Threshold21 Mali: System Dynamics-based national development planning in Mali

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Abstract

This paper describes how the Threshold21 Model developed for the Government of Mali has been used to support the preparation of the five-year strategic plan for the country. The model proven useful at different levels in the planning process: (1) it enabled testing the coherence of data collected; (2) provided insights into the future development of current issues and the emergence of new challenges in the Business-As-Usual scenario; (3) supported the discussion of alternative policies and development paths; and (4) provided a basis for monitoring and evaluation of implemented policies. This paper reports of the use of the model at levels (2) and (3), describing how it enabled an open discussion on the critical assumptions for economic growth to be used in the strategic plan, and on the delays involved in the country's growth process. Results from the model have been eventually incorporated in the national strategic plan.

Introduction

Mali is a Western African country, located south of Algeria and Mauritania, and north of Burkina, Niger, Cote d'Ivoire and Guinea. Landlocked, the country covers about 1.24 million square kilometers of savanna and desert, extending from the southern Sahara desert to the Niger River. A former French colony, Mali gained independence in 1960, and is experiencing democratic government since 1991.

Economic statistics about Mali give a rather clear picture of one of the poorest countries in the world. Most of the 12 millions Malians live below the official poverty line (68% form recent estimates of the National Statistical Office - DNSI). Despite the good economic growth observed in the last decade (in average about 5% per year) the resources available to the Government are insufficient to provide broad access to basic social services to the growing population. In terms of human development index (HDI), Mali ranks 175 of 177 (UNDP, 2006).

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As many other countries in Africa, under the auspices of the World Bank and of the International Monetary Fund, Mali developed a first medium-term strategic plan for poverty reduction in the early 2000 (the so called "Poverty Reduction Strategy Paper", PRSP, or CSLP in French; see www.worldbank.org for a full list of countries that developed a PRSP). The CSLP set very ambitious goals for the country, one above all a target economic growth rate of 6.7% per year. This target growth rate and the other main goals of poverty reduction were largely unattended, as stated in the official review of the performance for the period covered by the CSLP (Government of Mali, 2006a).

It is one common problem across African countries that of setting overoptimistic goals and objectives for development. Senge's goal erosion archetype (Senge 1990), stressed how goals need to be ambitious in order to encourage development, and how leaders have to oppose the natural tendency to lower their goals when performance is unsatisfying. Nevertheless, when goals are set at completely unachievable levels, performances are invariably perceived as a failure, and disillusion takes place. It is way too common in Africa that leaders set unrealistic goals, feeding the country with hope for a better future, hopes that are regularly not matched by performance (World Bank, 2004). In the long run, this process can lead to disillusion of people towards progress, and to general skepticism about the future.

Mali is not an exception to this general tendency of stating overoptimistic goals. When in 2004 the Government of Mali (GoM) contacted the Millennium Institute[3] (MI) to provide support for the development of their second CSLP (CSLP II), one of the objectives of our analysis was to provide a solid quantitative basis to develop realistic development scenarios for the CSLP II.

History of the project

The development of Threshold21 (T21) Mali has been carried out in close collaboration with the Malian Center for Planning and Forecasting (CPM). President Toure established the CPM in 2003, with the scope of analyzing mid and long-term development possibilities for the country. The CPM is composed of a panel of technicians and policy makers from various Ministries, with a preponderant participation of officials form the Ministry of Planning, and provides advices to other governmental institutions for the preparation of mid and long-term plans, including the CSLP.

Soon after its creation, the CPM identified the need of developing a quantitative tool for long-term development analysis and got in contact with the Millennium Institute, an American NGO specialized in long-term national planning. After a first round of consultations in Bamako in late 2004, the CPM asked the MI to develop a T21 model for Mali, and to support them in preparing the upcoming CSLP. The need for basing such analysis on a quantitative long-term model was mainly emerging from the scarce realism that characterized the first CSLP (Government of Mali, 2006b), where scenarios were based on exogenous estimations for economic growth.

Shortly after the first round of consultations, the Carter Center[4], who was actively supporting Mali's development planning activities via their Development And

[3] www.millennium-institute.org
[4] www.cartercenter.org

Cooperation Initiative (DACI), decided to provide financial support to the T21Mali initiative. In late 2004 we began the development of the T21Mali model, which led after a series of training and consulting sessions, to the final version of the model in June 2006.

The T21Mali model, while keeping the broad and integrate approach that characterize the T21 framework, is especially developed to analyze issues related to poverty and access to basic social services. The model has been conceived, in particular, with two functions in mind: provide endogenous growth and poverty scenarios for the CSLP-II; and project these scenarios way beyond the time horizon of the CSLP II (5 years) to analyze their results in the long-term. Based on these requirements, and on the scarce availability of historical data, we set the time horizon for the analysis to the period 1990-2025.

The T21Mali model and its complete documentation (English and French) are available at: http://www.millennium-institute.org/projects/africa/mali.html

Mali 2025 – Business as Usual

In order to provide an initial basis for the development of alternative scenarios for the CSLP-II analysis, we first used T21Mali to generate a so-called "Business as Usual Scenario" (BUA). In this scenario we replicated the major government policies and external conditions for the period 1990 to 2005, and then simulated the model until 2025 assuming such policy orientations and external conditions would not substantially change. Below, we provide a short summary of the results obtained in this scenario, while a detailed report of the results is available at:

http://www.millennium-institute.org/projects/africa/mali.html

In the BUA scenario, the results obtained for the major indicators for the period 1990 to 2005 were well in line with historical data from the National Statistical Office (DNSI), as discussed in the full report indicated above. The results for the period 2005 – 2025 are reported in Table 1.

Table 1: Summary results for the Business As Usual scenario (source: T21 Mali model).

Time (Year)	2005	2010	2015	2020	2025
real GDP growth rate	4.8%	3.7%	3.4%	3.5%	3.7%
agriculture production growth rate	5.0%	2.5%	1.8%	1.6%	1.7%
industry production growth rate	4.8%	3.5%	3.5%	3.6%	3.9%
services production growth rate	4.6%	4.9%	4.6%	4.6%	4.7%
public deficit as share of GDP	4.9%	3.9%	3.5%	3.0%	2.3%
total population growth rate	2.5%	2.5%	2.4%	2.3%	2.2%
total fertility rate	6.1	5.7	5.2	4.8	4.3
average life expectancy	53.1	56.4	59.7	62.4	64.8
average adult literacy rate	30.5%	36.3%	42.0%	47.1%	51.5%
proportion of population within 5 km from health center	48.7%	54.2%	59.9%	65.9%	70.7%
road km per 1000 people	1.60	1.69	1.77	1.84	1.92
proportion of population connected to electricity network	15.5%	16.8%	16.8%	16.6%	16.6%
proportion of population connected to water network	13.5%	16.6%	20.8%	24.9%	28.5%
proportion of population below poverty line	64.5%	62.1%	60.0%	57.8%	55.2%
HDI	38.9%	44.0%	48.4%	51.9%	55.0%

The picture of Mali's development over the next two decades that this scenario provides is not encouraging. While the population is growing at sustained rates, the GDP growth rate is decreasing, and the resulting growth in per capita GDP is small. Consequently, poverty rates are declining of less than 10% points over 20 years, a result that can be considered insufficient by any national or international standard (the internationally agreed Millennium Development Goals indicate a target poverty level in Mali of about 22% by 2015). Education is also progressing slowly, with only about 50% of literacy rate in 2025. Life expectancy shows some modest increases up to about 65 years in 2025. The combination of these results leads to an HDI growing slowly from 38.9% to 55%, which would bring Mali in 2025 at about the level of today's Pakistan.

The Figure 1 below provides a high-level interpretation of the mechanisms that we identified as of key importance for Mali socio-economic development. The positive feedback loops illustrated in Figure 1 are the source of economic growth in many countries. However, these mechanisms might work slowly over time when the initial resources base is small, due to the time delays involved in the accumulation of human resources and in the creation of proper infrastructure. Below is a brief description of these three loops, and of the factors that slow down their operation.

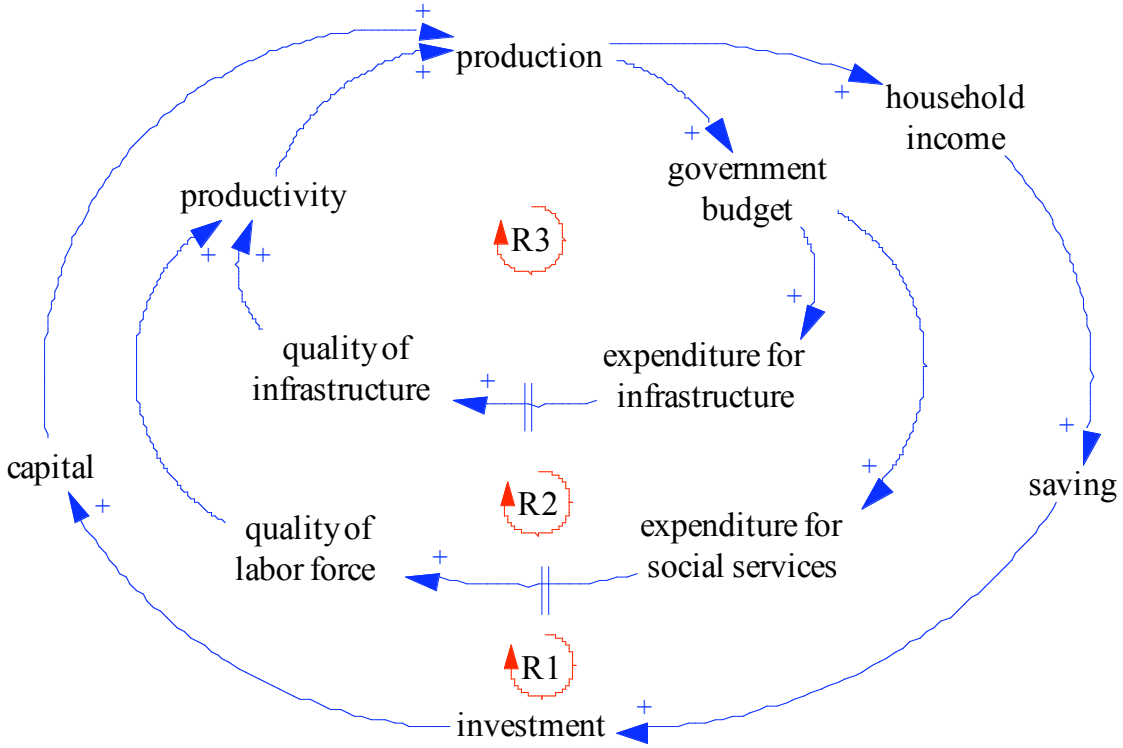

Figure 1: High level representation of the mechanisms underlying the socio-economic development of Mali.

Capital, infrastructure and a healthy and educated labor force are essential resources for production in Mali, as in most countries. These resources are built over time via private and public investment, and they need to be harmonically developed for productivity and production to continuously grow.

Rapid capital accumulation is a first prerequisite for growth (see feedback loop R1 in Figure 1). As thoroughly analyzed in neoclassic growth models, higher income implies higher saving, higher investment and capital accumulation, and thus higher production and income next time around. Unfortunately, per capita disposable income has been very low in Mali since local authorities begun collecting economic data. This very low level of income implies a very high propensity to consume, and thus very little funds allocated to saving. As a consequence of this low level of saving, investment and thus capital accumulation are penalized and the resulting economic growth is small. This flaw in the capital accumulation mechanism is a well known issue in many developing countries, and has been recently labeled as "poverty trap" (Sachs, 2004).

A second mechanism of great importance for development in Mali is the R2 loop in Figure 1. Production is not only the major source of income for households, but also for the government. A low level of production implies little resources available for the government to invest in the provision of basic social services that are indispensable to the population. Social services such as education and health care are not only vital for the social development of the country, but a healthy and educated labor force is also a key factor to increase labor productivity (Bosworth, 2003). Unfortunately, the government does not have the necessary resources for fostering education and health, boost productivity and eventually generate even more resources. Given the very low level of per capita income, it is also very difficult to increase the level of taxation on economic activities. In addition, accumulation of human resources requires long time, considering that a minimum of 6 years is necessary to acquire a primary school license and that a full turnover of the labor force may take a few decades. Currently, the inflow of human resources on the labor market is slightly larger than the natural loss of such resources, which are thus accumulating only slowly over time.

The GoM also has a fundamental role in the country as provider of basic infrastructure, for transportation and agriculture in particular (R3 in Figure 1). As the resources available to the government are limited, investment in these sectors has been scarce. In addition, creating efficient infrastructure is particularly time and resources consuming, since infrastructure has long implementation time, is often exposed to a high natural disruption, and requires a continuous effort for maintenance. The slow development of infrastructure implies high production and delivery costs for goods and services, and thus harm for productivity (Stiffel, 2003). This, in turn, implies a slow development of the economy and of government revenues.

Given the initial low level of resources available, and the long delays involved in their accumulation processes, the growth that Mali experienced over the last 10 years (growth rate oscillating around 5%) should not be considered a poor performance. Undoubtedly, several developing countries have experienced two-digit growth rates for extended periods and this is setting a new standard for developing economies. However, these countries started from substantially different conditions: most fundamental resources for production were available, and as a few crucial bottlenecks where removed, growth spurred (Hausmann, 2004).

On top of these fundamental issues, the economic development of Mali is also harmed by two other factors. First, gold mining, an important part of industrial production, has shown signs of decline in the last few years. Second, although new irrigation projects are

being implemented, only a limited share of Mali's surface can be used for agriculture, and growth on this end can be limited.

The presentation of the results of the BAU scenario to the CPM committee led to the conclusion that major structural changes needed to be undertaken in order to accelerate the growth performance of the country.

Optimistic scenario

At the same time as our BUA scenario was being developed, the team devoted to the development of the CSLP-II was synthesizing the basic targets to be achieved over the next five years. These targets included an ambitious 7% GDP growth rate per year, which was way above the projections obtained from the T21 model in BUA scenario. We were then asked by the CPM to work with their team of modeling experts in order to identify under which conditions/policies the T21 model would generate such high growth rate.

The subsequent investigation process lasted for about two weeks of alternate workshops, modeling and analysis sessions, and presentation of results to the CPM and CSLP representatives. The final result of this process was a highly optimistic scenario, based on the set of policies and assumptions summarized in Table 2. Note that the table indicates the changes introduced with respect to the values originally used in the BAU scenario.

Table 2: Summary of changes in policy and assumptions for the Optimistic scenario

Type	Description
Policy	Increase in expenditure for transport and equipment as share of government budget by 25% in 2025
Policy	Increase of 5% in expenditure for rural economic activities as share of government budget
Policy	Tripling of expenditure for industry, mining and water as share of government budget, by 2025
Policy	Lower fiscal pressure until 2011 (about 1 point lower in 2007)
Assumption	Gradual increase in value added per unit produced in the cotton sector (about 75% increase by 2025)
Assumption	Nearly doubling of agriculture land cultivated per worker by 2025
Assumption	Improvements in the weather conditions for agriculture production (from 10% better conditions for rice, to 100% for maize)
Assumption	Increase of fish industry production by 60% in 2025
Assumption	Increase of gold discoveries by 20% by 2025
Assumption	Rapid increase in gold extraction by 30% by 2011
Assumption	Reallocation of agriculture land among crops to increase efficiency in the sector
Assumption	More than doubling of foreign direct investment as share of GDP by 2025
Assumption	Decrease in Gini coefficient from .525 to .45
Assumption	Increase in tons of meat produced per head by 50% in 2025

The assumptions described above are the result of a selective process. Policies and assumptions were discussed and evaluated in official debates with CPM and CSLP unit representatives, and the resulting list has been thoroughly scanned by local experts. Interestingly, the four major policy changes simulated in the Optimistic scenario are all directed to increase productivity in the private sector, this being the first major axe of the strategy developed in the CSLP-II.

This new set of policies and assumptions results in faster economic growth and better performance for nearly all relevant socio-economic indicators. In summary, the new policies and assumptions affect the behavior of the model in two ways. First, most of the assumptions artificially increase productivity in the agriculture and gold sectors. Second, the new policies aimed at reducing fiscal pressure while accelerating the construction of basic infrastructure and thus increase productivity in the private sector. A summary of the results from this scenario is presented in Table 3.

Table 3: Summary results for the Optimistic scenario (source: T21 Mali model)

Time (Year)	2005	2010	2015	2020	2025
real GDP growth rate	4.8%	6.6%	6.2%	6.1%	6.4%
agriculture production growth rate	5.0%	7.7%	4.3%	3.8%	4.7%
industry production growth rate	4.8%	5.3%	5.6%	6.0%	6.4%
services production growth rate	4.5%	6.3%	8.2%	7.9%	7.3%
Public deficit as share of GDP	4.9%	3.9%	3.1%	3.2%	3.3%
total population growth rate	2.5%	2.5%	2.5%	2.5%	2.4%
total fertility rate	6.1	5.6	5.1	4.6	4.1
average life expectancy	52.2	56.6	63.0	68.6	72.1
average adult literacy rate	30.5%	36.3%	42.1%	47.5%	52.3%
fraction of population within 5 km from health center	48.7%	54.2%	61.6%	70.3%	73.3%
road km per 1000 people	1.6	1.7	1.9	2.2	2.5
proportion of population connected to electricity network	15.5%	17.4%	18.2%	19.3%	24.0%
proportion of population connected to water network	13.5%	17.2%	26.3%	40.6%	53.2%
average share of population below poverty line	64.6%	58.2%	50.5%	42.1%	33.9%
HDI	38.5%	44.2%	50.8%	56.6%	61.1%

Admittedly, the picture of Mali's development over the next two decades that this scenario provides is more pleasant that the one derived from the BUA scenario. Although the population is growing at nearly the same rates as those observed in the BUA scenario, the GDP growth rate is substantially higher, averaging 6.4% for the period 2007 – 2011. The resulting growth in per capita GDP is relevant. Due to the growth in per capita GDP and the assumed reduction in inequality, the proportion of population living below the poverty line is projected to decrease by 2025 to nearly half the level of 2005. Education is progressing slightly faster than in the BUA case, with about 53.2% of literacy rate in 2025. Life expectancy shows some significant increases up to about 72 years in 2025. The combination of these results leads to an HDI growing slowly from 38.9% to about 61.1%, about the level of today's India.

Despite the increase in expenditure for infrastructure and the strong assumptions about productivity in the agriculture and gold sectors, growth rate is still far from the target of 7%. Performance in terms of poverty reduction is also far from the stated targets (MDG

of 22% in 2015). These results highlight the importance of the long delays involved in accumulating human resources and infrastructure.

In this scenario, the assumptions for agriculture and gold production have boosted productivity, generating an extra inflow of resources for the government. In spite of the increase in the amount of resources available to the GoM, human resources (see for example literacy rate and life expectancy) and infrastructure (see for example road km per 1000 people) developed only slowly. A few decades are necessary to develop such resources (human resources in particular), and thus achieve high productivity levels.

As this Optimistic scenario was created, and the results were disseminated and discussed with our clients, we observed and increasing awareness of the time delays involved in accumulating human resources and creating proper infrastructure. Understanding of these mechanisms is fundamental not only for developing strategies that may reduce the delays, but also for setting realistic goals for the country's development.

Conclusions

This paper illustrates how the T21-Mali model has been used in the development of the five-year strategic plan in Mali. Having set a target GDP growth rate of 7%, the GoM asked us to identify under which policies and assumptions could Mali achieve such target. The results of the model illustrated that, even under optimistic assumptions and introducing policies directed to increase productivity, a GDP growth rate of 7% could not be achieved. The much needed increase in productivity could not be obtained in the short run, as that implied the building up of infrastructure and human resources that requires a few decades.

On the plan of the results, this analytical exercise resulted particularly useful as it stressed the importance of the delays involved in improving productivity. Awareness of these delays is important for stating adequate goals and for not discarding valid development strategies because performance is not rapidly raised. Also, once these delays are identified, strategies to reduce them can be investigated. The Millennium Institute is now beginning a new project with the GoM focusing on the possible strategies to achieve faster poverty reduction.

On the plan of the process, a major outcome of the study is that clear assumptions have been eventually associated with the expected growth rates used for the strategic plan. This will also help in the monitoring and evaluation of the plan, since it will provide a basis to track down where the differences between actual and expected results come from. Empowering monitoring and evaluation of poverty reduction strategies has been recently indicated as a key success factor for the implementation of such strategies (World Bank, 2005).

The final version of the CSLP-II for Mali includes the estimations for poverty reduction generated with T21, and two development scenarios: a "Volunteerism" scenario, with an assumed average growth rate of 7%; and a "Base" scenario, with an assumed average growth rate of 5%.

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