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BHUTAN

HYDROPOWER EXPORT BOOM:

ITS MACROECONOMIC IMPACTS AND POLICY IMPLICATIONS

September 2002

CURRENCY EQUIVALENTS

Currency Unit = Ngultrum (Nu)
US$1 = Nu 48.32
(September 18, 2002)

FISCAL YEAR

July 1 to June 30

ABBREVIATIONS AND ACRONYMS

BoP	-	Balance of Payment
BRER	-	Bilateral Real Exchange Rate
CPI	-	Consumer Price Index
CSO	-	Central Statistical Organization
DoP	-	Department of Power
FDI	-	Foreign Direct Investment
GDP	-	Gross Domestic Product
GoI	-	Government of India
IMF	-	International Monetary Fund
INR	-	Indian Rupee
MU	-	Mega Unit
MW	-	Mega Watt
Nu	-	Bhutanese Ngultrum
RMA	-	Royal Monetary Authority
UNDP	-	United Nations Development Programme
WPI	-	Wholesale Price Index

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EXECUTIVE SUMMARY

Bhutan has shown remarkable economic performance over the last two decades. Growth during the second half of the 1990s was particularly strong, with annual GDP growth averaging 6.5 percent. A large part of this performance has been supported by generous inflows of foreign aid and buoyant electricity exports to India, which have spurred growth both directly by expanding export earnings and indirectly by stimulating investment in the construction and transport industries. Growth prospects for Bhutan look bright, supported by enormous hydropower generation potential. In particular, the scheduled commissioning of the Tala hydropower project in 2005/06 is expected to give a major boost to growth by tripling the country's power generation capacity.

While the expansion in power exports has brought significant benefits to Bhutan, there has been concern that it may not be an "unmitigated blessing." Despite large net inflows of foreign capital, Bhutan's macroeconomic indicators suggest that inflation has so far been modest and under control. Over time, however, the real value of the ngultrum has appreciated steadily against the Indian rupee, eroding Bhutan's export competitiveness with India. Concern has been raised whether this is a sign of the Dutch disease caused by increased power exports to India, and whether additional foreign exchange inflows, including power export earnings and the World Bank's financial assistance, may undermine Bhutan's growth prospects by discouraging production and investment in the tradable sector such as agriculture and manufacturing.

The results of the empirical analysis of the Bhutanese economy indeed confirm that the power exports to India as well as financial assistance have caused real appreciation of the ngultrum against the rupee over time, through increased private spending and short-term monetary disequilibrium. Despite the real appreciation, however, the study finds little evidence to suggest contraction or stagnation of the non-power tradable sector. While the performance of the tradable sector may have been stronger in the absence of the real appreciation, thus far there is no sign of the Dutch disease, or the Dutch condition, in the Bhutanese economy.

Nevertheless, our empirical results indicate that further increases in power exports as well as foreign aid – regardless of which currencies they are denominated in – will likely put further upward pressure on the real value of the ngultrum against the rupee and could lead to the Dutch condition. Although there is no immediate threat that requires urgent policy attention, the country's long-term growth prospects will also depend on how effectively the Government uses the increasing power rents and foreign aid, and how well the Government manages the exchange rate.

1. INTRODUCTION

Bhutan has shown remarkable economic performance over the past two decades. Growth during the second half of the 1990s was particularly strong, with annual GDP growth averaging 6.5 percent. A large part of this performance has been supported by generous inflows of foreign aid and buoyant electricity exports to India, which have spurred growth both directly by expanding export earnings and indirectly by stimulating investment in the construction and transport industries. Growth prospects for Bhutan look bright, supported by enormous hydropower generation potential. In particular, the scheduled commissioning of the Tala hydropower project in 2005/06 is expected to give a major boost to growth by tripling the country's power generation capacity.

While the expansion in power exports has brought significant benefits to Bhutan, there has been concern that it may not be an "unmitigated blessing." Despite large net inflows of foreign capital, Bhutan's macroeconomic indicators suggest that inflation has so far been modest and under control. Over time, however, the real value of the ngultrum has appreciated steadily against the Indian rupee, eroding Bhutan's export competitiveness with India.

The 2000 *Country Assistant Strategy for Bhutan* views this as a sign of the Dutch disease caused by increased power exports to India, and suggests that additional foreign capital inflows, including further expansion of power export earnings and the World Bank's financial assistance, may undermine the country's growth prospects as real appreciation tends to discourage production and investment in the tradable sector such as agriculture and manufacturing.

This paper examines empirically the macroeconomic impacts of Bhutan's increased power exports to India. It is the first serious attempt to address the presence of the Dutch disease in the Bhutanese economy. Previous attempts had been hampered by lack of sufficiently long time-series data.[1] Four sets of key questions are addressed in this study: (i) what are the features of the power export boom in Bhutan? Is it a temporary or permanent phenomenon? How large are power exports? (ii) Have power exports appreciated the real value of the ngultrum? If so, would further increase in power exports put further upward pressure on the ngultrum? (iii) What have the impacts on the tradable sector been? Are there Dutch-disease symptoms? (iv) Are these impacts sizable enough to require policy interventions? If so, what kind of policy options are then available to the Government?

The results of the study may help the Royal Government of Bhutan formulate appropriate policy strategies to make effective use of power income to improve its population's living standards and well-being, while reducing heavy reliance on the foreign aid in order to achieve a self-sustained economy in the long-run.

The structure of this paper is as follows. Section 2 reviews the mechanism of how a natural resource export boom can lead to real appreciation and then to contraction of the tradable sector – that is, how the Dutch disease can happen. Section 3 then examines empirically Bhutan's power exports and their impacts on the domestic economy in line with the discussions in Section 2. It first discusses the features of Bhutan's power exports and assesses the main impacts on national

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[1] Data sets are available upon request.

income, government revenues, and external positions. It then empirically investigates the impacts on the real exchange rate and analyzes the impact on the economic structure in Bhutan. Section 4 provides a set of policy implications to the Government. Section 5 concludes the paper.

2. MINERAL EXPORT BOOM, REAL EXCHANGE RATES AND DUTCH DISEASE

A natural resource export boom can cause major distortions in an economy by discouraging production and investment in the non-booming exportables sector, often referred to as the "Dutch disease."[2] The extensive literature on the subject has been surveyed by Corden (1984) and Neary and van Wijnbergen (1986).[3] The discussion here is concise and selective. It serves only to provide the background information necessary for the analysis in Section 3.

2.1 Spending Effect

The Dutch disease can be analyzed in the context of two separate effects in the real sector – a spending effect and a resource movement effect – and a monetary effect (see Figure 1).

Let us assume a natural export boom. First, there will be a rise in real income. The increased real income will raise spending on both tradables and non-tradables through the income effect, in the form of government expenditures and private spending, thereby stimulating the demand for both goods.[4,5] However, since the prices of tradables are determined on the world market, the higher domestic demand does not push up the prices of tradables. Any excess demand for tradables is met by an increased volume of imports.

The domestic prices of non-tradables, in contrast, will rise in response to the higher demand.[6] Accordingly, there is a decline in the prices of tradables relative to the prices of non-tradables, which by definition is real appreciation of the home currency.[7] The extent of the real

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[2] Named because of the Netherlands' experience with the discovery of natural gas in the 1970s.

[3] Also see Buiter and Purvis (1983), Corden and Neary (1982), Eastwood and Venables (1982), Neary and van Wijnbergen (1984), and van Wijnbergen (1984). Amongst the literature, a formal analysis developed by Corden and Nearly (1982) has become a standard model in the literature. For computable general equilibrium model, see Bruno and Sachs (1982).

[4] Provided that both tradables and non-tradables are normal goods.

[5] The response of expenditure to real exchange rates does not matter whether the expenditure comes from the public or the private sector. According to Vaey-Zadeh (1989), even if all the windfall income accrues to the government, increases in mineral rent tend to generate a positive "confidence effect" on consumers, affecting aggregate expenditure by the private sector.

[6] Provided that there is no corresponding expansion in the domestic supply of non-tradables.

[7] Note that the (bilateral) real exchange rate of the home currency against the foreign currency, $BRER$, can be expressed as $BRER_t \equiv eP_t^T / P_t^{NT}$, where e is the fixed nominal exchange rate of the home currency, P_t^T the prices of tradables and P_t^{NT} the prices of non-tradables. Namely, the real exchange rate is merely the relative prices of tradables to non-tradables. A decline in $BRER$ indicates real appreciation of the home currency. BRER is frequently used to measure the relative profitability of producing tradables compared with non-tradables. A fall in BRER (real appreciation) indicates a loss of profitability by producing tradables relative to producing non-tradables, and vice versa.

Figure 1. Dutch Disease (Dutch Condition)


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                      ┌─────────────────────────────────┐
                      │   Natural resource export boom   │
                      └─────────────────────────────────┘

      Real Sector                              Monetary Sector

   ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐         ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
   │  Increase in real income │       │    Current account surplus    │
   │                          │       │         BoP surplus           │
   │  Confidence    Income    │       │                               │
   │   effect       effect    │       │   Fixed           Floating    │
   │                          │       │  ex.rate regime  ex.rate regime│
   │  Spending on both tradables│     │                               │
   │  & non-tradables increase│       │ Reserve          Nominal       │
   │                          │       │ accumulation    appreciation   │
   │  Spending  effect        │       │                               │
   │                          │       │ Money supply increases beyond  │
   │  Relative price of tradables│    │ demand for money (= monetary   │
   │  to non-tradables declines│      │ disequilibrium)                │
   │                          │       │              Monetary effect   │
   └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘         └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
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Real appreciation
(Relative price changes)

Reduces incentives for production &
investment in tradable sector

Resource movement effect

Resources move out of tradable to non-tradable sector

Dutch disease (Dutch condition)

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appreciation depends on the extent to which the prices of non-tradables rise relative to prices in tradables, namely on the marginal propensity to spend on non-tradables. This is the spending effect of increased real income.

2.2 Resource Movement Effect

Second, the real exchange appreciation will induce a consequent shift of resources from non-booming tradables to non-tradables, by reducing incentives for production and investment in the non-booming tradable sector.

With real appreciation of the home currency, the prices of tradables competing with imports in the domestic market as well as the prices of tradables sold in the competitive world market will tend to fall. As a result of the relative price change (real appreciation), incentives for production and investment in the non-booming tradable sector will likely decline in favor of the non-tradable sector. The growth rate of exports in the non-booming tradable sector will therefore slow, while the volume of imports will increase. Correspondingly, there will be a shift of labor and capital away from the non-booming tradables in favor of non-tradables, which will raise the real wage and lower the returns to capital accumulation. Wage rigidities may give rise to unemployment and productivity will decline in the non-booming tradable sector.

Real appreciation may also reduce the rents of the booming sector provided that the booming sector participates in domestic factor markets, but it may not be sufficient to bring down the booming sector's output. When the booming sector operates as an enclave sector, there will be no resource movement out of the booming sector.
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In summary, real appreciation driven by a natural resource export boom tends to slow down the rate of growth of the non-booming tradable sector relative to the rate of growth in the non-tradable sector, worsening the trade balance.

These adjustments following an export boom – contraction of the tradable sector relative to the non-tradable sector – summarize the classic model of the Dutch disease, which is accompanied by real appreciation of the home currency (decline in relative prices).[8,9] It is a natural factor movement due to changes in relative prices, and is a natural welfare improving symptom of the economy's adjustment to its new equilibrium.

Despite its name, however, the Dutch disease itself does not constitute a "disease" for which corrective actions are called for, but is a "condition" where real appreciation caused by a natural resource export boom leads to a shift of resources from the non-booming tradable sector to the non-tradable sector. Thus it would be more accurate to refer to it as the "Dutch condition" rather than the "Dutch disease." Whether the Dutch condition leads to a real disease largely depends on the country's policy responses to the boom. In the case of Nigeria, the economic deteriorations

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[8] Although the Dutch disease is usually discussed in the context of natural resource export booms, it can happen with any types of foreign capital inflows if they raise domestic spending through increased real income.

[9] While real exchange rate variabilities, often evidenced in countries experiencing a natural resource export boom, pose a threat to macroeconomic stability, they do not constitute a pre-condition leading to the Dutch disease. Regardless of the presence of exchange rate variabilities, with real appreciation, resources tend to move away from the tradable sector to the non-tradable sector.

Box 1. Nigeria's Dutch Disease

During the 1970s, Nigeria enjoyed an oil export boom as a result of dramatic increases in the prices of oil. The resulting real appreciation of the Nigerian naira reduced the relative export prices of non-booming tradable goods and subsequently damaged Nigeria's manufacturing and agricultural sectors. The Government responded to the boom with increased expenditures financed by external borrowing against the strength of oil, as well as a monetary expansion that was followed by high inflation. When the oil boom ended abruptly in the 1980s, Nigeria was left with deterioration of balance of payments, and a resulting loss of international reserves and large foreign indebtedness. The consequence was a substantial decline in output.

In the case of Nigeria, it was more of a poor policy response, rather than the resource movement out of the non-booming tradable sector, that was the most important cause of affliction, often erroneously referred to the Dutch disease.

that followed the oil export booms in the 1970s were clearly the direct result of the Nigerian government's inappropriate policy responses to the temporary boom, but not the direct result of the Dutch condition itself (see Box 1).

2.3 Export Boom and Monetary Effects

A standard Dutch disease model does not include the monetary factor. Hence, emphasis has been placed only on the spending and resource movement effects. However, natural resource export booms are also likely to have an important monetary effect through net reserve accumulation (under a fixed exchange regime) or nominal appreciation of the home currency (under a floating exchange rate regime).

Under a fixed exchange rate regime, the increased price of the booming natural resource will tend to raise the supply of money by generating a balance of payments surplus and a net accumulation of international reserves or capital outflows. Unless the increase in international reserves is fully sterilized, the real money supply could increase beyond the demand for money, generating short-term monetary disequilibrium. Inflation will tend to result in further real appreciation of the home currency, exacerbating the Dutch condition. Under a floating exchange rate regime, nominal appreciation of the home currency leads to real appreciation, without reserve accumulation and with partial sterilization. This monetary channel, however, would operate only in the short-run, affecting the dynamics of the real exchange rate. In the long-run real exchange rates respond only to changes in the real fundamentals.

3. EMPIRICAL ANALYSIS: BHUTAN'S POWER EXPORTS AND MACROECONOMIC IMPACTS

This section analyzes empirically how the expansion of hydropower exports to India has affected the Bhutanese economy. It addresses a number of important questions: Is the real appreciation of the ngultrum associated with power exports? Have power exports led to an increase in spending

by the Government and the private sector through increased real income, thereby resulting in appreciation of the ngultrum? What are the impacts on the tradable sector? Has there been a relative decline in the tradable sector? What about the monetary effect of power exports? Would further expansion in power exports undermine the growth prospects of Bhutan's tradable sector?

This section first provides the background information about Bhutan's power sector – the booming tradable sector – and discusses the main impacts of power exports on national income, government revenues and external positions. Next, it focuses on the movement of the real exchange rate of the ngultrum. A formal statistical analysis is conducted to examine whether power exports have indeed led to real appreciation of the ngultrum. Finally, it analyzes how the domestic economy has responded to the increased power exports. We examine the presence of the Dutch condition in the Bhutanese economy in terms of a spending effect, a resource movement effect, a monetary effect.

3.1 Power Sector

3.1.1 Background

Bhutan's hydropower exports began in 1987 with the commissioning of the 336MW Chukha hydropower project, which has boosted GDP directly through export earnings and indirectly through the growth of the construction and transport industries, as well as energy-intensive industries such as cement, ferro-alloys, and calcium carbide. According to the long-term bilateral purchase agreement between Bhutan and India, after Bhutan's domestic demand is met, all surplus supply of power is exported to India, whose vast market suffers chronic excess demand.

The power sector operates as an enclave sector in the Bhutanese economy. It does not participate in the domestic factor markets. The sector generates very little domestic employment and tends to use expatriate labor from India. Financing is provided exclusively by India. Thus, there is no resource movement between the power sector and the rest of the economy in Bhutan.

Over time, sales of hydropower have grown to become Bhutan's dominant source of export earnings. In 1999, power exports generated nearly 40 percent of Bhutan's total export earnings, and accounted for about 13 percent of GDP (see Figure 2). Tariff revisions in the late 1990s caused the growth of power exports to accelerate (see Figure 4). The commissioning of the Kurichhu project in the late 2001 is expected to add still more export revenues to the country beginning in 2002/03. By 2005/06, Bhutan's power export capacity is set to triple, with the commissioning of the Tala project (1,020 MW), but still up to only about one-tenth of the country's technically viable potential (16,000 MW).[10]

The tariff of electricity exports from the Chukha plant is set bilaterally with India at the political level. The nominal tariff has been revised every two or three years since 1992 primarily to keep pace with inflation (see Figure 5). Since 1996, however, the nominal tariff has been revised more frequently and more sharply. The real tariff of power more than doubled between 1996 and 2000 (see Figure 5).

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[10] Bhutan is endowed with enormous hydropower generation potential. The total capacity is estimated to be about 30,000 MW, of which over 16,000 MW is technically viable.

Figure 2. Bhutan: Power Exports (as percentage of total exports, GDP)
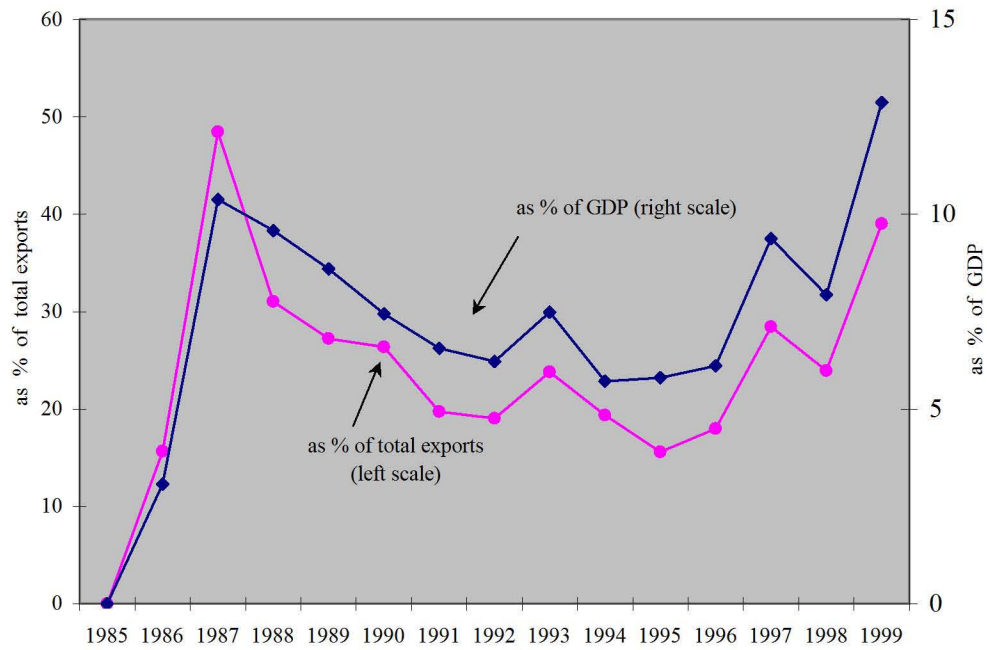
Figure 3. Bhutan: Volume of Sales by Chukha Hydropower Corporation (in mega unit)
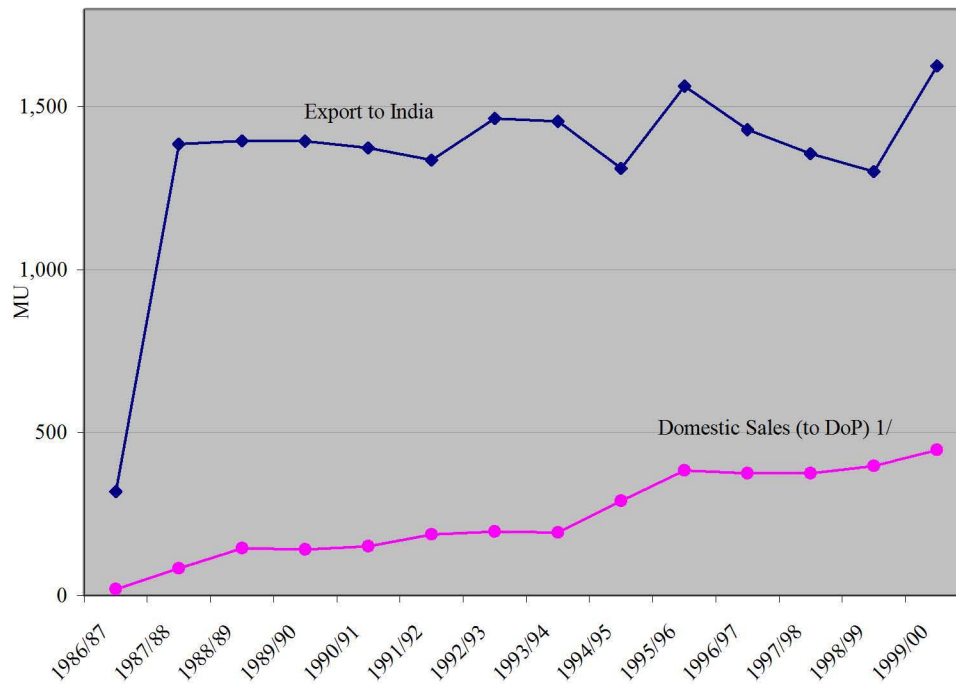
1/   Sale of electricity to the Department of Power, DoP, which distributes electricity domestically.
Source: Data provided by the Bhutanese authorities.

Figure 4. Bhutan: Power Tariff per Unit (in ngultrum)

Export Price

Domestic Price (to
DoP) 1/

1986/87 1987/88 1988/89 1989/90 1990/91 1991/92 1992/93 1993/94 1994/95 1995/96 1996/97 1997/98 1998/99 1999/00 2000/01

Figure 5. Bhutan: Real Power Tariff per Unit (in constant 1980 ngultrum)

Export price

Domestic price
(to DoP)

1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
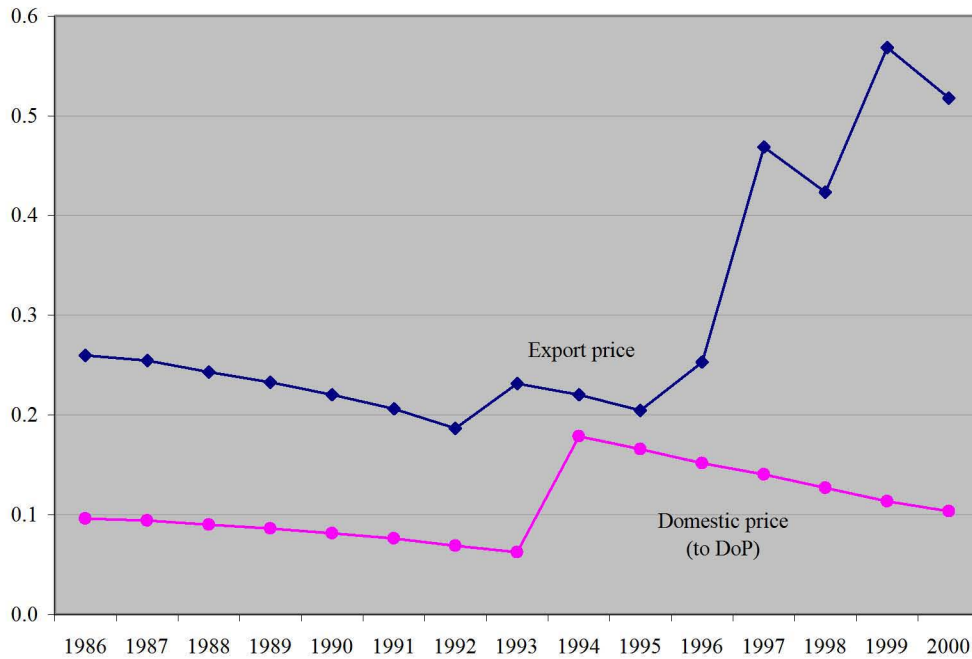
1/ The price at which power is sold to the DoP. DoP applies different tariff rates for domestic
power supply.
Source: Data provided by the Bhutanese authorities.

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The tariff for power to be exported from the Tala project, in contrast, will likely be determined at the commission level and take generation costs into account. Therefore it is expected to be closer to the market price. Payments for power sales, as well as all other imports and exports between Bhutan and India, take place in the Indian rupee according to the bilateral free trade agreement between the two countries.

The Government of India (GoI) has provided financial assistance (in the Indian rupee) for the construction of all major power plants, except the Basuchu project, which was built for domestic purposes only and was financed by Austria. Each GoI financing consists of 60 percent grant elements and 40 percent soft loan elements.

Chukha Hydropower Corporation is a government-owned corporation that is managed by the Department of Power in the Ministry of Trade and Industries. It is not a foreign direct investment from India. The export proceeds realized by the corporation are channeled to the Government via surplus transfers, corporate taxes and dividend payments. All the investments in the power sector are recorded outside the government budget.

Under the Electricity Act approved by the National Assembly in July 2001, the utility side of the Chukha Hydropower project was corporatized in July 2002. A regulatory body, the Bhutan Electricity Board, was also set up at this time. All other power plants, including those to be commissioned in the future (such as the Tala project), will be merged into Chukha Hydropower Corporation

Because of Bhutan's long-term sales agreement with India, electricity export earnings from India will continue to be a permanent source of income to Bhutan. The risks of reduced demand from India is likely to be very small. At present, Bhutan supplies less than 0.5 percent of India's demand. While internal demand in Bhutan will also rise substantially with progress in the Rural Electrification Program (supported by the Asian Development Bank), the rise in Bhutan's power generating capacity (when the Tala project is completed) is expected to meet both Bhutan's expected demands and a larger part of India's as well. The risks of sharp contractions in electricity supply as a result of technical and climate change are also considered to be low.[11] Bhutan's power plants are operated as run-of-the-river schemes and are environmentally benign.

Unlike other natural resource export booms based on exhaustible resources (such as oil, gas, coal, copper), Bhutan's hydropower is renewable and environmentally friendly, constituting a permanent resource for exports. Looking ahead, the power sector is expected to continue to be the main engine of growth in the country and a source of significant rupee earnings.

3.1.2 Impacts on National Income

Regular power exports to India since 1987 have permanently raised the level of Bhutan's national real income.

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[11] However, in May 2002 the power generation of the Kurichhu project was severely disrupted by a heavy storm, which damaged two transmission towers and two conductors. The damages also disrupted the supply of power from Kurichhu to India, causing a revenue loss of about Nu.8 million, equivalent to US$170,000 or 11 days of power generation from the Kurichhu project.
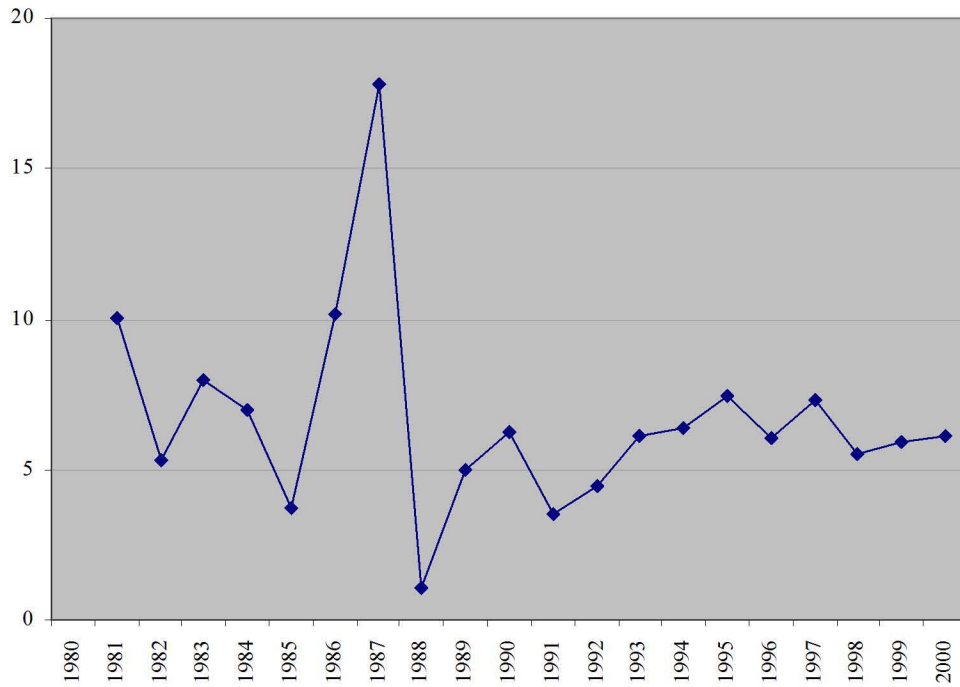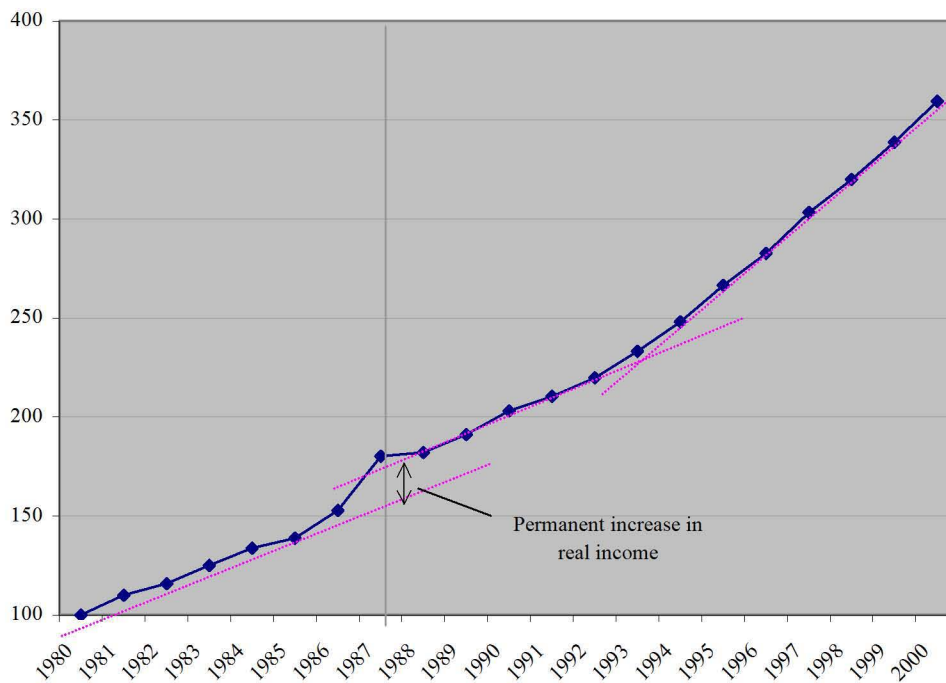
Figure 6. Bhutan: GDP Growth Rate (in percent per annum)

Figure 7. Bhutan: Index of GDP (1980 = 100)

Permanent increase in real income

Source: RMA Annual Reports (various issues.)

A plotting of the real annual growth rate of GDP in Bhutan for the period 1980-2000 shows a large spike (18 percent) in 1987, followed by a sharp decline to one percent in the following year, indicating that the regular power exports to India had a large "level effect" on GDP (Figure 6). However, the magnitude of the level effect should not be over-emphasized. First, fiscal year1987 was 15 months long (April 1, 1987 – June 30, 1988) due to the transition from old fiscal years (April 1 – March 30) to new ones (July 1 – June 30) that occurred in 1988. Strictly speaking, therefore, the growth rate in 1987 is not comparable to that of other years. If equally appropriated, the 12-month growth rate of the fiscal year 1987 could have been around 14 percent.

The index of GDP shown in Figure 7 indicates that the "accelerating effect" on the growth rate may have been marginal during the initial years after the power export had began. In the late 1990s GDP grew at an accelerating rate as the result of the tariff revisions.

3.1.3 Impacts on Government Revenues

Power exports have also contributed significantly to a rise in government revenues through increases in the corporate tax revenue, surplus transfers and dividend payments from Chukha Hydropower Corporation.

Figure 8 shows government tax and non-tax revenues together with power exports as percent of GDP over the last two decades. Although the Government does not publish the breakdown of revenues, it is evident from Figure 8 that there is a high correlation between government non-tax revenue and power export proceeds. The level of government non-tax revenue has risen significantly since 1987, most likely as a result of surplus transfers and dividend payments from Chukha Hydropower Corporation. In contrast, government tax revenue has risen gradually over time.

The overall fiscal position was more or less balanced during the 1990s (see Figure 9). From 1998 on, however, the fiscal position began to deteriorate. The fiscal deficit widened significantly from 1.9 percent of GDP in 1998 to 4.0 percent of GDP in 1999, and further to 6.1 percent of GDP in 2000. This fiscal easing is viewed as a reflection of increased capital expenditures related to the construction of new power projects, which are temporary in nature and financed exclusively by foreign aid.

3.1.4 Impacts on External Positions and Reserves

Because of the special relationship with India, Bhutan maintains two sets of external accounts: one with India denominated in the Indian rupee, and the other with countries other than India, or the "third countries" in the Bhutanese term, denominated in the US dollar.

(i) Current Account

Bhutan's current account position with India has improved markedly as a result of regular power exports. While Bhutan has continued to run a current account deficit with India throughout the past two decades, the magnitude of deficit has shrunk considerably since regular power exports began in 1987 – from the average of 38.4 percent of GDP for 1980-86 to the average of 10.2 percent of GDP for 1987-99 (see Figure 10). Between 1995 and 1997 net exports (trade balance) were even in surplus, but larger net transfer payments kept Bhutan's current account balance with India from turning positive.

Figure 8. Bhutan: Government Tax and Non-tax Revenues and Power Exports
(as percentage of GDP)
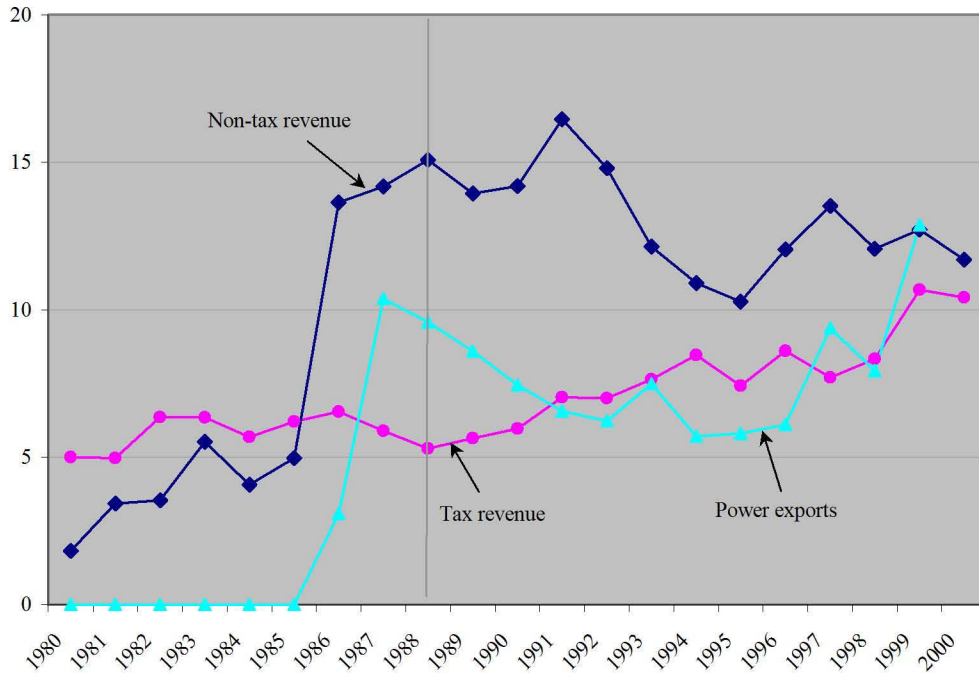
Source: RMA Annual Reports (various issues.)

Figure 9. Bhutan: Fiscal Development (as percentage of GDP)
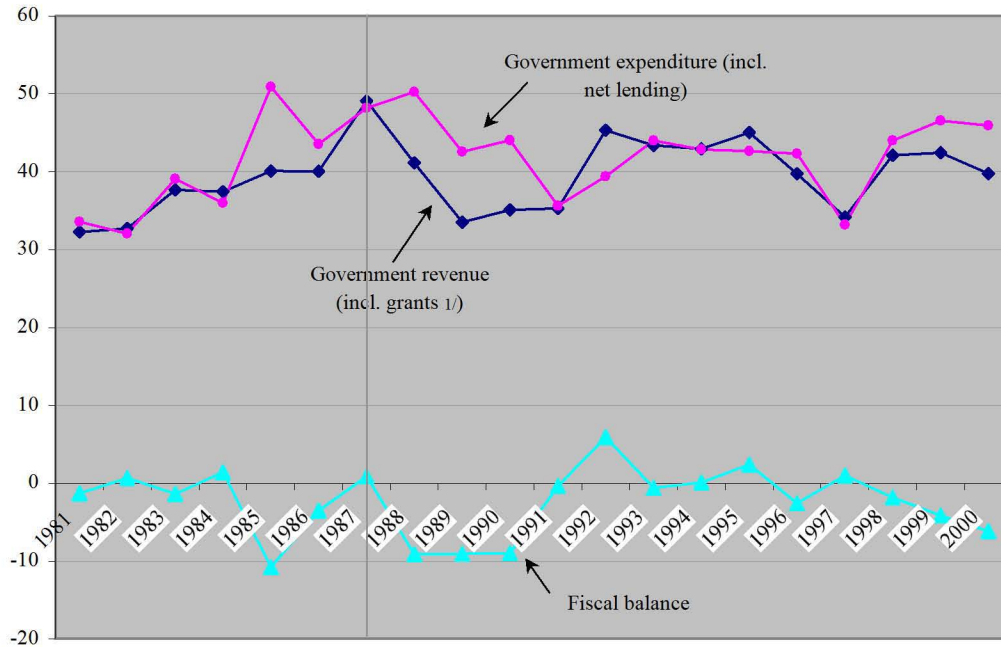
1/ Grants are both from India and countries other than India.
Source: RMA Annual Reports (various issues.)

Figure 10. Bhutan: Current Account Transactions with India (as percentage of GDP)

Imports from India

Exports to India

Current account balance with India
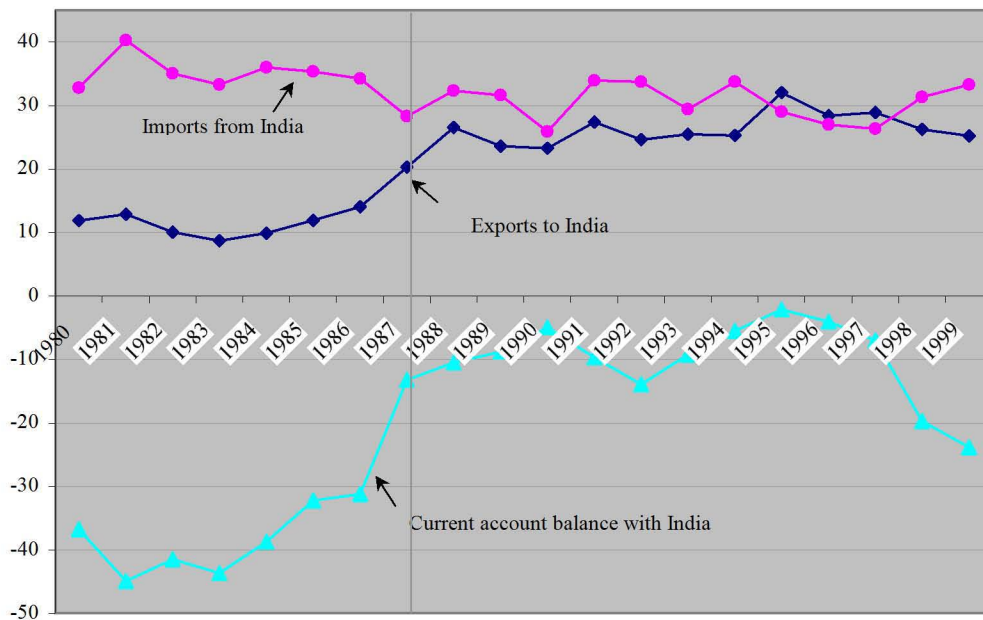
Source: RMA Annual Reports (various issues.)

Figure 11. Bhutan: Net Capital Inflows from India and Power Export Revenues
(as percentage of GDP)

Net catpial flows from
India 1/

Power export revenue
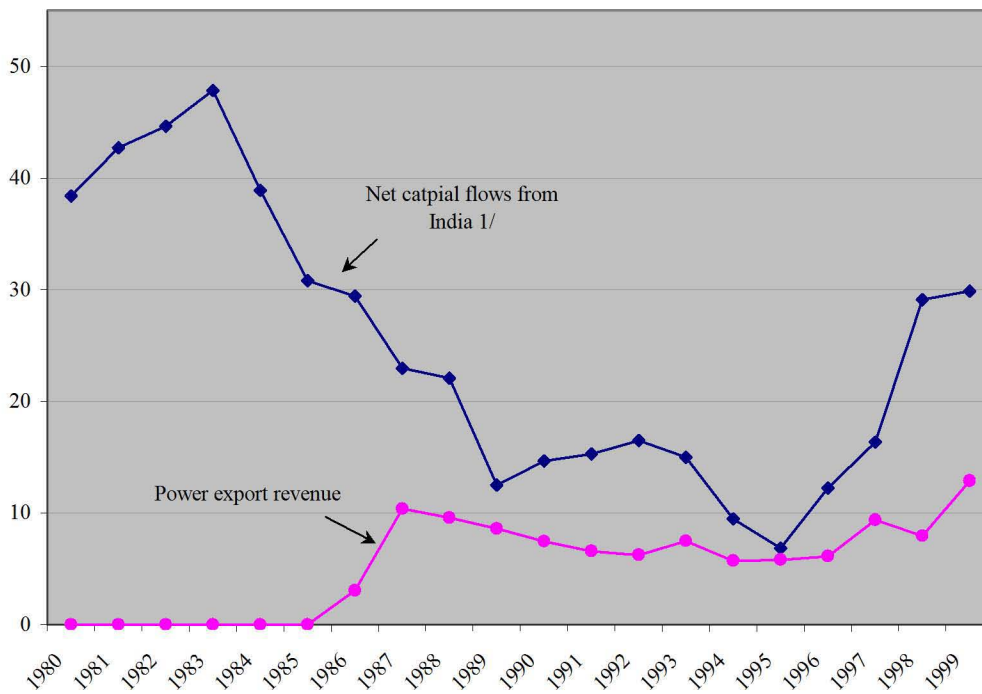
Source: RMA Annual Reports (various issues.)
1/ Consist of concessional loans and grants.

Figure 12. Bhutan: Balance of Payments (as percentage of GDP)

BoP w/ third countries

BoP w/ India
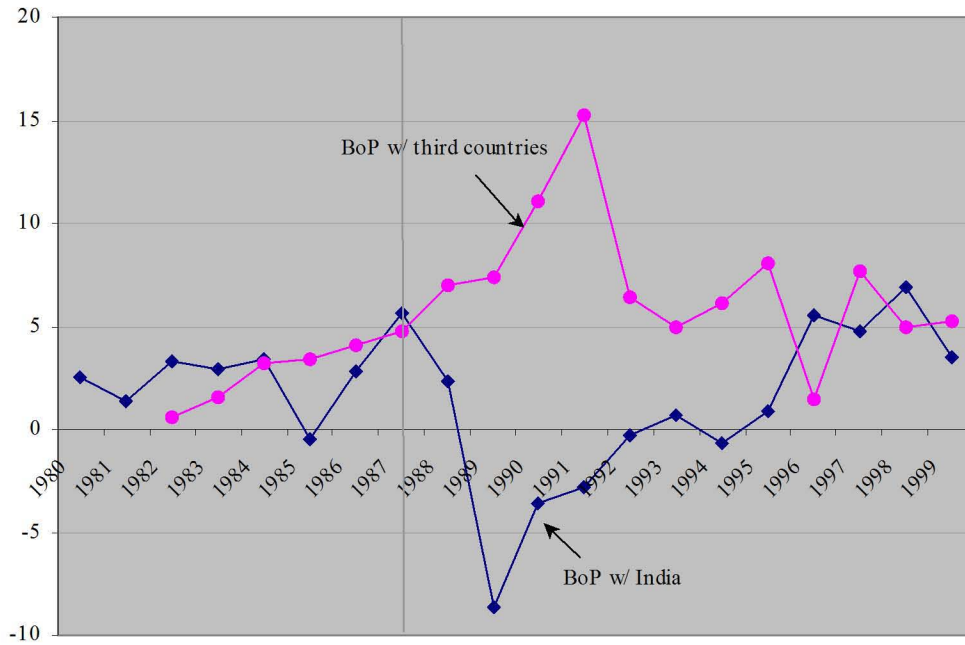
Source: RMA Annual Reports (various issues.)

Figure 13. Bhutan: Current Account and Balance of Payments with Third Countries
(as percentage of GDP)

Imports from
third countries

BoP w/ third countries

Current account w/ third countries

Source: RMA Annual Reports (various issues.)

Figure 14. Bhutan: Net Capital Inflows by Countries of Origin (as percentage of GDP)
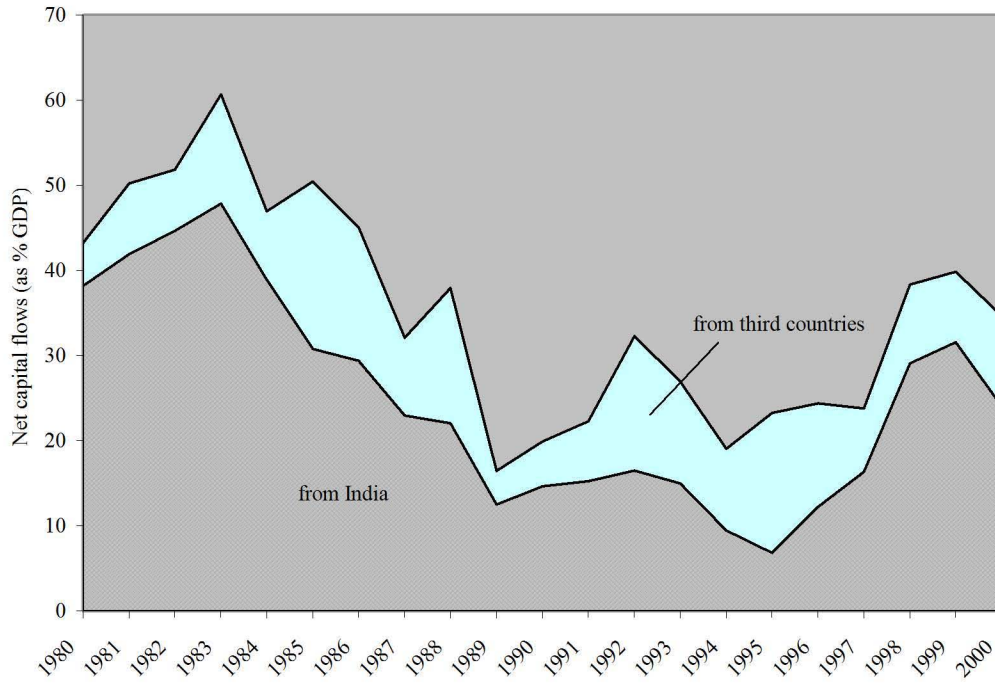
Source: RMA Annual Reports (various issues.)

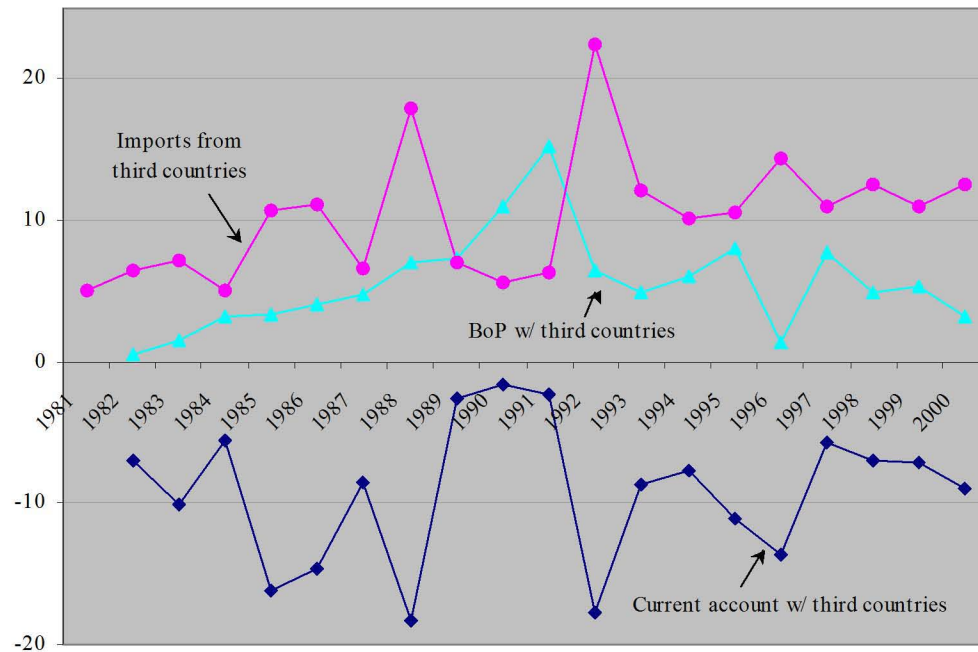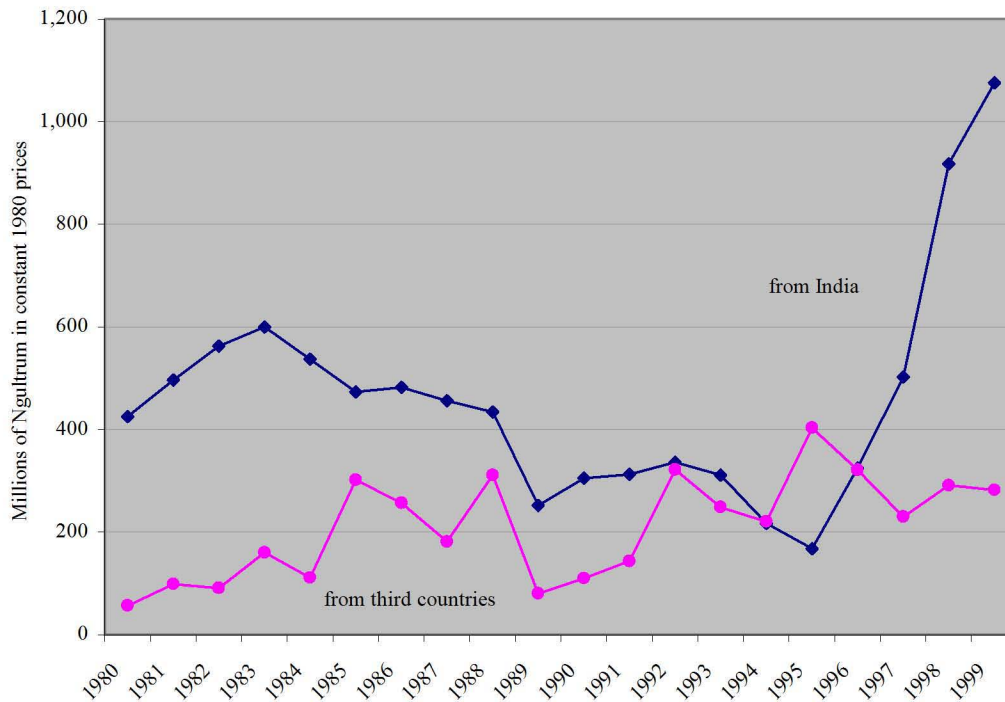Figure 15. Bhutan: Net Capital Inflows (in millions of ngrultrum, constant 1980 prices)

Source: RMA Annual Reports (various issues)

Figure 16. Bhutan: Gross Rupee and Hard Currency Reserves
(in millions of US dollars)
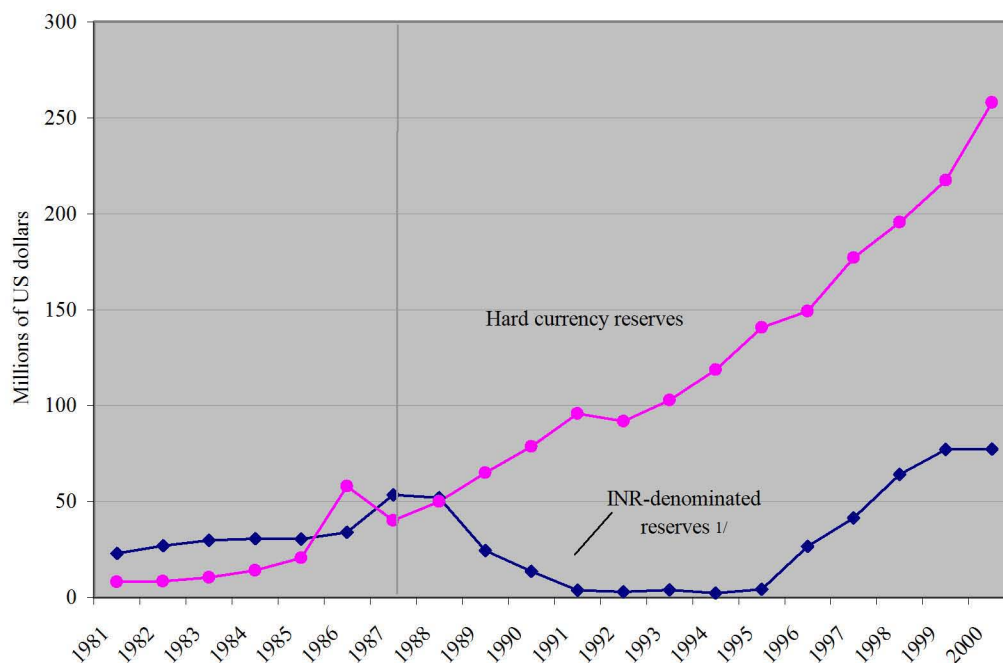
1/ Rupee-denominated reserves are converted to the US dollar using the nominal exchange rate.
Source: RMA Annual Reports (various issues).

Beginning in 1996, however, Bhutan's current account deficit with India began to widen. The current account position worsened from –2 percent of GDP in 1995 to –24 percent of GDP in 1999. It is clear that power exports had a positive effect on Bhutan's current account position up to 1995, but thereafter the net effect is ambiguous. Data indicate that imports of machinery, transport, mechanical appliances, and mineral products as well as base metal and base metal products have grown sharply since 1998. These are viewed to reflect increased imports of capital goods and intermediate goods related to the construction of new power projects and thus are temporary. However, in the absence of disaggregated data, the source of the increased current deficits is not clear.

Data also indicate that imports of non-durable consumer goods (in particular food items) have grown substantially, although a strict distinction between imports of consumer goods and capital goods is often difficult.[12] It is likely that power exports have fueled private consumption through the income effect. The Bhutanese authorities expect this trend to continue.

(ii) Balance of Payments

Notwithstanding the persistent current account deficits, Bhutan's balance of payments with India has been in significant surplus most of the time, except for the 1989-92 and 1994 periods. This has been attributed to large net capital inflows from India, comprising concessional loans and

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[12] The Bhutanese authorities noted that most of the economic growth for the past 5 years have been used to increase private consumption.

grants.[13] The magnitude of net foreign aid inflows has been large enough not only to finance current account deficits but also to turn the balance of payment position into a significant surplus. Figure 11 shows how large the aid flows from India have been in comparison to power exports.

In the early 1990s, when India suffered a balance of payments crisis, net capital inflows from India plunged sharply, causing deficits in Bhutan's balance of payments with India (see Figure 12). Even during this time, the magnitude of capital flows from India was still larger than power export revenues, although Bhutan's BoP deficit with India could have been 4-5 percent worse had there been no power exports. During this period, Bhutan financed its BoP deficit with India by running down the rupee reserves (see Figure 16). At the same time, imports from third countries were compressed significantly (see Figure 13) and Bhutan actively sought financial assistance form other countries (Figure 14), raising the US dollar BoP surpluses. The sharp rise in aid inflows from India in the late 1990s (Figure 15) reflects increased concessional financing for the construction of the 1,020MW Tala hydropower project, which is viewed as a short-term phenomenon.

(iii) International Reserves

Reflecting the strong BoP position with India, Bhutan has accumulated sizable rupee reserves (see Figure 16). Gross rupee reserves increased from Rs.71 million (US$2.3 million) in 1994 to Rs.3.6 billion (US$77 million) in 2000, equivalent to nearly 26 months of imports from India. Hard currency reserves have also increased steadily, reaching US$260 million in September 2000, equivalent to 6 moths of imports from countries other than India. Although Bhutan's international reserves may appear large when measured by months of imports, the authorities are concerned that purchase of two new aircraft planned in 2002/03, for example, would easily use up a large part of the country's hard-currency reserves, and noted that more reserve accumulation would be necessary to reach a comfortable level.

3.2 Power Exports and Real Exchange Rates

Have the increased power exports affected Bhutan's real exchange rates? If so, how has it happened?

Understanding the relationship between power exports and the exchange rate is very important to Bhutan's future macroeconomic management. Note that the country's power export earnings will triple within the next few years. If increased power exports have caused significant effect of appreciating the ngultrum against the rupee in the past, it is likely that the real exchange rate of the ngultrum will be significantly affected by the tripled power export earnings expected in the coming years. If the effect is deemed significant, the Government may need to counter these effects with appropriate policy responses.

This subsection answers the question raised above in four steps. First, as background information, the exchange arrangement in Bhutan is discussed. Second, the historical behavior of the ngultrum's real exchange rates is presented. In the third step, the historical movement of the exchange rate is compared with the historical movement of power exports. Finally, a formal statistical analysis is conducted to examine the relationship between the real exchange rates and power exports.

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[13] Since Bhutan receives no private capital inflows, except a very small scale of FDI, this paper uses capital inflows and foreign aid inflows (which consist of concessional loans and grants) interchangeably.

3.2.1 Bhutan's Exchange Rate System

Bhutan operates under a fixed exchange regime. Reflecting its special trade relationship with India, Bhutan's currency, the ngultrum, is fixed at par to the Indian rupee, which also circulates freely within Bhutan (as legal tender) and is the currency in which the bilateral trade between the two countries takes place. Goods move freely between the two countries, with India accounting for more than 80 percent of Bhutan's total trade and a substantial portion of its foreign aid.

Trade with countries other than India takes place in the US dollar and is an important source of hard-currency earnings for Bhutan. Since the exchange rate of the ngultrum against the rupee is one, the exchange rates of the ngultrum to the US dollar as well as to other non-rupee currencies are the same as the rupee exchange rates, which are determined on the basis of the prevailing quotations by the State Bank of India for those currencies.

3.2.2 Bilateral Real Exchange Rates (BRER)

Figure 17 shows the WPI/CPI-based bilateral real exchange rates of the ngultrum against the Indian rupee, BRER (Nu/INR), and against the US dollar, BRER(Nu/US$), as well as the bilateral real exchange rate of the rupee against the US dollar, BRER(INR/US$), for the period 1980-99 (see Appendix 1 for the measuring of BRER). Figure 17 indicates that BRER(Nu/INR), which is calculated using India WPI as a proxy for the prices of tradables and Bhutan CPI for

Figure 17. Bhutan: Bilateral Real Exchange Rates 1/
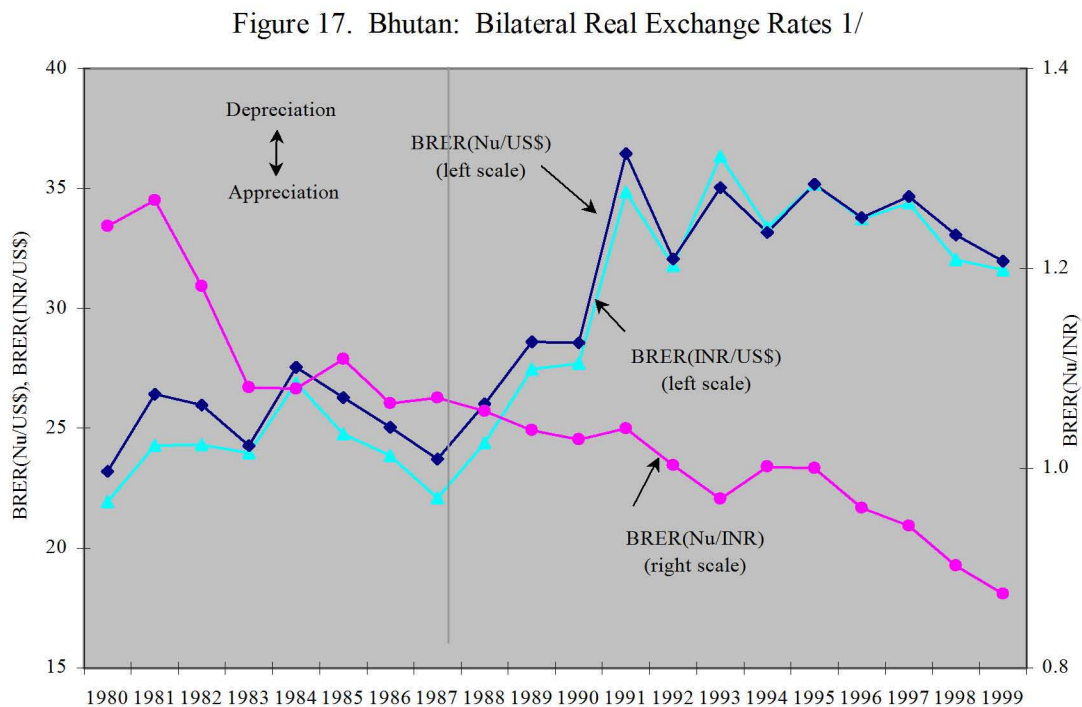
1/ The bilateral real exchange rates are calculated using CPI and WPI (base year = 1995).
Source: RMA Annual Report, IMF International Financial Statistics and World Bank staff estimates.

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Table 1. Cross-country Comparison: Bilateral Real Exchange Rate Variability

Country	Bhutan	Venezuela	Nigeria	Colombia
Exported commodity	Electricity	Oil	Oil	Coffee
Exchange variability [1/]	0.04	24.7	34.2	9.8
Period	1980-99	1980-00	1980-00	1980-00

1/ Measured as the standard deviation of the real exchange rate changes during the specified period.
Data source: IMF International Financial Statistics and World Bank staff estimates.

the prices of non-tradables, has been on the downward trend since 1981, meaning real appreciation of the ngultrum against the rupee. Given the fixed exchange rate, the real appreciation was driven primarily by the difference between Bhutan's CPI and India's WPI (see Figure 18). Between 1981 and 1999, the ngultrum appreciated by 45 percent against the rupee in real terms. The real appreciation was particularly rapid during 1981-83; the ngultrum appreciated by about 8 percent annually. On the other hand, 1984-94 saw a more gradual rate of real appreciation. The average annual real appreciation was 0.7 percent during this period. The appreciation accelerated again beginning in 1995, with the average annual appreciation being 2.5 percent for 1995-99.

It should be noted that BRER(Nu/INR) has shown a very steady movement, but not a volatile movement, as often seen in natural resource exporting countries. The exchange rate variability measured by the standard deviation of the BRER(Nu/INR) for the entire sample period is 0.02. This is significantly lower than that of other countries which experienced oil or coffee export booms in the 1980s (Table 1).

Figure 17 also shows a depreciating real exchange rate of the ngultrum against the US dollar, which is driven mainly by the real depreciation of the rupee against the US dollar. The sharp real depreciation of the rupee and the ngultrum to the US dollar in the early 1990s was driven by the balance of payments crisis of India. Note that BRER(Nu/US$) follows BRER(INR/US$) very closely. By definition, the gap between the two series represents a difference in CPI between Bhutan and India (see Figure 19), since the nominal exchange rate of the ngultrum to the rupee is one.

3.2.3 Bilateral Exchange Rates and Power Exports

Now that we have the historical behavior of the ngultrum real exchange rate, we are ready to examine its relationship with power exports. Hereafter, we focus only on the bilateral real exchange rate of the ngultrum against the Indian rupee. Given that Bhutan's primary trade partner is India, with whom power trade takes place, the exchange rate of the ngultrum to the rupee assumes more importance than any other rates. Unless otherwise specified, hereafter the "exchange rate" refers to the bilateral real exchange rate of the ngultrum to the rupee, BRER(Nu/INR). Similarly, "real appreciation" refers to real appreciation of the ngultrum against the rupee.

Figure 20 plots both BRER(Nu/INR) and real power exports from India for 1980-99. In Figure 20, there seems to be a negative relationship between the two series, that is, power exports seem to be negatively associated with real appreciation of the ngultrum against the rupee. While real

Figure 18. Price Indices: Bhutan CPI and India WPI (1980 = 100)

Bhutan CPI

India WPI
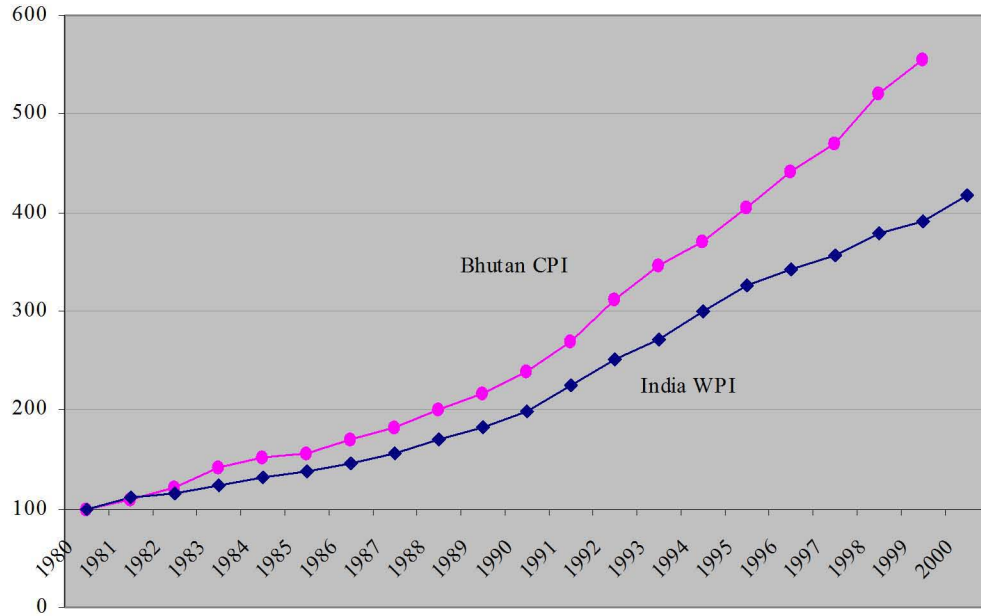
Source: IMF International Financial Statistics.

Figure 19. Price Indices: Bhutan CPI and India CPI (1980 = 100)

Bhutan CPI

India CPI
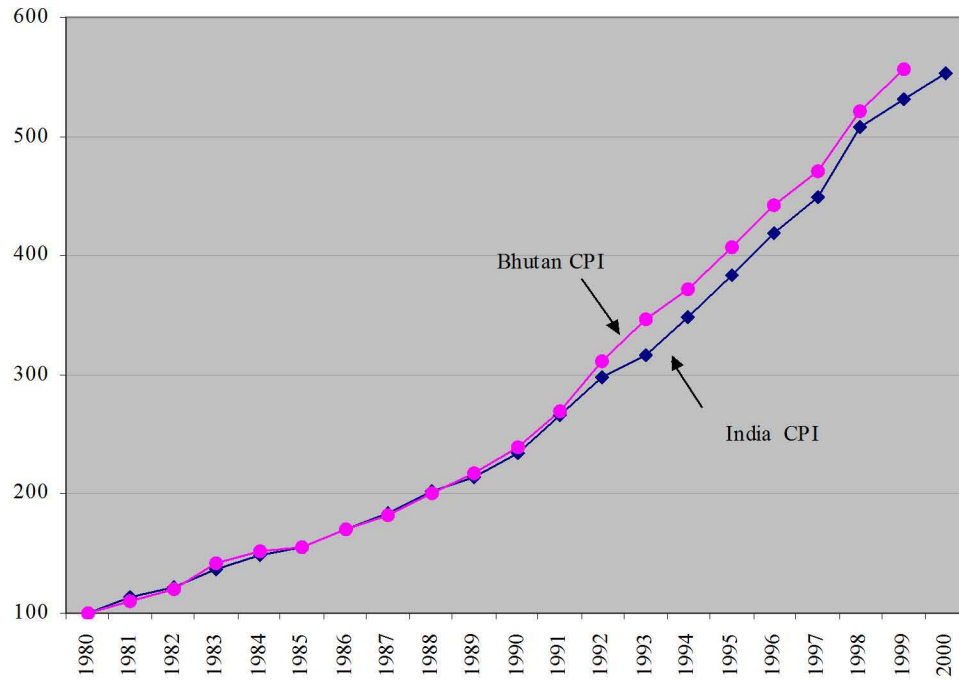
Source: IMF International Financial Statistics.

Figure 20. Bhutan: BRER(Nu/INR) and Power Exports to India (in millions of ngultrum, constant 1980 prices)
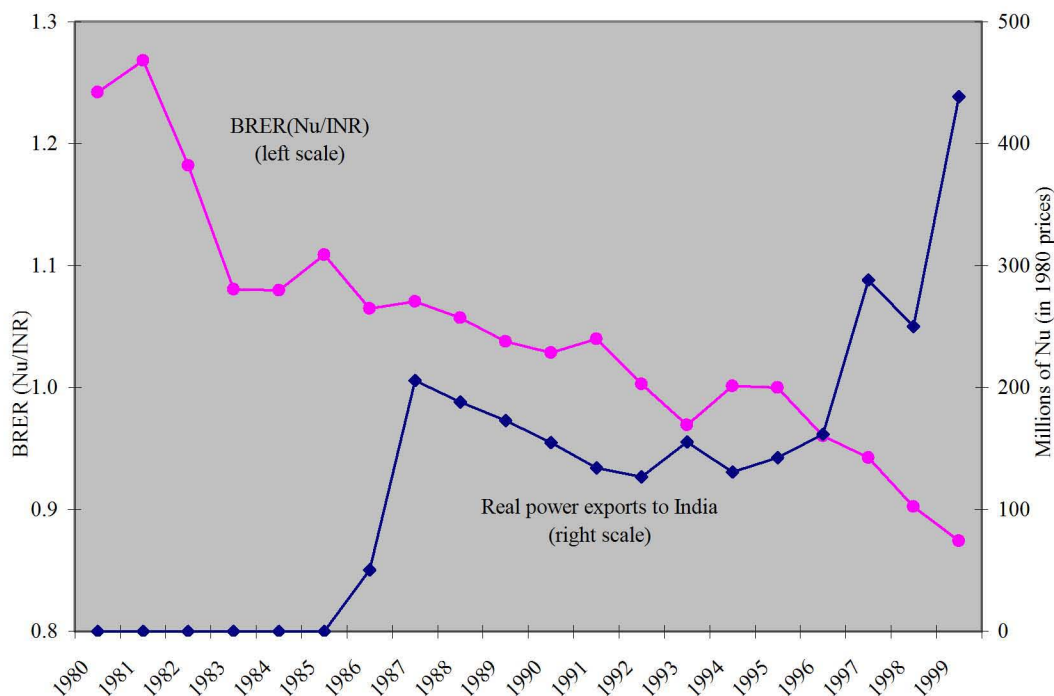
Source: Data provided by the authorities and World Bank staff estimates

appreciation started before the country began to receive regular power export income in 1987, the rate of appreciation accelerated in the late 1990s, when Bhutan's power export earnings increased substantially due to tariff revisions.

3.2.4 Empirical Analysis: Determinants of Bilateral Exchange Rate of the Ngultrum

To examine this relationship more formally, we have conducted a regression analysis using annual data for 1983-99, which is the longest period for which all variables are available.[14] The details of the empirical analysis are provided in Appendix 2. Here we present only the main findings.

The regression results indicate that increases in power exports have indeed caused real appreciation of the ngultrum over time. Both the power tariff (in real terms) and the volume of power exports appear to have contributed to the appreciation, implying that future increases in either variable are likely to cause further appreciation of the ngultrum.

The results also suggest that the real appreciation took place through the accumulation of international reserves (monetary effect), which have largely been affected by net capital inflows

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[14] While data on other variables are available for 1981-99, the monetary data are available only from 1983 onwards.

and power exports, rather than by power exports alone. Changes in government expenditure do not appear to have significantly affected movement of the ngultrum (that is, no significant spending effect by the Government), implying that a large part of the Government's spending may have been on tradables such as imported capital and intermediate goods instead of non-tradables. In other words, the marginal propensity to spend may have been lower on non-tradables than on tradables, or the private sector's spending on non-tradables may have been stronger than that of the public sector. Another possible explanation is that government expenditure is not a good proxy for government spending on non-tradables.

In summary, the real appreciation of the ngultrum has likely been caused by power exports and the monetary disequilibrium associated with large net capital inflows. An expansion in power exports or an increase in net capital inflows in the future, regardless of which currency they are denominated in, would likely put further upward pressure on the real value of the ngultrum against the rupee.

3.3 Power Exports and the Dutch Condition

We now turn to our second set of questions of this study. Has the real appreciation of the ngultrum reduced the incentive for production and investment in the tradable sector? Have there been resource shifts away from the non-power tradable to non-tradable sector? In other words, does Bhutan have the Dutch condition?

To address these issues, we closely follow the discussion in Section 2. We examine the domestic economy's adjustment to the increased power exports in light of (i) a spending effect; (ii) a resource movement effect; and (iii) a monetary effect.

We show below that increased power exports (and capital inflows) have caused real appreciation mainly through increases in private sector spending (spending effect) and through monetary disequilibrium (monetary effect). However, government expenditure on non-tradables appears to have had very little effect on the appreciation of the ngultrum. Despite changes in relative prices, we have found no evidence that production of the tradable sector has declined over time.

3.3.1 Spending Effect[15]

From Section 2 we know that the increased real income from a natural resources export boom is likely to lead to an increase in the prices of non-tradable goods relative to the prices of tradable goods (real appreciation) through a spending effect, which by definition is real appreciation of the home currency, provided that tradables and non-tradables are both normal goods.

From Section 3.2, we also know that Bhutan has experienced a gradual real appreciation of its home currency over the last two decades. The empirical analysis shows, however, that the real exchange rate of the ngultrum did not respond strongly to government spending, indicating that a large part of spending by the Government may have been on tradables rather than on non-tradables, or that the private sectors' spending may have been stronger than the public sector's. This subsection examines how the spending effect has taken place in Bhutan, in other words, how the power export income has been spent, following the rise in real income caused by power exports.

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[15] It would be ideal to examine the impact of the spending on inter-sectoral price relationships. However, effective assessment was hampered by Bhutan's weak statistical base.

Following Gelb (1986), we calculated how the extra power income was used within the domestic economy. Table 2 provides an indication of the base absorption structure of Bhutan averaged in four five-year periods: 1980-85, 1985-90, 1990-95 and 1995-00.

The calculation was conducted as follows. First, data on private consumption and public consumption were measured as a percentage of GDP, and investment as a percentage of GDP was derived as a residual. Second, the components of absorption were scaled by non-power GDP and then compared with those scaled by GDP (or "norms," according to Syrquin and Chenery, 1989). The difference between these two represents the extra domestic absorption of power income.

In Table 2, the breakdown of extra absorption indicates a particularly strong bias in favor of private consumption. Figure 21, which plots the breakdown of absorption as a percentage of non-power GDP for the period 1980-2000, shows two distinct private consumption booms in Bhutan, the first in 1988 and the second in 1999. From Figure 2 (p.13), it is evident that power exports

Table 2. Bhutan: Composition of Absorption (in percent)

	1980-85	1985-90	1990-95	1995-00
Private consumption				
Actual/ non-power GDP	67.5	70.3	49.5	56.0
Norm	67.3	65.2	45.7	49.5
Public consumption				
Actual/ non-power GDP	23.5	20.3	20.5	25.7
Norm	23.5	19.0	18.9	22.7
Investment				
Actual/ non-power GDP	9.2	17.0	38.6	31.3
Norm	9.2	15.8	35.5	27.8
Absorption				
Actual/ non-power GDP	100.2	107.6	108.6	113.0
Norm	100.0	100.0	100.0	100.0
Breakdown of extra absorption (as % of total absorption)				
Private Consumption	76.8	68.1	45.6	49.5
Public Consumption	11.5	16.1	19.0	22.7
Investment	11.6	15.9	35.4	27.8
Total	99.9	100.1	100.0	100.0
Breakdown of extra absorption (as % of non-power GDP)				
Private Consumption	0.0	1.3	1.7	3.0
Public Consumption	0.0	1.2	3.1	3.5
Investment	0.0	7.2	7.1	9.5
Total power income (as % of non-power GDP)	0.0	9.7	11.9	16.0
Total power income (as % of total GDP)				

Source: Data provided by the Bhutanese authorities and World Bank staff estimates.

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Figure 21. Bhutan: Composition of Absorption
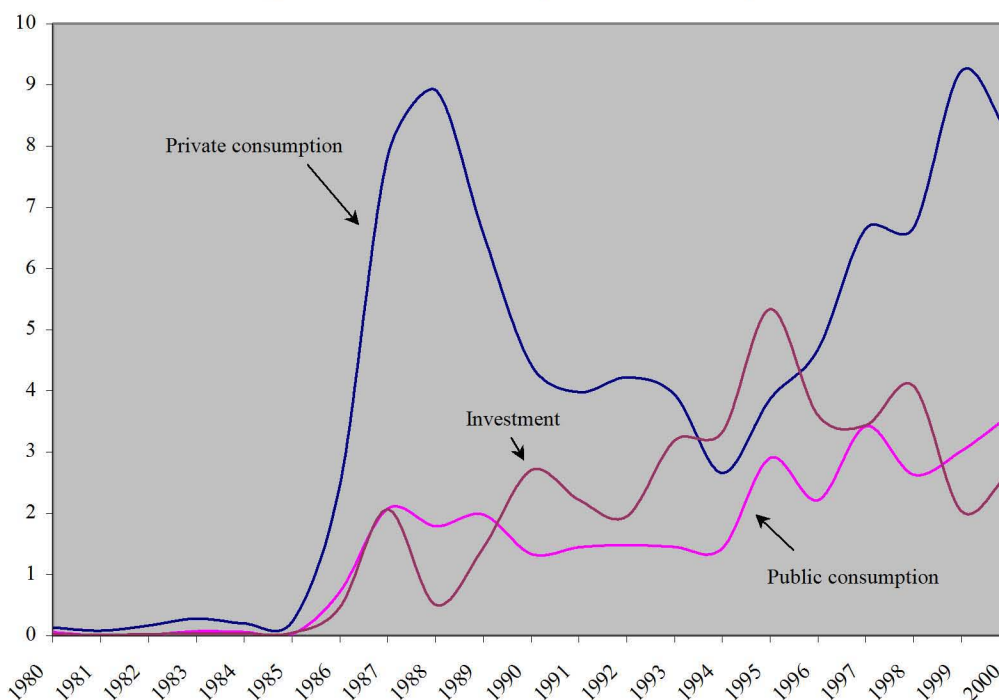
Source: Data provided by the Bhutanese authorities and World Bank staff estimates.

have given rise to these booms, probably through the confidence effect; there was a sharp rise in power income in both 1987 and 1998-99. During the time when the ratio of power exports to GDP declined (1989-95), the private sector consumed less of that power income.

The trend of private consumption is also reflected in the increases in the volume of food imports (private spending on tradables). Figure 22 presents the import volumes of rice and wheat and suggest that increased power revenues have been used to increase food imports from India. In per capita terms, rice imports rose from 11 kilograms in 1983 to 17 kilograms in 1999. Rice import peaks during this time period were 20 kilograms per person in 1988 and 22 kilograms per person in 1997.

The use of power income for investment rose during the early 1990s and declined in the late 1990s. Interestingly, the movement of investment is exactly opposite the movement of private consumption of extra power income. As explained above, in this calculation domestic investment is treated as a residual, and therefore it is not possible to distinguish investment as private or public capital formation.

Yet there are good reasons to believe that private sector investment has responded relatively more strongly to the extra power income than public investment. First, although data are sketchy, there is a general perception that the price of land, the primary asset in the composition of wealth in agrarian societies like Bhutan, has shown a dramatic rise in the last decade, indicating that private

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Figure 22. Bhutan: Volume of Food Imports (in metric tons) and Power Income
(as percentage of GDP)
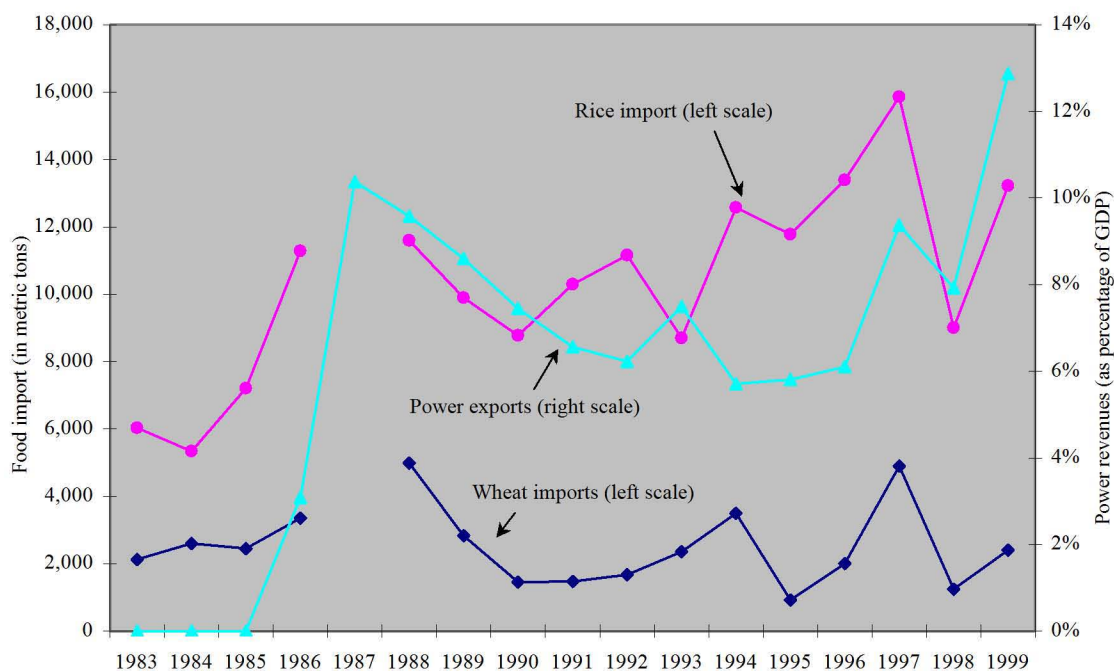
Data source: Statistical Yearbook of Bhutan, CSO (various issues), RMA Selected Economic
Indicators (2001) and World Bank staff estimates.

spending on non-tradables is on the significant rise.[16] Spending on another non-tradable good,
labor, also appears to be increasing. Again, data on wages are not readily available, but it is
commonly believed that wages in Bhutan are rising rapidly compared with those in India,
attracting a large number of illegal workers into Bhutan.

Second, a substantial part of government capital expenditure has been financed with grants
(budgetary support), thus less power income was likely used to finance public investment.[17]
Figure 23 shows the relationship of government capital expenditure with grants and with power
export revenues. From Figure 23, it is clear that government capital expenditure is closely linked
to the level of grants from foreign donors, but less closely linked to power income. This indicates
that less extra power income has been used to finance public investment in Bhutan and that more
of it has gone to finance private investment and private consumption. Notwithstanding, the
overall level of private investment in Bhutan remains very low, with most investment by the
public sector.

In fact, the Royal Government of Bhutan has adopted a public expenditure policy, in which
public investment projects take place only when matching foreign concessional financing is
available. Recurrent expenditures, in contrast, are entirely covered by internal revenues, which
include transfers, dividends and corporate taxes from Chukha Hydropower Corporation. See

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[16] See Kuensel (2002).
[17] Note that as explained in Section 3.1.1 public investments in power projects are recorded outside the
budget.

Figure 23. Bhutan: Government Capital Expenditure and Grants (as percentage of GDP)
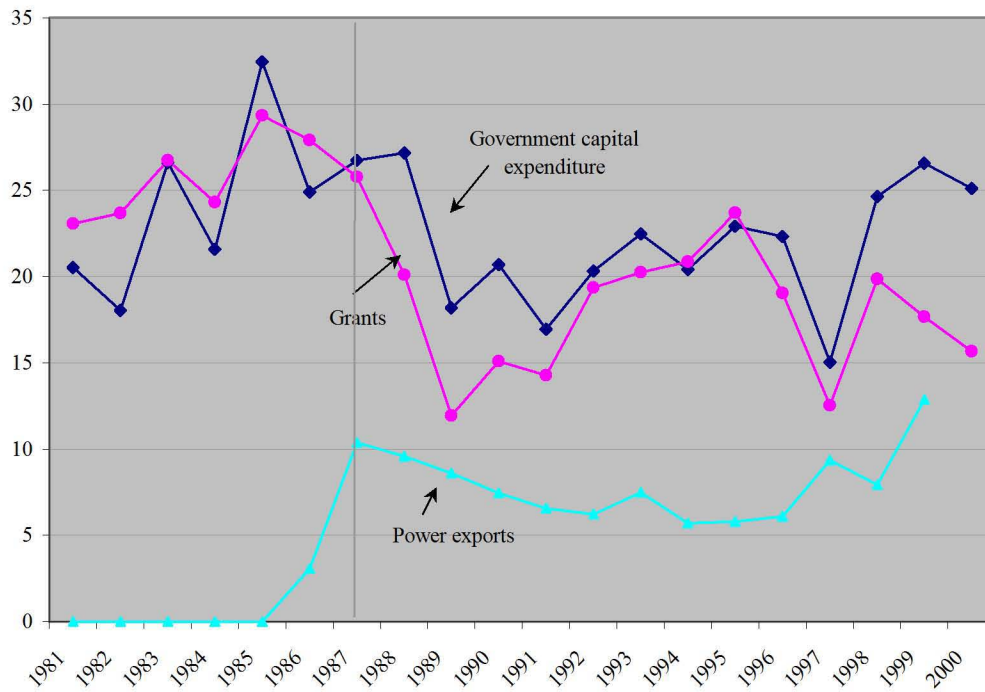

Figure 24. Bhutan: Government Internal Revenues and Current Expenditure
(as percentage of GDP)
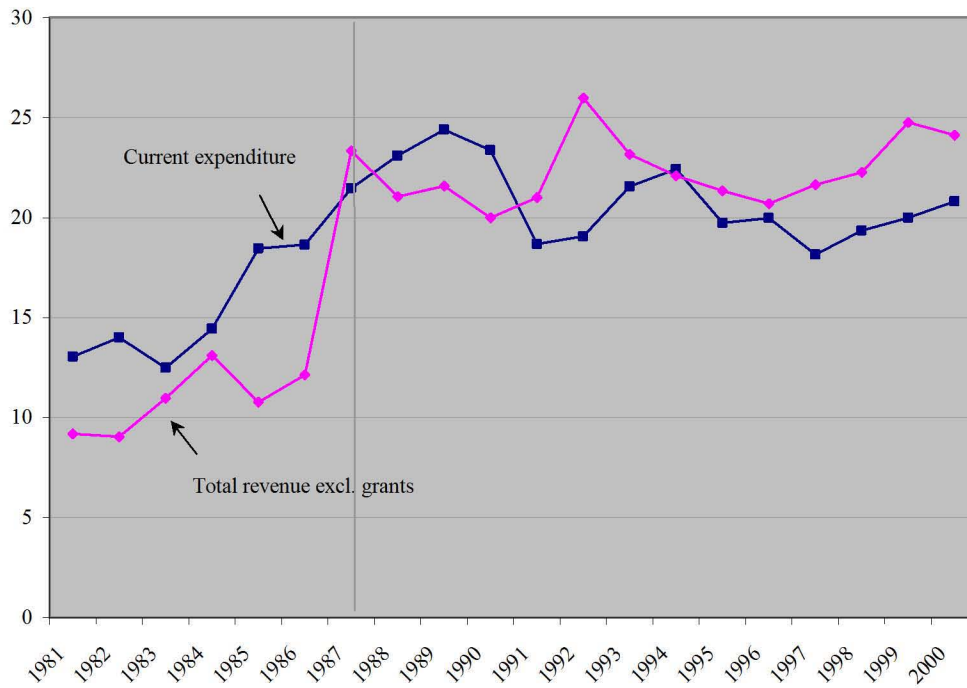
Source: RMA Annual Reports.

Figure 24, which confirms a strong one-to-one relationship between government current expenditure and total internal revenue.

3.3.2 Resource Movement Effect

Finally, this subsection attempts to answer the remaining set of questions we are addressing in this section. Have there been resource movements from the tradable towards non-tradable sectors? Has there been a decline in output in the tradable sector as a result of relative price changes, that is, the Dutch condition?

In the absence of sectoral data on investment and employment, it is not possible to examine resource movements from the tradable sector to the non-tradable sector. Therefore, we rely on data on sectoral production and trends of exports to examine whether relative price changes have affected the tradable sector in Bhutan.

Figure 25 presents the sectoral contribution to GDP in constant 1980 prices for 1981-2000. According to Figure 25, all sectors, both tradable and non-tradable, have grown strongly in real terms. While growth of agricultural production slowed from the late 1980s onwards, agriculture remains the principal contributor to GDP, accounting for about 40 percent of value added in 2000 (see Figure 27).[18] The modern sectors – services, construction (non-tradables), manufacturing,

Figure 25. Bhutan: Components of GDP (value added, in millions of ngultrum, constant 1980 prices)
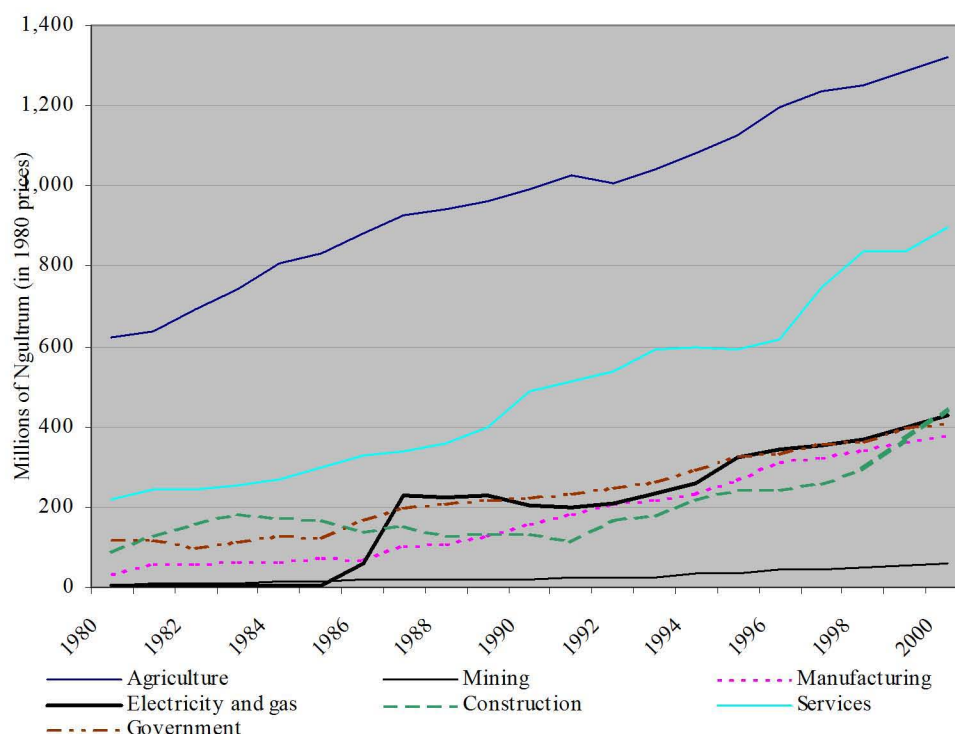
Source: RMA annual reports (various issues) and World Bank staff estimates.

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[18] The annual growth rate of agricultural production averaged at 6.0 percent for 1981-86 and at 2.9 percent for 1987-2000.

Figure 26. Bhutan: Index of Sectoral Output (1980 = 100) [1]
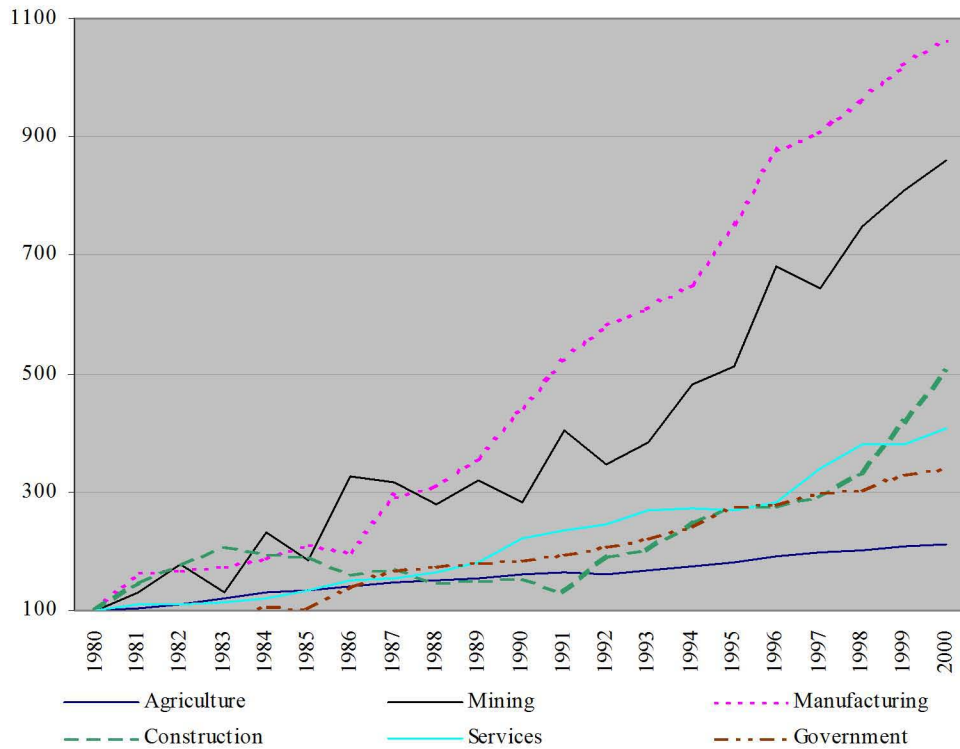
1/ Excludes the power sector.

Figure 27. Bhutan: Components of GDP (value added, as percentage of non-power GDP)

Source: RMA annual reports (various issues) and World Bank staff estimates.

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Figure 28. Bhutan: Real Exports and Real Non-power Exports
(in millions of ngultrum, constant 1980 prices)
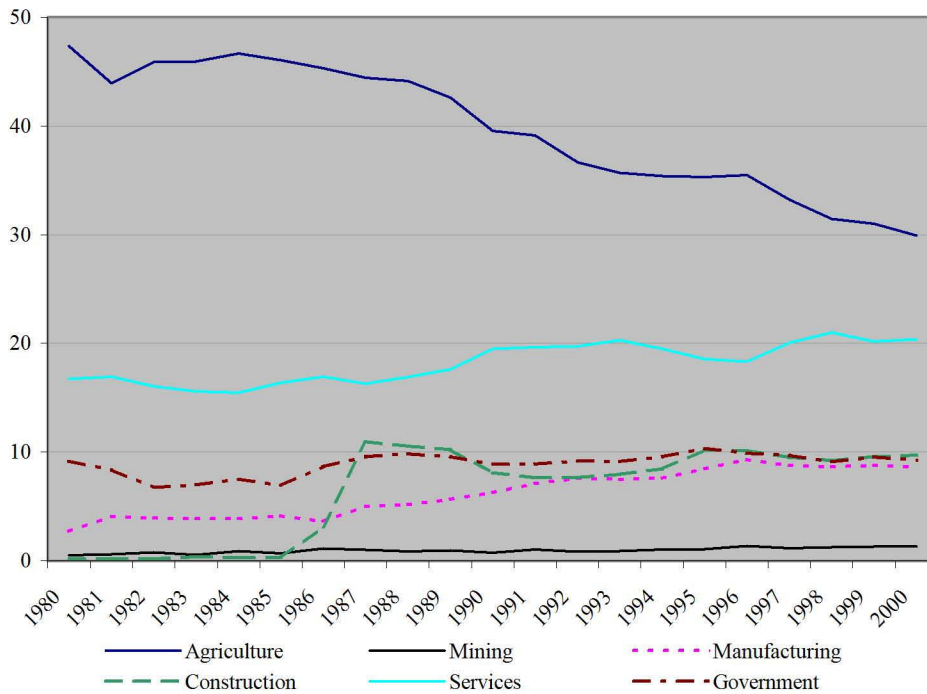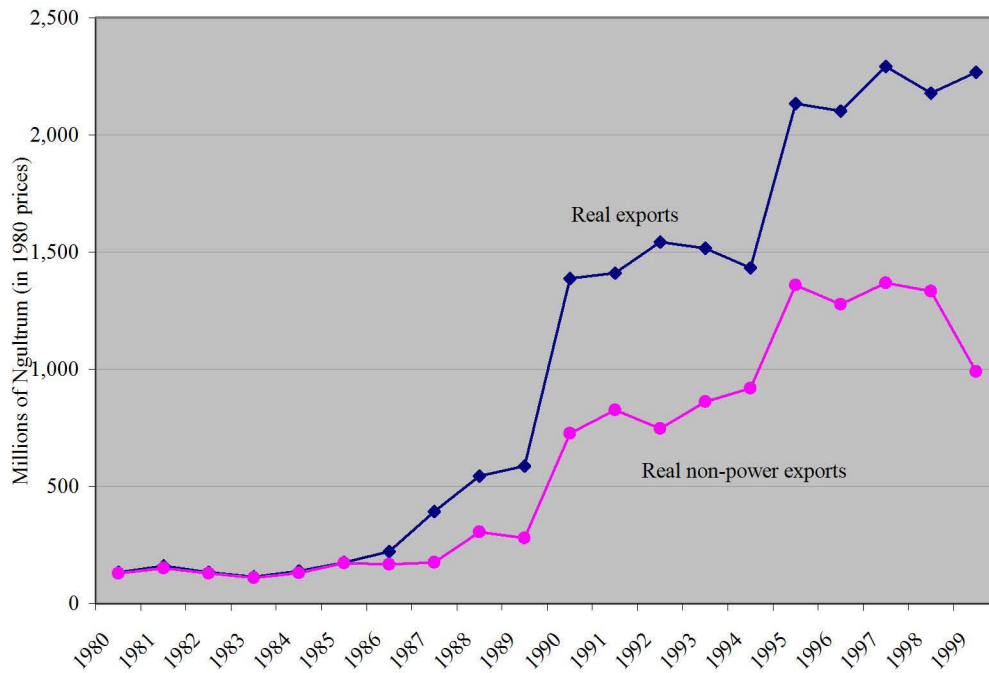
Source: RMA Annual Report and World Bank staff estimates.

Figure 29. Bhutan: Real Exports by Country of Destination
(in millions of ngultrum, constant 1980 prices)
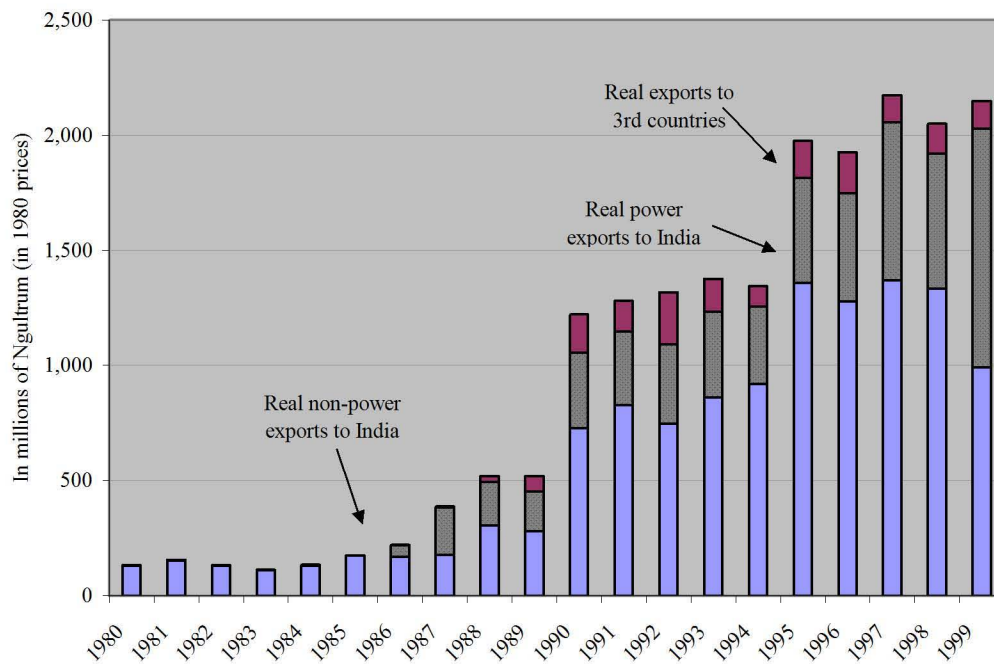
Source: RMA Selected Economic Indicators and World Bank staff estimates.

and mining (non-booming tradables) as well as hydropower (booming tradable) – have increased their value added over time (see Figure 26), indicating that the production structure of Bhutan has become slightly more diversified over the years. Growth of manufacturing and mining is most notable. During 1981-2000, manufacturing grew at an average rate of 13.5 percent a year, while mining grew at an even higher rate, 14.5 percent a year. Nevertheless, these two sectors are still in their infancy. Value added by manufacturing and mining remains still very small, respectively accounting for only 1.3 percent and 8.6 percent of non-power GDP in 2000.

Meanwhile, trends of exports, presented in Figure 28, suggest that despite real appreciation of the ngultrum against the rupee, Bhutan's total exports have grown sharply – some 13-fold during the last two decades. A large part of this increase is attributable to power exports. However, non-power exports have also grown strongly in real terms, from an average of Nu.175 million in the 1980s to an average of more than Nu1,000 million in the 1990s, both in constant 1980 prices (see Figure 28). Exports to countries other than India, mainly Bangladesh, which take place in US dollars, have also increased, although the magnitude is still small, accounting for about 5-6 percent of total exports (Figure 29).

In conclusion, from exports and sectoral production data alone, we find no evidence to suggest that increased power exports – and foreign capital inflows – have led to a contraction of the tradable sector, despite a substantial decline in relative prices (real appreciation) over the years. There are two possible interpretations of these results.[19] One is that the non-tradable sector would have grown more rapidly in the absence of real appreciation than otherwise. Another is that, only to a small extent, tradables may have competed with non-tradables for scarce factors of production. For example, although labor is mobile between non-power tradable and non-tradable sectors, little rural labor may have been pulled away from agriculture (a tradable sector by definition, subsistence-based in many rural areas) to more profitable non-tradable sectors such as services or construction, both of which are concentrated in Thimphu.

3.3.3 Monetary Effect

As discussed in Section 2, increased exports tend to raise the supply of money through balance of payments surpluses and net accumulation of reserves. Under the fixed exchange rate regime, without full sterilization of the increase in reserves, there will be a short-term monetary disequilibrium, which will cause inflation and consequently further appreciation of the home currency.

As we show below, however, in the case of Bhutan there has been little monetary effect related directly to increased power exports. Although Bhutan has enjoyed large balance of payments surpluses and corresponding increases in international reserves, these were largely driven by large net foreign capital inflows, rather than by increased exports alone (Section 3.1.4). Therefore, the monetary effect is largely of net capital inflows, rather than of power exports. In the regression

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[19] The most general interpretation in such a result can be that the domestic sectors producing tradables are heavily protected by tariffs and quotas and are insensitive to relative price changes. The effective relative price the protected tradable sector faces is $\left[eP^T(1+\tau)\right]/P^{NT}$, where τ is the tariff rate. Note that $\left[eP^T(1+\tau)\right]/P^{NT} > eP^T/P^{NT}$ for positive τ, meaning that the profitability of tradables is higher with the tariff than without. However, since there is no trade barrier between Bhutan and India, to which a substantial proportion of manufactured goods and mineral products are exported, this interpretation is not applicable in the case of Bhutan.

Figure 30. Bhutan: Inflation Rates (in percentage per annum)

CPI

GDP deflator
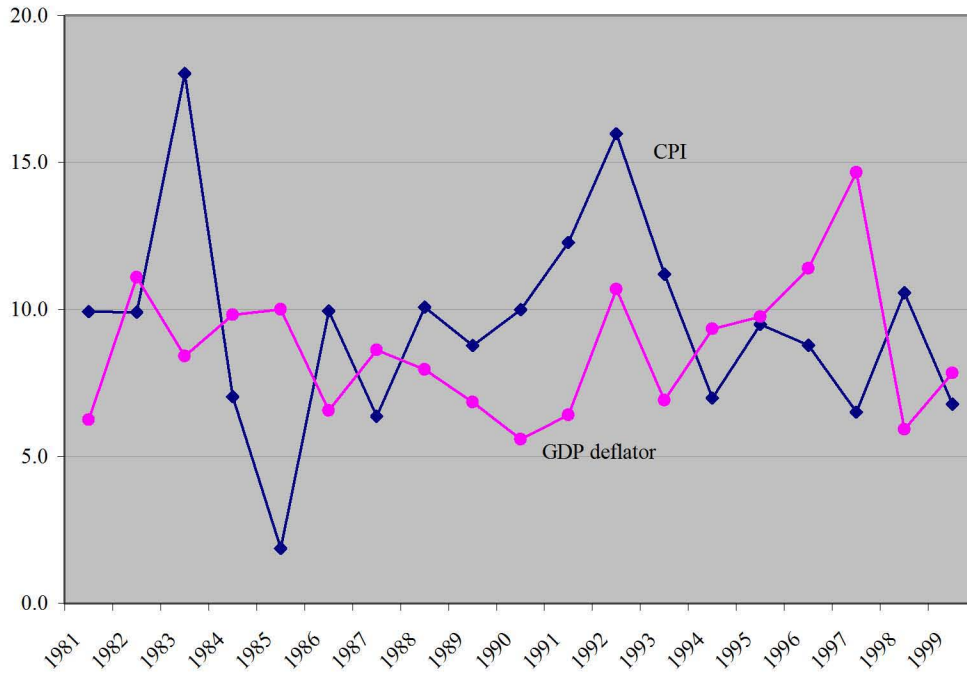
Source: IMF International Financial Statistics and data provided by the Bhutanese authorities.

Figure 31. Bhutan: Money Supply (M2) and Money Velocity

Velocity of money
(right scale)

M2 (left scale)
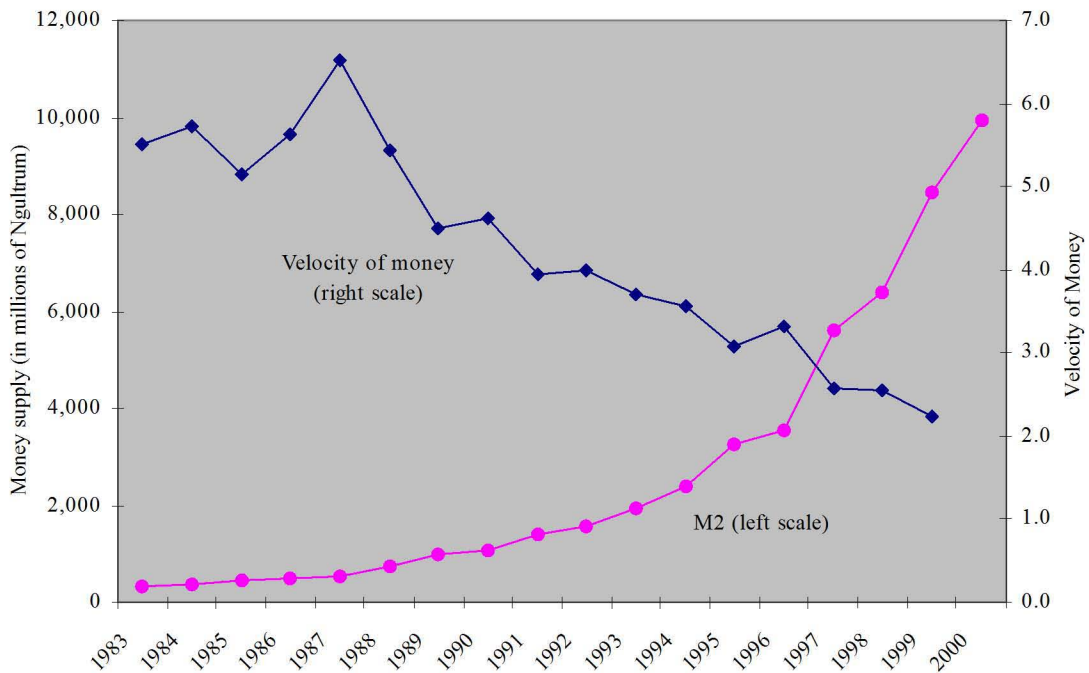
Source: IMF International Financial Statistics and World Bank staff estimates.

analysis of BRER in Appendix 2, what the monetary disequilibrium represented is likely the monetary effect of increased net capital inflows to Bhutan.

Regardless of the source of the monetary effect, the inflation rate in Bhutan has remained moderate (see Figure 30). This is because although the money supply has grown substantially over the years, the increases have been offset by declines in the velocity of M2 (see Figure 31), creating excess liquidity in the financial system (that is, *de facto* sterilization). With limited investment choices, the demand for advances from the financial sector has remained stagnant. Such a build-up of liquidity in the banking sector may continue as long as surpluses continue in the external sector.

4. POLICY IMPLICATIONS

We have discussed in Section 3 that the commencement of regular power exports to India brought enormous economic benefits to Bhutan – higher investment, faster growth, and rising living standards. However, in response to the large power export earnings and foreign capital inflows, the ngultrum has appreciated against the Indian rupee over time, mainly through increased private spending and monetary disequilibrium. Despite this real appreciation, however, there is little evidence to suggest contraction or stagnation of the non-power tradable sector. Although growth of the tradable sector might have been stronger in the absence of real appreciation, thus far, there is no sign of the Dutch condition in the Bhutanese economy.

Bhutan's medium-term growth prospects are generally favorable supported by large potential of exporting hydropower, which is a renewable natural resource. External vulnerabilities appear modest, with a strong commitment to financial assistance by Bhutan's development partners. In addition, both trade and sources of foreign aid are more diversified today than in the early 1990s.[20]

Nevertheless, Bhutan is not completely free of risks. Fist, growth prospects of the country are dependent on how effectively the Royal Government of Bhutan manages the increasing power rents. Thus far the Government has used power rents in an effective manner, channeling substantial power exports and foreign aid to promote investment in human capital and infrastructure. It is viewed that such fiscal prudence have helped mitigate macroeconomic distortions typically seen in countries experiencing a natural resource export boom. Section 4.1 suggests a broad fiscal policy strategy for the effective use of power rents.

The second risk is related to exchange rate management. With the commissioning of the Tala hydropower project in a few years, our empirical results anticipate further upward pressure on the real value of the ngultrum, which could discourage production and investment in the non-power tradable sector leading to the Dutch condition. This real appreciation is viewed as a long-term equilibrium phenomenon based on a renewable resource. With the strong expectation that the power sector will continue to dominate the country's exports, the non-power tradable sector may have a stronger incentive to get used to a strong real exchange rate than it would if the resource

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[20] Based on the experience of India's BoP crisis, Bhutan has sought to diversify its sources of foreign aid; Japan, Denmark, Switzerland, the Netherlands, Austria and Kuwait now figure among its major donors other than India.

were non-renewable and the export boom were temporary. Then it will become important for the Government to control the speed of appreciation since a rapid real appreciation could distort the relative prices in the domestic economy. Section 4.2 discusses ways to contain the speed of real appreciation.

The third risk is unemployment. As the economy will remain heavily dependent on exports, with few sectors competing with the power sector which creates few domestic jobs, the challenge for the Government is to create employment for Bhutan's increasingly educated labor force by fostering private sector development. A related challenge is immigration. As domestic wages rise, there will be increasing pressure for labor to move from the neighboring countries into Bhutan. A broad strategy for private sector development is discussed in Section 4.3.

4.1 Fiscal Policies – Effective Use of Power Rents and Attaining Self-Sufficiency

Despite recent fiscal easing, the Royal Government of Bhutan has maintained fiscal prudence, with domestic revenues more than covering recurrent expenditures and a maximum use of concessional financing for development expenditures. Over the last few years, more than a third of government expenditure was allocated to infrastructure, health and education. Much of that, however, was possible due to generous financial support from development partners.[21] While the risk of reduced foreign aid is viewed as very small, Bhutan's long-term goal should be to reduce heavy reliance on foreign aid and to achieve self-sufficiency. This requires effective use of power income to expand the economy's future production capacity.

4.1.1 Expenditure Policy

The first fiscal priority for the Government should therefore be to continue this fiscal prudence while maintaining essential expenditures for the delivery of public services. A substantial portion of power export proceeds and foreign aid should be channeled into the investment necessary to achieve balanced growth. However, caution needs to be taken so that the level of investment does not outstrip domestic implementation capacity, which would cause adverse effects on the efficiency of the capital invested (see Box 2, the experience of Botswana, which successfully used the income from diamond exports to achieve a higher growth rate).

While the Government expects much of the investment to be made by the private sector (with subsidies, if any, being minimum), complementary investment needs to be undertaken by the public sector, especially in areas where strong externalities are present, such as health and education, and in other areas where large-scale financing is required, such as large infrastructure projects. Human capital formation should focus on upgrading technical skills that would help raise future labor productivity. The priority of infrastructural investment should be to improve transport in order to reduce the disadvantages of Bhutan's landlocked and isolated location in serving regional and global markets.[22]

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[21] While the Bhutanese authorities have made concerted efforts to upgrade the country's statistical database recently, data limitation remain especially in areas of prices, public finance and employment, hampering effective assessment of the economy on which formulation of policy strategies should depend. Strengthening of the statistical base is therefore also an important part of policy strategies for sustainable growth in Bhutan.

[22] Especially, provision of efficient and reliable transport – both road and air transport – is expected to give a major boost to the agricultural sector by lowering the transport costs and assuring timely delivery, thereby strengthening the competitiveness of Bhutan's agricultural products in the world market. For example, in

Box 2. Botswana's Experience

Botswana is one of the most successful countries in managing a natural resource export boom. The diamond boom in Botswana began in 1965 with the discovery and development of large amounts of high quality diamonds. Over the last three decades the rapid expansion of diamond exports has quadrupled the per capita GDP of Botswana.

Botswana has not been affected by the Dutch disease or any other of the harmful consequences of a natural resource export boom. Its manufacturing production even doubled, albeit from a small base, to the point where it now employs three times as many workers as mining. There was a significant rise in construction prices, but there was no spillover of inflation to the rest of the economy. Agricultural production, however, seems to have suffered slightly.

What did the Government of Botswana do? First, a large part of the windfall was put in foreign savings and was used only when the absorptive capacity of the economy was deemed sufficient. In determining the level of government spending, close attention was paid to the two constraints: (i) availability of skilled manpower; and (ii) the future recurrent costs of development spending in relation to revenue forecasts (Harvey, 1992). Second, very close attention was paid to the exchange rate variability. While the policy aimed at a stable real exchange rate, the nominal exchange rate was adjusted periodically to contain the inflationary pressures caused by the boom. Third, the level of public investment was maintained, but emphasis was placed on health and education, literacy, life expectancy, infrastructure and water facilities.

The contribution of an improved infrastructure base (both physical and social) to economic diversification and growth lies in the stimulation and greater efficiency it promises for the future productivity and economic profitability of tradable and non-tradable goods.

4.1.2 Tax Policy

Meanwhile, the Government should continue to vigorously expand its internal revenue base by broadening the tax base and streamlining the tax system to ensure its efficiency and effectiveness, with the aim of attaining fiscal self-sufficiency in the long-run. While power exports have contributed to the substantial increase in government non-tax revenue, Bhutan is still unable to raise enough internal revenue to reverse the trend of external fiscal dependence. The introduction of the Personal Income Tax in January 2002 is an important and timely step not only to expand the revenue base but also to ensure that the income disparity between the rich and poor does not widen considerably.

4.2 Exchange Rate Management

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the case of timber products, the cost of transporting timber can be as high as, or even higher than, the value of timber themselves, eroding the price competitiveness of the Bhutanese timber. Another example is matsutake mushrooms, a time-sensitive product which needs to be delivered to the Tokyo market within 48 hours of being picked. In the absence of direct air route between Thimphu and Tokyo, and with unreliable domestic transport to reach the Thimphu Airport, exploration of the large Japanese market is severely constrained.

Power exports will continue to be the dominant source of export proceeds for Bhutan on a permanent basis. The associated real appreciation of the ngultrum is therefore a long-term equilibrium phenomenon. It is unavoidable and should not require automatic policy intervention. Nonetheless, too rapid a real appreciation, especially for a prolonged period, may substantially reduce incentives for production and investment in the non-power tradable sector and thus needs to be avoided. Appropriate exchange rate management should be to allow gradual real appreciation of the ngultrum over time.

Under the present fixed exchange rate regime, there are broadly three possible ways to slow the speed of real appreciation: (i) to contain the growth of domestic demand for non-tradables; (ii) to expand the domestic supply of non-tradables; and (iii) to contain the growth of overall domestic demand by influencing disposable income.[23] The first two solutions mitigate the upward pressure on the prices of non-tradables by influencing domestic demand for and supply of non-tradables, whereas the third solution works by controlling overall domestic demand for both tradables and non-tradables. Any of these have the effect of slowing the fall in the relative prices of tradables. Specific policy options are provided below. Nominal devaluation of the ngultrum is not considered an option here.

4.2.1 To Contain the Growth of Domestic Demand for Non-tradables

General policy recommendation for countries experiencing a permanent rise in exports is that governments should slow the pace of real appreciation by changing government expenditures. The rationale is that since public consumption and investment are a large part of domestic demand, lowering the proportion of government spending, especially recurrent spending, on non-tradables will mitigate the rise in domestic demand for non-tradables, thereby helping to contain the speed of real appreciation.

However, this policy recommendation does not apply to the case of Bhutan straightaway. First, in Bhutan, it is the private sector rather than the public sector that tends to have a higher marginal propensity to spend on non-tradables (Section 3.2). It follows that the extent to which changes in government expenditure alone can influence the prices of non-tradables, and in turn the speed of real appreciation, is likely to be limited. Second, compressing government spending on non-tradables is not a viable option for Bhutan at this stage of development, since maintaining adequate levels of development expenditure is deemed crucial in expanding the country's future production capacity.

The alternative can be to contain domestic demand by influencing private spending on non-tradables through higher taxation. Again, however, this option may not seem viable since higher taxation of non-tradables (construction, services and transport) may depress private sector investment, which will help transform the economy from aid-dependence to self-sufficiency in the long-term.

4.2.2 To Expand the Domestic Supply of Non-tradables

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[23] Recall that the bilateral real exchange rate of the ngultrum vis-à-vis the Indian rupee is simply the relative prices of tradables (P_t^T) to non-tradables (P_t^{NT}): $BRER_t = P_t^T / P_t^{NT}$, where P_t^T is determined in the Indian market and P_t^{NT} is determined by demand and supply within Bhutan. Real appreciation (i.e., a decline in $BRER$) happens since, in response to increased domestic demand, the prices of non-tradables (P_t^{NT}) rise relative to the prices of tradables (P_t^T). This suggests that measures aimed at containing the rise in P_t^T can effectively reduce the speed and magnitude of the decline in BRER.

Second, expanding the supply of non-tradables will mitigate the upward pressure on the prices of non-tradables from increased demand for non-tradables, thereby slowing the rate of the ngultrum's real appreciation. This can be done indirectly by emphasizing public investment in key physical and social infrastructure sectors that would help expand the non-tradable sector's production capacity. Allowing larger labor migration into Bhutan's labor-intensive non-tradable sector, such as construction and services, is another option, since that has the effect of relaxing the factor market constraint in the non-tradable sector.

4.2.3 To Contain Rapid Growth of Disposable Income

Third, the Government can slow the speed of real appreciation by influencing the growth of domestic disposable income, thereby limiting the rise in overall domestic demand. There are three possible approaches. One is through taxation, the second through sterilization, and the third through temporarily managing the size of export proceeds and net capital inflows to the economy. The last option could be done by temporarily maintaining some portion of export proceeds abroad[24,25] or by temporarily suspending net capital inflows should real appreciation be viewed as too rapid. Such measures to restrict capital inflows should be used only in the short-term to slow the speed of real appreciation when it is deemed too rapid, but not to prevent real appreciation of the ngultrum, which is a long-term phenomenon. The power tariff and volume of power exports cannot be used as short-term policy variables since they are pre-determined at a politically fixed level with India.

4.3 Private Sector Development

Private sector development holds crucial key to accelerating economic growth in Bhutan and addressing employment concerns in the medium term. Private sector development is also an effective means of addressing the excess liquidity in the financial sector. As private sector activities grow, the economy's capacity to absorb the increased power revenue will rise gradually, and the scope for higher tax collection by the Government will also improve. The authorities' long-term expectation is for the private sector to take up all commercial activity, other than projects that are too large to be financed privately.

Despite the Government's efforts in privatization and deregulation, and its more recent moves to improve the stability and competitiveness of the financial sector, however, the private sector in Bhutan remains under-developed. Lending to the private sector has hardly grown. This could be one reason why a large part of power income has been used to finance private consumption rather than investment. Establishing a favorable business environment may divert part of the power income from private consumption to private investment.

A broad set of policies can be implemented to stimulate private sector development. These include macroeconomic stability, trade liberalization, SME policies, labor policies, financial

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[24] In fact, this is not a new policy measure for Bhutan, although not as part of real exchange rate management. A large part of international reserves as well as pension fund is being held offshore with highly-rated financial institutions, individual contributions to the national pension fund are actively invested in foreign securities and equities, and the Bhutanese banks are allowed to maintain excess liquidity as deposits with commercial banks in India.

[25] See, for example, Norway's State Petroleum Fund. Detailed information can be found at www.norges-bank.no/english/petroleum_fund/. Also, see Fasano (2000) for cross-country experiences of oil stabilization and saving funds.

sector reform, provision of infrastructure, establishment of the FDI act, and improvement of the investment climate, to name a few. Most policy options for private sector development are discussed in the Private Sector Survey report, which was jointly conducted by the World Bank and UNDP in 2001. Readers may consult the report for more in-depth analyses and sector-wide policy recommendations.

5. CONCLUSIONS

This paper has empirically examined the impact of Bhutan's increased hydropower exports on the domestic economy. It has shown that power exports have brought enormous economic benefits to Bhutan, spurring growth and raising living standards through increased export earnings.

The results of this empirical analysis suggest that that power exports to India as well as net capital inflows have resulted in real appreciation of the ngultrum against the rupee over time, mainly through increased private spending and short-term monetary disequilibrium. Despite the large real appreciation, however, the study has found little evidence to suggest contraction or stagnation of the non-power tradable sector. While growth of the tradable sector might have been stronger in the absence of the appreciation, thus far there is no sign of the Dutch condition in the Bhutanese economy.

Looking ahead, Bhutan's growth prospects are favorable, supported by enormous hydropower export potential. Unlike other types of natural resource exports based on exhaustible resources (oil, gas, coal, copper), Bhutan's hydropower is a renewable, permanent resource for export. Our empirical results indicate, however, that further increases in power exports as well as foreign aid – regardless of which currencies they are denominated in – will likely cause further appreciation of the ngultrum against the rupee, which could erode the competitiveness of the non-power tradable sector and lead to the Dutch condition. Although there is no immediate threat that requires urgent policy attention, the country's growth prospects will also depend on how effectively the Government uses the increasing power rents and manages the exchange rate.

With the increasing role of hydropower in Bhutan's exports, there is an obvious question as to whether the Government should continue to seek policies for export diversification. While policy intervention may aid the growth of the non-power tradable sector, significant export diversification may not be a realistic aim for Bhutan. For a small country endowed with enormous hydropower export potential as well as a unique cultural heritage and delicate environment, a higher degree of specialization in power exports and tourism, similar to the strategy adopted by Brunei, may appear to be a natural outcome in the long-run.

APPENDIX 1: MEASURING REAL EXCHANGE RATES

This appendix describes the derivation of the bilateral real exchange rates of the ngultrum against the Indian rupee and the US dollar.

A1.1 BRER(Nu/INR)

By definition, the bilateral real exchange rate of the Bhutanese ngultrum against the Indian rupee, BERE(Nu/INR), can be expressed as:

$$BRER_t(Nu/INR) = \frac{e_t(Nu/INR)\ P_t^T}{P_t^{NT}},$$

where e_t stands for the nominal exchange rate of ngultrum against the Indian rupee (annual average), P_t^T for the prices of tradables expressed in the rupee, and P_t^{NT} for the prices of non-tradables in Bhutan, in time t.

Since the ngultrum is nominally fixed to the Indian rupee at par, e_t is one for all periods, and therefore, $BRER_t(Nu/INR) = P_t^T/P_t^{NT}$. Namely, the bilateral real exchange rate of the ngultrum to the rupee is merely the relative prices of tradables and non-tradables. Since Bhutan is a small country, it takes the Indian prices of tradables, P_t^T (which are determined on the Indian markets) as given. The prices of non-tradables, P_t^T, are determined by domestic demand and supply in Bhutan.

An increase in BRER(Nu/INR) represents real depreciation of the ngultrum to the rupee, whereas a decline in BRER represents real appreciation.

In this paper, we use the whole sale price index of India, $WPI_{I,t}$, as a proxy for the prices of (non-power) tradables in India, and the consumer price index of Bhutan, $CPI_{B,t}$, for the prices of non-tradables in Bhutan:

$$BRER_t(Nu/INR) = \frac{WPI_{I,t}}{CPI_{B,t}}. \tag{A1}$$

In Equation A(1), one might argue that it would be ideal to use the Indian consumer price index, CPI, rather than the Indian whole sale price index, WPI, in deriving the BRER(Nu/INR). We however believe that the WPI is a more appropriate measure, since a large part of items in the Indian CPI basket is non-tradables, particularly services, whereas the Indian WPI consists mostly of tradables, whose prices matter in calculating the bilateral real exchange rate.

Figure A 1. Bhutan: Bilateral Real Exchange Rates (Nu/INR)
(1980 = 100)
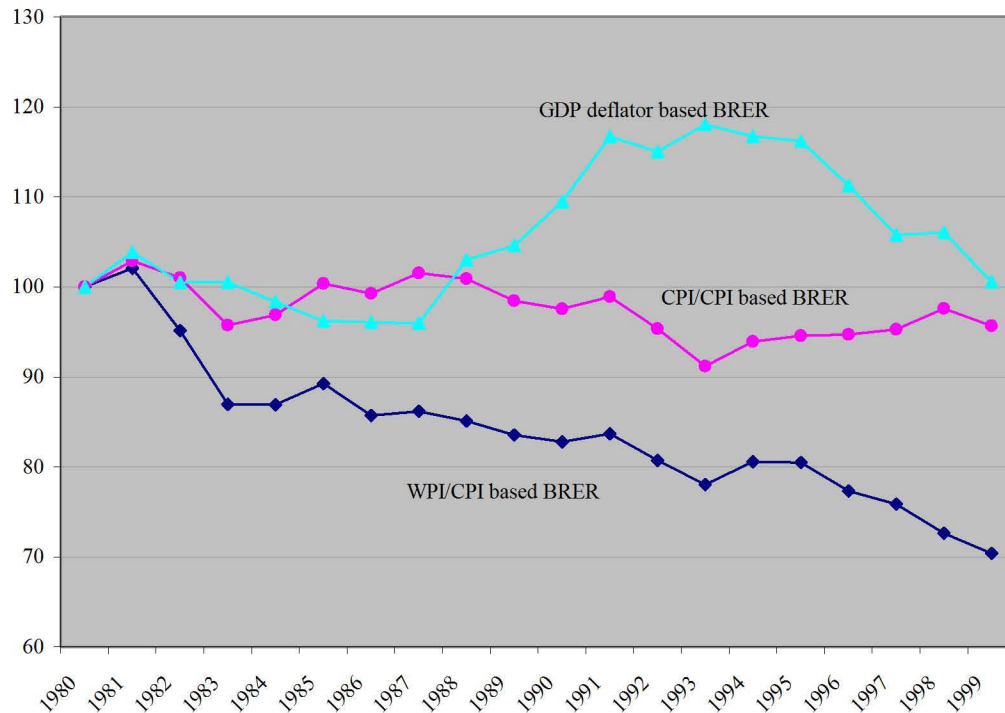
Source: IMF International Financial Statistics and World Bank staff estimates.

As regards the prices of non-tradables in Bhutan, the consumer price index, $CPI_{B,t}$, is not a perfect proxy since the consumer basket used for the CPI calculation consists of consumer goods only in Bhutan, but does not include services such as housing, transport and communication (non-tradables) that are usually included in the CPI calculation in other countries.[26] Despite this disadvantage, we view that Bhutan's CPI is a reasonably good indicator for the prices of non-tradables, since in the case of Bhutan the price of virtually all tradable goods brought into the country include high costs of transport, which is a non-tradable goods.

The computation of BRER (Nu/INR) using the Indian WPI and Bhutanese CPI yield a gradually declining real value of the ngultrum to the rupee, that is, gradual real appreciation of the ngultrum against the rupee, for 1980-99.

We have also calculated BRER(Nu/INR) using different price indices. First, as an alternative proxy for the prices of tradables, India's consumer price index is used. Second, we have used the GDP deflator, which could be a better indicator to capture inflation. The results of the computation are presented in Figure A 1.

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[26] The consumption basket was defined in 1979 and has not been revised since then. The basket consists of 72.3 percent of food items and 27.7 percent of non-food items, such as clothing and footwear, stationary goods, furniture and utensils, etc.

Figure A 1 shows three distinctive paths of the bilateral real exchange rate of the ngultrum against the rupee over the last two decades. These results are driven mainly by the choice of price indices. In contrast to the declining WPI/CPI-based BRER(Nu/INR), the GDP deflator-based BRER(Nu/INR) indicates real depreciation of the ngultrum to the rupee during 1989-95, followed by real appreciation. On the other hand the CPI/CPI-based BRER (Nu/INR) shows a relatively steady movement of the bilateral real exchange rate of the ngultrum against the rupee.

Despite this confusing result, there are good reasons to believe that the real value of the ngultrum has appreciated against the rupee over time, caused largely by the rising prices of non-tradables in Bhutan. For example, although data are not readily available, it is generally perceived that the Bhutanese wages – the price of a non-tradable good (labor) – have been rising rapidly, thereby attracting a large number of illegal Indian workers into the country. Both land and housing prices are also on the rise. The validity of the CPI/CPI-based and the GDP deflator-based BRER (Nu/INR) is therefore very unlikely. Thus we continue our analysis with the understanding that the WPI/CPI-based BRER(Nu/INR) may still be an imperfect measurement of the bilateral real exchange rate of the ngultrum against the rupee.

A1.2 BRER(Nu/US$)

In a similar manner, the bilateral exchange rate of the ngultrum against the US dollar, BRER(Nu/US$), is defined as:

$$BRER_t(Nu/US\$) = \frac{e_t(Nu/US\$) \; WPI_{US,t}}{CPI_{B,t}}$$

$$= \frac{e_t(INR/US\$) \; WPI_{US,t}}{CPI_{B,t}},$$

where e_t (Nu/US$) is the nominal exchange rate of ngultrum to the US dollar, which is equal to the nominal exchange rate of the Indian rupee to the US dollar, e_t (INR/US$), and $WPI_{US,t}$ is the US whole sale price index, which is used as a proxy for the world price of (non-power) tradables. Again, BRER(Nu/INR) may not be a perfect measurement of the bilateral real exchange rate of the ngultrum to the US dollar, given the limited coverage of prices for CPI calculation.

APPENDIX 2: EMPIRICAL ANALYSIS: DETERMINANTS OF BILATERAL EXCHANGE RATE OF THE NGULTRUM

A2.1 Introduction

This Appendix provides a detailed description of the regression analysis conducted in Section 3.2.4. We examine the relationship between the bilateral real exchange rate of the ngultrum to the Indian rupee, BRER(Nu/INR), and power exports using an econometric analysis. Specifically, we investigate the following three issues: (i) whether the increased power export revenues have affected the movements of BRER(Nu/INR) significantly; (ii) what other variables have affected BRER(Nu/INR); and (iii) through what channels the power exports have influenced BRER(Nu/INR).

A2.2 The Model

(i) BRER Dynamics

The modern analyses of real exchange rate behavior distinguish between fundamentals and monetary determinants of BRERs. This distinction is captured empirically in this equation:

$$\Delta \log e_t = \theta\left(\log e_t^* - \log e_{t-1}\right) - \rho\left(\log M_{t-1}^s - \log M_{t-1}^d\right) + \phi \, DEV_t, \qquad (A2)$$

where e^* stands for the equilibrium level of BRER, e for the actual BRER, M_{t-1}^s for the (nominal) supply of money in period t-1, M_{t-1}^d for the money demand in t-1, and DEV for the nominal devaluation. θ, ρ and ϕ are positive parameters. In the case of Bhutan, $DEV_t = 0$ for all t, since the ngultrum is pegged to the Indian rupee at par.

In Equation (A2), the observed BRER movements ($\Delta \log e_t$) are the result of two forces: $\theta\left(\log e_t^* - \log e_{t-1}\right)$ and $-\rho\left(\log M_{t-1}^s - \log M_{t-1}^d\right)$. The first term, $\theta\left(\log e_t^* - \log e_{t-1}\right)$, is a partial adjustment in response to discrepancies between the equilibrium BRER, $\log e^*$, and its lagged actual value. If the equilibrium BRER is above (below) its actual value, BRER will increase (decrease) accordingly towards its equilibrium level. The speed of the adjustment will depend on the parameter θ. In the case of an overvaluation ($e^* > e$), the adjustment will be rather slow because an "automatic" decline in e will normally require a drop in the nominal price of non-tradables and wages. To the extent that nominal prices show some degree of downward resistance, the adjustment will take time.

The second term, $-\rho\left(\log M_{t-1}^s - \log M_{t-1}^d\right)$, captures the impact of monetary disequilibrium on BRER and indicates that monetary pressures will cause real BRER appreciation ($\Delta \log e_t < 0$). Empirically, this impact is given by the coefficient ρ. If the power export boom and net capital

inflows from India affect the money supply process, M^s_{t-1}, BRER will be affected accordingly. This would affect the dynamics of BRER in the short-run, but not the long-run equilibrium of BRER.

(ii) Long-Run Equilibrium BRER

Equation (A2) suggests that to explain the behavior of the BRER (e), we need to understand what the evolution of the equilibrium BRER (e^*) is. Without loss of generalization, the equilibrium BRER can be expressed in the following manner:

$$\log e^*_t = \lambda_0 + \lambda_1 \log P^p_t + \lambda_2 \log V^P_t + \lambda_3 \log G^N_t + \lambda_4 NFA_t + \lambda_5 \log \tau_t, \qquad \text{(A3)}$$

where P^p_t is the real price of power, V^p_t is the volume of power export, G^N_t is the government expenditure on non-tradable goods, NFA_t is net foreign aid inflows, and τ_t is the measure of import tariffs all for period t. Since there exist no trade restrictions between Bhutan and India, $\tau_t = 0$ for all t. The coefficients λ_1, λ_2, λ_3 and λ_4 are expected to be negative. The effects of changes in the fundamentals on the equilibrium BRER are explained below.

Real price of power (P^p_t):
An increase in the price of power is expected to lower BRER and lead to real appreciation of the ngultrum. This is mostly due to the income effect explained in Section 2.1. The export boom induces higher expenditure on tradables and non-tradables, putting pressure on the prices of non-tradables, and causes real appreciation. The key is that the response of non-tradable prices to a power export boom will exceed that of tradables. This is independent of the exchange rate system. Because in Bhutan the power company is a public sector undertaking, the direct impact of a positive price change on BRER will be smaller than if the resources were privately owned. When the price of the enclave export increases, most of the export revenue goes to the Government, in the form of an increase in the surplus transfer, corporate tax, and dividend. Consequently, a significant proportion of the Dutch-condition effects is expected to take place via changes in government expenditure, a channel captured by $\log G^N_t$.

Besides, a direct power price effect is also expected to take place since increases in the price of power will generate a positive "confident effect" on consumers, affecting aggregate expenditure. Vaey-Zadesh (1989) makes this point using a model based on a "warehouse" approach to oil exploitation. Therefore, this analysis of the effect of the power boom on BRER considers the multiple channels through which the Dutch condition operates.

Volume of power export (V_t):
For similar reasons, an increase in the volume of power exported to India is likely to result in a real appreciation of the ngultrum, given the other factors.

Government expenditures on non-tradables (G^N_t):
Higher power export revenues are expected to affect the level of government expenditure significantly. The dependence of G^N_t on power export revenues would then constitutes an

indirect but predominant channel through which the power export will tend to affect BRER. An increase in government expenditures on non-tradables will raise both their demand and their relative prices, thereby appreciating the home currency.

Net Foreign Aid Inflows (NFA_t):

Higher net foreign aid inflows will result in higher disposable income and aggregate spending. If a proportion of this higher spending is on non-tradable goods, prices of non-tradables will rise, appreciating the real value of the ngultrum.

(iii) Specification for Econometric Analysis

Combining Equations (A2) and (A3) yields the following equation for the dynamics of BRER, which in principle can be estimated using conventional methods:

$$\log e_t = \sigma_0 + \sigma_1 \log P_t^P + \sigma_2 \log Z_t^P + \sigma_3 \log G_t^N$$
$$+ \sigma_4 \log NFA_t + \sigma_5 \log e_{t-1} - \rho\left(\log M_{t-1}^s - \log M_{t-1}^d\right) + \varepsilon_t, \tag{A4}$$

where

$$\sigma_0 = \theta\lambda_0; \quad \sigma_1 = \theta\lambda_1; \quad \sigma_2 = \theta\lambda_2; \quad \sigma_3 = \theta\lambda_3; \quad \sigma_4 = \theta\lambda_4; \quad \sigma_5 = (1-\theta)$$

and ε is an error term.

In Equation (A4), there are at least three channels through which the power export boom can impact the level of BRER. The first channel is disposable income and is captured by the coefficients σ_1 and σ_2. The second channel is changes in government expenditures, G_t^N and is captured by coefficient σ_3. Another channel is net foreign aid inflows, NFA_t, and is captured by coefficient σ_4. The fourth channel relates to the monetary disequilibrium, which is of short-term in nature, and is captured by ρ.

One problem of estimating Equation (A4), however, is the multicollinearity problem among the regressors. Although we have found no multicollinearity among P_t^P, V_t^P, NFA_t and the monetary variables, we have found significant collinearity between G_t^N and NFA_t, and M_t^s and NFA_t. Namely, the level of government expenditure on non-tradables and the magnitude of monetary disequilibrium are significantly influenced by the level of net foreign aid Bhutan receives every year (see Figure 23, p.32). To address this issue, we have decided to drop regressor NFA_t in our estimation.

A2.3 Regression Analysis

We estimate Equation (A4) and its variations using annual data for the period of 1983-99, which is the longest period available for all the variables.[27] Given the imperfect measurement of the real

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[27] While data on other variables are available for the period 1981-99, the monetary data are available only from 1983 onwards.

exchange rate, BRER(Nu/INR), and also the limited number of observations (17), the estimation results need to be taken as an indication only, but should not be used to draw a solid conclusion. Description of variables and data sources are provided in Section A5. The results of the empirical estimation using OLS and 2SLS are presented in Table A 1.[28]

The results support the hypothesis that in the short-run the BRER movements in Bhutan have responded to both the real and monetary factors.

First, the results of the regression analysis suggest an important relationship between power exports to India and the bilateral exchange rate of the ngultrum against the rupee. Specifically, increases in the power export tariff (P_t^p) and volume of power export (V_t^p) have been significantly associated with the ngultrum's real appreciation against the rupee, implying that future increases in either variables may likely cause further real appreciation of the ngultrum to the rupee. In all

Table A 1. Regression Results: Bhutan: Dynamics of the Bilateral Real Exchange Rates

Equation No. Method	(a) OLS	(b) OLS	(c) OLS	(d) 2SLS	(e) 2SLS
Constant	-0.031 (-1.510)	-0.033 (-1.629)	-0.026 (-1.188)	-0.015 (-0.433)	-0.005 (-0.144)
Log BRER(t-1)	0.823 (6.093)	0.843 (6.319)	0.809 (5.828)	0.688 (2.501)	0.631 (2.160)
Log Real Power Tariff (t)	-0.059 (-2.898)	-0.058 (-2.924)	-0.059 (-2.853)	-0.090 (-1.701)	-0.096 (-1.705)
Log Power Export Vol.(t)	-0.013 (-2.420)	-0.013 (-2.543)	-0.013 (-2.462)	-0.021 (-1.612)	-0.023 (-1.615)
D[Log Gov.Cons./GDP(t)]		-0.057 (-1.220)		-0.055 (-1.056)	
D[Log Total Gov.Exp./GDP(t)]			-0.021 (-0.738)		-0.022 (-0.672)
Monetary Diseq.(t)	-0.046 (-4.573)	-0.054 (-4.538)	-0.045 (-4.407)	-0.052 (-3.772)	-0.0423 (-3.530)
R-squared	0.948	0.954	0.951	0.911	0.936
S.E. of regression	0.017	0.017	0.017	0.018	0.020

Note: t-statistics in parentheses.

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[28] From the augmented Dickey-Fuller test, we found all variables, except government consumption and total government expenditure, are I(0). Both time series of government consumption and total government expenditure exhibit I(1). To get around this problem, we used the first difference of government consumption in the regression specification so that OLS and 2SLS are consistent.

regressions, the coefficients of the log of the real price of power and the volume of power export are negative as expected, and are statistically significant. A formal test of the equality of the coefficients of these two variables (Wald test) rejects the null hypothesis that $\sigma_1 = \sigma_2$.

According to Equation (c), a one percent increase in real power tariff will cause a 0.59 percent decline in $BRER_t$(Nu/INR), or real appreciation of 0.59 percent. Similarly, an increase in the power export volume by one percent will lead to a 0.013 percent real appreciation of the ngultrum.

Second, the results suggest that the ngultrum's real exchange rate has also responded significantly to the monetary disequilibrium term, $(\log M_{t-1}^s - \log M_{t-1}^d)$. The coefficient of monetary disequilibrium shows a negative sign, as expected, and the t-statistics indicate that the estimates are significant. As we discussed in Section 3, the increase in money supply in Bhutan has been affected by overall net capital inflows and power export earnings, rather than by power export earnings alone. According to Equation (c), a one percent increase in monetary disequilibrium will appreciate the real value of ngultrum against the rupee by 0.045 percent.

Changes in government expenditures do not appear to have had a significant impact on the level of BRER. Neither variables – government current expenditure nor total government expenditure scaled by GDP – are significantly correlated with BRER although the sign of the coefficients for are negative as expected..

There are three possible interpretations of this result. The fist is that a large part of spending by the government may have been on tradables, instead of non-tradables. The second is that the private sector's spending on no-tradables may have been stronger than the public sector's. The third is that neither government current expenditure nor total expenditure is a good proxy for government expenditure on non-tradables.

This analysis is however subject to limitations. First, as mentioned earlier, the WPI/CPI-based BRER is an imperfect measure of the real exchange rate. Second, given the limited data availability, the number of observations is small for this type of time-series analysis. Thus caution needs to be exercised in interpreting the results. Third, some of the independent variables can be measured with error. Additionally, some of them are potentially endogenous. To address issue, instrumental variables (2SLS) were also used in Equation (d). However, the 2SLS results do not differ significantly from the OLS results. This suggests no endogeneity problem. Fourth, the BRER equation does not incorporate explicitly the role of expectations about the behavior of the power exports. In principle, expected changes in power exports will affect BRER by influencing the domestic spending. This issue is not addressed in this analysis because of the difficulties in finding satisfactory data on expectations.

A2.4 Conclusions

In summary, the real appreciation of the ngultrum has been caused by power exports and monetary disequilibrium associated with large net capital inflows. An expansion in power exports or net capital inflows in the future would likely put further upward pressure on the real value of the ngultrum against the Indian rupee.

Despite limitations, the econometric analysis suggests an important relationship between power exports to India and BRER of the ngultrum. Specifically, increases in the power export tariff and

the volume of power export have been associated with appreciations of the ngultrum, indicating that future increases in power exports may likely cause further appreciation of the ngultrum against the Indian rupee. Besides, the bilateral exchange rate of the ngultrum has responded strongly to the monetary disequilibrium term. If increased net capital inflows – regardless of what they are denominated in – and power exports continue to strengthen the balance of payments position with India and to increase international reserves, without full sterilization, money supply could increase beyond the demand for money. Short-term monetary disequilibrium will prevail and the ngultrum will appreciate further. However, the results indicate that changes in government expenditures did not have significant bearing on the level of BRER.

A2.5 Definition of Variables and Data Source

The study requires annual data of various macroeconomic indicators as well as the information on power exports to India for the period 1983-99. The definition of variables and their data sources are provided below.

Bilateral real exchange rate of the ngultrum to the rupee: See Section 3.2 of the main text. Also, see Appendix 1. This variable appears a stationary series.

Real price of power: This is the nominal price of power deflated by the WPI in India. The data on the nominal price of power are provided by the Bhutanese authorities.

Volume of power exports: Power exports to India in mega units (MU). Data are provided by the Bhutanese authorities.

Government expenditure on non-tradables: This is a difficult variable to measure since disaggregated data on government expenditure are not available for the entire period. Two variables are used: (i) government current expenditure as a proportion of GDP; and (ii) total government expenditures as a proportion of GDP. Both data are taken from various issues of *Statistical Yearbook of Bhutan* published by the Bhutan Central Statistical Organization.

Monetary disequilibrium: This is the difference between the log of money (M1) and the estimated log of the long-run demand for money. This is calculated with the estimated parameters obtained from a demand for money equation, $(M/P)_t^d = \beta_1 y_t^{\beta_2} \exp(-\beta_3 i_t)$, using data for 1983-99.[29]

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[29] The estimated money demand equation for Bhutan is $\ln m_t^d = 16.4 - 1.60 \ln y_t = 0.13 i_t$, where m_t^d is real money demand, y_t real income and i_t the inflation rate for time t. Since all variables are I(1), the Johansen cointegration test was employed to estimate the money demand equation.

REFERENCES

Bruno, M. and J. Sachs (1982), "Energy and Resource Allocation: A Dynamic Model of the 'Dutch Disease'", *Review of Economic Studies*, 49 (special issue): 845-59.

Buiter, W. and D. Purvis (1983), "Oil, Disinflation and Export Competitiveness", in *Economic Interdependence and Flexible Exchange Rates*, by J. Bhandari and B. Putnam (eds.), Cambridge, MA, MIT Press, 1983.

Corden, W. M. (1984), "Booming Sector and Dutch Disease Economics: Survey and Consolidation", *Oxford Economic Papers*, 36:359-80.

Corden, W. M. and J. P. Neary (1982), "Booming Sector and De-Industrialization in a Small Open Economy", *Economic Journal*, 92 (December 1982): 825-48.

Eastwood, R. K. and A. J. Venables (1982), "The Macroeconomic Implications of a Resource Discovery in an Open Economy", *Economic Journal*, 92 (June 1982): 285-99.

Fasano, U. (2000), "Review of the Experience with Oil Stabilization and Savings Funds in Selected Countries", *IMF Working Paper*, WP/00/112, June 2000.

Gelb, A. (1986), "Adjustment to Windfall Gains: A Comparative Analysis of Oil-exporting Countries", in P. Neary and S. van Wijnbergen (eds.), *Natural Resources and the Macroeconomy*, MIT Press, Cambridge, MA.

Harvey, Charles (1992), "Botswana: Is the Economic Miracle Over?", *Journal of African Economies*, 1(3):335-68.

Kuensel (2002), "Soaring Land Prices: Real or Mere Speculation?", April 19, 2002.

Neary, J. P. and S. van Wijnbergen (1984), "Can an Oil Discovery Lead to a Recession? A Comment on Eastwood and Venables", *Economic Journal*, 94 (June 1984): 390-95.

Neary, J. P. and S. van Wijnbergen (1986), *Natural Resource and the Macroeconomy*, Oxford, UK, Basil Blackwell.

Syrquin, M. and H. B. Chenery (1989), "Patterns of Development 1950-83", *World Bank Discussion Paper*, No. 41, World Bank, Washington, DC.

Vaey-Zadeh (1989), "Oil Wealth and Economic Behavior: The Case of Venezuela, 1965-81", *IMF Staff Papers*, 36(2): 343-84.

van Wijnbergen, S. (1984), "Inflation, Employment and the Dutch Disease in Oil-Exporting Countries: A Short-Run Disequilibrium Analysis", *Quarterly Journal of Economics*, 99 (May 1984): 233-50.

World Bank (2000), *Country Assistance Strategy for Bhutan*, Report no. 20158BHU, February 22, 2000.

World Bank (2002), *Bhutan: Private Sector Survey*, June 14, 2002.