption (electricity, gas, and petroleum products with their derivatives). We found that economic growth has a corrective effect on VFI, so as the tax decentralization. Whereas expenditure decentralization is linked with higher government size and more transfer dependency.

Pakistan has been consistently following population-based distribution till 2010, and this structural rigidity is addressed by the Eighteenth Amendment to the Constitution of Pakistan by devolution of more taxation powers to the provinces. Since it has been just ten years post devolution, still we tested this structural intervention using a dummy variable, and we found both positive and negative effect of intervention on VFIs, which means own source revenues of provinces have increased over time, so as transfer dependency.

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Appendix

Table A1

Test for multicollinearity

Variable	Model 1		Model 1a		Variable	Model 2	
	VIF	1/VIF	VIF	1/VIF		VIF	1/VIF
lnpckwh	1.48	0.674978	1.30	0.769261	lnpckoe	1.48	0.677599
osr/trev	1.22	0.818354	1.20	0.833521	lnpcosr	6.31	0.158419
exp_dec	1.25	0.799295	1.22	0.819345	lnpcexp	6.24	0.160163
18th_amend	1.21	0.827631	1.13	0.883525	18th_amend	1.48	0.677599
Mean VIF	1.29		1.21			4.02	

Variable	Model 3, 4 & 4a	
	VIF	1/VIF
ec_growth	1.04	0.960559
trev/texp	1.06	0.947291
revexp/texp	1.06	0.943307
18th_amend	1.03	0.971545
Mean VIF	1.05	

Source: Author's computations.

Note: The rule of thumb value suggests that value of VIF should be less than 20.

Table A2
Test for stationarity Levin-Lin Chu and Im-Pesaran test for panel unit root

	LLC	
	Adjusted-t*	p-value
VFI-1 [%]	-1.7324	0.0416
VFI-2 [%]	-2.1923	0.0142
Electricity consumption per capita [Ln]	-4.8472	0.0000
Energy consumption per capita [Ln]	-3.3483	0.0004
Energy consumption growth [%]	-6.6204	0.0000
Own source revenue/total revenue [%]	-3.1663	0.0008
Total revenue/total expenditure [%]	-2.7456	0.0003
Per capita revenue [Ln]	0.8930	0.8141
Subnational expenditures/consolidated expenditures [%]	-3.3895	0.0004
Per capita expenditures [Ln]	-4.5311	0.0000
Revenue expenditure /total expenditure [%]	-1.5627	0.0050

Source: Author's computations