Conceptualizing Human Centered Development
The Case Pakistan

Muhammad Azeem Qureshi[1]
Associate Professor
School of Business, Oslo and Akershus University College of Applied Sciences
Post Box # 4 St. Olavsplass, 0130-Oslo, Norway
Muhammad-Azeem.Qureshi@hioa.no

Pål I. Davidsen
Professor
System Dynamics Group, University of Bergen
Post Box # 7802, NO-5020 Bergen, Norway
Pal.Davidsen@geog.uib.no

Abstract

This paper presents a system dynamics based macroeconomic model of the Pakistan. The model comprises of population, human development, production, international trade and system of national accounts, and public finance modules. Conscious efforts have been made to achieve the best possible blend of standard long-run theories and country-specific features to model underlying system structure of human centered development in Pakistan by focusing on long-term dynamics. The tracking performance of the model is evaluated. Empirical investigation of a number of topical macroeconomic issues utilizing model simulations have shown the model to be useful which would be extended to address 'spatial' dimension of socioeconomic planning issues of Pakistan. The model helps to better conceptualize the underlying system structure to bring in a broad-based improvement in the human condition without forgoing economic growth. It highlights the need to mobilize cost effective resource generation and suggests that priority be given to allocation of public finance to human development and not the economic services and infrastructure confirming that human development and economic growth are interdependent and intertwined in feedback processes which are mutually reinforcing and that human development is not only an end in itself but is a means to achieve higher productivity as well. This challenges the very basis of continued disregard of human development by public finance managers of Pakistan.

Keywords: Macroeconomic model, SAM consistency framework, Human development, System Dynamics, Pakistan.

[1] This study was done at University of Bergen as part of PhD work of first author.

Conceptualizing Human Centered Development
The Case Pakistan

1. Introduction

Poor human conditions and macroeconomic challenges facing the low-income developing countries necessitate ambitious social and development agenda. For which the governments assume an activist role in setting macroeconomic policies, investing to build infrastructure and expand basic services, fostering and sometimes engaging directly in productive activities. For this purpose the policy makers use a variety of methods and models to channel the country's meager investment resources to optimal use. However, impact assessment of macroeconomic policies is a difficult undertaking due to a complex network of feedbacks within and among different parts of an economy .

A long-standing view of the dynamics of the national development process was that a country had to raise its savings rate and transform it into productive investment to achieve 'progress of opulence' or an economic 'take-off' . Increasing investment in industrial sectors was at the core of this view, considering complimentary role of public investment in infrastructure like power and transportation systems, along with provision of social services like education and health. Later on technological progress was introduced as a critical determinant of long-term growth . The endogenous growth models, however, recognized investment in physical and human capital as a critical factor for long-term economic growth . Overall, theories of economic growth have been refined, modified and expanded over the years and now encompass a wide range of aspects, ranging from the purely economic to natural endowments, and from social to cultural considerations. Most explanations, however, identify investment and improvements in productivity as the fundamental sources of economic growth, being interrelated in a variety of ways. The continued effort and consequent enormous volume of literature indicates that the relationships among savings, investment, productivity and growth have been found to be more complex than initially imagined .

Development is about raising the living standards of people that needs to be central concern of national policymakers especially in developing countries where poor human conditions are typically pronounced. It is now widely recognized that human development (HD) and economic growth (EG) are interdependent and intertwined in feedback processes which suggest that both are mutually reinforcing either leading to an upward spiral of development or a poverty trap. HD is not only a means to achieve higher productivity but also an end in itself . The concept of HD puts people at the centre stage of all aspects of the development planning process and demands high level of government's commitment to HD . Accordingly, the development planning frameworks must recognize the central importance of people, not commodities, if it is to serve best the interests of policy design. But the policy makers in developing countries – Pakistan alike – tend to be myopic in their trade-off favoring maximizing current rate of output growth . However, the output growth may be a necessary but not the sufficient condition for sustained improvement in socio-economic standards .

The intent of national development planning process is to translate objectives into the policies to help achieve endogenously those objectives in the long run. The need for an endogenous and long-term sustainable national development introduces a high degree of complexity in the design of a national policy. One must take into consideration the processes that generate the momentum of national development, the delays involved, and the non-linear feedbacks that govern these processes and the interplay between socio-economic agents that make-up a nation. We use System Dynamics (SD) method[1] due to its inherent ability to properly represent elements of dynamic complexity. This paper contributes to the existing literature by presenting an endogenous growth model that focuses on the intertwining structure of human development and public expenditure in growth context, which considers both physical and human capital accumulation as engines of growth, to determine an effective fiscal structure. Another prominent feature of the model developed for the purpose of this paper is its explicit and detailed modeling of population cohorts and their interaction with other sectors of economy within consistency framework of national accounts.

Apart from the introduction presented in section 1 rest of the paper is organized in the following manner: section 2 briefly depicts the modeling context; section 3 introduces the methodology and extensively discusses the model and its causal structure along with presenting the parameter estimations; section 4 portrays the likely development trajectory of Pakistan given the continuity of current policies and discusses model calibration along with description of validation; section 5 portrays the policy design and presents policy analysis; section 6 is about the conclusions drawn and policy implications; and finally section 7 puts forward the possible limitations of this study and indicates to possible future research using this model as template.

2. Modeling Context

Pakistan presents a paradoxical case having track record of erratic socioeconomic performance. After recovering from initial teething problems following its creation on 14th August 1947, it witnessed uneven but relatively high economic growth in the 1960s. However, it could not maintain the economic growth momentum due to poor institutional support to develop indigenous human capabilities. Pakistan could not sustain its intermittent economic growth in 1980s due to its imbalanced socioeconomic development and now finds itself in a *'poverty trap'* with dismally low social indicators, low revenues and high indebtedness.

In terms of governance, Pakistan government has been dominated by autocracy of various forms where the state and the market are mere instruments of wealth accumulation and concentration for a tiny elite , frustrating fiscal and other reform efforts. Considering public policy on the revenue side, empirical literature suggests that despite measures taken by successive governments Pakistan has persistently low tax-GDP ratio. Any effort to increase progressive direct taxes results in decrease in total revenues as percentage of GDP forcing the government to rely on regressive indirect taxes . On the other hand, level of public spending is the key policy tool for the government to manage a balanced socioeconomic development of the country . Successive governments in Pakistan have been pursuing pro-growth *trickle-down approach* by allocating high public spending for economic growth with a consequent low public spending on social sector. The proclaimed intent was that the benefits of growth will ultimately reach all. Resultantly, the *'so-called'* good economic growth could not be translated into better social indicators . This is quite evident from the fact that Pakistan is placed at 136th position out of 177 countries in terms of Human Development Index[2]. The main reason may be under investment in HD due to which Pakistan may have lost considerable earnings as various studies suggest. Moreover, good economic growth not accompanied by increases in HD may prove to be ultimately unsustainable .
Historically, Pakistan has been a country with budgetary deficit – government revenues always fall short of government expenditure. Such a deficit results into public debt. The current period debt decision not only increases the public debt stock of the country but also increases non-developmental financial outflows of principal and interest payments. The developmental expenditures are natural victims of such increased obligatory non-

developmental outflows from already constrained and overstretched financial resources, because the policy makers presume the current expenditures as a must for keeping the government operational. Another dimension to this problem is that the policy makers; while deciding to distribute these debt-constrained public finances among economic services, infrastructure and HD; have been consistently ignoring HD with the intent that economic growth will itself take care of social well being in the long run . Their belief is reinforced by sporadic economic growth. However, under investment in HD may limit its capacity to grow and produce endogenous resources , to finance its budgetary needs and to offset its debt obligations. Such a debt accumulation process may not only entangle Pakistan in *'debt trap'* but may also limit its sovereign fiscal options and expose it to macroeconomic risks including squeeze on social and development spending thereby compromising the very social and development objectives for which the debt was raised . We hypothesize that due to the shortcoming in representing the characteristics of the processes; that generate the momentum of national development, the delays involved, the non-linear feedbacks that govern these processes and the interplay between socio-economic agents that make-up a nation; in models including mental models used for national planning purposes result into the policies, although deemed reasonable when considered in a short-term and local perspective, that are inconsistent with the national agenda when considered in a medium and long-term overall perspective. Therefore, we develop an integrated macroeconomic model to overcome these shortcomings and put forward alternative policy framework for a balanced socio-economic development.

3. Methodology and Model Description

There are four interacting economic agents in an economy; households, producers, government and rest of the world. We describe the principal characteristics of our representation of the economic system by means of a model flow chart wherein we present, in Figure 1, the main assumptions about interrelationships of these economic agents in the economy as a graphic and general introduction to the model. It is a conscious effort to keep all relevant concepts endogenous to the model.

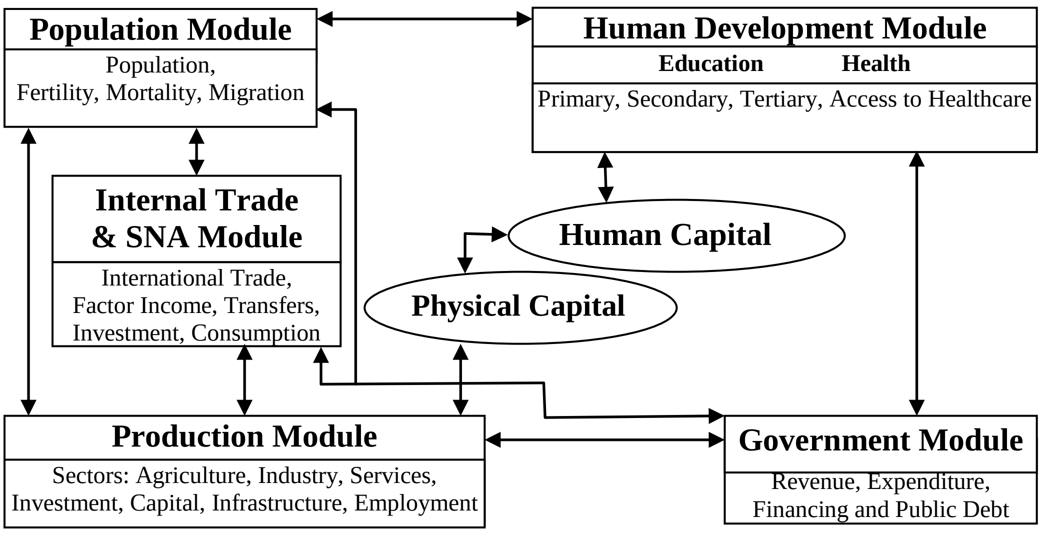


Figure 1. Model Flow Chart

3.1.Methodology

Based on the relevant literature and the interrelationships identified in Figure 1, we use the SD method to develop a simulation model[3] which seeks endogenous explanation for the phenomena under investigation . For this purpose we specify simultaneous system of equations[4] that describes the interrelationship of different variables grounded in relevant literature within the structural consistency framework of system of national accounts (SNA)[5] and social accounting matrix (SAM)[6] to determine the behavior over time.

The SD focuses on the relationship between structure and behavior of complex dynamic systems. Its stock and flow approach is ideal to properly represent elements of dynamic complexity – feedback loops, accumulations and non-linearity – while maintaining a certain degree of model transparency. For this purpose we use simulation software Vensim®[7] to develop the model. We present and discuss the model features as stock and flow diagrams in the subsequent sections and see annexure for detailed mathematical relationships.

3.2. Model Boundary

The model boundary marks the separation between the system being modeled and the rest of the universe to keep the model manageable and without compromising its purpose . Like all other models, the model developed for the purpose of this study (hereinafter the model) too has a boundary. The model attempts to represent, in an integrated manner by keeping all important feedback loops endogenous, the structures at an aggregate level that determine the dynamic behavior of the whole national economic system of Pakistan. Such an endogenous focus generates the dynamics of a system through the interaction of the variables represented in the model. This is an explicit attempt to address the broader research question as to what Pakistan itself can do for its sustainable human centered development. The model, by keeping its focus endogenous, does not isolate itself from rest of the world. Rather incorporates simplified assumptions about impact of world economic growth and exchange rate on Pakistan. Moreover, the influence of Pakistan on the rest of the world is not modeled. Further, there is no monetary or financial subsystem and its associated price level. We assume a neutral or passive monetary policy that supplements the purposes of fiscal policy. Figure 2 presents the conceptual and spatial boundary of the model.

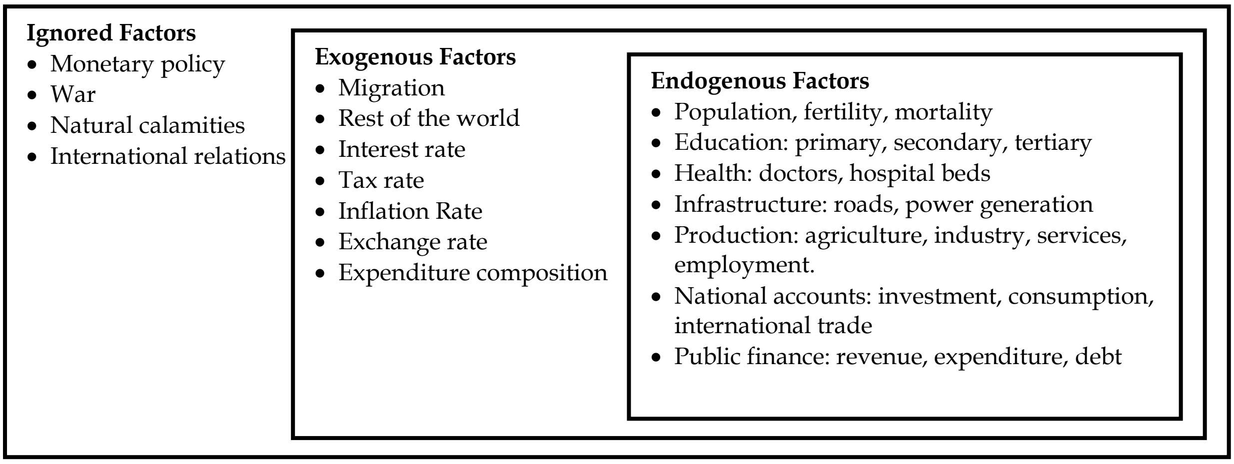


Figure 2: Model Boundary Diagram

3.3. Data Sources

We have used several data sources to estimate a variety of parameters in different modules. For this purpose we have primarily used various issues of Pakistan Statistical Year Book (PSYB) of Government of Pakistan, the World Development Indicators (WDI) of the World Bank, and the World Population Prospects-2002 revision (WPP) of United Nations, along with using optimization feature of the software to estimate parameters where there was no data available. Moreover, we use these data sources to estimate time series of various variables used for model calibration.

It is customary to have an accounting system, like system of national accounts (SNA), corresponding to every macroeconomic model, and it is particularly useful to make the accounts explicit in the form of SAM as a framework for not only arrangement of different sources of data in a consistent, informative and useful manner but also for a consistent simulated data set . Therefore, we developed a consistent SNA following standard national accounting practices. Further, SNA, SAMs and macroeconomic models are intimately related and making this relationship explicit is potentially useful for model construction and analysis . We use this connotation in three ways: first as an arrangement framework of economy-wide data from different sources to improve the quality of available data ; second as a tool for model calibration; and third as a reality check for model validity where SNA and SAM, being accounting systems, help match resource flows at different levels and among different economic agents in the economy .

3.4. The Model Structure

Generally macroeconomic development planning models have not explicitly recognized the interdependence between the macro economy and social sector development. However, we explicitly recognize this interdependence by endogenous development of population and its socio-economic progress over time and its dynamic impact assessment of different levels and composition of public expenditure on different HD and EG indicators grounded on their inter-linkages found in literature. We use the consistency framework of SNA and SAM to construct the model so as to include dynamically relevant aspects. The model legend, Figure 3, may help better understand the model structure described in the following sections.

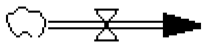
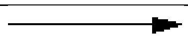
Model Legend	
Layout	**Meaning**
Inside Box With First Letters Capitalized	**Stock Variable**
	**Flow Variable**
name with no caps	**Auxiliary**
NAME WITH ALL CAPS	**Constant or Time series data**
	**Information Link**

Figure 3: Model Legend

3.4.1. Population Module

The critical importance of population in a country's development planning makes it essential to keep it as a fundamental module of the model based development planning. Such an endogenous focus helps estimate the demand and supply side of human centered development of a country as well as to assess the productive capacity of its economy and its impact on the demographic development .

The conceptual framework of this module is grounded in the demographic transition theory , theories of fertility decline , and empirical observations that suggest a definite relationship between population change and socio-economic development . This framework provides an effective generalized picture of the population development on an aggregated level which serves the purpose of the model. Studies also suggest that higher infant and under-five mortality rate in Pakistan and other developing countries are one of the many reasons of higher fertility rates. Couples are observed to have more children so that few may survive considering higher mortality rate . Empirical literature also indicates that per capita income, education especially mothers' literacy and access to health services are major determinants of mortality decline in developing countries . Based on the above literature, Figure 4 presents the modeled causal relationship of the socioeconomic variables with the population.

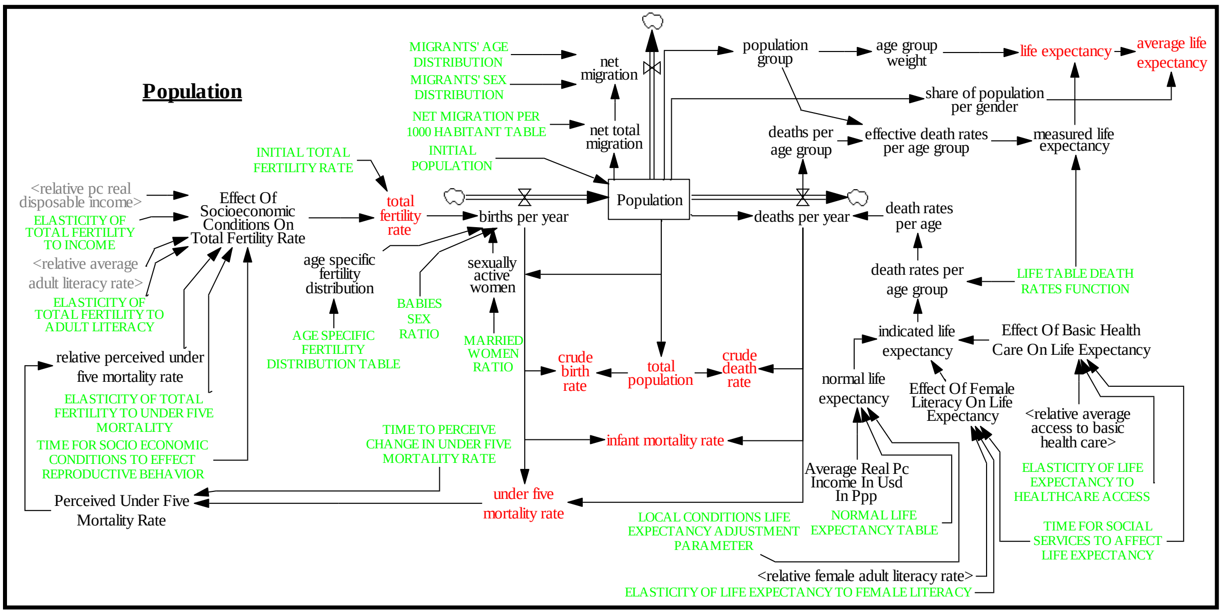


Figure 4. Population Module

The births, deaths and net migration are three flows that bring changes in level of human population in a country over time . To reproduce this we model the stock of population as 82-one year age cohorts, ‘new born’ and age 0 to age 80 and above, for each of the two genders. The inflow *‘births per year’* of the two genders accumulates in first age cohort ‘new born’ which transfers all ‘new born’ to the next cohort at the beginning of each period. The stock of all age cohorts other than ‘new born’ get inflow from their previous cohort and give outflow to the next cohort subject to their adjustments due to *‘deaths per year’* and *‘net migration’* of each cohort. We assume net migration as exogenous[8], but the model endogenously determines the *‘births per year’* and *‘deaths per year’* based on the assumed causal structure, Figure 4, and the simultaneous interaction with other modules. Demographic literature has identified a variety of determinants of human births and deaths. However, any population model that tries to include each separate determinant soon becomes hopelessly confusing . To avoid such problem and without compromising the fundamental objective, this model is also an effort to represent simplified causal structure.

We depict on the left hand side of Figure 4, the theories of fertility decline and empirical demographic studies of Pakistan which advocate that higher literacy levels, control on child mortality and better economic growth help reduce fertility rate reducing births per year . While on the right hand side of Figure 4, we determine age-specific *‘deaths per year’* by mapping life tables [9] over the life expectancy estimated by the World Bank based on endogenously determined per capita real income adjusted for local conditions adjustment and impact of female adult literacy and access to basic healthcare on life expectancy .

We initialize ‘new born’ age cohort at zero[10] and use WPP to estimate initial stock of the remaining age cohorts of the two genders. We also use this data to estimate total net migration, age specific fertility distribution. Based on these estimations, the empirical literature, the above described causal structure, and at the same time similar estimation and causal structure of the other modules; we use optimization features of the software for multivariate parameter estimation of population module which we present in Table 1.

Estimated Parameters	Value
elasticity of total fertility to income	-0.10
elasticity of total fertility to adult literacy	-0.15
elasticity of total fertility to under five mortality	0.15
time for socio economic conditions to effect reproductive behavior (year)	5
time to perceive change in under five mortality rate (year)	3
babies sex ratio[female]	0.487
babies sex ratio[male]	0.513
local conditions life expectancy adjustment parameter[female] ($81/Year/Person)	320
local conditions life expectancy adjustment parameter[male] ($81/Year/Person)	370
elasticity of life expectancy to female literacy	0.05
elasticity of life expectancy to healthcare access	0.04
time for social services to affect life expectancy (year)	5

Table 1: Estimated Parameters of Population Module

In addition to these parameters, presented in Table 1, we estimate one parameter as a time series; married women ratio[11] which is 98% in 1981 and 90% in 2030.

3.4.2. Human Development Module

It is now widely recognized that human capital is one of the key drivers of economic growth and constitute main wealth of a nation. Human resources characterized by high levels of skills, education, lifelong learning and good health are catalyst for robust and sustainable economies. Moreover, HD is not only a means to achieve higher productivity but also an end in itself . The concept of HD puts people at the centre stage of all aspects of the development planning . The literature identifies education and health as the strategic components of HD , which we reflect in this module, and have positive impact on economic development that we will depict in production module.

Considering public policy the level of public spending is the key policy tool for the government to pass on the benefits of economic growth to the society and reflects the level of government's commitment to the desired level of HD in the country . We depict this as our basic assumption in HD module; literature presents analogies to this approach ; which comprises of two elements: primary and secondary education (Figure 5), and tertiary education and access to health (Figure 6).

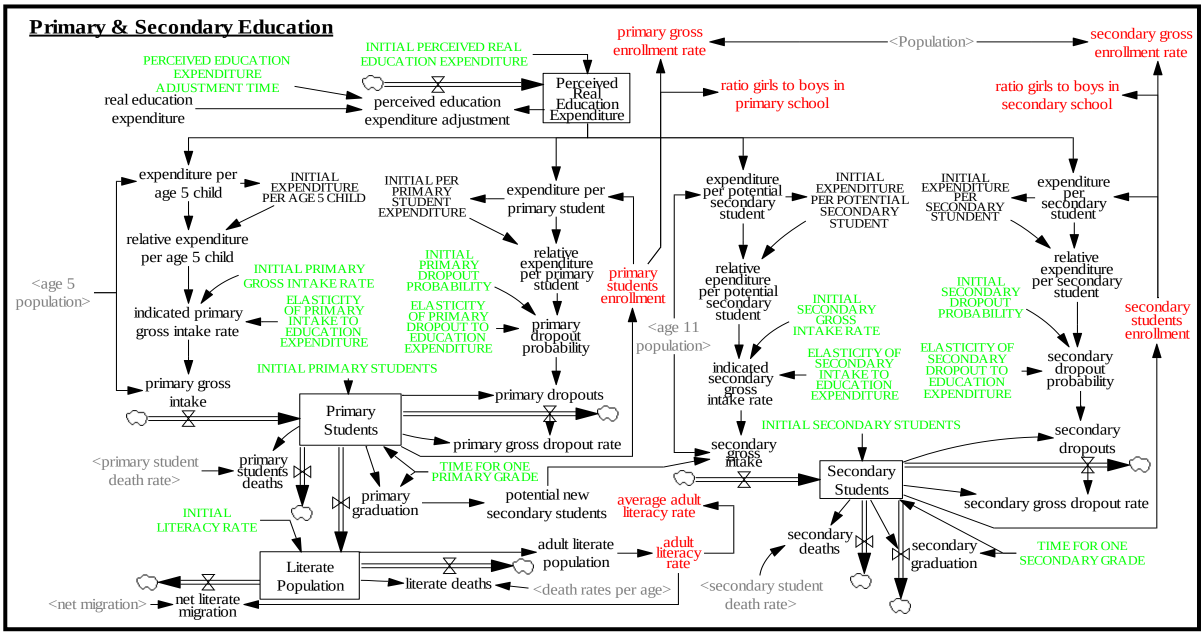


Figure 5. Primary and Secondary Education

We assume in education component that the real[12] public spending on education per prospective student has a positive impact on students' intake which is conditioned by number of available prospective students which is, in turn, based on endogenous flow from population/education system. Further, the real public spending on education per enrolled student has a negative impact on the students' dropout rate. Similarly, in health component the intake of medical students is from tertiary education and subject to real public spending on health and these medical students will graduate to become medical doctors, while hospital beds is subject to real public investment on health as well as its depreciation. We formulate the average access to basic healthcare as an index giving 0.6 weight to doctors per 1000 people and 0.4 weight to hospital beds per 1000 people.

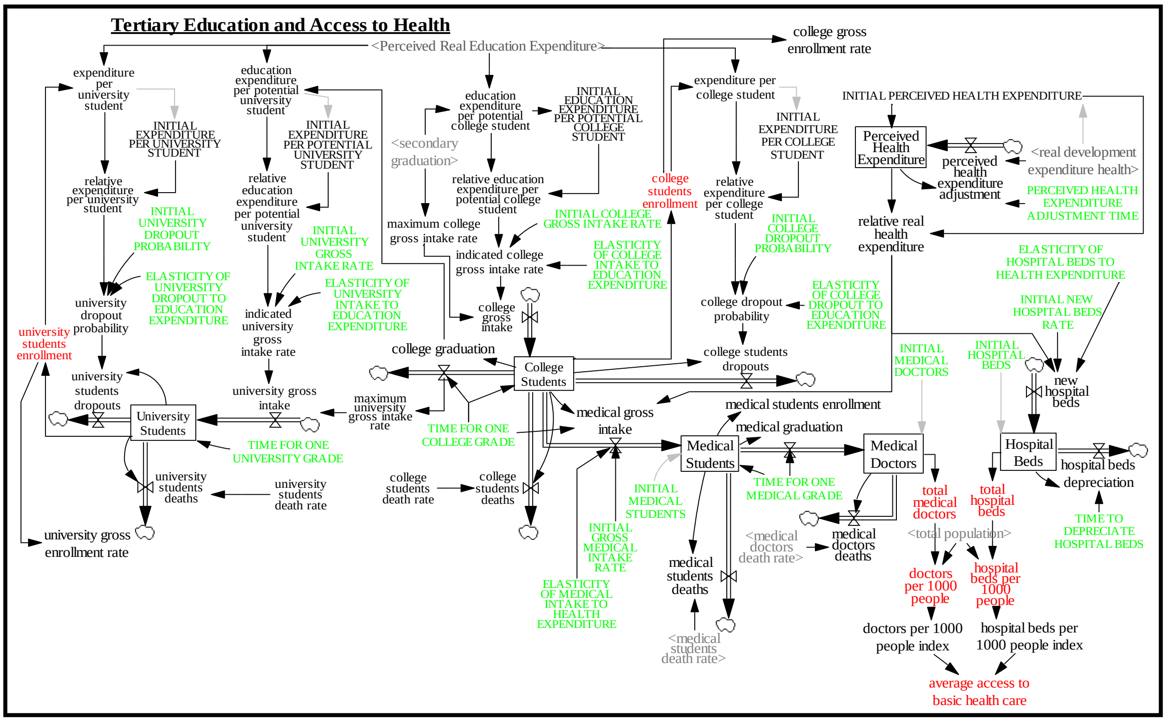


Figure 6. Tertiary Education and Access to Health

This system structure identifies the dynamics of development of education in the country. The growing prospective students, *citrus paribus*, dilute the per capita spending on prospective students to have a negative impact on fresh intake. But as the growth in per capita spending on prospective students asserts a positive impact to increase the current students' level, this in turn dilutes the spending per student to increase the dropout rate bringing down the students' level. This unintended policy consequence is generally ignored.

Following the pattern of stock of population we model the stock of students as 17 cohorts for each of the two genders – one for each class; 6 for primary, 5 for secondary, 4 for college, and 2 for university education; and there are 5 cohorts of the two genders for 5 years' of medical education. Each stock of students has four flows; intake, dropout, graduation, migration and deaths. The previous paragraph describes the intake and dropout. To determine flow from one grade to another and rate of graduation, we estimate average time to complete one grade at each level with the help of optimization feature of the software due to non availability of the relevant data. Further, for the students we assume the same age and gender specific migration and death rates as determined in population module.

We initialize stock of students, medical doctors of the two genders and the hospital beds as well as to estimate initial average intake rate and initial average dropout probability of each class of the students using PSYB. We use optimization features of the software to estimate the following parameters of HD module, Table 2, based on estimations and the causal structure of this module as well as similar activity carried out for the other modules.

Estimated Parameters	**Value**
elasticity of primary intake to education expenditure	0.75
elasticity of primary dropout to education expenditure	-0.60
time for one primary grade (year)	1.20
elasticity of secondary intake to education expenditure	0.45
elasticity of secondary dropout to education expenditure	-0.55
time for one secondary grade (year)	1.20
perceived education expenditure adjustment time (year)	5
elasticity of college intake to education expenditure	0.35
elasticity of college dropout to education expenditure	-0.30
time for one college grade (year)	1.30
elasticity of university intake to education expenditure	0.30
elasticity of university dropout to education expenditure	-0.10
time for one university grade (year)	1.20
elasticity of medical intake to health expenditure	0.04
time for one medical grade (year)	1.20
elasticity of hospital beds to health expenditure	0.15
perceived health expenditure adjustment time (year)	5

Table 2: Estimated Parameters of Human Development Module

3.4.3. Production Module

Provision of appropriate public infrastructure is considered a key element of development policy in developing countries where infrastructural deficiency is quite conspicuous. It is observed that growth and public infrastructure has a positive relationship in a large number of countries that have more likely causation from infrastructure investment to output growth rather than the other way around . We depict this causation in production module and use roads and power generation capacity as its proxy. Some of the researchers consider infrastructure as a flow , while others consider it as a stock . Following the later strand we consider infrastructure as stock and normalize these stocks by per 1000 people to develop an infrastructure index giving equal weight to both, Figure 7. In terms of public policy, we assume that real public expenditure on these two components of infrastructure has a reinforcing impact on their available stock. While, average life of these stocks determines their rate of depreciation.

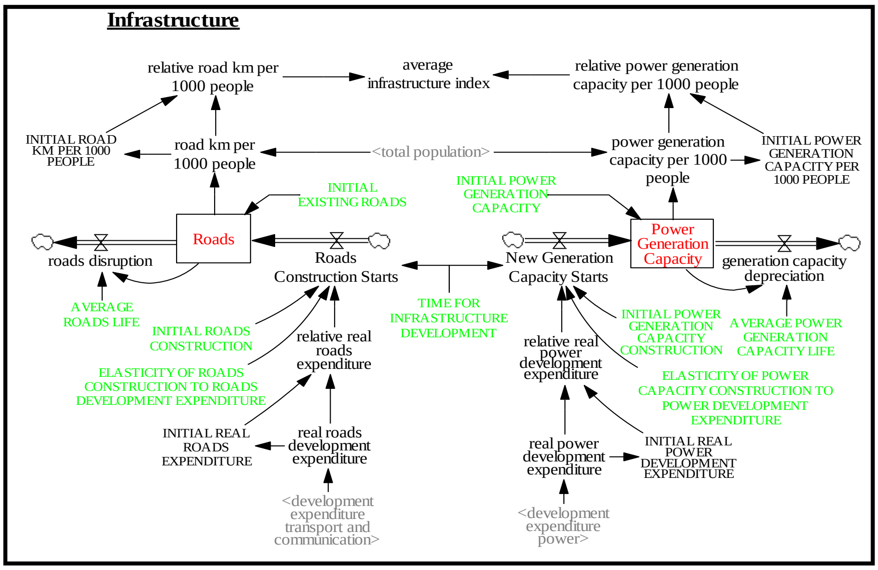


Figure 7. Infrastructure

Literature suggests that human and physical capitals are the productive capacities and their accumulation is the source of growth in the system . This is the core assumption of this module. Based on the available macroeconomic data in PSYB, we assume that agriculture, industry and services are three production sectors. Equation 1 illustrates the modified Cobb-Douglas production function we assume for the total value added in each sector.

$$Y_t = Y_0 * [K_t/K_0]^{\alpha} * [H_t/H_0]^{(1-\alpha)} * [p_t/p_0] \quad ; \quad (0<\alpha<1) \quad \ldots\ldots\ldots\ldots\ldots\ldots 1$$

where Y_t and Y_0 are current and base period total value added,
K_t and K_0 are current and base period total physical capital – public as well as private,
H_t and H_0 are current and base period human capital,
α is capital elasticity, and
p_t and p_0 are current and base period factor productivity; a function of infrastructure availability.

The K increases by investment and depreciates over time. The H is based on labor force, average education index[13] and average life expectancy index[14]. We follow Jung and Thorbecke approach , but map public expenditure on education and health to the creation of human capital. We assume the factor productivity as a function of infrastructure . Further, the endogenous incentive mechanism to allocate private investment in agriculture and industry sectors is based on growth trend in each sector's contribution to total GDP and that of services sector is based on growth trend in agriculture and industry sectors being its users. Moreover, the composition of public investment affects the composition and direction of the private sector investment . Along with the common notion of level of capital, we also consider level of education in the country as a determinant of employment level[15] .

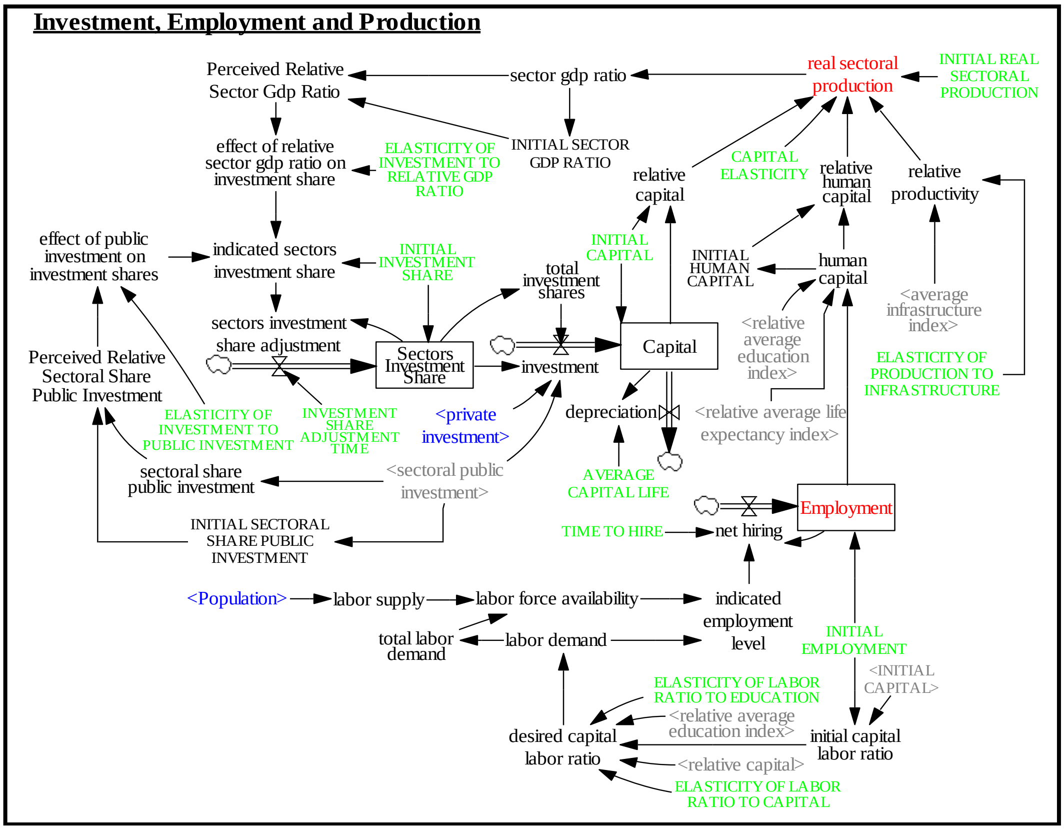


Figure 8. Investment, Employment and Production

To present a simplified view, we model this module in such a way that most of the variables in Figure 8 independently represent the three sectors. We initialize this module with the data estimated from our data sources, and estimate the following parameters, Table 3, along with similar simultaneous estimation of parameters in other modules.

Estimated Parameters	Value
elasticity of roads construction to roads development expenditure	0.40
average roads life (year)	30
elasticity of power capacity construction to power development expenditure	0.70
average power generation capacity life (year)	30
time for infrastructure development (year)	10
capital elasticity[agriculture, industry, services]	0.28, 0.35, 0.3
average capital life[agriculture, industry, services] (year)	20, 25, 20
elasticity of investment to relative GDP ratio[agriculture, industry, services]	0.01, 0.35, 0.02
elasticity of investment to public investment[agriculture, industry, services]	0.2, -0.35, -0.15
elasticity of production to infrastructure[agriculture, industry, services]	0.05, 0.1, 0.15
investment share adjustment time[agriculture, industry, services] (year)	2, 2, 2
elasticity of labor ratio to capital[agriculture, industry, services]	0.1, 0.75, 0.35
elasticity of labor ratio to education[agriculture, industry, services]	0.05, 0.2, 0.4

Table 3: Estimated Parameters of Production Module

3.4.4. International Trade and System of National Accounts Module

For international trade component of this module, Figure 9, we determine the exports based on endogenous GDP and exogenous growth rate of world GDP as well as effect of exchange rate on exports. On the other hand we determine imports as residual based on the GDP identity[16].

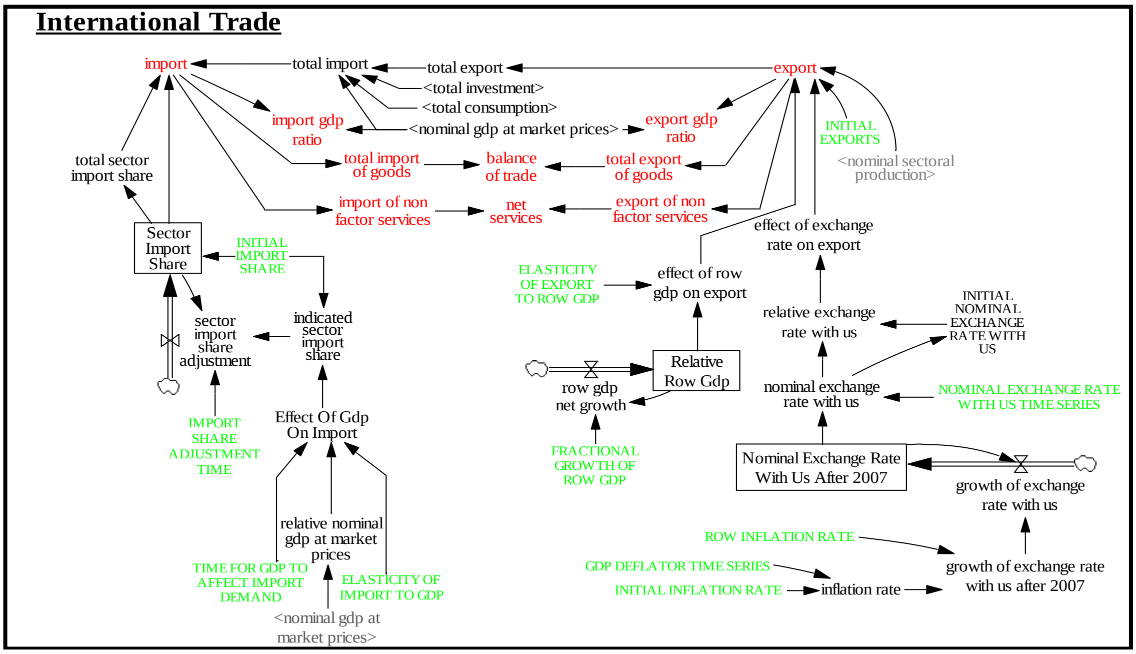


Figure 9. International Trade

It is customary to have an accounting system, like SNA, corresponding to every macroeconomic model, and it is particularly useful to make the accounts explicit in the form of SAM as a framework for not only arrangement of different sources of data in a consistent, informative and useful manner but also for a consistent simulated data set . To achieve this objective we develop this component, Figure 10, following standard national accounting practices.

The balance of payments (BoP) position, which we represent as ‘overall balance’ in Figure 10 and follow standard accounting formulations based on SNA, represents net flow of payments between a country and rest of the world. Theoretically, the ‘overall balance’ should be zero, meaning that assets (credits) and liabilities (debits) should balance. But in practice this rarely happens and overall balance indicates if a country has a deficit or a surplus and tracks the source of such discrepancy in the economy. Remaining glued to the long-term perspective of the model we only consider the long-term factors that may affect BoP and ignore the other factors. This may be a limitation of this module but it serves the purpose of this study.

There are two components of BoP: the current account and the capital and financial account. By and large we endogenously determine both. The current account has three main components: the resources balance which is strategic component of the current account – it tracks the inflow and outflow of goods and services of a country and is endogenously determined in this module; earnings on investments by both public and private (net factor income) – endogenously determined interest on foreign debt for public and exogenously determined private factor income; and un-requited transfers which are mostly workers remittances as well as official grants received by the country (total net transfers) – both exogenously determined. On the other hand the capital and financial account records all international capital transfers for which we endogenously determine net foreign financing, in public finance module, as public capital and financial account. The formulation of foreign investment (private capital and financial account) is based on the common perception that high taxes reduce investment , and hence fiscal pressure on GDP; tax-GDP ratio; has a mild inverse effect on foreign investment. The reason for this mild effect is existing low tax-GDP ratio. We consider it a simplified assumption which may be a limitation of this module. However, it serves the overall purpose of the model without materially affecting it.

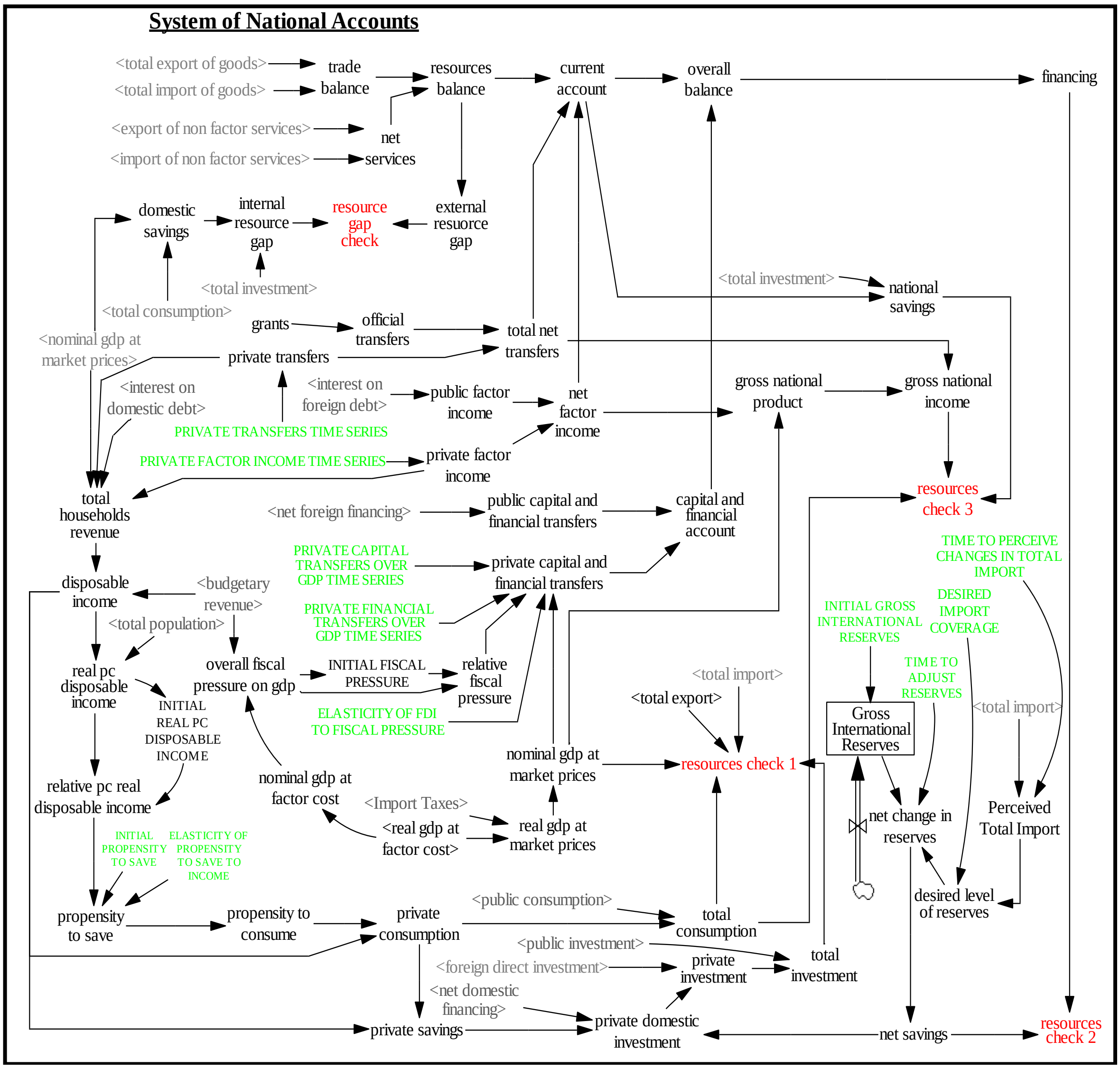


Figure 10. System of National Accounts

We use our data sources to initialize this module. Table 4 presents the estimated parameters of this module using empirical literature as well as optimization feature of the software along with similar simultaneous estimation of parameters in other modules.

Estimated Parameters	Value
elasticity of export to row gdp[agriculture, industry, services]	0.3 ,1.8,0
fractional growth of row gdp (dmnl/Year)	0.04
elasticity of import to gdp[agriculture, industry, services]	0.07,0.05,0.1
time for gdp to affect import demand (year)	2
import share adjustment time[agriculture, industry, services] (year)	2,3,2

elasticity of fdi to fiscal pressure	-0.006
initial propensity to save	0.145
elasticity of propensity to save to income	0.055
time to perceive changes in total import (year)	5
time to adjust reserves (year)	1

Table 4: Estimated Parameters of International Trade and SNA Module

The SNA, SAMs and macroeconomic models are intimately related and making this relationship explicit is potentially useful for model construction and analysis . We use this connotation in three ways: first as an arrangement framework of economy-wide data from different sources to improve the quality of available data ; second as a tool for model calibration; and third as a reality check for model validity where SNA and SAM, being accounting systems, help match resource flows at different levels and among different economic agents in the economy . This condition requires ‘resource check’ and ‘SAM check’, in Figure 10 & 11 which depict the SNA and SAM, to be zero each year and the simulation results, Figure 12, indicate that the model error is less than 0.001% which indicates the model validity in this context.

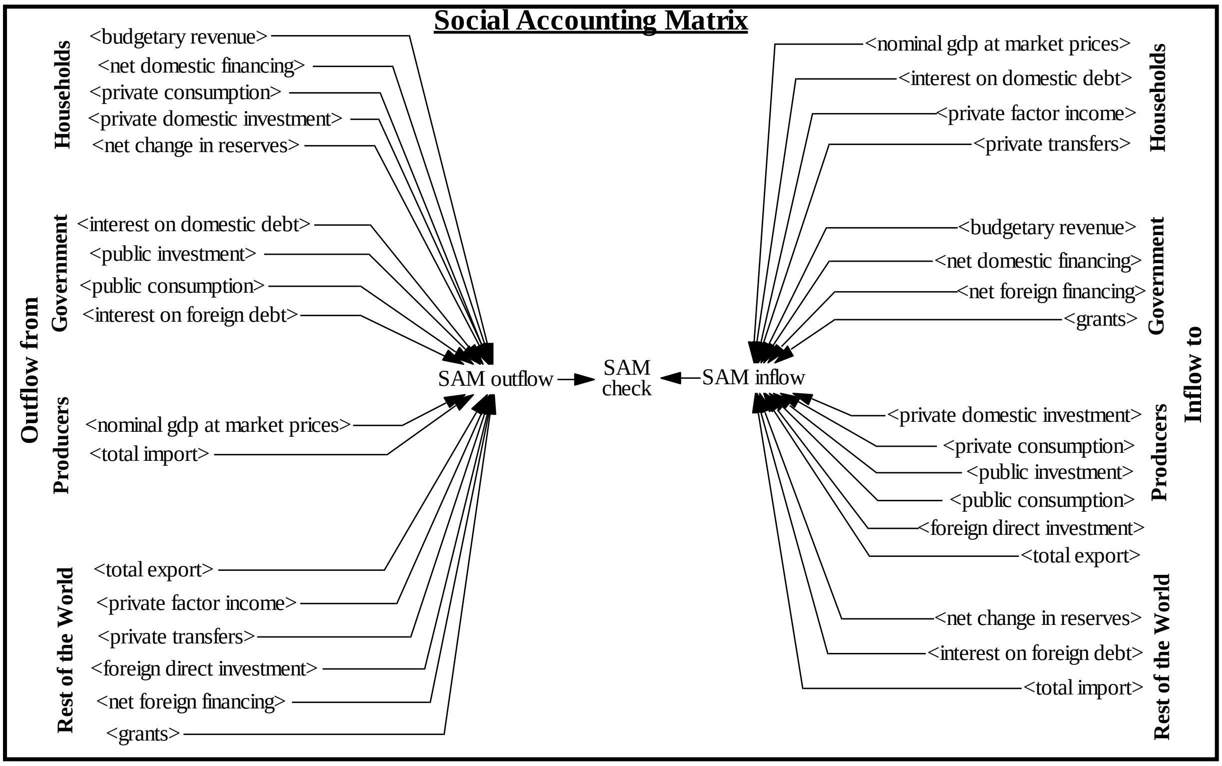


Figure 11. Social Accounting Matrix

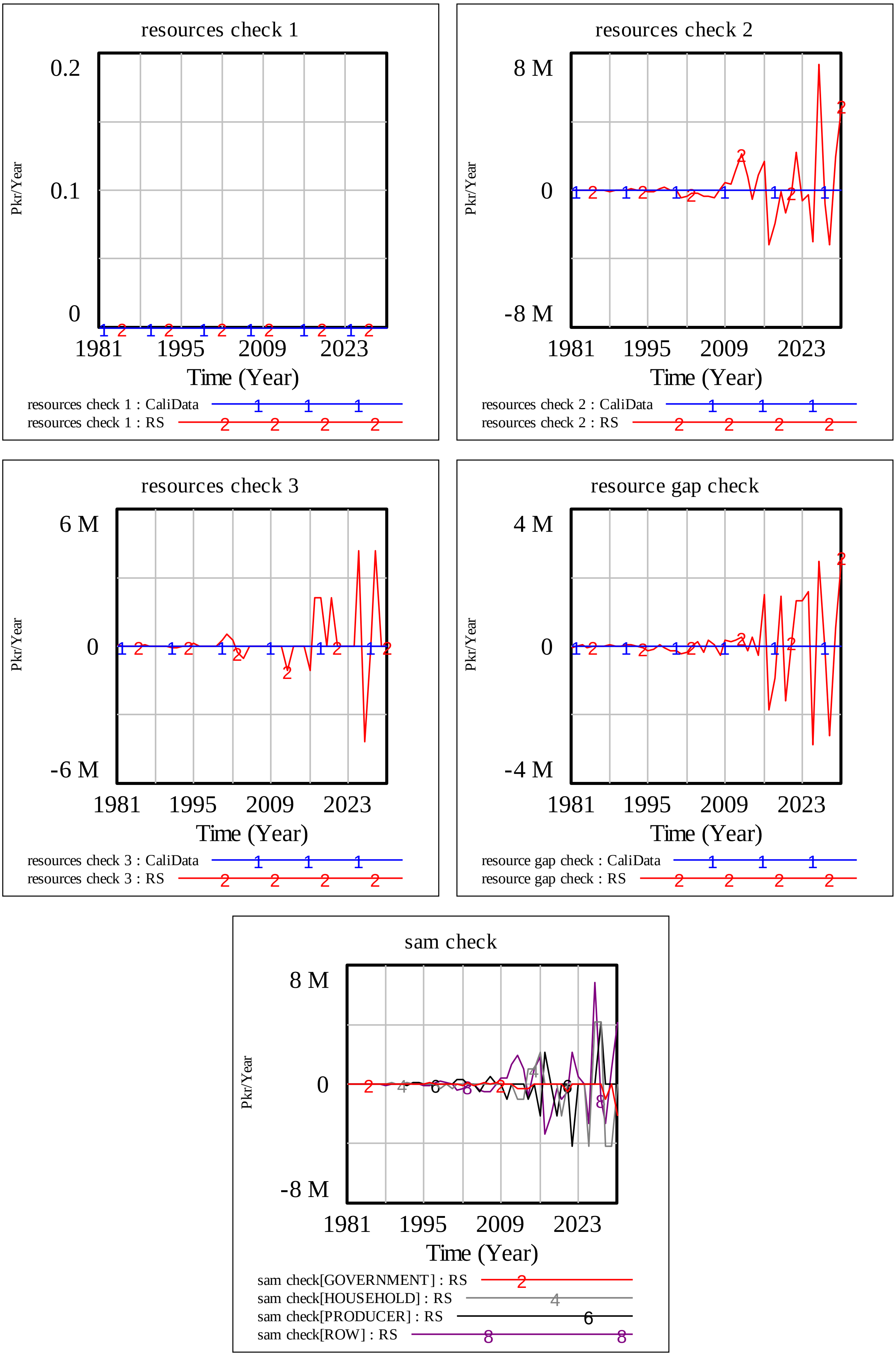


Figure 12. National Accounting Consistency Indicators

3.4.5. Public Finance Module

The conceptual framework of this module is based on the well known economic principle of government budget constraint. It is common knowledge that government finances its expenditure by taxing the production along with grants (aid) from high income countries and multilateral agencies and finances any gap; as is the case in most of the low income developing countries – Pakistan alike; by raising public debt. Figure 13 not only explicitly portrays the fiscal structure grounded in literature but will also facilitate to design an effective fiscal policy which is intertwined in tax collection structure and the allocation of public resources among alternative expenditure heads.

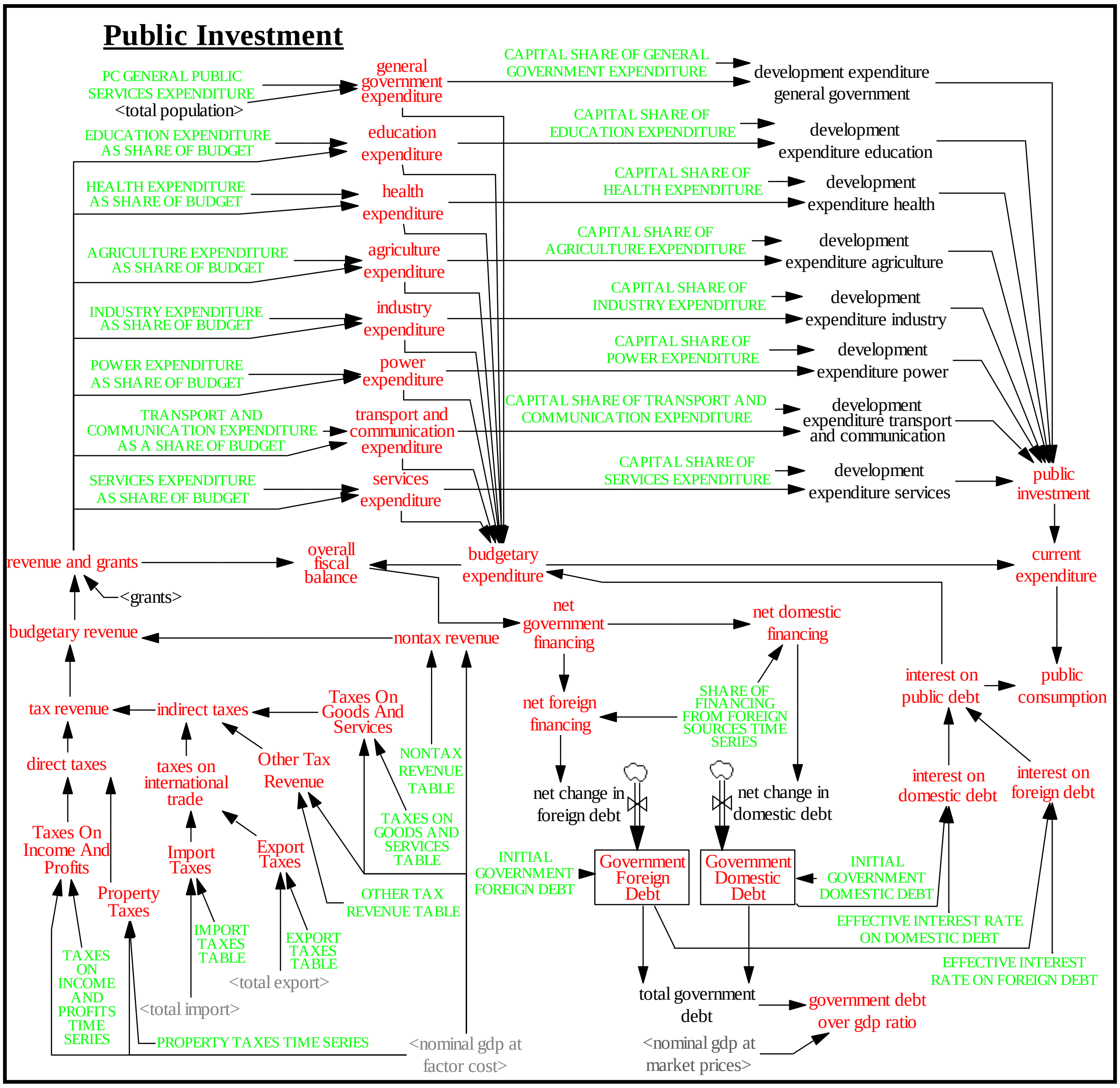


Figure 13. Public Finance Module

4. Model Calibration and Validation

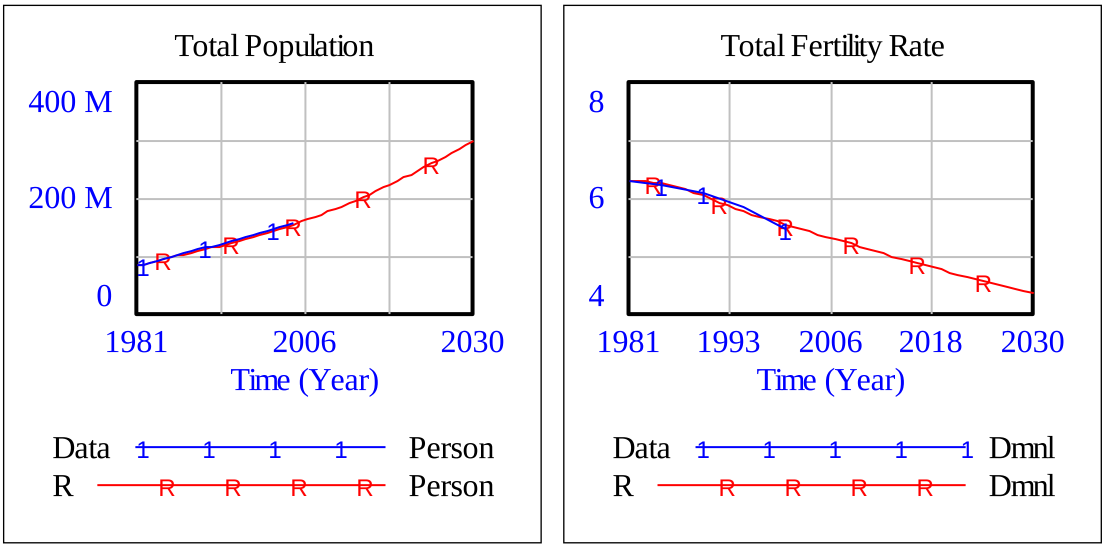
The SD method seeks to identify structure of the system under consideration and characterize dynamically the behavior pattern of variables of interest over time, which shows how these have evolved and how these might develop given the continuity of current trends. Such a characterization is called *'Reference Mode'*. For the so-called *'Reference Mode'* (*R*) we estimate the parameters in two ways: First, directly by using the data sources mentioned in section 3.3 and in the light of relevant empirical literature described in section 3.4, and second, indirectly by using multivariate techniques and optimization feature of the software. This process of parameterization helps us to calibrate the model to the available time series data. The data output from *'R'* depicts the likely development trajectory of Pakistan given the continuity of current policies.

4.1. The Reference Mode

The simulation output of *R* fits very well with multi-layers of 25 years' time series data of 1981-2005 (hereinafter the data) with R^2 ranging from 53% to 99%. The following paragraphs will present and discuss the likely development trajectories of different variables of interest along with pointing out their goodness of fit.

4.1.1. Demographic Indicators

The Figure 14 presents different demographic indicators of interest under *R* and compares these with the data. The total population (R^2 = 0.993) of Pakistan is likely to be around 300 million persons in 2030 which is a bit higher than WPP estimate of 251 million to 292 million persons; and the total fertility rate (R^2 = 0.977) is likely to be 4.43 dimensionless (dmnl) which is much higher than WPP estimate of 2.29 to 3.29 children per woman. Under the assumptions of this model the crude birth rate (R^2 = 0.743) may reach 30.46 per year by 2030 as compared to WPP estimate of 19.7 to 26.4 per year. The estimated crude death rate (R^2 = 0.755) is likely to be 6.44 per year by 2030 a little higher than WPP estimate of 6 per year. Further, the children mortality indicators also fit very well with the data; infant mortality rate (R^2 = 0.784) and under-five mortality rate (R^2 = 0.965); which are likely to be 50.0 dmnl and 57.0 dmnl respectively with former being somewhat higher than WPP estimate of 49.2 and latter being reasonably lower than WPP estimate of 65.7 deaths per 1000 live births. Finally, the life expectancy for females and males is likely to 70.12 year and 70.42 year is quite close to WPP estimate of 69.4 and 70.9 years respectively for the two genders. This description and the Figure 14 illustrate the model capability to dynamically determine the demographic indicators which are intertwined in a feedback relationship with economic indicators. The model output indicates a gradual improvement in demographic indicators of Pakistan.



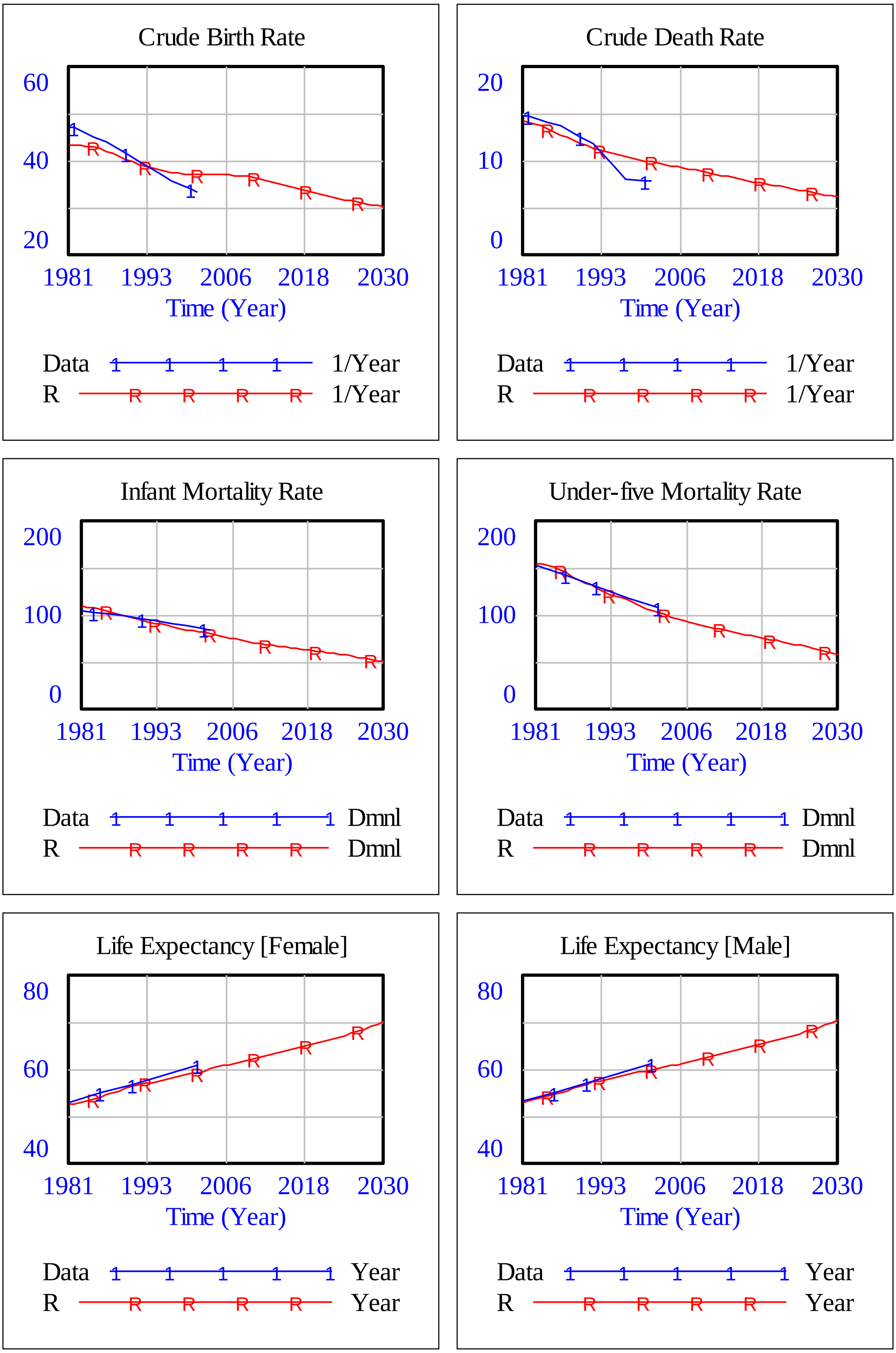
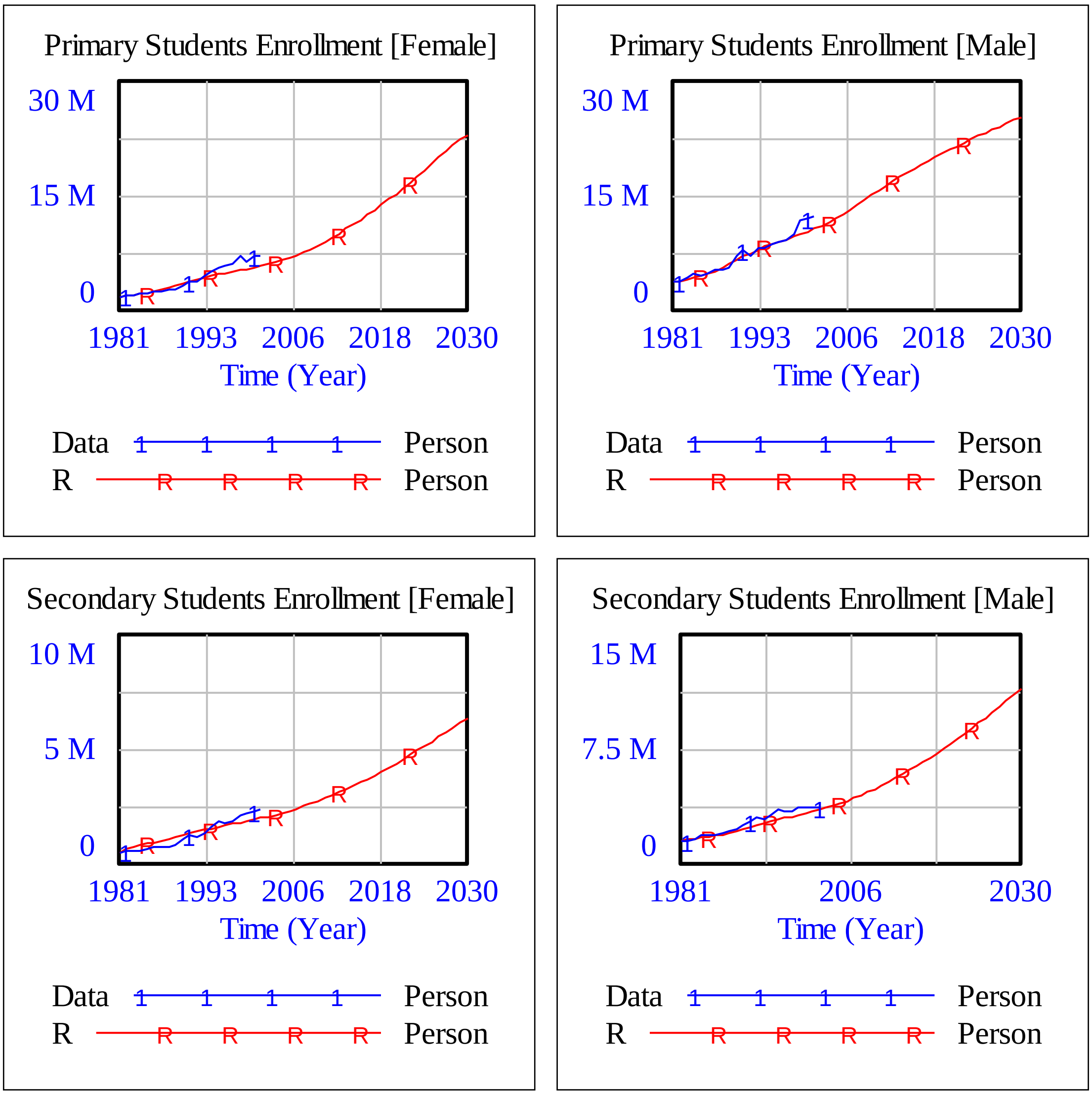
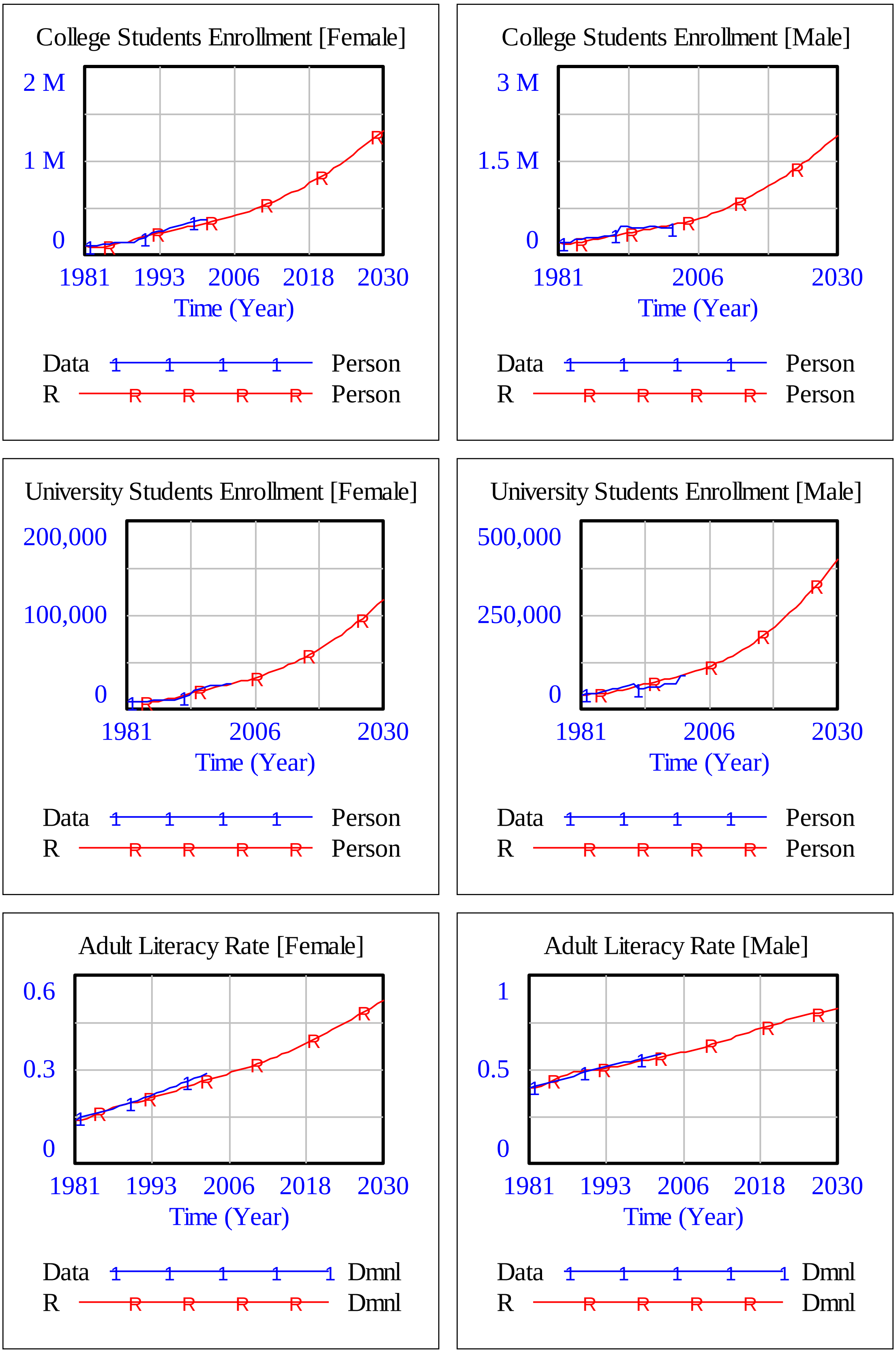


Figure 14. Demographic Indicators

4.1.2. Human Development Indicators

The Figure 15 indicates that the model tracks the data for different variables of interest in human development module reasonably well. The model performs reasonably well to simulate students' enrollment at various levels, for example primary students enrollment (for female $R^2 = 0.842$, and for male $R^2 = 0.925$), secondary students enrollment (for female $R^2 = 0.862$, and for male $R^2 = 0.868$), college students enrollment (for female $R^2 = 0.931$, and for male $R^2 = 0.702$), and university students enrollment (for female $R^2 = 0.955$, and for male $R^2 = 0.530$). Given these outcomes the model estimates average adult literacy rate to reach 67.5% by 2030 (for 52.1% female with $R^2 = 0.943$, and 82.3% for male with $R^2 = 0.945$), far away from the desired 100% adult literacy rate. The model also tracks the data of medical students enrollment for female reasonably well ($R^2 = 0.675$), but it does not follow the data of medical students enrollment for male. However, the model output beautifully fits the data of total medical doctors ($R^2 = 0.988$). This confirmatory test indicates that there may be some problem with the data of medical students' enrollment for male. Further, the simulation output for total hospital beds also fits very well to the data ($R^2 = 0.969$). Given the continuity of current composition of the public finances we observe that even supply of medical doctors is gradually improving, the doctors per 1000 people is likely to remain quite low at 1.5 by 2030. Moreover, the initial increase in hospital beds per 1000 people stabilizes in early 1990's and after that we observe a continuing decline, highlighting the continued insufficiency of public funds to provide adequate basic health facilities to Pakistanis.




College Students Enrollment [Female]
2 M
1 M
0
1981 1993 2006 2018 2030
Time (Year)
Data Person
R Person
College Students Enrollment [Male]
3 M
1.5 M
0
1981 2006 2030
Time (Year)
Data Person
R Person
University Students Enrollment [Female]
200,000
100,000
0
1981 2006 2030
Time (Year)
Data Person
R Person
University Students Enrollment [Male]
500,000
250,000
0
1981 2006 2030
Time (Year)
Data Person
R Person
Adult Literacy Rate [Female]
0.6
0.3
0
1981 1993 2006 2018 2030
Time (Year)
Data Dmnl
R Dmnl
Adult Literacy Rate [Male]
1
0.5
0
1981 1993 2006 2018 2030
Time (Year)
Data Dmnl
R Dmnl

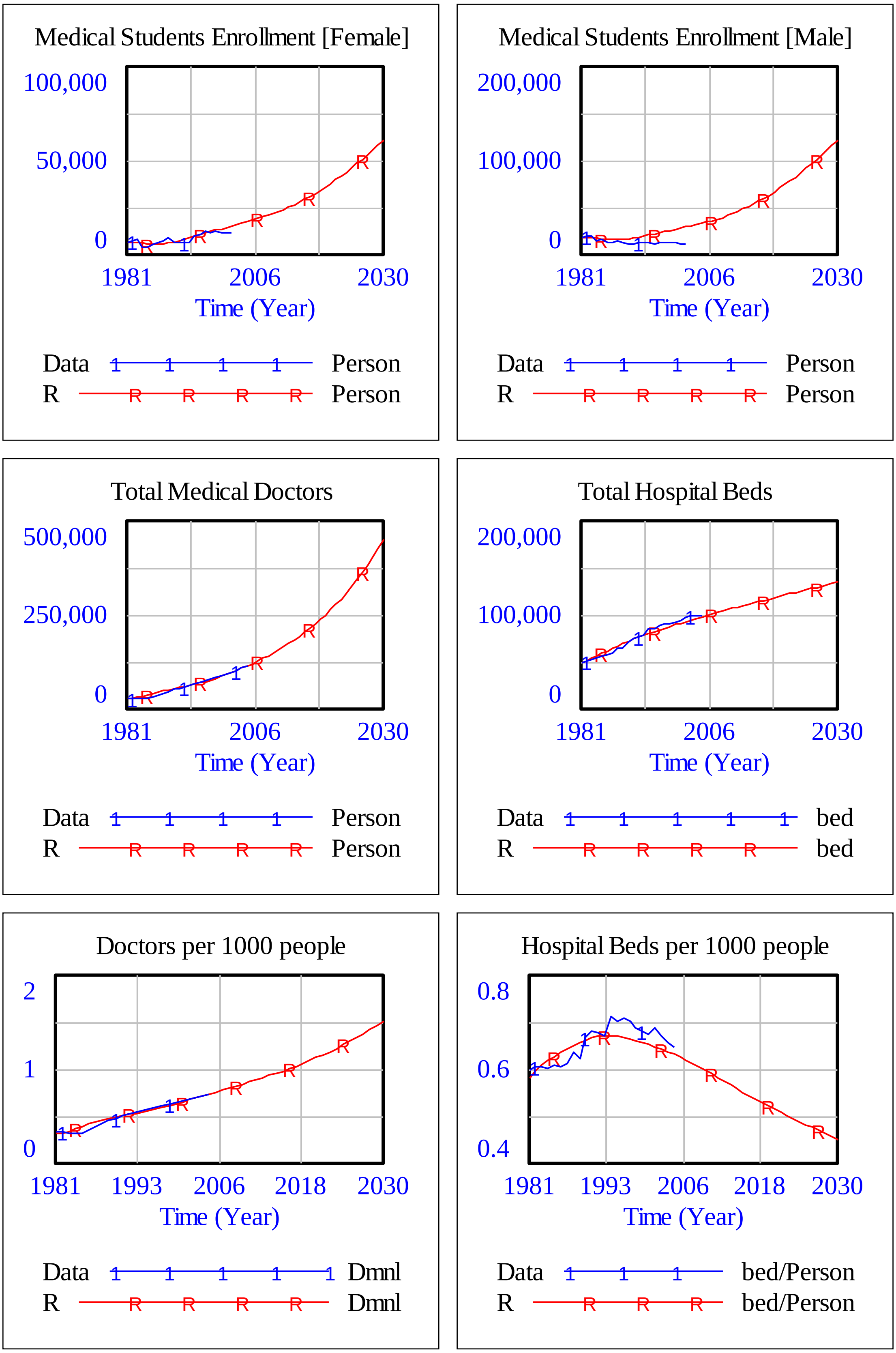


Figure 15. Human Development Indicators

4.1.3. Economic Indicators

The model output of total roads and power generation capacity, as the Figure 16 depicts, fits very well to the data; having R^2 of 0.914 and 0.921 respectively. It is likely that given the assumptions of *R* Pakistan may have 517,500 kilometers (km) of roads and power generation capacity of 24.1 million kilowatt hour per year (kw*hour/Year) which may indicate growth in absolute terms but in relative term, per 1000 people, we observe stabilization in roads and decline in power generation capacity for future.

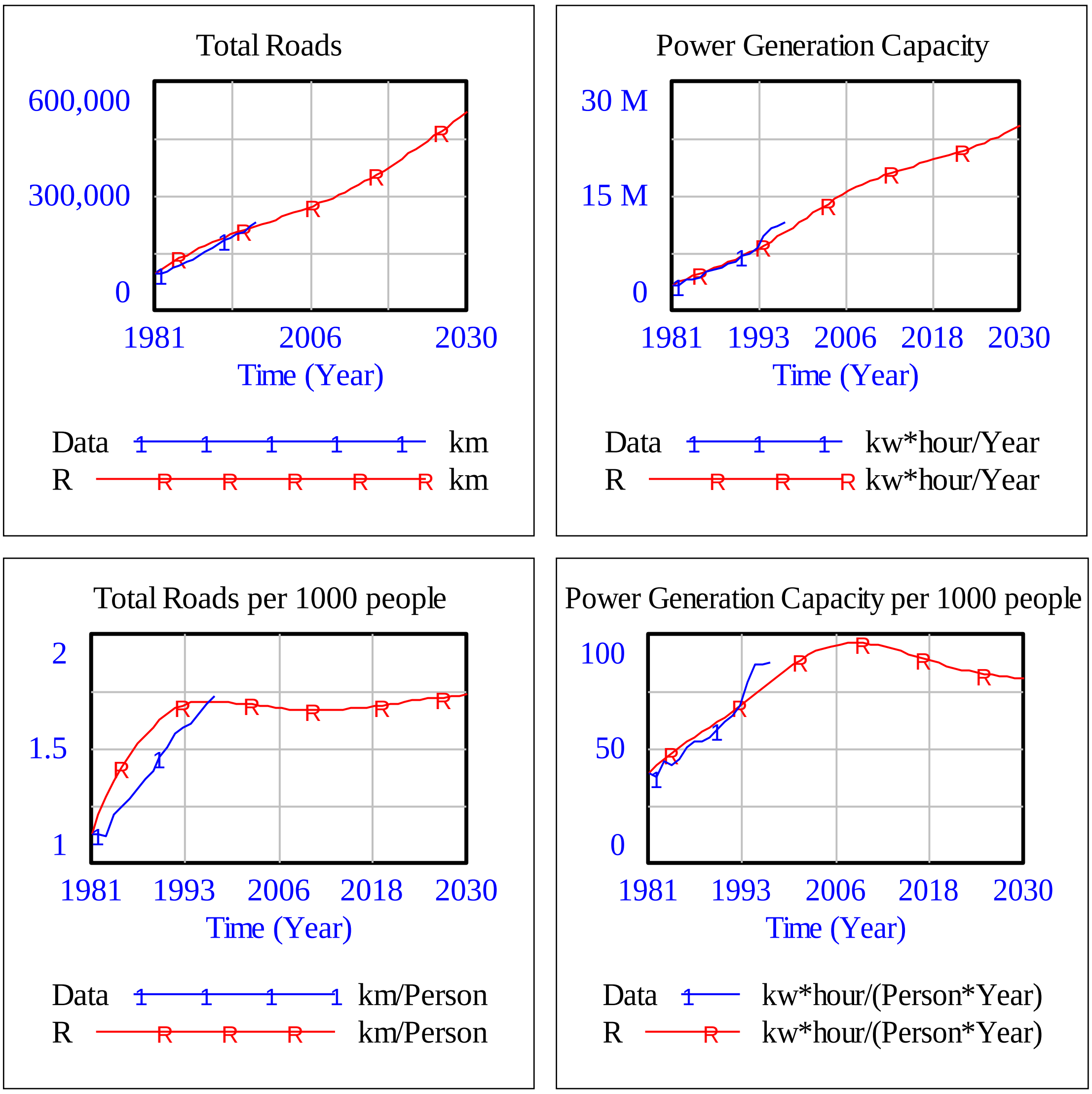
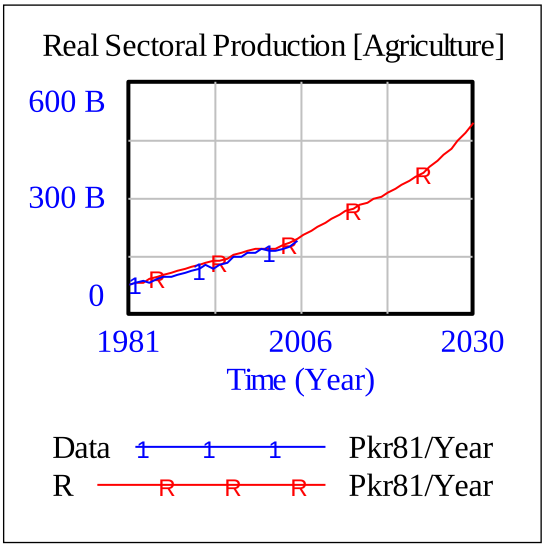
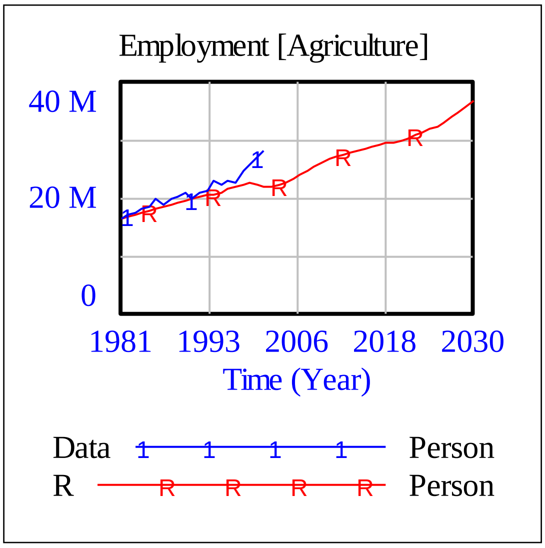
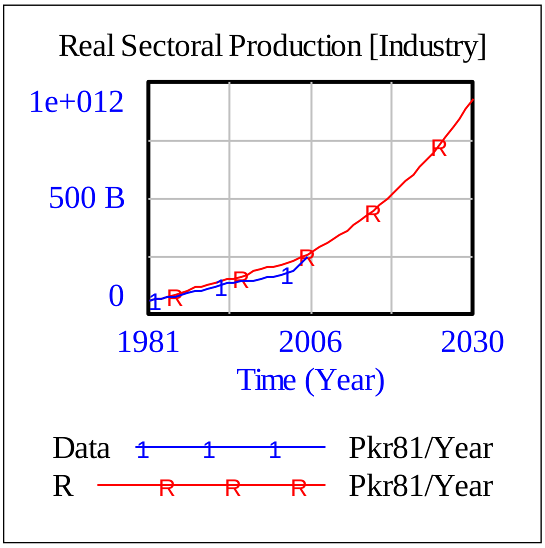


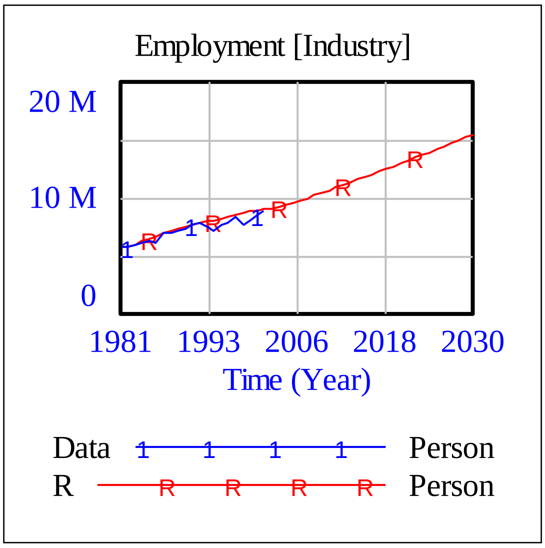
Figure 16. Infrastructure Indicators

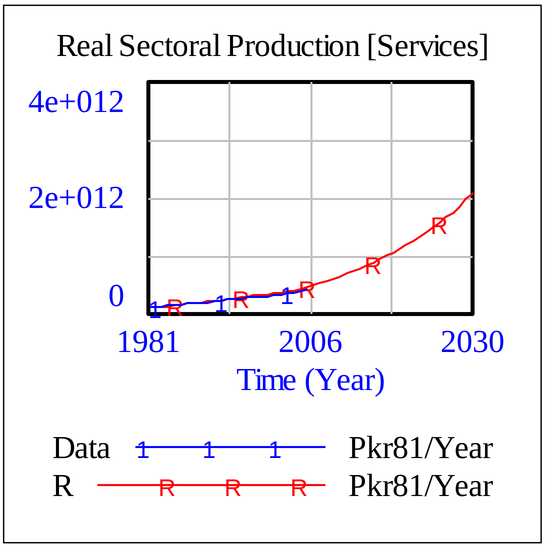
Figure 17 depicts the goodness of fit for agriculture sector (R^2 = 0.940 for real sectoral production and R^2 = 0.547 for employment[17]), for industry sector (R^2 = 0.705 for real sectoral production and R^2 = 0.762 for employment), and for services sector (R^2 = 0.914 for real sectoral production and R^2 = 0.733 for employment). It indicates the capability of the model to track well the real sectoral production and employment in the three sectors. The real GDP growth rate (R^2 = 0.254[18]) is likely to gradually decline to around 5% by 2020 and start a gradual recovery after that. Moreover, Figure 17 highlights that the model can efficiently track the data with R^2 of 0.853 for total export and 0.906 for total import in international trade, and R^2 of 0.960 and 0.989 for budgetary revenue and budgetary expenditure respectively in public finance module.

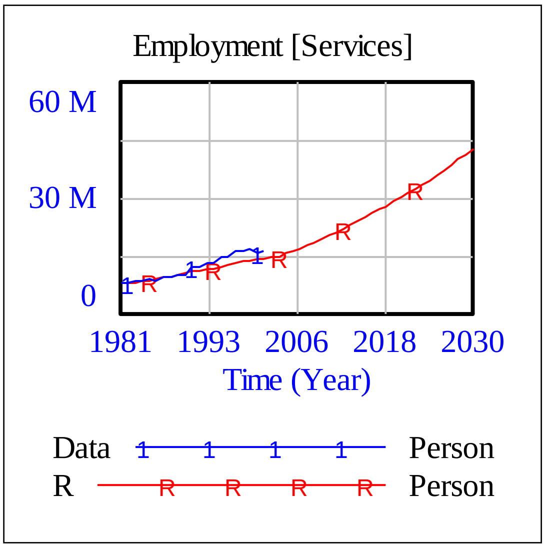

Real Sectoral Production [Agriculture]
600 B
300 B
0
1981
2006
2030
Time (Year)
Data Pkr81/Year
R Pkr81/Year


Employment [Agriculture]
40 M
20 M
0
1981
1993
2006
2018
2030
Time (Year)
Data Person
R Person


Real Sectoral Production [Industry]
1e+012
500 B
0
1981
2006
2030
Time (Year)
Data Pkr81/Year
R Pkr81/Year


Employment [Industry]
20 M
10 M
0
1981
1993
2006
2018
2030
Time (Year)
Data Person
R Person


Real Sectoral Production [Services]
4e+012
2e+012
0
1981
2006
2030
Time (Year)
Data Pkr81/Year
R Pkr81/Year


Employment [Services]
60 M
30 M
0
1981
1993
2006
2018
2030
Time (Year)
Data Person
R Person

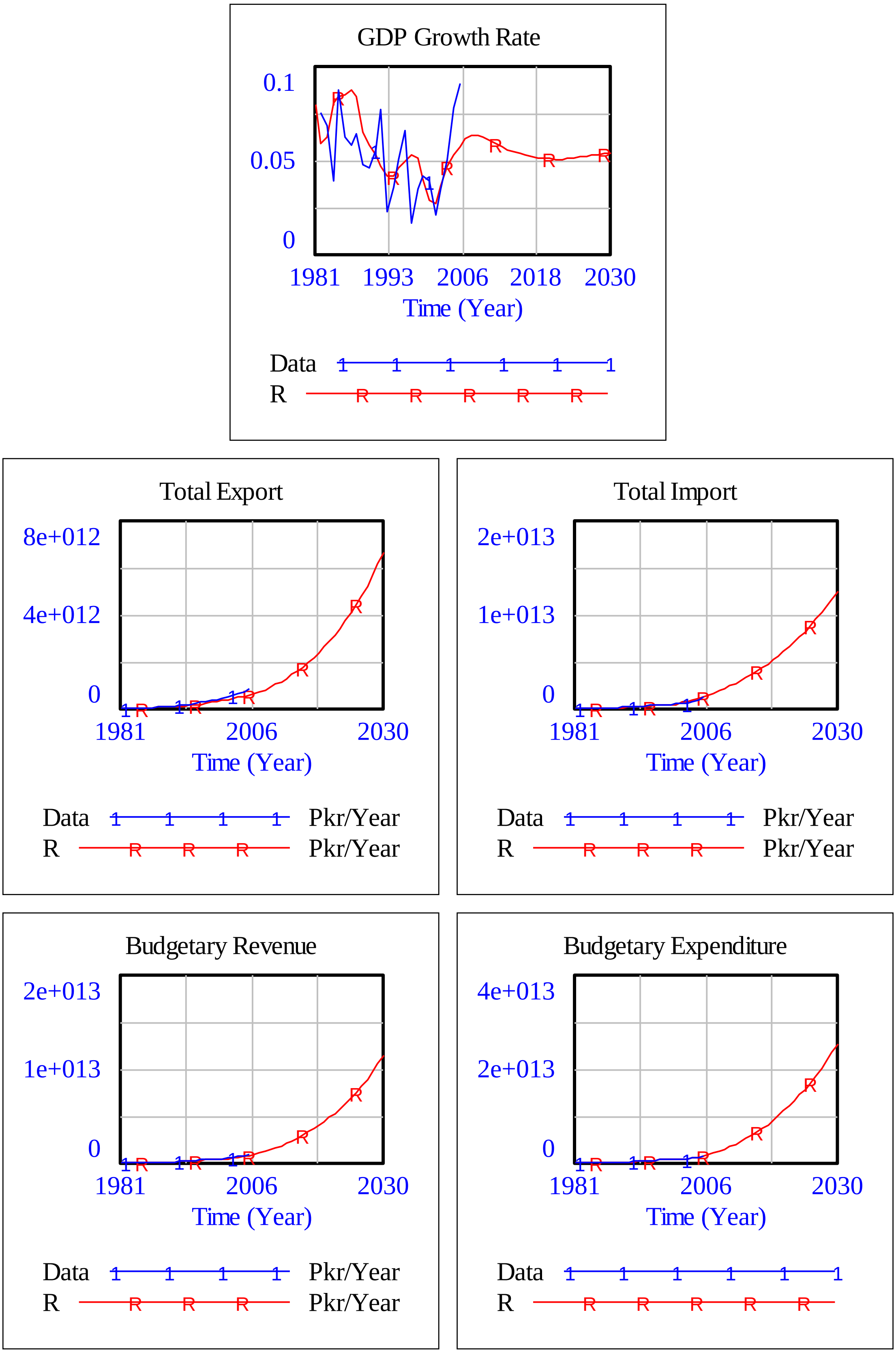


Figure 17. Economic Indicators

4.2. Model Validation

The validity of a model should be judged by its suitability for a particular purpose. A model is sound and defendable if it accomplishes what is expected of it . Further, SD models are causal models and should endogenously generate the right behavior for right reasons. The validity of SD models primarily means validity of its internal structure which comes from the descriptive knowledge about the system structure. Moreover, the comparison of the model behavior with the real system behavior portrays the behavioral validity .

The purpose of this model is to identify the system structure of human centered development in Pakistan and to suggest alternative macroeconomic policy framework for this purpose. The organic relationships found in the relevant theoretical and empirical literature described in section 3 above provide the logical grounding of our approach to model causal structure underlying each module as well as the two-way links among these modules. This furnishes the structural validity of the model. Further, the model formulations are dimensionally consistent, another validation measure . On the other hand, if the model output (*R*) corresponds with past development acceptably well, then some confidence may be attributed to its output. The section 4.1 suggests that the model simulation (*R*) very well tracks the important variables. Nevertheless, the system structure and the parameters; although stable in the past; may change in future and consequently may affect model validity. Considering the relevance of the causal relationships of the model and its ability to endogenously track the multi-layers of the data without involving any dummy variable, the model may be considered as 'valid' and a viable tool for exploring the response of a complex structure to different interventions.

5. Policy Design and Policy Analysis

It is commonly agreed that the real challenge for policymakers in a developing country context is to select the policies that are not only socially most desirable but also facilitate growth . Moreover, considering the erratic track record of socio-economic performance of Pakistan and its likely consequences, there is a need to identify a set of macroeconomic policies that facilitates improvement in HD in Pakistan without foregoing economic growth, which is the overriding policy objective for this study. For this purpose we will put forward few policy options and simulate the model to generate scenarios. We will compare the results of these scenarios with *'R'* and in this way *'refer back'* to *'R'* throughout the policy analysis. The following paragraphs discuss these two objectives, and we will compare *'R'* with model output of different policy runs in policy analysis section.

5.1. Policy Design

We identify public finance and international creditors as framework for the policy design. There are several policy options within this framework where the government can supply resources for its expenditure demands. The government generally considers the trade-off between costs and benefits associated with the supply and use of resources to take its budgetary decision. The objective of this policy design and analysis is to facilitate this budgetary decision which may promote human centered development without forgoing economic growth. On the supply side, review of relevant literature and the modeling process help identify the following four probable policy options to facilitate human centered development of Pakistan.

- **Policy 1: Increase government revenues**
  Under this policy we analyze the impact of increasing the government revenue, even though empirical literature suggests that despite measures taken by successive governments Pakistan has persistently low tax-GDP ratio . In a simplistic way to do this we increase budgetary revenue by 10% after year 2007, please refer to Figure 10, and label it the 'incremental budget'. Figure 11 indicates the implicit cost of this policy option. The increased budgetary revenue reduces disposable income of households leaving lesser to consume as well as to invest inversely affecting the

private investment and production in the country which further decreases disposable income next period resulting into a decrease in government revenue, *citrus paribus*.

- **Policy 2: Increase government budget through borrowing**
  This policy assumes that after year 2007 government raises the 'incremental budget' through borrowing. This incremental borrowing will increase government debt to increase its interest expenses next time around.

- **Policy 3: Capping the debt service**
  The continued inability of the Government of Pakistan to increase tax-GDP ratio and the probable risks generally associated with incremental borrowing indicate to another policy option; the international creditors allow capping the foreign debt service to the extent of 'incremental budget' per year which accumulates as a stock of frozen debt. We assume an average time of 20 years for the frozen debt to gradually become part of normal debt stock. As against the commonly recommended debt cancellation policy, this policy effectively requires two things from international creditors: one, deferring the current period liability; and two, not charging any interest on accumulated frozen debt. In other words there is no debt cancellation. This option provides cost free resource to the government.

- **Policy 4: Reduce general government expenditure**
  In this scenario we assume that the government is able to save the amount equivalent to 'incremental budget' from general government expenditure. We assume that the only cost associated with this option is the proportionate reduction in public investment and its consequent effect on production etc.

On the demand side there are four types of expenditure: the general government expenditure[19], interest expenditure, HD expenditure which includes education and health, and economic services and infrastructure expenditure. It is generally advocated that the general government expenditure may be reduced and as such we choose this as a policy option, Policy 4. Hence, the 'incremental budget' will neither be spent on the general government expenditure nor on the interest expenditure being endogenously determined. So we choose the following three policy options to expend the 'incremental budget' along with the normal budgetary expenditure which will be spent as in *'R'*. The benefits associated with these allocation decisions will be weighed against the costs associated with their supply side counterparts as a basis for budgetary decision.

- **Policy 5:** This policy assumes that the government maintains the current composition of expenditure of HD, and economic services and infrastructure for future.

- **Policy 6:** Spend entire 'incremental budget' on HD proportionately spending on education and health;

- **Policy 7:** Expend the 'incremental budget' proportionately on economic services and infrastructure.

Different combinations of two dimensional policy options determine policy design, as presented in Table 4. We simulate the model independently under each of these policy scenarios, *citrus paribus*. We will compare and analyze the behavior of different variables of interest with their behavior under reference scenario *'R'* in the following paragraphs.

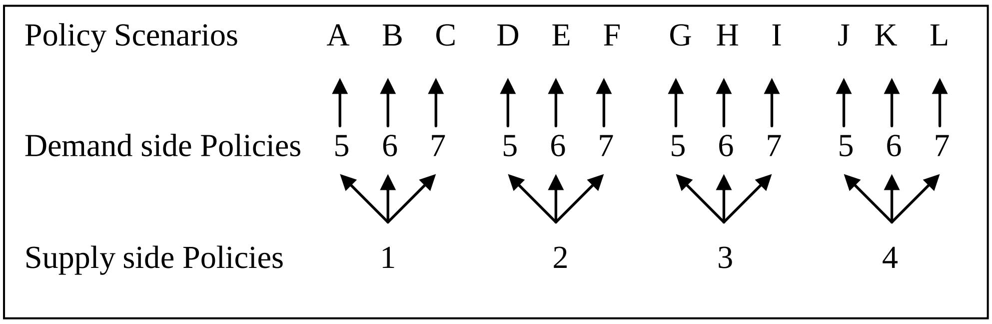


Figure 18. Policy Design

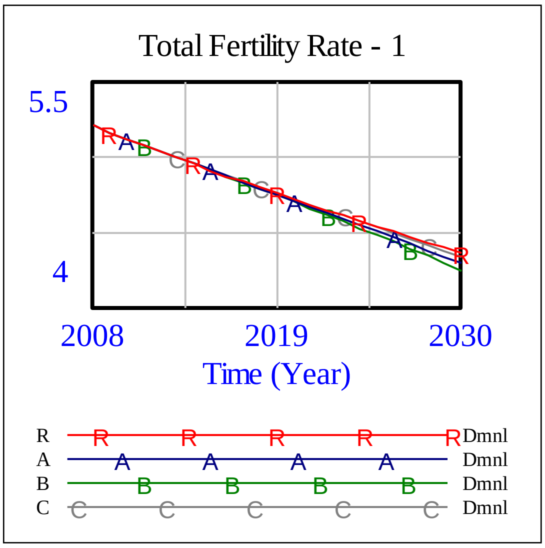
5.2. Policy Analysis

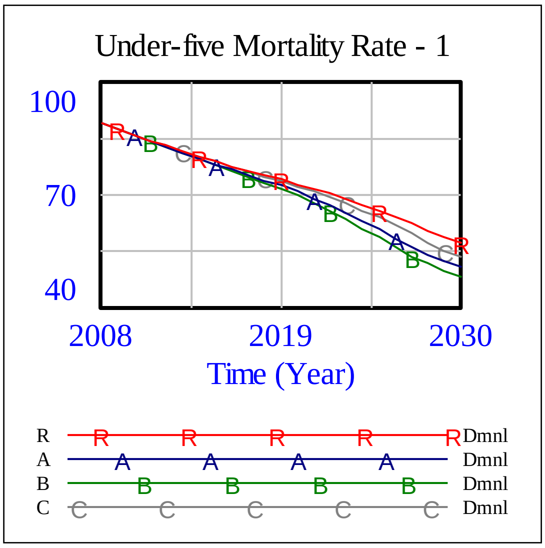
Different policies will produce different outcomes over time. The desirability of a policy will depend on its implications (over time) for the state of HD and the economy reflected by certain relevant indicators. The following paragraphs discuss the behavioral outcomes of the policy scenarios painted in Figure 18.

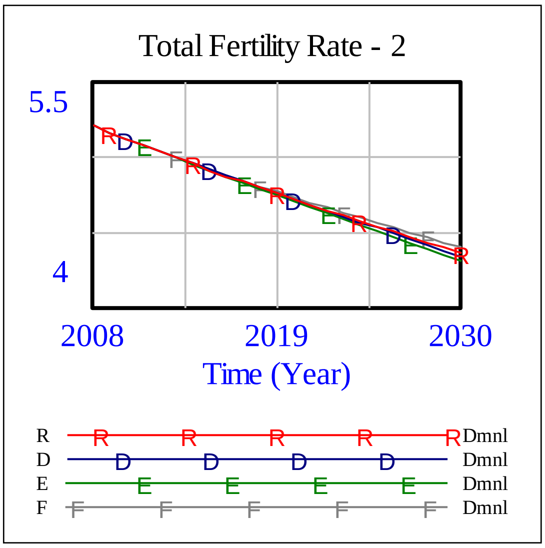
5.2.1. The Demographic Indicators

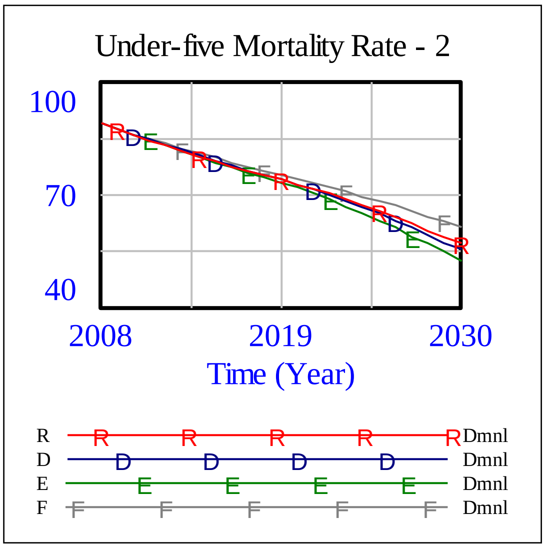
The policy experimentations suggest that the size of total population, being quite difficult to change with small interventions like these, is not likely to change under all scenarios vis-à-vis *'R'*. Nevertheless, the declining trend in total fertility rate (*TFR*) suggests that development of population is in right direction. The decrease in population achieved from decline in *TFR* balances the increase in population due to decrease in death rate and consequent increase in life expectancy, resulting into improved quality of life. The declining trend in *TFR* continues under all scenarios including *'R'* indicating the capability of these policy frameworks to keep *TFR* in desired direction, Figure 19(1-4). As the behavior of the system is an outcome of its structure so referring back to the system structure in Figure 4, which considers income, adult literacy and under-five mortality rate (*U5MR*) as determinants of *TFR*. Moreover, it considers income, female literacy and average access to basic healthcare as the determinants of *U5MR*. In total we may state that income and HD are determinants of *TFR* and *U5MR* and these two; *TFR* and *U5MR*; are mutually reinforcing. The observation of Figure 19(1-4 & a) indicates the following:

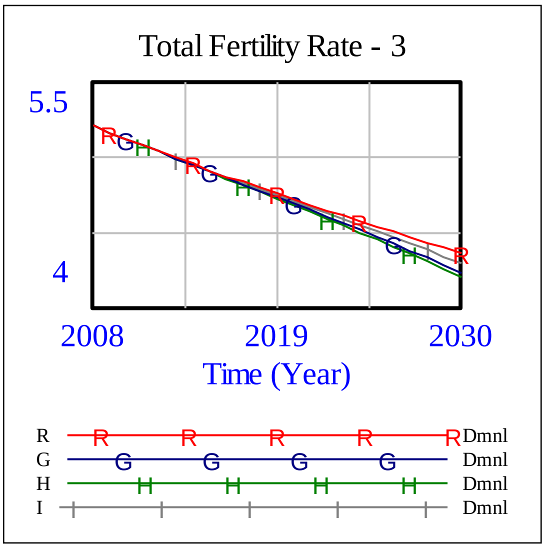
a. All scenarios except F perform better to control *TFR* and *U5MR* vis-à-vis *'R'*, Figure 19(2). This suggests that increased spending on economic services and infrastructure raised through borrowing may deteriorate *TFR* and *U5MR* vis-à-vis *'R'*. This may partially explain why Pakistan had relatively high *TFR* and *U5MR* in past when borrowed funds were utilized for economic growth by ignoring HD and suggests not raise additional borrowing for economic services and infrastructure in future.
b. The demand side Policy 6 which entails allocation of entire 'incremental budget' to HD is relatively more effective as compared to the other two competing policies. This finding suggests that increased allocation of public finance to HD helps to better control *TFR* and *U5MR*.
c. For the supply side policies, Figure 19(a), compares the best scenarios of Figure 19(1-4) and indicates that Scenario H, a combination of Policy 6 and 3, is the most effective. The reason is the cost free availability of the required resource, without squeezing the household income and government expenditure.

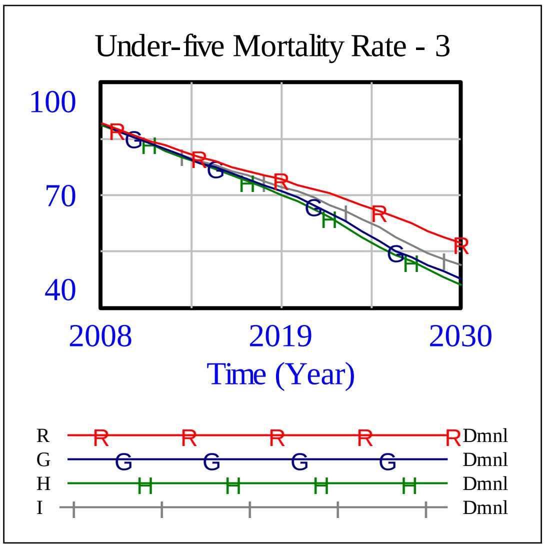

Total Fertility Rate - 1
5.5
4
2008
2019
2030
Time (Year)
R Dmnl
A Dmnl
B Dmnl
C Dmnl


Under-five Mortality Rate - 1
100
70
40
2008
2019
2030
Time (Year)
R Dmnl
A Dmnl
B Dmnl
C Dmnl


Total Fertility Rate - 2
5.5
4
2008
2019
2030
Time (Year)
R Dmnl
D Dmnl
E Dmnl
F Dmnl


Under-five Mortality Rate - 2
100
70
40
2008
2019
2030
Time (Year)
R Dmnl
D Dmnl
E Dmnl
F Dmnl


Total Fertility Rate - 3
5.5
4
2008
2019
2030
Time (Year)
R Dmnl
G Dmnl
H Dmnl
I Dmnl


Under-five Mortality Rate - 3
100
70
40
2008
2019
2030
Time (Year)
R Dmnl
G Dmnl
H Dmnl
I Dmnl

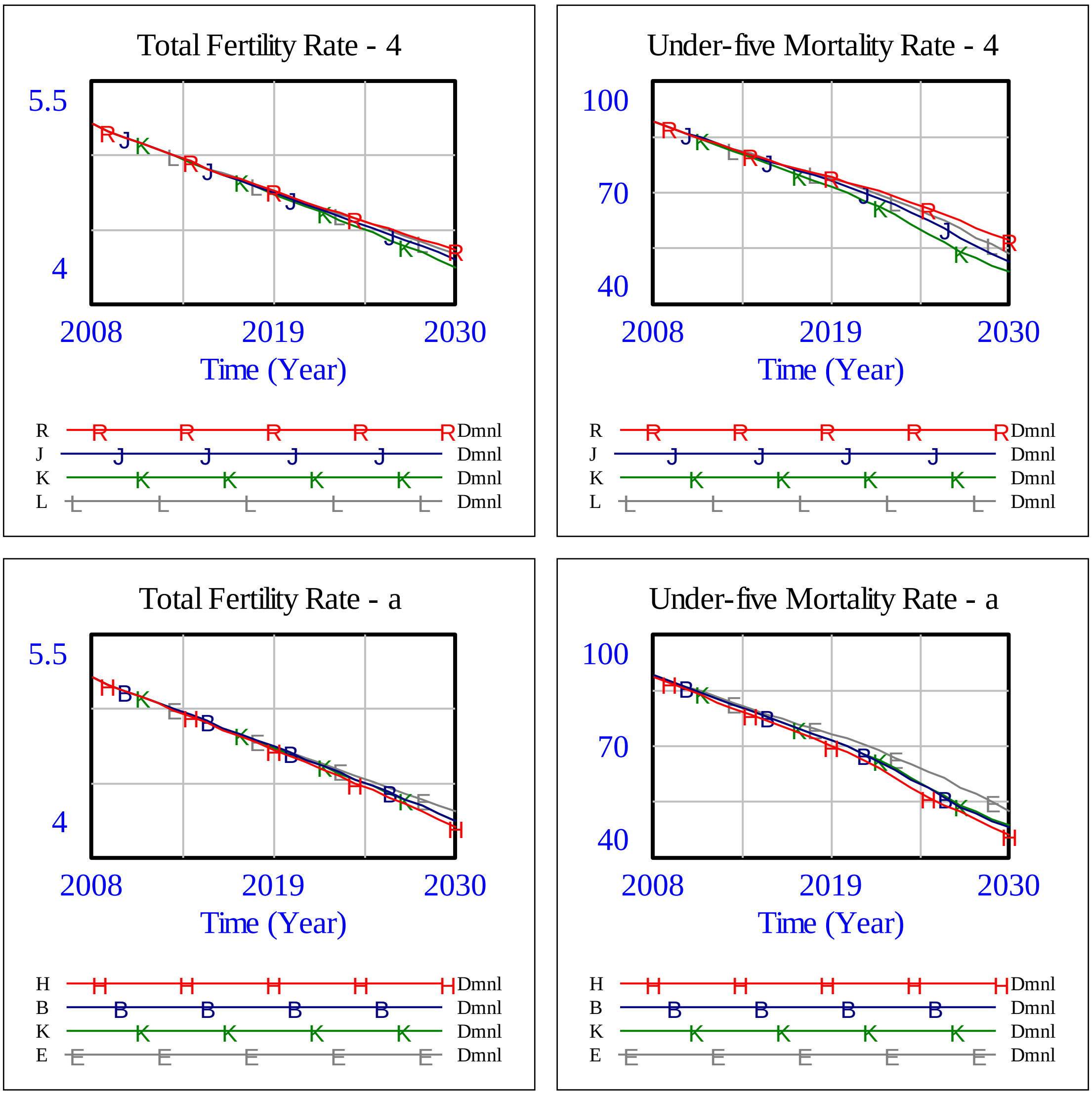


Figure 19: Fertility and Mortality Indicators under all Policy Scenarios

We find that of the two determinants of the fertility and mortality indicators; income and HD; latter has relatively stronger impact and in our view it may get precedence over income while designing macro policies for Pakistan. Further we observe similar outcomes, as in Figure 19, in crude birth rate and crude death rate with the trend being more pronounced in the latter. The increased budget improves life for the population, except under Scenario F, which is also indicated in Figure 19 and consequently we observe increase in life expectancy, Figure 20. These observations have two implications for Pakistan to improve the quality of life for its people: First, there is a need to mobilize cost effective resource generation including non-traditional resources with the sequential ranking as debt service cap, increasing government revenue, a cut on general government expenditure, and the additional debt being the last option; Second, for allocation of public finance especially additional resources priority is to be given to HD and not the economic services and infrastructure.

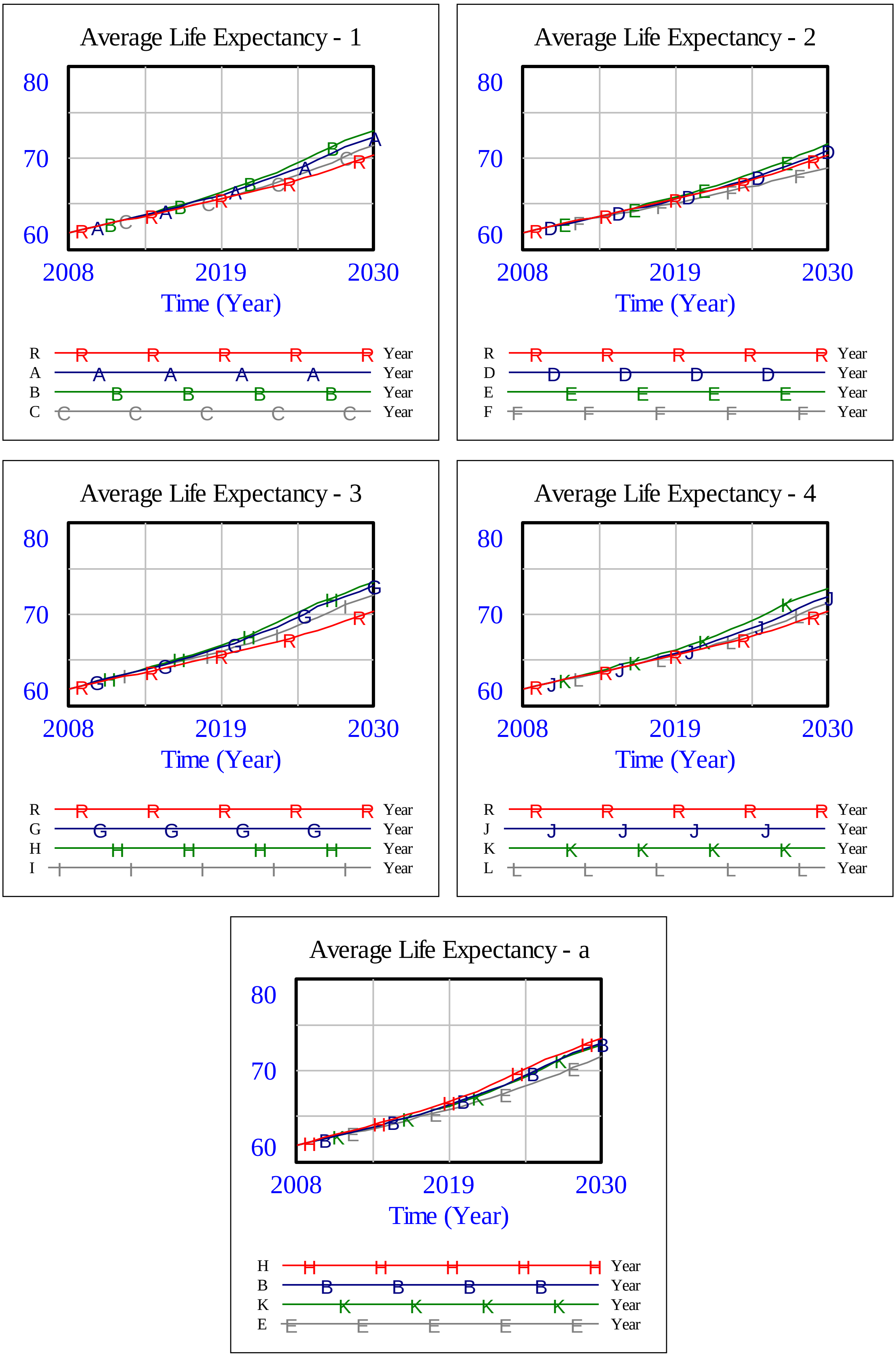
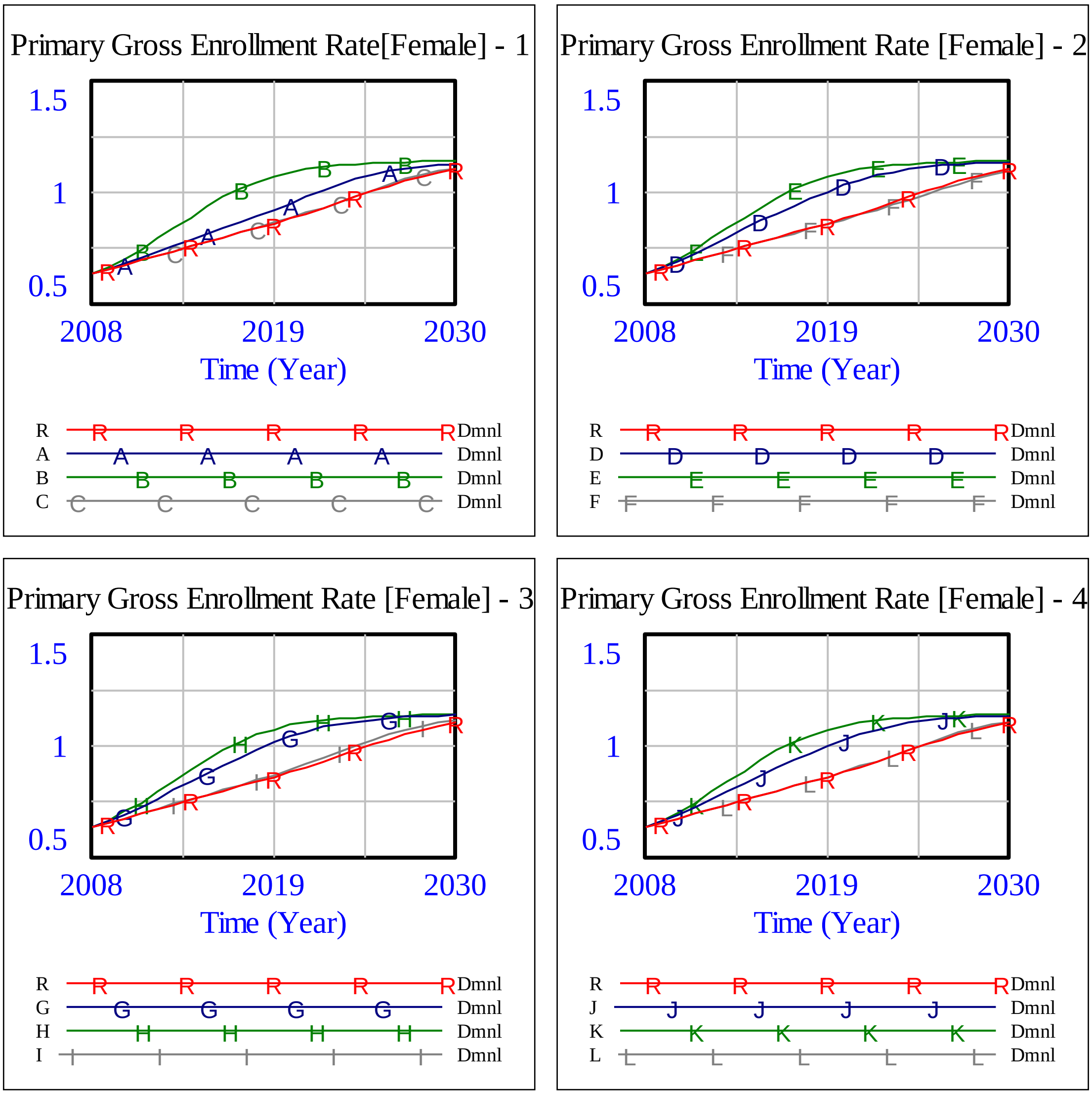
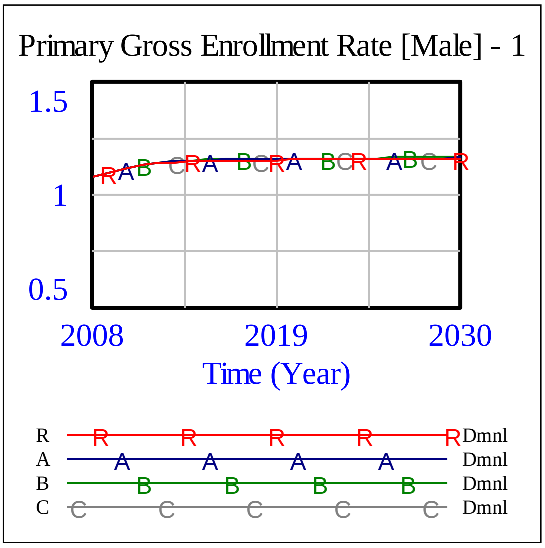


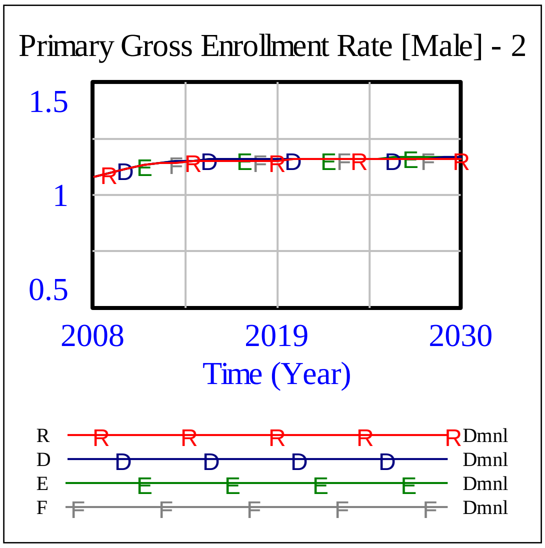
Figure 20: Average Life Expectancy under all Policy Scenarios

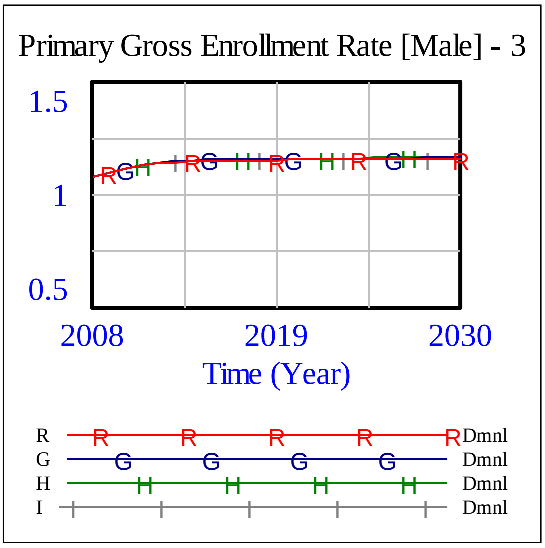
5.2.2. The Human Development Indicators

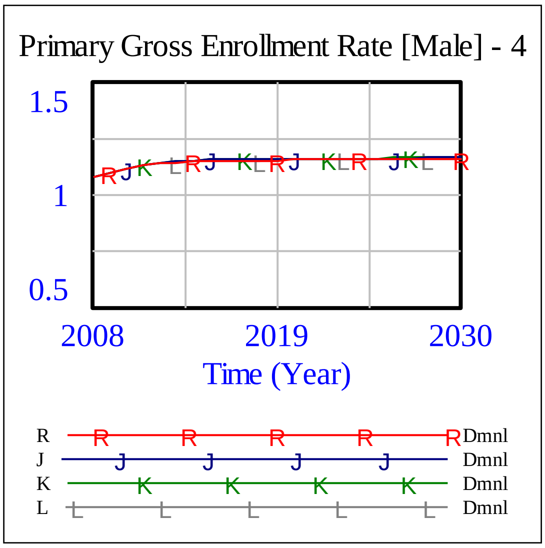
We observe a gradual improvement over time in education sector under all scenarios including *'R'*. Ironically there is no differential impact of Policy 7, which assumes allocation of entire ‘incremental budget’ to infrastructure and economic services, vis-à-vis *‘R’* on gross enrollment rate at all levels in education sector and hence the following paragraphs will not discuss this policy. This finding however, suggests that there may not be any *‘trickle down effect’* of public spending on economic growth confirming earlier observations in this context . On the other hand in primary education, Figure 21,we observe a quick and sizeable increase in primary gross enrollment rate for female if the ‘incremental budget’ is allocated to HD followed by the allocation to the current composition of public expenditure. But we do not observe any improvement in gross enrollment rate of male students due to supply saturation. Moreover Figure 21 indicates that along with the allocation composition, the source of ‘incremental budget’ may also have implications for gross enrollment rate for female; however, it also indicates a governance issue. Primary gross enrollment rate[20] may not be more than 1 in an efficient system and the value higher than 1 indicates that students are on the average staying more than 1 year in a grade, which is estimated at 1.2 years in Table 2, and needs improvement. The simulation experiments also yield similar outcomes for adult literacy rate, but the Figure 21 also indicates to another governance issue. Even though gross enrollment rate for male students saturates quite earlier on, Pakistan may not be able to achieve 100% adult literacy for males. The reason for this is the school dropouts who leave the education system rather permanently which needs to be addressed.

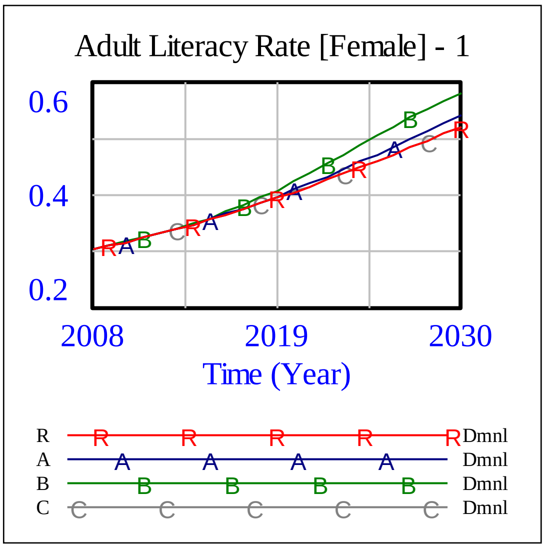


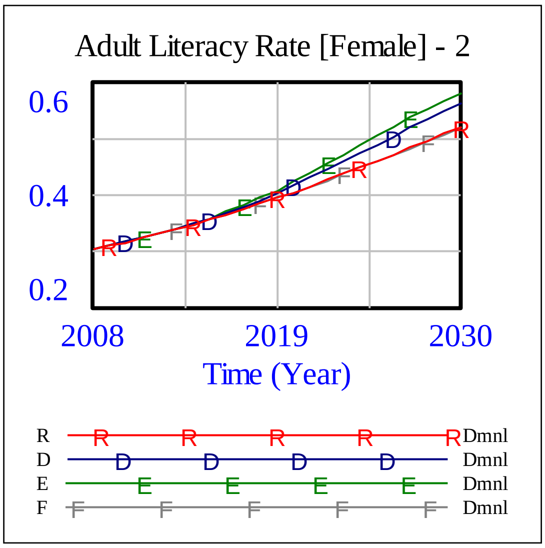

Primary Gross Enrollment Rate [Male] - 1
1.5
1
0.5
2008
2019
2030
Time (Year)
R Dmnl
A Dmnl
B Dmnl
C Dmnl


Primary Gross Enrollment Rate [Male] - 2
1.5
1
0.5
2008
2019
2030
Time (Year)
R Dmnl
D Dmnl
E Dmnl
F Dmnl


Primary Gross Enrollment Rate [Male] - 3
1.5
1
0.5
2008
2019
2030
Time (Year)
R Dmnl
G Dmnl
H Dmnl
I Dmnl


Primary Gross Enrollment Rate [Male] - 4
1.5
1
0.5
2008
2019
2030
Time (Year)
R Dmnl
J Dmnl
K Dmnl
L Dmnl


Adult Literacy Rate [Female] - 1
0.6
0.4
0.2
2008
2019
2030
Time (Year)
R Dmnl
A Dmnl
B Dmnl
C Dmnl


Adult Literacy Rate [Female] - 2
0.6
0.4
0.2
2008
2019
2030
Time (Year)
R Dmnl
D Dmnl
E Dmnl
F Dmnl

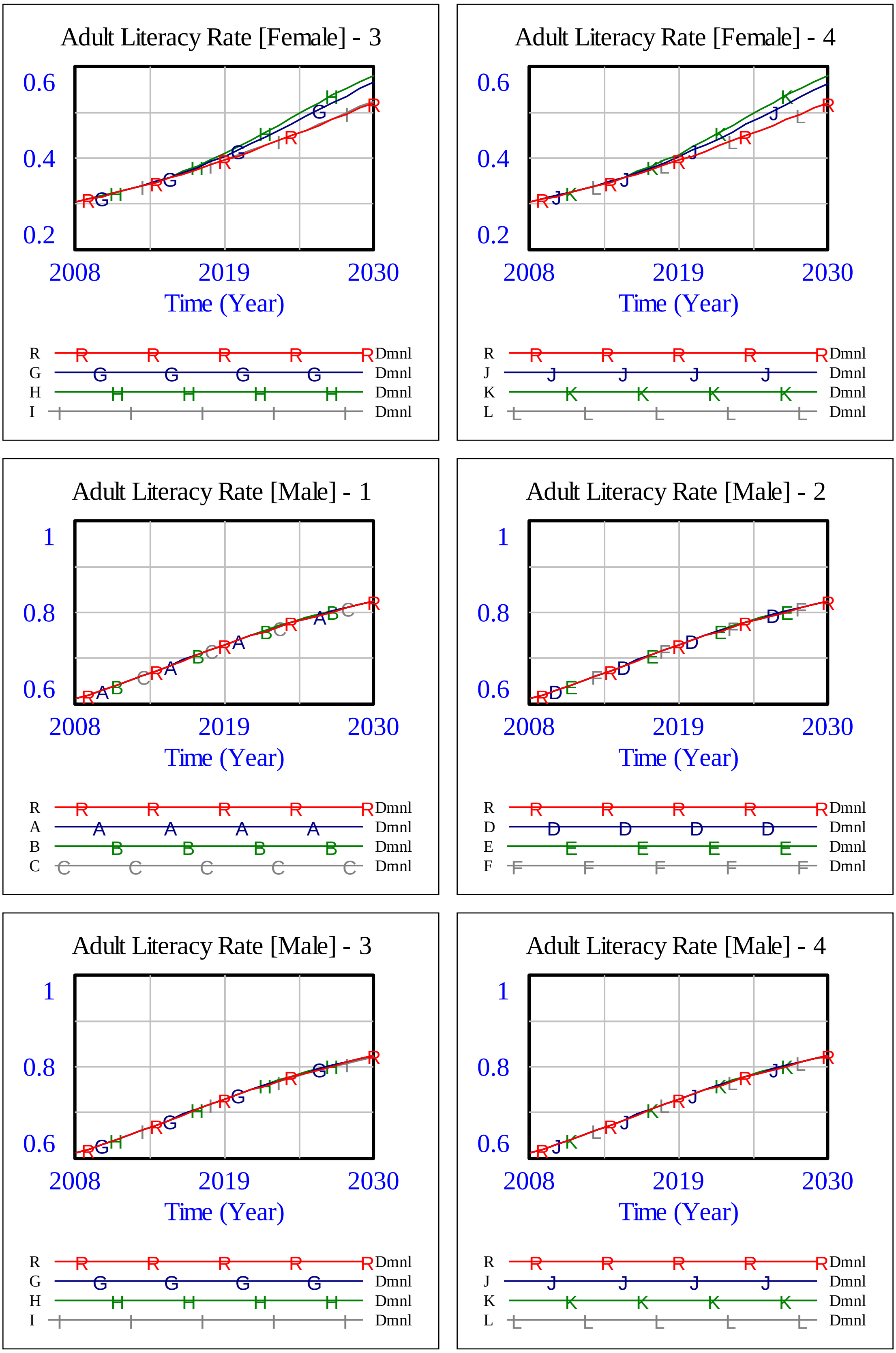


Figure 21: Primary Enrollment Rate and Adult Literacy Rate under all Policy Scenarios

In secondary education, Figure 22, we observe a little gain in gross enrollment rate for male students and relatively large gain for female students. However, in no case this rate reaches the desired level of 100% for any of the two genders. This indicates that even though Pakistan may achieve 100% primary gross enrollment rate but may not achieve 100% secondary gross enrollment rate by 2030. On the average secondary students also stay more than one year and many of the primary graduates leave the education system. Considering the role of human capital to improve productivity , this may have strong implications for long-term human centered macroeconomic planning. Improving efficiency of education system and bringing all primary graduates into the education system indicate high leverage points of policy intervention for policy makers to improve state of basic education in Pakistan.

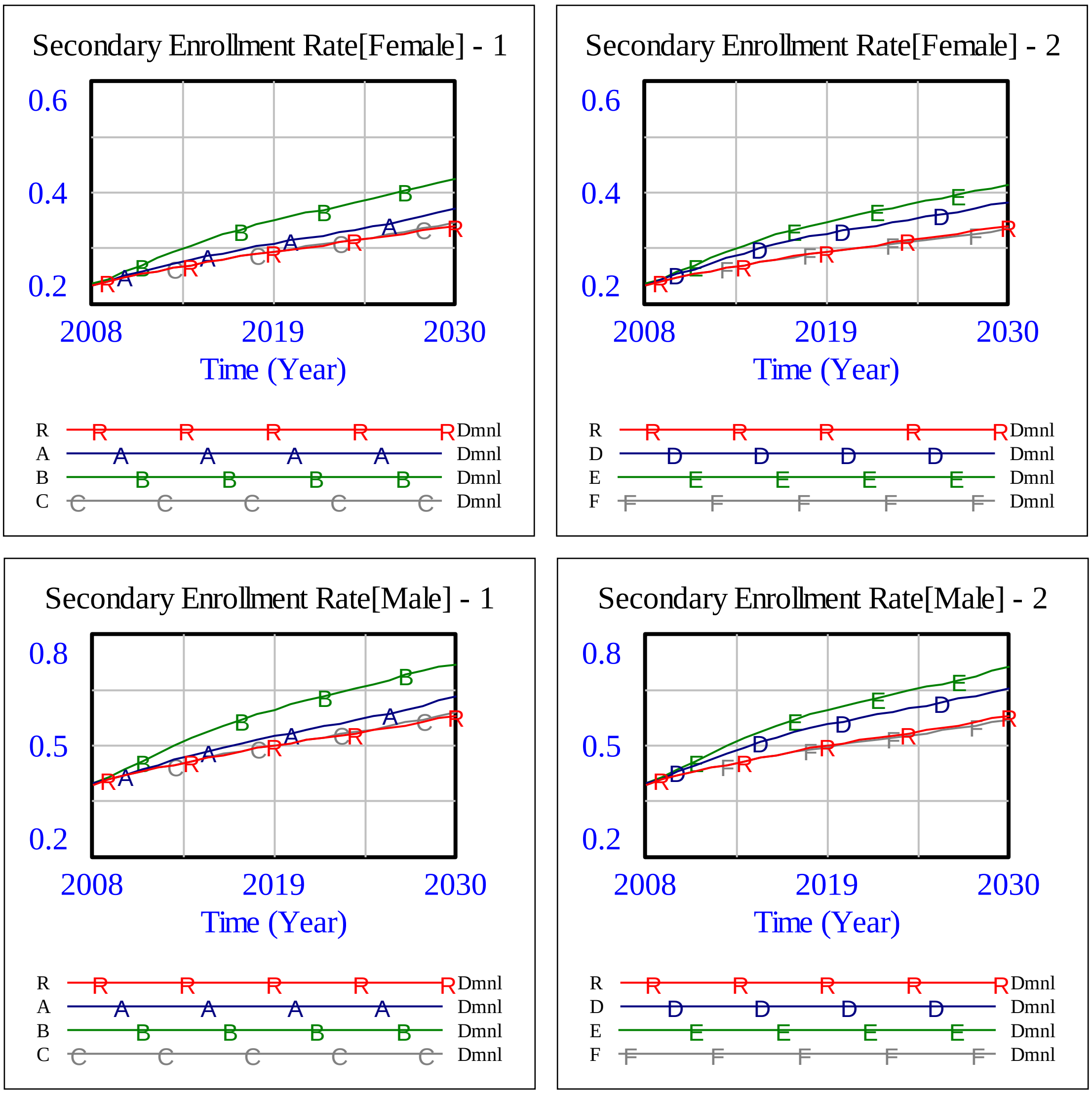
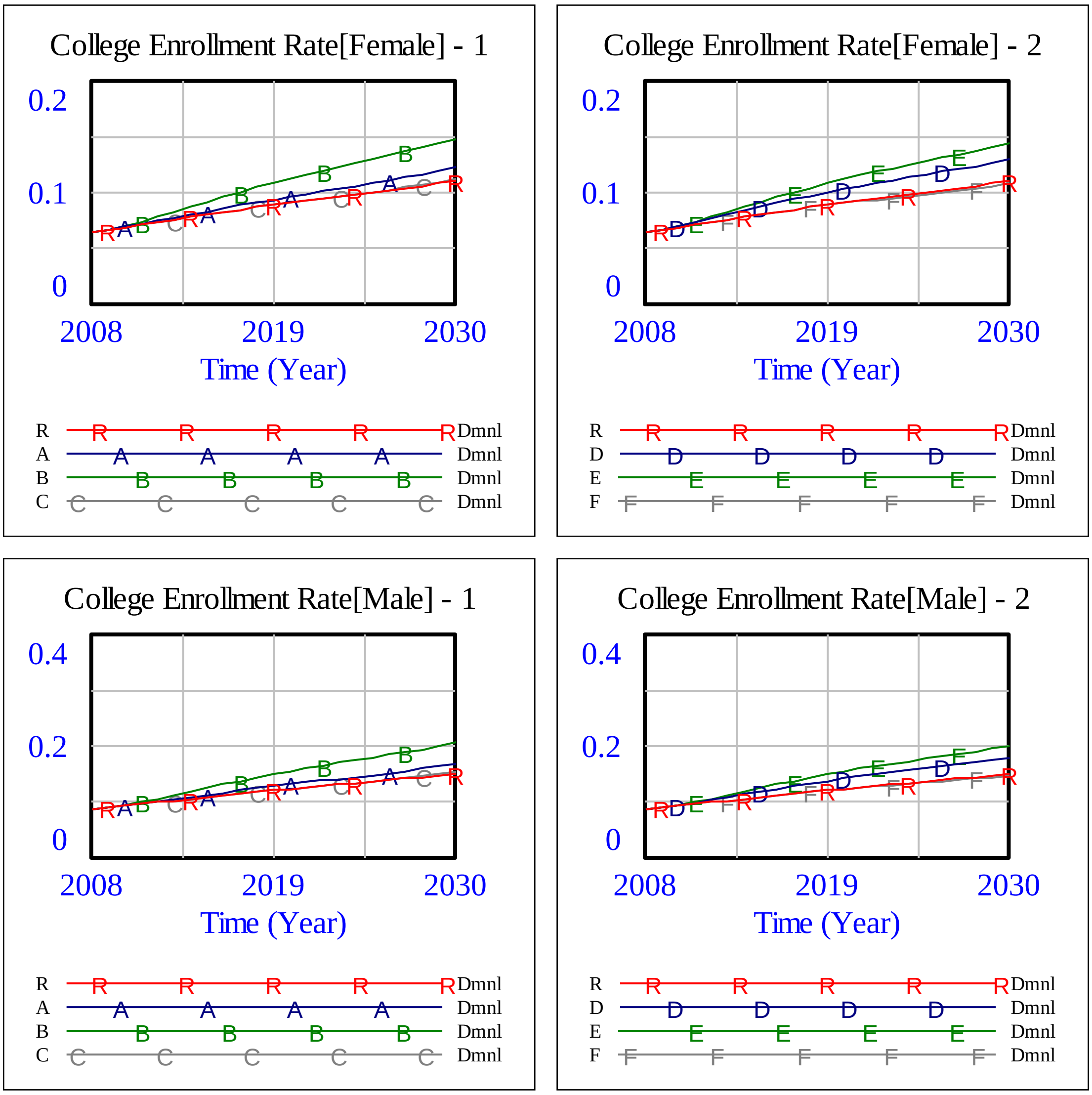


Figure 22: Secondary Enrollment Rate under all Policy Scenarios

The increased budget has almost same implications for the gross enrollment rate of the two genders but again a sizeable number of secondary graduates never enter college education. Poor initial conditions coupled with low input from college keeps university gross enrollment rate dangerously low. These low enrollment rates indicate that only increasing the overall budget by 10% may not bring much improvement in education related HD indicators but along with a sizeable budgetary increase it may require some qualitative measures related with culture and governance where the people and policy makers alike are given to understand the importance of education for a balanced socio-economic development of Pakistan. Moreover, the chain structure of education also highlights the need for rather added focus of policy makers on primary and secondary education being the foundation blocks of whole educational system.

Further, we observe only a nominal increase in health related HD indicators; doctors per 1000 people and hospital beds per 1000 people; if entire ‘incremental budget’ is spent on HD. As discussed in section 4.1.2, spending on the health budget since mid 1990’s has never been in such a proportion that could have provided increased hospital infrastructure per 1000 people resulting into its continuing gradual decline. We consider it important to increase health spending, beyond what we consider in this policy design, to make available more hospital infrastructure for people of Pakistan to increase access to basic healthcare.



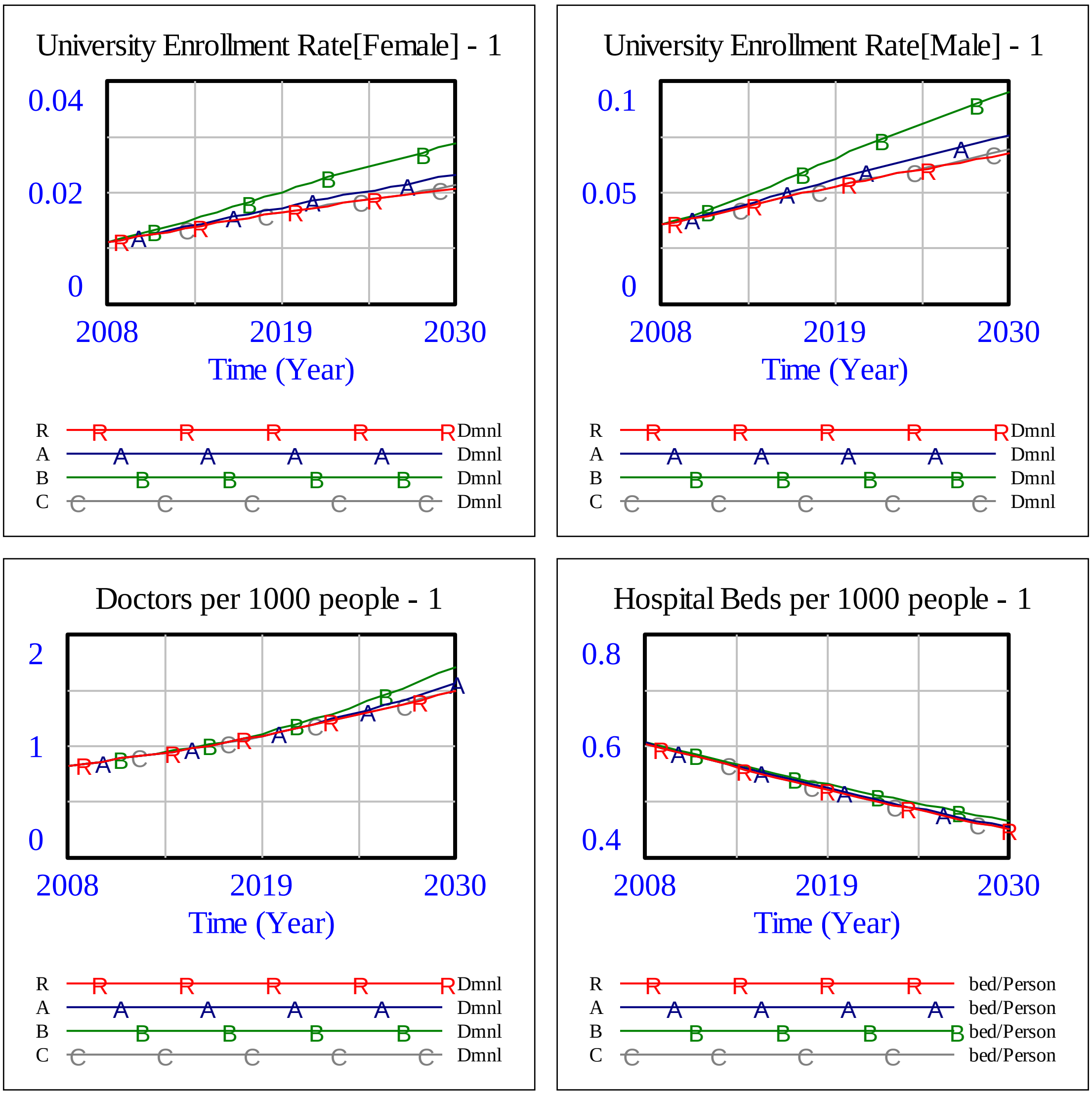
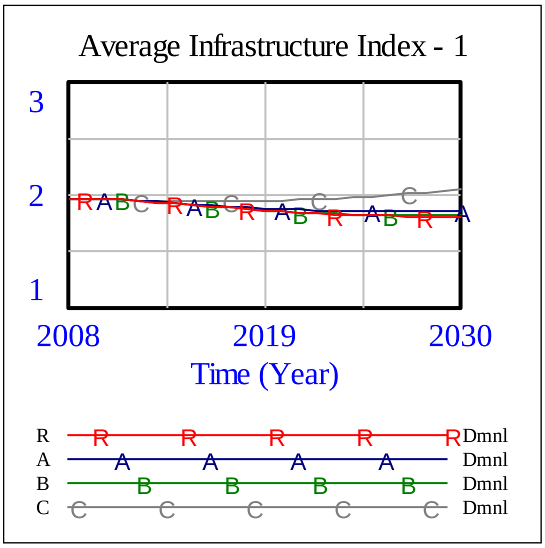


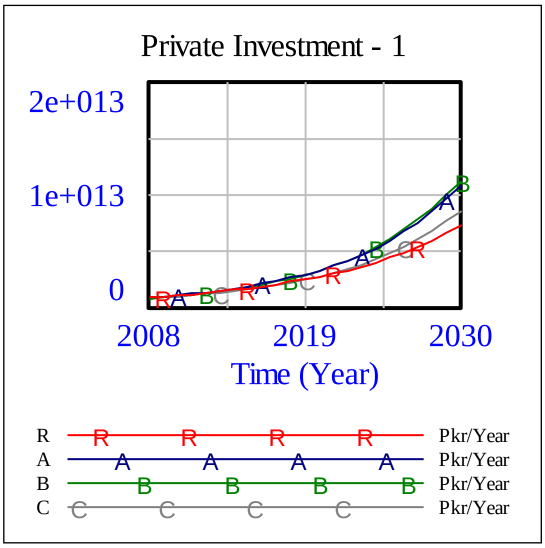
Figure 23: Tertiary Education and Access to Healthcare Indicators under all Policy Scenarios

The socio-economic importance of education and access to healthcare is unquestioned. The provision of basic education and healthcare is both an individual and public investment, as well as one of the core responsibilities of the state. However in a country like Pakistan where more than one third of the population lives below poverty line, the government cannot abdicate all responsibility by making these services available in the market through private sector for those who could buy it. State intervention is therefore considered mandatory. For this purpose, the above discussion makes out the need for increased resource allocation to HD and in this context it identifies the role of international creditors to allow capping the foreign debt service, the need to increase government revenues, and to economize on government expenditure. The above policy experimentations establish that the investment so made in HD by Pakistan (the public sector) will improve the quality of life for its citizens especially the females. Over and above the public finances, we also identify the need to focus on the qualitative aspects as to bring into all those who leave the educational system, and to improve the efficiency of educational system.

5.2.3. The Economic Indicators

It is commonly argued that having infrastructure promotes investment in the country. This argument usually ignores the role of human capital in this process. The simulation outcomes, Figure 24(1-4), indicate that infrastructure may be a necessary but not the sufficient condition to promote investment in the country rather it indicates that human capital has complimentary role along with infrastructure to attract investment in the country. Increasing government revenue necessitates increasing taxes leaving lesser disposable income with the households and possibly less private domestic investment - a common perception about the inverse relationship of taxation and investment, which ignores the feedback relationship. Figure 24(1), however, points out an interesting finding that increasing revenue by increasing taxes will improve investment in the country which is quite contradictory to the common perception which is an outcome of the feedback relationship considered in Figure 10 and 13. As a result of increased revenue, *citrus paribus*, government is required to raise lesser debt; both domestic and foreign. Lesser domestic financing means more funds available for private domestic investment, Figure 24(1). Conversely, if the government generates the 'incremental budget' by borrowing, Figure 24(2), it leaves lesser funds available for private domestic investment if it borrows in domestic market and thus we observe *'crowding out'* of private investment. Figure 24(2) further suggests that borrowing in domestic market not only *'crowds out'* private investment but investing borrowed resource in infrastructure and economic services further discourages private investment. Figure 24(3) indicates that capping the debt service and investing the resource so generated in HD or as per current composition also reinforces private investment. Figure 24(4) indicates a slow down in private investment if the amount saved from general government expenditure is invested in infrastructure and economic services or is invested under the current composition, but its investment in HD attracts higher private investment. However, these observations are qualified with the fact that we assume effective utilization of the resources and indicate to the improvement of fiscal governance in Pakistan. The above observations have strong implications for policy makers in Pakistan. Moreover, Pakistan needs to reduce domestic borrowing to promote private domestic investment as such borrowing as well as government investment in infrastructure and economic services of borrowed funds may be detrimental to private investment in the country. The policy implication for the public finance managers in Pakistan is that they should not divert and/or dilute scarce public finances by investing in infrastructure and economic services which discourages private investment in the country. The government role in these avenues may be reduced which may be effectively filled in by private sector under an effective governance structure of the government. The public finances so set free may be utilized to promote HD, by improving education and basic health services in the country, where it may not be profitable for the private sector to operate and may not be affordable by a dominant majority of the people to avail.





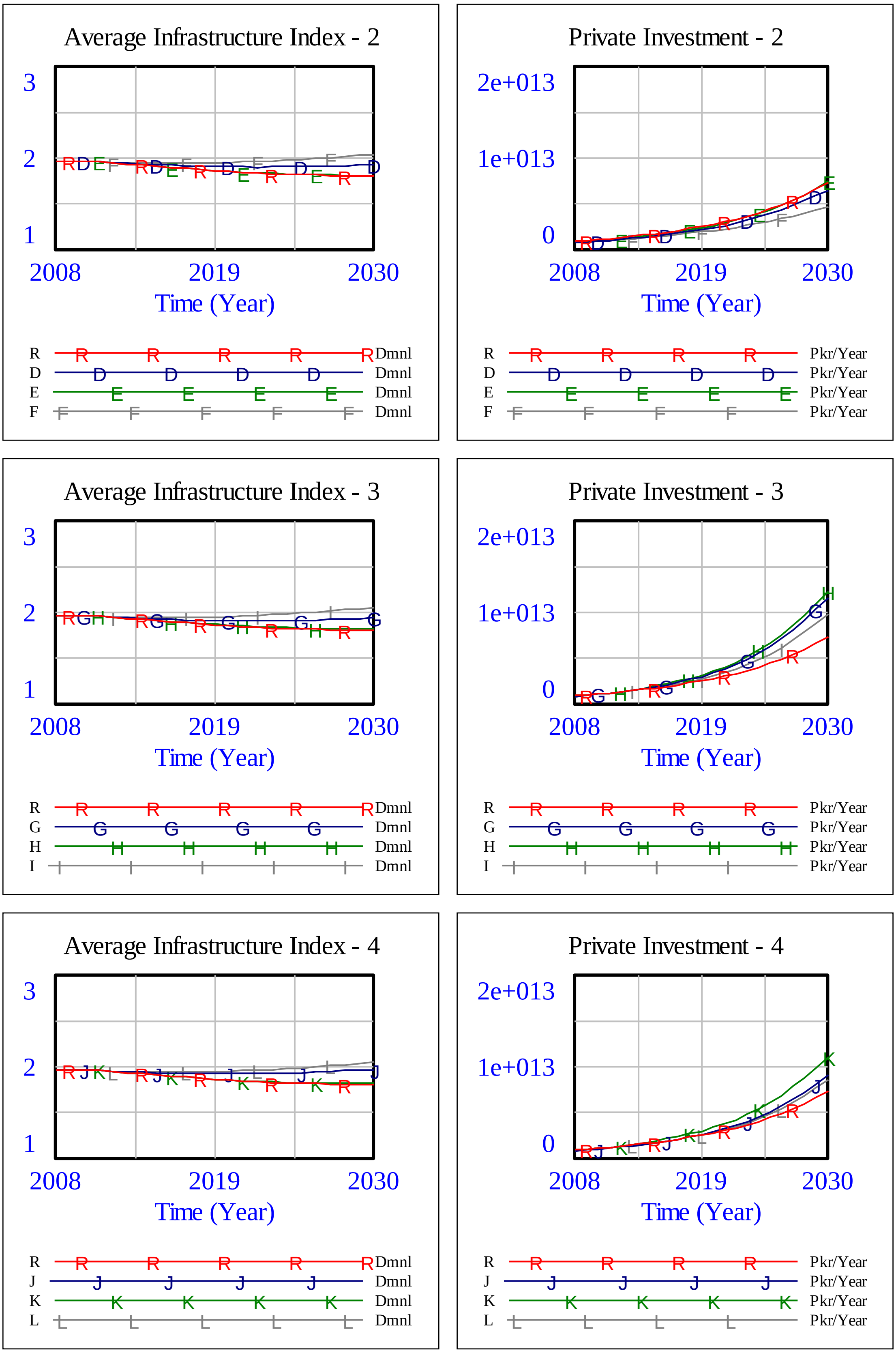
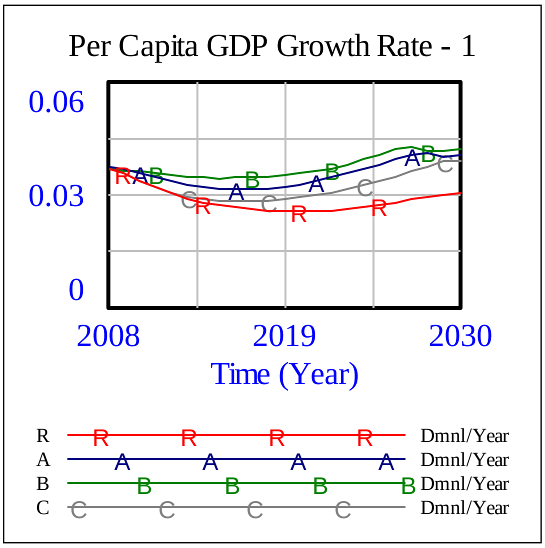
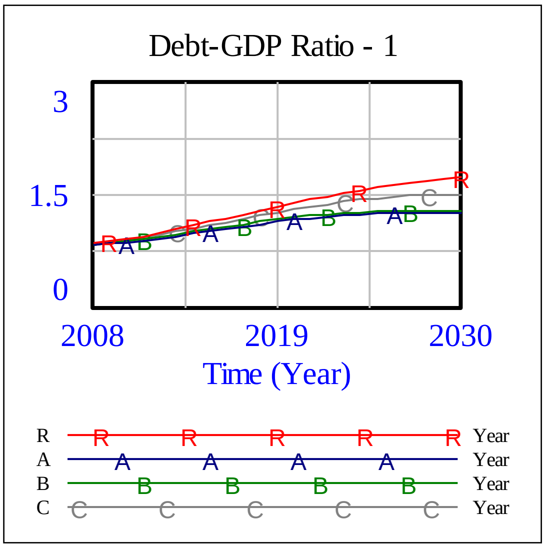
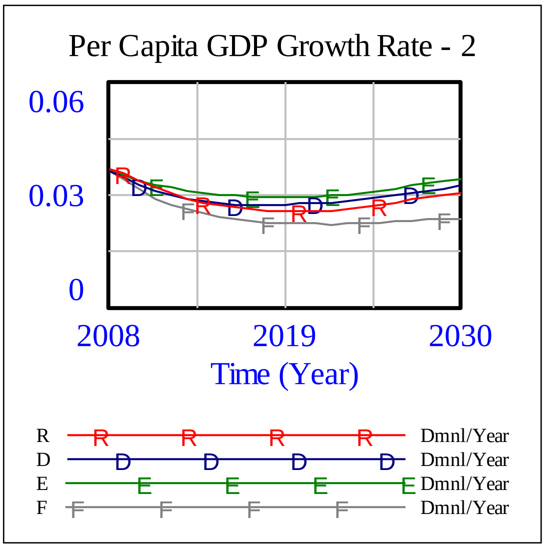


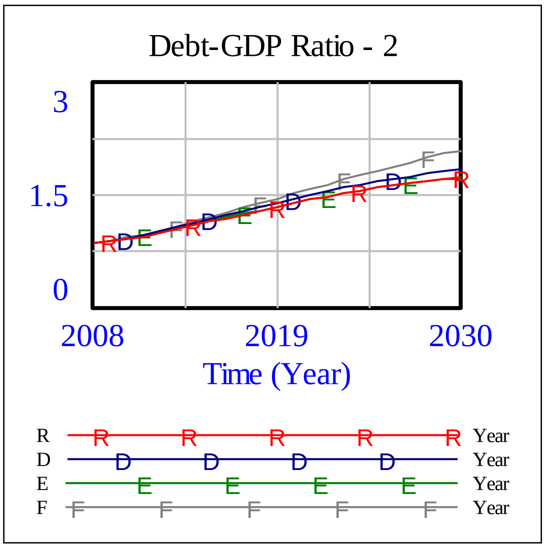
Figure 24. Infrastructure and Private Investment under all Policy Scenarios

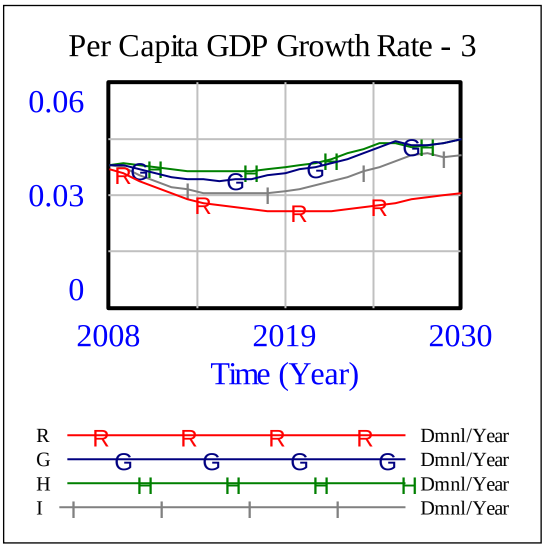
It is generally agreed that the role of investment, private as well as public[21], in the country is to promote its GDP. In this context the public finance policy may be preferred which not only provides better per capita GDP growth rate but also leaves lesser debt burden on the country, Debt-GDP ratio. Figure 25(1-4) demonstrates that Policy 6 outperforms the other two competing policies 5 and 7 in terms of per capita GDP growth rate as well as Debt-GDP Ratio. This finding has implication for the policy makers, who have been consistently ignoring HD in favor of economic services and infrastructure development , to reconsider their policy framework to make it tilted in favor of HD.

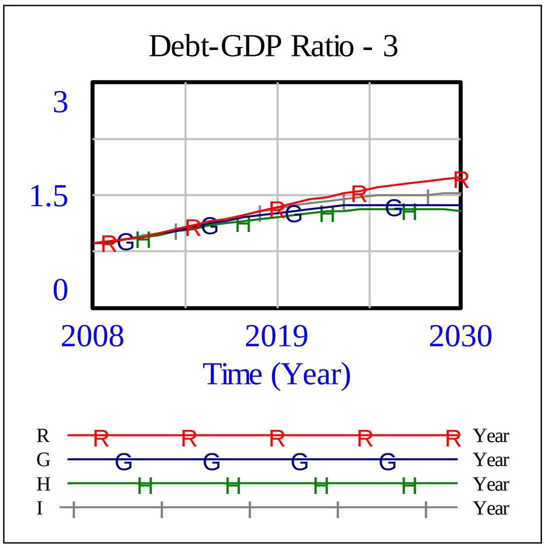












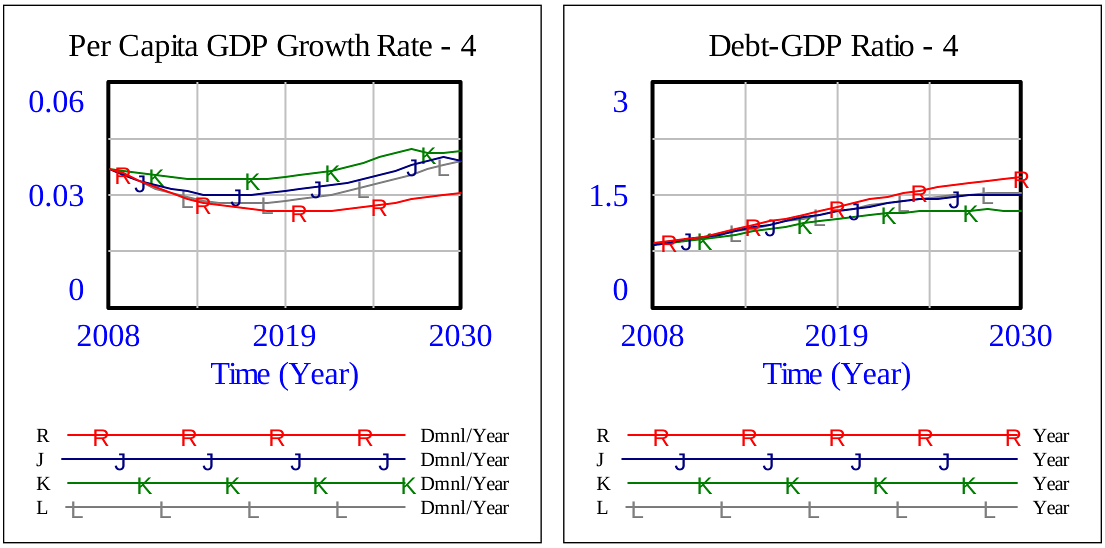


Figure 25: Economic Indicators under all Policy Scenarios

6. Conclusions and Policy Implications

Sustainable national development must achieve not only the minimum civic facilities for the citizens but also create a resilient and self-reliant economy. The planning objective must be specified not simply in economic terms but in terms of specific quality of life targets. The trend in many of economic and social indicators of Pakistan is not encouraging. If the goal of national policies is to improve the human condition, then the policies of the successive governments in Pakistan have failed.

Better understanding of the system structure of the economy of Pakistan and origins of the economic crises faced by her are the key to formulate workable policies. It is observed that the conventional economic policies are no longer helpful and that many of the economic difficulties are rooted in the improper use of the resource base. Although the formulation of national policies that will put Pakistan on a human centered development path is over ambitious, yet this study is an effort to better conceptualize the underlying system structure to bring in a broad-based improvement in the human condition without forgoing economic growth.

The policy experimentations highlight the need to mobilize cost effective resource generation including non-traditional resources with the sequential ranking as debt service cap, increasing government revenue, a cut on general government expenditure, and the additional debt being only the last option and not a quick fix. On the other hand simulation outputs suggest that for allocation of public finance especially additional resources priority is to be given to HD and not the economic services and infrastructure confirming that HD and EG are interdependent and intertwined in feedback processes which are mutually reinforcing and HD is not only an end in itself but the simulations confirm that it is a means to achieve higher productivity as well. This challenges the very basis of continued disregard of HD by public finance managers of Pakistan.

7. Limitations of the study and suggestions for future research

The causal structure of the model gets its grounding in the relevant theoretical and empirical literature. Moreover, it has its own assumptions including but not limited to its boundary assumptions. While doing so the model not only assumes the limitations of this literature but also its independent assumptions are prone to limitations. Thus the model contains an element of randomness which can be reduced but not eliminated. On the other hand, all economic data we use for parameter estimations, even though taken from commonly utilized data sources for such a study, is subject to its relevant limitations and consequent implications. Hence, these limitations imply that the results of the model simulations should be interpreted as indicating the probable direction and intensity of the effects of different planned changes in the structure of the economy or policy scenarios. They are, at best, conditional forecasts, but they should not be taken as exact predictions. Moreover, these projections become less and less accurate over time.

We consider this model as a template national model developed within consistency framework of SNA and SAM. We intend to develop SNA-type consistent accounts for each of the four provinces of Pakistan and use those accounts and this template to develop macro model for each province and use that output to put forward alternative policy framework for a balanced regional development in Pakistan to better address social, economic and political problems emanating from the current asymmetric development. We are in the process of modeling the system structure of production and trade of food in Pakistan to address the critical food security issue facing Pakistan – the four provinces. These two future research projects will build on this work.

References:

Agénor, Pierre-Richard. "Fiscal Policy and Endogenous Growth with Public Infrastructure." *Centre for Growth and Business Cycle Research, Economic Studies, University of Manchester, Manchester, M13 9PL, UK* Discussion Paper Series No. 059 (2005).

Ahmed, Q. M. "Structure of Public Finances: Historical Perspectives and Future Prospects." *Pakistan Journal of Applied Economics* 14, no. 1&2 (1998): 89-105.

Akram, Muhammad, and Faheem Jehangir Khan. "Health Care Services and Government Spending in Pakistan." *Pakistan Institute of Development Economists Working Paper: 32 (2007)* (2007).

Anand, S., and M. Ravallion. "Human-Development in Poor Countries - on the Role of Private Incomes and Public-Services." *Journal of Economic Perspectives* 7, no. 1 (1993): 133-50.

Aqeel, Anjum, and Mohammed Nishat. "The Determinants of Foreign Direct Investment in Pakistan." *The Pakistan Development Review* 43 : 4 Part II (Winter 2004) (2004): 651–64.

Asterioua, D. , and G.M. Agiomirgianakis. "Human Capital and Economic Growth: Time Series Evidence from Greece." *Journal of Policy Modeling* 23 (2001): 481–89.

Aziz, A. "Proximate Determinants of Fertility in Pakistan." *Pakistan Development Review* 33, no. 4 part 2 (1994): 729-39.

Barlas, Yaman. "Formal Aspects of Model Validity and Validation in System Dynamics." *System Dynamics Review* 12, no. 3 (1996): 183-210.

———. "Multiple Tests for Validation of System Dynamics Type of Simulation Models." *European Journal of Operation Research* 42, no. 1 (1989): 59-87.

Barro, Robert J. "Government Spending in a Simple Model of Endogeneous Growth." *The Journal of Political Economy* 98, no. 5 (1990): S103-S25.

Bhargava, Alok, Dean T. Jamison, Lawrence J. Lau, and Christopher J. L. Murray. "Modeling the Effects of Health on Economic Growth." *Journal of Health Economics* 20, no. 3 (2001): 423-40.

Birdsall, Nancy, David Ross, and Richard Sabot. "Underinvestment in Education: How Much Growth Has Pakistan Foregone." *Pakistan Development Review* 32(Winter) (1993): 453-99.

Bryant, J. "Theories of Fertility Decline and the Evidence from Development Indicators." *Population and Development Review* 33, no. 1 (2007): 101-+.

Chakraborty, L.S. "Public Expenditure and Human Development: An Empirical Investigation." Paper presented at the Wider International Conference on Inequality, Poverty and Human Well-Being, Helsinki, May 30-31, 2003.

Chang, Wen-ya. "Government Spending, Endogenous Labor, and Capital Accumulation." *Journal of Economic Dynamics and Control* 23, no. 8 (1999): 1225-42.

Coale, A.J., and P. Demeny. *Regional Model Life Tables and Stable Population*. Second ed: Academic Press, 1983.

Dasgupta, Dipankar. "Growth Versuswelfare in a Model of Nonrival Infrastructure." *Journal of Development Economics* 58, no. 2 (1999): 359-85.

De, Prabir, and Biswa Bhattacharyay. "Prospects of India–Bangladesh Economic Cooperation: Implications for South Asian Regional Cooperation." *Asian Development Bank Institute Discussion Paper No: 78* (2007).

Easterly, W., and Sergio Rebelo. "Fiscal Policy and Economic Growthan Empirical Investigation." *Journal of Monetary Economics* 32, no. 3 (1993): 417-58.

Esfahani, H.S, and M.T. Ramirez. "Institutions, Infrastructure, and Economic Growth " *Journal of Development Economics* 70, no. 2 (2003): 443-77(35).

Esrey, Steven A., and Jean-Pierre Habicht. "Maternal Literacy Modifies the Effects of Toilets and Piped Water on Infant Survival in Malaysia." *American Journal of Epidemiology* 127, no. 5 (1988): 1079-87.

Essama-Nssah, B. "Assessing the Distributional Impact of Public Policy " *The Policy Research Working Paper 2883, The World Bank* (2002).

Fan, Emma Xiaoqin "Pakistan's Public Debt: A Brief Overview." *Asian Development Bank, PRM Policy Note* Series 1 (2007).

Fasihuddin, and M. Akram Swati. *Pakistan's Economic Journey: Need for a New Paradigm*. Islamabad: Institute of Policy Studies, 2006.

Fedderke, J. W., P. Perkins, and J. M. Luiz. "Infrastructural Investment in Long-Run Economic Growth: South Africa 1875-2001." *World Development* 34, no. 6 (2006): 1037-59.

Fernald, John G. "Roads to Prosperity? Assessing the Link between Public Capital and Productivity." *The American Economic Review* 89, no. 3 (1999): 619-38.

Flegg, A. T. "Inequality of Income, Illiteracy and Medical-Care as Determinants of Infant-Mortality in Underdeveloped-Countries." *Population Studies-a Journal of Demography* 36, no. 3 (1982): 441-58.

Forrester, J. W. *Industrial Dynamics*. Cambridge, MA: Productivity Press, 1961.

———. " The Model Versus Modeling Process." *System Dynamics Review* 1, no. 2 (1985): 133-34.

Futagami, Koichi , Yuichi Morita, and Akihisa Shibata. "Dynamic Analysis of an Endogenous Growth Model with Public Capital." *The Scandinavian Journal of Economics* 95, no. 4 (1993): 607-25.

Haupt, A., and T. K. Thomas. *Population Handbook*. 5th ed: Population Reference Bureau, 2004.

Husain, Ishrat. "Education, Employment and Economic Development in Pakistan." *Inaugural address delivered by Governor State Bank of Pakistan at the Conference on Education held at Woodrow Wilson Center, Washington DC USA on April 15, 2005* (2005).

———. *Pakistan: The Economy of an Elitist State*: Oxford University Press Pakistan, 1997.

Jones, Larry E., Rodolfo E. Manuelli, and Peter E. Rossi. "Optimal Taxation in Models of Endogenous Growth." *The Journal of Political Economy* 101, no. 3 (1993): 485-517.

Jung, H. S., and E. Thorbecke. "The Impact of Public Education Expenditure on Human Capital, Growth, and Poverty in Tanzania and Zambia: A General Equilibrium Approach." *Journal of Policy Modeling* 25, no. 8 (2003): 701-25.

King, B. B. "What Is Sam?" In *Social Accounting Matrix:A Basis for Planning*, edited by G. Pyatt and J. I. Round. Washington D.C.: The World Bank, 1988.

Kraev, Egor, and Bishop Akolgo. "Assessing Modelling Approaches to the Distributional Effects of Macroeconomic Policy." *Development Policy Review* 23, no. 3 (2005): 299-312.

Lewis, W. A. " Economic Development with Unlimited Supplies of Labour." *The Manchester School* 22, no. 2 (1954): 139-91.

Looney, Robert E., and Peter C. Frederiken. "Government Investment and Follow-on Private Sector Investment in Pakistan1972-1995." *JOURNAL OF ECONOMIC DEVELOPMENT* 22, no. 1 (1997): 91-100.

Lucas, R. E. "On the Mechanics of Economic Development." *Journal of Monetary Economics* 22, no. 1 (1988): 3-42.

———. "Supply-Side Economics - an Analytical Review." *Oxford Economic Papers-New Series* 42, no. 2 (1990): 293-316.

Mankiw, N. Gregory, David Romer, and David N. Weil. "A Contribution to the Empirics of Economic Growth." *The Quarterly Journal of Economics* 107, no. 2 (1992): 407-37.

Mayer-Foulkes, David. "The Human Development Trap in Mexico." *World Development* 36, no. 5 (2008): 775-96.

Meadows, D.L., D.H. Meadows, Randers J., and Behrens W.W. *The Limits to Growth*. New York, USA: Universe Books, 1972.

Mukherjee, Anit N. "Public Expenditure on Eductaion: A Review of Selected Issues and Evidence." *Working Paper, National Institute of Public Finance and Policy* (2007).

Notestein, Frank W. "Population: The Long View " In *Food for World*, edited by T.W. Schultze. Chicago: Chicago University Press, 1945.

Pasha, H.A. "Political Economy of Tax Reforms: The Pakistan Experience." *Pakistan Journal of Applied Economics* 11, no. 1&2 (1995): 129-54.

Pasha, H.A., and M.A. Iqbal. "Taxation Reforms in Pakistan." *Pakistan Journal of Applied Economics* 10, no. 1&2 (1994): 47-75.

Philippe, Aghion, and Peter Howitt. *Endogenous Growth Theory*: The MIT Press, 1999.

Pyatt, G. "A Sam Approach to Modeling." *Journal of Policy Modeling* 10, no. 3 (1988): 327-52.

Pyatt, G. , and J. I. Round. *Social Accounting Matrices: A Basis for Planning*: The World Bank, Washington, DC., 1985.

Pyatt, G., and J. I. Round. *Social Accounting Matrix:A Basis for Planning*. Edited by G. Pyatt and J. I. Round. Washington D. C.: The World Bank, 1988.

Qureshi, Muhammad Azeem. "Challenging Trickle-Down Approach: Modelling and Simulation of Public Expenditure and Human Development - the Case of Pakistan." *International Journal of Social Economics* 35, no. 4 (2008): 269-82.

———. "Human Development, Public Expenditure and Economic Growth - a System Dynamics Approach." *International Journal of Social Economics* 36, no. 1 (Forthcoming 2009).

Qureshi, R., and D.J. Adamchak. "Determinants of Marital Fertility in Pakistan: The Impact of Education, Work and Family Planning." *Sociol Focus* 29, no. 2 (1996): 167-78.

Rana, Abdul Wajid. "Assessment of the Prsp Process in Pakistan." *Pro-poor growth policies symposium of UNDP and PIDE, 17th March 2003, Islamabad* (2003): 45-51.

Ranis, Gustav., Frances. Stewart, and Alejandro. Ramirez. "Economic Growth and Human Development." *World Development* 28, no. 2 (2000): 197-219.

Rashid, Abdul. "Public-Private Investment Linkage in Pakistan " *South Asia Economic Journal* 7, no. 2 (2006): 219-30.

Romer, P. M. "Endogenous Technological-Change." *Journal of Political Economy* 98, no. 5 (1990): S71-S102.

———. "Increasing Returns and Long-Run Growth." *Journal of Political Economy* 94, no. 5 (1986): 1002-37.

Saha, Somnath. "Improving Literacy as a Means to Reducing Health Disparities." *Journal of General Internal Medicine* 21, no. 8 (2006): 893-95.

Sandiford, P., J. Cassel, M. Montenegro, and G. Sanchez. "The Impact of Women's Literacy on Child Health and Its Interaction with Access to Health Services." *Population Studies* 49, no. 1 (1995): 5-17.

Sathar, Z. A. "Child Survival and Changing Fertility Patterns in Pakistan." *Pakistan Development Review* 31, no. 4 part 2 (1992): 699-711.

Sathar, Z. A., and K. O. Mason. "How Female Education Affects Reproductive Behavior in Urban Pakistan." *Asia-Pacific Population Forum* 6, no. 4 (1993): 93-103.

Schwartz, G., and T. Ter-Minassian. "The Distributional Effects of Public Expenditure." *Journal of Economic Surveys* 14, no. 3 (2000): 337-58.

Smith, Adam. "An Inquiry into the Nature and Causes of the Wealth of Nations." *http://en.wikipedia.org/wiki/The_Wealth_of_Nations* (1776).

Sterman, John D. "Appropriate Summary Statistics for Evaluating the Historical Fit of System Dynamics Models." *Dynamica* 10, no. Part II, Winter (1984): 51-66.

———. *Business Dynamics - System Thinking and Modeling in a Complex World*: McGraw-Hill Higher Education, 2000.

Streeten, P. "Human-Development - Means and Ends." *American Economic Review* 84, no. 2 (1994): 232-37.

Thompson, W.S. "Population." *American Journal of Sociology* 34 (1929): 959-75.

Tsoukis, Chris, and Nigel J. Miller. "Public Services and Endogenous Growth." *Journal of Policy Modeling* 25, no. 3 (2003): 297-307.

Turnovsky, Stephen J. "Fiscal Policy in a Growing Economy with Public Capital." *Macroeconomic Dynamics - Cambridge University Press* 1, no. 3 (1997): 615-39.

———. "Fiscal Policy, Elastic Labor Supply, and Endogenous Growth." *Journal of Monetary Economics* 45 (2000): 185-210.

Turnovsky, Stephen J. . "The Transitional Dynamics of Fiscal Policy: Long-Run Capital Accumulation and Growth." *Journal of Money Credit and Banking* 36, no. 5 (2004): 883-910.

UN. "The System of National Accounts." United Nations, 1993.

Wai, U Tun , and Chorng-huey Wong. "Determinants of Private Investment in Developing Countries." *Journal of Development Studies* 19, no. 1 (1982): 19-36.

WDI. "The World Development Indicators." (1997).

Wolfe, B. L., and J. R. Behrman. "Determinants of Child-Mortality, Health, and Nutrition in a Developing-Country." *Journal of Development Economics* 11, no. 2 (1982): 163-93.

Yousuf Khan, M. Tariq, and Komei Sasaki. "Roles of Public Capital in Pakistan's Economy: Productivity, Investment and Growth Analysis." *Review of Urban & Regional Development Studies* 13, no. 2 (2001): 143-62.

Notes:

[1] For a detailed explanation please see http://www.ifi.uib.no/sd/sdinfo.html

[2] This is a composite index of education, health and income used by United Nations Development Program (UNDP). Please see http://hdr.undp.org/en/statistics/

[3] This model gets its inspiration from T21 an integrated model of Millennium Institute, 2200 Wilson Blvd., Suite 650, Arlington, VA 22201.

[4] Please see appendix.

[5] The System of National Accounts consists of an integrated set of macroeconomic accounts, balance sheets and tables based on internationally agreed concepts, definitions, and classifications and accounting rules. Together, these principles provide a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for purposes of economic analysis, decision-taking and policy-making. For more details please visit http://unstats.un.org/unsd/sna1993/introduction.asp

[6] A Social Accounting Matrix represents flows of all economic transactions that take place within an economy (regional or national). It is a statistical representation of the economic and social structure of a country. SAMs refer to a single year providing a static picture of the economy. SAMs are square (columns equal rows) in the sense that all institutional agents (Firms, Households, Government and Rest of the world) are both buyers and sellers. Columns represent buyers (expenditures) and rows represent sellers (receipts). Ref: G. Pyatt and J. I. Round, *Social Accounting Matrices: A Basis for Planning* (The World Bank, Washington, DC., 1985).

[7] of Ventana Systems, Inc. , 60 Jacob Gates Road, Harvard, MA 01451 ; http://www.vensim.com/

[8] This may be a limitation of this study which may be addressed in future research. However, given the scope of current work it may not materially affect the findings of this study.

[9] They have estimated these tables separately for four regions of the world: east, west, north and south. Pakistan being in eastern region we adopt that. However, Pakistan has a relatively higher infant and under-five mortality rate which require some amendment in the relevant tables. We have estimated the tables for these two age groups of the two genders keeping in view UN population data.

[10] This stock will remain at zero as at the beginning of each year this will empty itself to pass on all *'new born'* to age 0 cohort.

[11] This excludes from the productive age women those who are either not married or are not productive.

[12] Any variable labeled as 'real', for example real public spending on education means the value of public spending on education expressed in the prices of some base year, 1981 in this case. Moreover, real sectoral production [Agriculture] in this case, measures the value of all the goods and services produced in agriculture sector expressed in the prices of some base year, of 1981 in this case. The objective to using real values is to eliminate the effect of inflation overtime which is a common approach in such studies.

[13] It is a weighted average index of adult literacy rate and gross enrollment rate of primary, secondary and tertiary education, based on technical notes of Human Development Reports of United Nations Development Programme.

[14] This index measures the relative achievement of a country in life expectancy at birth, based on technical notes of Human Development Reports of United Nations Development Programme.

[15] like self-employment or entrepreneurship.

[16] GDP = Total Consumption + Total Investment + Exports - Imports

[17] Relatively poor fit indicates that employment survey may also have included under and/or seasonally employed labor force.

[18] The low R^2 may indicate an error in model fit and its decomposition through Theil inequality statistics helps to identify the origin of the error John D. Sterman, "Appropriate Summary Statistics for Evaluating the Historical Fit of System Dynamics Models," *Dynamica* 10, no. Part II, Winter (1984). For this purpose the root mean square percentage error (RMSE) is an appropriate statistic which is 0.561. It means that the model has a capability to reproduce the data by 43.9% and the error is 56.1% which is decomposed as: i. The error due to unequal mean of data and simulation $U^M = 0.023$; ii. The unequal variance of data and simulation $U^S = 0.025$; and iii. The unequal covariance $U^C = 0.952$. The high U^C indicates that most of the error is unsystematic i.e. 95.2% of the error (which was 56.1%) is due to unequal covariance. This clearly suggests that the model tracks the underlying trend of GDP growth rate quite well but is unable to give point-by-point prediction, which is otherwise not generally a purpose of SD models Sterman, "Appropriate Summary Statistics for Evaluating the Historical Fit of System Dynamics Models.", and in particular not an objective of this study as well.

[19] This includes general government and defense expenditure.

[20] primary gross enrollment rate[sex]=primary students enrollment[sex]/SUM(Population[sex, primary school age!])

[21] We however, consider the fundamental role of public investment is the development of HD in the country.