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Estimating the Footprint of Government on the Economy

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The government's footprint on the economy in Pakistan is more than what annual general government spending (22 percent of GDP) suggests. In addition to spending; about 200 State Owned Entities, SROs' culture, and cumbersome business regulations combine towards a footprint of the government amounting to approximately 67 percent of Pakistan's Economy.

JEL Classification: H11: Structure, Scope, and Performance of Government
Keywords: Government Footprint, General Government Expenditure, Government Intervention, State Owned Enterprise(s), Regulations, Cost of Regulations, Dead Capital, Public-Private

1. INTRODUCTION

Total Government Expenditure and the percentage that it represents of the total Gross Domestic Product (GDP) is often taken as a measure of the size of the *government's footprint* and its involvement in the economy. A low percentage reflects that the government's capacity to influence the economy through fiscal instruments is limited, and low rates are often cited as prime reasons for governments pursuing aggressive taxation policies to build their financial muscle. In Pakistan, the general government expenditure as a percentage of GDP stands at about 22 percent. Many quarters, including multilateral donors agencies, have persistently called for the government to increase its tax revenue collection capacity through either increasing its tax rates and/or increasing the number of total tax filers in the country because the government is always in a deficit. The issue of the tax system in Pakistan is a separate matter and has been discussed through various other PIDE publications over the years.[1]

Box 1

Total General Government Expenditure =
Final Consumption Expenditure (A) + Capital Expenditure (B) + Transfer Payments (C)

(A) Government spending on goods & services for current use.
(B) Government spending on goods & services intended to create future benefit e.g. investment in infrastructure, research etc.
(C) Government spending that doesn't involve transaction of goods or services e.g. pensions, social safety net payments etc.

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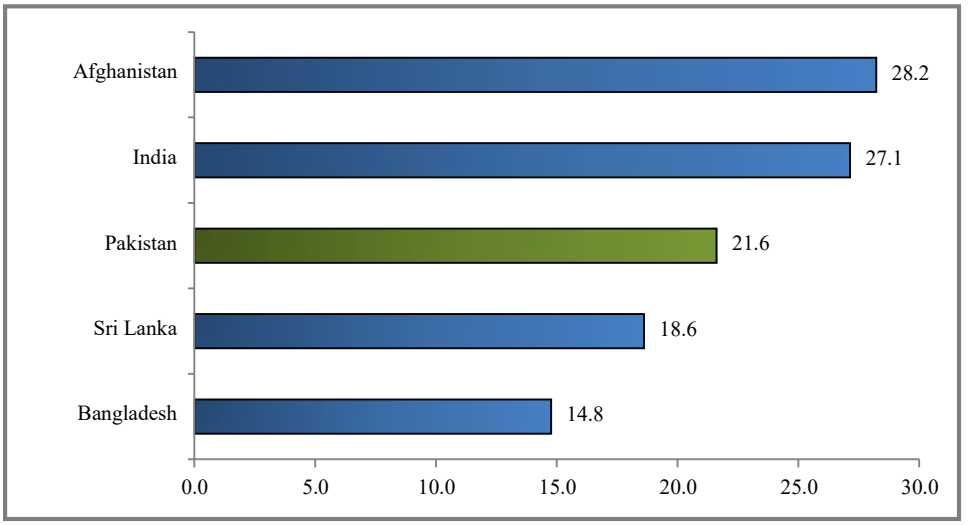
[1]Doing taxes better: Simplify, open and grow economy (2020). *Policy Viewpoint* 17, PIDE.

For a start, if we look at the General Government Expenditure (2019), the current figure as a percentage of GDP for Pakistan is indeed below the World Average; having said that, the percentage is not out of line with other countries in the region. (See Figure 1).

Fig. 1. General Government Expenditure (% of GDP)[2]



2. THE FOOTPRINT OF THE GOVERNMENT[3]

The government is far more than what it spends. Yet the common discourse does not support it. Here we estimate the *footprint of the government*. This would be a measure of what the government controls in the economy beyond mere regulation and policy. Alternatively, it could be seen as an economy that is market competition without government involvement other than market development regulation and monitoring.

For a start, it should be explicitly stated that the practice of using government expenditure as the only indicator of the *government's footprint* on the overall economy is misleading. This is particularly true in Pakistan where the government has a significant influence on the economy than what the government spending as a percentage of GDP figures might suggest. This is true due to a combination of reasons listed in the sections below.[4]

(1) **State-Owned Entities (SOEs) & Public Sector Companies (PSCs)**—The government still owns over 200 State-Owned Entities (SOEs) of which the majority are Public Sector Companies (PSCs) also listed on the stock exchange. In fact, many of the large companies listed on the Pakistan Stock Exchange are PSCs owned and managed by the government. Figure 2 gives a sectorial distribution of all SOEs according to the latest report on State-Owned Enterprises published by the Finance Division.

[2]*World Economic Outlook* (2019), IMF.

[3]Haque, Nadeem Ul (2013). Estimating the Footprint of the Government on the Economy. [Blog] Development 2.0.

[4]Ibid.

Fig. 2. Sectoral and Sub-sectoral Distribution of State-Owned Entities (SOEs)[5]

Energy PSCs		
1	Hydrocarbons	16
2	Power DISCOs	10
3	Power GENCOs	6
4	Power Others	9
Industry and Engineering		
1	Chemicals	5
2	Engineering and Industrial Metals	15
Services		
1	Services	26
Transportation		
1	Aviation	4
2	Ports and Shipping	23
3	Railways	6
4	Roads and Highways	2
Financials		
1	Banks	17
2	Insurance	7
3	NBFCs & DFIs	9
Trading		
1	Trading	3
Promotional and Advocacy		
1	Agriculture	1
2	Arts	1
3	Auto	3
4	Food	1
5	Funds and Foundations	16
6	Industries and Production	17
7	Information Technology	1
8	Minerals and Mining	1
9	Rural Development	1

(2) **Government Transactions in Markets as Dominant Player**—The government through its influence over large Public Sector Companies (PSCs) engages in market transactions often as a dominant player. This is particularly true for sectors such as energy and engineering & construction where PSCs have entrenched monopolies. There are about 41 PSCs in the energy sector alone giving the government control of energy generation and distribution in the country. The dominant position of PSCs in important sectors like energy and construction comes at the cost of stifling private investment in these sectors at the expense of often loss-making PSCs which are protected through recourse to taxpayers' money. One crisp example of this is the energy sector, of the top 10 loss-making PSCs according to the Finance Division Report on the performance of state-owned entities, 7 were public companies involved in the energy sector.[6]

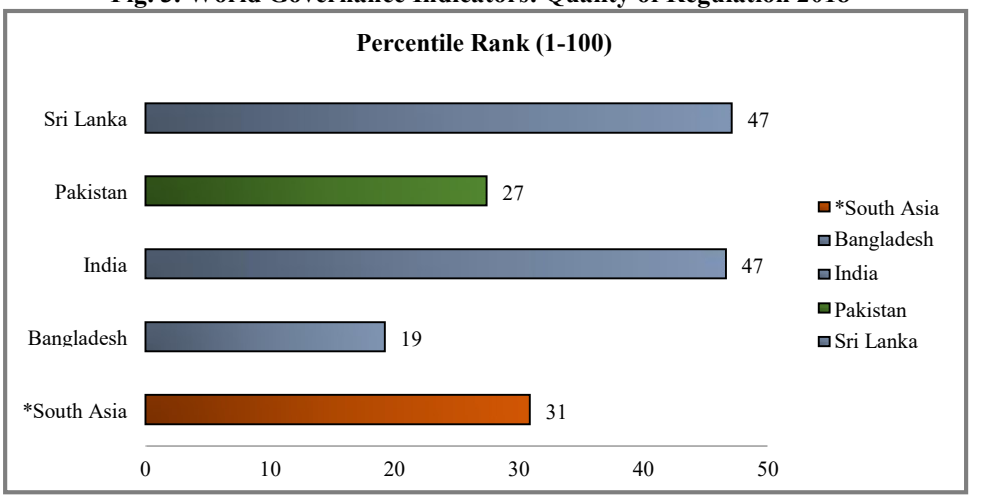
(3) **Statutory Regulatory Orders (SROs) and Taxes & Subsidies**—According to the Constitution of Pakistan, the tax regime and any changes to it are required to have legislative approval. Despite this, the executive and in particular the Federal Board of Revenue (FBR) frequently issues SROs to grant tax subsidies and subsidies on regulatory duties. This practice is unconstitutional and creates a complex political economy of vested stakeholders influencing the government to take advantage of the system at

[5]SOE Report (2017), Finance Division, pg. 25.
[6]SOE Report (2017), Finance Division, pg. 21.

the expense of the government treasury.[7] The practice of issuing SROs positions the FBR in an overwhelming influential position in the economic landscape of Pakistan and ultimately increases the total *footprint of the government* on the economy.

(4) **Extensive Regulatory Frameworks**—Government expenditure alone, or even the totality of government-influenced transactions in the economy, cannot reflect the entirety of the *government's footprint*. Other important factors that determine the total footprint are both the number and nature of government regulations that affect business activities. In Pakistan, many sectors of the economy are heavily regulated, something that is reflected in the country's percentile ranking on the World Bank's Worldwide Governance Indicator (WGI) on 'Quality of Regulation', with Pakistan ranked below the South Asian average and being third on the list of four major South Asian economies i.e. India, Bangladesh, and Pakistan & Sri Lanka. (See Figure 3).

Fig. 3. World Governance Indicators: Quality of Regulation 2018[8]



One direct influence that increased and poorly thought-out regulations have is that they are a significant impediment to ease of doing business in the country. The easier it is for private investors to open and run businesses, the more chances of vibrant competitive markets leading to sustained economic growth. Unfortunately, according to World Bank's Doing Business Unit which ranks countries worldwide for business regulation, Pakistan is ranked 108th in the world in terms of 'Ease of Doing Business'.[9] When it

[7]According to Article 77 of the Constitution of Pakistan "no tax shall be levied for the purposes of the Federation except by or under the authority of the Act of the Parliament". Supreme Court Judgments have also declared the practice of issuing SROs unconstitutional. [*Engineer Iqbal Zafar Jhagra & Senator Rukhsana Zuberi vs. Federation of Pakistan (2013)*; and *Messers Mustafa Impex, Karachi vs. Federation of Pakistan (2016)*]. Yet changes in tax laws through Finance Act 2017 have meant that the FBR and the executive continue to exercise unconstitutional powers in contradiction of both the Article 77 of the constitution and Supreme Court Judgments.

[8]Worldwide Governance Indicators (2018), World Bank Group.

[9]Doing Business Rankings (2020), World Bank Group.

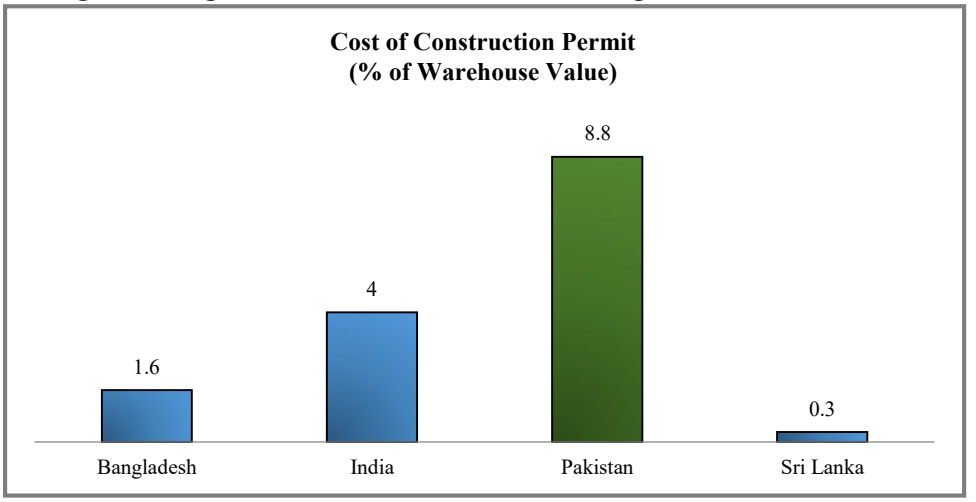
comes to business regulations, the Pakistan government's regulatory influence on the economy is not only limited to the taxation system—there are other important facets such as trade barriers, excessive documentation, excessive paperwork and permissions, and obstacles to investment. It should be noted that the aim here is not to criticise all business regulations as some regulations are necessary to make markets function; however, there are also other regulations that make transactions difficult and inhibit competition. The latter add to the regulatory burden and increase the *government footprint* while the former makes markets create competition, jobs, and growth.

The entire breadth of the regulatory framework and how it establishes a footprint of the government is an overarching topic that requires detailed explication. Here we will just give a few representative examples of how the government influences the economy through regulation in Pakistan.

(i) Creating a Permission Economy

In Pakistan, there is an extensive system that requires businesses to go through government regulatory agencies and other related government bodies to gain permission to do business in almost all sectors of the economy. Although most countries have permissions and licensing frameworks in place, in Pakistan these frameworks often involve countless procedures, lengthy delays, and high transaction costs to go along with complex rent-seeking games between businesses and regulators. For instance, in the construction industry which other than being an important industry in its own right is further integrated with other industries, it takes an average of 9 procedures to gain a construction permit in the country.[10] Furthermore, the cost of these procedures is at average 8.8 percent of the actual value of the intended construction project. This percentage cost is highest for Pakistan when compared to the other three major South Asian economies i.e. India, Bangladesh, and Sri Lanka. (See Figure 4).

Fig. 4. Dealing with Construction Permit: Percentage of Warehouse Value[11]



[10]Ibid.

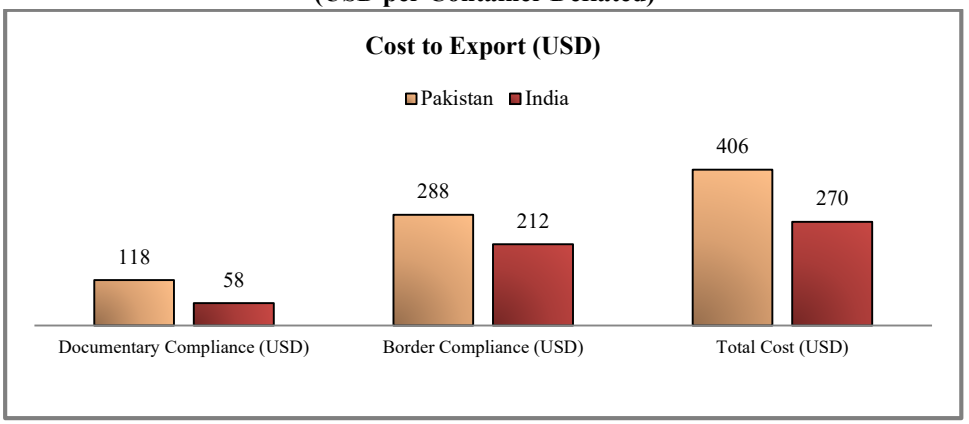
[11]Dealing with Construction Permits (2020), Doing Business, World Bank.

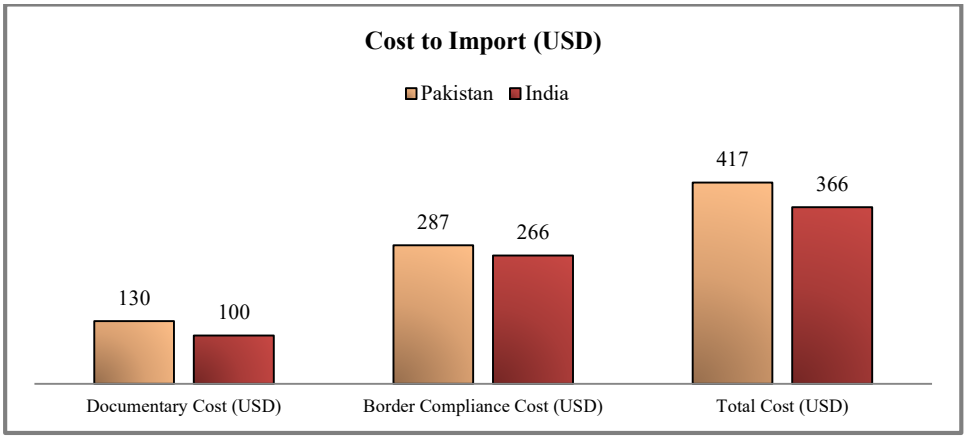
(ii) Regulations Increasing Transaction Costs

In addition to domestic transactions, the associated transaction costs of both cross-border money and goods transfers are high for Pakistan. One egregious example of high transaction costs affecting the economy is the costs associated with remittances to Pakistan. This is an important facet as in the 2018-19 financial year these remittances stood at approximately $21 Billion, nearly equivalent to the total export receipts for Pakistan.[12] These high transaction costs are partly the reason why many foreign Pakistanis prefer to send money through informal channels such as the 'hawala' system and so forth.

Furthermore, when it comes to across-the-border trade, despite high tariffs being the primary obstacle, transaction costs amounting to documentary and border compliance are also another reason why it is difficult for businesses in Pakistan to trade across the border. This particularly affects SMEs which represent 90 percent of all businesses in Pakistan more pronouncedly than larger businesses because of economies of scale. The documentary and border compliance costs of both importing and exporting are significantly higher for Pakistan than neighbouring India. (See Figure 5).

Fig. 5. Trading Across Border: Documentary & Border Compliance Costs (USD per Container Deflated)





[12]Mughal, M. & Ahmed, J. (2019), *Cost of remitting to Pakistan across major corridors*, PIDE, p.1.

(iii) Regulations that Limit Competition

The country has over the decades followed policies that have centered around granting tax rebates and subsidies to many industries, particularly those that are involved in the production of potentially exportable goods. However, despite the export of high value-added goods showing little growth, the government has insisted on protectionist policies for these industries who themselves have often been not able to make their goods neither high-value nor competitive in the international market. Similarly, through high tariffs and other non-tariff barriers, government regulation has protected many industries at the expense of the consumers and the overall growth of the economy. The full length of how protectionist policies have inhibited the growth of competitive markets is not in the purview of this brief, but to clarify, below are two examples of how business regulation has affected competition.

- If we take the case of the automobile industry in Pakistan, it is heavily protected through the imposition of very high import duties on imported cars to a point that they are significantly more expensive than locally assembled cars. Due to this protection, the industry itself is now only dominated by a handful of big manufacturers who have often resorted to price-setting tendencies due to almost non-existent competition from imported cars.[13]
- The engineering sector in Pakistan is another example. The sector is regulated by the Pakistan Engineering Council (PEC), which along with being in charge of recognising engineering qualifications, is also tasked with granting licenses to contractors. As of now, foreign contractors are not allowed to operate in the country without a partnership with a local contractor and are required to renew their licenses every year.[14] This has over the years served as a significant barrier to entry of foreign engineering firms and contractors, while local firms without serious competition have lagged in innovation and betterment of their quality standards.

(5) **Controlling Cities and Investment in Cities: The Burden on Government Ownership**—There is excess demand and shortage of supply of the city and urban space for commercial activities in Pakistan which leads to lost opportunities and costs to the economy. The shortage of city space stems from government regulations on zoning and also due to government ownership of large tracts of prime urban land that can instead be used for more productive commercial activities.

(i) City Zoning Regulations—Most urban space in Pakistani cities is governed by zoning regulations that divide space between distinct categories: 'residential' and 'urban'. The current zoning regulations due to their biases against mixed-use of land and high-rise building have led to a shortage of urban space for commercial activities and are a significant opportunity cost to the economy as a whole.[15]

[13]Automobile Sector of Pakistan, Pakistan Institute of Trade and Development.

[14]Foreign Operators, Pakistan Engineering Council at https://www.pec.org.pk/Foreign_Firms.aspx

[15]Haque, Nadeem Ul (2014), Achieving Progress, Growth, and Development through Urban Renewal, Policy Brief Series, Wilson Centre, pg. 1-5.

(ii) Government Ownership of Urban Space—Furthermore, to go along with cumbersome zoning regulations, the government also owns large tracts of land in and around city centres. In addition to being used as public offices, this land is also predominantly used to provide housing for public sector officials.[16] There are valid arguments to be made that either public sector officials' housing should be shifted to cheaper land out of city centres or that these housing benefits for public sector officials should be monetised and the prime land vacated in city centres as a result can be used for commercial purposes. These changes can not only increase commercialisation of city centres but also be a source of income for the government that can potentially rent out such prime real estate to private sector bidders.

Box 2
Zoning Regulations in Action: Lahore's Urban Dilemma

- City space is largely divided into two mutually exclusively categories: Commercial and Residential.
- Mixed-uses of land i.e. for both residential and commercial purposes are rare and often prohibited by regulations.
- Added to these restrictions on mixed-use of land, all localities including those parts of the city still under LDA's control have arbitrarily set height restrictions that restrict high-rise development.
- No mixed-use of land, low-rise development and restrictions on doing business in 'residential zones' leads to a shortage of city space for commercial and economic activities.
- Lahore's urban landscape is dominated by single-unit housing/residential localities with businesses forced into commercial zones.
- The ultimate cost is to the economy in shape of lost commercial and economic activities.

3. ESTIMATING THE GOVERNMENT'S ACTUAL FOOTPRINT ON THE ECONOMY IN PAKISTAN

- **Government Share in the Economy**—Given that the *government's footprint* on the economy amounts to more than just annual government expenditure numbers, Planning Commission brought together a core group of economists, practitioners, and other experts in 2011 to formulate a new framework for economic growth in Pakistan. As a part of the process of developing the new framework, the working group also attempted to first estimate the actual *footprint that government* has on the economy in Pakistan. The team estimated that in Pakistan the government directly influences about 44 percent of the total economy.[17] The revised calculation adjusted for minor changes in sectoral share

[16]Haque, Nadeem Ul & Nayab, Durr-e- (2007), Renew Cities to be the Engines of Growth, Policy Viewpoint 2, PIDE, pg. 3.

[17]Haque, Nadeem Ul (2013). Estimating the Footprint of the Government on the Economy. Development 2.0.

percentages yields a similar figure of approximately 43 percent. (See Figure 6). This number of approximately 43 percent is what the government directly controls in the economy; "decisions in these areas are dependent on the government."[18]

Fig. 6. Estimating the Government's Share of the Economy

Sector	Govt. Share in Sector (%)	Sector Share in Economy (%)	Govt. Share in Economy (%)
Agriculture	43.1	19.3	8.3
Manufacturing	11.9	12.5	1.5
Mining & Quarrying	79.6	2.5	2.0
Construction	75.0	2.5	1.9
Transport & Communication	73.4	12.3	9.0
Electricity Oil & Gas	77.6	1.8	1.4
Wholesale & Retail	7.9	18.2	1.4
Health & Education	49.3	6.5	3.2
Finance & Insurance	45.5	3.6	1.6
Other Services	60.0	20.8	12.5
Total		**100**	***42.8***

Authors' Calculations.

- ***Government Footprint* through Regulation**[19]—Estimating the cost of government regulations to the economy in general and compliance costs incurred by businesses in Pakistan are complex processes. Existing research on the issue is either absent or limited at best, both in Pakistan and at an international level. Having said that, an interesting study was conducted by Crain & Crain (2014) to estimate the costs of government regulation on the economy of the United States. The study was commissioned by National Association of Manufacturers and in its latest version put the total cost of regulation at 12 percent of the total national income in the United States in 2012.[20]

  For the purpose of estimation, we are going to use the study in the United States as a proxy from which we can make a logical conclusion about the cost of government regulation in Pakistan. Pakistan's percentile score on the Worldwide Governance Indicator's 'Quality of Regulation' indicator is 27.40 compared to the United States' score of 92.31. Considering this statistic, which is calculated by taking into account various measures that influence the effectiveness of regulation, one can logically assume that the regulatory burden and the associated regulatory costs are markedly more in Pakistan than in the United States. If one were to double the 12 percent cost of regulation as estimated by Crain & Crain (2014) to 24 percent and take that as an estimate for Pakistan, it would still amount to a relatively conservative estimate of what the cost actually is for the Pakistan economy.

[18]Ibid.

[19]Ibid.

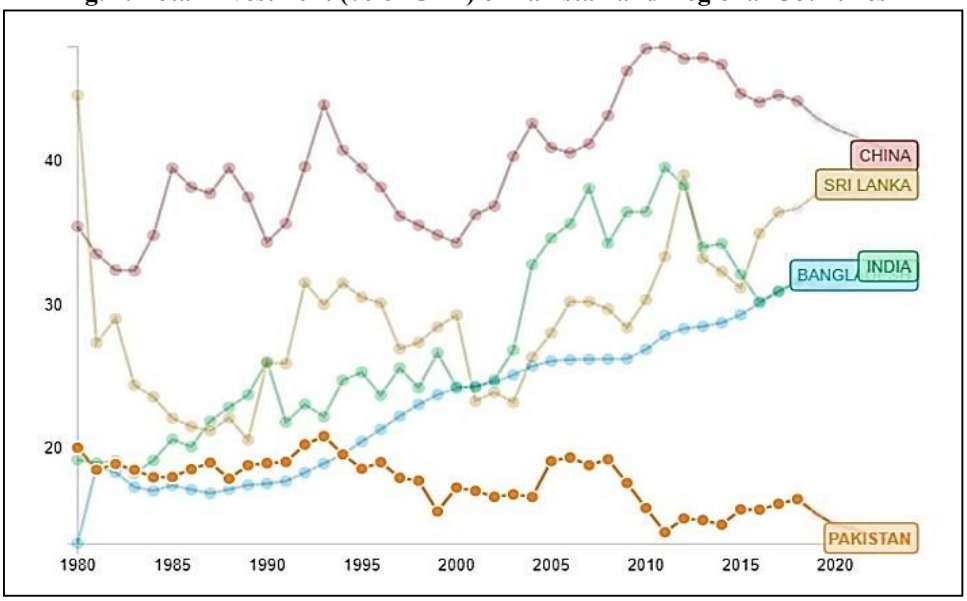
[20]Crain, William & Crain, Nicole (2014), The Cost of Federal Regulation to US Economy. National Association of Manufacturers.

- **Total Estimate of the *Government's Footprint* on Pakistan's Economy**—For sake of discussion and simplicity,[21] let's take the estimated total *footprint of the government* on the economy in Pakistan to be a sum of the percentage of the economy that the government directly controls through its influence on State-Owned Entities (SOEs), and the percentage of the costs that are incurred by the economy as a result of government regulations including trade barriers, impediments to investment, building restrictions and cumbersome land-use and zoning policies among others. The combined total estimate for the *footprint of the government* in Pakistan then comes to 67 percent of the GDP. (43 percent directly controlled and 24 percent in regulatory costs).

Why the *Government's Footprint* is Important?

The calculation can and should be refined continually. Knowing the *footprint of the government* clarifies the role of the market and the space for private investment. Every leader (dictator or otherwise) and every donor talks of private sector-led growth without understanding what the *Government's Footprint* on Pakistan's economy is.

Fig. 7. Total Investment (% of GDP) of Pakistan and Regional Countries[22]

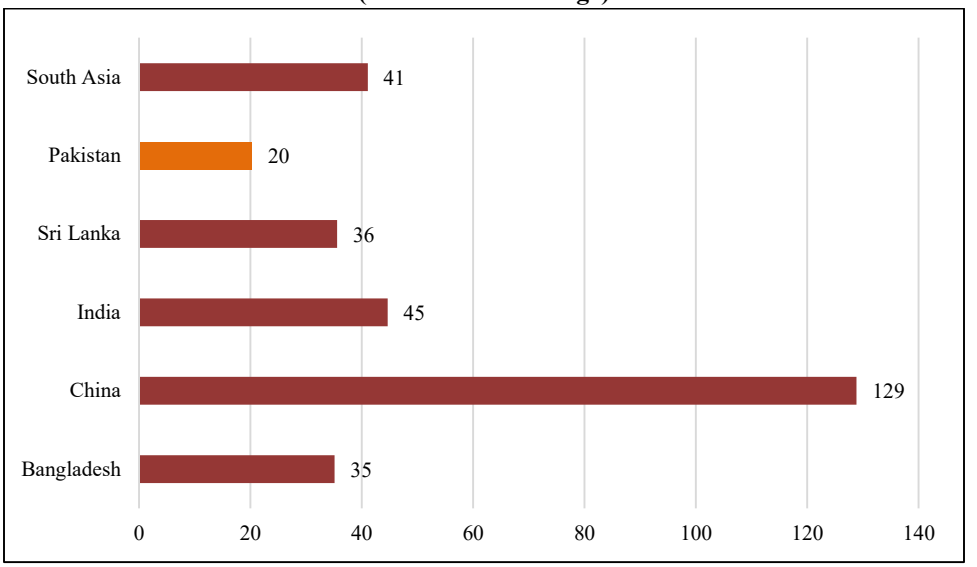


Another indicator of a depressed investment environment is the chronically low level of credit to the private sector. Domestic credit to the private sector as a percentage of GDP in Pakistan is one of the lowest in the entire region. (See Figure 8)

[21]Adding the two percentages is not a straightforward process, because 43 percent represents Government's share as a percentage of GDP, whereas 24 percent represents loss/cost as a result of regulation as a percentage of GDP. The addition is done for discussion purposes only, while particularly keeping in mind that there is only negligible difference in two calculations and that the conceptual underpinnings of the argument do not change.

[22]*World Economic Outlook* (2020), IMF.

Fig. 8. Domestic Credit to Private Sector (% of GDP)
(2000 – 2019 Average)



The question however is that with the government involved in most markets and with a huge burden of regulation, where is the space for private investment? Perhaps this is the reason that our investment-to-GDP ratio remains the lowest in the region and is on a declining trend. (See Figure 7). The ratio is now very close to the accounting depreciation rate. It seems new investment to expand the economy is virtually not happening.

Our estimate shows that the *footprint of the government* may be as large as 67 percent of the economy. The government is substantially involved in agriculture, construction, finance and banking, electricity and gas, and even wholesale and retail.

One important area that we have not included is the government's large holding of prime real estate for the housing of officials and old offices. What was once low-priced suburban land that the colonial government used for housing and offices is now downtown valuable land. Instead of reducing the size of these holdings or relocating them to cheaper areas or even eliminating these through "monetisation of perks" initiatives, the government under pressure from growing officialdom is increasing the use of valuable land for these purposes.

Furthermore, regulations prohibit building around these estates and offices prohibit large tracts from development on commercial lines. The "wealth of cities" and nations is severely taxed as a result of such policies is significantly eroded. We at PIDE are taking steps to evaluate the wealth of cities and how the official holding of valuable land and the regulations that support it impact through furthering the *government's footprint* on the economy. For the moment we can assume that the *footprint of the government* on the economy is more than 67 percent and that there is an urgent need to decrease it.

Reducing the footprint of the government will not only open up space for the private sector to drive economic growth but also help the government in reducing its fiscal deficits through the following:

- Many State-Owned Enterprises (SOEs) are consistent loss-making enterprises and they put a strain on the government and the overall credit system in the country. By minimizing these loss-making SOEs and opening space to private sector enterprises government can reduce the fiscal and economic burden of SOEs.
- An increase in private sector activity will open new revenue streams for the government in the shape of taxes that can be levied on the new private sector enterprises.

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Population Growth and GDP Growth in Pakistan: Three Models

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Three dynamic population—GDP growth models, are developed, each based on a Cobb-Douglas production function. The first model simulates the effects of average wealth on population and GDP growth, whereas the second model simulates the effects of wealth inequality. The third model simulates the effects of a demographic dividend. The models successfully simulate the observed historical and projected future population and GDP of Pakistan. Scenario simulations with the first model with higher and lower population growth rates result in larger or smaller GDP, respectively, but smaller or larger GDP per capita at 2100. The inequality model simulations with reducing or increasing inequality result in a smaller or larger population, respectively, and smaller or larger GDP, but higher or lower GDP per capita at 2100. The demographic dividend model simulations result in larger GDP and higher GDP per capita than the other models.

JEL Classification: C60, J10, O10
Keywords: Endogenous Growth, Dynamic Model, Demographic Transition, Inequality

1. INTRODUCTION

Pakistan's vision is to become a high-income country by 2047 (Planning Commission, 2014). However, rapid population growth and modest economic growth present many challenges in achieving this vision (Planning Commission, 2014, World Bank, 2019). Population growth and economic growth are linked, and reducing the rate of population growth is central to boosting economic growth (Planning Commission, 2014; World Bank, 2019). Reducing population growth and boosting economic growth would also help Pakistan meet other challenges, such as ensuring water security (Kirby, et al. 2017).

In the decade to 2020, the population of Pakistan grew by a little more than 2 percent per year (UN, 2019a), and its gross domestic product (GDP) grew by about 4 percent per year (PBS, 2020). Projecting future population and economic growth is necessary to plan for future needs across many sectors, such as the water sector noted above. My aim in this paper is to examine three candidates dynamic population—GDP growth models for making long-term projections. Each is based on a Cobb-Douglas type of production function. While these models are based on Pakistan, they are quite general and can be applied to any country or region.

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Note: A great many papers explore the issues described in what follows. Some key papers are given as examples, with emphasis on papers about Pakistan. No attempt is made here to comprehensively review this large literature.

Production function models include neo-classical economics models, the classic example of which is that presented by Solow (1956) who proposed a long-run economic growth model of whole economies, based on a production function with decreasing returns to capital. Population growth and savings were treated as exogenous. Critiques of this and similar models noted that they failed to account for the increasing growth observed over the long run in many economies (Shaw, 1992; Howitt, 2010). The critiques led to endogenous growth models in which economic growth was also a function of technological progress based on knowledge accumulation (Shaw, 1992; Howitt, 2010). There are many such models, with different assumptions and differing predictions (Shaw, 1992; Romer, 1994). In some versions, knowledge accumulation itself is a function of population size (Birchenall, 2016; Bucci & Prettner, 2020). One application of such models has been to attempt to explain the differences in growth rates amongst countries, and suggest policies for enhancing growth (Mankiw, et al. 1992; Shaw, 1992; Romer, 1994). In the case of Pakistan, endogenous growth models have been applied to examine the impact on the economic growth of foreign direct investment (Falki, 2009), of education (Abbas, 2001), and of human capital and total factor productivity (Amjad & Awais, 2016). The latter authors note that in recent years a decline in total factor productivity growth is associated with slower economic growth than experienced in nearby and broadly comparable countries. Saleem, et al. (2019) also noted the weak growth in total factor productivity in Pakistan and its contribution to weak economic growth.

Development of these models is the unified growth theory (Galor, 2005), which describes the joint evolution of education, technological progress, resource use, and population; these variables are used in a production function to give the overall output of the economy. Unified growth theory models use a dynamic, time-stepping approach, in which the values of the variables (for population and so on) are updated iteratively in each time step. A key feature of the models is that fertility rates and mortality rates are functions of household preferences, as influenced by wealth and education. These models have been applied to very long-run development and display two regimes, in the first of which there is limited growth, and in the second of which a demographic transition leads to substantial and sustained economic growth. This is consistent with very long-run human development before and after the industrial revolution (Galor, 2005, 2010; Strulik & Weisdorf, 2008).

A demographic transition, in which birth rates fall and per capita wealth rises, is often cited as a key factor in economic growth in developing economies (Bloom & Williamson, 1998; Cervellati, et al. 2017; Bawazir, 2019). The falling birth rates lead to a period in which the fraction of the population that is of working age increases, and there is thus a decline in the number of dependents per worker. The effect lasts a few decades, after which the ageing population results in many older people to be supported by those of working age (Bloom & Williamson, 1998; Ahmad & Khan, 2019). Bidisha, et al. (2020) suggested that in Asia, the demographic transition has limited short-run effects, but significantly boosts economic growth in the long run; Iqbal, et al. (2015) concluded the same for Pakistan. However, Amjad (2013) found that in Pakistan, the onset of a demographic transition from the 1990s appears not to have stimulated economic growth. Choudry & Elhorst (2010) found that the impact of demographic transition is less in

Pakistan than in India and China, though they expect the impact to be greater in the future. Bloom, et al. (2011) also noted that the demographic transition in Pakistan started somewhat later than some of its neighbours, and caution that (for all countries) capturing the benefits is not automatic but depends on governance, trade, and macro-economic management. Bongaarts, et al. (2013) also noted the importance of education and gender equity, while Jehan & Khan (2020) noted the importance of employment opportunities. Ahmad & Khan (2019) developed a model of economic growth which incorporates age structure and a demographic transition, which they used as a basis for an econometric model of human capital dynamics.

Although the impact is debated (Sinding, 2009), poverty is also often cited as a factor in economic growth. Sinding (2009) regards recent evidence as conclusive; reducing poverty leads to lower birth rates, which in turn contributes to economic development. Tahir, et al. (2014) and Afzal, et al. (2012) found that poverty and GDP growth are associated in Pakistan. Afzal, et al. (2012) found that the causality in Pakistan is bi-directional, whereas others such as Chani, et al. (2011) and Cheema & Sial (2012) assume that poverty (or its alleviation) is a result of economic growth. Nevertheless, the latter authors find a positive association between growth and poverty.

A positive association between economic growth and poverty means that with a larger economy, there is less poverty, even if the relative distribution of income remains unchanged. However, income inequality itself may play a role (e.g. Galor, 2011). Shahbaz, et al. (2014) and Soharwardi, et al. (2018) found that income inequality in Pakistan is positively associated with economic growth; Shahbaz, et al. find that the causality is bi-directional. However, Asad, et al. (2011) found that the picture is more complicated, with periods of declining consumption inequality and periods of increasing inequality. Income inequality may also be linked to population growth. Qureshi & Arif (2001); ADB (2002); Hyder, et al. (2010); Arif (2013); Majeed & Malik (2015); Ibrahim, et al. (2019) all found a positive association between poverty and family size. Baulch and McCulloch (1998) analysed a five-year longitudinal survey and found that larger households increased the probability of entering poverty and decreased the probability of exiting. However, as shown by Naschold (2009) several other factors, in particular education, influence moving out of poverty.

My aim in this paper is to present three candidate dynamic population—GDP growth models for Pakistan, each based on a Cobb-Douglas type of production function. The models arise from the factors noted above about the relationships amongst GDP growth, population, wealth inequality, and demographic dividend. The models are based on the example of the unified growth theory models of Galor (2005, 2010, 2011), but are more restricted in scope. In all three models, GDP and population co-evolve: GDP growth results from an increase in population, and the growth in population is in turn influenced by GDP growth. In the first model, which I term the simple model, GDP is related to the size of the total population. In the second model, the wealth inequality model, GDP is related to the size of the population and the distribution of wealth amongst the population. In the third model, the demographic dividend model, GDP is related to the size of the working population and to the ratio of the non-working population to the working population. I examine the behaviour of the three models from 1960 to 2100. From 1960 to the present, the simulations are compared to historical data, whereas from 2020 onwards they are compared to projections of population and GDP growth.

In developing the models, I do not seek to test explanations of GDP and population growth. I accept the evidence from the literature noted above. As noted above, endogenous growth models have been applied to Pakistan, and the historical associations between GDP growth and population growth are well studied. However, I am not aware of any study that uses a dynamic model of the co-evolution of GDP and population in Pakistan. The novel contribution in this paper is the development of models that satisfactorily simulate this co-evolution.

The paper is organised as follows. In the next section, I will outline the GDP and population growth in Pakistan from 1960, with projections from 2020 to 2100. In Section 3, I present the three models, followed in Section 4 by examining the results of model simulations, and their comparison to historical and projected data. In Section 5, I discuss the results in light of other literature, and also discuss influences on GDP and population growth that are not incorporated into the models. This is followed by some overall conclusions.

2. GDP GROWTH AND POPULATION GROWTH IN PAKISTAN: HISTORICAL TRENDS AND FUTURE PROJECTIONS

Historical GDP data were obtained from Table 3 of the Pakistan national accounts (PBS, 2020) which gives the main aggregates at constant prices from 1960-61 to 2019-20. PWC (2017) project that GDP growth at constant purchasing power parity in Pakistan to 2050 will average 4.3 percent per annum. The growth rate was projected to decline slightly over the period. For a projection from 2020 to 2100, therefore, I assumed a constant GDP growth rate of 4.1 percent per annum, slightly less than the PWC (2017) average value to 2050. Figure 1 shows the growth of GDP over the whole period.

Fig. 1.

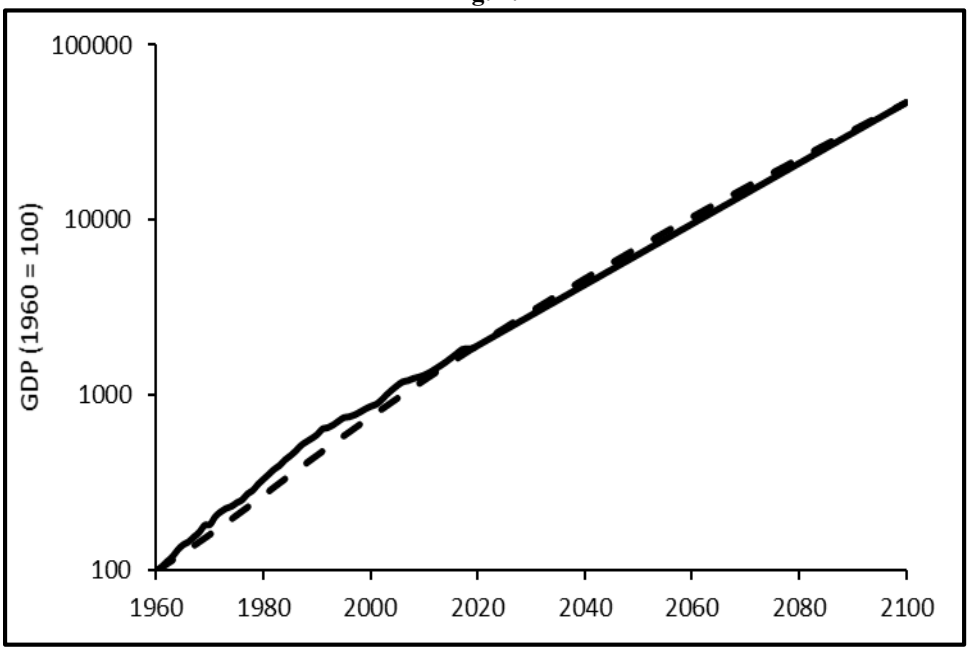
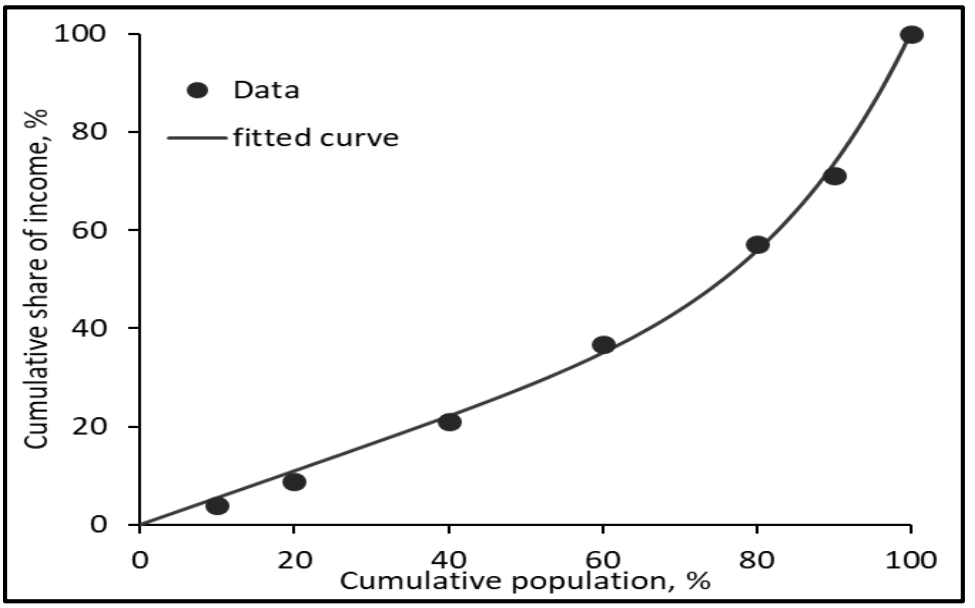


Figure 1. GDP in Pakistan at constant prices plotted as an index with 1960 = 100. The solid line is based on the data from PBS (2020) for 1960-2020, extrapolated at 4.1 percent per year from 2020-2100. The dotted line is the result of a simulation using the simple model (see results section for explanation).

Income distribution data were obtained from the World Bank Poverty and Equity Database (World Bank, 2020). The data give income shares from 1987 to 2015 of the bottom 10 percent and top 10 percent of the population, plus each population quintile. Figure 2a shows the data plotted as a Lorentz curve. The calculated Gini coefficient from 1987 to 2015 is shown in Figure 2b. There is no significant trend in the Gini coefficient.



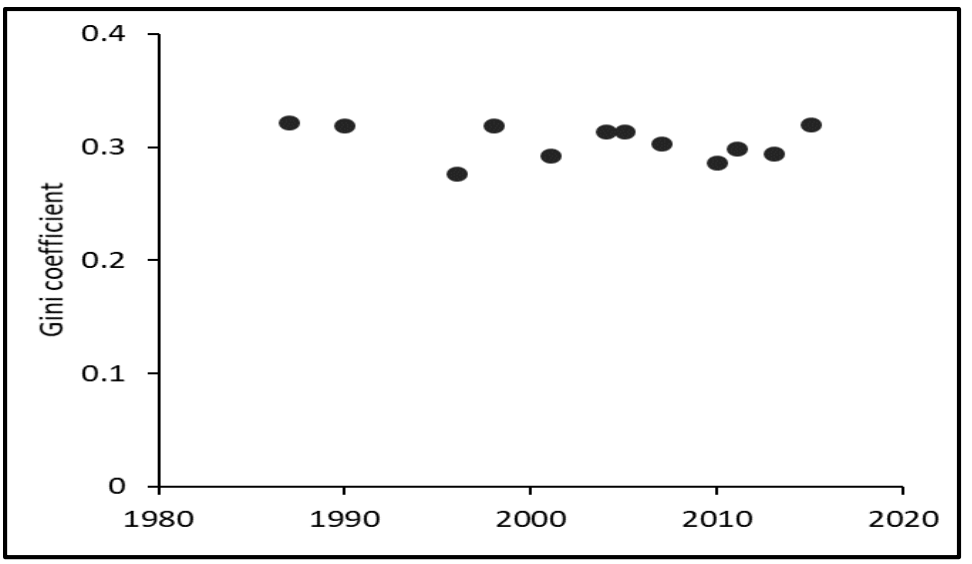
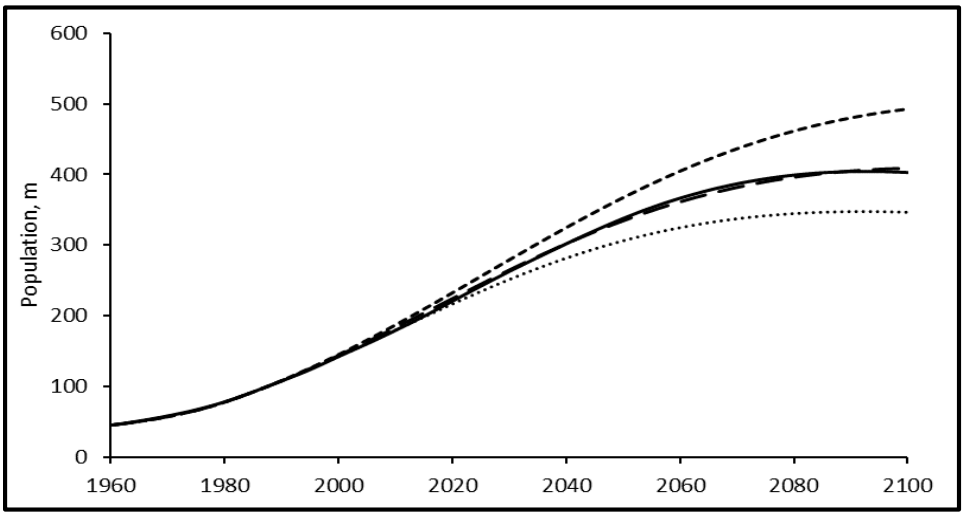


Figure 2. (a). (left) Lorentz curve of cumulative share of income vs cumulative proportion of the population in 2015; (b). (right) Gini coefficient from 1987 to 2015. Based on data in the World Bank Poverty and Equity Database (World Bank, 2020)

Historical and projected population data were obtained from the 2019 World Population Prospects (UN, 2019a). The figures used here are all based on the Median Projection. Figure 3a shows that the population increased dramatically over the historical period, with growth projected to slow and eventually slightly reverse towards the end of the century. The growth rates throughout the period are shown in Figure 3b. The population growth rate rose from 1960 to about 1990, in response to falling death rates, particularly in the early childhood years. Since about 1990, it has fallen in response to declining birth rates. The fall is projected to continue to the end of the century, by which time (according to the median projection) rising deaths in the growing aged population will begin to outnumber births, and the population will start to fall (that is, the growth rate becomes slightly negative).



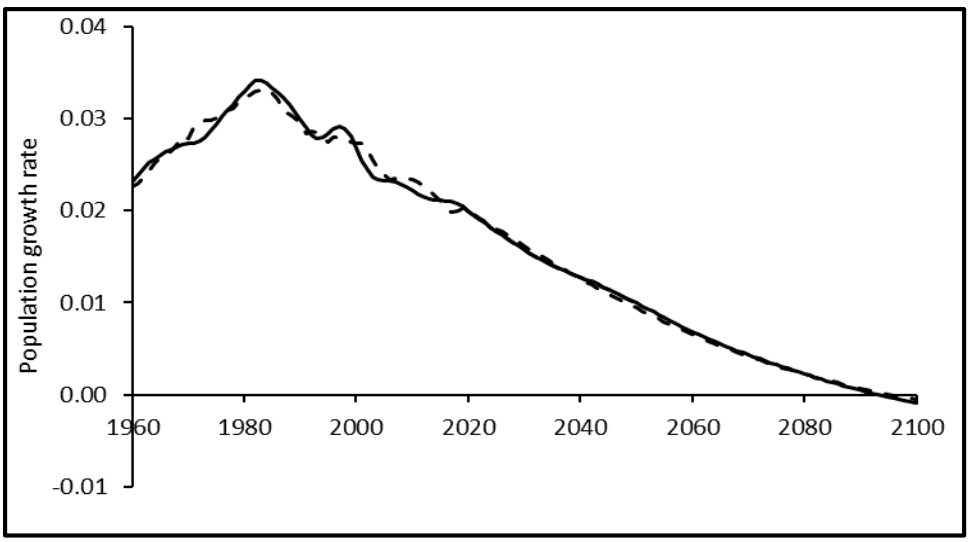
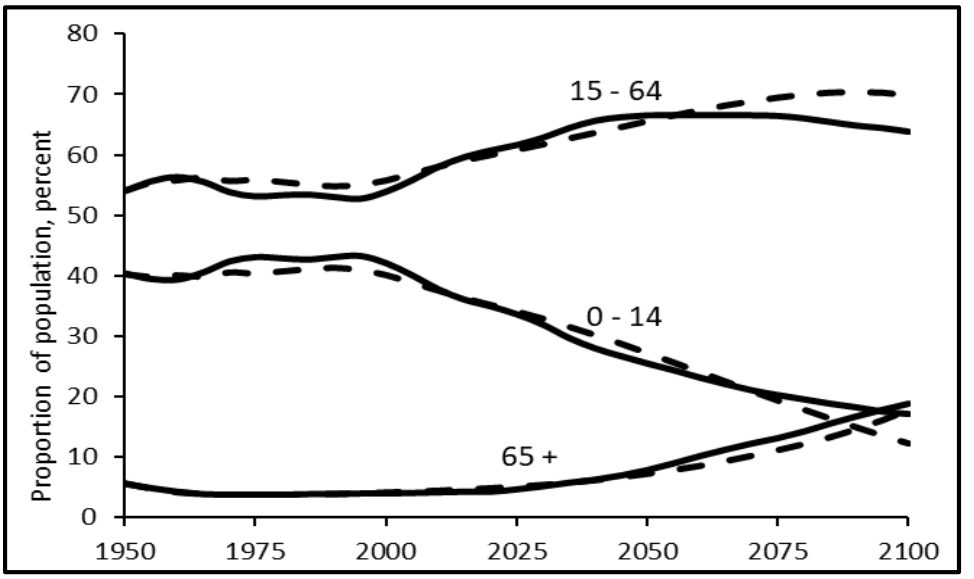


Figure 3. (a) (top) population. The solid line is based on the data from the UN (2019a). The dashed lines are the results of simulations using the simple model (see results section for explanation). (b) (bottom) population annual growth rate. The solid line is based on data from the UN (2019a). The dashed line results from a line fitted to the population annual growth rate as a function of per capita GDP (see section 3.1 for an explanation).

Data for the population in different age groups (available from the World Population Prospects database in five-year increments) were used to construct Figure 4a, which shows the share of the population of young dependents, working age, and aged dependents. Figure 4b shows the dependency ratio.



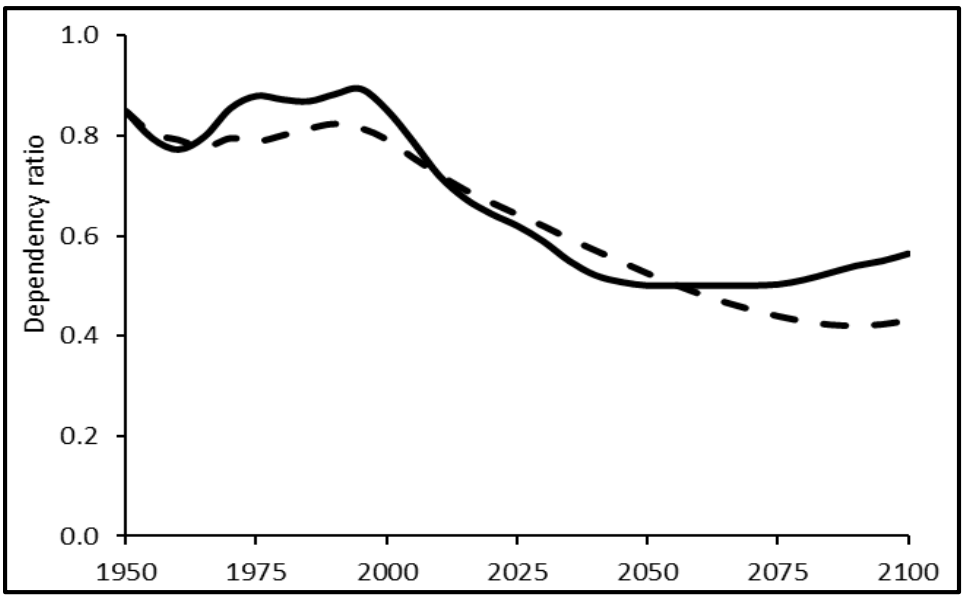


Figure 4. (a) (top) proportion of the population below working age (0–14), at working age (15–64), and older than working age (65+), b. dependency ratio. The solid lines are based on the data from the UN (2019a). The dashed lines are the results of simulations using the demographic dividend model (see section 3.3 for explanation).

3. POPULATION GROWTH—GDP GROWTH MODELS

As noted in the Introduction, the models developed here are based on the unified growth theory models of Galor (2005, 2010, 2011). The models use a dynamic, time-stepping approach, in which the values of the variables (population, GDP, factor growth rates, and other variables) at one-time step are used to calculate the values of the variables in the next time step. Applying the scheme over many time steps simulates the trajectory of population, GDP, and other variables over the long run.

3.1. Simple Model

In the simple model, a Cobb-Douglas production function is assumed in the form:

$$Y = A\,K^{0.5}L^{0.5} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where Y is output (i.e. GDP), A is total factor productivity, K is capital inputs and L is labour inputs. Capital and labour are assumed to have constant returns to scale, indicated by the exponents of the two factors summing to one. Here, I use the production function in an incremental form:

$$\frac{GDP_{t+\Delta t}}{GDP_t} = \frac{A_{t+\Delta t}}{A_t}\,\frac{K_{t+\Delta t}^{0.5}}{K_t^{0.5}}\,\frac{L_{t+\Delta t}^{0.5}}{L_t^{0.5}} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

hence

$$GDP_{t+\Delta t} = GDP_t\,A'K'L' \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where the GDP at time $t + \Delta t$ is evaluated from the GDP at time t, and the increment over the time step of the total factor productivity (A'), capital (K'), and labour (L') inputs. In the case of A' and K', these are constants a little greater than 1, representing the annual growth in total factor productivity and capital.

$L' = L_{t+\Delta t}^{0.5}/L_t^{0.5}$ is calculated from the labour input at times t and $t + \Delta t$. The labour inputs are assumed to be in direct proportion to the total population, and hence

$$L' = 1 + PGR_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

where PGR_t is the annual population growth rate. As shown in Figure 3b, the annual population growth rate varies with time. Here, I assume that the population growth rate results from increasing wealth per capita. That is, with rising per capita wealth, death rates start to fall, perhaps as a result of better nutrition and health care. Then, with further increases in per capita wealth, birth rates fall, perhaps as a result of household preferences as suggested by Galor (2005, 2010, 2011). Figure 5 shows the population growth rate of Figure 3 replotted as a function of wealth per capita (itself calculated from the GDP data of Figure 1 and the population data of Figure 3a).

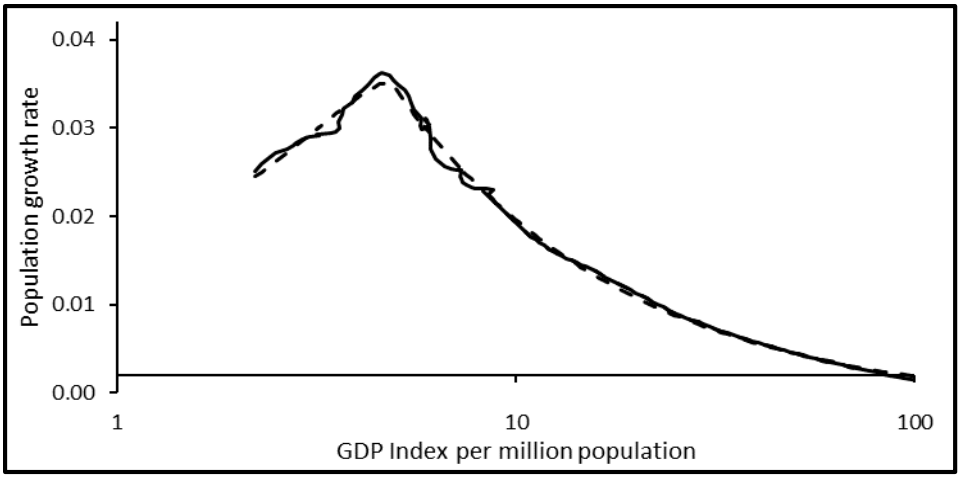


Figure 5. Population growth rate as a function of GDP per capita, where GDP is given as an index (with 1960 = 100) divided by the population in millions. The solid line is based on the GDP data in Figure 1 and the population data in Figure 3a. The dotted line is a fitted function (see text for explanation).

The fitted function shown in Figure 5 is a pair of straight lines in log (PGR') – log (GPD/capita) space (one for the rising part of the curve, the other for the falling part), but with $PGR = (PGR' - PGR_o)$ where PGR_o is a small offset to allow PGR to take on negative values.

Finally, the population, P, at time $t + \Delta t$ is evaluated from the population at time t,

$$P_{t+\Delta t} = P_t\,(1 + PGR_t) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

Note that in this model (and in the two models that follow), GDP and population co-evolve. Causality, in modelling terms, is bi-directional and iterative.

To evaluate the model as specified in Equations (3) and (5), the GDP in 1960 is set at an index value of 100, and the population in 1960 is set at the empirically observed value given by the UN (2019a). The population growth rate uses the fitted curve shown in Figure 5, and I selected the values of A' and K' by trial and error to produce simulated results that are a good match to the historical data and independent projections shown in Figures 1 and 3. Of course, numerical fitting algorithms could be used in place of trial and error.

3.2. Inequality Model

The inequality model is very similar to the simple model, except that the population growth rate as a function of wealth per capita is applied separately to each percentile of the population. At each time in the simulation, the share of wealth in each percentile of the population is calculated from the GDP and the function fitted to the Lorentz curve in Figure 2. This is then divided by the population size in each percentile to give the wealth per capita. A function of the same form as that fitted in Figure 5 (and used in the simple model), but with slightly different coefficients, is then used to calculate the population growth rate separately for each percentile of the population, and the results are summed to give the overall population growth.

The effect of this model is that each percentile of the population moves independently along a population growth curve similar to that in Figure 5. The wealthier groups move early to fewer children and smaller family sizes, and the poorer groups move later.

3.3. Demographic Dividend Model

The final model is based on the modelling of the population dynamics of different age groups. The age groups are those for which the UN (2019a) gives birth rate and death rates; namely, 0-4, 5-9, 10-14, 15-19, 20-49, 50-64, and 65+. The data are given for five-year periods, so in this model, I used a time step of five years, rather than the time step of one year in the simple and inequality models. As a consequence, the input factors A' and K' are raised to the power of 5, so that an annual growth rate of 3 percent becomes a five-year growth rate of about 16 percent, for example.

In each five-year period, the population of an age group is the population in the previous period plus new entrants less exits. Entrants are births for the 0–4 age group, or the whole of the next younger age group less deaths in that group. Exits are deaths in each group. The birth rates as a function of time are transformed into a function of wealth per capita in the same manner as the transformation of the overall population growth rate, as described in section 3.1 above. The result is shown in Figure 6. A two-part function is fitted to the data, with a linear function up to a GDP per capita of about 5.5, and a log-log function for larger values. The best-fit function slightly underestimates the birth rate at high values of GDP per capita.

Figure 6. Crude birth rate as a function of GDP per capita, where GDP is given as an index (with 1960 = 100) divided by the population in millions. The solid line is based on the GDP data in Figure 1 and the birth rate data from the UN Population Division (2109). The dotted line is a fitted function (see text for explanation).

The death rates also must be estimated in the model for each population group. In principle, this could be done by fitting functions as with the birth rates. However, this would lead to several functions with a large number of adjustable parameters. For simplicity, I used the deaths per age group, transformed from a time-based to GDP per capita-based form, as a lookup table from which values were interpolated in the model as required.

The above procedures give the population dynamics, including the size of the working-age population and the dependency ratio (which equals the ratio of the 0–14 plus 65+ populations to the 15–64 population). These results were employed in Equation (3) in two ways:

(1) The working age population effect: the labour input term is modified from $\boldsymbol{L'} = \boldsymbol{L_{t+\Delta t}^{0.5}/L_t^{0.5}}$ *to* $\boldsymbol{L'} = \boldsymbol{WAP_{t+\Delta t}^{0.5}/WAP_t^{0.5}}$*, where WAP is the working-age population.*

(2) The dependency ratio or added productivity effect. With fewer dependents, the working-age population in principle has greater time to deploy on work and greater disposable income to deploy on things such as investments and education. Any of these effects will cause one or more of the total factor productivity (A'), capital (K') and labour (L') inputs to grow at a faster rate than they would in the absence of the demographic dividend. There are a number of ways in which this could be modelled. I chose one expression for illustrative purposes, without implying that it is the correct or only explanation. The capital input term in equation (3) is modified from $\boldsymbol{K'} = \boldsymbol{K_{t+\Delta t}^{0.5}/K_t^{0.5}}$ to $\boldsymbol{K'} = \boldsymbol{K_{t+\Delta t}^{0.5/DR\hat{}0.04}/K_t^{0.5/DR\hat{}0.04}}$, where *DR* is the dependency ratio. Since the dependency ratio is less than 1, this expression has the effect of slightly increasing the rate of growth resulting from capital inputs. Furthermore, K' is no longer a constant but evolves with the changing dependency ratio.

3.4. Scenarios

The three models above were each deployed to simulate illustrative scenarios, three each in the case of the simple and inequality models, and two for the demographic dividend model. The scenarios were all assessed to 2100; for some long-term planning, such as for water resources, a period of this order is useful

(1) Simple Model: (i) a simulation that results in a good fit to the observed and projected GDP and population growth from 1960 to 2100; (ii) a simulation in which the population grows slightly faster during the second, slowing growth phase, than is given by the function fitted in Figure 5; and (iii) a simulation in which the population grows slightly slower during the second, slowing growth phase than is given by the function fitted in Figure 5. The faster and slower population growth was achieved by changing the slope of the falling part of the log (*PGR'*) – log (GPD/capita) curve to be 11 percent less and 11 percent more than in the good-fit simulation.

(2) Inequality Model: (i) a simulation that results in a good fit to the observed and projected GDP and population growth from 1960 to 2100; (ii) a simulation in

which the wealth per capita is distributed more evenly with the passing of time than is given by the Lorentz curve in Figure 2a; and (iii) a simulation in which the wealth per capita is distributed less evenly with the passing of time than is given by the Lorentz curve in Figure 2a. The second and third scenarios start with the distribution given in Figure 2a, which has a Gini coefficient of 0.31, and evolve linearly with time to new distributions. In the second scenario, the Gini coefficient finishes in 2100 at 0.18, and in the third, it finishes at 0.45.

(3) Demographic dividend model: (i) a simulation that results in a good fit to the observed and projected GDP and population growth from 1960 to 2100, using only the working age population effect in 3.3; and (ii) a simulation in which GDP and population grow according to both the population effect and the dependency ratio effect in 3.3.

4. RESULTS

4.1. Simple Model Simulations

The results of a simple model simulation that is a good fit to the observed historical and projected future GDP and population is shown in Figure 1 (GDP) and Figure 3a (population). The fits overall are very good. However, the observed GDP grows faster than is simulated from 1960 to about 1990, and then slower from about 1990 to 2020. I shall return to this point in the discussion section below but, briefly, it is likely to be a result of factors other than the growth in capital and labour, and the assumed constant total factor productivity growth. The growth of GDP, population, and GDP per capita from 1960 to 2100 is shown in Table 1. Overall, the GDP is simulated to have increased 470 times from 1960 to 2100, with the population increasing 9.1 times and GDP per capita increasing 51.7 times.

Table 1

GDP, Population and GDP per Capita in 1960 (all Models) and Simulated in 2100

Model / Simulation / Year	GDP (1960 = 100)	Population (m)	GDP / Capita
All Models, Values in 1960	100	45.0	2.22
Simple Model, Values in 2100			
Good Fit	46,979	409	114.9
Faster Population Growth	51,565	493	104.7
Slower Population Growth	43,262	347	124.8
Inequality Model, Values in 2100			
Good Fit (Gini 2100 = 0.31)	46,988	409	114.9
More Equal (Gini 2100 = 0.18)	43,947	358	122.8
Less Equal (Gini 2100 = 0.45)	50,195	467	107.5
Demographic Dividend Model, Values in 2100			
No Dependency Ratio Effect	50,961	409	126.2
Dependency Ratio Effect	53,240	409	134.8

The two scenario simulations with faster and slower population growth result in the populations shown in Figure 3a. The population in 2100 of 347 m (slower population growth scenario) or 493 million (higher population growth scenario) are well within the upper and lower 80 percent probabilistic bounds (of 282 and 571 m) of UN (2019a) using the probabilistic method (UN, 2019b). The faster population growth scenario results in a higher GDP through the labour input effect, but in a GDP per capita about 9 percent lower than in the good-fit case. The slower population growth scenario results in lower GDP, but GDP per capita is about 8.7 percent higher than in the good-fit case.

4.2. Inequality Model Simulations

The results of the inequality model simulation that is a good fit to the observed historical and projected future GDP and population are barely distinguishable from the simple model good-fit case (Table 1). The simulation with greater equality leads to a lower population because the population growth rate falls more rapidly with greater equality, as the poorest people gain wealth more rapidly in this scenario. This in turn leads to a smaller GDP, but a larger GDP per capita (Table 1), similar to the slower population growth scenario of the simple model. Conversely, the simulation with less equality leads to a higher population, and higher GDP but lower GDP per capita (Table 1). Again, this is similar to the simple model with faster population growth. However, the degree of change to inequality required to achieve this similarity, as indicated by the Gini coefficients of 0.18 (low population case with much-reduced inequality) and 0.45 (high population case with much increased inequality) are outside all historical experience (cf Figure 2b) and should be considered unlikely to obtain in practice.

4.3. Demographic Dividend Model Simulations

The demographic dividend model simulation with no dependency ratio effect results in a population in 2100 similar to that of the good-fit simple model, but with GDP and GDP per capita similar to the faster population growth simple model scenario. This is because the working-age population grows faster than the population overall. The addition of an additional effect from savings as an investment in capital leads to even faster GDP and GDP per capita growth, without impact on population growth. The population dynamics simulated for the young, working-age, and aged population age groups are shown in Figure 4a, and the resulting simulated dependency ratio is shown in Figure 4b. The model simulates the observed and projected population dynamics reasonably well.

5. DISCUSSION

The results outlined above show that the models can simulate the co-evolution of population and GDP with varying population growth, varying inequality, and varying population age-group dynamics producing a demographic dividend effect. While the scenario simulations do not include cases where the total factor productivity and/or capital input factors are varied, incorporating such variation would be straightforward.

The models simulate the observed and projected population and GDP growth reasonably well. However, they do not perfectly match the observed historical GDP. As shown in Figure 1, the models simulate faster GDP growth from 1960 to about 1990 and

slower growth from about 1990 to 2020, resulting from the increasing rate of population growth in the first period and the decreasing population growth thereafter. Nevertheless, the observed GDP growth in the first period is faster than that simulated, and it is slower than simulated in the second period. GDP growth in Pakistan is influenced by many other factors, including a slowing of total factor productivity (López-Cálix, et al. 2012; Amjad & Awais, 2016; Saleem, et al. 2019), a decline in capital accumulation (López-Cálix, et al. 2012), constraints on growth due to periods of poor foreign exchange reserves (Amjad, 2014), increased terrorism (Sami & Khattak, 2017), and foreign direct investment and remittances (Ullah, et al. 2014; Tahir, et al. 2015).

Incorporating some or all of the other factors into the production function model for GDP growth would not be difficult. However, it is not the purpose of this article to test explanations of GDP growth in Pakistan. Rather, the purpose here is to develop models for the effect of population growth, poverty, and population dynamics. A model that incorporates the full range of factors would obscure the population effects.

The relationship between population growth and economic growth is controversial, with some authors arguing that population growth enhances economic growth, while others conclude the opposite (as reviewed by Peterson, 2017). Peterson (2017) notes that a high economic growth rate may be associated with a high population growth rate, but this will not necessarily produce growth in per capita GDP. The simple model scenarios resulted in lower population growth associated with higher growth in per capita GDP, and vice-versa. The scenarios assumed independence of per capita economic growth and population growth; more precisely, the total factor productivity and capital input growth effects in Equation (3) were assumed not to be affected by population growth. Peterson (2017) notes that this is not necessarily the case. As noted above, the total factor productivity has slowed in Pakistan (López-Cálix, et al. 2012; Amjad & Awais, 2016; Saleem, et al. 2019), and the population growth rate has slowed over the same period (as shown in Figure 3b). Testing alternative assumptions about total factor productivity and capital input growth effects would be straightforward with the simple model (and with the two other models).

The inequality model incorporates the overall population growth effect of the simple model, and for a base case in which inequality is set at the historically observed level, it produces results very similar to those of the simple model. As noted above, however, the similarity is achieved with assumptions about the degree of change in inequality that are outside historical experience and are unlikely in practice. The inequality model then adds the association between income level and family size (noted in Pakistan by Qureshi & Arif, 2001; ADB, 2002; Hyder, et al. 2010; Arif, 2013; Majeed & Malik, 2015; Ibrahim, et al. 2019; Baulch & McCulloch, 1998) postulated as an association between population growth rate and income. This model can be used to examine the implications of inequality on population and GDP growth (cf. Shahbaz, et al. 2013; Soharwardi, et al. 2018).

The third model introduces the impact of the changing age structure of the population in Pakistan, and hence the prospect of a demographic dividend. The results of this model are consistent with the observations of Amjad (2013) that the onset of a demographic transition has as yet limited impact on economic growth. However, consistent with Choudry & Elhorst (2010) and Iqbal (2015), the impact may be greater in the future.

While it is not the purpose of this paper to assess or explain future projections of population and GDP, a few remarks may nevertheless be made. As noted in the Introduction, In the decade to 2020, Pakistan's population grew at a little more than 2 percent per year, and its gross domestic product (GDP) grew at about 4 percent per year. In terms of Equation (3), the contribution to GDP growth of the labour input term (L') for the simple and inequality models is about $1.02^{0.5}$, or about 1 percent per year. The other approximately 3 percent per year results from the combined total factor productivity (A') and capital (K') input terms. By 2100, the population according to UN (2019a) will have just started to shrink, so under the assumption that A' and K' remain constant, the GDP growth by 2100 for the simple and inequality models will be around 3 percent per year. The demographic dividend model based on the working age population effect alone produces a similar result for GDP growth at 2100. However, if there is also a dividend resulting from the lesser dependency ratio boosting GDP growth (perhaps through savings as investment in capital, used here as an illustrative example), the GDP growth will be greater (under the assumption that A' and K' remain constant). Given these competing influences, the projection of 4.1 percent annual growth in GDP assumed here (and broadly consistent with PWC, 2017) is not unreasonable. However, as noted by Bloom, et al. (2011) and Bongaarts, et al. (2013), capturing the benefits of the demographic dividend is not automatic but requires the right policies. The UN population projections, while they recognise that socio-economic factors influence population growth, do not explicitly use them in the calculations (UN, 2019b).

Since all three models have produced broadly similar results, they are not suited to discriminating amongst explanations of the links between population growth and GDP growth. Their purpose, as noted, is to test assumptions and influences on broader issues of long-term planning, such as food and water security.

The unified growth theory of Galor (2005, 2010) seeks to explain human development in the very long run. Galor (2010) discussed the recent demographic transition as resulting in part from the evolution of preference for having fewer offspring, but devoting more resources to the education of those offspring (Galor terms this quality or human capital). The evidence and the models presented here are consistent with this aspect of the unified growth theory. Figure 6 shows a slightly declining birth rate up to a GDP per capita of about 5 (with GDP given as an index with 1960 = 100, divided by the population in millions), after which the birth rate declines steeply. The onset of the steeper decline occurred around 1980–85. Figure 5 shows that in the early period when the birth rate was only slightly declining, the population growth rate was increasing. This is because the death rate was falling rapidly during this period (UN, 2019a). From about 1980–85, the decline in the death rate slowed (because it began to reach lower levels and so had less far remaining to fall), and the birth rate began to fall rapidly, and so Figure 5 shows the reversal of the population growth rate at the same GDP per capita (and hence the same time) as the decline of the birth rate in Figure 6. Evidently, parents started to have fewer offspring around 1980–85, somewhat after death rates had begun to fall. The case of Pakistan and the models derived here are consistent with the unified growth theory idea that with increasing wealth, parents have fewer offspring and invest more in human capital.

Finally, the models presented here shed light on what might be achieved by way of population growth and GDP growth, but they do not tell us how to achieve particular

outcomes. The scenarios indicate that lower population growth appears achievable in the sense that the simulated lower population is well within the 80 percent probabilistic bounds of the UN (2019a). If achieved, this would render planning for future resource demands (such as water and food supply) easier, and also be associated with higher per capita GDP. Such a future is consistent with the vision propounded in Vision 2025 (Planning Commission, 2014) and by the World Bank (2019), which suggests that reducing population growth in Pakistan is necessary for economic growth. The scenario analyses suggest that, whatever the merits of reducing inequality in Pakistan, it is alone insufficient to result in substantial reductions in population; as noted above, the degree of change in inequality required is quite unlikely to be realised in practice. The scenarios assessed with the demographic dividend model suggest that there is a substantial opportunity to capture the economic dividend in the coming decades, consistent with the suggestion of Choudry and Elhorst (2010). If this is achieved, there is the prospect of substantial gains in GDP and GDP per capita.

6. CONCLUSIONS

We conclude that the three population—GDP growth models presented here are well suited for their intended purpose, which is to help examine trends in population growth and economic growth. The models simulate the co-evolution of population and GDP as affected by GDP growth input factors, population growth rates, wealth inequality, and population age dynamics leading to a demographic dividend. They are consistent with theories of population and economic development.

Pakistan has the opportunity to change its population growth and GDP growth trajectory. Policies should aim to slow population growth, which in turn will ease future challenges such as planning for water and food security and could also lead to a reduction in poverty through greater GDP per capita. In the coming decades, there will be a higher ratio of workers to dependents. Policies should aim to capture this demographic dividend, by ensuring that the dividend is directed to purposes such as infrastructure investment rather than consumption; if successful, there will be substantial gains in GDP and GDP per capita, again potentially leading to a reduction in poverty. On the other hand, reducing inequality, while undoubtedly desirable on other grounds, appears to be marginal in terms of lowering population growth or raising GDP.

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Total Factor Productivity and Economic Growth in Pakistan: A Five-Decade Overview

OMER SIDDIQUE

This paper traces Pakistan's TFP and GDP growth from 1972 to 2021. The analysis shows that Pakistan's TFP and economic growth have declined over time. The sectoral—agriculture, industry, and services—trends are also not different. The TFP and GDP growth rates of the total economy and the three sectors were the highest in the 1980s. In general, whenever TFP growth has increased, Pakistan's economic growth has also increased. The analysis further shows that whenever attempts were made to deregulate and liberalise the economy, it resulted in higher TFP growth and consequently higher GDP growth. Similarly, macroeconomic and political stability also seems to be important factors in higher TFP and GDP growth. The comparison with other countries shows that Pakistan's TFP growth performance has been reasonable, especially when compared with India. At the same time, however, the experience of other countries shows that to achieve GDP growth above 8 percent, Pakistan needs to enhance its productivity growth to 3 percent or above.

JEL Classifications: O4, D24, Q1, L60, L80
Keywords: Economic Growth and Aggregate Productivity, Total Factor Productivity, GDP Growth, Agriculture, Industry, Services

1. INTRODUCTION

The evolution of total factor productivity (TFP) is a key determinant of long-run output growth. There is substantial evidence available that shows that the countries that managed to boost their TFP grew at a much higher rate and for a sustained period. The Second Industrial Revolution resulted in unprecedented improvements in technology, altering human life in significant ways, and resulting in income increases that lasted well into the 20th century, as explained by Gordon (2016). For a much more recent period, Yalçınkaya, et al. (2017) show that in G7, G12, and G20 countries, TFP growth has a greater impact on GDP per capita growth than fixed capital formation and employed labour. According to Warren Buffet, TFP is the 'secret sauce' in the US economic success story over the last 150 years (Lambert, 2016). On the other hand, those countries that managed to grow impressively without the significant contribution from the TFP growth,

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could not sustain their growth. Economic growth that is based on the expansion of inputs rather than on an increase in output per unit of input is inevitably subject to diminishing returns. Impressive economic growth in the Soviet Union in the 1950s and the 1960s, for example, was based entirely on savings. Therefore, unless the economies do not learn to produce more and better output more efficiently, they will suffer the law of diminishing returns (Krugman, 1994).

The TFP reflects a shift in the production function arising from technological progress (Barro, 1999). It may also increase economic growth by allocating inputs more appropriately and efficiently, resulting in production getting very close to the optimum combination of inputs and outputs (Balk, 2001). A country may produce at the production possibility frontier but improvements in technology push the frontier out and enable more output to be produced for given factors of production. The concept of TFP growth essentially incorporates technical change and improvements in economic efficiency in the use of factor inputs. The TFP may also contribute to higher economic growth through the effect that economies of scale have on changing the scale of operations (Jorgenson and Griliches, 1967). According to Bosworth and Collins (2008), the TFP not only measures technical efficiency but can also be attributed to several sociopolitical and economic factors, such as government policy, institutions, market structure, or weather shocks that determine the efficiency of factor use.

Keeping in view the importance of TFP growth for long-run economic growth, in this paper, an account of Pakistan's output and TFP growth rates for the total economy as well for three main sectors, viz. agriculture, industry, and services sectors is presented. A contribution of this paper is that it uses data at 2015-16 constant prices for the whole economy as well as for three main sectors, i.e., agriculture, industry, and services. To the best of our knowledge, this has not been done so far for Pakistan. Secondly, we used data till 2021, which is the latest year for which the final data (final means revised and final figures and not provisional figures) are available. Therefore, this paper presents an updated and latest account of TFP growth in Pakistan's economy.

The paper is organized as follows. In Section 2, methodology and data are discussed. Section 3 presents trends and analyses of the GDP growth rate, TFP growth rate, and investment-GDP ratio are presented for the total economy. In Section 4 the contribution of TFP and factor inputs are discussed, while Section 5 presents a comparison of Pakistan's TFP and output growth with selected countries. The sectoral output and TFP growth, and investment trends are discussed in Section 6, while Section 7 summarises the intersectoral comparison. The discussion is summarised in Section 8.

2. METHODOLOGY AND DATA

2.1. Methodology

In this paper, total factor productivity (TFP) is estimated using the standard growth framework based on the neoclassical production function of the following form:

$$Y = F(A, K, L) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

In Equation 1, Y is real output, K is capital stock, L is the employed labour force, and A is the residual term, which is the TFP.

Equation 1 can be written in the growth form as follows:

$$g^Y = \alpha g^L + (1 - \alpha) + g^{TFP} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

g^Y denotes the growth rate of output, g^L denotes the growth rate of labour, g^k denotes the growth rate of capital, g^{TFP} denotes the growth rate of the TFP, α is the share of labour in output, and *(1-α)* is the share of capital in output. According to Equation 2, the output growth rate is a weighted average of growth in the employed labour force, capital stock, and technological progress, given by the growth of the TFP, and the weights are shares of labour and capital.

Assuming that output and inputs can be observed, the TFP can be calculated using the following equation:

$$g^{TFP} = g^Y - \alpha g^L - (1 - \alpha) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

The TFP can be estimated using either regression techniques or the growth accounting framework. For our analysis, the growth accounting framework is used, assuming that the output in the economy can be approximated by constant returns to scale Cobb-Douglas production function.

Following Romer (1990), a human capital variable is also added to the model. The, thus, becomes:

$$Y = (K)\ (LH)^{(1-\alpha)} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

In the above equation, all the variables are the same as in Equation 1, except for LH, which is the human capital-augmented employed labour force. This variable captures increases in labour productivity as a result of educational attainment and is calculated by using the mean years of schooling. We assume that an additional year of education raises the level of productivity by 7 percent following López-Cálix, et al. (2012).

Writing Equation 4 in the growth form, it becomes:

$$\Delta \ln (Y) = \alpha\ [\Delta \ln (K)] + (1 - \alpha)[\Delta \ln(LH)] + \Delta\ln(A) \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

Using Equation 5, TFP growth is estimated as:

$$\Delta\ln(A) = \Delta \ln (Y) - \alpha\ [\Delta \ln (K)] - (1 - \alpha)[\Delta \ln(LH)] \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

Different studies assume different factor shares. For the analysis in this paper, using data from the Asian Productivity Organisation, the share of capital is assumed to be 0.5008 and that of labour 0.4992.

2.2. Data

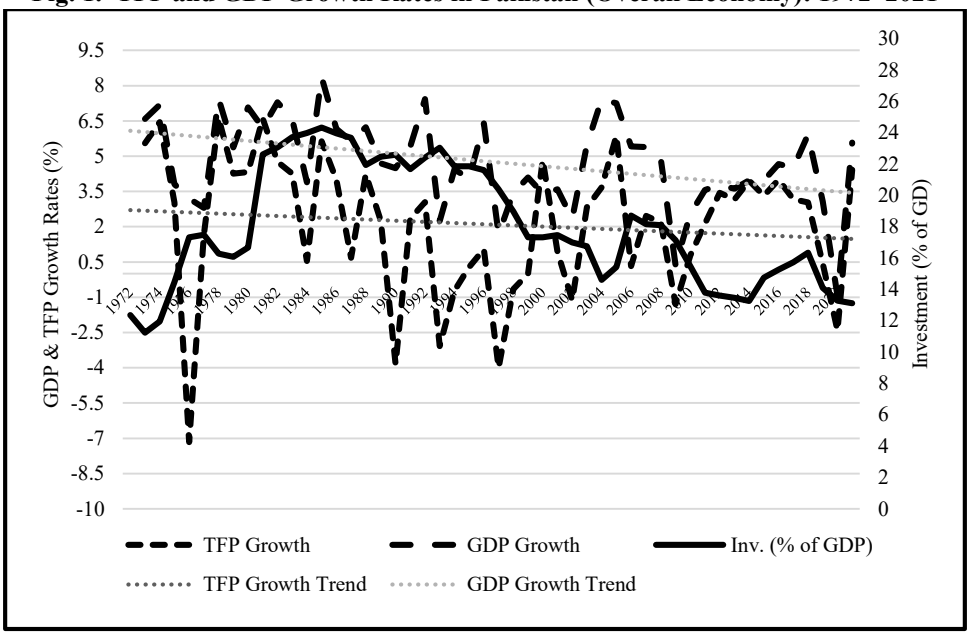
The data used in the analysis is at 2015-16 constant prices. Data on GDP (total economy and its sectors, i.e., agriculture, industry, and services) gross fixed capital formation (GFCF) (total economy and its sectors, i.e., agriculture, industry, and services) and employed labour force (total economy and its sectors, i.e., agriculture, industry, and services) are obtained from various issues of the Pakistan Economic Survey. Since data for the entire period of analysis (1972-2021) is not available at one base, the data at older bases (1959-60, 1980-81, 1990-00, and 2005-06) are converted to 2015-16 constant prices using the splicing method. Values for some years are missing, especially for the employed labour

force and human capital, which are interpolated. The capital stock series is estimated using data on the GFCF at constant prices and depreciation rate (δ). The data on the depreciation rate is obtained from Penn World Tables (PWT 10.0). The proxy used for human capital is the average years of schooling, which is obtained from PWT 10.0. The capital stock is estimated using the standard perpetual inventory method (PIM), which is the most widely used method to estimate capital stock. The details of estimating the capital stock are given in the Appendix.

3. EVERY FIGURE TELLS A STORY—DECLINING TRENDS IN TFP, GDP, AND INVESTMENT

Figure 1 tells the story of Pakistan's declining output and TFP growth rates since 1972. The fact that Pakistan's growth experience has been erratic and that the long-term growth rate is on a downward spiral is now well established. The analysis herein reaffirms these facts. Figure 1 clearly shows declining trends in the GDP growth rate, the TFP growth rate, and in investment as a percentage of GDP. According to our estimates, the TFP grew, on average, at 1.77 percent per annum, which is reasonable when compared internationally. However, the figure clearly shows the volatility in GDP and TFP growth rates—brief spurts followed by slumps. It also shows that GDP and TFP growth rates, and investment as a share of GDP have followed the same path. In other words, whenever the TFP growth has increased, there has also been an improvement in the GDP growth rate and vice versa. Though it does not establish causality, the literature and experiences of other countries show that TFP growth leads GDP growth. In Pakistan's case as well, there is an indication of a strong relationship between TFP and GDP growth rates. This implies that TFP growth has led GDP growth in Pakistan.

Fig. 1. TFP and GDP Growth Rates in Pakistan (Overall Economy): 1972–2021



Source: Author's estimations.

The downward trend of Pakistan's GDP and TFP growth rates since the 1970s illustrates the structural weaknesses that have plagued its economy. The inconsistent economic performance is indeed a puzzle despite various reform efforts undertaken, with support from international agencies and institutions. It highlights little or no impact of these reforms on improving structural weaknesses and economic efficiency. Table 1 shows the growth rates of GDP and TFP during the overall period (1972-2021) and different decades. Pakistan's average economic growth during the last 49 years (1972–2021) has been anaemic 4.75 percent.

Table 1

Sources of Growth in Pakistan's Economy:1972-2021

	Annual Average Growth (%)				Annual Average
Period	GDP	Capital	Labor	TFP	Investment (% of GDP)
1972-2021	4.75	3.14	2.82	1.77	17.96
1972-1980	5.06	0.13	5.14	2.44	14.87
1981-1990	6.00	5.89	0.47	2.81	23.23
1991-2000	4.01	5.35	3.53	–0.43	20.65
2001-2010	5.06	1.23	4.62	2.13	16.88
2011-2021	3.92	–0.12	2.61	2.68	14.24

Source: Author's estimations.

As Table 1 indicates, GDP, TFP, and capital grew at the highest rates during the 1980s. The growth rate of employed labour was below 1 percent during that period. Hallmarks of this period were halting the nationalisation regimes of the 1970s and the revival of private industrial investment (Anjum & Sgro, 2017). It is argued that although there were not many reforms in the 1980s, the industrial policy framework emphasised the role of the private sector and greater import liberalisation of industrial raw materials (Mahmood, et al. 2008). However, it is also argued that the impressive economic performance of the 1980s was not due to sound economic policy or institutional reforms, it rather came on the back of the large public sector investments made in the 1970s, such as Tarbela Dam, fertiliser, and cement factories (Husain, 2010). Table 1 also shows that TFP was the highest in the period (the 1980s) when the investment-GDP ratio was also the highest at 23.23 percent. The role of investment is important because innovations, R&D, and new technology are embodied in the new investment, which helps the TFP grow and thereby boost economic growth.

In the 1990s, also sometimes remembered as Pakistan's "lost decade", the economy took a turn for the worse: TFP growth turned negative at –0.43 percent and the GDP growth rate, unsurprisingly, declined to 4.01 percent. There are many explanations, such as soaring external and public debts, for the lacklustre performance of Pakistan's economy during the 1990s. Although significant liberalisation reforms were introduced in the 1990s, the policy environment was unstable in terms of rules, taxes, and import tariffs. Particularly, the policy environment was dominated by the arbitrary use of statutory regulatory orders (SROs), which affected the level playing field.

López-Cálix, et al. (2012) argue that the decline in TFP growth in the 1990s—a period of trade liberalisation and other economic reforms—was not caused by trade liberalisation, but by what they see as poorly sequenced economic reforms together with macroeconomic instability and the failure of policymakers to implement and sustain reforms. They note that financial sector reforms in the 1990s were implemented before substantial reforms on the fiscal side. As a result, during the 1990s government finances were under stress due to higher borrowing costs emanating from financial liberalisation. They conclude that unless Pakistan's record in structural reforms improves, the TFP will not improve and that "reform is fragmented and littered with a myriad of policy reversals (p. 11)."

According to Hussain (2010), the 1990s were marred by poor macroeconomic management and political instability. Due to these reasons, the policies of economic liberalisation, deregulation, and privatisation could not affect growth positively. Although many liberalising steps were taken, such as the removal of non-tariff barriers, due to political uncertainty and frequent changes of governments, it did not translate into higher economic growth.

In fact, the poor performance of the economy in the 1990s is often attributed to macroeconomic imbalances carried over from the 1980s. During the 1980s, defence spending increased by 9 percent per annum which resulted in the soaring debt burden in the 1990s. Coupled with high defence expenditures, low development spending, which rose by 3 percent per annum, also contributed to slow growth in this "lost decade".

The TFP growth rate improved during the 2000s to 2.13 percent and so did the GDP growth rate, which was 5.06 percent. The improvement in the growth rate in the 2000s can be attributed to improvements in stabilisation policies and, most importantly, to structural reforms. There were improvements in trade openness and financial depth. It is argued in the literature that the growth in the 2000s took place due to better macroeconomic fundamentals, structural reforms, institutions, governance, and private sector dynamism (Muslehuddin, 2007). Certain structural reforms, i.e., financial sector restructuring, privatisation, liberalisation and deregulation of the economy and bank reforms, leading towards a market-led economy, were undertaken. The privatisation process was pursued; the focus was on banking, telecommunication, oil and gas and the energy sector. The relaxation of sanctions post-September 2001, which were imposed in the wake of nuclear detonations in 1998, also helped improve the economic conditions in the 2000s. Pakistan also received significant funding from the US for supporting the War on Terror. Overall, a favourable external environment led to improvements in TFP and GDP growth rates.

In the 2010s, the GDP growth declined to 3.92 percent from 5.06 percent in the 2000s. What is surprising though is the impressive growth rate, by Pakistan's standards, of the TFP. It grew at 2.68 percent during this period, which is higher than TFP growth rates in all the decades except for the 1980s. In the 2010s, the TFP growth rate accounted for almost half of the GDP growth during the decade. It may reflect the growing contribution of the services sector to Pakistan's economy, which requires less investment as compared to the industrial sector. Moreover, an increase in capacity utilisation, especially in the latter half of the decade, which was lying idle due to the energy crisis in the first part of the 2010s could have also contributed to an increase in TFP growth during the decade.

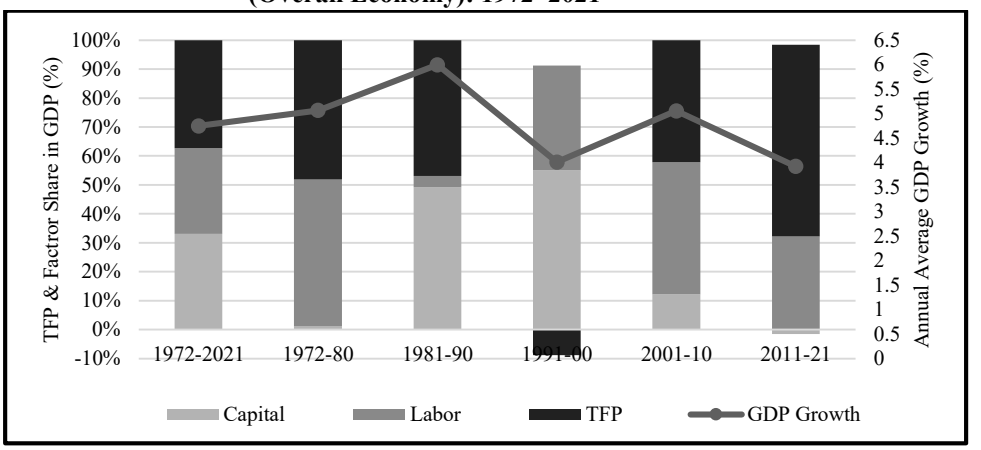
According to the literature on Pakistan's growth experience (see, for example, Favaro & Koehler-Gieb, 2010; Husain, 2010; World Bank, 2010; López-Cálix et al., 2012),

high productivity growth periods coincide with periods of deregulation, especially in finance and insurance. The same could be the reason for high TFP growth in the 2010s despite a low investment-GDP ratio and modest GDP growth. In the 2000s quite a few reforms were undertaken to liberalise the financial sector of Pakistan. The increase in TFP growth during the 2010s may have been a result of liberalisation undertaken in the preceding decade. For example, tariffs were rationalised in 2005-06. Similarly, the financial sector was liberalised considerably during the 2000s, which perhaps bore fruits in the 2010s, which is evident from impressive TFP performance during the decade.

4. INPUT AND TFP CONTRIBUTION TO GDP GROWTH

Figure 2 below shows the relative contributions of TFP and factor inputs to GDP growth rates from 1972 to 2021 and decade-wise. As the figure indicates, whenever average TFP growth increased in a decade, Pakistan's GDP growth also followed suit, an exception being the 2010s. During the 1990s, the GDP growth rate declined from 6 percent in the 1980s to 4 percent, which is reflected in a negative contribution of the TFP contribution to GDP growth. In the 2010s (2011-2021), although TFP growth increased, GDP growth registered a decline. Capital input contributed the most in the 1990s. It contributed approximately 67 percent of the GDP growth during the decade. Labour's contribution was the highest during the 1970s at approximately 50 percent, whereas the labour input's contribution was the lowest (3.91 percent) in the 1980s. For the entire period (1972-2021), factor inputs contributed almost 67 percent to GDP growth whereas the rest 33 percent was contributed by TFP growth.

Fig. 1. Share of TFP and Factor Inputs in GDP Growth (Overall Economy): 1972–2021



Source: Author's estimations.

The contribution of human capital-augmented labour to output growth has been low for a labour-intensive country such as Pakistan. The modest contribution of labour input is also observed by others, including Amjad & Awais (2015) and López-Cálix, et al. (2012). The low contribution of labour may be due to low levels of average years of schooling, i.e., human capital in the economy. Although the employed labour force has grown over the years, the growth in human capital has been modest, which grew by 2.76 percent from 1972 to 2021.

As shown in Table 2, Pakistan's low TFP growth rate is also documented by various other studies. The studies cited in Table 2 report the TFP growth rate ranging from 1.08 percent (Saleem, et al. 2019) to 2.2 percent (Pasha, et al. 2002). The contribution of TFP to GDP growth rate ranges from 22.59 percent (Saleem, et al. 2019) to 40 percent (Pasha, et al. 2002). A word of caution is warranted, though, when comparing the results of different studies. There is a vast literature on growth accounting that points out that TFP estimates are highly sensitive to the period of analysis, data used, base period, factor shares, and the methodology employed (see, for example, Srinivasan, 2005 & Hulten, 2000). The above caveat notwithstanding, the analysis of sources of growth in the economy's main sectors (agriculture, industry, and services) further corroborates low TFP growth in Pakistan resulting in low GDP growth.

Table 2

Total Factor Productivity in Pakistan: Cross-Study Comparison

Study	Period	GDP Growth (%)	TFP Growth (%)	TFP Contribution (%)	Factor Input Contribution (%)
Saleem, et al. (2019)	1976-2016	4.78	1.08	22.59	77.41
Amjad & Awais (2015)	1980-2015	4.80	1.70	35.42	64.58
López-Cálix, et al. (2012)	1980-2010	5.00	1.40	28.00	72.00
Chaudhry (2009)	1985-2005	4.10	1.10	26.83	73.17
Sabir & Ahmed (2003)	1972-2002	5.10	1.80	35.29	64.71
Pasha, et al. (2002)	1973-1998	5.50	2.20	40.00	60.00
This study	1972-2021	4.75	1.77	37.30	62.70

5. INTERNATIONAL COMPARISON

Pakistan's TFP growth rate, compared internationally, is not very low. As can be seen from Table 3, Pakistan's TFP growth rate of 1.77 percent from 1972 to 2021 was only lower than that of Taiwan, which was 2.39 percent during 1970-2020. Despite a reasonable TFP growth rate, Pakistan's GDP growth has remained below par. On the other hand, India, despite having a lower TFP growth rate than Pakistan, grew at above 5 percent per annum from 1970 to 2020. However, the decade-wise breakdown of TFP and GDP growth rates shows that higher TFP growth rates have been accompanied by high GDP growth rates. For example, in the 1980s, a higher TFP growth rate in Pakistan was accompanied by a higher GDP growth rate. South Korea grew by over 10 percent when its TFP growth rate was above 3 percent in the same decade. The other decades show a similar pattern. However, as mentioned above, in the 2010s, although Pakistan's GDP growth declined, its TFP growth rate increased, whereas other countries' TFP growth as well as GDP growth declined from the previous decade.

Table 3

GDP and TFP Growth Rates (%): Cross-Country Comparison

	1971-2017		1971-1980		1981-1990		1991-2000		2001-2010		2011-2017	
Country	GDP	TFP	GDP	TFP	GDP	TFP	GDP	TFP	GDP	TFP	GDP	TFP
Pakistan	4.75	1.77	5.06	2.44	6.00	2.81	4.01	–0.43	5.06	2.13	3.92	2.68
India	5.43	1.66	3.30	0.01	5.01	1.84	5.65	2.26	8.01	2.60	5.76	2.04
China	7.98	1.54	4.67	–0.73	8.58	2.35	8.63	1.98	9.98	2.35	5.67	1.05
South Korea	7.12	1.30	9.86	1.65	10.31	2.36	6.49	1.63	4.55	0.92	2.55	0.74
Taiwan	6.76	2.39	10.08	3.06	9.19	3.99	6.51	2.09	4.63	1.71	2.79	1.00

Source: For Pakistan, the estimates are based on our calculations from 1972 to 2021. For other countries, the estimates are based on the Asian Productivity Organization (APO) dataset 2022.

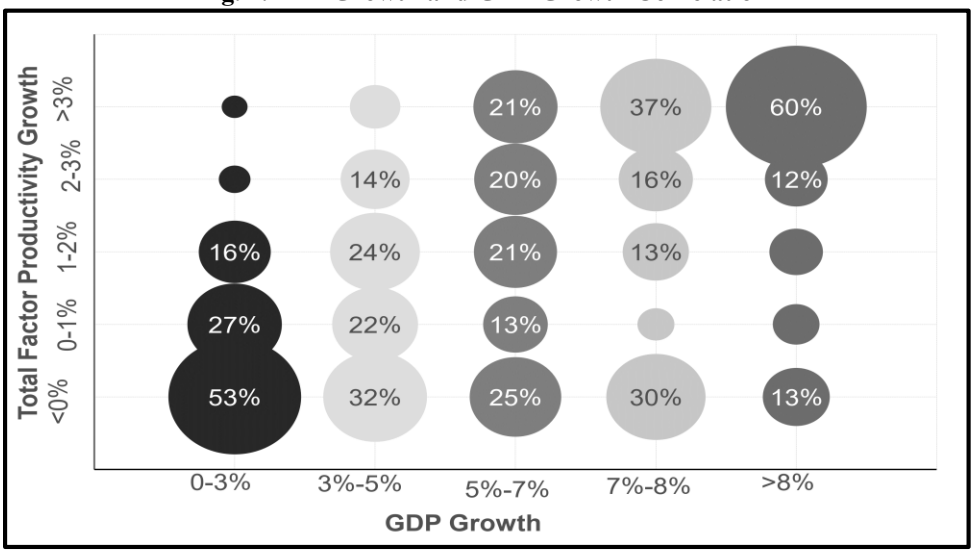
Note: For Pakistan, the period is 1972-2021.

As regards India, one reason for low TFP growth in the Indian economy could be that the TFP growth in its manufacturing and agriculture sectors has been low, pulling down the overall TFP growth. Economic growth in India picked up in the 1990s, which was due to, among other things, the remarkable performance of its services sector. The TFP growth in India's services sector has been impressive, averaging 3.9 percent during 1993–2004 (Bosworth & Collins, 2008).

Therefore, international evidence suggests that to achieve and sustain high growth rates, productivity improvement is crucial. It is especially important for developing countries, such as Pakistan, which are far away from the productivity frontier. In the case of developed countries, such as Japan or the US, the productivity slowdown or stagnation does not matter much because they are already at or near the productivity frontier. Their higher standards of living have been achieved through technological progress.

The importance of TFP growth for high GDP growth is highlighted by Citi GPS (2018) report. The report shows that a 3 percent growth in TFP is a good threshold to explain high GDP growth economies. As shown in Figure 3, in 60 percent of the economies that experienced GDP growth of more than 8 percent, TFP growth was more than 3 percent. Conversely, TFP growth higher than 3 percent ensured that in at least 50 percent of the cases, the GDP growth for that year exceeded 8 percent.

Fig. 2. TFP Growth and GDP Growth Correlation



Source: TED, Citi Research [Citi GPS (2008)].

Note: Bubble size represents the percentage of instances at different levels of GDP growth. For example, if GDP growth is higher than 8 percent, then in 60 percent of cases TFP growth is greater than 3 percent.

If TFP growth was between 2-3 percent, then in 66 percent of the sample points, GDP growth was between 3-7 percent. Sustained average TFP growth of more than 3 percent was achieved only by China in the 1980-2010 period. Some other countries have sporadically achieved such sustained growth in TFP, such as Japan (the 1960s), Germany (the 1950s), Brazil (the 1950s and the 1970s), and Turkey (the 1950s and the 1960s). Sustaining TFP growth above 3 percent over a longer period, however, is a difficult task.

6. DIGGING DEEPER—SECTORAL OUTPUT AND TFP GROWTH

6.1. Agriculture

During 1972-2021, the agriculture sector contributed around 29 percent to the GDP and absorbed almost 47 percent of the employed labour force. Over the years, agriculture's share in Pakistan's economy has contracted. During the 2011-21 period, the agriculture sector's share, on average, in the economy has come down to almost 24 percent and the employed labour's share has reduced to 42 percent. Despite its declining share in output and employment, it is still an important sector. It is a source of livelihood for a major segment of Pakistan's population and fulfils the food requirements of the country. It is also a source of raw materials for other industries in Pakistan. Besides, the sector also has linkages with small-scale industries, such as motorcycles and other consumer goods.

Table 4 shows the sources of growth and investment-GDP ratio in agriculture. The decline in the share of the agriculture sector is a stylised fact and is often accompanied by an increase in TFP growth (Favaro & Koehler-Geib, 2009). However, this is not the case for Pakistan. In the agriculture sector, the TFP growth throughout the analysis period was a mere 0.67 percent. Looking at the sub-periods shows that TFP growth has fluctuated widely, ranging from –0.88 percent (the 1970s) to 1.18 percent (2010s).

Table 4

Sources of Growth in the Agriculture Sector in Pakistan

	Annual Average Growth (%)				Investment
Period	Output	Capital	Labor	TFP	(% of GDP)
1972-2021	3.34	5.27	2.03	0.67	4.15
1972-1980	2.68	–0.38	4.54	–0.88	1.25
1981-1990	4.04	15.51	0.04	0.90	7.84
1991-2000	4.18	3.87	3.86	0.32	5.16
2001-2010	3.06	1.68	4.68	–1.02	3.32
2011-2021	2.29	2.48	0.77	1.18	3.03

Source: Author's estimations

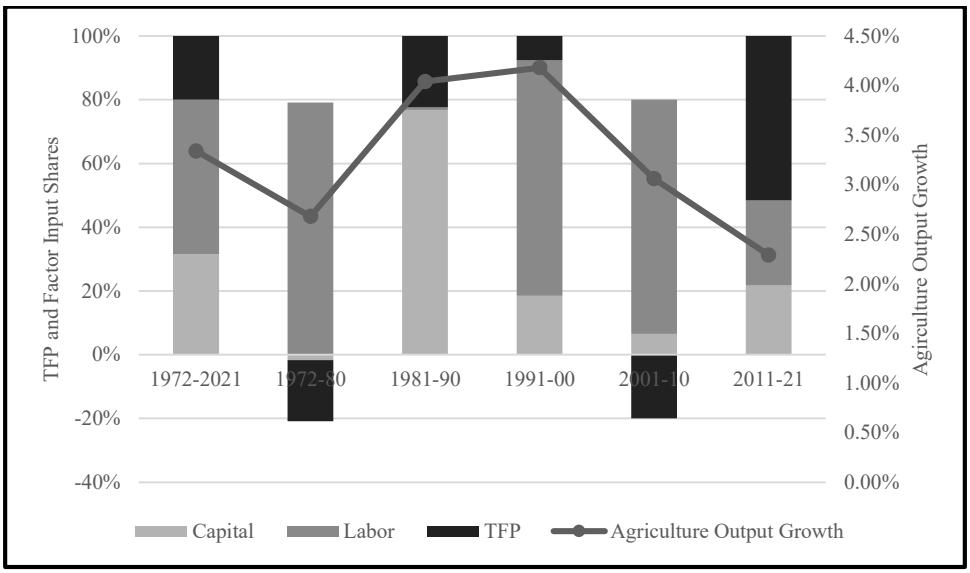
The overall TFP growth rate in the agriculture sector (0.67 percent) in our analysis is similar to what other studies report but the sub-period TFP growth and the share of TFP in agriculture output growth (Figure 4) vary widely across studies. That is due to the different periods chosen as well as the use of different datasets.

The TFP growth turned positive in the 1980s from negative growth in the 1970s. The negative TFP growth in the 1970s may be attributed to the then government's nationalisation programme, which kept the production and distribution of key farm products to itself. The benefit of the rupee's devaluation was also not transferred to the agricultural sector. The agriculture sector was subject to export duties and government monopolies. In the 1980s, as Amjad & Awais (2015) have noted, the better performance of agriculture was partly due to the availability of credit to the farmers, especially to small farmers. This reform increased the use of fertilisers and pesticides. Furthermore, input distribution was liberalised encouraging private firms to distribute and produce these inputs, which were previously subject to many government controls. Several high-yield

varieties were also introduced in the 1980s that contributed to better performance of the agriculture sector in the 1980s as well as in the 1990s.

Although the agriculture sector's performance was respectable in both these decades, Figure 4 shows that the main contributors to the agriculture output growth have been labour—overall as well as in the 1980s, the 1970s, the 1990s, and the 2000s. In the period 2001–10 again, the agriculture growth rate declined to just over 3 percent and the TFP growth rate turned negative. One of the main reasons for the lacklustre performance of agriculture in this decade was drought-like conditions in the earlier half of this decade. High energy costs, resulting in high fertiliser prices also contributed. The period 2011–21 paints an interesting picture. In this period although the agriculture sector grew at a very modest 2.29 percent and the investment was only 3.03 percent of the GDP, the TFP grew at 1.18 percent. TFP growth's contribution to the agriculture output growth in the 2010s is also the highest among all the decades at 51.54 percent.

Fig. 3. Share of TFP and Factor Inputs in Agriculture Output GDP Growth: 1972–2021



Source: Author's estimations.

Due to the potential benefit of the agriculture sector for large parts of the population, addressing the low productivity in agriculture is very important. The literature has identified numerous reasons, but the major reasons are still high levels of government intervention in the production and marketing of crops, low level of education of the rural population, and poor development of the service interface linking farmers to markets. The modern business farm sector or the commercial interface between farmers and industry is not very developed in Pakistan. The presence of such an interface in most countries allows farmers to focus on producing crops and outsourcing outsource supporting services, such as the selection of appropriate seeds, fertilisers, and pesticides, mechanical support to plant and harvest crops, financing of crops, and transportation to farmer cooperatives, associations, or private corporations (Favaro & Koehler-Geib, 2009).

6.2. Industry

The industrial sector, which includes the manufacturing sector, is supposed to be the linchpin of economic activity as structural change takes place. In Pakistan, however, this has not been the case. The share of industrial output in GDP has increased from 18.37 percent in 1972 to only 18.90 percent in 2021. Similarly, the total labour force employed by the industrial sector has increased from 16.7 percent to only 25.3 percent in 2021. As can be seen from Table 5, the performance of the industrial sector since 1972 has been modest, except for in the 1980s when the sector grew at 7.35 percent, on average. The TFP growth rate for the entire period was 1.94 percent.

Table 5

Sources of Growth in the Industrial Sector in Pakistan

	Annual Average Growth (%)				Investment
Period	Output	Capital	Labor	TFP	(% of GDP)
1972-2021	5.30	3.14	3.59	1.94	5.91
1972-1980	6.13	0.13	6.95	2.60	4.66
1981-1990	7.35	5.89	1.99	3.41	8.78
1991-2000	3.45	5.35	2.42	–0.43	8.75
2001-2010	6.01	1.23	5.30	2.75	5.01
2011-2021	3.43	–0.12	4.22	1.39	2.58

Source: Author's estimations.

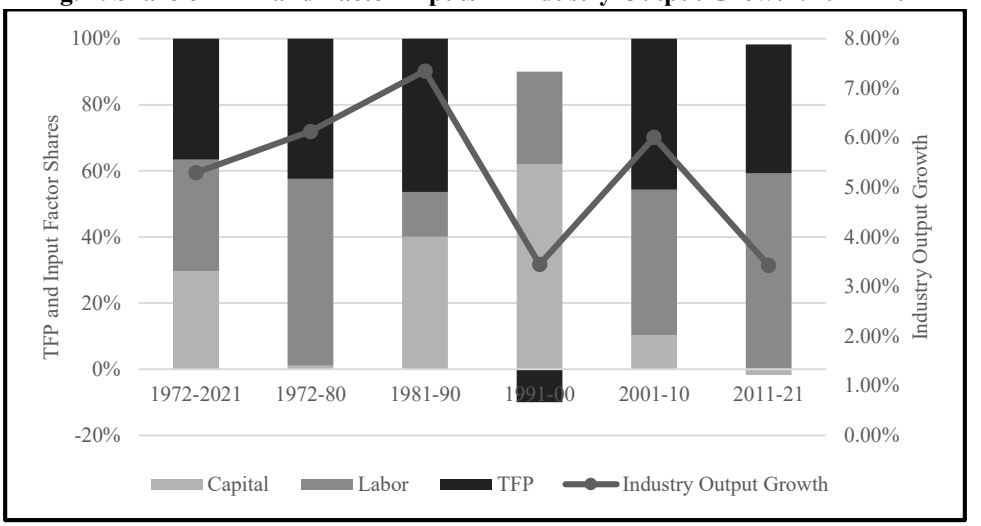
The highest output and TFP growth were observed in the 1980s, which is also the period when the investment-GDP ratio was the highest. The 1990s saw a sharp downturn in industrial output growth and the TFP growth turned negative during this period. Starting from this decade, the investment-GDP ratio in the industrial sector started to decline. Activity in the industrial sector picked up in the decade that followed, i.e., in the 2000s. The industrial output grew at 6.01 percent and the TFP grew at 2.75 percent. The dynamics of the growth in this decade, as also observed by Amjad and Awais (2015), are difficult to explain because the investment-GDP ratio declined from 8.75 percent in the 1990s to 5.01 percent. The capital grew marginally at 1.23 percent but the labour force grew at 5.30 percent. This could be due to the engagement of the idle capacity resulting from a high investment-GDP ratio in the preceding decade. This could also be due to data issues but what is important to note is that there is a strong correlation between output growth and TFP growth.

The last period, i.e., 2010 to 2021 presents an even more intriguing case. During this period although output growth in the industrial sector declined to 3.43 percent, TFP growth, though lower than in the previous decade, is 1.39 percent. The investment rate has also declined in this period to 2.58 percent of GDP.

Figure 5 shows the shares of TFP growth and factor inputs in GDP growth in the industrial sector. The figure clearly shows that the contribution of TFP growth to output growth has been consistently high in the industrial sector, barring the 1990s, when it was negative. Consistent with the overall economy and the agriculture sector, during 2011–21, although the industrial sector's output growth declined sharply to 2.58 percent, TFP growth remained at a respectable 1.39 percent. As Figure 5 further shows, the contribution of

capital in the industrial sector has been modest except for in the 1990s when it contributed over 77 percent to industrial output growth. On the other hand, labour's contribution has remained between 44 percent and 61 percent, except for in the 1980s when it was as low as 13.52 percent.

Fig. 4. Share of TFP and Factor Inputs in Industry Output Growth: 1972–2021



Source: Author's estimations.

6.3. Services

The services sector of Pakistan has become the most important sector in terms of its share in the GDP, which has increased to almost 56 percent in 2011-2021 from about 47 percent in the 1970s. It also employs 35.10 percent of the total employed labour force, up from 26.79 percent in the 1970s. The average output and TFP growth in this sector from 1972 to 2021 was 5.15 percent and 0.42 percent, respectively. The decade-wise patterns are quite similar to those observed in the industrial sector. The output growth rate was high at 6.46 percent in the 1980s, which dropped down to 4.15 percent in the 1990s. The TFP growth rate also turned negative to –0.45 percent. In the subsequent period, however, both the output and TFP growth rates picked up.

Table 6

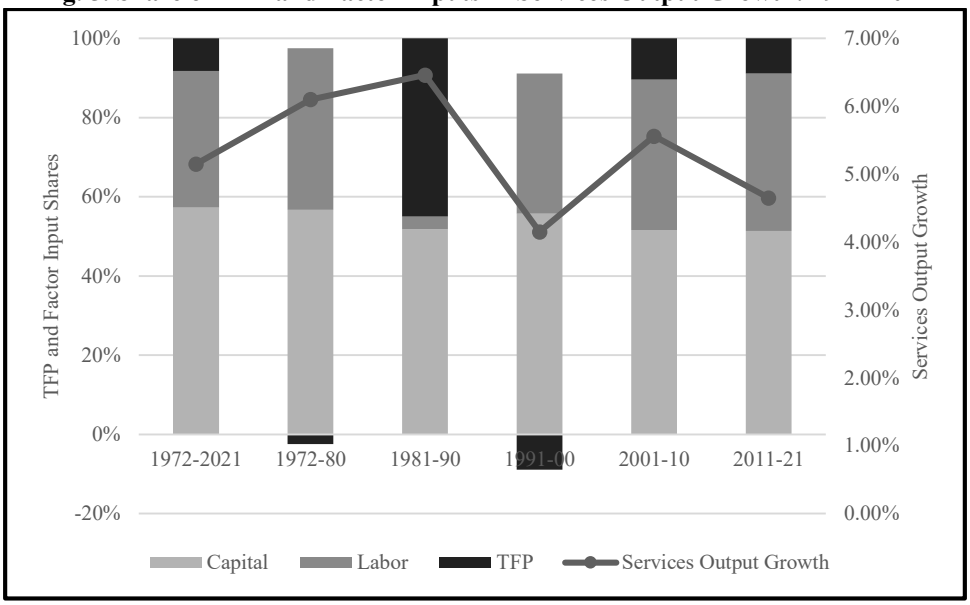
Sources of Growth in the Services Sector in Pakistan

	Annual Average Growth (%)				Investment
Period	Output	Capital	Labor	TFP	(% of GDP)
1972-2021	5.15	5.90	3.56	0.42	8.27
1972-1980	6.10	7.27	5.25	–0.16	8.37
1981-1990	6.46	6.68	0.42	2.91	8.32
1991-2000	4.15	5.61	3.57	–0.45	7.76
2001-2010	5.56	5.73	4.23	0.58	8.73
2011-2021	4.65	4.77	3.71	0.41	8.18

Source: Author's estimations.

During the 2011-2021 period, the output growth rate of the services sector decreased from 5.65 percent in the 2000s to 4.65 percent. The TFP growth rate also decreased from 0.58 percent to 0.41 percent. This pattern of a decrease in both output and TFP growth rates is opposite to the trends in the total economy, agriculture, and industry sectors. On average, the contribution of TFP to output growth was 28.04 percent, which means that in the services sector, the output growth is mainly input driven. The contribution, however, has fluctuated between decades. The highest contribution was in the 1980s and the lowest in the 1990s. On average, the capital input has contributed more to the output growth in the services sector as compared to the labour input.

Fig. 5. Share of TFP and Factor Inputs in Services Output Growth: 1972–2021



Source: Author's estimations.

Despite having the highest investment-GDP ratio among the three sectors, the services sector's performance has been underwhelming. This fact is also highlighted by others, including Amjad & Awais (2015), López-Cálix, et al. (2012), and Pasha, et al. (2002). To understand why TFP growth in the services sector has been low compared to the agriculture and industrial sectors, it is helpful to look at the investment in the subsectors of the services sector.[1] According to the data, the highest investment in the subsectors of the services sector is in the housing services[2] followed by the general government services.[3] In the 2010s, for example, the investment in housing services and general government services averaged about 60 percent of the total investment in the services sector. The financial services sector, which is perhaps the most productive among the services, has the

[1]The subsectors are the following: (i) wholesale and retail trade, (ii) transport, storage, and communication, (iii) finance and insurance, (iv) housing services (including ownership of dwellings), (v) general government services, and (vi) other private services.

[2]The housing services include services provided to tenants as well as (imputed) services provided to the owner of the dwelling.

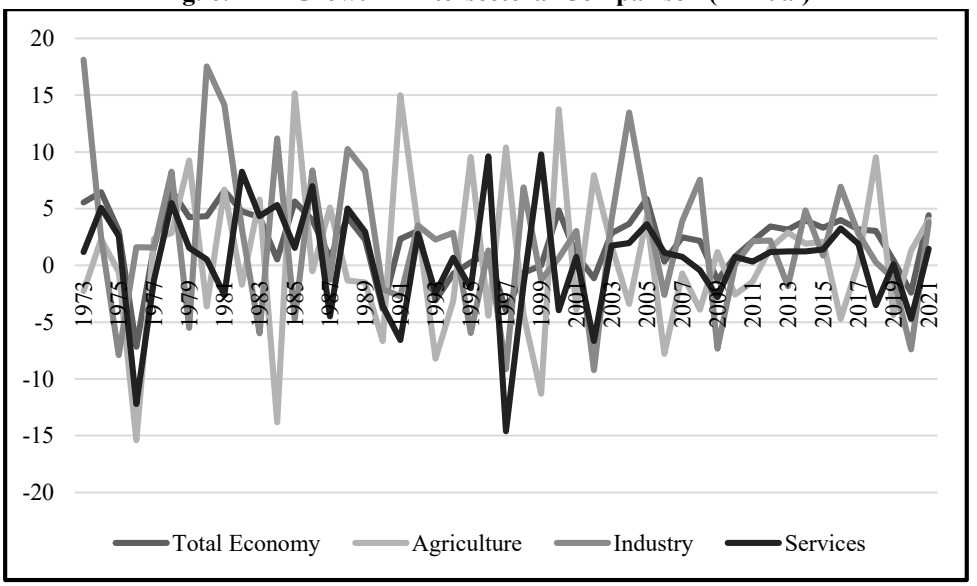
[3]The general government services include public administration and defense services, among others.

lowest investment in the services sector in Pakistan. Both housing services and general government services, although important in terms of their share in the output, are low-productivity sectors. This is perhaps the reason that despite having the highest investment-GDP ratio, TFP growth in the services sector has been low.

7. INTERSECTORAL COMPARISON

TFP growth in different sectors has followed almost the same pattern from 1972 to 2021, as shown in Figure 7 below. There are only a few years in which sectoral TFP growths, especially that of industry and agriculture, moved in the opposite direction. This becomes clearer in Table 7, which presents decade-wise annual averages of TFP growth rates for the total economy and sectors as well. Table 7 shows that the TFP growth rates in different sectors have followed the same path. from the 1990s to the 2000s, TFP growth in the services sector increased from –0.45 percent to 0.58 percent and also in the industrial sector from –0.43 percent to 2.75 percent. On the other than, the TFP growth in the agriculture sector declined from 0.32 percent to –1.02 percent.

Fig. 6. TFP Growth—Intersectoral Comparison (Annual)



Source: Author's estimations

Table 7

TFP Growth — Intersectoral Comparison (Decade-Wise)

	Total Economy	Agriculture	Industry	Services
1970s	2.44	–0.88	2.60	–0.16
1980s	2.81	0.90	3.41	2.91
1990s	–0.43	0.32	–0.43	–0.45
2000s	2.13	–1.02	2.75	0.58
2010s	2.68	1.18	1.39	0.41

Source: Author's estimations.

The reasons for the slump in the agriculture output and TFP growth in the 2000s include drought-like conditions in 2000 and 2001, hostile weather conditions, power cuts, an increase in energy prices that led to an increase in fertiliser prices, and a significant decrease in investment in the agriculture sector. As noted above, the reason for the increase in industrial output and GDP growth rate during the 2000s was structural reforms that led to trade and financial sector openness. Besides, there was macroeconomic and political stability in that period which was missing from the 1990s. As regards the services sector, it also witnessed an increase in output and TFP growth though not as pronounced as in the industrial sector.

8. SUMMING UP AND KEY TAKEAWAYS

Framework for Economic Growth (FEG) concludes that the most crucial problem for Pakistan's growth challenge is its abysmally low productivity (Planning Commission, 2011). It has been almost 11 years since the FEG was published and our analysis shows that Pakistan's GDP and TFP growth are declining. Our results are broadly in concordance with the results found in other studies.

The main results of the analysis are that, on average, whenever TFP growth has increased, Pakistan's economic growth has also increased. On the other hand, whenever factor inputs' share in GDP growth has been more than TFP growth's contribution, the GDP growth has declined, for example, in the 1990s. However, the agriculture sector was an exception in this regard in the 1990s. In the 1990s, the contribution of labour input increased and so did the agricultural output growth. In general, the labour input has contributed the most to the agriculture output growth, except for in the 1980s. On the other hand, in the services sector, the main contributor has been capital input except for in the 1980s.

The analysis in the present paper shows that there is substantial scope for the private sector to invest and lead the economic recovery of Pakistan. In agriculture, for example, there is a need to do away with the government's purchase of the output and setting the prices. Also, the agriculture supply chain can benefit from the presence of the private sector, which encourages competition and ultimately benefits both producers and consumers. In Pakistan's agriculture sector, seeds used are of low quality but the import and the use of imported hybrid seeds, which have significantly higher yields, is not allowed.

Pakistan's economy is also held back by overregulation and the presence of the public sector in the economy. Evidence shows that the government's footprint on Pakistan's economy is as high as 67 percent (Haque & Ullah, 2020). Similarly, excessive requirements of licences and NOCs, also affect investment negatively (Haque & Qasim, 2022). For example, in the housing sector and the construction industry, there is excess demand, but the private sector is held back by overregulation in the form of zoning laws.

Evidence points towards the positive effects of participation of the private sector and deregulation on GDP and TFP growth (Kim & Loayza, 2019), necessitating the opening up of the economy in Pakistan. The decade-wise trends in the TFP growth and GDP growth clearly show that liberalisation episodes in Pakistan's economy have resulted in higher TFP growth leading the GDP growth. Moreover, political stability, which perhaps leads to macroeconomic stability, is also associated with better economic performance in

Pakistan. In this regard, a World Bank study notes, "not only political stability" but high levels of external aid and ability to push through reforms appear associated with growth spurts" (World Bank 2010). However, in Pakistan, the reform efforts to deregulate and liberalise the economy have been sporadic to have any meaningful impact on long-run economic growth.

In the 1980s, as discussed above, the participation of the private sector was encouraged along with greater import liberalisation. On the contrary, in the 1990s despite the introduction of major economic reforms, the economy went into a lull. The main reasons identified for low economic growth are political instability, macroeconomic instability, and an unstable policy environment in terms of rules, taxes, and import tariffs. Particularly, the arbitrary use of SROs distorted the level playing field.

The 2000s saw improvements, albeit mild ones, in stabilisation policies and, most importantly, in structural reforms. There were improvements in trade openness and financial depth. The growth in the 2000s took place due to better macroeconomic fundamentals, structural reforms, institutions, governance, and private sector dynamism (Muslehuddin, 2007). Certain structural reforms, i.e., financial sector restructuring, privatisation, liberalisation and deregulation of the economy and bank reforms leading towards a market-led economy were undertaken. The privatisation process was pursued; the focus was on banking, telecommunication, oil and gas and the energy sector.

APPENDIX

The net capital stock at the beginning of period *t* can be written as a function of net capital stock at the beginning of period $t-1$, K_{t-1}, investment in the previous period I_{t-1}, and consumption of fixed capital stock, D_{t-1}. Hence:

$$K_t = K_{t-1} + I_{t-1} + D_{t-1} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(A1)}$$

Assuming that capital stock depreciates at the rate δ, the capital stock can be written as:

$$K_t = (1-\delta)K_{t-1} + I_{t-1} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(A2)}$$

Iteration of this equation backwards up to the initial period leads to the following equation:

$$K_t = \sum_{i=0}^{\infty}(1-\delta)^i I_{t-(i+1)} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(A3)}$$

PIM requires an estimate of initial capital stock to arrive at a series of capital stock for subsequent years. One way is to guess the initial value and then estimate capital stock for later years, using data on GFCF. However, it is highly arbitrary. Another method reported in the literature to obtain the initial capital stock is to use the following equation:

$$K_{t-1} \approx \frac{I_t}{g_I+\delta} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(A4)}$$

where $K_{t-1}$is initial capital stock, in period $t-1$, I_t is GFCF in period t, g_I is the growth rate of GFCF for the entire period for which the capital stock period is to be estimated, and δ is the capital stock depreciation rate. The rationale behind using the above equation to

estimate initial capital stock is that capital stock and investment grow at roughly the same rate and the growth rate of investment can be used to approximate initial capital stock. Following Berlemann and Weselhöft (ibid.), we regress GFCF on time to derive initial investment for the period t, using data from t_2 to T. Specifically, the following equation is used to estimate initial investment, using the OLS method:

$$lnGFCF_t = \alpha + \beta \cdot Time + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(A5)}$$

Next, using the estimated parameters, α and β from Equation 3, the fitted value of the investment for period t is calculated using the following equation:

$$ln\widehat{GFCF}_{t1} = \alpha + \beta \cdot Time_1 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(A6)}$$

This gives a series of investment, ranging from t to T, using the exponential function. the first value of the fitted investment for t to calculate initial capital stock, using Equation A6. Instead of calculating the growth rate of investment, g_I, calculated from the data, β as a measure of trend investment growth is used. The capital stock for subsequent years is then calculated using Equation A2 above.

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Evaluating Yield Gap and Yield Improvement Potential in the Dairy Sector of Pakistan

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A survey data of 600 dairy farms obtained from the largest dairy cluster in Pakistan's Punjab was used to provide new evidence on the yield gap and yield improvement potential of dairy farms producing milk and meat. The yield gap was estimated by the frontier-based input distance function analysis. The results indicated that a large yield gap exists in the sample where an average dairy farm has a yield improvement potential of 55 percent. By closing the gap, an average dairy farm can increase yearly production of fat-corrected milk (FCM) by 120,036 kg and non-milking herd for meat by 25 heads. The evidence also shows that small farms (< 25 herd-size) are technically more efficient than those of medium (26 ≤ herd-size ≤ 50) and large farms (> 50 herd-size). The study finds clear evidence of an efficiency boost for keeping a higher share of non-milking to milking herd, a greater proportion of exotic cows to local breeds, and a higher farm-gate price of milk, which can all trigger efficiency gains. Policymakers hence have room to provide adequate intervention strategies that can help in enhancing efficiency.

JEL Classification: D24, L25, Q12, Q13, Q18
Keywords: Yield Gap, Yield Potential, Input Distance Function, Technical Efficiency, Dairy Farms

1. INTRODUCTION

The world human population is projected to exceed 9 billion by 2050; a continuing population and consumption growth means the need for more processed food, meat, dairy, and fish to meet the global demand (Godfray, et al. 2010). Higher production targets, without converting additional agricultural land and water resources into dairy production, will require increased productivity. Thus, exploring

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this potential is necessary to formulate intervention strategies. Although extensive literature available about yield gap in the crop sector (e.g., van Ittersum, et al. 2013; FAO, 2015; Fischer, 2015; Silva, et al. 2017), there is a dearth of knowledge on the yield gap in dairy sectors of developing countries where yields are low and thus have large potential of increasing.

The scant literature on the dairy yield gap tends to examine mixed crop and livestock farmers in Sub-Saharan Africa (Henderson, et al. 2016), cross-bred cattle in the North-Eastern state of India (Paul and Chandel, 2010), milk production in the Indian Himalayan state of Meghalaya (Kemboi, et al. 2021), attainable bovine milk yields in Ethiopia and India (Mayberry, et al. 2017) and genetic yield potential of milk in Pakistan (Iqbal & Ahmad, 1999).

Pakistan is one of the five major milk producers in the world producing 65.5 billion kg of milk/per year from ninety-seven million cattle and buffaloes (GoP, 2022). Milk is easily the largest agricultural produce in the country with a market worth US$20 billion, valued at a dairy farm-gate price of PKR 50/kg. Most of the cattle population consists of indigenous breeds, which have low milk yield. Nearly 62 percent of milk comes from buffaloes and 38 percent from cows with average lactation yields of less than 2300 kg, which is far less than average lactation yields of more than 6000 kg in the developed world (Burki & Khan, 2019).

Gross milk production in Pakistan has increased over the past decades mainly due to the growth in the population of dairy animals (Burki & Khan, 2019). Due to the growth in human population, increased incomes, and urbanisation, demand for milk and meat will increase in the near future (Herrero & Thornton, 2013). To meet the demand, increasing the production of low-yielding cattle by cross-breeding offers the greatest potential, however, genetic improvement is a long-term strategy spanning decades (Burki & Khan, 2019). A short-term strategy is to close the yield gap to ensure a potential increase in yields.

The objective of this paper is to evaluate and provide new evidence on the yield gap and yield improvement potential in Pakistan's largest dairy cluster by estimating the yield gap by the frontier-based input distance function. The paper uses a sample survey of 600 dairy farms drawn from five districts located near Lahore metropolitan city. The dairy farms in this largest cluster share many common characteristics of dairy farms in other dairy clusters of the region Therefore, the analysis will have many similarities in outcomes to give the findings wider applicability.

2. LITERATURE REVIEW

The yield gap refers to the difference between realised yields and the best that can be achieved using available genetic material, technologies, and management (Godfray, et al. 2010). Yield gap analysis identifies growth potential and constraints in existing production systems for future yield improvement with the adoption of better management practices and implementation of improved production technologies (Nin-Pratt, et al. 2011). Iqbal & Ahmad (1999) provide evidence of milk yield gap in Pakistan indicating that productivity in the dairy sector is far below than its genetic potential. Their findings suggest that by overcoming the yield gap, milk production can go up by 50 percent to 100 percent.

Actual yield generally refers to the average observed yield of sampled farmers in a particular area. The potential yield has several definitions, e.g., the yield obtained from experimental stations, economically feasible yield, maximum yield observed by farmers, and yield obtained from mathematical crop simulation models (Singh, et al. 2009). Agronomists often study yield gaps from crop simulation models (van Ittersum, et al. 2013; Silva, et al. 2017), which commonly assume that optimal conditions always prevail on farms, which is a moot question. Neumann, et al. (2010) and Nin-Pratt, et al. (2011) have noted that crop simulation models often end up getting over- or under-estimated potential yields. That is why such models have received less attention in yield gap analysis in the livestock and dairy sector.

Recent studies have used the frontier efficiency approach to calculate the yield gap in the livestock and dairy sector (Henderson, et al. 2016; Mayberry, et al. 2017). This approach has strong theoretical underpinning due to which it has been extensively used in several technical efficiency and yield gap assessments in agriculture, dairy, and livestock sectors (Parik, et al. 1995; Abdulai and Tietje, 2007; Neumann, et al. 2010; Nin-Pratt, et al. 2011; Henderson, et al. 2016; Mayberry, et al. 2017; Silva, et al. 2017, and Ahmad, et al. 2021).

Henderson, et al. (2016) have used the stochastic frontier analysis to examine the yield gap in mixed crop and livestock farmers operating in six Sub-Saharan African countries to increase food production and reduce greenhouse gas emissions. Based on a cross-section survey data they find a substantial yield gap at all survey locations and evaluated determinants of technical inefficiency to apprise policymakers to devise intervention strategies. Similarly, Mayberry, et al. (2017) have studied the yield gap in Ethiopia and India to quantify attainable bovine milk yields based on survey data. They also find a huge yield gap in milk production in both countries and propose intervention strategies to increase milk yields.

3. DATA

The data from dairy farms from five districts of Pakistan's Punjab province, *viz.*, Lahore, Kasur, Okara, Pakpattan, and Sheikhupura was used in the study. The data was collected through a survey conducted from June to August 2020. The study area represents one of the largest dairy clusters in Pakistan, where individual dairy farms supply raw milk to households, milk shops, manufacturers of traditional and modern dairy products, and more than two dozen UHT and pasteurised milk plants.[1] Milk is a perishable good that cannot be easily transported from far-off places without a cold chain that is largely missing in the raw milk market, except milk collection network of UHT and pasteurised milk plants. Most raw milk supplies to Lahore metropolitan city come from nearby districts. Therefore, sample farms share many common features of dairy farms in other dairy clusters in the region. The present study focuses on the analysis of five districts considering that the similarities in the outcomes will give the findings of this paper much wider applicability.

[1]Two unique properties of supply of dairy products in developing countries are that milk is perishable, and it is produced during a short-period. These properties require middlemen into the dairy supply who specialise and collect small quantities of milk from several dairy farms to provide efficient delivery to the end users by reaping economies of scale in transportation (Jung, et al. 2012).

A multi-stage sampling technique was used to draw a representative sample of the dairy farms. Firstly, five districts from one of the major dairy clusters in the country were selected based on a purposive sampling plan.[2] The selected districts had a 200 km radius consisting of Lahore and its surrounding districts (although not all of them border it). Secondly, a *mouza* level list of dairy farms provided by the Punjab Livestock and Dairy Development Department (L&DD) served as the total population, which helped to obtain *mouza* level concentration of farms and dairy animals. Thirdly, a cluster sampling method (Lahiri, 1951) was used to sample 15 *mouza*s of each district (Annexure-1). The *mouza* census was done to determine the population of eligible farms in selected *mouzas.* Thereafter, a random sampling plan was used to draw a sample of 8 dairy farms from each *mouza*. Finally, a sample of 600 dairy farms was obtained consisting of 120 farms each from each district.

A ten-page structured questionnaire was used to record information related to the period from 1st January 2019 to 31st December 2019. The questionnaire was pre-tested, revised, and restructured based on responses from the farms. The survey was delayed due to the first wave of the Covid-19 pandemic and was finally carried out between June to August 2020 through in-person interviews with respondents.

4. METHODOLOGY

The frontier efficiency approach was employed to calculate the yield gap from technical efficiency scores obtained from the maximum likelihood estimates of the stochastic frontiers. More specifically, the paper uses the stochastic frontier input distance function approach, which can effectively deal with the effects of data noise arising from measurement and reporting errors and data anomalies often hard to avoid in developing countries.[3] Since dairy farms have more discretionary control over the use of inputs, rather than outputs, it is more appropriate to use input orientation of the distance function (Coelli & Perelman, 2000). Shephard (1970) introduced the input distance function, which is defined in the input requirement set, $L(y)$. It represents the set of all input vectors, $x \in \Re_+^J$, which can produce the output vector, $y \in \Re_+^M$, given by

$$L(Y) = \{x \in \Re_+^J : x \text{ can produce } y\} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

We can express a multiple-input and multiple-output input distance function defined in the input set, $L(y)$, and written as

$$D_I(x, y) = \max_{\theta} \left\{\theta \mid \left(\frac{x}{\theta}\right) \in L(y)\right\} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where $D_I(x, y)$ is decreasing in each output level and non-decreasing, homogenous of degree 1 and concave in input vector x (Kumbhakar, et al. 2015). Moreover, $D_I(.) \geq 0$ if $x \in L(y)$. Imposing homogeneity, the input distance function is expressed as

$$\frac{D_I}{x_1} = f\left(\frac{x_2}{x_1}, \ldots, \frac{x_j}{x_1}, y\right) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

[2]Other districts in this cluster includes Sahiwal, Bahawalnagar, Vehari, Khanewal, Mandi Bahauddin, Hafizabad, Chiniot, Faisalabad, Nankana Sahib, Sargodha and Toba Tek Singh.

[3]The distance functions also help avoid the limitations associated with the conventional cost or production frontier approaches, e.g., limited price variation and simultaneous equation bias (Kumbhakar, et al. 2015).

The functional form for the distance function should ideally be flexible, easy to calculate, and should permit the imposition of linear homogeneity (Coelli & Perelman, 2000). A translog function fulfills these properties and is commonly used in such applications. However, it can run into problems by violating monotonicity and curvature properties while multicollinearity is a common obstacle in some datasets, including the data used in this paper. Therefore, a Cobb-Douglas input distance function is chosen as the most appropriate functional form representing underlying technology as it is easy to calculate and allows the imposition of homogeneity. While the transformation function in not concave in the output dimension, this should not be a serious concern as the primary interest of this paper is not the optimisation behaviour, but to obtain technical efficiency measures (Coelli & Perelman, 2000). With this background, the stochastic frontier Cobb-Douglas input distance function for two outputs and five inputs is given below:

$$\ln D_{Ii} = \alpha_0 + \sum_{j=1}^{J} \beta_j \ln x_{ji} + \sum_{m=1}^{M} \gamma_m \ln y_{mi} \quad \dots \quad \dots \quad \dots \quad (4)$$

where $i = 1, 2, \dots, N$ denotes *i*th dairy farm in the sample, y_{mi}, is *m*th output quantity of *i*th farm, x_{ij} is *j*th input quantity of *i*th dairy farm and α, β and γ are unknown parameters to be estimated. Imposing linear homogeneity conditions and rewriting the distance function $D_I(x, y)$ as;

$$\ln D_{Ii} - \ln x_{ji} = \alpha_0 + \sum_{j=2}^{J-1} \beta_j \ln \frac{x_{ji}}{x_{Ji}} + \sum_{m=1}^{M} \gamma_m \ln y_{mi} \quad \dots \quad \dots \quad \dots \quad (5)$$

Given the nature of dairy farming in Pakistan, certain dummy variables are added. Grazing is part of green roughages; however, it cannot be easily quantified in the data of input variables. The paper includes a dummy variable for grazing farm (GR) as a control variable in the base model. The herd size (HS), and district dummy variables, which allow technologies to differ in levels due to the peculiar nature of the dairy farms, were also included. To make this a stochastic function, we added a random error term, v_i, and denote $\ln D_{Ii} = u_i > 0$ and move it to right-hand side of the equation as

$$-\ln x_{ji} = \alpha_0 + \sum_{j=2}^{J-1} \beta_j \ln \frac{x_{ji}}{x_{Ji}} + \sum_{m=1}^{M} \gamma_m \ln y_{mi} + \beta_1 GR_i + \sum_{k=1}^{3} \theta_k HS + \sum_{m=1}^{5} \rho_m District + v_i - u_i \quad \dots \quad \dots \quad \dots \quad \dots \quad (6)$$

where $v_i - u_i$ is the composite error term; v_i is for the stochastic error component, which captures the exogenous shocks due to reasons beyond the control of the dairy farms and are assumed to be independently and identically distributed or $iid\ N(0,\ \sigma_v^2)$; and u_i is a non-negative random variable measuring farm-specific technical inefficiency. A higher value of u_i indicates increase in technical inefficiency and when u_i is zero, it indicates that the farm is perfectly technically efficient.

To explore the impact of farm attributes on technical inefficiency a vector of observable explanatory variables included by assuming that the stochastic term u_i is independently distributed and is obtained by truncation at zero. It implies that the technical inefficiency of each farm can be replaced by a linear function of a vector of explanatory variables specified by;

$$u_i = \delta z_i + \varepsilon_i \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (7)$$

where z_i is a vector of explanatory variables for technical inefficiency, δ is a vector of unknown parameters to be estimated, and ε_i is an unobservable random variable obtained

by truncation of the normal distribution with mean zero and variance σ^2 and the truncation point occurs at $-\delta z_i$ or $\varepsilon_i \geq -\delta z_i$.

Two output variables (FCM and non-milking herd) and five input variables (labour, animal capital, concentrate, roughages, and other farm expenses) are used in the estimation. Table 1 provides definition of variables. To construct FCM variable, data of 14,813 milking buffaloes and cows at an average of 25 animals per farm was recorded

Table 1

Definition of Variables

Variable Name	Definition
Input Distance Function	
Labour (Number)	The number of hired, family, and part-time workers measured in full-time equivalents by taking total hours divided by 40 hours for a full-time work week.
Animal Capital (Number)	Animal capital is measured in cow equivalents to account for the quality of a breed. The number is obtained by dividing the value of all milking and dry animals on a farm by average price of Sahiwal cow in the full sample.
Concentrate (PKR '000 per Year)	The concentrate input variable is constructed using the Lowe input aggregator function based on an *x*-vector measuring 22 concentrate ingredients consumed on each farm and the average price ($\overline{w}_c$) of each ingredient in the full sample written as $X_{ci} = \overline{w}_{c1}x_{c1i} + \overline{w}_{c2i} + \ldots + \overline{w}_{cn}x_{cni}$.
Roughages (PKR '000 per Year)	Roughages input variable is constructed using the Lowe input aggregator function based on actual input quantities (x_r) consumed (in kg) of various purchased and homegrown dry (straws) and green (fodders) roughages and average prices ($\overline{w}_r$) in the full sample written as $X_{Ri} = \overline{w}_{r1}x_{r1i} + \overline{w}_{r2}x_{r2i} + \ldots + \overline{w}_{rn}x_{rni}$.
Other Farm Expenses (PKR '000 per Year)	Simple sum of all expenditures on structures and machinery, expenses on veterinary services, and other direct dairy expenses.
Fat Corrected Milk (kg '000 per Year)	Milk yield is measured in kilograms corrected to 4 percent fat using 6.5 percent fat content for Nili-Ravi and non-descript buffaloes, 4.2 percent for Sahiwal cows, 3.9 percent for Friesian-cross and Jersey cross, 3.7 percent for Friesian pure and 3.5 percent for non-descript cows.
Non-milking Herd (Numbers)	Measures the number of heifers, young stock, and bulls by the end of the year.
Grazing Farm (Yes=1, No=0)	Dummy equals 1, if the farm is feeding on grasses or agricultural grazing, but has feed supplements, and 0 otherwise.
Small Herd-size: ≤ 25	Dummy equals 1, if herd size is less than or equal to 25, 0 otherwise.
Medium Herd-size: 26 ≤ HS ≤ 50	Dummy equals 1, if herd size is greater than or equal to 26 but less than or equal to 50, 0 otherwise.
Large Herd-size: HS > 50	Dummy equals 1, if herd size is more than 50, 0 otherwise.
District Effects	Includes five district dummy variables, where Lahore district is excluded.
Technical Inefficiency Effects	
Time to Metaled Road (Minutes)	Travel time on motorcycle from the farm to the nearest metaled road in minutes.
Small Herd-size: ≤ 25	Dummy equals 1, if herd size is less than or equal to 25, 0 otherwise.
Medium Herd-size: 26 ≤ HS ≤ 50	Dummy equals 1, if herd size is greater than or equal to 26 but less than or equal to 50, 0 otherwise.
Large Herd-size: HS > 50	Dummy equals 1, if herd size is more than 50, 0 otherwise.
The proportion of Exotic Cows to the Milking Herd	The ratio of pure Friesian or Jersey cows to the total milking herd on the farm.
The proportion of Non-milking to Milking Herd	The ratio of the non-milking herd (including calves, heifers, and bulls) to the milking herd on the farm.
Milk Price (PKR)	Average farm gate price of milk in PKR.
Lahore District	Dummy equals 1, if the farm is in Lahore district, 0 otherwise.
Kasur District	Dummy equals 1, if the farm is in Kasur district, 0 otherwise.
Okara District	Dummy equals 1, if the farm is in Okara district, 0 otherwise.
Pakpattan District	Dummy equals 1, if the farm is in Pakpattan district, 0 otherwise.
Sheikhupura District	Dummy equals 1, if the farm is in Sheikhupura district, 0 otherwise.

Table 2

Summary Statistics of Variables in Input Distance Function and Technical Inefficiency Model

Variables	Mean	SD	Min	Max
Input Distance Function				
Labour (Number)	7	4	2	42
Animal Capital (Number)	27	20	6	175
Concentrate (PKR '000 per Year)	1212070	1295480	2387	19558614
Roughages (PKR '000 per Year)	2675245	7989197	42179	145927857
Other Farm Expenses (PKR '000 per Year)	133432	120094	24800	1596250
Fat Corrected Milk (kg '000 per Year)	67137	58829	13974	580578
Non-milking Herd (Numbers)	16	12	4	168
Grazing Farm (Yes=1, No=0)	0.27	0.45	0	1
Small Herd-size: ≤ 25	0.27	0.44	0.00	1.00
Medium Herd-size: 26 ≤ HS ≤ 50	0.55	0.50	0.00	1.00
Large Herd-size: HS > 50	0.18	0.39	0.00	1.00
Lahore District (Yes=1, No=0)	0.20	0.40	0	1
Kasur District (Yes=1, No=0)	0.20	0.40	0	1
Okara District (Yes=1, No=0)	0.20	0.40	0	1
Pakpattan District (Yes=1, No=0)	0.20	0.40	0	1
Sheikhupura District (Yes=1, No=0)	0.20	0.40	0	1
Technical Inefficiency Effects				
Time to Metaled Road (Minutes)	9	8	0	40
Small Herd-size: ≤ 25	0.27	0.44	0.00	1.00
Medium Herd-size: 26 ≤ HS ≤ 50	0.55	0.50	0.00	1.00
Large Herd-size: HS > 50	0.18	0.39	0.00	1.00
The Proportion of Exotic Cow to Milking Herd	0.12	0.25	0	1
The Proportion of Non-milking to Milking Herd	0.73	0.43	0.10	3.18
Milk Price (PKR)	71.85	19.32	40	120
Lahore District (Yes=1, No=0)	0.20	0.40	0	1
Kasur District (Yes=1, No=0)	0.20	0.40	0	1
Okara District (Yes=1, No=0)	0.20	0.40	0	1
Pakpattan District (Yes=1, No=0)	0.20	0.40	0	1
Sheikhupura District (Yes=1, No=0)	0.20	0.40	0	1
Sample Size	600	–	–	–

during the period from 1st January to 31st December 2019. The unadjusted milk yield was used to convert it into 4 percent FCM to compare the milk yield of different breeds of cows and buffaloes on the farms as this is what the farmers in Pakistan get paid for. The method suggested by Gaines (1928) was used to convert milk into 4 percent FCM

$$FCM = [(0.4*\text{kg milk}) + (0.15*\text{kg milk}*\text{fat \%})]$$

Using information gathered from industry sources, raw milk of different breeds was converted into 4 percent FCM (Table 1). Non-milking herd output was measured by the number of other adults and young stock, e.g., heifers, calves, and bulls, on a farm by end of the year. The Lowe quantity index, which is a member of the class of fixed weight indices, was used to aggregate both concentrate and roughage inputs (O'Donnell, 2012). The Lowe index satisfies all index number axioms including transitivity, which allows to make multilateral comparisons across farms at a given point in time (Hill, 2010). Determinants of technical inefficiency include a z-vector of variables (Table 1). Table 2 presents summary statistics of the variables.

5. RESULTS

The average yearly milk yield (arithmetic mean) per farm was 58.7 MT that ranged from 10.8 MT to 500 MT (Table 3). Farm yield in Sheikhupura averaged 90.7 MT farm^{-1}, ranging from 15.7 to 490 MT farm^{-1}, which was the highest of the five districts.[4] The average yield was 60.3 MT farm^{-1} in Pakpattan (10.8 MT farm^{-1} to 500 MT farm^{-1}), 50 MT farm^{-1} in Kasur (14.9 MT farm^{-1} to 180.3 MT farm^{-1}), and 49.1 MT farm^{-1} in Lahore (16.4 MT farm^{-1} to 269.5 MT farm^{-1}). Similarly, the lowest mean farm yields were observed in Okara, averaging 43.7 MT farm^{-1} (15.9 MT farm^{-1} to 234.7 MT farm^{-1}).

Table 3

Descriptive Statistics of Surveyed Dairy Farms in Five Districts of Punjab

	Sample	Milk yield MT farm^{-1}						
Farms	Size	Mean	SD	Minimum	25%Q	Median	75%Q	Maximum
All Farms	600	58.7	55.1	10.8	29.0	43.1	68.0	499.8
Kasur	120	49.7	33.7	14.9	25.7	38.7	61.8	180.3
Lahore	120	49.1	35.8	16.4	24.7	39.7	62.7	269.6
Okara	120	43.7	27.3	15.9	28.6	37.0	49.6	234.7
Pakpattan	120	60.3	69.8	10.8	29.0	42.0	60.8	499.8
Sheikhupura	120	90.7	76.3	15.7	47.9	72.6	104.4	490.1

Note: MT farm^{-1} indicates milk yield in metric tons per farm per year.

Table 4 reveals that the yield improvement potential of FCM varies across breeds, which is highest for non-descript cows (61 percent), but more uniform for buffaloes, Sahiwal, Cholistani and Friesian crossbred cows, ranging from 41 to 45 percent. This is consistent with the results of Iqbal and Ahmad (1999) who reported a yield gap between 50 and 100 percent of dairy animals' genetic yield potential in Pakistan. Despite comparing current milk yields with genetic yield potential, the findings of Iqbal and Ahmad (1999) are not far from the present study. The breed comparison indicated that Friesian pure cow potential milk yield was highest (8.61 MT head^{-1}) than buffaloes (2.99 MT head^{-1}), Friesian crossbred (2.79 MT head^{-1}), and Sahiwal cows (2.34 MT head^{-1}). A similar pattern of yield gap also emerged when raw milk yields were compared, however, the results are not reported here for brevity.

[4] The difference in yield is numeric, not statistically.

Table 4

Actual Yields of Breeds and Yield Gap at 4 Percent fat Corrected Milk: The Benchmarking Analysis

		Milk Yield MT head^{-1}		Yield Gap MT head^{-1}	
Animal Breed	Sample Size	Maximum Potential Yield (top 10 Percent Farms) Mean (SD)	Current Yield (Average All Farms) Mean (SD)	Potential Minus Current	% Increase
All Buffaloes	8873	4.33 (265)	2.99 (754)	1.33	45
Sahiwal	3124	3.29 (341)	2.34 (535)	0.95	41
Cholistani	1004	2.48 (241)	1.73 (420)	0.75	43
Friesian Crossbred	1222	3.99 (785)	2.79 (796)	1.20	43
Friesian Pure	25	9.87 (45)	8.61 (608)	1.26	15
Non-descript Cows	465	2.72 (494)	1.69 (562)	1.03	61

5.1. Estimating the Distance Functions and Technical Inefficiency Effects

The maximum likelihood parameter estimates of the input distance function (Equation 6) and technical inefficiency effects (Equation 7) assuming a truncated normal distribution for the technical inefficiency are presented in Table 5. Caudill & Ford (1993); and Hadri (1999) have reported that the presence of heteroscedasticity can have serious implications on technical inefficiency estimates in such models. Therefore, robust standard errors corrected for heteroscedasticity are used (Abedullah, et al. 2015). The null hypothesis, that herd size has no differential impact was accepted at a 1 percent level (LR test = 6.36, χ_2^2 =9.21). Farm location might be a constraint limiting the capability of dairy farms to make the best use of available inputs, which could potentially be a reason for estimating a separate frontier for each district, but due to the small sample size, this was not an option (also see, Ahmad, *et al*. 2021). Alternatively, we introduce district effects but null was strongly rejected at 1 percent level (LR test= 19.35, χ_4^2 =13.28). Thus, district effects are important variables in this application. Hence, model 2 is selected based on the tests and its results are explained. The null hypothesis that technical inefficiency effects are absent, i.e., $H_0: \gamma = \delta_0 = \cdots = \delta_9 = 0$, was strongly rejected indicating that most of the dairy farms are operating below the frontier. A large value of γ parameter (γ = 0.330; t = 10.34) also confirms that most of the deviations from the input requirement set are due to inefficiency instead of random shocks.

The estimated coefficients of inputs and outputs denote elasticities as the data on inputs and outputs is divided by respective sample means. The result shows that the input distance function is non-increasing in outputs since the estimated coefficients of two outputs are negative and highly significant (Table 5, model 2). The absolute value of two output elasticities is less than one (0.85), indicating increasing returns to scale at the sample means. In economic terms, a 10 percent increase in joint production decreases total cost by 8.5 percent (Coelli, et al. 2003). A 10 percent increase in FCM production results in a 3.9 percent increase in total cost. However, a similar increase in the production of non-milking herd leads to 4.7 percent increase in total cost. The estimates show a dominance of production of the non-milking herd along with milk production. Elasticities of the distance function with respect to input quantities are equal to cost shares, showing the importance of each input in dairy production. The elasticities are either positive or statistically equal to zero. The elasticity with respect to animal capital is

the largest, which is corroborated by some past studies reporting similar findings (Burki & Khan, 2011; Irz & Hadley, 2003).[5]

Table 5

Estimated Parameters of the Input Distance Functions

	Cobb-Douglas Function	
	Model 1	Model 2
Input Distance Function	0.043***	0.042***
Labour (Number)	(4.20)	(4.23)
Animal Capital (Number)	0.921***	0.922***
	(65.01)	(66.42)
Concentrate (PKR '000 per Year)	0.007	0.006
	(1.18)	(1.13)
Roughages (PKR '000 per Year)	–0.007	–0.008
	(–1.42)	(–1.57)
Other Farm Expenses (PKR '000 per Year)	*0.036*	*0.038*
Fat Corrected Milk (FCM) (kg '000 per Year)	–0.389***	–0.388***
	(–14.35)	(–14.45)
Non-milking Herd (Numbers)	–0.466***	–0.465***
	(–14.06)	(–13.54)
Grazing Farm (Yes=1, No=0)	0.017*	0.017*
	(1.88)	(1.84)
Medium Herd-size: 26 ≤ HS ≤ 50	–	0.039
		(0.68)
Large Herd-size: HS > 50	–	0.027
		(0.39)
District Fixed-effects included (Yes=1, No=0)	Yes	Yes
Technical Inefficiency Effects		
Time to Metaled Road (Minutes)	–0.001	–0.001
	(–1.35)	(–1.16)
Medium Herd-size: 26 ≤ HS ≤ 50	0.062***	0.102*
	(5.55)	(1.69)
Large Herd-size: HS > 50	0.174***	0.203***
	(6.93)	(2.84)
Proportion of Exotic Cow to Milking Herd	–0.032**	–0.033**
	(–2.06)	(–2.11)
Proportion of Non-milking to Milking Herd	–0.805***	–0.792***
	(–16.30)	(–15.26)
Milk Price (PKR)	–0.001***	–0.001***
	(–2.73)	(–2.65)
Kasur District (Yes=1, No=0)	0.149**	0.084
	(2.24)	(1.36)
Okara District (Yes=1, No=0)	0.175***	0.094
	(2.65)	(1.36)
Pakpattan District (Yes=1, No=0)	0.180***	0.140**
	(2.72)	(2.36)
Sheikhupura District (Yes=1, No=0)	0.04	–0.046
	(0.67)	(–0.70)
Log-likelihood	628.12	630.36
Mean Technical Efficiency	0.647	0.632
Sample Size	600	600

Note: z-values are reported in parentheses as robust standard errors have been used to correct for heteroscedasticity.

[5]There may be some concern that the Cobb-Douglas function might have imposed unnecessary restrictions. For comparison, we also estimated the translog function, but most of the first-order coefficients were statistically insignificant, indicating presence of multicollinearity in this data (see also, Newman & Mathews, 2006). However, the translog results were qualitatively similar to the Cobb-Douglas model especially the signs and significance of technical inefficiency effects were consistent.

Turning to technical inefficiency effects, Table 5 also shows that increased herd-size increases the technical inefficiency of dairy farms. Relative to small dairy farms, large and medium farms are 20.3 and 10.2 percent more inefficient, respectively. These results suggest that an average dairy farm may reduce average cost by decreasing the scale. The cost-reducing effects are also relevant to medium dairy farms (i.e., $26 \leq HS \leq 50$) which could also reduce their production cost by operating at a lower scale.

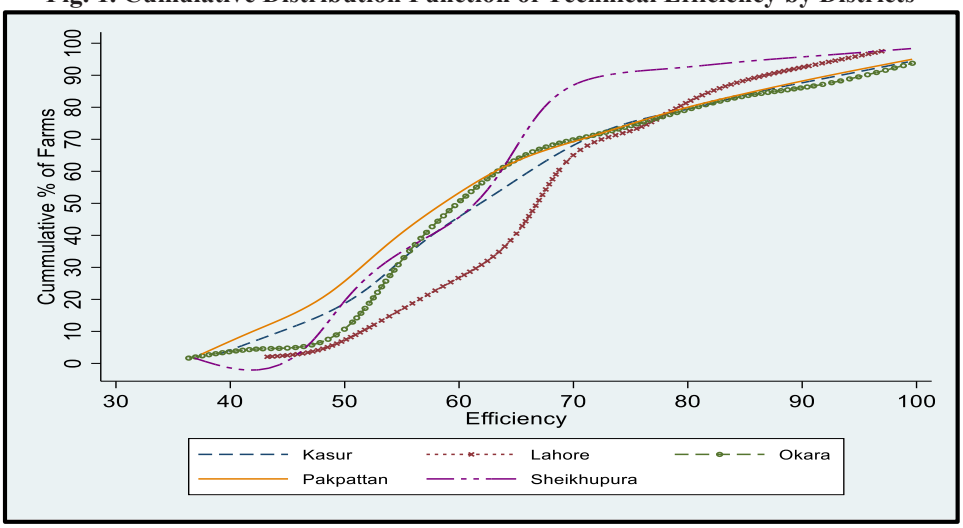
Similarly, dairy farms having a higher proportion of non-milking to milking herds operate closer to the technological frontier. The coefficient of the proportion of non-milking to milking herd is negative and significant (–0.792, $t = –15.26$), which indicates that the increased presence of heifers and calves decreases technical inefficiency. The proportion of exotic cow to milking herd variable is negative and statistically significant (–0.033, $t = –2.11$), which indicates that an increase in the proportion of high-yielding exotic cow varieties decreases technical inefficiency (or improvement in technical efficiency). Hence, these farms operate much closer to the technological frontier.

As one would expect, the farm-gate price of milk has a negative and significant effect on the technical inefficiency of dairy farms, indicating that higher milk prices provide an incentive to improve farming practices and get closer to the technological frontier. However, the coefficient measuring the time to metaled road turns out to be statistically insignificant.

5.2. Finding Yield Gaps with the Frontier Analysis

The mean technical efficiency is 63.2 percent ranging between 32.3 percent and 99.9 percent, while the average standard deviation is 16.1 percent (Table 6). Dairy farms in Lahore, Kasur, and Okara have relatively higher mean technical efficiency than other districts, however, the differences are rather small. The data on cumulative distribution functions (CDFs) of technical efficiency scores of five districts (Figure 1) revealed that

Fig. 1. Cumulative Distribution Function of Technical Efficiency by Districts



no district has a clear edge in efficiency scores over the other districts. However, dairy farms from the Lahore district are technically more efficient than the farms from other districts. The CDF of Lahore depicts this, which is mostly to the right of the CDFs of

other districts. Of all the dairy farms in Lahore, efficiency scores of some 95 percent of them fall in 45 to 95 percent intervals. By contrast, of all the farms in Sheikhupura, 90 percent of them fall in the efficiency range of 35 to 72 percent intervals, indicating a relatively large average yield gap. Although, mean yield gaps are relatively small, yet the standard deviations indicate that large yield gaps are present within the districts (see Table 6).

Table 6

Mean Technical Efficiency and Yield Gap by Districts

	Technical Efficiency Scores				Yield	CV
District	Mean	SD	Min	Max	Gap (%)	(%)
Kasur	0.652	0.173	0.366	0.998	53	26.5
Lahore	0.681	0.131	0.397	0.992	47	19.2
Okara	0.656	0.172	0.342	0.999	52	26.2
Pakpattan	0.635	0.184	0.323	0.999	57	29.0
Sheikhupura	0.612	0.127	0.362	0.996	63	20.8
Full Sample	0.647	0.161	0.323	0.999	55	24.9

Note: Yield gap equals [(1-TE)/TE]*100. The coefficient of variation (CV) equals standard deviation over mean. The coefficient of variation (CV) equals standard deviation over mean.

The regional patterns in the FCM yield gap range from 47 to 63 percent, whereas the average yield improvement potential, from better use of existing resources, is 55 percent (Table 6). Significant differences in yield gap also exist within districts as shown by the higher coefficient of variation (CV). Closing the yield gap can accrue substantial benefits that are highest in Sheikhupura, followed by Pakpattan, Kasur, Okara, and Lahore districts. Several factors may be blamed for putting constraints on dairy production resulting in a large yield gap, therefore, a single intervention may not work.

The output targets, which the dairy farms can potentially realise by closing the yield gap are presented in Table 7. For instance, the farms could increase yearly production of FCM by 72,022 MT (178.8 percent) and non-milking herds by 14,851

Table 7

Potential Growth in Dairy Production by Closing the Yield Gap

	FCM		Non-milking Herd	
District	Quantity (MT)	Increase (%)	Quantity (Heads)	Increase (%)
Kasur	12561.55	179.11%	3203	158.33%
Lahore	12074.09	165.51%	2316	153.68%
Okara	10863.82	170.81%	2896	147.53%
Pakpattan	16223.20	189.07%	3553	162.09%
Sheikhupura	20299.19	183.97%	2884	167.67%
Full sample	72021.85	178.79%	14851	157.91%

Note: Yield gap target quantities are calculated by dividing farm-level FCM quantities and non-milking herds by their respective technical efficiency scores.

heads (157.9 percent). More precisely, an average dairy farm could increase yearly FCM production by 120,036 kg (i.e., 329 kg/farm/day) and non-milking herd by 25 heads/farm by simply closing the existing yield gap. The growth potential is highest in Sheikhupura where an average dairy farm could increase production of FCM by 463 kg per day and non-milking herd by 24 heads per annum. A large potential for output growth also exists in other districts.

It is important to mention that technical inefficiency (efficiency) of the dairy farms monotonically increased (decreased) with the herd- size (Table 8). Farms maintaining small herd size have clear efficiency gains over medium and large herd sizes, implying that the average potential of yield gap improvement is highest for large farms (73.3 percent), followed by medium (53.4 percent) and small farms (45.8 percent). Therefore, intervention strategies to close the yield gap of dairy farms should particularly focus on medium and large farms.

Table 8

Technical Efficiency and Yield Gap by Herd-size

Herd-size	Mean Technical Efficiency	Yield Gap (%)
Small Herd-size: ≤ 25	0.686	45.77%
Medium Herd-size: 26 ≤ HS ≤ 50	0.652	53.37%
Large Herd-size: HS > 50	0.577	73.31%

Farms with a higher share of exotic cows (pure Friesian or Jersey cows) to milking herds operate closer to the frontier and thus face a lower yield gap. Average milk yields of pure Friesian are three to four times more than other breeds while its milk yield relative to non-descript cows is five times more. Culling of less productive stock and cross-breeding of cattle with high-yielding exotic breeds offers the largest potential as a long-term strategy because there are more than 15 million breedable cattle in the country (Burki & Khan, 2019). The government can realize the potential of increasing milk yields by extending the crossbreeding program. Present artificial insemination facilities are insufficient as they cover a limited stock of dairy animals. Restructuring the entire breeding program can put it on a fast-track to achieving desired results.

6. CONCLUSIONS AND POLICY IMPLICATIONS

This paper evaluated the nature and causes of the yield gap in one of the largest dairy clusters in Pakistan and find evidence of a sizable yield gap. Considering frontier efficiency as upper bound of what can be achieved with available technology and management, we find an average yield improvement potential of 55 percent, which translates into an average yearly production improvement of FCM by 120,036 kg per farm and non-milking herd for meat by 25 heads per farm. Productivity differentials are widespread across districts that are geographically not far from each other and share common characteristics of the dairy farms in the cluster. The best-performing farms indicate a capacity to use locally available information and knowledge to their advantage but less-performing farms face technical constraints in raising productivity.

Technical inefficiency monotonically increases with herd size where small dairy farms are more efficient. Thus, policies aimed at promoting small and medium dairy farms through loans or splitting the large dairy farms into smaller units can trigger major efficiency gains. The econometric results highlighted the importance of raising calves and heifers for meat as an important by-product. The dairy farms that have a higher proportion of non-milking to milking herds operate closer to the technological frontier. We find strong evidence that the increased presence of heifers and calves decreases technical inefficiency. This is hardly a surprising result due to the presence of a lucrative market for the meat and sacrificial animals all over Pakistan, especially on the occasion of Eid-ul-Adha. This is contrary to the business model of corporate dairy farms which keep exotic cow breeds but sell male calves within the first month of calving and cull excess cattle to maintain herd sizes that support the limited capacity of milking parlours (Burki & Khan, 2019). Thus, multi-output dairy farms that produce optimal quantities of both milk and meat have significantly lower yield gaps, and promoting joint production of milk and meat can yield handsome returns.

The yield gap also exists for dairy farms that face low returns to increased production, which makes it hard to raise production to full potential. As they face high risks in investment, not investing is a more rational decision. The results indicate that a higher farm-gate price of milk decreases the yield gap because a higher milk price provides an incentive to farmers to improve farm practices to get closer to the frontier. The raw milk price offer in the upstream milk market by bulk buyers who possess large market share, e.g., UHT/pasteurised milk processing companies, has a significant impact on milk price. Besides poor transport infrastructure and farm-to-market roads raise the price of moving raw milk to high-demand urban centres. Improved networks of highways, motorways, and farm-to-market roads reduce these price differentials and provide much-needed incentives to farmers from far-off places.

Breaking away from traditions is a major challenge in designing strategies to close the yield gap in developing countries like Pakistan. The households who are into the dairy business for generations dominate most of the dairy production and for them change is painfully slow. For example, silage-making equipment is readily available in the market, but there is a lack of demand as only 2 percent of the farms in the dairy survey were using silage for their dairy herd. This is alarming because on-farm silage preparations can reduce the cost of fodder/concentrate, improve nutritional levels in the dairy herd and increase milk yields. It will be particularly helpful if policymakers adopt measures that promote the use of on-farm silage making and the availability of high-quality silage in the market. Similarly, milk removal from hand milking of animals is dominant in the sample dairy farms, which is not only a slow process often marred by seasonal labour shortages, but it also results in lower average yield per lactation (Burki & Khan, 2019). Improvements in labour productivity, milking performance, and hygiene can be achieved by making small capital investments in bucket milking systems or mobile milking machines, which offer a cheaper alternative to hand-milking. Social media, training programs, and extension visits are the tools that policy-makers can use to achieve positive results. Demonstrating the production practices of best-performing dairy farms to less-performing dairy farms can also pay dividends.

ANNEXURE-1

Lahiri's Method

For each district, two random numbers were generated: first between 1 and *N* (the total number of *mouzas* in that district) and second between 1 and *M* (the largest farm size in the district). The sampling was carried out in three steps given below:

(1) A random number was drawn between 1 and *N*. For instance, in Kasur district, the first random number was generated between 1 and 356 while the number drawn was 3 indicating that *mouza* 3 will be considered for data collection.
(2) We draw a random number between 1 and *M*. If this random number is less than or equal to M_i (the total number of farms in i^{th} *mouza*), then include i^{th} *mouza* in the sample; otherwise go back to step 1. For instance, the second random number generated for Kasur was between 1 and 40. Suppose for *mouza* 3 second random number was 16 and the total number of secondary sampling units in *mouza* 3 were 30 then this *mouza* will be included in the sample. On the other hand for *mouza* 2, the second random number was 31 which is less than the total number of farms in *mouza* 2 therefore it was rejected.
(3) Repeat until desired sample size is obtained.

The table below shows the example of two accepted and two rejected PSUs of the Kasur district. The process was repeated to obtain a list of 15 *mouzas* from each district

Table A1

Example of Accepted and Rejected Mouzas

Serial No.	*Mouza*	Farms	First Random Number	Second Random Number	Accept
2	Deo Sial	30	2	31	0
3	Deena Nath	30	3	16	1
4	Orara Nau	27	4	18	1
9	Ellahabad	17	9	39	0

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Factors Influencing Youths' Career Aspirations: A Case Study of Azad Jammu and Kashmir, Pakistan

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The paper measures youths' career aspiration index based on achievement, leadership, and educational aspirations and determines the role of career counselling and mentorship in career aspirations by applying heterogeneity bias-adjusted OLS on the primary data, collected through a questionnaire in the year 2020 from 1015 youth in Muzaffarabad, Azad Jammu and Kashmir, comprised of 42:58 male-female ratio. Findings show a 39 percent educational, 30 percent achievement, and 31 percent leadership aspirations index score with an overall index of 54 percent. The career plans, academic background, and mentorship appeared significant in shaping career aspirations among selective youth. It is suggested to hire qualified mentors and offer formal career counselling at institutions that can help in reinforcing youths' motivation and efforts for better career choices that will ultimately bridge the labour market gaps in the area.

Keywords: Career Aspirations, Youth, Mentorship, Career Counselling

1. INTRODUCTION

Career aspirations refer to the ambitions of individuals they want to accomplish and subsequently endure to turn them into reality. Career aspirations are generally connoted with the professions or occupations individuals aspire to join in their future course of career path. These aspirations are set forth as future planning to attain personal and professional satisfaction and play a significant role in career choices. Besides, this also represents the goals and expectations of individuals towards a specific course of action. Hence, career aspirations can be termed as long-run goals which are required to be settled for career progression. Johnson (1995) regarded career aspirations as point-in-time expressions of career-oriented goals.

According to Crites (1978) and Levinson (1993), career aspirations reflect the ability of individuals to make an appropriate career decision which should be realistic and should remain consistent over time. Successful career growth relies on the determinants of career aspirations and is influenced by various factors including lifestyle, mindset, norms, and personal aptitude of individuals. Career aspirations among youth depend on the extent to which they gain the knowledge and skills which is required for smart and practical career decisions. Such career aspirations and hence, decisions are crucial for

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bridging the industry-academia gap and the existing mismatch between available labour market opportunities and acquired skills, as well.

The significance of career aspirations has been widely recognised in the literature. Hellenga, et al. (2002) pointed out that career ambitions inform society about an individual's interests as well as hopes. When it comes to young people's personal development, social adjustment, and future well-being, good career preparation can serve as a development tool as well as a responsibility. Attempts have been made recently by career theorists and academicians to understand youth's professional choices to give signals to the educators of the twenty-first century. Providing opportunities to discuss and decide the career path with professionals, such as teachers and counsellors, is critically useful to reflect individuals' interests and goals and career options, and labour market demands which eventually lay down the educational requirements and possible avenues. According to the literature, those students who involve in career planning and mentorship programmes see a favourable transformation in their perspectives regarding their future careers (Schunk & Mullen, 2013; Eby, Allen, Evans, Ng & DuBois, 2008). In the context of Kram's Mentor Role Theory (1985), mentors offer career and psychosocial advancement to apprentices to grow within the company and to improve personally and professionally. Mentoring is a fundamental part of advancing one's administrative expertise and career. Conventional mentorship has played a significant role in assisting juniors who need to succeed in their professional goals. Those who were able to have a mentor in their life are more likely to grow in their careers, earn more money, and have a successful career than people without a mentor. Hence, students' career counselling sessions and other interventions are vital to providing students updated information about available options for career paths (Dreher & Ash, 1990; Scandura, 1992; Scandura & Schriesheim, 1994; Ragins, Cotton, & Miller, 2000).

Several factors have been identified as the determinants of career choice other than mentorship. The system Theory Framework of Career Development cited by Patton & McMahon (2015) provides the basis for the development of an extended collection of constructivist approaches to career counselling and career assessment activities. Similarly, traits and behavioural researchers believe that career adaptability build up around one's future work is critical in generating proactive career behaviour (Taber & Blankemeyer, 2015). Similarly, personality traits, interests, cultural identity, socioeconomic status, parental educational and occupational background, family structure, globalisation and socialisation along with financial and social support are among other pertinent determinants of career aspirations.[1] Therefore, the factors determining career choice may be intrinsic, extrinsic, or both.

With this background, this study endeavored to quantify the career aspirations among youth and investigate the factors that influence their career aspirations. Approximately 64 percent of the population in Pakistan is below 30 years of age with 29 percent of them falling between the age group of 15-29 years, according to UNDP (2019). Azad Jammu and Kashmir, the point of the investigation, has 27 percent of the young population defined as the age group of 15-29 years old individuals as per information available in the Labour Force Survey (2017-18). Muzaffarabad is a self-governing state of Pakistan and has a 76.8 percent literacy rate with male-female literacy

[1]c. f. Kerka (2000).

ratios of 86.9:67.3 percent (Pakistan Statistics Bureau, 2017-18). The majority of students in Pakistan choose their careers haphazardly, with little thought given to any potential paths (Humayon, et al. 2018). Ahmed, Sharif, & Ahmad (2017) contend that if Pakistan's educated populace is unable to choose the appropriate careers, the nation would undoubtedly be unable to advance in such a challenging environment. According to Boon & Ilias (2011), students choose careers in a variety of ways. For example, some students lack a thorough understanding of the range of careers because either they are uninformed or they lack the necessary background. Due to this issue, they tend to base their professional decision on what their relatives or peers have done. Zeb, Ali, Rahman, Jan, & Khan (2020) while exploring the role of secondary school career aspirations employed an exploratory research approach and discovered that medical, teaching, engineering, and the military forces are the most inspired professions among the students of secondary school in Swat. Furthermore, male career aspirations are generally driven by socioeconomic variables, whilst females are mainly influenced by sociocultural factors. According to Nadeem & Khalid (2018), females exhibited stronger career aspirations than males. Tovar-Murray, et al. (2021) investigated the extent to which sociodemographic variables impact the links between self-efficacy beliefs, feminist beliefs, and career aspiration categories. She, et al. (2008) conducted a survey of 85 Chinese medical students to assess medical career aspirations and their relationship with family background, personal skills, English language proficiency, and interest in biomedical research, all of which appeared as significant factors influencing their career interest. Several recent studies investigate the features of Generation Z individuals (born between 1995 & 2012), their values, attitudes toward work and organisations, and how they adjust to the workplace. Barhate & Dirani (2021) discovered that intrinsic and extrinsic variables influence the career aspiration of Gen Z and concluded that Gen Z has well-defined professional standards and career development plans. To the authors' knowledge, no study is available specifically for the selected area which focuses on career aspirations among youth. The study contributes to the literature by highlighting the significance of awareness programmes and the establishment of an information management system for youth in the selected area by the government. It identifies the requirement for official career counselling facilities at colleges and the hiring of skilled mentors who can support students and their prospective counselors, parents, and universities by providing them with career guidelines and orientation programmes to facilitate the right and timely choice of career on the part of youth. This will eventually close the region's labour market disparities.

Specifically, the study focused on the construction of an overall career aspirations index based on the sub-scales of educational aspirations, achievement aspirations, and leadership career aspirations indices among youth aged between 15-29 years of Muzaffarabad, Azad Jammu and Kashmir (AJ&K) based on the information collected through a well-structured questionnaire. Secondly, the study empirically determines the lead factors of career aspirations including various socio-economic and demographic variables like age, gender, education, employment status, educational and family background, academic performance, career plans, mentorship, and religiosity.

The rest of the study is organized as follows; Section 2 deals with the review of the literature. Section 3 provides a theoretical framework, empirical model, data

description, and estimation technique along with summary statistics. Section 4 reports and discusses empirical findings. The last section concludes the chapter with policy implications.

2. REVIEW OF LITERATURE

Social Cognitive Career Theory (SCCT) proposed by Lent, Brown, & Hackett (1994) elaborates on the process of decision-making and career development. The further development in research by Lent, et al. (2000) and Blanco (2011) suggested that career development behaviour is mainly inclined to socio-cognitive outcomes; intentions, career goals, and self-efficacy which is further connected with socioeconomic status, societal support, gender, cultural and societal obstacles. Gottfredson (1981) postulated that according to the development theory of occupation aspirations, career choice is conditional on cognitive development and a given social environment. The compromised decision among competing goals depends on the individuals' perceptions of opportunities. Alternatively, the three-dimensional framework provided by Carpenter & Foster (1979) and Beyon, Kelleen, & Kishor (1998) put forth intrinsic factors including personal interest and satisfaction with a job; extrinsic factors like jobs availability and monetary benefits including pay structures while the third dimension focuses on the interpersonal factors which involve family system, parental, peers and teachers' influence. Besides, Meece, Parsons, Kaczala, Goff, & Futterman (1982) provided the grounding for investigating certain factors i.e., academic performance and background through Career Choice Model.

In another study by Super (1985), individuals' personal recognition of their abilities, interest, and characteristics boost their self-esteem to determine their career path. According to Ismail, Ramly & Rasdi (2008), career aspirations are the desire of an individual which can relate to potential job prospects and can be attained if the individual put up serious effort into that direction. Similarly, Bandura (2001) recounted that career choices are influenced by talent, skills, academic achievements, and environment. Cantor (1990), Sellers, Satcher, & Comas, (1999) and Gati & Saka (2001) added the role of age and parental socioeconomic status in determining the career path of individuals and provided that aspirations become more focused when they move from young age to adulthood especially when their parents' socioeconomic status improves.

The empirical evidence on the subject matter shows the role of mentorship as a leading determinant of career aspirations. According to Dreher & Ash (1990), individuals who were able to seek advice from mentors were also able to secure job advancements, better salaries, and higher levels of job satisfaction than those who were not being mentored. According to Kram & Isabella (1985), peers can serve as an effective substitute for mentors in terms of both psychological well-being and professional growth. Lester, et al. (2011) conducted a six-month field experiment for two sub-groups; one who received leadership mentoring and the other who received group-based leadership educational programme. There was a significant difference in leadership efficacy and performance between the mentored and educated groups. Students appeared to feel more secure and inspired while working with a mentor from industrial background and have entrepreneurship exposure. This reflects that the nature of mentorship also matters in establishing one's career path. The studies by Scandura (1992) and Srivastava (2013) also provided similar evidence. Additionally, academic achievements are

also attached with the mentoring programme as supported by Maxwell & Connell (2013) and Jekielek, et al. (2002). Informal mentoring and structured mentoring programmes offer diverse evidence in self-efficacy and moving ahead on the leadership ladder (Ragins, Cotton, and Miller, 200l; Raabe & Beehr, 2003). Over time, the mentor has become a generic term broadly used for anybody who serves as a role model, coach, guide, sponsor, or counsel (Garvey, Stokes & Megginson, 2014). The mentorship supports individuals in realising their potential as well (Spencer, et al. 2016). In addition, a mentor can also exert a positive influence on adolescents who are at risk of academic failure by increasing retention rate, enthusiasm for learning, and academic success (Schargel & Smink, 2014). Lack of mentorship has also been considered a primary reason for poor academic career development and advancement by Ibegbulam & Jacintha (2016). The results of their study further show that research mentorship has a significant impact on how many publications are produced at the individual level.

Besides, other socioeconomic factors are also explored for their likely impact on career aspirations. Shumba & Naong (2012) examined the influential factors for 133 South African university students and found family's and students' ability and teachers' capabilities as significant factors in affecting students' career choices and aspirations. For a sample of 125 girls, Mesa (2013) provided that self-efficacy, parental influence, and school-related factors dominate girls' career aspirations. The role of the guardian is examined by Kumar (2016) for 175 respondents in Bahirdar, Ethiopia. Determining the head of household, the study found an overwhelming role of fathers' qualification and decision-making in career choice decisions among students as compared with mothers. The role of interventions in influencing career aspirations is investigated by Ahmed, Sharif, & Ahmad (2017) for a sample of 120 students. The counseling sessions and other sorts of interventions in providing information to the students appeared to play an important role. Moreover, affordability, employability, finances, and social class also influence career choices as is evident from Akosah-Twumasi, et al. (2018). The study found extrinsic, intrinsic, interpersonal, and emergent bicultural factors dominant in career choice among youth. In a case study of Pakistan, Arif, et al. (2019) found a little role of demographic factors in determining the career choices of selective students from the University of Management and Technology (UMT). Few other studies also investigated the role of family background, peers and friends, personal interest, teachers, mentors, and gender and found them significant (Tesha, 2020).

A number of factors have been identified as the drivers of career aspiration however, there is a dearth of studies for Pakistan that can portray not only the determinants of career aspiration but also reflects the level of career aspirations. The study related to youth in our selected location i.e., Muzaffarabad, Azad Jammu, and Kashmir has remained a neglected area to be discovered from that context. This study endeavors to fill in the gap in the literature by offering interesting insight. Additionally, the study also contributes to existing literature by constructing a career aspirations index of youth on three sub-scales of educational, achievements, and leadership aspirations. Mainly this study addresses the following questions; how well do the young people in Muzaffarabad, AJ&K, aspire to be leaders in the future? And to what extent do different socioeconomic and demographic characteristics affect the career aspiration of young people in Muzaffarabad, AJ&K?

3. METHODOLOGY

Career selection is imperative for its long-term bearing in terms of socioeconomic status, the standard of physical and mental health, and well-being. The inconsistency between individuals' needs and motives and the labour market demands may lead to low performance, subdued productivity, job discontent, depression, and stress (Gagné & Deci, 2005). Johnson (1995) specified career aspirations as an expression of career-related goals which tend to reflect in career choices and attainments in the future. Human Capital Theory by Schultz (1961), Becker (1964) & Mincer (1974) posits that higher education and skills training is instrumental in improving the productive capacity of individuals and in converting them to human capital. Investing in education not only enhances productivity but also provides social stability and a quality lifestyle. It turns out as better lifetime earnings with every higher year of schooling, better access to high-profile jobs, and brighter career prospects (Wahrenburg & Weldi, 2007). Mesa (2013) validates that people with good job aspirations set high learning goals as the quest for new skills and full-time jobs and overcoming career adversity go hand in hand with job descriptions. According to Adler's theory of ambition (1927), the desire to achieve a higher level of accomplishment is a natural motivation. The individual's drive to achieve perfection and advancement occurs to compensate for the emotions of inadequacies and struggle. The theory also highlights the value of self and social relationships and this is asserted that individuals are largely motivated by social incentives and life objectives. Overall, the theory of ambitions (Adler, 1927) and career development theory (Super, 1953) are working behind the empirical modelling of this study.

3.1. Research Design and Sample Size

The research is based on the primary data collected through a questionnaire from 1015 youth aged 15-29 years, from Muzaffarabad, AJ&K. The sample is comprised of 42 percent of males and 58 percent of females. Initially, a pilot survey was conducted for the accuracy of the questionnaire and was modified according to the received observations. Final data were collected in the year 2020 through a purposive sampling technique with the support of officials from private and government schools, colleges, and university located in Muzaffarabad.[2] The major questions in the questionnaire are related to the demographic factors, family and educational background of respondents, mentorship, and religiosity.[3] The quantitative analysis of data includes descriptive and inferential statistics both based on Ordinary Least Square (OLS) and Heckman-adjusted OLS due to possible heterogeneity bias in the sample. The data processing, statistical analysis, and estimation of the empirical model were done in SPSS and STATA software.

3.2. Empirical Model

The study adapted Gregor & O'Brien's (2015) revised measure of career aspiration where educational aspirations, leadership aspirations, and achievement

[2]The educational institutes in Muzaffarabad were visited and management were contacted for support in data collection between July-August 2020.

[3]Questionnaire is available on demand.

aspirations are the sub-scales for measuring the overall career aspirations index.[4] The benchmark model is specified below:

$$CAI_i = \beta_o + \beta_{1j}\sum_{j=1}^{4} DEM_{ij} + \beta_{2j}\sum_{j=1}^{3} CP_{ij} + \beta_{3j}\sum_{j=1}^{2} ACB_{ij} + \beta_{4j}\sum_{j=1}^{3} FAM_{ij} + \beta_{5j}\sum_{j=1}^{5} MENT_{ij} + \beta_6 ACP_i + \beta_7 REL_i + \varepsilon_i \quad \ldots \quad (1)$$

Where *i* refers to youth and *j* indicates respective number of categories in each variable. The variables include both the discrete variables measured as dummy variables and continuous variables. *CAI* stands for Career Aspiration Index. *DEM* refers to the demographic variables including age, gender, education, and current status, *CP* refers *to* career plans including the decision about the field of prospective career, support needed for career goals, and area of job preferences, *ACB* denotes academic background comprised of the mode of teaching and location of the school, *FAM* stands for family background including the gender of the head of household, number of siblings and members of a household. Similarly, *MENT* refers to mentorship-related variables like the role of the mentor in career progression, career mapping and planning, and internship opportunities. While *ACP* refers to the academic performance measured through individual position in class and *REL* stands for religiosity.

Career Aspiration Index (*CAI*), adapted from Gregor and O'Brien (2015) revised index of career aspirations, is based on 5-point Likert scale ranging between 0 and 4, where a higher score represents higher career aspirations. The indices at disaggregated level measure the degree to which respondents aspire to a leadership position within their career for the leadership aspirations index (*LAI*). The educational aspirations (*EAI*) subscale refers to the degree to which respondents aspire to continue education or training within their careers. And the achievement aspirations (*AAI*) subscale measures the degree to which respondents aspire to significant achievements and recognition within their careers.[5] The scores for each dimension are standardised by aggregating and applying the Human Development Index (HDI) formula on each dimensional index that ranges between 0-1, given as below:

$$AI_i = \frac{\sum_{j=1}^{6} x_{ij} - minimum\ value}{maximum\ value - minimum\ value} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where *i* refers to each dimension and *AI* stands for Aspiration Indices. Finally, the composite career aspiration index (*CAI*) is computed by equal weighted sum of each dimension, as follows:

$$CAI_i = \frac{1}{3}(LAI_i + EAI_i + AAI_i) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

3.3. Justification of the Determinants of Career Aspirations

The expected sign of age and gender can go in either direction. For some, career desires can tend to diminish as they get older while for some others it can maintain a high degree of prominence over time. Ginzberg (1952) assumed that young people's choices are more interests driven and less realistic. Studies provided that men tend to be more

[4]A test of reliability of the measure was applied in STATA 13 which yields a significantly high value of the reliability coefficient i.e., 0.80.

[5]See Gregor & O'Brien (2015) for further details.

focused on pay and management positions as compared with their counterparts. Similarly, women are largely inclined to develop their skills and qualifications (Burke & McKeen, 1994; Sturges, 1999; Powell, 2011). The aspirations based on location are expected to be high for youth living in urban areas as compared to rural areas where children are less likely to enroll due to limited educational facilities (Lu & Treiman, 2007; Acosta, 2006). Pakistan has a dual system of education, Urdu and English medium, and can offer diverse findings over the career aspiration. Parental background and religious practices have been identified as significant cultural-cognitive variables in literature which are likely to influence individuals' career choices (Wong, 2007; Wong & Liu, 2010). This is expected that high academic achievers are more likely to have high career ambitions than others. The success in educational setup is largely determined by the academic performance in summative assessments. The expectations are in line with the empirical evidence from Adragna (2009). Most people attribute their career success to their mentors. The mentors-mentee relationship has been considered an intimate learning alliance that happens formally or informally and can be attained at any point in life. According to Ezarik (2002), youth getting the chance of having mentors in their lives tend to get high grades, better self-esteem, and future plans.

3.4. Descriptive Statistics

Table 1 provides the descriptive statistics of variables used in the analysis. The average age of the selected sample of youth is 22 years which is comprised of 58 percent of females. The average completed years of education are 14 years. *Current Status* is split into studying, currently in employment, and currently unemployed and data reflects majority sample is currently studying only i.e., 64 percent while 20 percent are also doing some jobs and 16 percent are willing to work but were not able to get a job at the point of data collection. Seventy-nine percent of respondents have decided on their prospective field of career for the future as compared to 21 percent who haven't decided yet. Forty-three percent of youth consider family support as the most important factor in pursuing their prospective careers. The majority of respondents are willing to do jobs in their own city (73 percent) which shows less inclination towards future mobility of respondents. A nominal number (2 percent) didn't show any preference. Around sixty-five percent of youth attend English medium schools and the location of these schools are in urban areas. Father is the head of the household (81 percent) in most cases. About 63 percent of youth classified their academic performance as above average and 22 percent regarded themselves as the top of class students in their academic career.

The variables on mentorship indicate that 32 percent of the sample think no one has any influence on them in decision making while 53 percent can recall a single such person in their lives. This is connected with the other variables of mentorship where again 52 percent have the view that mentors have little role in career determination. Comparatively, 32 percent regarded the considerable role of a mentor in career planning. When the question was asked about career mapping, a majority had no idea of this term but comparatively 34 percent of youth have some concrete career planning in their mind. The figures on career planning show some diversified situation here. Additionally, 61 percent have decided to do some sort of internship during or after their studies for getting some hand on practice. Table 1 provides summary statistics of the variables.

Table 1

Summary Statistics

Variable	Definition	Frequency	Mean/Sample Proportion
Demographic Features			
Age	age in years	–	22.50
			(3.99)
Education	Completed years of Education	–	13.74
			(2.60)
Gender	=1 if youth is male	424	0.42
Gend	= 0 otherwise		
Current Status	=1 if youth is studying		
Studying	= 0 otherwise	650	0.64
CurrEmpl	=1 if youth is currently employed	198	0.20
	= 0 otherwise		
Unempl	=1 if youth is currently unemployed	167	0.16
	= 0 otherwise		
Academic Background			
Mode of Education	=1 if mode of teaching was English only		
Eng	= 0 otherwise	657	0.65
Urdu	=1 if mode of teaching was Urdu only	301	0.30
	= 0 otherwise		
Regional	=1 if mode of teaching was Regional	35	0.03
	= 0 otherwise		
Both	=1 if mode of teaching was English and Urdu both	22	0.02
	= 0 otherwise		
Location	=1 if location of school is urban	671	0.66
Urban	= 0 otherwise (rural)		
Academic Performance			
Academic Performance	=1 if youth has top of the class performance		
Top Clas	= 0 otherwise	224	0.22
Above Avg	=1 if youth has above average performance	642	0.63
	= 0 otherwise		
Avg	=1 if youth has average performance	141	0.14
	= 0 otherwise		
Below Avg	=1 if youth has below average performance	8	0.01
	= 0 otherwise		
Family Background			
Head of Household	=1 if the head of household is father	818	0.81
Father	= 0 otherwise		
Mother	=1 if the head of household is mother	103	0.10
	= 0 otherwise		
GraMoth	=1 if head of household is grandmother	7	0.01
	= 0 otherwise		
GraFath	=1 if head of household is grandfather	35	0.03
	= 0 otherwise		
Husb	=1 if head of household is husband	22	0.02
	= 0 otherwise		
Uncle	=1 if head of household is uncle	5	0.05
	= 0 otherwise		
Brother	=1 if head of household is brother	14	0.01
	= 0 otherwise		
Self	=1 if youth is head of household	11	0.01
	= 0 otherwise		

Continued—

Table 1—(*Continued*)

Household Members		–	6.50 (2.48)
Career Plans			
Decided Field of Prospective Career (DFPC)	=1 if youth has decided field of prospective career = 0 otherwise	803	0.79
Support to Achieve Career Goals: Famsupp	=1 if youth needs family support to achieve career goals = 0 otherwise	438	0.43
Social	=1 if youth needs social support = 0 otherwise	184	0.18
Financial	=1 if youth needs financial support = 0 otherwise	357	0.35
All above	=1 if youth needs all of above supports = 0 otherwise	12	0.12
None	=1 if youth needs no support = 0 otherwise	24	0.02
Preference HomeT	=1 if youth's work preference is hometown = 0 otherwise	326	.32
AJK	=1 if youth prefers to work within city = 0 otherwise	418	0.41
Abroad	=1 if youth prefers to work abroad = 0 otherwise	221	0.22
Pak	=1 if youth prefers to work anywhere in country = 0 otherwise	34	0.03
Mentorship Influence	=1 if none has influence about career decision		
None	= 0 otherwise	320	0.32
One	=1 if there is a single person in life who influenced career decision = 0 otherwise	539	0.53
More	=1 if there are more than one person to influence career decision = 0 otherwise	156	0.15
Mentor None	=1 if mentor does not have any effect in the life = 0 otherwise	169	0.17
Large	=1 if the role of mentor is to a larger extent = 0 otherwise	319	0.31
Small	=1 if the role is to a small extent = 0 otherwise	527	0.52
Career Mapping Career Map Y	=1 if youth has heard about career mapping = 0 otherwise	448	0.44
Career Planning No	=1 if individual has not planned the career = 0 otherwise	103	0.12
Yes	=1 if youth has made his career planning = 0 otherwise	345	0.34
NA	=1 if youth has no idea about career planning = 0 otherwise	567	0.54
Internship:	=1 if youth plan to do internship = 0 otherwise	618	0.61
Religiosity			
Religious Rites/Prayers: Reg	=1 if youth observes religious rites regularly = 0 otherwise	1012	1.00
Sample Size	1015		

Notes: (1) Third column shows frequency and the last column depicts average values for continuous variables and sample proportion for discrete variables. (2) Standard deviation is reported in parentheses of continuous variables.

3.5. Estimation Technique

The empirical model is estimated by Ordinary Least Square (OLS) and Heckman-adjusted OLS technique due to possible heterogeneity bias in the sample. Heckman (1976, 1979) proposed a solution to the problem by offering a two-step procedure. In our model, the variable of youth's employment status may create heterogeneity bias. And running simple OLS regression with employment status as an explanatory variable of career aspirations may create a build-in-bias in the sample, because a number of factors relying on employment status can also influence career aspirations. To overcome this concern, a 2-step Heckman procedure is applied where the first step is to determine the selection process by estimating selection equation. The model choses the employment status variable carrying value 1 for yes and 0 otherwise in the Probit regression model. And the residuals of the selection equation are used to construct a bias control factor denoted by λ. This factor captures the effects of all unmeasured characteristics related to the employment status of youth. The magnitude and sign of the coefficient of λ indicates the existence and direction of heterogeneity bias. This procedure offers to control the selection effect and endogeneity as well.

Incorporation of the bias control factor (λ) changes Equation (1) in the following way:

$$CAI_i = \beta_o + \beta_{1j}\sum_{j=1}^{4} DEM_{ij} + \beta_{2j}\sum_{j=1}^{3} CP_{ij} + \beta_{3j}\sum_{j=1}^{2} ACB_{ij} + \beta_{4j}\sum_{j=1}^{3} FAM_{ij} + \beta_{5j}\sum_{j=1}^{5} MENT_{ij} + \beta_6 ACP_i + \beta_7 REL_i + +\theta\lambda_i + \varepsilon_i \quad (4)$$

4. RESULTS AND DISCUSSIONS

4.1. Career Aspirations among Youth

The computation of the career aspiration index shows the educational aspirations as highest among youth i.e., 39 percent followed by leadership aspirations scoring 31 percent and achievement aspiration 30 percent. The higher percentage of educational aspirations as compared to the other two indicators might be due to the high literacy rate in Azad Jammu and Kashmir i.e., 76 percent. The overall career aspiration index (CAI) carries a score of 54 percent, which can be regarded as a moderate level of aspiration among selected youth, looking at the computed ranges of the index. Table 2 shows that 18 percent of youth lies in the low career aspiration range, followed by 32 percent falling among high career aspirants while half of the sample are moderately career inspired among the selected sample of youth.

Table 2

Distribution of Youth around Career Aspiration Index

Career Aspirations	Frequency	Percentage
Low	180	18
Moderate	510	50
High	325	32
Total	1015	100

4.2. Determinants of Career Aspirations among Youth

The determinants of career aspirations are measured using Ordinary Least Square and Heterogeneity-bias adjusted OLS. As discussed in methodology, the Heckman 2-step procedure is applied for possible heterogeneity in the sample and the significant selection

Table 3

Determinants of Career Aspirations: OLS and Heterogeneity-Bias adjusted OLS Estimates

Dependent Variable: Career Aspirations Index (CAI)

	(1)		(2)		(3)		(4)	
Variables	OLS	Heckman	OLS	Heckman	OLS	Heckman	OLS	Heckman
Demographic Variables								
Age	–0.002	–0.008**	0.002	–0.004	–0.001	–0.009**	0.003	–0.005*
	(0.002)	(0.003)	(0.003)	(0.004)	(0.002)	(0.003)	(0.003)	(0.004)
Education	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Gender	0.014	0.014	0.011	0.011	0.015	0.015	0.012	0.012
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Current Status								
Studying	_	_	0.081***	0.088***	_	_	0.080***	0.087***
			(0.019)	(0.019)			(0.019)	(0.019)
Currempl	_	_	0.071***	0.057***	_	_	0.070***	0.054***
			(0.020)	(0.021)			(0.020)	(0.021)
Employment Status								
Employed	0.010	–0.003	_	_	0.011	–0.004	_	_
	(0.016)	(0.017)			(0.016)	(0.017)		
Academic Background								
Mode of Teaching								
English	0.058***	0.063***	0.057***	0.062***	0.056***	0.061***	0.055***	0.060***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Regional	0.002	0.009	0.012	0.020	0.002	0.010	0.012	0.021
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
Both	–0.020	–0.013	–0.025	–0.018	–0.022	–0.016	–0.027	–0.020
	(0.041)	(0.041)	(0.040)	(0.040)	(0.041)	(0.041)	(0.040)	(0.040)
School Location								
Urban	0.000	–0.002	0.003	0.001	0.000	–0.002	0.002	0.000
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Academic Performance								
Top class	0.075***	0.072***	0.070***	0.068***	0.074***	0.071***	0.070***	0.067***
	(0.020)	(0.020)	(0.019)	(0.019)	(0.020)	(0.020)	(0.019)	(0.019)
Above avg	0.049***	0.048***	0.044***	0.042**	0.049***	0.047***	0.044***	0.042**
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Family Background								
Head of Household								
Father	0.049*	0.051*	0.048*	0.048*	0.053*	0.056*	0.051*	0.052*
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
Mother	0.072**	0.073**	0.068*	0.067*	0.071**	0.073**	0.067**	0.066*
	(0.037)	(0.037)	(0.037)	(0.036)	(0.037)	(0.037)	(0.037)	(0.036)
Gramoth	0.006	0.001	0.000	–0.012	0.013	0.009	0.006	–0.004
	(0.076)	(0.076)	(0.076)	(0.075)	(0.076)	(0.076)	(0.076)	(0.075)
Grafath	–0.003	–0.004	0.000	–0.003	0.003	0.004	0.006	0.005
	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)
Uncle	0.045	0.040	0.044	0.034	0.049	0.044	0.048	0.037
	(0.088)	(0.088)	(0.087)	(0.087)	(0.088)	(0.088)	(0.087)	(0.087)
Brother	0.017	0.025	0.012	0.015	0.019	0.027	0.013	0.017
	(0.059)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)

Continued—

Table 3—(*Continued*)

Siblings	0.003	0.002	0.002	0.000	_	_	_	_
	(0.011)	(0.011)	(0.011)	(0.011)				
Household Members	_	_	_	_	–0.004*	–0.005**	–0.003*	–0.004*
					(0.002)	(0.002)	(0.002)	(0.002)
Career Plans								
Decision About Field of Prospective Career								
Yes	0.038***	0.038**	0.032**	0.032**	0.038**	0.037**	0.032**	0.031**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Support to Achieve Career Goals								
Social	0.024*	0.025*	0.024*	0.025*	0.025*	0.026*	0.024*	0.026*
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Financial	0.022*	0.025**	0.022*	0.025**	0.022*	0.025**	0.022*	0.025**
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Job Preference								
AJK	-0.004	-0.003	-0.006	–0.004	–0.004	-0.002	–0.005	-0.004
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Abroad	0.025*	0.026*	0.026*	0.027*	0.025*	0.026*	0.026*	0.026*
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Pak	0.033	0.035	0.022	0.024	0.030	0.033	0.020	0.022
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
Mentorship								
Person's Influence of CA								
One	0.029**	0.028**	0.026**	0.024*	0.030**	0.028**	0.027**	0.025**
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
More	0.048***	0.048***	0.040**	0.040**	0.045**	0.045**	0.038**	0.037**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Role of Mentor								
None	0.022	0.022	0.021	0.020	0.022	0.022	0.021	0.020
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Large	0.029**	0.028**	0.026**	0.024**	0.030**	0.028**	0.027**	0.025**
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Heard about Career Mapping								
Yes	0.006	–0.003	0.003	–0.006	0.006	–0.004	0.004	–0.007
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)	(0.014)
Career Planning								
No	0.002	0.001	0.006	0.005	0.004	0.002	0.008	0.006
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Yes	0.013	0.013	0.018*	0.018*	0.016	0.017	0.020*	0.021*
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Internship								
Yes	0.027***	0.032**	0.027**	0.032**	0.026**	0.031**	0.026**	0.032**
	(0.013)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.012)	(0.012)
Religiosity								
Rel.	0.091	0.133	0.105	0.150*	0.099	0.147*	0.112	0.162*
	(0.105)	(0.106)	(0.104)	(0.105)	(0.105)	(0.106)	((0.104)	(0.105)
λ	–	0.135**	–	0.148***	–	0.151**	_	0.163***
		(0.055)		(0.055)		(0.055)		(0.056)
Diagnostic Test Results								
N	1015	1015	1015	1015	1015	1015	1015	1015
R^2	0.11	0.11	0.13	0.13	0.11	0.11	0.13	0.14
Adjusted R^2	0.08	0.08	0.09	0.10	0.08	0.08	0.10	0.11
F-statistics	3.78***	3.87***	4.38***	4.49***	3.86***	4.00***	4.45***	4.60***
F-Test Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VIF	1.60	1.86	1.67	1.92	1.60	1.87	1.67	1.93
Breusch Pagan Test BP (χ^2)	0.63	0.55	0.74	0.63	0.68	0.67	0.81	0.79

Note: Values in parenthesis are standard errors. *Significance at 10 percent; **Significance at 5 percent; ***Significance at 1 percent.

term denoted by λ in our results identifies the presence of heterogeneity. Total of eight equations are estimated due to high collinearity among a few of the variables. The results in terms of sign and significance remain consistent throughout the regressions showing the robustness of the empirical findings. The results show demographic factors, academic background, family-related variables, career planning, and mentorship as significant determinants of career aspirations. The diagnostic test results show 11 to 14 percent of the variation in the dependent variable with respect to explanatory variables which is a reasonable number keeping in view the heterogeneity of the selected sample. The joint significance is validated via F-test. The variance inflation factor (VIF) for all equations depicts a value lower than 10 and indicates no sign of multicollinearity among included variables in respective equations.

Among the demographic variables age and current status of youth appeared as significant variables.[6] The results show that age has a negative effect on career aspirations implying the lower value of career aspiration with every passing year of age. Gottfredson (1981) asserted that individuals tend to sacrifice their ambitions to accommodate the ground realities with the passing of age. Career decision becomes more demanding with the advent of the age factor as supported by Gati & Saka (2001). For the variable *current status* three categories are used namely; studying, employed and unemployed. Taking *unemployed* as the base category results show that currently studying and employed youth have relatively higher career aspirations than unemployed individuals. Understandably, young people who are studying and/or are employed set the targets around their field of study and profession. Another demographic variable *gender* didn't show a statistically significant difference among male and female youths' career aspirations and is a good factor reflecting less gender bias towards aspirations in the selected area.

Coming towards the academic background and youths' performance, the *medium of instruction at educational institutes* shows that youth acquiring education in the *English* language has significantly high career aspirations than those whose medium of instruction is *Urdu*, the base category. Approximately, 30 percent of respondents in our sample have Urdu language as the medium of instruction as compared to 65 percent studying in English. This result signals the upshots of the dual education system which can exacerbate the socio-economic gaps among the youth of the area in the future. The role of *academic performance* is vital in inspiring youth as the students who are top of the class and produce above-average results have relatively higher career aspirations than the below average students, chosen as the base category. The result is in line with Bandura (2001) and Adragna (2009) who reported that career choices are largely influenced by the academic achievements of individuals. *The location of the educational institute* however remains insignificant in affecting career aspirations throughout the regression which might be due to the fact that there is not a significant diversity among the amenities in rural and urban areas of Muzaffarabad.

The variables on *family background* include the number of siblings of respondents, the number of household members, and the head of the household. And according to estimates, youth having their parents as heads of household have high career aspirations. In our sample, 81 percent of youth have father while 10 percent have a mother as their

[6]For parsimony, the results of equation 8 are interpreted in detail.

head of households with a nominal number of other categories (might be another reason for such results). Kumar (2016) pointed out that parents, especially the father, is the true drive behind children's motivations and ambition setting for their prospective futures. It also improves self-confidence among youth. This can be attributed to the cultural norms of the selected area as well. The result is consistent with Kumar (2016) that proved the significant role of the father in career choice. The *household* members are significantly negatively associated with career aspirations which shows that the larger the family size lower would be the career aspirations of youth. As the large family size puts pressure on available resources such as income and basic utilities including food, education, and health facilities, youth find themselves less aspirants. Besides, in large families per capita income tends to be lower and parents' attention also gets divided. According to Benedictis, et al. (2010) and Chaaban & Mansour (2012), large family size discourages school enrollment as parental investment tends to decline in schooling. Another study by Hetherington (1992) also supported a negative relationship between achievement and motivation with family size.

The factors related to career planning and mentoring are crucial in determining youth's career aspirations. The results show youth who have a firm decision about their future career path are more career inspired. Similarly, those individuals are more career oriented who consider social or financial support as the most significant factor to follow their planned career path than those who need family support to achieve career goals. O'Brien & Fassinger (1993) pointed out that the profession's choice and dedication may largely hinge on the socioeconomic status of the family. The location of *Job Preference* shows that those who endeavor to go abroad are more career inspired as compared with those who prefer to remain within their hometown. This is a logical finding and indicates the high ambitions cut across the target setting

The variables on mentorship offer interesting findings. The role of a mentor plays significantly a positive role in aspiring them for future career. The individuals having one or more such mentors have high career aspiration scores as compared to those who do not have any. The findings are consistent with literature like Tesha (2020) who found the role of teachers and mentors positively significant in career preferences choice. Further, the *role of mentor* or counselor is categorised into three categories and according to results, those individuals who regarded the role of mentor as pertinent are more career inspired than others. In other words, individuals having mentors feel more confident to pursue their career path. This factor highlights the significance of counselling in the early age of schooling among youth. Osborn & Reardon (2006) asserted that the support of a mentor in raising awareness, professionalism, and career information ultimately leads to better identification of interests, academic opportunities, and decision-making. The importance of career guidance and counselling in choosing a suitable career and profession is the need of time and cannot be ignored. Dreher & Ash (1990) also argued that climbing up the ladder of career success path is related to the presence of mentors in lives. When it comes to professional growth, mentorship becomes more valuable, especially at the earlier stage of career.

Moreover, those who have *planned their career* well have higher career aspirations as compared to those who don't have any idea. Moreover, those who don't have any career plans are not statistically significantly different from those who don't

have any idea, in terms of their career aspiration, another finding in line with the literature. Besides, individuals who consider an internship as mandatory are those who have high career aspirations as well. The internship experience contributes to professional growth and helps get financial benefits. Such programmes integrate classroom knowledge with workplace realism and provide the attendees a real-time experience along with unrolling new opportunities (Agboola & Ademiluyi, 2016). The variable *religiosity* also relates regularity in religious activities with high career aspirations.

Overall, the findings of the study are consistent with the Social Cognitive Career Theory, and Gottfredson's Theory of Circumscription and Compromise. Both intrinsic and extrinsic values and factors play a lead role in determining career aspirations among youth.

5. LIMITATIONS AND FUTURE RESEARCH

This was documented in the questionnaire and the prospective participants were well informed about the extent to which the privacy of their information would be protected during the whole course of the research. Despite this, most of the parents and particularly women chose not to respond to the questionnaire which leads the sample selection a bit sort of a convenient sampling. This study can be further supported by investigating the quantity and quality of counselling centers in the region.

6. CONCLUSIONS AND POLICY RECOMMENDATIONS

The study is based on the micro-level data collected from the youth of age 15-29 from Muzaffarabad, AJ & K. The data was collected in 2020 through purposive non-probability sampling and OLS and Heckman-Adjusted OLS for heterogeneity bias were applied for estimating the determinants of career aspirations among selected youth. The career aspiration index is calculated on the basis of O'Brien (2015) revised scale which is further based on three subscales on educational, achievement, and leadership aspirations indices. The overall index shows the average value of the educational aspirations index is 39 percent, the leadership aspirations index is 31 percent and achievement aspirations is 30 percent. The overall percentage of the career aspiration index is 54 percent, which is considered as moderately career aspired youth. The demographic features, family background, academic background, career planning, mentorship, and religiosity are regressed on the computed career aspiration index which shows that youth who are good academic performers have decided about the field of prospective career, prefer to work abroad in future and less hesitant in terms of mobility have relatively high career ambitions than their counterpart. The role of mentorship and career planning also signifies the importance of counselling in determining youths' career aspirations. The overcrowded home, financial hurdles, low academic performance, lack of career motivations, and hence, limited planning deprive them for setting high ambitions in life. Although many youths who haven't planned their career (12 percent of the sample) and those who don't have any idea about it (54 percent) are less career-inspired as compared to a smaller number i.e., 34 percent of individuals who have planned their career. The majority (79 percent) have already decided about their prospect career and 61 percent consider internship as crucial in their career path. In contrast, almost half of the sample have never heard about career mapping. These are the factors that need attention to enable the youth of the selected area to gain self-confidence to explore various career

paths and achieve their well-informed career goals adequately and in a timely manner. The study highlights the unprecedented role of counselling and mentorship in this regard.

Moreover, the study suggests familiarising youth with career mapping, providing them opportunities for internship and accessibility to career counseling centers. An appropriate and formal counselling programme is expected not only to improve career aspirations among youth but also to support society in bridging the gap between academia and industries. The frustration and feeling of deprivation among youth can be mitigated by providing them timely support to choose such a career which bridges the demand-supply gaps in the labour market as well. A critical evaluation and monitoring of existing internship programmes in the area might be another focus to serve its purpose effectively.

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Inflation Forecasting for Pakistan in a Data-rich Environment

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This paper uses machine learning methods to forecast the year-on-year CPI inflation of Pakistan and compare their forecasting performance against the comprehensive traditional forecasting suite contained in Hanif and Malik (2015). It also augments the comprehensive forecasting suite with the dynamic factor model which is able to handle a large amount of information and put all of these models in competition against the latest machine learning models. A set of 117 predictors covering a period of July 1995 to June 2020 is used for this purpose. We set the naïve mean model as the benchmark and compare its forecasting performance against 14 traditional and 5 sophisticated machine learning models. We forecast the year-on-year CPI inflation over a 24 months horizon. Forecasting performance is measured using the RMSE. Our results show that the machine learning approaches perform better than the traditional econometric models at 18 forecast horizons.

JEL Classification: C22, C53, C55, G10
Keywords: Inflation, Pakistan, Classical Models, Machine Learning, LASSO, DFM

1. INTRODUCTION

The recent availability of high-frequency data has allowed researchers to forecast key macroeconomic variables in a data-rich environment. At the same time, use of the machine learning (ML) algorithms to forecast these key variables has risen. For example, central banks all around are using sophisticated ML algorithms to forecast key variables such as inflation, gross domestic product (GDP) growth, interest rates, etc. Pratap & Sengupta (2019).

Inflation forecasting has remained at the heart of macroeconomic forecasting literature since 1990 when a number of central banks adopted the inflation targeting regime. Under this system, inflation forecasts become an explicit intermediate target Svensson (1997). Therefore, accurate and timely forecasts of inflation become an

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important element for central banks around the world. Resultantly, for the purpose of forecasting inflation, academics, researchers, and staff at the central banks have used univariate to multivariate econometric models. Among these models, the dynamic factor model (DFM) which can accommodate a large amount of information in the shape of a few factors has gained popularity overtime. The main reason for this fame emerged due to the fact that the factor models could bypass the usual problem of the "curse of dimensionality", faced by the existing vector autoregressive (VAR) and other econometric methods at the time Bernanke, et al. (2005).

The popularity of this method was initiated with the work of Stock & Watson (2002), where the authors forecasted the Federal Reserve Board's index of industrial production using a large set of variables representing different sectors of the US economy. However, Boivin & Ng (2006) pointed towards the addition of relevant factors with the idea that this may result in an increase in the forecasting power of the models and provide improved forecasts. Following their paper, the literature moved toward the selection of explanatory variables through different statistical methods. For example, Stock & Watson (2012) minimised the weights on less relevant principal components using shrinkage methods from the recently developed machine learning literature.

Ever since, there has been a vast number of studies that used this technique to forecast key macroeconomic variables such as inflation, industrial production, key interest rates, etcetera. While the use of DFM was on the rise, machine learning gradually started to make its way into the economic literature, Hanif, et al. (2018). For a discussion on the use of machine learning and a large amount of information in the field of economics, see Mullainathan & Spiess (2017).

Expansion in this strand of literature continued and many authors came up with forecasts of inflation and other key macroeconomic variables with a combination of the DFM and ML models. For example, Li & Chen (2014) used the least absolute shrinkage and selection operator (LASSO) based approaches and LASSO combined with DFM to forecast several key macroeconomic variables using a dataset containing 107 macroeconomic indicators of the US economy. Upon comparison of predictive accuracy with the DFM model as the benchmark, the authors found that the LASSO-based approaches outperformed the DFM at all forecast horizons for all the variables forecasted.

With regards to Pakistan, Syed & Lee (2021) used several ML methods to forecast inflation, GDP growth, and policy interest rate and compared their forecast performance with conventional models including the DFM. Papers written prior to their work have either used the conventional econometric models to forecast inflation or the artificial neural network and compared its forecasting performance against the conventional econometric methods (see Hanif, et al. 2018; Haider & Hanif, 2009). However, none of the papers before their work employed the DFM model for forecasting the key macroeconomic variables for Pakistan.

More recently, there has been an interest to forecast inflation using a set of classical econometric models and compare their forecast accuracy against sophisticated ML techniques. For example, Medeiros, et al. (2021) used the FRED-MD database to forecast U.S. inflation using conventional techniques and several ML techniques. They found that the random forest (RF) outperformed the benchmark and other models at the

majority of the forecast horizons. A similar kind of exercise has been undertaken for other countries as well, for example, Australia (see, Milunovich, 2020) and Brazil (see, Araujo & Gaglianone, 2020, among others). Although, there are studies present that compare the forecasting accuracy of ML methods against the classical econometric models for forecasting inflation. There is not a single paper that compares ML with a comprehensive forecasting suite from a well-renowned inflation forecasting paper for any country.

Therefore, our paper contributes to the existing literature on inflation forecasting in the following ways. First, to the best of our knowledge, there is not a single paper in the existing literature that compares forecasts from 16 econometric models including the DFM against 5 machine learning algorithms. Second, a forecast evaluation from a set of econometric models that can predict inflation well is not easily available for every country; therefore, our paper is unique in the sense that it provides such a suite in the shape of Hanif & Malik (2015) and uses a long time-series for comparing most of their models with the ML algorithms. Finally, such a paper has not been written for Pakistan in the past; hence, a focused contribution of our work is to enhance the existing literature on inflation forecasting in general and on Pakistan's economy in particular.

The rest of the paper is organised as follows. Section 2 provides details about the data used in our study. Section 3 contains the alternative forecasting methods we employ in this paper. Section 4 discusses the measures of forecasting accuracy we use, and Section 5 contains the main empirical results. Section 6 contains discussion and conclusion.

2. MATERIAL AND METHODS

2.1. Data Description

The dataset used in this paper contains 118 aggregate and dis-aggregated macroeconomic time series variables covering the real sector, fiscal sector, monetary and financial sector, and the external sector of the economy of Pakistan.[1] The frequency of the data is monthly, and the sample period is from July 1995 to June 2020. The data is taken from the Statistics and Data Warehouse Department, State bank of Pakistan (SBP) (the central bank).

There are no specific codes/acronyms assigned to the variables by SBP, therefore we assigned short names based on the complete names of the variables included. All the non-stationary variables have been transformed to make them stationary. Both the variables stationary in levels and in transformed shape have been standardised to have mean zero and standard deviation one (similar to Panagiotelis, et al. 2019) and Table A1 in the appendix contains the variables along with details of transformations.[2]

[1]As Pakistan is a small open economy and oil imports comprise a heavy portion of Pakistani imports; therefore, we also add world oil prices in our dataset under the external sector.

[2]It is important to note that Hanif & Malik (2015) did not transform their variables in such a manner; however, in our case as we are going to compare the results of their models with the DFM and ML models. Therefore, for consistency across the use of information, all the variables used in the models taken from their paper are also made stationary and standardised.

2.2. Forecasting Methods

In this paper, we use several classical econometric models taken from Hanif & Malik (2015) and compare their forecasting accuracy against the DFM and ML models. We follow Syed & Lee (2021) in explaining the general methodology for forecasting used in this paper. We initiate our analysis by using the simple mean model (naïve), the AR, the ARDL models, the structural VAR models followed by the DFM, and the sophisticated machine learning techniques such as the Ridge (Ridge), the LASSO, the elastic net (EN), artificial neural network (ANN) and the RF.

Let $x_t = \{x_{i,t}\}_{1\leq i\leq K}$ be a vector of length K where each element represents the value of macroeconomic variable i at time t, after it has been transformed to stationary and standardised to have mean zero and standard deviation one. Now $(x_t\ , x_{t-1},\ \ldots, x_{t-L+1})'$ includes all the lagged information available at time t. We define y_t as the target variable which will also be an element of x_t. All learning methods we consider in this paper assume linear combination of the predictors and have the general form:

$$\hat{y}_{t+h} = x_t'\hat{\theta}_1 \ + \ x_{t-1}'\hat{\theta}_2 \ + \cdots + \ x_{t-L+1}'\hat{\theta}_L\ , \quad h = 1,2,\ldots,24 \qquad \ldots \ (3.1)$$

where $\hat{y}_{t+h}$ is a h-step-ahead forecast of the target variable and $\hat{\theta}_l = (\hat{\theta}_{1,l}, \hat{\theta}_{2,l},\ \ldots\ , \hat{\theta}_{K,l})$ is the estimated coefficient on the l^{th} lag of the variables.

To select the lags for each model estimated in the paper, we use the Autoregressive (AR), $AR(p)$ model which is a natural competitor against the univariate techniques that use big data. Since the data is at a monthly frequency, we allow for a maximum of 10 lags and select p by minimising the Bayesian Information Criteria (BIC) Schwarz (1978). We found $p = 1$ for the standardised inflation series. To have a consistent comparison across models, we keep 1 lag of all the explanatory variables in all the machine learning models considered in this paper. For the autoregressive distributed lag (ARDL) models and the VAR models, we allow 10 lags, and the BIC picks the appropriate number of lags for each iteration that ensures the stability of these models. The models used in this paper are listed below.

2.2.1. *Unconditional Mean Model*

The mean model is the simple unconditional average of the standardised YOY inflation series itself. It can be represented as:

$$Y_t = \mu + \varepsilon_t \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

Where Y_t is a dependent variable at time t, μ is the constant parameter and ε_t is a stationary, white noise process.

2.2.2. *Autoregressive Model*

AR model is given by:

$$Y_t = \mu + \sum_{i=1}^{p} \theta_i Y_{t-i} + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where Y_t is a dependent variable at time *t,* μ is the constant parameter and ε_t is a stationary, white noise process.

2.2.3. *Moving-average Model*

Moving-average model is given by:

$$Y_t = \mu + \sum_{i=1}^{p} \theta_i \varepsilon_{t-i} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3)$$

Where Y_t is a dependent variable at time t, μ is the constant parameter and ε_t are the errors.

2.2.4. *Autoregressive Distributed Lag Models*

The ARDL model is given by:

$$Y_t = \mu + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{j=1}^{q} \theta_i \boldsymbol{X_{t-j}} + \varepsilon_t \quad \dots \quad \dots \quad \dots \quad \dots \quad (4)$$

Where Y_t is a dependent variable and X_t is a vector of independent variables at time t, μ is the constant parameter and ε_t is a stationary, white noise process. We estimated two variants of the ARDL model. ARDL1 contains inflation as a dependent variable while average lending rate, global oil price, money supply, and output gap as the independent variables. In ARDL2, we capture the impact of world inflation, nominal exchange rate, money supply, industrial production proxied by the quantum index of large-scale manufacturing, and output gap on CPI inflation. We allow ARDL models to choose the appropriate length for each simulation based on the BIC.

2.2.5. *Vector Autoregressive Models*

For multivariate models, we use the widely used Sim's (1980) VAR methodology with different variables and Choleski decomposition scheme to produce its structural variants. The VAR(p) is given by:

$$Y_t = \mu + \sum_{i=1}^{p} \theta_i Y_{t-i} + \varepsilon_t \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (5)$$

Where Y_t is a vector of endogenous variables at time t, $\theta_i's$ are the parameters and ε_t are the uncorrelated white noise disturbance terms. A maximum of 10 lags is allowed for the lags in the VAR models and BIC is used to select the lag at each iteration.[3] We estimated five variants of the VAR model. In each model below, the model variables are listed in terms of their ordering in the Choleski decomposition. Credit VAR (CVAR) contains a Discount rate, treasury bill rate of 3 months, weight average lending rate, private sector credit, and inflation.

Monetary VAR (MVAR) contains Discount rate, weighted average lending rate, reserve money, money supply, and inflation External VAR 1 (EVAR1) contains global oil price, US industrial production, remittances, real effective exchange rate, industrial

[3]A series of different checks have been conducted to ensure that the results are robust to all these checks. They are; competing naïve, RW and AR model with each other to select the benchmark and then compare its performance with all the advanced models used to forecast inflation in this paper, estimation of all models with 6 lags, change in the ordering of the variables, addition of world oil price (Brent, Dubai Fateh and average of the two). All these checks revealed that the results of our models qualitatively remained the same.

production (Pakistan), and inflation. External VAR 2 (EVAR2) contains World inflation, output gap, money supply, nominal exchange rate, and inflation. External VAR 3 (EVAR3) contains global oil prices, world food prices, output gap, money supply, weighted average lending rate, real effective exchange rate, and inflation

2.2.6. *Bayesian Vector Autoregressive Models*

It is well known that the Bayesian estimated VARs provide more accuracy depending on the reduced parametric estimation Canova (2007). The bayesian approach treats data as given and it estimates the parameters inferences conditional on the data. To tackle the issue of a high number of parameter estimations, Bayesian methodology uses the prior information which is given in form of density function. One such example is Minnesota priors which was originally proposed by Litterman (1986); Doan, et al. (1984), and been found to increase the forecasting performance of VAR models in forecasting different macroeconomic time series.

Therefore, we also used the benchmark Minnesota priors from Canova (2007), which are (0.2, 1, 0.5), representing the general tightness parameter, decay parameter, and other variable lags parameter respectively. We tried to keep the variables almost the same as in the structural VAR models for different sectors.

We estimated three variants of the Bayesian VAR model. Bayesian Monetary VAR (BMVAR) is a five-variable model and includes discount rate, weighted average lending rate, reserve money, money supply, and inflation. Bayesian Credit VAR (BCVAR) is comprised of six variables: discount rate, public sector borrowing, Treasury bill rate, weighted average lending rate, private sector credit, industrial production, and inflation. Bayesian External VAR (BEVAR) is a seven-variable model and includes global oil price, US industrial production, discount rate, real effective exchange rate, remittances, industrial production (Pak), and inflation.

2.2.7. *Dynamic Factor Model*

The DFM assumes that a small number of unobserved dynamic factors can explain the information set of the predictors (117 variables). We estimate these factors by principal component analysis (PCA), following Stock and Watson (2002) who use the expectation-maximisation (EM). Once the factors are estimated, CPI inflation is then forecasted as follows:

$$Y_t = \mu + \sum_{i=1}^{p} \theta_i f_{t-i} + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

Where Y_t is CPI inflation, f_t is the vector of unobserved factors and ε_t are the uncorrelated white noise disturbance terms. We estimate two variants of the DFM model. DFM5 contains the first five and DFM10 contains the first ten factors estimated from the complete information set respectively.

2.2.8. *Ridge Regression*

Introduced by Hoerl & Kennard (1970), Ridge regression is a well-known linear regression model which minimises the sum of squared residuals with an additional l_2-norm penalty term. Ridge adds this penalty to the overemphasised coefficients. The

value of lambda plays a significant role in determining the weight assigned to the penalty for coefficients. Ridge does not shrink the coefficients to zero. However, the coefficients get closer and closer to zero as the value of lambda becomes larger. Ridge regression is given by:

$$argmin_{\beta} \sum_i (y_i - \beta' x_i)^2 + \lambda \sum_{k=1}^{K} \beta_k^2 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

We use 10-fold cross-validation to find the optimal shrinkage parameter λ.

2.2.9. *Least Absolute Shrinkage and Selection Operator*

The second shrinkage method we implement in our forecasting exercise is the LASSO that was introduced by Tibshirani (1996). LASSO, short for Least Absolute Shrinkage Selection Operator is a regularisation model that assigns penalty to the linear model coefficients using the formula:

$$argmin_{\beta} \sum_i (y_i - \beta' x_i)^2 + \lambda \sum_{k=1}^{K} |\beta| \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

Hence, variables with zero coefficients are eliminated. This is known as shrinkage, where values are shrunk to a central point, for instance, mean. From the formula, we can infer that lasso adds a penalty equal to the Lamba multiplied by the absolute value of the coefficients' magnitude. This penalty shrinks many coefficients to zero, which are then eliminated. Consequently, the degree of overfitting is reduced within the model. We use 10-fold cross-validation to find the optimal shrinkage parameter λ.

2.2.10. *Elastic Net*

The third machine learning algorithm that we apply to our data is the Elastic Net. Elastic Net was proposed by Zou & Hastie (2005) and it is a combination of both Ridge and Lasso characteristics. It reduces the effect of different variables while preserving some of the features. The Elastic Net can be mathematically written as:

$$argmin_{\beta} \sum_i (y_i - \beta' x_i)^2 + \lambda_1 \sum_{k=1}^{K} |\beta| + \lambda_2 \sum_{k=1}^{K} \beta_k^2 \quad \ldots \quad \ldots \quad (9)$$

We use 10-fold cross-validation to find the optimal shrinkage parameters λ_1 and λ_2.

2.2.11. *Neural Network*

Neural Networks have extensively been used to forecast inflation in many countries including Pakistan (see, Haider & Hanif, 2009; Hanif, et al. 2018). In this paper, we employ Long Short-Term Memory (LSTM) which is a type of recurrent neural network (RNN) architecture. It was developed to model temporal sequences more accurately with their long-range dependencies than the traditional RNNs. LSTM forgets all irrelevant data and remembers past knowledge that has been passed through the network.

Hence, LSTM contains special units; "memory blocks", in the hidden recurrent layer. These memory blocks consist of "memory cells" with self-connections which store the network's temporal state. In addition to the temporal state, special multiplicative units called gates are also stored. A typical network consists of 4 different gates: input

gate, output gate, cell state and forget gate. These gates filter out the useless data and only keep what is required. After identifying the data, it can pass information down the chain of sequences in order to make predictions.

2.2.12. *Random Forest*

The only ensemble method we use in our study is the random forecast. Introduced by Breiman (2001), the random forest model is based on bootstrap aggregation (bagging) of randomly created regression trees and strives to reduce the variance of regression trees. A regression tree is very well-known is a non-parametric model which is an approximation of an unknown nonlinear function with local forecasts that uses recursive partitioning of the response variable space Breiman (1996).

3. FORECASTING EVALUATION

For forecast evaluation, we examine h = 1, 2, . . . , 24 steps-ahead forecasts and use a training window of 22 years, which is 264 observations. Each model we described in the previous section is estimated within this window, from which h = 1, 2, . . . , 24 steps-ahead forecasts are generated. The training window is then moved forward one month at a time until we reach the end of the sample. For each step, model parameters are re-estimated, and forecasts are generated. By following this process, we get out-of-sample forecasts for each forecast horizon "h" and these are used to compare the forecasting performance of different models.

For the lag structure of ARDL and VAR models, each model is allowed to choose lags based on BIC for each simulation. Hence, each simulation utilised data points in a range of 254-264 depending on the lag structure picked by the models. Finally, as mentioned earlier, to be consistent across classical as well as machine learning models, we use 1 lag of each predictor in machine learning models. For the forecasting accuracy measurements, we consider the root mean squared error (RMSE). For fixed forecast horizon h, we can calculate RMSE with $\sqrt{mean(e_{t+h}^2)}$ where $e_{t+h} = \hat{y}_{t+h} - y_{t+h}$.

4. EMPIRICAL RESULTS AND CONCLUSION

In this section, we present the results of our analysis. Table 1 presents the forecast accuracy for h = 1 to 24 steps ahead forecast of competing forecast approaches for the year-on-year CPI inflation. Each entry in the table shows the RMSE of the forecasting method relative to the naïve benchmark model. The entries in bold show the RMSE equal to or lower than the naïve benchmark model attained by forecasting model across each row.

An analysis of Table 1 shows that the competing approaches are able to beat the naïve benchmark model at all forecast horizons, that is, we observe at least one entry is below the value of 1 in each row of the table. The main result of the study is that the LASSO beats all the other competing approaches and the naïve benchmark model at 17 forecast horizons (first 16 forecast horizons and at the 22nd horizon). Hence, it is the best model for forecasting year-on-year CPI inflation against the models applied and the sample period considered in our study.

A few other notable results are; first, the DFM model that has been used extensively in the past two decades as a forecasting tool for macroeconomic forecasting

is comprehensively beaten by the LASSO, second, the elastic net beats the naïve benchmark at all 24 forecast horizons, followed by the LASSO and the random forest, these models outperform the naïve benchmark model at 23 forecast horizons. Table 1 also shows that the random forest model beats the naïve benchmark and all other models at a single forecast horizon whereas the classical econometric models beat all the competing models at 6 forecast horizons.

It is also common knowledge that the forecast performance of models usually deteriorates as we move to longer forecast horizons; we can observe with phenomenon in the RMSE figures produced by the competing models in Table 1. We note that with exception of three models, all the competing approaches perform quite worse than the benchmark.[4]

At a broader level, our results are in line with Li and Chen (2014) who found that the LASSO-based approaches outperform the commonly used DFM in forecasting a set of macroeconomic indicators including the CPI. Therefore, we conclude that for the sample period of our study, the machine learning approaches perform better than the DFM and all the other classical econometric methods in forecasting the year-on-year CPI inflation for the economy of Pakistan.

5. ROBUSTNESS CHECK

In this section, we report the results for one of the ways to confirm that our analysis is robust to the different sets of checks we applied in this paper. We first compared the forecasting performance of the naïve model, the RW, and the AR model against each other. We found that the RW model beats the mean model at 13 different forecast horizons whereas the AR model beats the naïve model at 12 different forecast horizons.

Once we found that both these models beat the naïve mean model at 13 and 12 forecast horizons respectively, we tested to see how these models perform against each other. We found that the RW model beats the AR model at 18 different forecast horizons. Therefore, we select the RW as the benchmark model in our robustness check analysis and compare its forecasting performance against the classical econometric as well as the machine learning models.

Table 2 contains the results of the models against the RW model. An analysis of Table 2 shows that the LASSO once again beats the RW benchmark model and all the other competing models at 16 forecast horizons. It outperforms all from 1-14th, 16th, and 22nd forecast horizons, respectively. The random forest model now beats the forecast approaches at 2 forecast horizons than only 1 in the results against the naïve benchmark. Finally, we see that the MVAR beats the competing approaches at 3 forecast horizons, which is about the same/similar to the case of the naïve model as a benchmark. The BEVAR continues to beat all others at the 23rd forecast horizon, whereas the last horizon is once again dominated by the benchmark model itself. None of the competing approaches beat the RW model at the 24th forecast horizon.

[4]This is not a computational error, the RMSE figures in the table has been checked multiple times before we conclude that they are computed correctly. If this was a computational error, only a single value or a few models should have produced large RMSE figures; showing supremacy of the naïve model over these approaches. However, we find that except for a few models, the RMSE values for all the models rise substantially at the last forecast horizon.

Table 1

Table 1

Forecast accuracy for h = 1–24. Each entry shows RMSE relative to the naïve benchmark. All models use full information set and does not contain lags of the dependent variable (Standardised year-on-year CPI inflation). Bold entries indicate the RMSE equal to or lower than the benchmark model achieved by the competing approaches for the variable of interest across each row

h	AR	MA	ARDL1	ARDL2	BCVAR	BEVAR	BMVAR	MVAR	CVAR	EVAR1	EVAR2	EVAR3	LASSO	RIDGE	EN	NN	RF	DFM5	DFM10
1	1.005	1.005	1.166	1.203	**0.990**	1.003	1.021	1.064	1.048	1.004	1.030	**0.987**	**0.707**	1.135	**0.806**	2.114	**0.746**	**0.946**	1.018
2	1.001	1.001	1.145	1.185	1.010	**0.991**	1.036	1.057	1.068	**0.984**	1.010	**0.995**	**0.711**	1.146	**0.804**	1.474	**0.737**	**0.952**	1.018
3	1.002	1.003	1.158	1.183	1.009	**0.992**	1.029	1.048	1.055	**0.985**	1.012	1.025	**0.709**	1.102	**0.809**	1.458	**0.753**	**0.950**	1.018
4	**0.995**	**0.996**	1.169	1.199	1.004	**0.982**	1.035	1.057	1.069	**0.998**	1.016	1.048	**0.719**	1.070	**0.816**	1.389	**0.742**	**0.967**	1.031
5	**1.000**	**1.000**	1.168	1.205	**0.988**	1.008	1.057	1.080	1.038	1.073	1.047	1.079	**0.745**	1.154	**0.849**	1.338	**0.772**	**0.976**	1.009
6	**1.000**	**1.000**	1.156	1.194	**0.985**	**0.986**	1.059	1.092	1.004	1.034	1.053	1.121	**0.754**	1.129	**0.852**	1.389	**0.772**	**0.973**	1.008
7	**0.995**	**0.996**	1.146	1.185	**0.985**	**0.954**	1.036	1.056	1.018	1.020	1.044	1.049	**0.755**	1.159	**0.845**	1.598	**0.811**	**0.974**	1.020
8	1.001	1.002	1.168	1.205	**0.989**	**0.961**	1.046	1.070	1.029	1.033	1.002	1.029	**0.770**	**0.992**	**0.810**	1.506	**0.780**	1.001	1.054
9	1.006	1.006	1.160	1.230	**0.993**	1.006	1.042	1.066	1.031	1.059	1.099	1.092	**0.756**	1.003	**0.810**	1.489	**0.775**	1.005	1.064
10	**0.997**	**0.998**	1.148	1.218	**0.996**	1.033	1.069	1.112	1.033	1.084	1.086	1.114	**0.769**	1.086	**0.826**	1.217	**0.831**	1.019	1.085
11	**0.999**	**0.999**	1.127	1.202	**0.976**	**0.985**	1.050	1.087	1.001	1.023	**0.951**	1.050	**0.733**	1.067	**0.810**	1.255	**0.762**	1.025	1.077
12	**1.000**	1.001	1.110	1.188	**0.967**	**0.996**	1.017	1.034	**0.985**	1.021	**0.949**	**0.998**	**0.734**	1.065	**0.809**	1.576	**0.793**	1.019	1.072
13	**0.983**	**0.986**	1.092	1.168	**0.927**	**0.941**	**0.960**	**0.993**	**0.958**	1.018	**0.890**	**0.966**	**0.734**	**0.955**	**0.818**	1.659	**0.764**	1.010	1.068
14	**0.989**	**0.992**	1.170	1.255	**0.943**	**0.972**	**0.921**	**0.913**	**0.969**	1.078	**0.914**	**0.927**	**0.783**	1.011	**0.844**	1.062	**0.796**	1.082	1.168
15	**1.000**	1.001	1.203	1.272	**0.967**	1.043	**0.953**	**0.943**	**0.990**	1.141	1.001	**0.863**	**0.830**	1.013	**0.864**	1.907	**0.826**	1.099	1.170
16	**0.986**	**0.984**	1.217	1.289	1.014	1.030	**0.957**	**0.941**	1.059	1.123	1.067	**0.895**	**0.793**	**0.933**	**0.877**	1.508	**0.805**	1.074	1.133
17	**0.959**	**0.960**	1.244	1.286	**0.826**	**0.833**	**0.686**	**0.577**	**0.850**	1.033	**0.929**	**0.838**	**0.655**	1.004	**0.738**	**0.865**	**0.656**	1.084	1.246
18	1.002	1.002	1.276	1.339	**0.886**	**0.836**	**0.724**	**0.634**	**0.915**	1.117	1.020	**0.927**	**0.715**	1.050	**0.739**	1.583	**0.698**	1.063	1.319
19	1.005	1.005	1.252	1.284	**0.778**	**0.925**	**0.668**	**0.621**	**0.784**	1.197	**0.823**	**0.975**	**0.678**	**0.960**	**0.669**	1.497	**0.716**	1.088	1.322
20	1.038	1.031	1.332	1.353	**0.731**	**0.990**	**0.677**	**0.624**	**0.720**	1.375	**0.990**	**0.976**	**0.700**	**0.937**	**0.682**	**0.734**	**0.727**	1.150	1.397
21	1.062	1.044	1.219	1.248	**0.773**	**0.989**	**0.834**	**0.813**	**0.829**	1.363	1.112	**0.882**	**0.757**	1.056	**0.781**	1.801	**0.706**	1.043	1.419
22	1.144	1.117	1.132	1.166	**0.878**	1.161	1.085	1.027	1.095	1.500	1.466	1.044	**0.552**	1.421	**0.645**	1.641	**0.751**	1.000	1.710
23	**0.767**	**0.711**	**0.365**	1.509	1.523	**0.198**	**0.661**	1.240	2.515	**0.739**	1.006	1.488	**0.985**	2.836	**0.587**	4.945	**0.836**	**0.759**	1.802
24	**0.223**	**0.560**	1.132	5.252	10.896	2.897	21.852	32.182	19.737	3.711	6.504	12.373	1.523	9.302	**0.983**	54.270	9.914	2.262	2.504

Models used: AR = autoregressive, MA = moving-average, ARDL = autoregressive distributed lag. BCVAR, BEVAR and BMVAR denotes Bayesian credit, external and monetary vector autoregressive models respectively. MVAR, CVAR and EVAR denotes monetary, credit and external vector autoregressive model respectively. LASSO, Ridge, EN, NN and RF denotes least absolute shrinkage operator, Ridge, elastic net, neural network and random forest model respectively. Finally, DFM5 and DFM10 denotes dynamic factor model with 5 and 10 factors respectively.

Table 2

Table 2

Forecast accuracy for h = 1–24. Each entry shows RMSE relative to the RW benchmark. All models use full information set and does not contain lags of the dependent variable (Standadardised CPI year-on-year inflation). Bold entries indicate the RMSE equal to or lower than the benchmark model achieved by the competing approaches for the variable of interest across each row

Horizon	MA	ARDL1	ARDL2	BCVAR	BEVAR	BMVAR	MVAR	CVAR	EVAR1	EVAR2	EVAR3	LASSO	RIDGE	EN	NN	RF	DFM5	DFM10
1	1.000	1.161	1.197	**0.986**	**0.998**	1.017	1.060	1.044	**0.999**	1.026	**0.983**	**0.704**	1.130	**0.802**	2.105	**0.743**	**0.942**	1.014
2	1.001	1.145	1.185	1.010	**0.991**	1.036	1.057	1.069	**0.984**	1.010	**0.995**	**0.711**	1.146	**0.804**	1.474	**0.737**	**0.952**	1.018
3	1.002	1.157	1.181	1.008	**0.991**	1.028	1.047	1.054	**0.984**	1.011	1.024	**0.708**	1.101	**0.808**	1.456	**0.752**	**0.948**	1.017
4	1.001	1.175	1.205	1.009	**0.988**	1.041	1.063	1.074	1.004	1.021	1.054	**0.723**	1.076	**0.821**	1.396	**0.746**	**0.972**	1.037
5	1.000	1.168	1.205	**0.988**	1.009	1.057	1.081	1.038	1.073	1.047	1.079	**0.745**	1.154	**0.849**	1.338	**0.772**	**0.976**	1.009
6	1.000	1.156	1.194	**0.985**	**0.986**	1.058	1.092	1.004	1.034	1.053	1.121	**0.754**	1.129	**0.852**	1.389	**0.772**	**0.973**	1.007
7	1.001	1.152	1.192	**0.991**	**0.959**	1.042	1.062	1.024	1.026	1.050	1.055	**0.760**	1.166	**0.850**	1.607	**0.816**	**0.979**	1.026
8	1.001	1.167	1.204	**0.988**	**0.960**	1.044	1.069	1.027	1.031	1.001	1.028	**0.770**	**0.991**	**0.809**	1.504	**0.779**	**0.999**	1.053
9	**1.000**	1.152	1.222	**0.986**	**1.000**	1.035	1.059	1.024	1.052	1.092	1.085	**0.751**	**0.996**	**0.805**	1.480	**0.770**	**0.999**	1.057
10	1.000	1.151	1.221	**0.999**	1.035	1.071	1.114	1.036	1.087	1.089	1.117	**0.771**	1.089	**0.829**	1.220	**0.833**	1.021	1.087
11	**1.000**	1.128	1.204	**0.977**	**0.986**	1.051	1.089	1.003	1.024	**0.952**	1.051	**0.734**	1.069	**0.811**	1.257	**0.763**	1.026	1.079
12	1.001	1.110	1.188	**0.967**	**0.996**	1.017	1.034	**0.985**	1.021	**0.949**	**0.998**	**0.734**	1.065	**0.809**	1.576	**0.793**	1.019	1.072
13	1.004	1.111	1.189	**0.943**	**0.958**	**0.977**	1.010	**0.975**	1.035	**0.906**	**0.983**	**0.747**	**0.972**	**0.833**	1.688	**0.777**	1.028	1.087
14	1.003	1.183	1.269	**0.954**	**0.983**	**0.932**	**0.923**	**0.979**	1.090	**0.925**	**0.937**	**0.791**	1.022	**0.854**	1.073	**0.805**	1.094	1.181
15	1.001	1.204	1.273	**0.967**	1.044	**0.953**	**0.943**	**0.990**	1.141	1.001	**0.863**	**0.830**	1.013	**0.864**	1.908	**0.826**	1.099	1.170
16	**0.999**	1.235	1.308	1.029	1.046	**0.972**	**0.955**	1.075	1.140	1.083	**0.908**	**0.805**	**0.947**	**0.890**	1.531	**0.818**	1.090	1.150
17	1.001	1.298	1.341	**0.861**	**0.869**	**0.715**	**0.602**	**0.886**	1.077	**0.968**	**0.873**	**0.683**	1.047	**0.769**	**0.902**	**0.685**	1.130	1.300
18	1.001	1.275	1.337	**0.884**	**0.834**	**0.723**	**0.634**	**0.914**	1.115	1.019	**0.926**	**0.714**	1.048	**0.738**	1.580	**0.697**	1.061	1.317
19	1.001	1.246	1.278	**0.774**	**0.921**	**0.665**	**0.618**	**0.781**	1.192	**0.820**	**0.971**	**0.675**	**0.956**	**0.667**	1.491	**0.713**	1.084	1.316
20	**0.994**	1.284	1.304	**0.705**	**0.954**	**0.652**	**0.601**	**0.694**	1.325	**0.955**	**0.941**	**0.675**	**0.903**	**0.657**	**0.708**	**0.701**	1.108	1.347
21	**0.985**	1.151	1.178	**0.730**	**0.933**	**0.788**	**0.768**	**0.783**	1.287	1.049	**0.833**	**0.714**	**0.997**	**0.738**	1.700	**0.666**	**0.984**	1.339
22	**0.991**	1.005	1.035	**0.780**	1.030	**0.963**	**0.912**	**0.972**	1.331	1.301	**0.927**	**0.490**	1.261	**0.573**	1.456	**0.667**	**0.887**	1.518
23	**0.918**	**0.471**	1.948	1.966	**0.256**	**0.854**	1.601	3.248	**0.955**	1.300	1.922	1.272	3.663	**0.759**	6.387	1.080	**0.981**	2.328
24	2.233	4.518	20.954	43.477	11.559	87.189	128.405	78.749	14.807	25.951	49.367	6.078	37.113	3.923	216.536	39.558	9.026	9.989

Models used: MA = moving-average, ARDL = autoregressive distributed lag. BCVAR, BEVAR and BMVAR denotes Bayesian credit, external and monetary vector autoregressive models respectively. MVAR, CVAR and EVAR denotes monetary, credit and external vector autoregressive model respectively. LASSO, Ridge, EN, NN and RF denotes least absolute shrinkage operator, Ridge, elastic net, neural network and random forest model respectively. Finally, DFM5 and DFM10 denotes dynamic factor model with 5 and 10 factors respectively.

These results support our main findings that the LASSO model is the best model for predicting the year-on-year CPI inflation in Pakistan. Furthermore, in line with the earlier results we find that the forecast performance of all the models deteriorates enormously at the last forecast horizon. Hence, re-affirming our position that the computations of the models have been computed, examined, and reported with extreme care.

Conflict of Interest: The authors certify that there is no conflict of interest.

APPENDIX A

Table A1

Transformation (T) denotes the transformation applied to achieve stationarity: 1 = no transformation; 2 = first difference; 3 = log; 4 = first difference of log; 5 = second difference of log. Seasonally Adjusted (SA) denotes seasonal adjustment of variables using the Bureau of Census X12 procedure using Eviews.

S. No.	T	Name of the Variables	Short Names
		Real Sector (Output)	
1	4	Production of Paints & Varnishes (l) (SA)	PNVL
2	4	Production of Hydrochloric Acid (SA)	HYCA
3	4	Production of Paints & Varnishes (s) (SA)	PNVS
4	4	Production of Soda Ash (SA)	SODAA
5	4	Production of Polishes & Creams (SA)	PNCR
6	4	Production of Chlorine Gas (SA)	CHGAS0
7	4	Production of Sulphuric Acid (SA)	SULA
8	4	Production of Cement (SA)	CMNT
9	4	Production of Glass Plates & Sheets (SA)	GPNSH
10	5	Production of Jeeps and Cars (NSA)	JNCR
11	4	Production of Tractors (SA)	TRACT
12	4	Production of L.C.V.s (NSA)	LCVS
13	4	Production of Scooters/Motor Cycles (SA)	STMC
14	4	Production of Buses (NSA)	BUS
15	4	Production of Trucks (NSA)	TRKS
16	4	Production of Coke (NSA)	COKE
17	4	Production of Pig Iron (NSA)	PIRON
18	4	Production of Billets (SA)	BLTS
19	4	Production of H.R sheets/strips (NSA)	HRSS
20	4	Production of Phosphatic Fertilisers (NSA)	PFERT
21	4	Production of Nitrogenous Fertilisers (Total) (SA)	NFERT
22	4	Production of Electric Transformers (SA)	ETRANS
23	4	Production of Refrigerators (SA)	REGRI
24	1	Production of Switch Gears (NSA)	SGEARS
25	4	Production of T.V. Sets (SA)	TVSET
26	4	Production of Electric Tubes (NSA)	ETUBES
27	4	Production of Electric Meters (SA)	EMETRS
28	4	Production of Air conditioners (SA)	ACS
29	4	Production of Electric Bulbs (SA)	EBULBS
30	4	Production of Electric Motors (SA)	EMTRS
31	4	Production of Upper Leather (SA)	ULEAT
32	4	Production of Sole Leather (SA)	SLEAT
33	4	Production of Cotton Yarn (SA)	CYARN
34	4	Production of Cotton Cloth (SA)	YCLOTH
35	4	Production of Woolen & Carpet Yarn (SA)	WCARY

36	4	Production of Jute Goods (Total) (SA)	JDS
37	4	Production of Knitting Wool (SA)	KWOOL
38	4	Production of Vegetable Ghee (SA)	VEGG
39	4	Production of Sugar (NSA)	SUG
40	1	Production of Cigarettes (SA)	CIG
41	4	Production of Cooking Oil (SA)	COIL
42	4	Production of Tea (SA)	Tea
43	4	Production of Tablets (SA)	TAB
44	4	Production of Liquid/Syrups (SA)	LIQS
45	4	Production of Injections (SA)	INJ
46	4	Production of Capsules (SA)	CAPs
47	4	Production of Galenical (Tincture/Spirits) (NSA)	GALS
48	4	Production of Ointments (SA)	ONTT
49	4	Production of Caustic Soda (SA)	CSODA
50	4	Production of Leather Footwear (SA)	LEATFW
51	4	Production of Paper & Board (SA)	PNB
52	4	Production of Safety Razor Blades (SA)	SRBLD
53	4	Production of Bicycles (SA)	BCYC
54	1	Production of Sewing Machines (SA)	SMACH
55	1	Production of Power Looms (NSA)	PLOOMS
56	4	Production of Diesel Engines (SA)	DENG
57	1	Production of Sugarcane Machines (NSA)	SCANEM
58	1	Production of Shuttles (SA)	SHUTS
59	4	Production of Wheat Thrashers (NSA)	WTRASH
60	4	Production of Chaff Cutters (SA)	CCUTS
61	4	Production of Cycle Tires (SA)	CYCT
62	4	Production of Motors Tires (SA)	MTYRE
63	4	Production of Motors Tubes (SA)	MTUB
64	4	Production of Cycle Tubes (SA)	CYCTUB
65	4	Quantum Index of Large-Scale Manufacturing Industries (SA)	SALAM
		External Sector	
66	4	Gold	GOLD
67	4	Foreign Exchange Reserves with SBP	FXSBP
68	4	Foreign Exchange Reserves with Scheduled Banks	FXSch
69	4	Workers' Remittances	WREM
70	4	Exports (BOP)	EXP
71	4	Imports (BOP)	IMP
		Exchange Rates and Interest Rates	
72	4	Saudi Arabian Riyal	SAR
73	4	UAE Dirham	UAED
74	4	US Dollar	USD
75	4	Canadian Dollar	CAD
76	4	UK Pound Sterling	GBP
77	4	Euro	EURO
78	4	Japanese Yen	JPY
79	4	French Franc	FFRANC
80	4	Deutsche Mark	DMARK
81	4	Real Effective Exchange Rate (REER)	REER
82	4	Nominal Effective Exchange Rate (NEER)	NEER
83	2	Call Money Rate	CMR
84	2	Discount Rate	DR
		Fiscal Sector	
85	4	Accounts - National Savings Scheme (NSS)	ANSS
86	4	Certificates – NSS	CNSS
87	4	Prize Bonds – NSS	PBNSS
88	4	Permanent Debt	PD

89	4	Floating Debt	FD
90	4	Unfunded Debt	UFD
91	4	Foreign Currency Loans	FCL
		Monetary Sector (Money, Reserves and the Banking System)	
92	4	Currency in Circulation	CIC
93	4	Other Deposits with SBP	ODSBP
94	4	Bank Deposit with SBP	BDSBP
95	4	Currency in Tills of Scheduled Banks	CTSCH
96	4	Demand Deposit	DD
97	1	Time Deposits	TD
98	4	Resident Foreign Currency Deposits	RFCD
99	4	Government Sector Borrowing (net)	GSB
100	4	Budgetary Support	BSUP
101	4	Commodity Operations	COPS
102	5	Credit to the Private Sector	CPS
103	4	Credit to Public Sector Enterprises	CPSE
104	5	Net Domestic Assets - SBP	NDASBP
105	5	Net Domestic Assets - Scheduled Banks	NDASCH
106	4	Net Foreign Assets - SBP	NFASBP
107	4	Net Foreign Assets - Scheduled Banks	NFASCH
		Stock Market	
108	4	SBP General Index of Share Prices/KSE All Index	SBPGI
109	4	SBP Sensitive Index of Share Prices/KSE 100 Index	SBPSI
110	4	Market Capitalisation	MCAP
111	1	Turnover	TOV
		Prices	
112	4	Consumer Price Index - Food	CFOOD
113	5	Consumer Price Index - Non-Food	CNONF
114	4	Consumer Price Index - Core	CPIC
115	4	Consumer Price Index - General	CPIG
116	4	World Oil Price	OP
117	4	Wholesale Price Index	WPI
118	4	Consumer Price Index - Year-on-Year Inflation	INF

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Commentary

A New Measure of Inequality in Asian Economies

HAFIZ A. PASHA

The paper describes a new measure of inequality the Pashum ratio, which was first used in the UNDP Human Development Report for 2020 of Pakistan. The latest estimates of the extent of income inequality are derived from 18 Asian economies using the Gini coefficient and the Pashum ratio respectively. The relative position of nine out of the 18 countries varies in the two measures. Also, the greatest inequality among quintiles is observed in virtually all countries between the top and the second quintile.

A number of inequality measures have been developed in the literature. The first and the simplest measure is the quintile dispersion ratio which is the ratio of the share of the top quintile and the bottom quintile. This measure focuses only on the extreme of a distribution.

The Palma ratio quantifies the ratio of the share of the top decile and the combined share of the bottom two quintiles. It is a useful measure for policy-makers who need to decide on the extent of redistribution via progressive taxation and other measures.

The most widely used measure of inequality is the Gini coefficient. It ranges from zero to one. The value of these coefficient is derived from the Lorentz curve. It satisfies the requirements of mean independence, that if incomes are doubled, the measure remains unchanged. Similarly, it has the property of population size independence and satisfies the Pigou-Dalton axiom that a transfer of income from the rich to the poor should reduce income inequality.

The more complex measure is the Theil index from the viewpoint of measurement. It is not intuitive in nature and does not have a clear interpretation the Gini coefficient. As such, it has seldom been used in empirical research.

The objective of this paper is to present a new measure of inequality, the Pashum ratio. It was first developed and presented in the UNDP country human development report of 2020 for Pakistan (2020).

Section 1 describes the methodology for deriving the Pashum ratio. Section 2 demonstrates that the Pashum ratio satisfies the various axioms of inequality. Section 3 then applies the Pashum ratio to construct a ranking of selected Asian countries in terms of the level of inequality.

This ranking is then compared in Section 4 with the ranking obtained by estimation of the Gini coefficient of inequality of the selected countries.

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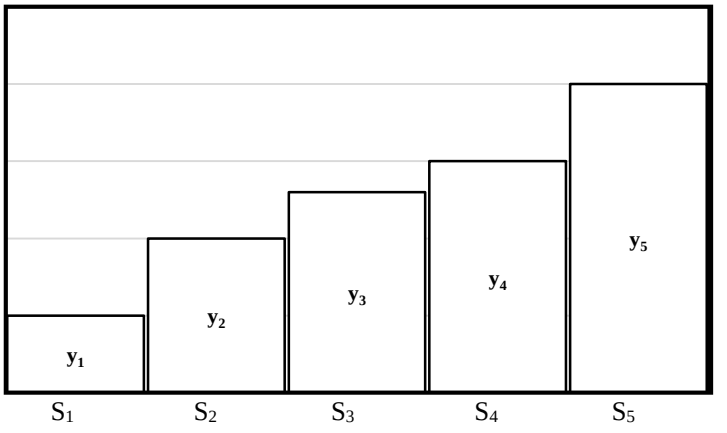
1. THE PASHUM RATIO

The Pashum ratio is derived first in the case where the share of different quintiles are available, as shown in Figure 1. Here, we have that

Fig. 1.



$S_i = 0.2, \mathrm{i} = 1 \sum_{i=1}^{n} y_i = 1$ and $y_{\mathrm{i}+1} > y_i$ for $i = 1, n-1$

The Pashum ratio, PR, is derived as

$$\mathrm{PR} = \left(\frac{1}{1-\mathrm{S}_1}\right) \sum_{\mathrm{i}=1}^{\mathrm{n}-1} \left(\frac{y_{i+1}}{y}\right) \mathrm{S}_\mathrm{i} - 1 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

In effect, the PR is the weighted average of the ratio of income shares of successive quintiles.

It may be noted that in the case of a uniform distribution

$\mathrm{S_i} = 0.2$, $\mathrm{y_i} = 0.2$

$$\mathrm{PR} = 0$$

Therefore, PR ranges from 0 to α.

Also, where we have the quintile distribution of income, Equation (1) is simplified as follows:

$$\mathrm{PR} = \frac{1}{4}\left[\frac{\mathrm{y}_2}{\mathrm{y}_1} + \frac{\mathrm{y}_3}{\mathrm{y}_2} + \frac{\mathrm{y}_4}{\mathrm{y}_3} + \frac{\mathrm{y}_5}{\mathrm{y}_4}\right] - 1 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

2. SATISFACTION OF AXIOMS OF INEQUALITY

The first axiom is scale invariance. This is the case with the Pashum ratio. The important axiom is the Pigou-Dalton principle of transfers as highlighted above.

The rich are in the top quintile and the poor generally in either the bottom quintile or in the bottom top quintiles.

A transfer of ε from the quintile to the bottom quintile changes the Pashum ratio to the following:

$$\mathrm{PR} = \frac{1}{4}\left[\frac{\mathrm{y}_2}{\mathrm{y}_1 + \varepsilon} + \frac{\mathrm{y}_3}{\mathrm{y}_2} + \frac{\mathrm{y}_4}{\mathrm{y}_3} + \frac{\mathrm{y}_5 - \varepsilon}{\mathrm{y}_4}\right] - 1 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

The new PR in [2] is clearly less than that in [1] because

$\frac{y_2}{y_1+\varepsilon} < \frac{y_2}{y_1}$ and $\frac{y_5-\varepsilon}{y_4} < \frac{y_5}{y_4}$.

The final axiom is that of decomposability. This is very much the case with the Pashum ratio and it is possible to locate in which part of the income distribution inequality is the greatest.

The generalized expression when the S_i are not the quintiles is as follows:

$$PR = \left(\frac{1}{1-S_1}\right)\left\{\sum_{i=1}^{i=n-1}\frac{\left(\frac{y_{i+1}}{S_{i+1}}\right)}{\left(\frac{y_i}{S_i}\right)}\cdot S_{i+1} - 1\right\} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

3. RANKING OF COUNTRIES IN INCOME INEQUALITY

A number of countries of Asia have been selected from different regions, namely, South Asia, SouthEast Asia, Northeast Asia and the Pacific. The total number of countries is eighteen. Data on the income distribution by quintile has been obtained from the World Development Indicators data base of the World Bank. The data for the latest year for which the information is available has been selected. For each country selected the magnitudes of the Gini-coefficient and the Pashum ratio have been derived. The estimates are presented in Table 1 in order of the ranking.

Table 1
Rank Ordering of Selected Asian Countries by the Magnitude of the Gini Coefficient and the Pashum Ratio respectively

Ranking	Country	Gini Coefficient	Ranking	Country	Pashum Ratio
1	Papua New Guinea	0.388	1	Papua New Guinea	0.765
2	Philippines	0.387	2	Philippines	0.717
3	Malaysia	0.380	3	Malaysia	0.711
4	Sri Lanka	0.359	4	Samoa	0.650
5	China	0.356	5	Sri Lanka	0.647
5	Samoa	0.356	6	China	0.642
5	Lao PDR	0.356	7	Lao PDR	0.635
8	Indonesia	0.352	8	Indonesia	0.628
9	Vietnam	0.330	9	Vietnam	0.610
10	India	0.328	10	India	0.565
11	Thailand	0.324	11	Thailand	0.550
12	Nepal	0.305	12	Japan	0.540
13	Japan	0.304	13	Korea, Rep of	0.522
13	Mongolia	0.304	14	Mongolia	0.520
15	Bangladesh	0.299	15	Nepal	0.510
16	Korea, Rep of	0.293	16	Bangladesh	0.500
17	Pakistan	0.291	17	Pakistan	0.480
18	Myanmar	0.282	18	Myanmar	0.473

The Gini-coefficient varies by 37.5 percent between the most unequal distribution country and the least inequal country. The variation is larger in the Pashum ratio at 61.7 percent. Also, while all countries have different magnitude in the Pashum ratio, this is not the case with the Gini-coefficient. For example, three countries, namely, China, Samoa and Lao PDR have the same Gini-coefficient at the third place of decimals. Therefore, it appears that the Pashum ratio is a more sensitive inequality measure as it can range from zero to infinity, whereas the Gini-coefficient can vary only from zero to unity.

There are also significant differences in country rankings as revealed by the two measures. For example, out of the 18 countries, the biggest difference in ranking is observed in case of the Republic of Korea. It is ranked 16th according to the Gini-coefficient while the ranking given by the Pashum ratio is 13th. Among the eighteen countries, nine have different rankings in the two measures. However, the rankings are robust at the upper end and lower end of the country distributions. The overall rank correlation coefficient is 0.97.

4. POLICY IMPLICATIONS

The Pashum ratio enables determination of which part of the income distribution, inequality is the highest and the lowest. The findings are reported below in Table 2.

Table 2

Greatest and Least Inequality within Income Distribution

	Location of Greatest Inequality	Location of Lowest Inequality
4th vs. Lowest Quintile	Korea, Rep of	
3rd vs. 4th Quintile	Korea, Rep of	Indonesia, China, Papua New Guinea
2nd vs. 3rd Quintile	Korea, Rep of	All Countries, except Indonesia, China, Papua New Guinea
Top vs. 2nd Quintile	All countries, except Korea, Rep of	

A clear pattern is visible. The greatest inequality is observed between households in the top quintile versus these in the fourth quintile. This is frequently due to mechanisms of state capture by the elite of a country.

These include tax breaks and concessions, preferential access to ownership of land and access to bank credit, unbridled exercise of monopoly power and so on. The real challenge is for the authorities to reduce inequality, especially when many of them are part of the elite.

In conclusion, an attempt has been made to present an alternative measure of inequality, the Pashum ratio, which is relatively easy to compute, has a clear intuitive interpretation, satisfies the various axioms of inequality and is a more sensitive measure than the Gini-coefficient.

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Policy

Electricity Tariff Design: A Survey

AFIA MALIK and AMENA UROOJ

Pakistan's tariff structure should be designed so that each consumer pays as per their service cost.
No more uniform tariffs.
Move from increasing block tariff to a flat linear tariff.
It will not only maximise revenues but minimise inefficiencies in the sector.

1. INTRODUCTION

In a perfectly competitive market, electricity is priced at the Marginal Cost (MC); MC pricing guarantees economic efficiency (Gunatilake, et al. 2008). In other words, efficient electricity tariffs consider all power supply costs. To a great degree, it also accounts for capital investments for future expansion and up-gradation (Kojima, et al. 2014). In a free market, market forces of demand and supply pushed for MC recovery.

In contrast, for a regulated market, the regulator sets the tariff according to the costs and reasonable return determined through the regulatory process. The regulator followed pre-determined guidelines, parameters, and standards set by the government; it may or may not be MC pricing. When a regulated tariff is set at a low level, it distorts the development/ functioning of the market at both the wholesale and retail levels.

"If regulated end-user prices are not in line with wholesale market conditions, suppliers without significant low-cost generation capacity or equivalent long-term contracts will not be able to make competitive offers that will allow them to recover their costs. Consequently, with a limited number of suppliers, there will be no development of the wholesale markets. Liquidity will remain at a low level. As a result, neither the wholesale nor retail markets will be competitive" (Cited from Suzzoni, 2009, p. 5).

The electricity tariff includes the operating and maintenance costs involved in generating, transmitting, and distributing electricity and a return on investment for a company engaged in these activities. Besides, it considers subsidies, surcharges, or taxes as per government policy, especially in the case of regulated tariffs.

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Authors' Note: Our thanks to Nadeem Ul Haque for suggesting the topic and guiding us through the research.

This survey presents different electricity tariff structures and designs across countries. It heavily relies on regional and global surveys (Foster and Witte, 2020; AfDB-ERERA, 2019; and INNOGATE, 2015).[1] On top, it reflects on Pakistan's electricity tariff structure, identifies loopholes, and suggests a way to improve them.

2. ELECTRICITY TARIFF CATEGORIES

Across the world, a volumetric tariff is applied—linear, and IBT structures are common (Table 1). ***The linear tariffs*** are generally applied to agricultural, commercial, and industrial consumers but are used less frequently for residential consumers, especially in developing countries. Load-based tariffs sometimes combine with other volumetric tariff structures in commercial and industrial schedules. For commercial and industrial customers, linear charges are modified by time-of-use factors and complemented with load-related fixed charges. Evidence suggests the simultaneous presence of various tariff designs in countries; variation is across sectors.

Tariff Categories
There are four types of volumetric tariffs:
Linear Tariff—every unit consumed is charged the same rate.
Increasing Block Tariff (IBT)—unit rate increases with an increase in successive bands/- blocks of marginal consumption stepwise.
Decreasing Block Tariff (DBT)—unit rate decreases with successive bands/ blocks of marginal consumption increasing stepwise.
Volume Differentiated Tariff (VDT)—linear tariff increases (or decreases) if total monthly consumption crosses a specific volume limit; otherwise, a single linear rate is charged.
In some countries/ consumer categories, volumetric charges are accompanied by fixed load charges.
Fixed Load Charges—capacity rather than the energy consumed determines fixed costs on the power system. These are linear load charges per KW.
Time-of-use Charges—that apply multipliers to standard charges depending on consumption during peak or off-peak hours. These are linear but vary with time blocks.

Tariffs with ***demand-based charges*** are more widely used for industrial and commercial and industrial customers but rarely exist for residential consumers and are more prevalent in high-income countries. In almost all countries where demand charges exist, these are linear load charges per kW.

Time-Based Rates are designed to reflect the real impact of the peak-hour load more accurately. It is designed to encourage customers to participate in reducing overall system costs or achieve other goals. Time-based rates (peak and off-peak) can provide more accurate price signals to customers, better reflecting the marginal cost of supplying and delivering electricity during specific day hours. These price signals may lead customers to change their consumption patterns to reduce peak and total consumption. It is common in industrial and commercial tariff schedules but rarely applied in residential tariff schedules.

In countries applying time-of-use blocks mainly consists of peak and off-peak hour blocks. Less common are broader divisions into day and night times and seasonal variation applied to those that do not use their facilities year-round (e.g., a cottage). Some of the modern utilities offer weekend /holiday rates to residential consumers. When time-of-use is practiced, unit charges during peak hours are almost double that of off-peak hours.

[1]The information is mainly drawn from these studies, otherwise cited.

Table 1

Tariffs Followed Across Countries

Volumetric Tariff Types	Countries			Description
	Residential	Commercial	Industrial	
Linear Tariff	Germany, Chile, Czech Republic, Slovak Republic, Austria, Georgia, UK, Canada, Congo, US, Guatemala, Malawi, Niger, Nigeria, Rwanda, Solomon Islands, Turkey, Uganda	Algeria, Austria, Bangladesh, Benin, Burkina Faso, Cambodia, Chile, Congo, Côte d'Ivoire, Egypt, Germany, Greece, Guatemala, Guinea, Iran, Kenya, Korea, Kyrgyz, Lebanon, Madagascar, Malawi, Mali, Malaysia, Mongolia, Nepal, Nicaragua, Nigeria, Pakistan, Rwanda, Solomon Islands, Tanzania, Tunisia, Turkey, Uganda, Vanuatu, Venezuela, Yemen, Zambia, Zimbabwe	Algeria, Benin, Bolivia, Burkina Faso, Cambodia, Chile, Congo, Egypt, Ethiopia, Ghana, Guinea, Haiti, India, Iran, Jordan, Kenya, Kyrgyz, Lebanon, Madagascar, Malawi, Malaysia, Mongolia, Morocco, Mozambique, Nepal, Niger, Nigeria, Pakistan, Philippines, Rwanda, Senegal, Sierra Leone, Solomon Islands, Tanzania, Turkey, Uganda, Vanuatu Venezuela, Yemen, Zambia, Zimbabwe	Mostly Developed Countries
Increasing Block Tariff (IBT)	Pakistan, India, Bangladesh, Philippines, Bhutan, China, Indonesia, Iran, Malaysia, Japan, Algeria, Guinea, Haiti, Honduras, Jordan, Benin, Bolivia, Burkina Faso, Burundi, Cambodia, Cameroon, Côte d'Ivoire, Egypt, Ethiopia, Ghana, Greece, Indonesia, Iran, Kenya, Korea, Kyrgyz, Lebanon, Madagascar, Malaysia, Mali, Mongolia, Morocco, Mozambique, Myanmar, Philippines, Senegal, Sierra Leone, Tanzania, Togo, Vanuatu, Yemen, Zambia, Zimbabwe	Bolivia, Cameroon, Ethiopia, Ghana, Haiti, Honduras, Indonesia, Jordan, Morocco, Mozambique, Philippines, Sierra Leone, Thailand, Togo	Thailand, Togo	Mostly Developing Countries
Decreasing Block Tariff (DBT)	Australia, Benin,	Australia		
Volume Differentiated Tariff (VDT) Fixed Load Charges	Sri Lanka, Nepal, Vietnam, Albania, Angola, Armenia, Nigeria, Sri Lanka, Venezuela	India	Armenia, Bangladesh	
Volume Differentiated Tariff (VDT)_Time-of-use Charges	Russia, Nepal, Thailand, Tunisia	Armenia, China	China, Côte d'Ivoire, Nicaragua	
Non-Linear Block Tariff	Nicaragua, Myanmar		Myanmar	

Source: Countries' electricity Tariff websites and Foster and Witte (2020).

Increasing Block Tariffs (IBTs) are commonly applied to residential customers. These are designed to provide a social safety cover where all consumers can access electricity at an affordable tariff, including low-end consumers. In this tariff design, a shortfall in revenue is recovered from high-end consumers. The first block is usually priced to cover about 50 per cent or less of operating costs, while in the final block/blocks, the tariff applied is above the average operating expenses or actual cost of service. The design of IBTs varies with these blocks' number, size, and unit price across countries applying this tariff design. The number of blocks incorporated in the residential tariff design varies from two to eight.

Apart from IBT, countries rely on other forms of complex volumetric design, including ***decreasing or non-monotonic block structures***. Based on available information, Australia and Benin are the two countries found with evidence of DBT.[2]

Energy tariff structures for each customer classification may be different but are designed (in general) to closely align them with the cost of service for that class. Tariff design is the process by which the cost of providing the services is allocated among the customers who use those costs. When designing a tariff mechanism, the following principles should be considered:

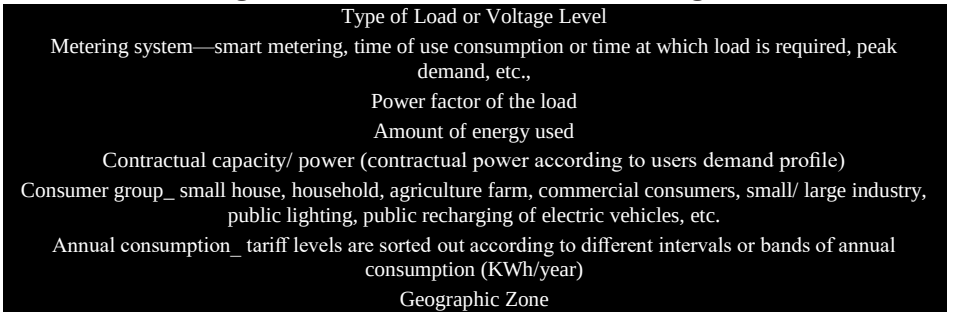
- Economic efficiency, i.e., a tariff ensuring MC recovery.
- Cost recovery, i.e., a tariff covering operating, maintenance, and capital costs.
- For users' acceptance—simplicity and transparency, i.e., easily understandable with transparent features.
- Non-discriminatory, i.e., a tariff which treats all users equally.
- Social affordability and political acceptance are other vital considerations requiring a gradual approach supported by transitional arrangements.

Generally, most of these considerations are not considered in developing countries with regulated tariff structures. But these are considered in countries (primarily developed countries) with well-established electricity markets.

3. TARIFF STRUCTURE

The electricity tariffs depend on the factors, as shown in Figure 1, but the combination of factors varies across countries. The last two factors are typically found

Fig. 1. Factors considered in Tariff Design



[2]https://www.energy.gov.au/sites/default/files/watts_in_your_business_fact_sheet_5_electricity_tariffs.pdf

in EU countries.[3] A single variable or a combination of these variables is used to allocate users to a given tariff category. For instance, in Denmark, Estonia, Romania and Slovenia, only the voltage level is used to allocate users to a certain consumer tariff category.

Two-part or three-part tariff structures are commonly applied in many countries across the globe. The objective is to correctly reflect the cost of providing electricity to a particular consumer category. In the case of a two-part tariff, residential consumers have a fixed charge and a variable energy charge as recorded by the meter. For industry, a two-part tariff consists of a demand charge (capacity agreed in the contract) and the variable energy charge recorded by the meter. A two-part tariff is justified because it provides stability for the service provider, thus preventing large swings in revenue that may result from changes in usage conditions. On the consumer's side, they may make better choices in their energy use under this tariff.

A three-part tariff is used only for specific consumer categories, e.g., bulk power consumers. The consumer electricity bill covers fixed costs (D), semi-fixed costs (Ax) and variable costs (By). That is,

$$C = Ax + By + D$$

Where C is the total charge for a period, x is the maximum (peak) demand during the period in units, and A is the cost per unit of maximum demand; y is the total energy units consumed during the period, and B is the total cost of energy units consumed; and D is the fixed charge during each billing period.

- The fixed costs typically include what the service provider incurs in reading meters, billing and collections, and a charge for the installation/repair/ maintenance necessary to provide electricity service to the consumer.
- The energy costs vary depending upon the amount of energy consumed.
- The service provider incurs the demand costs in providing the peak load of the consumer at any given time during the billing period. The service provider incurs the costs of providing the facilities for meeting a designated peak load of the customer, regardless of whether the customer uses that peaking amount during the month or the year.
- Distribution tariff structures by user groups are different among countries.

In the African region and many Asian countries, the tariff includes fixed, capacity, and energy charges. The energy charge is further categorised as flat charge (a flat rate for all units consumed, irrespective of the level of consumption), consumption block (different prices applied to the KWh according to the consumption level) and TOU (different prices depending on the time of use).

Cross-subsidisation across Consumer Groups

Cross-subsidisation across various consumer groups is quite common. Evidence suggests that cost-recovery from a politically favoured group, i.e., domestic and

[3]https://ec.europa.eu/energy/sites/ener/files/documents/20150313%20Tariff%20report%20fina_revREF-E.PDF

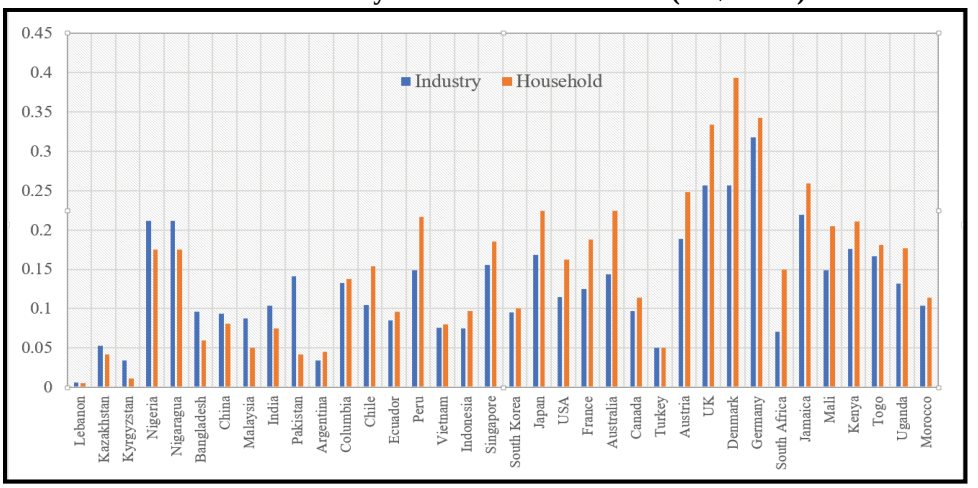
agriculture consumers, is challenging in developing countries. The tariff structures in most of these countries cross-subsidise domestic and agricultural consumption at the expense of industry and commercial users. Some residential tariff categories are about half or below industrial and commercial tariffs. At the same time, agricultural users tend to pay only about a fifth of what other user categories are charged.

In over 60 per cent of the countries (mainly low and middle income), industrial customers pay more than residential customers despite imposing likely lower costs on the system. Likewise, in almost 80 percent of the countries, commercial customers spend more than residential customers despite imposing similar charges on the utility (Foster and Witte, 2020). In contrast, in the developed countries, e.g., in the United States, EU countries, Japan, and South Korea residential tariff rate is more than that of the industry, commercial and transport sectors.[4]

Even in some low- and middle-income countries that have prioritised their industrial growth, the industrial and commercial tariffs are lower than residential tariffs, for instance, Argentina, Peru, Indonesia, Vietnam, Columbia, South Africa, Morocco, and Kenya. Even some African countries like Mali, Rwanda, and Togo, with low income per capita, prefer productive business activities more by charging a lower tariff than household electricity tariff (Chart 1). It is beyond doubt that price variation across sectors creates horizontal injustice to the productive sectors of the economy.

Most countries cross-subsidising domestic consumers apply increasing block tariffs (IBTs). There is a significant variation in tariff across tariff blocks or slabs within the same consumer category; the number of slabs also varies across countries. In other words, cross-subsidisation within the sector as well. The aim is to protect the disadvantaged group of consumers against tariff hikes.

Chart 1. Electricity Tariff Across Countries (US$/KWh)



Source: https://www.globalpetroleprices.com/electricity_prices

There is extensive evidence that IBTs are ineffective at protecting lifeline consumers. Even if they are effective in protecting them, it is at the cost of supporting those

[4]https://www.eia.gov/energyexplained/electricity/prices-and-factors-affecting-prices.php

who may not necessarily fall into the low-income group (Komives, et al. 2005). Cross-subsidisation or IBTs yields positive results only when a higher percentage of poor households are connected to the grid (Huenteler, et al. 2017). Perhaps, the opposite is the case in actual practice in developing countries, where many rural poor are not connected to the national grid. Another issue common in African countries is that poor households often share meter/connection to divide high upfront connection costs. This increases their total consumption, preventing them from taking benefits of lower slabs in IBTs (Kojima and Trimble, 2016).

Besides, IBT creates a deadweight loss relative to transfers_ such targeting of the poor is less effective than direct cash transfers for the poor. It has no cost basis and nurtures a conflict between efficiency and distributional goals (Borenstein, 2012). Non-linear electricity tariffs and taxation complicate economic decisions via charging varied marginal prices for the same good (Ito, 2014).

4. TARIFF REGULATION

Two types of cost-based tariff regulation are common:[5]

- **Rate-of-return regulation—**assures the regulated company a specific pre-defined rate of return on its regulatory asset base.
- **Cost-plus regulation—**provides a pre-defined profit margin to be added to the company's costs.

There is little incentive to minimise costs in the rate-of-return regulation because a service provider can increase its profits by simply expanding the assets or cost base. Whereas, in cost-plus regulation, a company may have an incentive to signal incorrect costs to the regulator or waste resources to increase the cost base in extreme cases. Cost-based tariffs are based on assumptions and forecasts as tariffs are calculated for future periods. The regulator gauges the necessary costs based on the actual operation of the company but remains uncertain regarding the service provider's efficiency.

- **Incentive-based regulation** was developed to overcome shortcomings in cost-based regulation. The focus of this regulatory approach is on efficiency.

The United Kingdom (UK) was the first to introduce this approach. Later, followed by many other countries in developed countries and some developing countries like Pakistan and India before the privatisation or intended privatisation of network companies. This regulatory approach has been dependent on reliable data on costs and additional information for several years.

The overall policy towards energy pricing in the European Union and other developed countries is market-based wherever it is practical. Generation and supply procurement and tariffs are generally through a competitive market. Where regulated tariffs are applied, the underlying principles are that they should be fair, transparent, cover reasonable costs, allocate the cost efficiently between

[5]Cost of service regulation or average cost (AC) is primarily applied in developing countries with no competitive market. The apparent preference for cost-of-service regulation is the complexities in determining other pricing principles, e.g., MC pricing.

consumers, and provide for necessary investment and a valid return (INOGATE, 2015).

When most EU members have regulated tariffs, either rate-of-return regulation or cost-plus regulation were used. But now, these countries have switched to an incentive-based tariff. The objective is to incentivise performance, reduce the asymmetry of information between the regulator and the subject companies and improve the efficiency of the tariff-setting process. Yet, incentive-based regulation is effective only when the network companies are privately owned and the operational cost and asset valuations are fixed (INOGATE, 2015).

The tension between regulated and market-based tariffs can be removed once the tariffs are based on Marginal Costs (MC).

5. ELECTRICITY TARIFFS IN PAKISTAN

National Electric Power Regulatory Authority (NEPRA) determines electricity tariffs in Pakistan. Table 2 highlights the types of tariffs applied across various consumer groups. Figure 2 elaborates the tariff structure for generation, transmission, and distribution. Although the rules for competitive bidding in generation and transmission exist but are rarely applied, cost-plus and up-front are typically used. The tariff Regime/ Procedures followed are elaborated in Figure 3.

Table 2

Tariff Types Across Different Consumer Groups

Consumer Groups	Tariff Applied
Residential	IBT (Since FY2014 moved from all slab benefit to only previous slab benefit)/ TOU
Industry	Linear (Varies with load; higher price for lower load)/ TOU
Commercial	Linear (Varies with load and TOU)
Agriculture	Linear (Lower for tube wells as compared to Scarp)/ TOU
Public Lighting	Linear

Fig. 2. Tariff Structure

Generation	Capacity Charges Energy Charges
Transmission	Use of System Charges (fixed cost) determined annually Pool generation cost (fixed and variable cost) transfer pricing mechanism for DISCOs including K-Electric (KE) to the extent of 650 MW (Power Purchase Charge for DISCOs - Distribution Margin - Power Purchase Price (PPP) charged to DISCOs.
Distribution	It includes energy price and capacity price. - T &D losses - Prior Year Adjustments

Fig. 3. NEPRA Tariff Regimes

Generation	Cost-plus Up-front Competitive Bidding Interim Power Procurement Regulation
Transmission	Cost-plus Competitive Bidding
Distribution	Revenue Cap Price Cap
Multi-Year Tariff (MYT) Regulator	

Multi-year tariff (MYT) regulatory framework was introduced for KESC in 2002 for seven years, given its expected privatisation. Later, the same tariff regime was established for FESCO, IESCO and GEPCO, anticipating their privatisation. The objective behind MYT is to obviate regulatory uncertainty and incentivise efficiency. Since March 2001, an automatic tariff Adjustment mechanism for fuel cost variations has also been adopted, applied every month.

Fig. 4. Electricity Tariff in Pakistan—Historical Perspective

Consumer-end Tariff Methodology

From 1960 to 1973—DBT, i.e., high rates for initial units and lower on succeeding units. In the 1960s, 60 percent of the electricity was produced from hydro sources; therefore, initial units were expensive to cover the capacity price.

The trend reversed in 1973 to IBT, i.e., initial units became cheaper. Shortage of energy capacity led to this change.

Electricity tariffs for WAPDA have remained above the cost of production, that is, above MC until 1996.

Tariff for Distribution Companies

- **During the transition phase** towards the complete corporatisation of the former WAPDA companies, the bulk tariffs charged for the electricity purchased by the distribution companies have been determined at the discretion of NTDC.
- **Until 2000,** a uniform bulk tariff was charged to all distribution companies to purchase electricity.
- **In 2001,** a new pricing methodology was established, allowing each distribution company to retain a margin that reflects its cash expenses, debt services, and line losses (but not capital expenditures or non-cash expenses).

Source: Suhail (2014) & Malik (2022).

6. SOME REFLECTIONS ON PAKISTAN'SELECTRICITY TARIFF STRUCTURE

The tariff structure in Pakistan is not based on regional and consumer-specific long-run marginal costs but political considerations. NEPRA determines consumer-end tariffs. In deciding the average sale price, NEPRA considers the annual revenue requirement of DISCOs which includes all the costs involved in the supply chain. The main factors in the annual revenue requirements or tariff determined include Power Purchase Price[6] (a combination of Energy Purchase Price (EPP), Capacity Purchase Price (CPP)), Use of System Charges (UoSC) or market operator fee, net distribution

[6]It includes the generation and transmission costs of the power a DISCO has projected to purchase.

margin,[7] Transmission & Distribution (T&D) losses, and Prior-year Adjustments (PYA).[8]

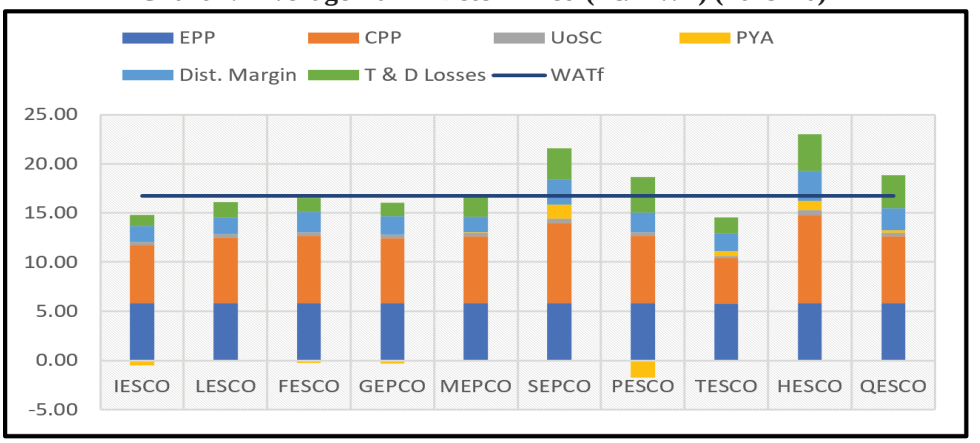
In addition, electricity utility bills are increasingly cluttered with taxes, fees, and surcharges. Consumers also pay:

- For investment in hydro projects, a Neelum Jhelum Surcharge of Rs 0.10 per unit.
- For servicing of circular debt parked in the Power Holding Private Limited, a financial cost surcharge of Rs 0.43 per unit.
- Sales tax @ 17 percent per unit, electricity duty @ 1.5 percent per unit and a TV fee of Rs 35 per meter.
- Sales tax is also charged on fuel price adjustments. There are few additional taxes for non-filers of income tax.

These are charged irrespective of units consumed. The proliferation of these surcharges generally shifts risks away from utility operators/ investors and onto consumers. Besides increased costs to compliant consumers, surcharges can also result in more inefficiency in the distribution system. It reduces DISCOs' incentives to improve and control costs. And in the case of the Neelum-Jhelum project, the surcharge shifts utility business risks away from investors and puts extra pressure on consumers (Malik, 2020).

As demonstrated in Chart 2, taking the weighted average of tariffs (WATF) across DISCOs, we find that consumers in distribution companies like IESCO, LESCO, FESCO, GEPCO and TESCO are subsidising consumers of SEPCO, PESCO, HESCO and QESCO by paying more than their actual determined tariffs.

Chart 2. Average Tariff Determined (Rs/KWh) (2019-20)



Source: SROs 182(1)/ 2020 to 190(1)/2020, February 12, 2021.
Note: WATF is the weighted average of tariffs across DISCOs, weights are based on units consumed.

[7]It is the difference between DISCOs gross margin and other income. Gross margin includes operation and maintenance (O&M) costs, depreciation and returns on the asset base of DISCO. Other income refers to remuneration of deferred credit, meter and rental income, late payment surcharge, profit on bank deposit, sale of scrap, income from non-utility operations, commission on PTV fees and miscellaneous incomes.

[8]It is the gap between the projected and the actual cost in the previous year, built into tariffs for that year. This adjustment is for the difference between the projected and actual electricity units purchased by DISCOs; the difference between the projected and actual distribution margins; the difference between actual and notified previous year adjustment; the difference between projected and actual other income; and the difference between the projected and actual consumption mix.

Before the amendment to the NEPRA Act in 2018—NEPRA determined consumer-end tariffs for each distribution company (DISCOs) separately. The tariff determined for each DISCO was different because of its distinct characteristics: the difference in annual revenue requirement and T & D losses (as evident in Chart 2). NEPRA evaluates cost and revenue requirements and sends its recommendation to the Government of Pakistan (GOP). The GOP notified the uniform tariff after adjusting for subsidies.

After the amendment to NEPRA Act in 2018—NEPRA determines a uniform tax for distribution licensees wholly owned and controlled by a common shareholder based on their consolidated accounts, even though all distribution companies are separate corporate entities. This compromises the inefficient behaviour of some of the DISCOs. The Government of Pakistan notified the final applicable tariff after adjusting for subsidies.

Subsidy & Cross-subsidy Across Sectors

Uniform tariffs as determined by NEPRA, and the applicable tariffs as notified by the GOP are displayed in Charts 3 to 6. For the end-consumer, the current tariff structure is uniform throughout the country. Still, it distinguishes between residential, commercial, industrial, agriculture, and other customer categories. It is further divided by consumption level (tariff slabs), load, or time of use. The tariff structure is progressive for residential consumers. At higher consumption levels, it is more expensive. For residential consumers, the price of electricity is greater than the supply cost in the highest slab. But for agriculture tube wells, a tariff is linear and heavily subsidised.

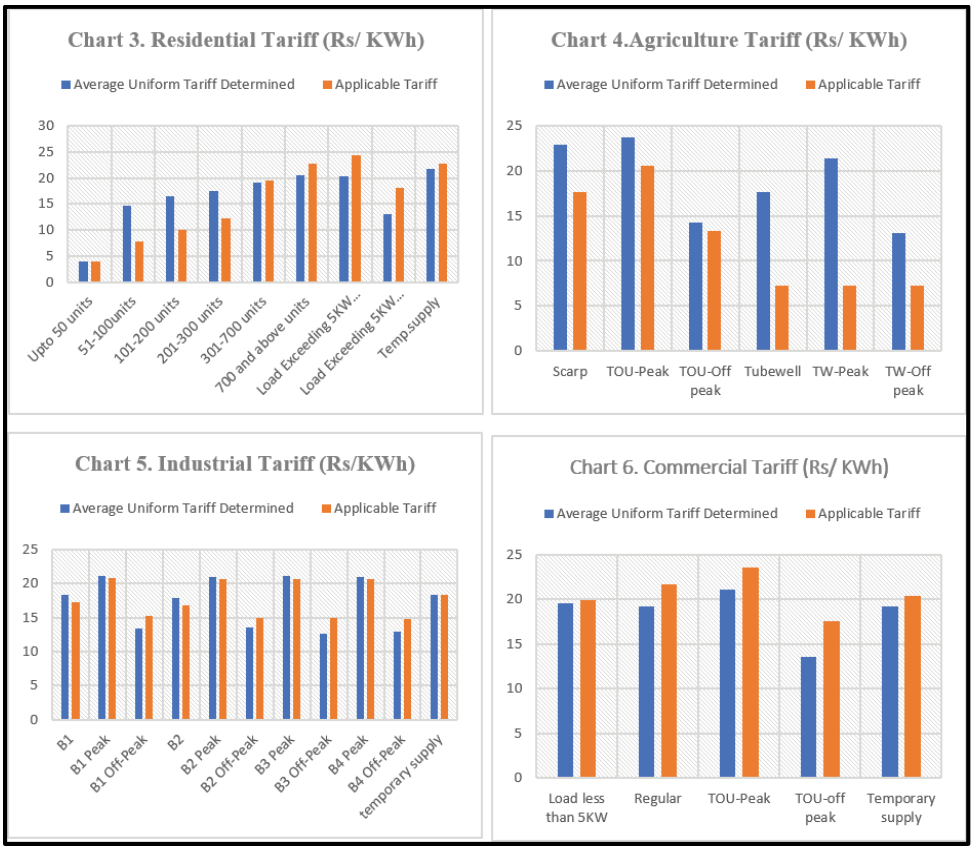
The system of electricity subsidies, cross-subsidisation across sectors and different geographical regions (DISCOs), and the inability to pass on the actual cost to some consumer categories are of great concern. Besides creating financial difficulties for the government, a tariff structure in which charges are not recovered from all consumer categories indiscriminately creates inefficiencies and misleads investment decisions in the supply system (Malik, 2020).

The Government of Pakistan provides several subsidies to the power sector. The most significant portion of this subsidy is for inter-DISCO tariff differential. Out of Rs 366.4 billion of electricity subsidy in FY2021, 55 percent (Rs 201.8 billion) was for inter-DISCO tariff differential, and about 2 percent (Rs 7.5 billion) was for Agriculture tube wells.[9] Since FY2007, the government has paid over Rs 3.4 trillion as subsidies. Out of which about 75 percent are for the policy to maintain the same tariff across the country. Due to fiscal constraints, the government can't manage this subsidy amount in time. Thus, adding to circular debt. The consumer tariff notified in February 2021 created a financial gap of more than Rs 180 billion, to be covered through direct subsidies by the government. This is apart from tariff hikes due to fuel and other adjustments.

Apart from inefficient use of resources, some distortionary effects are associated with these subsidies and price structures. This welfare move discourages inefficient companies from improving their performance. Suppose a different tariff is charged in each DISCO. In that case, there will be pressure on companies like SEPCO, HESCO,

[9]Consumption of electricity in agriculture is about 9 percent of the total.

PESCO and QESCO to improve, but companies like IESCO, GEPCO and FESCO would be able to sell electricity at a lower rate. Uniform tariff and subsidy policy burden compliant consumers through various surcharges, taxes, and tariff hikes.



Source: SROs 182(1)/ 2020 to 190(1)/2020, February 12, 2021.

IBT (Non-linear Tariff)—Domestic Sector

Since 2013-14, the tariff structure has moved from all slab benefits to only a previous slab benefit. The residential consumers are given the advantage of one last slab. As we can see in Chart 3, for domestic consumers who consume up to 300 units of electricity, the applicable uniform tariff is much lower than the NEPRA determined uniform tariff. Moreover, whatever the government announces, an increase in tariff is only applicable to those who consume 300 plus units (most of the time). As per the tariff notification of February 12, 2021, 67 percent of domes- tic consumers use electricity up to 300 units, while the remaining 33 percent consume electricity above 300 units in Pakistan. In other words, 67 percent of the consumption is below the weighted average cost of service. This government policy is meant to insulate the poor and the lower middle income (0-300 units) from the tariff hike.

Are all these 67 percent poor and lower-middle-income households? About 46 percent of the population is not connected to the national grid in rural areas. In urban

areas, poor and lower-middle-income households that presumably consume (0-300 units) reside typically in congested localities. However, there are apprehensions that crowded areas mean more power theft (through meter-tempering) and line losses.

Moreover, there is ample evidence that the households opted for options to remain in lower slabs, for instance, two to three meters in a residential premise dividing load, meter tampering or electricity theft, or payment of a fixed amount to the lower staff of a company (Malik, 2020). So perhaps, this group is getting the subsidised tariff unnecessarily, increasing the burden for the government and the complaint consumers.

Unless or until tariffs are not allowed to cover the cost of providing electricity to consumers, the sector will continue to face financial difficulties. As Burgess, et al. (2020) argued, the issue arises when we start treating electricity as a right rather than a private good. It leads to subsidies, theft, supply without payment, and losses for distribution companies, which may limit supply.

Cross-subsidisation across Sectors

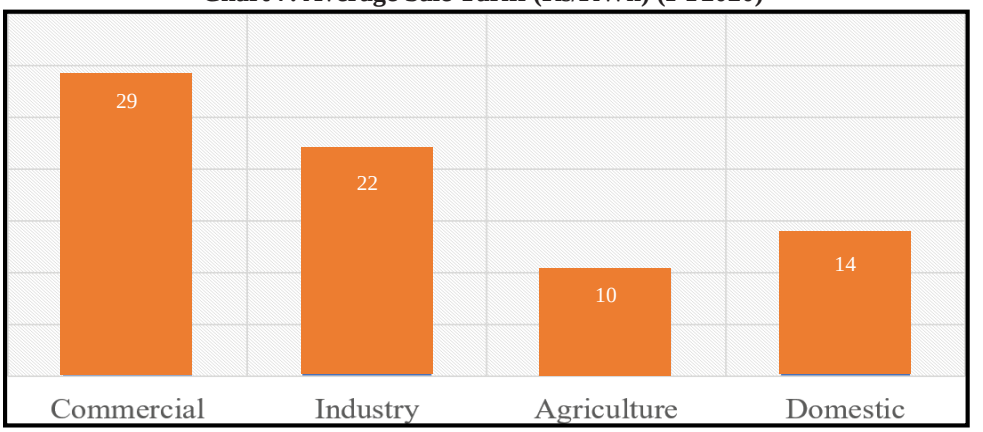
Over the years, a weak link between price and demand and substantive cross-subsidisation has skewed consumption toward less-productive domestic consumers. Domestic consumption of electricity in FY-2021 was more than 50 percent. In comparison, the industry consumes 26 percent. The industry relies on other energy sources due to expensive electricity from the national grid. In other words, the productive sectors that require a continuous supply of electricity either must restrict their production or rely on other sources when electricity service is considered a 'right' (Burgess, et al. 2020).

The unit cost of service to the industry is around Rs 13.7/KWh for the year 2020 in Pakistan (PIDE, 2021). However, the average unit price charged to industrial units is around Rs 21.90/kWh (Chart 7) during 2020.[10] There is a significant cross-subsidy from industrial and commercial consumers to agricultural and domestic consumers (below 300 units). Over the years, limited progress has been made in reducing cross-subsidies. Some of our low value-added exports rely heavily on electricity consumption. The high cost of electricity has reduced the competitiveness of our exports, thereby impacting the country's trade deficit and balance of payment. Large cross-subsidies (especially in favour of domestic and agriculture consumers) and heavy tax incidence are contributing to grid defection by large consumers (industry, commercial and high-end consumers) (cited from Malik, 2022).

The energy tariffs are high due to governance issues, operational, financial, and commercial inefficiencies, inapt policies, distortions in applicable tariff schemes, irrational cross-subsidies, and sub-optimal energy mix (Malik, 2020). The policymakers try to cover all these inefficiencies through subsidies or by charging a higher tariff to industry, commercial and high-end residential consumers. Over the last ten years, these subsidies have exhausted fiscal resources immensely, leaving little (in the form of PSDP) for the renovation or expansion of transmission and distribution infrastructure (SBP, 2019).

[10] It is despite the subsidy rates to zero-rated industry.

Chart 7. Average Sale Tariff (Rs/KWh) (FY2020)



Source: NEPRA State of Industry Report 2021 and PIDE (2021).

7. ELECTRICITY TARIFF AND POWER SECTORCHALLENGES

Tariff and Circular Debt Nexus

Consumer end tariffs are highly sensitive to the losses in the transmission and distribution (T&D) systems. With every percentage increase in losses, the tariff increases exponentially (as the generation cost increases). When a certain percentage of these losses are not accounted for in tariffs, it adds to the circular debt. Likewise, in tariff determination, NEPRA counts 100 percent recovery. However, the reported recovery percentage of DISCOs remained around 90 percent on average (Malik, 2020).

In 2021, T & D losses were equivalent to *Rs 473 billion, Rs 402 billion were recovered through tariff, and a financial loss of Rs 71 billion was added to circular debt. Power sector loss from low bill recovery was Rs 39 billion in the same year.* Unless or until tariffs are not allowed to cover the actual cost of service to consumers, the power sector will continue to face financial difficulties, and the circular debt will continue to rise.

It is estimated that a per unit increase in price by Rs 1 adds to an additional loss of more than Rs 10 billion; as it affects the paying capacity of consumers, that in turn will increase poverty, theft and delayed or no payment; increasing arrears (Faraz, 2018). *Increasing tariffs will not resolve circular debt or power sector inefficiencies.*

Moreover, as mentioned in the previous section, a significant portion of power sector subsidy is for inter-DISCO tariff differential. Due to fiscal constraints, the government cannot manage this subsidy amount in time, consequently adding to the sector's deficit (that is, circular debt).

Tariff Design and Privatisation of Distribution Companies

K-Electric is a privatised entity operating in a regulated environment. The same uniform tariff policy is applied to K-Electric consumers. The utility faces delays in tariff determination, delays in the disbursements of Tariff Differential Claims, and delays in receivables from the government departments (Malik & Khawaja, 2021). Thus, affecting the utility's ability to pay back and increasing its payables to Rs 225 billion.

As per National Electricity Policy 2021, the uniform tariff policy will continue—meaning the continuation of tariff differential subsidy. The privatisation of state-owned distribution companies is on the GOP plan. *A uniform tariff policy is no incentive for a privatised company.*

Additionally, theoretically, it should have been relatively more straightforward for K-Electric as a privatised company to make investment decisions based on tariffs, to upgrade or replace distribution infrastructure. However, the company still needs regulatory approvals from NEPRA.

Tariff Structure and Independent Power Plants

Another shortfall associated with the current structure of tariffs and subsidies is shifting pressures away from inefficient power producers who continue to use more expensive fuels for thermal generation. For instance, as we can see in Chart 1, in the end-user NEPRA-determined tariff, the power purchase price (PPP=CPP+EPP) constitutes more than 73 percent (on average). The tariff notified by the government to subsidise households consuming up to 200 units is Rs 10.06 per KWh (Chart 2), which is much lower than the price at which DISCOs procure electricity from CPPA. This implies that while subsidising power to end-consumers, the government pays not only for the inefficiencies at the DISCOs level; but for inefficiencies and excess capacities in the generation sector (Khalid, 2019). *The current tariff/ subsidy policy led inefficient power producers to continue their ongoing practice.*

Tariff Design and Market Development—CTBCM

The GOP is in the process of implementing the Competitive Trading Bilateral Contract Market (CTBCM). The ultimate objective of CTBCM is to generate competition among market players to benefit consumers in terms of service quality and pricing. There will be *no competition when accounts of inefficient and efficient DISCOs are treated as one, and the uniform tariff is charged.*

8. WAYFORWARD FOR PAKISTAN

A tariff structure in which costs are not recovered from all consumer categories indiscriminately, besides creating financial difficulties for the government, also generates inefficiencies in the system and misleads investment decisions in the supply system (Malik, 2020).

In Pakistan, more than 60 percent of electricity is produced by thermal sources providing costly electricity. Further, the tariff mechanism adopted provides electricity charges different across categories, time of use and sanctioned load etc., creating inefficiencies and making electricity expensive for productive sectors (industry and businesses) of the economy.

Pakistan is among the top thirty countries globally with relatively high tariff rates. Due to long-term agreements with guaranteed capacity payments to thermal generation companies, switching to cheaper indigenous energy sources is impossible in short to medium term. Therefore, the complex tariff mechanism needs to be revised to reduce electricity prices in Pakistan. The sector is about to implement a wholesale market model (CTBCM), demanding significant tariff reforms.

There should be fair pricing, where each consumer pays according to their consumption on a progressive trend, i.e., the more per unit energy is consumed, the more consumer pays on average.

- The best way is to move from increasing block tariff to a flat linear tariff. It will not only maximise revenues but minimise inefficiencies in the sector.
- Moving from a uniform tariff to a different flat rate across DISCOs will also minimise inefficiencies significantly.
- Tariffs should be based on the actual cost of services to all geographical markets.

Based on data from Tariff Determination of February 12, 2021, total revenue is estimated for NEPRA determined uniform tariff, GOP applicable tariff, and for a flat (linear) tariff, i.e., the weighted average across DISCOs. Estimates are reported in Table 3 and Table 4. Maximum revenue is generated if we apply a linear (flat) rate which (in this case) is the weighted average across DISCOs,[11] without any subsidy.

Tariff Structure in Turkey

A flat (linear) rate is charged for all consumption per consumer category (i.e., domestic, industry, agriculture and commercial).

Consumers can pay a single price or a variable price depending on the time of day using a smart meter.

All regulated tariffs are based on the cost of service, and there is no electricity subsidy for the low-income households or any other sector.

Turkey relied primarily on its social safety services to address the adverse impacts of electricity tariff reforms on low-income households.

Source: CONECC, 2018.

However, the flat (linear) tariffs may not be a win-win situation for all (e.g., poor households) but will reduce tariff-related distortions and inefficiencies. Empirical literature highlights that direct cash transfers, compared to electricity subsidies, have proved to be a better welfare alternative for low-end consumers (Borenstein, 2012; Khalid and Salman, 2020; Awan, et al. 2019).

A tariff structure, as in Turkey, is the best option to adopt before moving towards a wholesale market structure. Our estimations also suggest that the sector would be better off adopting a linear tariff mechanism.

Empirical evidence also suggests that service provision is cheaper for the industry than domestic consumers. Besides, in countries prioritising productive sectors, tariffs are lower for industry and business than domestic consumers. Currently, our billed demand is lower than the contracted generation capacity, increasing the capacity payment burden (CPPA, 2020). There is a need to increase billed demand to reduce the burden of capacity payments. In our exercise, we focus on the same (flat) tariff for all sectors. The option of a flat or linear tariff, different across sectors, as per their service cost, can also be considered, as in many European countries like Germany, Austria, and the UK.

[11] Only a hypothetical exercise.

- Increase billed demand by making grid electricity attractive to the productive sectors of the economy by offering them lower tariffs.

There is a need to re-visit the policy of imposing surcharges. A simplification of tariffs—for every consumer category/geographical market is required. We need a tariff based on MC.

Table 3

Revenue Generated Using Different Tariffs

Sector	Sales across DISCOs Gwh	Total Revenue Generated (Rs Billion) NEPRA Determined Uniform Tariff	Govt. Applicable Tariff	Flat (Linear) Tariff (Weighted Average across DISCOs)
Residential	48948	828.61	650.57	816.94
Industry	25857	371.42	411.11	431.55
Commercial	7117	121.66	137.97	118.78
Agriculture	10405	166.01	79.15	173.66
Single Point	3327	49.53	69.13	55.53
Gen. Services	2575	43.9	50.24	42.98
Public Lighting	287	5.46	5.92	4.79
Res. Col.	59	1.24	1.22	0.98
Total		1587.83	1405.31	1645.22

Table 4

Revenue Generated Using Uniform and Different Flat (Linear) Tariffs Across DISCOs (Rs Billion)

	IESCO	LESCO	FESCO	GEPCO	MEPCO	SEPCO	PESCO	TESCO	HESCO	QESCO	Total
Flat (Linear) Tariff (Weighted Average Across DISCOs)	161.11	369.68	229.19	168.65	277.92	58.43	187.50	28.56	73.14	91.04	1645.22
Flat (linear) Rate Different Across DISCOs	137.94	354.18	223.28	158.55	281.09	75.48	189.97	24.88	100.65	102.77	1648.79

Source: Author's Estimates.

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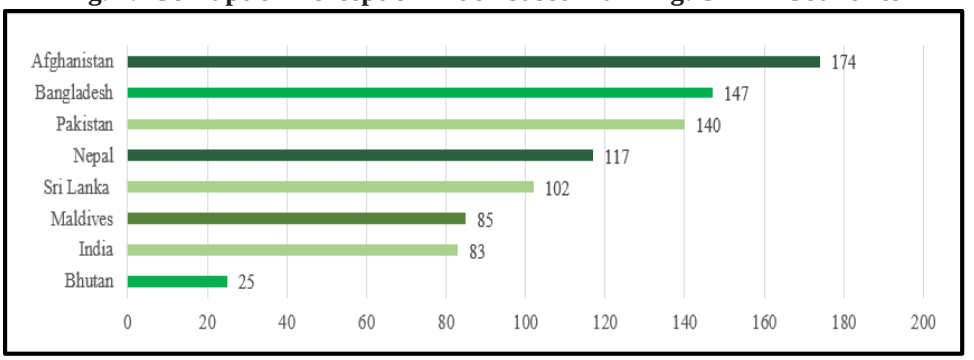
A Review of Accountability Systems: Learning from Best Practices

NASIR IQBAL and GHULAM MUSTAFA

1. BACKGROUND

Over the last two decades, 'accountability' has become Pakistan's most famous political slogan (Mehboob, 2022). Despite numerous reforms in the accountability system, Pakistan got the worst ranking in the region based on the Corruption Perception Index (CPI) published by Transparency International (TI) (TI, 2022).[1] The CPI-based ranking shows that Pakistan ranked 140th out of 180 countries in 2021. Pakistan ranked well below the South Asian economies (Figure 1).

Fig. 1. Corruption Perception Index based Ranking: SAAR Countries



Source: Author's formulation based on data taken from TI (2022).

Pakistan established numerous accountability systems to reduce corruption. However, Pakistan's performance in implementing accountability is poor. The index to

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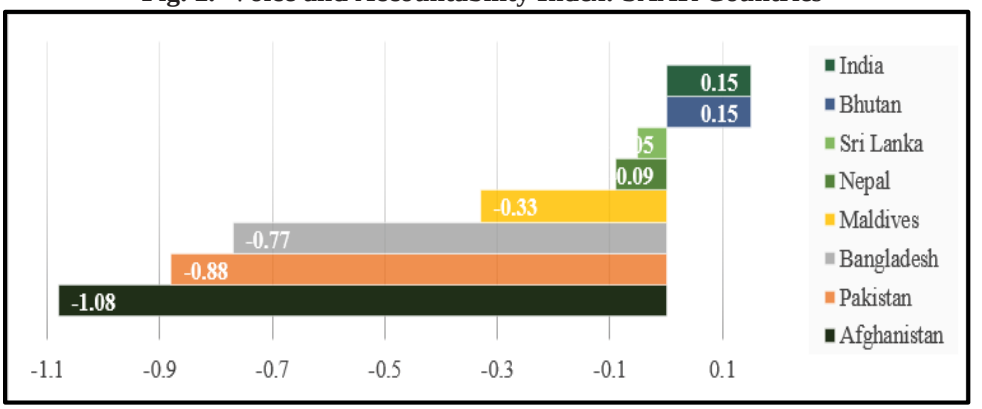
[1]The Corruption Perception Index (CPI) ranks economies based on "how corrupt their public sectors are perceived to be." The index ranges from 0 to 100, where 0 is highly corrupt and 100 is very clean (TI, 2022).

measure vertical accountability is called Voice and Accountability Index (VAI).[2] Their values range between -2.5 (weakest accountability) and +2.5 (strongest accountability). Pakistan's score is well below the South Asian average (-0.36) (Figure 2). Pakistan has had weaker vertical accountability over the years. All values of the VAI are found to be less than zero, demonstrating that Pakistan has failed to implement strong vertical accountability (World Bank, 2022).

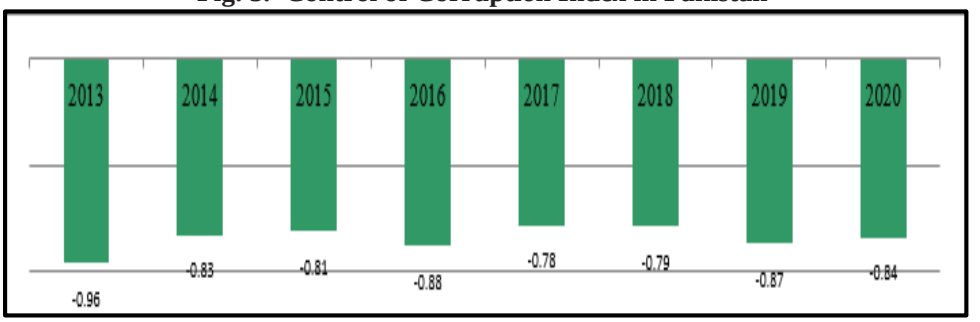
Fig. 2. Voice and Accountability Index: SAAR Countries



Source: Author's formulation based on data taken from World Bank (2022).

The Control of Corruption Index (CCI),[3] which measures the horizontal accountability for countries, also does not show encouraging performance in Pakistan. The CCI discloses that values for the CCI for all years are found negative, which is indicative of the adverse performance of Pakistan on horizontal accountability. Horizontal accountability is perpetrated through the institutions like NAB and Anti-Corruption in Pakistan.

Fig. 3. Control of Corruption Index in Pakistan



Source: Author's formulation based on data taken from World Bank (2022).

[2]The index for Voice and Accountability captures perceptions of the extent to which the citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.

[3]The index for Control of Corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as capture of the state by elites and private interests.

The existing accountability system, especially National Accountability Bureau (NAB), led to political instability and dwindling economic growth and prosperity in the country. Apart from the poor performance of accountability systems, we heard voices from media, politicians, and even the judiciary against selective accountability, political victimisation, political engineering through unjust accountability tools, and misuse of authority by the officials. Given this background, this brief aims to understand the structure of the accountability system with a particular focus on NAB in Pakistan. The brief also aims to review global best practices to provide legislators with a way to reform Pakistan's accountability system.

2. WHAT IS ACCOUNTABILITY?

Accountability is used for surveillance and oversight of the exercise of power. The term "accountability" often refers to the discussion of public governance or its transparency (Philip, 2009; Boyce & Cindy, 2009). The question of accountability arises when there is a concern about the abuse of public office—which almost every government or institution across the globe. According to Maile (2002), accountability is a two-dimensional concept: answerability and enforcement. Answerability implies that public officials are answerable for their actions. Accountability in public governance transcends beyond the answerability in the form of information generation and its justification.

It contains the components of enforcement which refers to rewarding the right doers and punishing the wrong doers (Domina and Parfenova, 2019). The question of accountability arises when there is a threat to the general use of power in public governance or administration matters. Establishing anti-corruption agencies is the response when accountability seems to be at stake at the behest of the public interest. The seeming simplicity of response poses a lot of difficult questions. The unchecked and rampant corruption militates against the core of democracy and democratic institutions like parliament, judiciary, and civil service (Berggren & Bjornskov, 2020).

Broadly, there are three institutional modes to pursue accountability: vertical and horizontal, and diagonal accountability. Vertical accountability is electoral accountability, which the people do through elections to the incumbent governments. In contrast, horizontal accountability is perpetrated by the state authority to bring to the book for misappropriation of the authority, grabbing the money by using its authority, and all other means of corruption. They are establishing NAB or other Anti-Corruption departments in the form of horizontal accountability. The media and civil society do the diagonal accountability to hold the incumbent government accountable. These modes of accountability play a significant role in stopping the misuse of authorities and contributing to sustainable economic growth and development (Walsh, 2020). The institutional school of thought argues that accountability fosters economic growth and prosperity (Nawaz, 2015; Iqbal, et al. 2012). However, we must be specific to gauge the modality of the NAB, being the most prominent horizontal mode of accountability (Ahmed, 2020; Imran, 2020).

3. HORIZONTAL ACCOUNTABILITY: THE CASE OF THE NAB

NAB was established in 1999 to deal with the investigation and prosecution of white-collar crimes, which happened to be public office holders, politicians, and citizens who have been accused of having abused their powers or depriving the national treasury of millions under section 5(m). According to Section 2 of the NAB ordinance, National Accountability Ordinance (NAO) shall come into force from the first day of January 1985.

In February 2002, the government launched National Anti-Corruption Strategy (NACS) project to survey and assess international anti-corruption agencies and their models. NACS, based on global best practices, presented a need to rethink and revise the anti-corruption narrative. Therefore, the government made relevant amends in NAO. With the revised NAO, the NAB has been entrusted with the investigation and prosecution of crimes and prevention and awareness against them. So, the NAB is the premier anti-corruption organisation in Pakistan, with a sole mission to eradicate corruption and corrupt practices. It mandates holding those accused of such practices accountable during an elaborative investigative process (Javed, 2021).

The United Nations Convention against Corruption (UNCAC)

The UNCAC—the only legally binding universal anti-corruption instrument- also demanded that a member state have an effective anti-corruption agency or organisation. Therefore, the NAB is an inter- nationally recognised anti-corruption agency for Pakistan under the UN charter. NAB considers all the offenses that fall under National Accountability Ordinance (NAO) under section 9(a). Offenses have been highlighted below as there is a need:

- To provide adequate measures for the detection, investigation, prosecution, and speedy disposal of cases involving corruption or corrupt practices, misuse of power or authority, property misappropriation, loan write-offs, taking undue commissions, and for matters connected.
- To recover outstanding dues from people who have willfully committed default in the repayment of dues to banks, financial institutions, government agencies, and other agencies.
- To recover the state's money and assets from those who have misused and removed those assets or money through corrupt practices and abuse of power.
- To educate society regarding the threats and causes of corruption and corrupt practices and to implement policies for its prevention.

3.1. Standard Operating Procedures (SOPS) of NAB

Besides awareness and prevention, enforcement is also one of the NAB's strategies to cope with corruption. NAO mandates NAB to adopt a three-pronged approach for curbing corruption in the country.

Stage 1: Complaint Verification:

NAB's Enforcement Strategy functions on the admission of written complaints or information by NAB about an alleged act of corruption. In stage one, the initiation of the process begins with the verification of the contents of the information. The contents

of the information are verified in light of law provisions. This process is known as complaint verification (CV). At the same time, a complainant is summoned for the confirmation of status and evidence available to him. Once confirmed that the alleged act of corruption falls under NAO and the information procured justifies to move forward, and it is processed further for subsequent action.

Stage 2: Inquiry:

Section 18(c) of NAO 1999 speaks of inquiry for the collection of oral and documentary evidence in much formal way, and the scope of the inquiry is reasonably enlarged, and experts are engaged in case the need arises, i.e., banking experts, revenue experts, corporate experts, etc. Their statements are recorded, and preliminary reports are obtained regarding the commission of the offense if any. The investigation officer and the legal experts scan the evidence and reports furnished and obtained before the above-mentioned experts. The decision is taken considering the collected evidence if any offense is made. According to section 25(a), the option of Voluntary Return (VR) is made to the accused persons during the inquiry without entailing the consequences of section 25(b), which is a Plea Bargain.

Stage 3: Investigation:

Upon digging out the evidence against the accused person(s) and assessing the same as trial-worthy evidence to stand the test of cross-examination by the defense lawyers at the trial, the inquiry mentioned above is upgraded to the investigation, which is to be concluded expeditiously and preferably within 90 days. Upon completion of the investigation, if the chairman of NAB is satisfied and decides to refer the matter to the accountability court in the form of a reference upon receipt of the reference to the concerned accountability court. The court proceeds accordingly, and the trial proceeds in the code of Criminal Procedure, 1898. Suppose evidence collected during inquiry investigation is insufficient to file a reference against the accused person(s) or set of accused persons. In that case, the investigation is closed to their extent only under section 9(c). Suppose an accused person or a set of accused persons want to avail of the option of a plea bargain under section 25(b). In that case, he may do so, and if accepted by the chairman of NAB.

The acceptance of Plea Bargain and its approval by the accountability court shall be deemed a conviction carrying all the consequences of section 15 of the NAO minus the jail sentence. To lend credence to the inquiry or investigation, the accused is allowed to explain or tell his side of the story in respect of the allegations that surfaced or the material collected against him. The accused is also free to place any documentary or oral evidence in favour of his defense. As for the SOPs and the judgments of superior courts, the version of the accused is analysed, given the NAB's Enforcement Strategy begins with an initiative of fact-finding without having to blame any person for an alleged act of corruption.

The entire process has been designed to move with an explanation from the complainant for the clarification of charges pressed against the accused to assess whether their position falls in line with material evidence. Suppose the version stated by the accused is found plausible in lieu of the supporting evidence. In that case, the

benefit of the same is given to him. For verification, the evidence collected vis-à-vis allegations are verified against the explanations given by the accused and the recorded statements from witnesses.

Regional Bureaus are the operational arms of NAB, which are actively involved in field operations such as CVs, inquiries, and prosecution of cases at trial and appealing stages. The Operations Division and Prosecution Division at NAB Headquarters support the smooth conduct of operational activities per law and the standing operating procedures (SOPs). Under NAO, the chairman of NAB has been authorised to file references anywhere in Pakistan, keeping in view the smooth prosecution of the case and convenience of placing evidence before the concerned court without jeopardising the accountability process in general at the hand of the accused person who is very powerful, and they tend to destroy the evidence over raw witnesses and influence the court and the prosecution (Tariq & Mumtaz, 2021).

Reforms/Amendments in NAB Ordinance: History

NAB Ordinance 1999: The NAO 1999 was promulgated on November 16, 1999. The objective was to tackle corruption by taking legal actions against corruption (NAO, 2002). Nonetheless, the pending proceedings and cases fell under Ordinance No. XX of 1997 and the Ehtesab Act, 1997 were continued. The primary purpose of the NAO 1999 was not only to take adequate measures against corruption but also to take measures to recover the outstanding amount from the guilty. Following are the key takeaways from the said ordinance.

(i) The president of Pakistan shall appoint the NAB chairman on the advice of the prime minister and opposition leader. The duration shall be for four years.
(ii) The chairman of the NAB cannot be removed except on the grounds which meet the removal of a Supreme Court of Pakistan judge.
(iii) The chairman of the NAB shall be fully powerful to conduct an inquiry and move the reference against the accused. NAB can arrest and keep in detention anyone for investigation
(iv) The accused can be detained for 90 days.
(v) The domain of the NAB is mega corruption matters

NAB Amendment Ordinance 2002: In 2002, the NAO 1999 was amended. Under this amendment, any person or public office holder can voluntarily come forward and offer to return the assets and gains before the commencement of the investigation against that person. This amendment allows the NAB chairman to accept such volunteer offers aĕr determining the due amount. It is not the person offering a plea bargain; it is the discretion of the chairman of the NAB (NAB Ordinance, 2002). The rest of the setting is the same as in NAO 1999.

NAB Amendment Ordinance 2021: The PTI government amended the NAB ordinance in 2021. The following are the key points of the NAO amendment 2021:

(i) This amendment mainly focuses on granting the extension of the NAB chairman. The incumbent government granted the extension to the existing chairman of NAB despite its controversies. The chairman shall be appointed for four years, which is extendable.

(ii) The president of Pakistan shall appoint the chairman with the consultation of the prime minister and opposition leader. If they fail to bring consensus, the 12 members committee is formed to nominate the NAB chairman.
(iii) Under this amendment, the president of Pakistan has the authority to establish as many accountability courts as they want.

NAB Ordinance Amendment 2022:

PML(N) led coalition government introduced the following amendments in 2022

(i) Commencement of appointment of chairman two months before the retirement of incumbent chairman.
(ii) Federal and provisional tax matters to be removed from NAB adjudication.
(iii) Cases to be decided in a year
(iv) Judges are to be appointed to the accountability court for three years.
(v) NAB to ensure the availability of evidence before the arrest and imprisonment of five years in case of filing a false reference. In this regard, Amendment to Section 36 explains, "if the accused has been acquitted by the court on the ground that case was initiated with mala fide intention or based on false/fabricated evidence, the person responsible shall be punished with imprisonment of either description for term which may extend to five years and shall also be liable to fine."
(vi) Similarly, section 33-F explains, "No official of NAB, in any capacity, shall make any statement in public or media regarding person involved in any inquiry or investigation conducted by NAB until a reference has been filed against such person."
(vii) The most prominent and significant amendment is regarding Section 24 of NAO-1999, which restricts the power of the chairman to arrest the accused.
(viii) The duration of detention is curtailed to 14 days from earlier 90 days
(ix) The removal of the chairman is restored to the NAO-1999 position contrary to the NAB Amendment Law 2021, wherein the president was given the power to remove the chairman.

4. LEARNING FROM GLOBAL BESTPRACTICES: THE CASE OF HONG KONG & SINGAPORE

Our study takes practices perpetrated by Hong Kong and Singapore as references—Anti-Corruption Agencies (ACA) in the Asian Pacific region, Hong Kong's Independent Commission against Corruption (ICAC), and Singapore's Corrupt Practices Investigation Bureau (CPIB). The discussion on these two accountability institutions is weaved up as follows.

Since its establishment in 1974, ICAC has enjoyed astounding success in its fight against corruption and is often quoted as a "Universal Model" (Heilburn, 2006; Lam, 2009). ICAC came into being when corruption was known to be systematic among high-level officials and police officers, which fueled prostitution, drug trafficking, and gambling in lieu of hefty returns. The legal framework of which ICAC is part has been made to be as clear, detailed, and effective as possible. According to a recent ranking, Hong Kong ranks 12th among 180 countries on Corruption Perception Index (CPI) for

2021. It controls corruption with the help of three functional departments: Investigation, prevention, and community relations. The investigation is done through Operations Department, which is responsible for investigating. The Corruption Prevention department is responsible for creating awareness, funding research related to the implication of corruption-related policies, conducting seminars for business leaders, and helping public and private institutions formulate strategies to reduce corruption.

The role of the Community Relations Department is to spread awareness in society regarding the societal costs of corruption, which is pursued through launching multiple campaigns against corruption (Speville, 2010). The institutional hierarchy comprises a special administrator, ICAC director, and three oversight committees. The ICAC submits regular reports with procedural guidelines for investigations, confiscation of property, and inquiries durations, whereby the oversight committee ensures that all investigations are carried out with integrity. When the ICAC was established, it did not have a credible record. Nonetheless, Hong Kong has known to be the least corrupted in East Asia (Owusu, et al. 2020; Tsao and Hsueh, 2022).

On the other hand, Singapore's Corruption Practices Investigation Bureau (CPIB) was established in 1975, focusing primarily on investigation and enforcement. The function of CPIB was to receive and investigate complaints about corruption in the public and private sectors. Their prevention function is responsible for screening candidates before appointments in civil service statutory boards to appoint candidates with clean conduct, hence working in a corruption-free environment within CPIB (Hutahaen & Pasaribu, 2022).

On the other hand, Singapore's Corruption Practices Investigation Bureau (CPIB) was established in 1975, focusing primarily on investigation and enforcement. The function of CPIB was to receive and investigate complaints about corruption in the public and private sectors. Their prevention function is responsible for screening candidates before appointments in civil service statutory boards to appoint candidates with clean conduct, hence working in a corruption-free environment within CPIB (Hutahaen & Pasaribu, 2022).

4.1. Benchmarking CPIB and ICAC Performance

There are myriad reasons why Hongkong ICAC and Singapore's CPIB are successful because they have firm support in and out of government in carrying out these core missions. Even in totalitarian regimes, the hierarchical influence goes a long way to influence how an ACA should work. Yap (2022) suggests comparing outcomes based on the following indicators.

(1) Corruption Perception Index (CPI): Hong Kong and Singapore rank 12th and 4th in CPI for 2021 out of 180 countries.
(2) Expenditure Per Capita and Staff-Population Ratio: Agency indicators are used to see whether the agency has been provided with adequate personnel and budget by their governments to perform their functions.
(3) Credibility and Independence: The benchmarking identifies four pre-requisites in analysing the performance of ACA: independence, permanence, coherence, and credibility.

5. RESTRUCTURING THE NAB

Multiple internal and external factors hamper accountability in Pakistan, including:

5.1. Internal Factors

Delay has emerged as one of the leading factors in concluding the inquiries in investigations. Due to the complex and vast scope of the NAB ordinance, oral or documented evidence collection is quite cumbersome. Although the NAB is fully empowered to collect evidence, the influential accused persons do everything they can to hide the truth and delay the investigations by conceding documents and concealing/stealing the original record.

(i) When the trial proceeds, the procurement of evidence is another arduous task because the generally very resourceful accused tend to prevail.
(ii) The potential witnesses deviate from their statement earlier given to the NAB under investigation. The witnesses who exhibit the official record before the courts are also very cooperative.
(iii) The transfer postings of the judges and the NAB officials, concerned NAB officials, and other government officials concerned with the trial are also one of the problems contributing to the delay. It takes 2 to 5 years to conclude the prosecution before the accountability court.
(iv) A Long-drawn, cumbersome, and time-consuming legal process generally takes almost 20 years for an account- ability case to get adjudicated by the apex court and get concluded either in favour of the prosecution in case of conviction or the favour of the accused, resulting in acquittal. The law prescribes that an accountability court completes the trial within 30 days, and the appeal shall be disposed-off within 90 days.
(v) In the case of absconding of one or some of the accused persons before the accountability court, the declaration of absconding takes about 5 to 6 months before the accountability court before the regular trial gets underway as per the mandate of the criminal procedure court.
(vi) The numbers of accountability courts are also not enough to cope with the rush of work. Moreover, the prosecution is under-resourced and short of the number of prosecutors to deal with the factum of delay.

5.2. External Factors

(i) Relying on corrupt political leaders to handle corruption.
(ii) Using NAB as an "Attack Dog" against political opponents: According to Transparency International (TI), the NAB lacks operational autonomy because of the government's dependence on weaponising NAB against its political opponents. It has often been accused of being a partisan agency used for political victimisation by the incumbent governments. The National Accountability Ordinance (NAO) 1999 has given NAB abundant operating authority and powers. But in reality, it is not free from political pressures.
(iii) Lack of maintaining transparency by the NAB.

6. THE WAY FORWARD

The discussion demonstrates that Pakistan is experiencing poor performance on all global indices, which measure corruption and vertical and horizontal accountability in Pakistan. Moreover, the common perception among judiciary and civil society is that the NAB is used for political manipulation against the opposition leaders. The following points are important to improve the transparent performance of the NAB.

(i) There is a dire and unavoidable requirement to change the NAB's structure. All political parties, civil society representatives, and lawyers' bars and associations prepare the legal and institutional structure of the NAB so that the transparent accountability system may be promulgated.

(ii) This is the era of digitalisation, and the NAB must be trained and technologically well-equipped to build its capacity and skilful human resource to hatch the agenda for creating a transparent and inclusive accountability system.

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BASICS Notes

Desire to Live in Pakistan: Stay or Leave?

DURR-E-NAYAB

In our daily lives, we often hear people say, "things are so bad in Pakistan, I wish I could leave". On the contrary, we also hear, "I can never ever think of leaving Pakistan, no matter what". While there is almost a consensus among the population that the country is not going the way it should have been,[1] the response to it is varied.

To gauge the desire of the people to stay in or leave the country, the PIDE BASICS Survey[2] asks the respondents if they were given a chance to leave Pakistan would they like to do it, and if yes, the reason(s) for it. We see this sentiment in the four provinces and the three territories, and across regions, sex, age, and education and income levels.

WANT OUT

Let us now see how people responded when they were asked about their desire to leave the country if they were offered such an opportunity.

Desire by Province, Territory and Region

Figure 1 shows the desire to leave Pakistan across the four provinces and the three territories. We see that 37 percent of the total population would like to leave the country if they are given an opportunity to do so. The figure shows:

- Slightly more people in urban Pakistan (40 percent) than in rural Pakistan (36 percent) desire to leave the country.
- Among the four provinces, the desire to leave the country is highest in Balochistan (42 percent), followed by Khyber Pakhtunkhwa (KP) and Sindh. The desire is lowest in Punjab but not by much.
- Among the three territories, people in Azad Jammu and Kashmir (AJK) have the highest proportion (44 percent) of those wanting to leave the country, followed by Gilgit Baltistan (GB).

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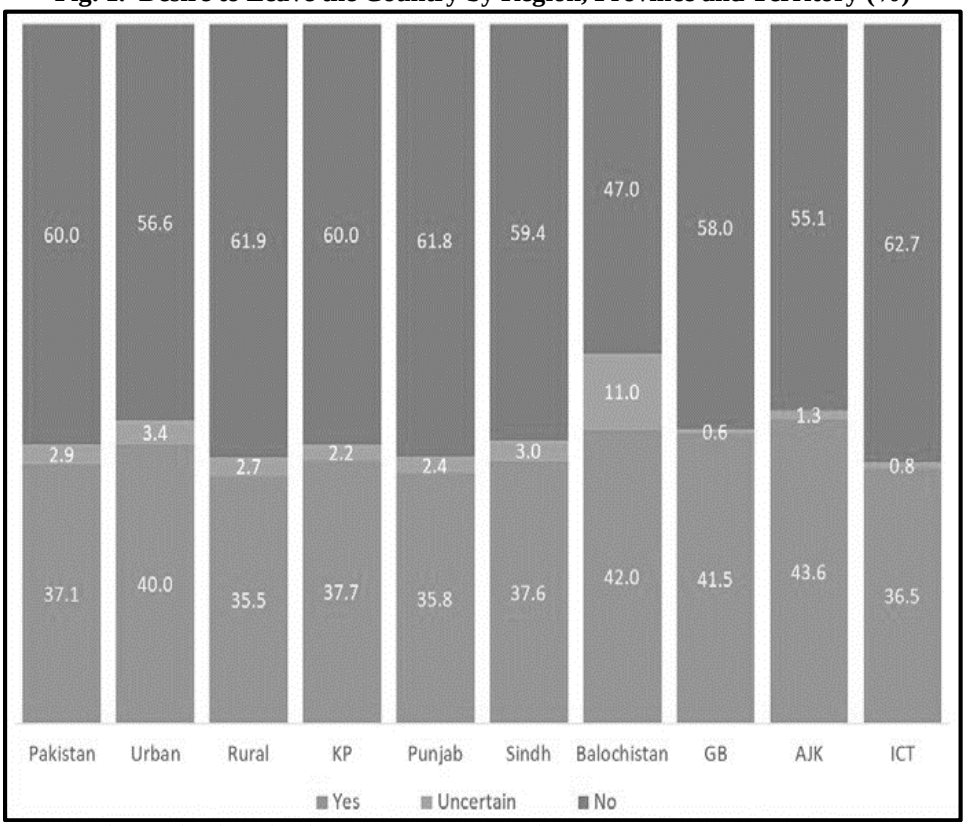
Author's Note: Basics Notes, Number 4, shows that a major proportion of Pakistanis, given a chance, would like to leave the country. Search for better income notwithstanding, is not the level of social and civic engagement binding people to each other and strengthening the community?

[1]The question was asked in the PIDE BASICS Survey, and a forthcoming BASICS Note will talk about it.

[2]See BASICS Note 1 for details about the survey sample and methodology used.

- Islamabad Capital Territory (ICT) has the lowest proportion of those wanting to leave the country across all administrative categories.
- Balochistan has not just the lowest number (47 percent) of those wanting to stay in the country but also the largest proportion of those who are ambivalent, expressed by the 11 percent who are uncertain about whether they want to leave the country or stay on.

Fig. 1. Desire to Leave the Country by Region, Province and Territory (%)



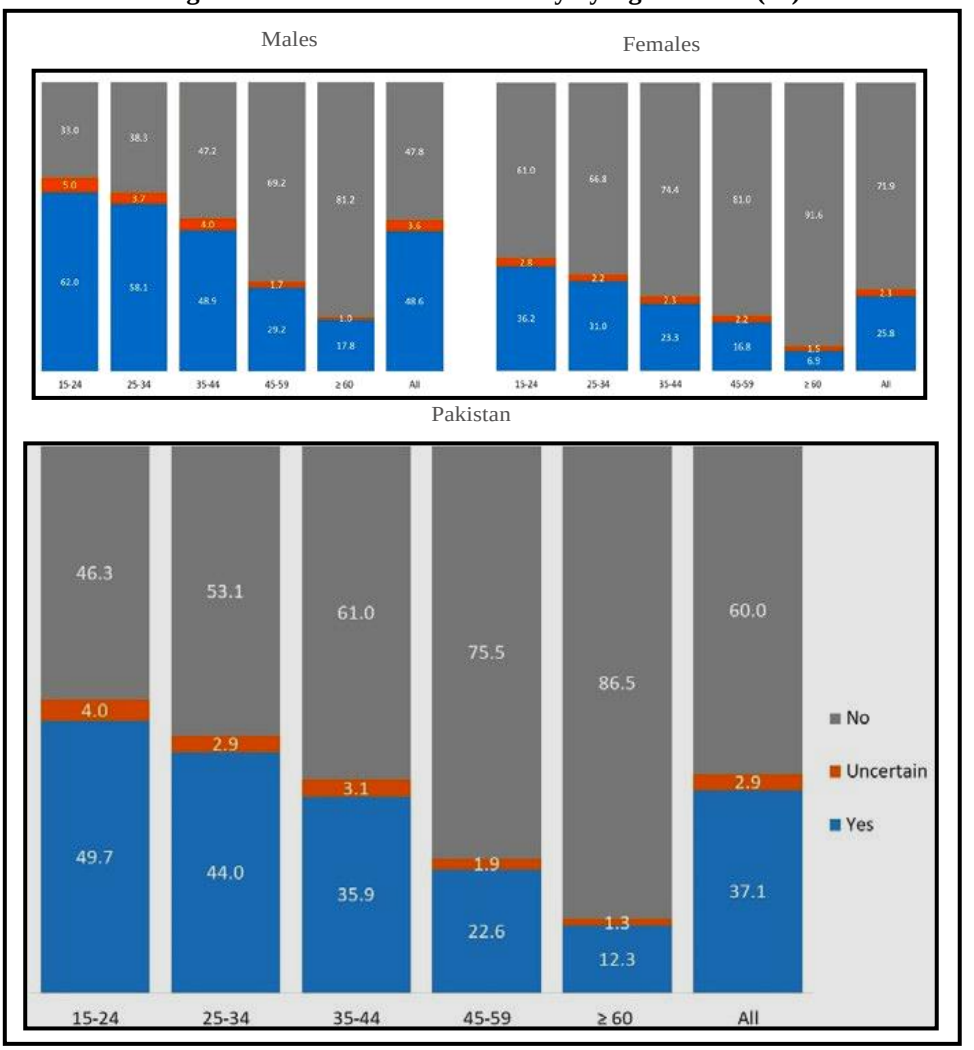
Source: Author's estimation using the PIDE BASICS Survey dataset.

Desire by Age and Sex

We saw in BASICS Note Number 3 how strongly age and sex affect the way people conceptualised their identity. We find that the desire to leave the country is even more strongly linked to a person's age and sex, and Figure 2 shows this striking pattern. The desire to leave the country:

- Is much higher for males than females, across all age groups without any exception.
- Is the strongest among the youngest age group (15-24-year-olds) males, with a huge 62 percent wanting to leave the country.
- Dims with age for both males and females.

Fig. 2. Desire to Leave the Country by Age and Sex (%)



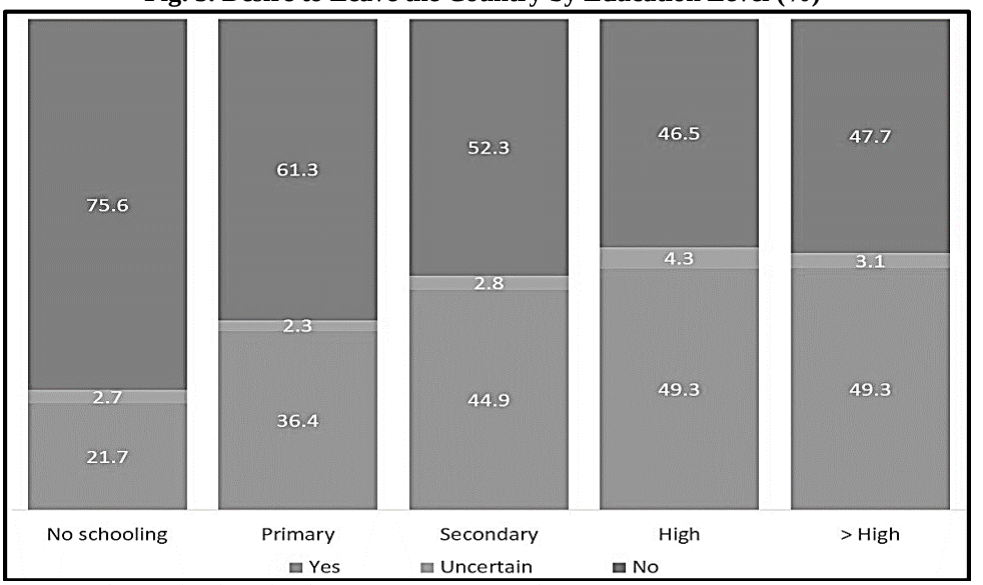
Source: Author's estimation using the PIDE BASICS Survey dataset.

Desire by Education Level

Education, as mentioned in the previous BASICS Notes as well, is considered a variable that can have far-reaching consequences for most aspects of a human's life. Figure 3 shows that education does influence the desire, or lack of it, to leave the country but after a certain level of education, the trend stagnates. It can be observed in Figure 3 that:

- The desire to leave the country is the weakest among those who have never been to school (22 percent).
- Those wanting to leave the country increase with increasing level of education but the increase is not proportionate to the level of education achieved. The rates stagnate after secondary schooling.

Fig. 3. Desire to Leave the Country by Education Level (%)



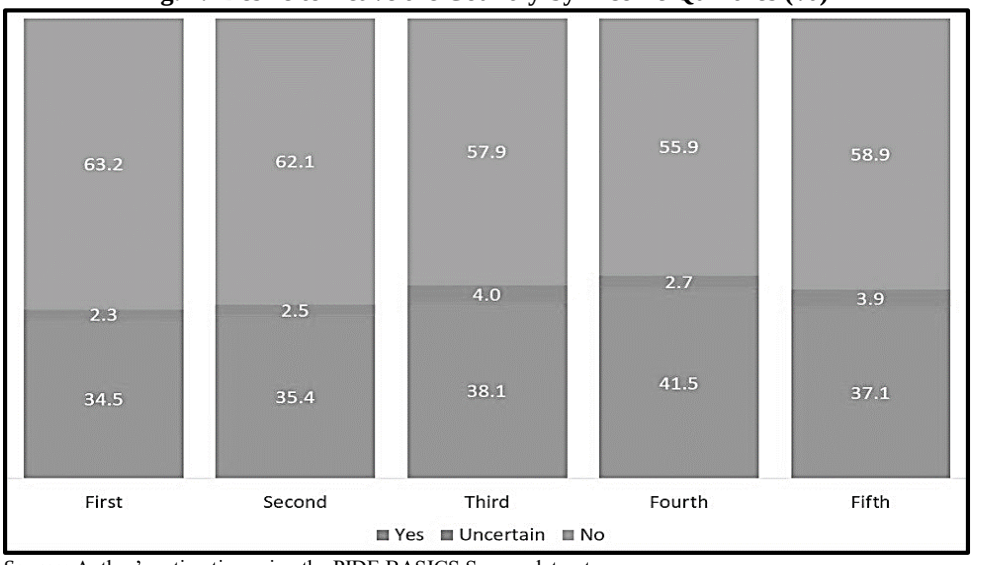
Source: Author's estimation using the PIDE BASICS Survey dataset.

Desire by Income Level

Are those with less income more likely to wish for leaving the country? The answer from the PIDE BASICS Survey says, not really! Looking at the income quintiles and the proportion wanting to leave the country, we see in Figure 4:

- The desire increases with increasing income but not by any drastic proportions.
- After the fourth quintile (42 percent), the desire dips again (37 percent).

Fig. 4. Desire to Leave the Country by Income Quintiles (%)



Source: Author's estimation using the PIDE BASICS Survey dataset.

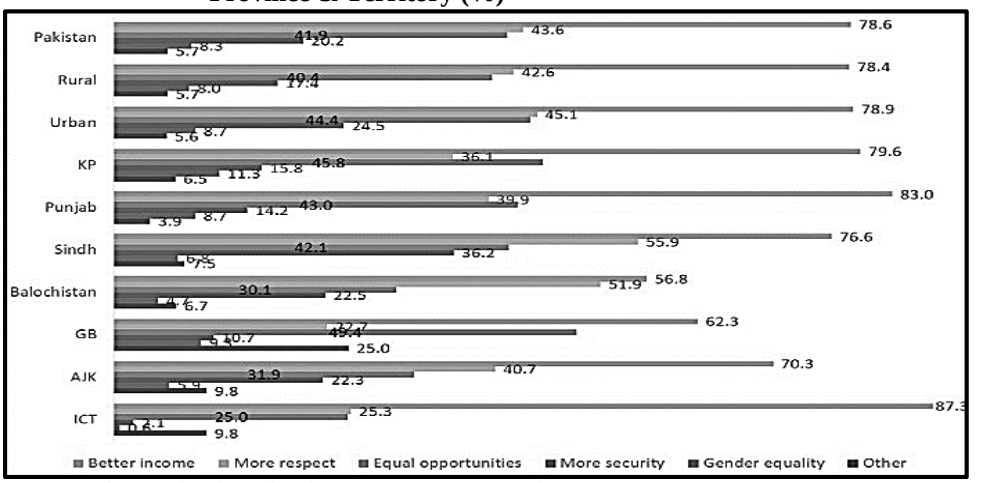
WHY WANT OUT?

Why do people want to leave if they want to leave? Leaving one's home is not an easy option, but if people desire to do so there have to be some very strong reason(s) behind it. The PIDE BASICS Survey look into these reasons and find economic reasons to be the most dominant one (see Figure 5). Search for equal opportunities and more respect comes out to be the next two important reasons. Looking for gender equality and more security also feature among the major reasons for the desire to leave the country.

Looking at the trends across regions, provinces and territories we see some very interesting reasons reported for the wish to leave the country, including:

- Looking for more income and equal/better all-around opportunities was not surprising but moving out to gain more respect was an unexpected response. At the national level, it is the second most reported reason (44 percent) for the desire to leave the country.
- Not much difference is found between urban and rural Pakistan, defying yet again the notion that people in these two regions are very different.
- Across the provinces and regions, we see quite different reasons spurring the desire to leave the country. The monetary factor (better income) is the major factor for all, but in Sindh and Balochistan, the desire for more respect outweighs the urge for equal opportunities.
- Moving out for more security was reported the most in Sindh, followed by Balochistan and AJK.
- Gender equality as a reason to desire moving out of the country was reported the most in KP. This links to the biological basis for identity as a major source reported by the people of the province, as shown in BASICS Note Number 3.
- GB has a large proportion giving 'other' reasons, and it mainly comprised of reasons linked to getting better/higher education.

Fig. 6. Reasons for the Desire to Leave the Country by Region, Province & Territory (%)

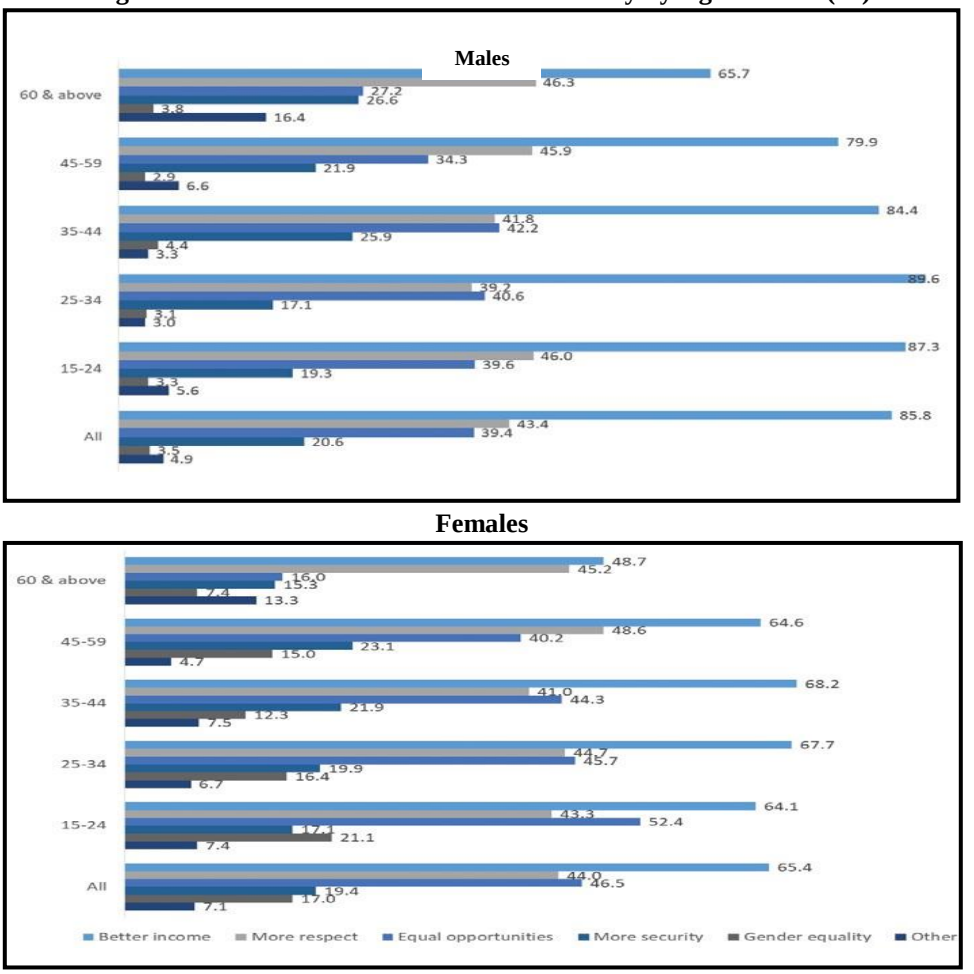


Source: Author's estimation using the PIDE BASICS Survey dataset.

In the discussion above we saw the younger population, especially young males, to be overwhelmingly inclined towards leaving the country. Figure 7 shows the reasons for this desire disaggregated by age and sex, and we observe:

- Better income remains the top reason for both males and females, of all ages but the rates are much higher for the former (above 80 percent) than the latter (± 65 percent).
- Gender equality as a pull factor to other countries is higher for females than males, and more so for younger females than older ones.
- The idea that moving overseas would bring in more respect can be seen for both sexes across all age categories.
- 'Other' reasons become substantial at the oldest age category for both the sexes, and analysis of the survey data shows that it is mainly to be with children residing overseas.

Fig. 8. Reasons for the Desire to Leave Country by Age and Sex (%)



Source: Author's estimation using the PIDE BASICS Survey dataset.

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Who Do We Think We Are: The Question of Identity!

DURR-E-NAYAB

Who do we think we are? What is our identity? The PIDE-BASICS Survey shows that these seemingly straightforward questions elicit very complex responses. The perception of identity cross-cuts many of the factors we are focussing in BASICS. It is a self-image that is both the cause and the consequence of a person's beliefs, attitudes and social capital. It is the 'feeling of we', the feeling of in-group with those having the same characteristic(s) that we think define us.

Identity "refers to the ways in which individuals and collectivities are distinguished in their social relations with other individuals and collectivities" (Jenkins, 1996).[1] How we socially interact, the people we trust, the vibrancy of communities and the way they are formed and function draw a lot on our sense of identity.

So what is the identity of those living within the boundaries of Pakistan? The PIDE-BASICS Survey shows that identity is a social construct, as it does not merely stem from the ascribed characteristics. Identity, the findings show, is based on some distinguishable characteristic(s) which are socially consequential as well. Social capital's notions of binding and bonding (see BASICS Notes 2) are linked to how the idea of identity is constructed.

LAYERS OF IDENTITY.....

We are Pakistanis. We are Muslims. We usually hear these statements giving the impression that identity is a single thing. PIDE-BASICS Survey's[2] findings tell us otherwise. Identity is a multi-layered phenomenon with the majority not perceiving it in singularity.

The survey showed that the most reported identities are linked to: (i) religion; (ii) nationality; (iii) ethnic background; (iv) caste, which is a sub-group distinct from the ethnic group, for instance, Rajput, Khattak, Kakar or Gujjar; (v) being a human; (vi) biological, that is the sex of the person; (vii) relationship, with reference to someone like being a mother, father, son or daughter; (viii) one's profession.

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Author's Note: Basics Notes, Number 3, shows that being a Pakistani is not the prime identity of the people living in Pakistan. Given a choice would they like to leave the country or stay on?

[1] Jenkins, R. (1996). *Social identity*. London Routledge.

[2] For details about the survey, see BASICS Notes No. 1.

Table 1 shows that the majority of the population has a multi-layered identity, ranging from 76 percent in GB to 44.5 percent in AJK. It is worth noting that the trends shown in urban and rural Pakistan are not very different (see Table 1). Among the four provinces, the population of Punjab has the biggest proportion that has a specific, single identity, with just half the population (50.6 percent) having a multi-layered identity. Among the regions, Islamabad Capital Territory (ICT) has the biggest proportion of the population with a multi-layered identity (89 percent), as can be seen in Table 1.

Table 1

Multiplicity of Identity by Region, Provinces and Region

	Pakistan	Urban	Rural	KP	Punjab	Sindh	Balochistan	GB	AJK	ICT
Multi-layered	61.5	60.8	62.1	68.4	50.9	64.0	64.3	76.0	44.5	89.0
Ethnic	2.4	2.2	2.6	3.2	1.8	2.2	4.0	2.7	3.2	0.6
Religion	12.3	12.8	12.8	10.8	16.7	8.4	10.5	1.3	28.3	5.8
Nationality	3.1	3.4	3.4	2.7	3.9	3.0	2.4	1.8	5.2	0.7
Human	6.2	7.3	7.3	7.7	7.8	4.7	4.3	3.9	8.9	2.5
Biological	2.2	2.2	2.2	2.9	2.6	1.5	3.6	0.6	2.3	0.1
Profession	1.9	1.8	1.8	0.4	2.1	1.1	4.0	7.0	1.1	0.5
Relationship	1.0	1.0	1.0	0.3	1.3	0.9	1.2	1.6	1.4	0.1
Caste	8.8	7.8	7.8	3.4	12.3	13.7	5.0	2.9	1.9	0.6
Other	0.6	0.7	0.7	0.2	0.4	0.5	0.6	2.2	3.1	0.0
Total	100	100.0	100.0	100	100	100	100	100	100	100

Source: Author's estimation using the PIDE-BASICS Survey dataset.

Note: KP-Khyber Pakhtunkhwa, GB-Gilgit Baltistan, AJK-Azad Jammu and Kashmir, and ICT- Islamabad Capital Territory.

Looking at those who report a specific identity, it is not surprising to see religious identity be the most common one, at both national and regional levels (see Table 1). Among provinces and territories, single religious identity is strongest in Punjab (16.7 percent) and AJK (28.3 percent), respectively. People of GB report the lowest single religious identity (1.3 percent).

National identity, that of being a Pakistani, as the single identity is not a strong one nationally, regionally or across provinces and territories (Table 1). Being a human is an identity kept by some, but many more give importance to caste as their single identity. It was a rather surprising finding that more than ethnicity it was caste, a narrower ascribed characteristic, that was considered more important by the people of Pakistan. Mainly two provinces push this rate up, namely Punjab and Sindh (Table 1).

Identities

The above discussion shows that a singular identity, whatever that may be, is not a reality for the majority of the people in Pakistan. Let us now see the various identities maintained by the populace.

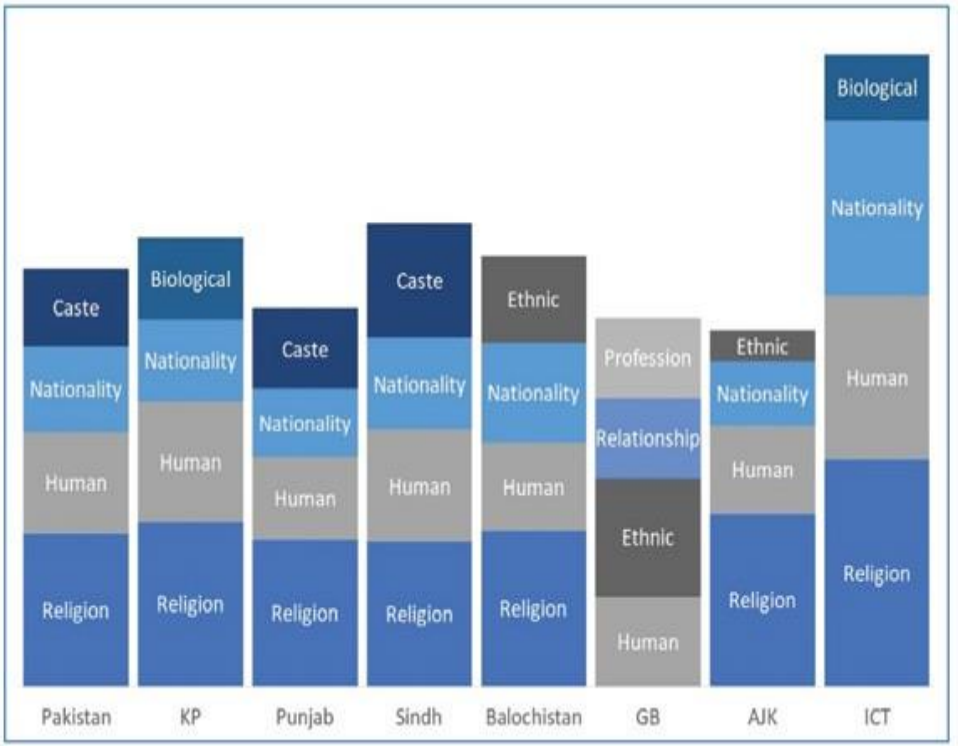
Identity by Province and Territories

Looking at the national level, religion is part of the multi-layered personal identity for the majority (57.4 percent), as can be seen from Table A-1. Identity of being a human (38.4 percent), a Pakistani (32.4 percent) and belonging to a particular caste (29.4 percent) follow in that sequence.

If we look at the most reported identities, the four provinces and the three territories show a lot of variation in the type of identities and their respective prevalence. If we pick the four most reported identities across the seven geographical boundaries, the trend appears as shown in Figure 1. We see that:

- Being a human is an identity maintained by a substantial population across the whole country. Religious identity is a strong one, except for in GB where it is not among the top four identities.
- National identity is prevalent, with varying intensity, across Pakistan. Among the four provinces, the largest proportion is in Balochistan which considers being a Pakistani as part of their identity, followed by Sindh and KP. The population of Punjab has the smallest proportion including nationality as a layer of their identity.
- While ethnicity is an important part of identity in Balochistan, GB and AJK, it is caste in Sindh and Punjab.
- Being a male or female, is a major layer of identity in KP and ICT.
- GB has the most distinct pattern, with profession and relationship featuring among the major identities.
- ICT exhibits a strong multiplicity of identities.

Fig. 1. The Four Most Reported Identities



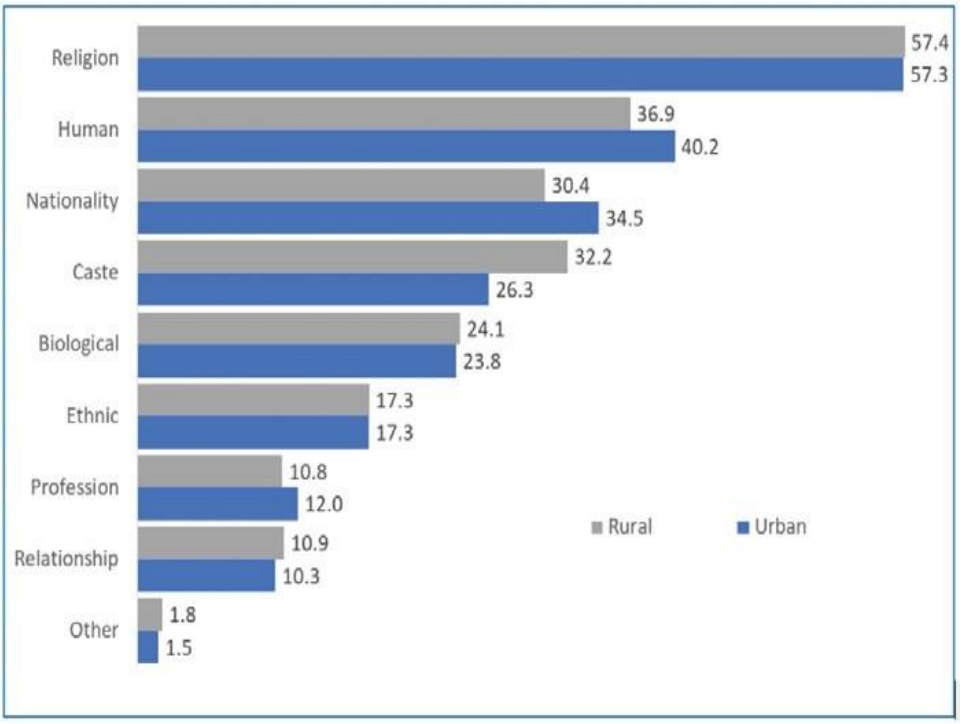
Source: Author's estimation using the PIDE-BASICS Survey dataset.

Note: 1. See Table A-1 for details. 2. Size of each block within a column represents the magnitude of the response.

Identities by Region

Contrary to the common belief, rural and urban Pakistan show very similar trends in how the population perceive their identity (see Figure 2). Nationality and caste are the two identities that show some level of difference, with the prior higher in urban and the latter more prevalent in rural areas.

Fig. 2. Layers of Identity by Region (%)



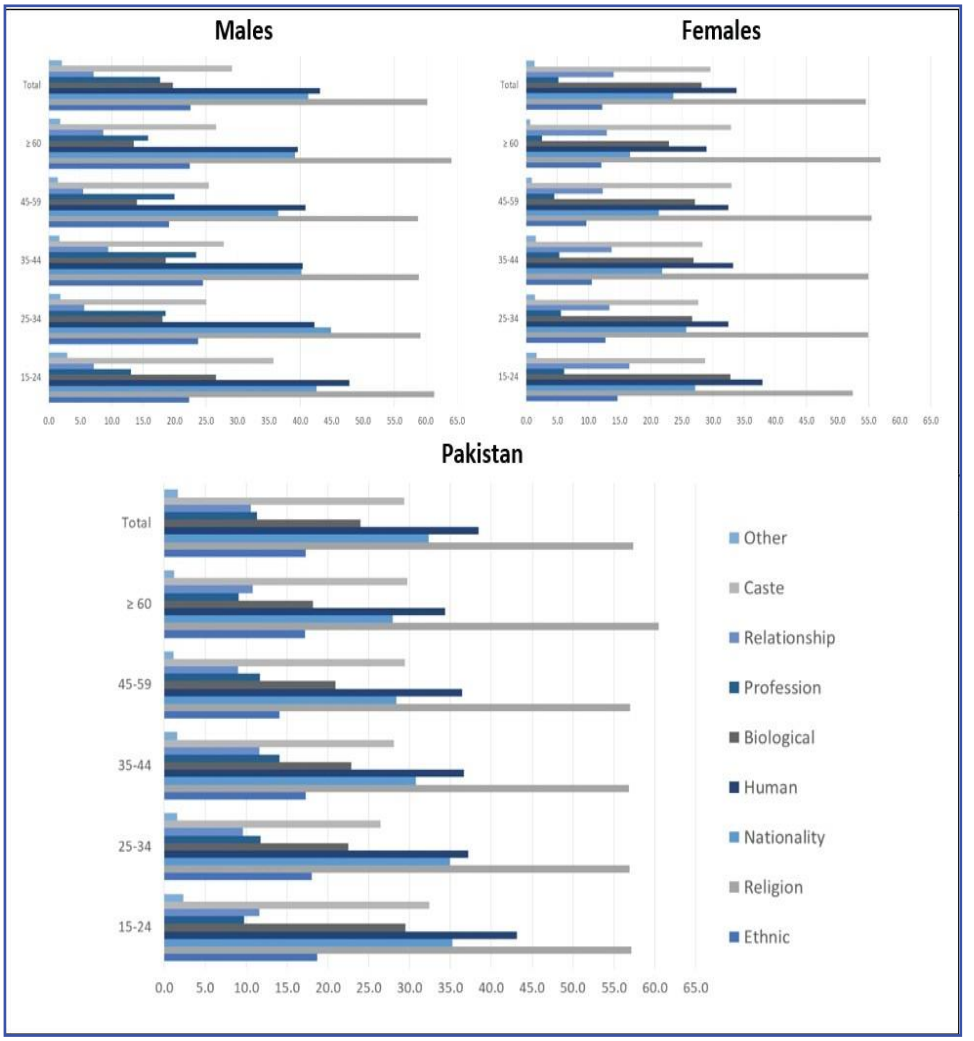
Source: Author's estimation using the PIDE-BASICS Survey dataset.
Note: Includes multiple responses—the multi-layers of identity.

Identity by Age and Sex

Age and sex define trends like no other demographic variable, and the same is true when we look into identities as well. Figure 3 shows the many layers of identity that the males and females of the country have at different ages. We see the following trends:

- Multiplicity of identities reduces with age females have fewer layers of identity than males.
- Religious identity is stronger in males than females.
- National identity is maintained much more strongly in males than females, and by younger population than the older. The same trend is shown for those who consider being a human as part of their identity.
- Caste as an identity reduces with age for males and increases for females.
- Relationship as a source of identity is more frequent for females than males across all ages.

Fig. 3. Layers of Identity by Age and Sex (%)



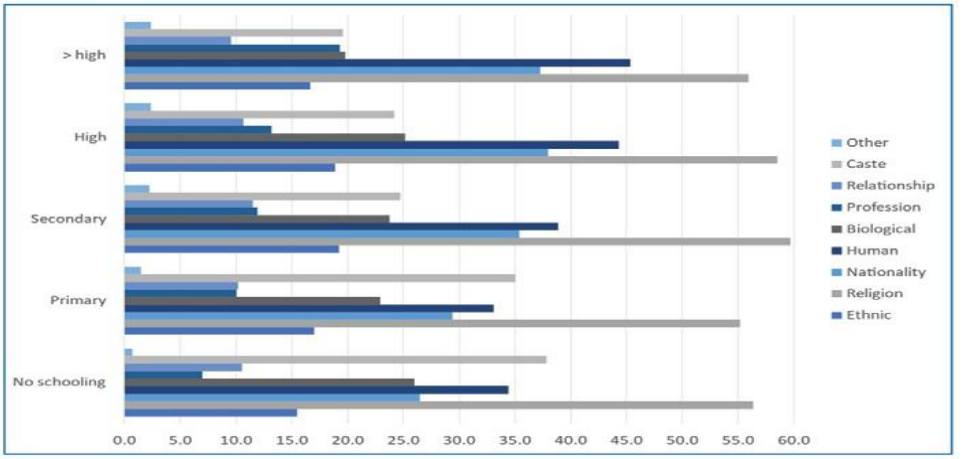
Source: Author's estimation using the PIDE-BASICS Survey dataset.
Note: Includes multiple responses—the multi-layers of identity.

Identity by Education

Does education change the way people conceptualise their identity? Figure 4 shows the multi-layers of identity maintained by the people of Pakistan by education, and we see that:

- Religion and ethnicity as layers of identity remain almost the same across educational levels. Being a Pakistani (nationality) as an identity increases with increasing education.
- Increasing educational level shows an increasing proportion taking 'being a human' as a source of identity, as does profession.
- Caste as a layer of identity shrinks with increasing education.

Fig. 4. Layers of Identity by Level of Education (%)



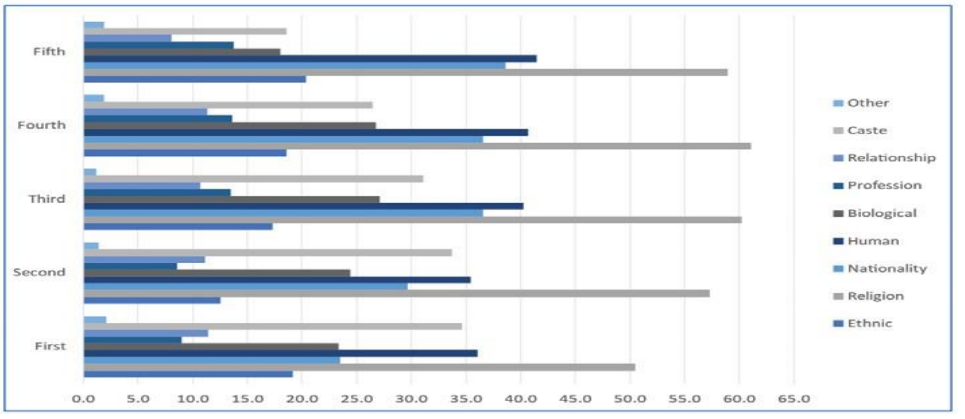
Source: Author's estimation using the PIDE-BASICS Survey dataset.
Note: Includes multiple responses—the multi-layers of identity.

Identity by Income

Lastly, we look into how identity varies with the income level of the household (see Figure 5). PIDE-BASICS survey shows that there are no major differences across the income quintiles, but the trends show that:

- Religious identity matters the least for the bottom income quintile. Nationality as an identity increases with improving income level.
- Caste as a source of identity is strongest for the lowest quintile, getting weaker with higher quintiles.
- Identity drawn from profession and being a human goes up, and that based on relationship goes down as we go up the income ladder.
- Identity stemming from biology is the strongest for the middle quintile.

Fig. 5. Layers of Identity by Income Quintile (%)



Source: Author's estimation using the PIDE-BASICS Survey dataset.
Note: Includes multiple responses—the multi-layers of identity.

ANNEX

Table A-1

Identities Across Provinces and Territories (%)

	Pakistan	KP	Punjab	Sindh	Balochistan	GB	AJK	ICT
Ethnic	17.3	16.7	11.4	15.8	32.4	44.7	12.1	10.5
Religion	57.4	61.7	55.1	54.4	58.3	30.1	65.0	85.2
Nationality	32.4	31.1	25.6	34.7	37.6	27.4	23.9	65.8
Human	38.4	45.6	31.3	42.2	33.7	33.7	33.2	62.3
Biological	24.0	30.6	18.4	30.4	24.1	22.4	9.8	25.0
Profession	11.4	4.6	11.6	12.8	13.0	30.2	4.2	8.5
Relationship	10.6	4.8	9.2	15.2	8.9	30.4	3.1	7.7
Caste	29.4	29.6	30.4	43.58	25.3	15.4	9.4	3.6
Other	1.7	0.5	1.3	1.0	1.1	9.9	5.4	0.3

Source: Author's estimation using the PIDE-BASICS Survey dataset.

Note: 1. Each column would not add to 100 because of multiple responses—the multi-layers of identity.

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