# I. Managing the Macroeconomic Impact of the Hydropower Sector[1]

## A. Introduction

1. **The hydropower sector in Bhutan has been growing, and a number of projects are being planned**. Bhutan currently has four hydropower projects in operation (including Tala). Of these, the first major hydropower station, Chukha, came on stream in 1986. Construction of Tala hydropower station started in 1997. Upon coming on stream in 2006, Tala more than tripled Bhutan's electricity generation capacity. Looking forward, other hydropower projects are being planned. The Royal Government of Bhutan (RGB) intends to accelerate implementation of new projects to exploit its estimated 12,000 MW potential. Construction of Dagachu and Puna I projects is intended to start in 2007/08.[2] Two other projects are in early stages of conception.

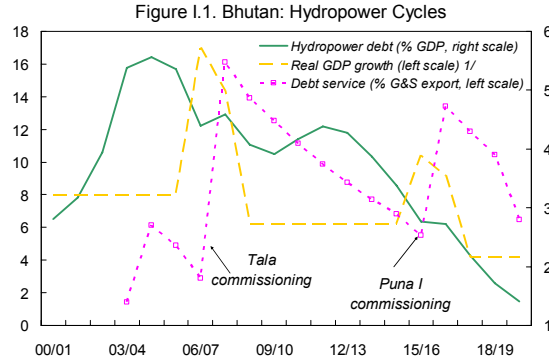
Table I.1. Bhutan: Hydropower Projects

| Project | Date of Commissioning | Peak Capacity | Financing |
|---|---|---|---|
| | | (In megawatts) | |
| Chukha | 1986, 1988 | 336 | Government of India: 60 percent grant; 40 percent loan (9 percent interest) |
| Kurichhu | 2001, 2002 | 60 | Government of India: 60 percent grant; 40 percent loan (10.75 percent interest) |
| Basochu | 2001, 2004 | 64 | Government of Austria: 65 percent grant; 25 percent loan (0.25 percent interest). RGoB: 10 percent |
| Tala | 2006 | 1,020 | Government of India: 60 percent grant; 40 percent loan (9 percent interest) |
| Dagachu | 2013 | 114 | Government of Austria, AsDB, RGoB, and possible UNDP financing |
| Punachu I | 2016 | 1,095 | Government of India: 40 percent grant; 60 percent loan (9.5 percent interest) |

Source: Royal Government of Bhutan, Ministry of Trade and Industry, Department of Power.

2. **As in the past, the new projects are likely to create hydropower cycles with ample growth dividends**. Construction activities for the projects would support growth in the early years. Growth would rise significantly when the new power projects come on stream. Past projects have been successful due to a combination of factors, including political stability and prudent macroeconomic policy management; favorable relationship with India; India's high economic growth; and a large demand-supply gap in the electricity

Figure I.1. Bhutan: Hydropower Cycles




1/ Period averages are shown for years except for Tala and Puna I commissioning.

[1] Prepared by Hiroko Oura.

[2] Fiscal year starts on July 1.

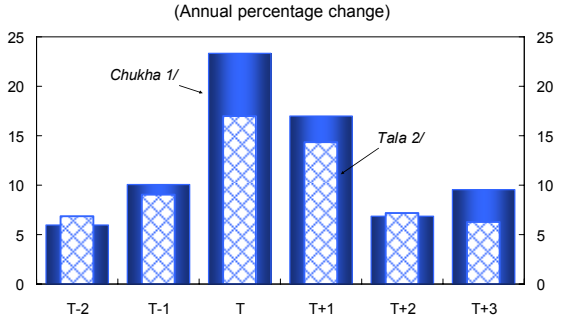
sector in India. Continuation of these factors and human capital accumulation in the sector from past projects bodes well for future projects.

3. **This chapter discusses macroeconomic policy challenges posed by the hydropower sector**. Section B discusses the macroeconomic impact of Tala, drawing on the experience of Chukha and similar projects in other countries. Section C analyzes the financial viability of the projects. Section D concludes.

## B. The Macroeconomic Impact of Tala

4. **The economic impact of Tala is substantial**. The total construction cost at 1997 prices was 240 percent of 1997 GDP. During the construction phase, Tala supported economic growth strongly. Real GDP growth averaged 7 percent during 1997/98–2006/07. Upon commissioning, Tala tripled Bhutan's hydropower generation capacity. GDP growth is expected to jump to nearly 17 percent in 2007/08. Tala's electricity exports are projected at 11 percent of GDP; exports from existing hydropower stations are about 6 percent of GDP.

Figure I.2. Bhutan: Large Hydropower Projects and Real GDP Growth
(Annual percentage change)

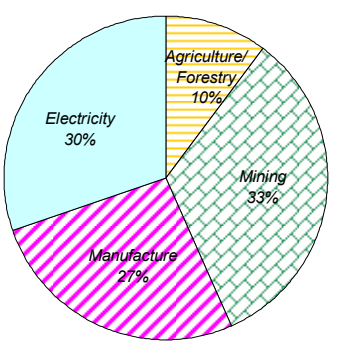



1/ Time period T refers to 1986/87.
2/ Time period T refers to 2006/07. The growth rates for the Tala cycle are staff projections.

5. **Affordable and stable electricity supply would provide benefits to the domestic economy as well**. First, cheaper energy prices can have direct disinflation effects. Second, electrification would add to productivity gains in energy-intensive manufacturing sector and enhance competitiveness in some new business areas. Third, rural electrification would increase productivity in the agricultural sector.

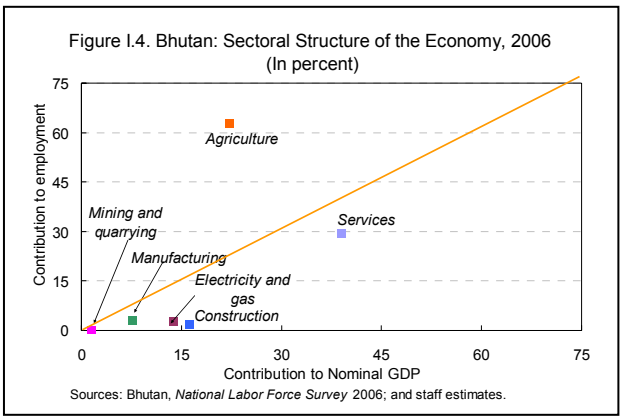
6. **However, a dominant, booming sector poses potential risks and policy challenges**. A potential problem posed by such a sector is the "Dutch disease" effect. These problems are particularly marked if they lead to higher budgetary spending and wage increases to government employees, potentially generating general wage and inflationary pressures. Higher domestic wages and other costs without matching productivity gains can adversely affect nonelectricity tradable goods sectors in

Figure I.3. Bhutan: Composition of Goods Export, 2005



the case of Bhutan, including agriculture (vegetables, fruits, and processed food), forestry (wood products), mining, and manufacturing.

7. **Limiting "Dutch disease" effects is important for job creation and poverty alleviation**. Despite the GDP contribution of the hydropower and construction sectors, job creation in these sectors has been limited.[3] Therefore, fostering private sector development and strengthening competitiveness in the non-hydropower sectors are critical to creating employment opportunities for a rapidly growing working age population. Furthermore, any negative impact on agriculture could have an adverse impact on poverty through the impact of higher inflation on real income.




8. **For Bhutan, there are potential countervailing factors at work**:

- Debt service on Tala is to start in 2007/08, limiting the net impact on the balance of payments. Annual debt service is projected at 4−6 percent of GDP in initial years.

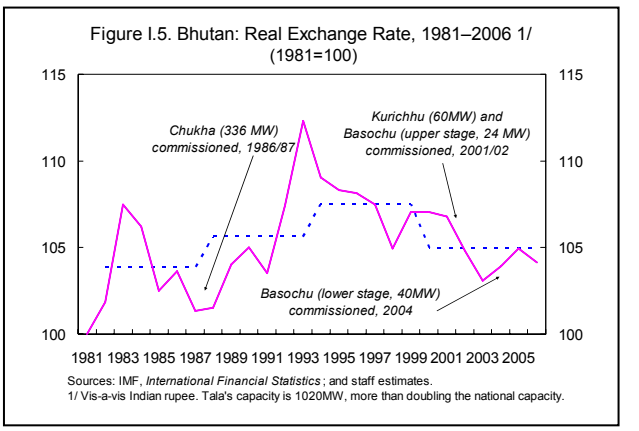
- Balance of payments and budgetary contributions from Tala would increase only gradually. Large hydropower stations often need a few years to operate at full capacity. For instance, it took almost five years after commissioning for Chukha to operate fully.

- Bhutan is dependent on international aid which could moderate over the medium term as per capita income rises.

[3] Construction of Tala was supported by skilled and unskilled Indian immigrant workers. It is estimated that about 90 percent of the construction spending were on Indian capital goods and labor.

## A Comparative Perspective on Tala

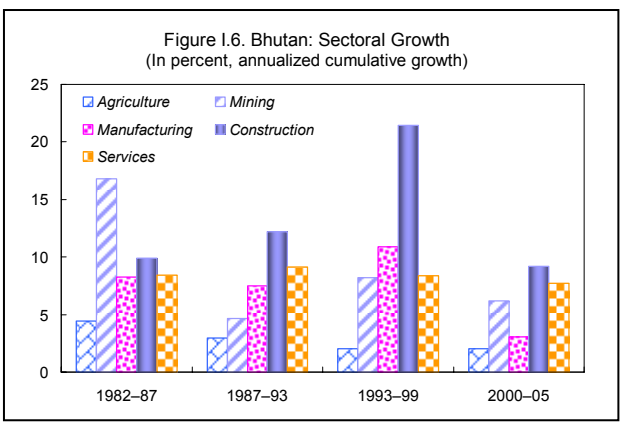
9. **Bhutan showed some signs of "Dutch disease" with the Chukha power project**.




- Inflation in Bhutan has generally tracked price developments in India, as about 75 percent of goods in Bhutanese CPI basket consists of tradables with India. However, the deviation from Indian CPI was noticeable in the immediate years after Chukha commissioning.

- The real exchange rate vis-à-vis India appreciated after Chukha commissioning.

- Revenues increases from Chukha have often expanded budgetary current expenditure. For instance, the upward revision of the electricity export tariff in January 2005 was accompanied by a 45 percent increase in civil servants' wages.




- The growth rate in the non-hydropower tradable sectors (agriculture, mining, and manufacturing) decelerated somewhat after Chukha came on stream. On the other hand, nontradable sectors (construction and services) showed stronger growth.

10. **International evidence on "Dutch disease" effects of booming sectors is mixed**. Clear empirical results are hard to come by owing to difficulties with controlling for other factors that may affect the real exchange rate, sectoral structure, and growth (see Kremer (1985), Forsyth (1985), and Stijns (2003) for a discussion of Dutch and British manufacturing industries in 1970s). Cross-country studies are also not conclusive. For instance, Stijns (2003) finds that non-energy exports in oil producing countries are negatively affected after energy price booms. To the contrary, Spatafora and Warner (1999) do not find contractions in agriculture and manufacturing production for oil-producing countries in response to terms of trade shocks. In developing countries, empirical studies often find a slowdown in nonresource tradables sector growth rate in resource rich economies compared to economies without substantial natural resources (Sachs and Warner, 1995). Sala-i-Martin

and Subramanian (2003) note that weak institutions, rent seeking and corruption, rather than Dutch disease, may be the proximate causes of such lower growth.

11. **Policy measures can help limit "Dutch disease" effects**. An appropriate monetary and fiscal policy mix can help contain demand pressures effectively. Some countries have directly used exchange rate policy to cope with a resource boom (for Indonesia, see Warr, 1985). Maintaining a tight fiscal stance becomes particularly important when the majority of resource revenue accrues to the government. In addition, government expenditures can be geared to productivity-enhancing investment and education/health spending rather than public consumption. Establishing revenue saving rules and investing export earnings in foreign financial assets can also help (e.g., Timor-Leste).

12. **The Itaipu hydropower project in Paraguay provides a useful comparative case study of the potential impact of large hydropower projects** (Baer and Birch, 1987; World Bank, 1992; and Valdovinos and Naranjo, 2004).

- **Itaipu is the largest hydropower plant in the world with 14,000 MW installed capacity (over 13 times of Tala)**. Construction on the project started in 1973; major work was completed by 1981; the project started generation in 1985; was operating at full initial capacity in 1991; and capacity was expanded in 2007. The cumulative cost at the end of 1989 was about US$18 billion (400 percent of 1989 GDP). The project was mostly financed by external debt guaranteed by Brazil.

- **The economy appears to have undergone a boom and bust cycle around the project**. The direct growth and employment effects were large. During 1974−81, construction and real GDP expanded at average rate annual rates of 21 percent and 9 percent, respectively. Private sector investment rose from 10 percent of GDP in the 1960s to 20 percent in the late 1970s. Initially, macroeconomic policies were conservative. In the early 1970s, public saving increased and the central bank accumulated reserves. Inflation accelerated, but in line with the U.S. prices, reflecting the peg to the dollar. Credit growth averaged 13 percent. However, policies became looser at the end of the decade: credit growth picked up to over 25 percent, and domestic inflation rose. A sharp fall in foreign inflows and Itaipu construction activities in 1981, around the time of the Latin American debt crisis, triggered a recession. Moreover, private investment of the 1970s turned out to be unproductive. GDP declined by 4 percent between 1981 and 1983. Macroeconomic policies were eased, and the exchange rate peg was abandoned in 1984.

- **Itaipu's experience points to some relevant factors**. Full commissioning was delayed from 1988 to 1991. Boom and bust cycles do appear to be associated with large projects. However, the impact may be hard to gauge given the long gestation periods and other complicating factors.

## C. Financial Viability of Projects

13. **Past hydropower projects in Bhutan have been financially viable**. The following table compares project costs, internal rate of return (IRR—the threshold discount rate setting NPV at zero), the net present value (NPV) of each project, and the NPV of project cash flows retained in Bhutan. The main points are:

- Chukha has the highest IRR, in part due to a higher export tariff rate. During the twenty years after commissioning, Chukha's tariff was raised by 37 percent in 1993, 35 percent in 1995, 100 percent in 1997, 50 percent in 1999, and 33 percent in 2005. The expected schedule for export tariff rate increases for Tala is 10 percent every five years until debt service ends and 5 percent every five years once the debt is repaid.

- Puna I is expected to have a smaller real cost of construction than Tala for a larger generation capacity and similar costs per unit of installed capacity to Chukha. As a result, Puna I's IRR is about 2 percentage points higher than that of Tala. However, the slower pace of tariff rate increases keeps the IRR lower (set at the same pace as Tala, lower than Chukha).

Table I.2. Comparing Project Viability

| | Installed Capacity | Total Costs 1/ | Internal Rate of Return 2/ | Project NPV 3/ | Bhutanese Share NPV 4/ |
|---|---|---|---|---|---|
| | (In megawatts) | (In percent of GDP) | (In percent) | (In percent of GDP) | |
| Chukha | 336 | 59 | 16.9 | 135 | … |
| Tala | 1020 | 239 | 11.9 | 44 | 160 |
| Punatsangchu I | 1095 | 165 | 13.7 | 169 | 144 |

Sources: Department of Energy; and IMF staff calculations.

1/ In 1997 prices in percent of 1997 GDP.

2/ Assuming 10 percent scrap value of total cost at the end of 35 years of commercial operation, annual operation and management cost at 1.5 percent of the total costs with 4 percent annual increase, 15 percent spared for domestic sales, starting export tariff for Tala at 1.8 and for Puna I at expected averages tariff rate for Chukha and Tala in 2016.

3/ Using 10 percent discount rate. In 1997 prices in percent of 1997 GDP. Based on total cashflows for the project.

4/ Using 10 percent discount rate. In 1997 prices in percent of 1997 GDP. Based only on cashflows for Bhutan.

- The NPV of cash flows retained in Bhutan is expected to be lower for Puna I than that for Tala, reflecting the higher amount of debt in financing than Tala. A higher interest rate (10 percent) than Tala (9½ percent) also contributes to lower cash flows retained in Bhutan in NPV terms.

14. **Furthermore, mitigating factors built into project financing limit risks**. The expected project return is high enough to absorb unforeseen negative shocks. For example, with a 50 percent cost overrun for Puna I, the IRR for the project would still be over 10 percent, providing positive project NPV with a 10 percent discount rate. The same shock would knock off about 20 percent of net cash flows retained in Bhutan (in NPV terms). For large shocks, renegotiation over export tariff rates and financing conditions could take place.

As in the case of Tala, the expectation is that cost overrun would be financed by India, using the same grant-to-debt ratio, with RGB liable for debt service.

## D. Conclusion

15. **Tala poses "Dutch disease" risks but there are countervailing factors**. There could be a negative impact on growth prospects of non-hydropower sectors and on the poor through nontradable prices inflation. International experience suggests that an appropriate policy mix can help manage financial flows related to such projects. In Bhutan, as the bulk of Tala-related flows go through the government accounts, this requires an appropriate fiscal stance and skillful expenditure management. Wage increases for civil servants would need to be limited, and expenditure would need to be geared to improving infrastructure, education, and health. Expenditures on rural electrification and transportation could help raise productivity. On the monetary side, the authorities need to improve liquidity and reserves management, and ensure that excess liquidity does not generate excessive credit creation.

16. **Hydropower projects in Bhutan have been financially viable, and are likely to produce significant dividends in the future as well**. Tala has come on stream, despite some delays. The expected returns to Tala and Puna I are favorable. Strong ties with India are expected to mitigate project-related risks.