The London School of Economics and Political Science

Distribution and Sustainable Development in a Natural Resource-Based Economy

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Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD Degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I declare that my thesis consists of 55,536 words.

Abstract

There is still some ambiguity about what is sustainable development. From an economic point of view it involves maintaining a stock of assets for posterity that is equal to or greater than the stock of assets of the current generation. This is the basis of the capital approach to sustainable development. To measure how sustainable an economy is, based on the capital basis of sustainable development, multilateral institutions such as the World Bank use wealth accounting combined with the genuine savings approach to measure how well economies are saving for the future, net of current asset depreciation. These measures are useful for telling policy makers how their policies are contributing to sustainability and whether their economies are on a sustainable development path. Although these measures tell which assets are being depleted and the level of savings required, they do not tell why inadequate savings or inadequate investments might be occurring and how these assets are distributed among income groups within the economy. These measures are also not linked explicitly with the development prospects of the country and the needs of the current generation. This thesis attempts to assess if distributional outcomes affect how much countries save and therefore whether this has any impact on sustainability. To examine the impact of distribution on sustainability, a case study of Trinidad and Tobago (T&T) is conducted. T&T has had a negative genuine savings rate for most of the last two decades, primarily due to the excessive exploitation of its natural resources (oil and natural gas) without sufficient savings or reinvestment of the revenues from these resources. Has the distribution of these resource rents had any impact on saving outcomes? An attempt is made to answer these questions by assessing how government expenditure is distributed and who benefits most from the exploitation of the natural resources. The analyses contained within the thesis show that expenditure on energy subsidies, the distribution of human capital and the overall distributions of rents are all regressively distributed.

Contents

Tables, Figures, Annexes and Appendices

List of abbreviations

ANS Adjusted net savings
DfID United Kingdom Department for International Development
EKC Environmental Kuznets Curve
GDP Gross domestic product
GCF Gross Capital Formation
GNI Gross National Income
GS Genuine saving
HC Human Capital
HDI Human Development Index
IMF International Monetary Fund
IO Input-output table/matrix
LNG Liquefied Natural Gas
LMC Lower middle Income country
SD Sustainable Development
T&T Trinidad and Tobago
TT$ Trinidad and Tobago dollar
UC User Costs
UN United Nations
US$ United States dollar
WCED World Commission on Environment and Development

Chapter One Introduction

This thesis attempts to examine the relationship between sustainable development and inequality. The relationship is examined specifically within the context of a small open resource rich economy, Trinidad and Tobago (T&T). The reason for examining this phenomenon within T&T is that, despite T&T's vast non-renewable natural resource wealth and its ability to monetise that wealth, the country has not transformed these rents into adequate savings and investment in other forms of capital, particularly as it relates to measures of genuine savings and comprehensive wealth. Does the distribution of resource rents matter for sustainability? The resource curse literature by for example Auty and Kiiski (2001) and Auty (2007) as well as earlier work on the Plantation economy by for example Best (1968), Demas (1971) and Beckford (1972) suggests that inequalities are a persistent problem for some resource abundant countries. However, these theorists along with more recent work by for example van der Ploeg (2011) find that in addition to uneven distribution of incomes, institutional failures and political economy considerations play an important part in the developmental outcomes for these countries. Furthermore research by Berry (2006), Buccellato and Mickiewicz (2008), El-Katiri et al. (2011) and Freije (2006) have also found that income inequality is a common problem among resource abundant countries. The subsequent analyses conducted for this thesis also finds this to be true.

I attempt to find the link between savings distribution and sustainability in comprehensive wealth measures, the thesis does not provide a full distributional assessment of all of the factors related to genuine savings, because of the lack of available data and the difficulty in estimating some factors such as ecosystem services and environmental services. However, this thesis attempts to begin the process of examining the overall savings distribution for Trinidad and Tobago to help provide policy recommendations that could help resource abundant countries that consistently have negative genuine savings rates and subsequent growth collapses and staple trap problems.

Furthermore research pioneered by the UK's Department for International Development (DfID) on sustainable livelihoods, suggests that at the individual and household levels, access to various capitals such as human capital, physical capital, social capital, financial capital and natural capital along with people's vulnerabilities and their interaction with institutions and the culture around them can play an important part in their life outcomes, DfID (1999) and Bebbington (1999). So while this thesis begins to look at the impact that access to capitals and the general distribution of assets can have on sustainability, it is apparent that there are many other microeconomic interactions such as the quality of institutions, access to decision makers and rent seeking behaviour that are important in determining sustainability outcomes and which become apparent in the subsequent analyses. So while distribution is an important consideration for sustainability and sometimes a disincentive for poorer households to invest for the future, Birdsall, Pinckney and sabot (2001), tackling political inertias and institutional failures are also important.

Background

Although T&T had economic growth for various periods of its history (the latest period being from about 1998 to 2008) fuelled by oil and natural gas exploitation and high export prices, a casual observation of the economic conditions for the vast majority of the population reveals that pockets of substantial poverty and inequality still exist; the official poverty rate stood at 16.5 per cent in 2005 (Henry, 2008), although unofficial estimates from the University of the West Indies put the rate at 27 per cent of the population in 2008 (Sookram, 2008). Depletion estimates provided in Chapter Three of this thesis reveals that economic growth has been associated with exploitation of natural resources and the consumption of the rents from the sale of these natural resources. This has also recently been confirmed by the World Bank in its 2006 and 2011 publications on the national wealth of nations. The World Bank's latest publication, World Bank (2011), also suggests that if T&T had invested more of its rents rather than consuming them, the so-called Hartwick rule, the level of per capita produced capital in 2005 would have been

about three times higher than actual estimates.[1] This, it would seem, is also true for a number of other countries that also rely on natural resource exploitation for economic growth, such as the Bolivarian Republic of Venezuela, Gabon, Nigeria and Democratic Republic of Congo, to name a few.

While there have been in the past many development theories that describe why countries that are reliant on natural capital exploitation for their economic growth do not perform as well as others, such as theories about Rent-seeking, the Resource curse, Dualism within dualism[2], Dutch disease and the Mechanism of the open petroleum economy, none of these have examined how inequality within these societies may be leading to these perverse outcomes. However, more recent literature on sustainable livelihoods (for example, Pantin (1994), Farrington et al. (1999), Dixon et al. (2001) and Di Stefano (2010) and the literature which examines the link between poverty degradation and the environment have touched on this concept (see, for example DFID (2000)). Literature on social accounting matrices also makes an implicit link between resource use and distribution, such as Thorbecke (1995) and Chander, Gnasegarah, Pyatt & Round (1980) and Adger & Winkels (2007).

Comprehensive measures of savings, such as adjusted net saving rates, calculate how a country performs amongst a series of key indicators including conventional net savings rates, investment in education, depletion and depreciation of natural assets and the amount of pollution produced by the economy. The rationale behind this measure is that a country's future prospect relies on its level of current wealth, since as Hicks (1946) explained; net national product should be exactly the rate of return on a country's capital base. Thus calculating this correctly means including as many dimensions of savings so that the analyst gets a clearer picture of true net national product and wealth of a country. Solow (1974, 1986, 1992 and 1993) and later Hartwick (1977 and 1990) have also theorised that a country cannot afford to consume the proceeds from one form of capital

[1] The World Bank estimates counterfactual savings rates had T&T followed the Hartwick rule.

[2] Although Barbier (2005) in his theory about 'Dualism with Dualism' speaks about frontier land degradation by the rural poor, he believes that it is inequalities in wealth between households even at the rural level that has an important impact on resource degradation processes.

indefinitely without using some of those proceeds to build up the stocks of other forms of capital. If this reinvestment of rents, particularly from non-renewable assets is not achieved, it becomes apparent that the future economic prospects of the country will be precarious, as the country will have a diminished asset base upon which to generate income. However, none of these theories explicitly state how the distribution of these savings may also affect the final outcome. Although the ANS rate is a good estimator of sustainability, other frameworks such as sustainable livelihoods also provides interesting commentary and also suggest that individual capital endowments are important but that vulnerabilities and structures such as government and the private sector also play an important part. Institutions and policies as well as culture are also important factors. Many of these issues are reviewed further in chapter two. Although this thesis does not measure the distribution of all forms of capital and the additional factors that might affect sustainability, the subsequent analyses begin this process by measuring human capital distribution which is important from the sustainable livelihoods approach and for the genuine savings measure. Proxy indicators of resource use distribution are also estimated. However, the thesis leaves some questions unanswered such as how to measure the distribution of pollution or physical capital depreciation, which are areas for future research.

Trinidad and Tobago (T&T)

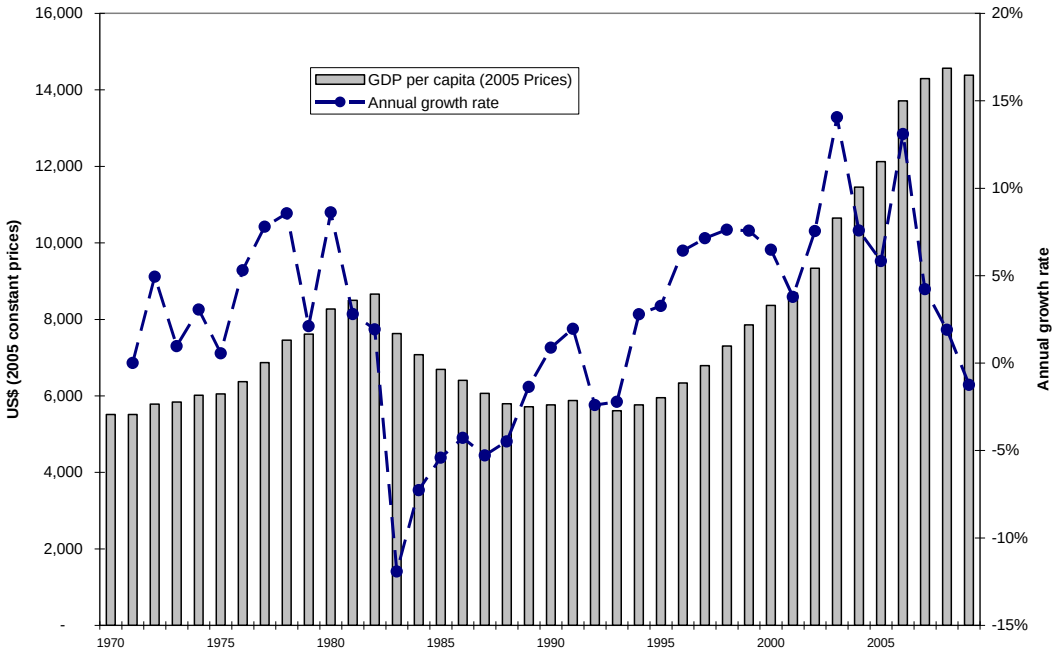
The analysis of how some of the savings and investment generated primarily from the exploitation of natural resources are distributed is focussed specifically on T&T. T&T is a republic made up of two main islands,[3] Trinidad being the larger island with a population of about 1.25 million and also being where the country's industrial base is situated. Tobago is the smaller of the two islands with tourism as its economic infrastructure and with a population of about 50,000. The islands gained independence from Britain in August 1962 and became a full republic in 1976. As most island states, exports have always driven economic growth and although The American Merrimac Oil Company drilled what is said to be "the first successful oil well in the world" at La Brea in Trinidad in 1857, only in the last forty years has oil and later natural gas become the

[3] There are also five smaller islands which are part of the Republic of T&T.

dominant industries of the economy, with petroleum contributing 48 per cent of GDP in 2008. Although the petroleum sector contributes almost half of national output, it only accounted for about 3.5 per cent of total employment in 2008. However, since the petroleum sector accounts for over half of government revenues (57.1 per cent in 2008), how these rents or proceeds are distributed could be very important for overall development and the eventual level of savings and investment within the economy.

Driven primarily by the petroleum sector's output and revenues, T&T's GDP per capita has trended higher over the last four decades, peaking at US$19,475 in 2008 in nominal terms[4] (US$14,562 in 2005 constant prices). From 1970 to 2009, the overall growth in per capita GDP has been about eighteen-fold, although the average over this period was about US$7,858 in constant 2005 prices, but within this time there were massive variations or swings depicted by the standard deviation of US$2,688 with, for example, an increase of 14 per cent in 2003 and decreases of 12 per cent in 1983 (see Figure 1.1).

Figure 1.1 Per capita GDP (constant 2005 prices)

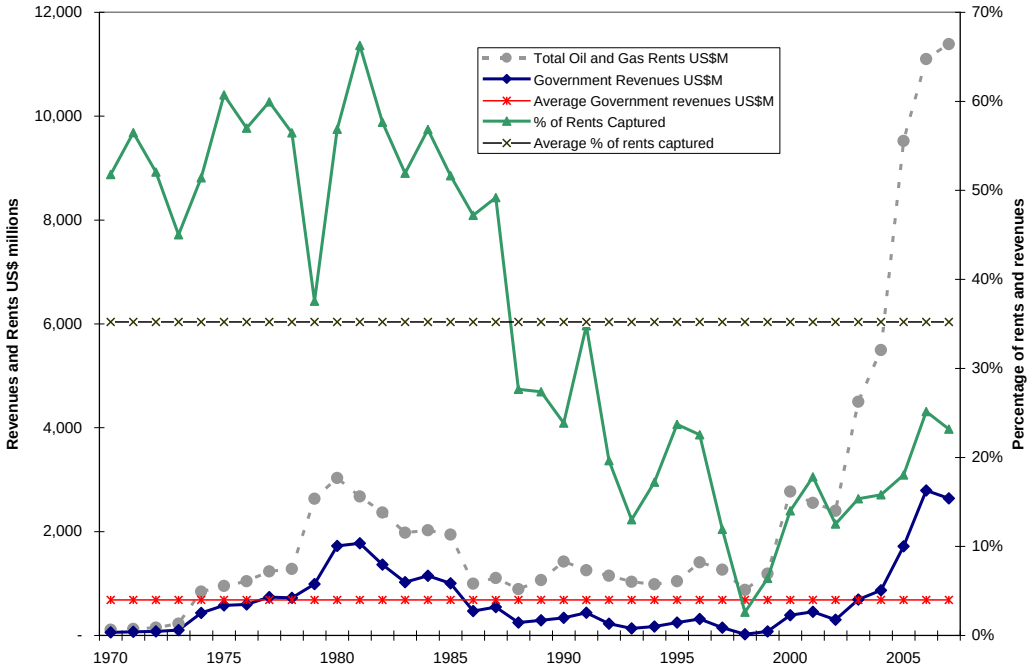


Source: UN Statistics

[4] This has since dropped to US$15,782 in 2009.

Figure 1.2 below shows the trends in government revenues from the oil and gas sector from 1970 to 2007 and estimates of total rents from the sector. Although total government revenues have increased during the last decade due primarily to high hydrocarbon prices in the last decade (oil and natural gas prices), the general trend before 1999 was a decline in the percentage of rents captured. Thus from 2001, there would have been scope to capture much more rent through better regulation of royalty and tax rates (Ram, 2005). However, on the other hand, the effectiveness of the government's deployment of those rents to achieve sustainable growth and adequate investment in all other forms of capital is also important.[5]

Figure 1.2 Oil and gas rents and government revenues



The importance of this policy is laid bare when adjusted net savings rates for T&T are estimated. Using estimates from the World Bank for Adjusted Net Savings (ANS), which is calculated as net national savings plus education expenditure minus energy depletion,

[5] This is the focus of the thesis.

mineral depletion, net forest depletion, and carbon dioxide,[6] T&T, although exploiting successfully its petroleum resources, has not been investing sufficiently for the future and in doing so has been consuming too much of its captured rents and also not capturing a sufficient amount of those rents.[7] Figure 1.3 shows that for the period 1970 to 2008, T&T's estimated average ANS was -4 per cent of gross national income indicating that the country has not been saving sufficiently given the rapid depletion of its non-renewable resources. Although the average ANS rate was negative 4 per cent of GNI over the period 1970 – 2008, the rate did fluctuate over this period. Much of the change has been driven by fluctuations in the price of oil and the level of extraction of hydrocarbon reserves, e.g. the significant decline in the ANS rate in the latter years is a function of the increased production of natural gas since 1999 which has led to the natural gas reserves to production ratio declining from 65 years to about 12 – 15 years.

From a policy perspective and for sustainability how have adjusted net savings or comprehensive wealth been distributed? Given the importance that access to capital plays for sustainable life outcome in the sustainable livelihoods framework, has uneven distribution impacted on sustainability? Figure 1.4 shows the main factors associated with estimating ANS, namely; gross savings, capital depreciation, education expenditure, resource depletion and pollution damages. The distributional analyses that follow in chapters four, five and six, do not estimate the distribution of each of these factors but only begins the process of measuring total distribution. Estimating the distribution of some of these factors such as renewable resource rents and pollution could be very difficult because of data availability and cost and have not been explicitly measured as part of this thesis.

Structure of Analysis

For T&T what's the underlying cause of these negative savings? Since in T&T there has been some investment of the natural resource rents in education and infrastructure and in

[6] This series excludes particulate emissions damages.
[7] Particularly from the monetising of natural gas through liquefied natural gas (LNG).

consumption opportunities through subsidies; who has benefitted from these expenditures and has this distribution affected overall savings rates?

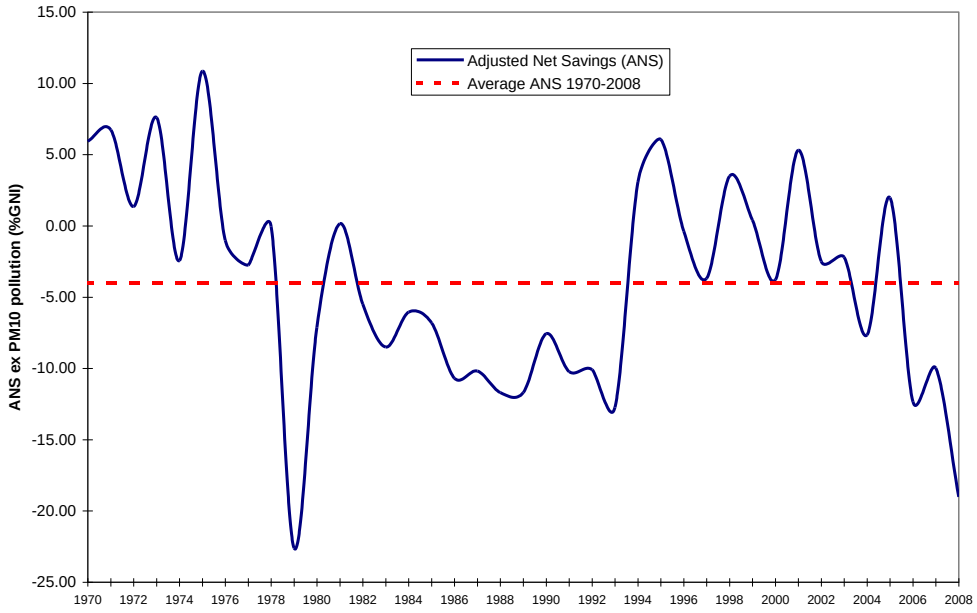
This thesis examines what seems to be a major discrepancy of the concept of sustainable development (SD) and its primary international measurement (ANS), i.e. its focus on intergenerational equity and not enough focus on intragenerational equity. Does intragenerational equity also matter for sustainability? If a country has an insufficient ANS rate, does equality and distribution matter? While this question has not been answered entirely in this thesis, the analysis that follows begins to assess this issue by for example analysing the distribution of human capital and approximately assessing the distribution of the benefits associated with resource exploitation or depletion. An assessment of the distribution of fuel subsidies, could also act as an indicator of the distribution of energy use and by extension carbon and pollution emissions. The distribution of the other components namely capital formation and other environmental assets are difficult to estimate and are areas of research that could be assessed or examined in the future.

If sustainable development depends on sufficient investment in a portfolio of assets including environmental, social, man-made and human assets then the relationship a society has with each of these asset types becomes important for sustainable development, i.e. how these assets are distributed will foster greater trust among communities, instil better stewardship of the environment, and the rates of return on man-made and human capital will be more evenly distributed (Wilkinson and Pickett, 2009). This is also the prediction of the sustainable livelihoods framework which looks at the problem at a micro level in terms of outcomes. However, institutional and policy failures are also important factors to consider and although not explicitly measured in this thesis, they become extremely important in the conclusions that arise from the analyses. Furthermore the empirical evidence and research of the development policy of some Asian economies have shown that governments in these Asian countries e.g. Republic of Korea, Taiwan, Singapore and Hong Kong specifically focused on equitable development, which allowed the even distribution of the benefits of development and

which has been a major factor influencing their overall economic performance (Page, 1994 and Birdsall & Sabot, 1993).

Earlier and recent research have also shown that income inequality has a debilitating effect on social outcomes, health outcomes, trust and general wellbeing of all members of the population within an unequal society (Wilkinson and Pickett, 2009). Added to this, the disadvantaged within society become highly vulnerable to environmental threats and pollution (and themselves pose threats to the environment through, for example, frontier land expansion), are affected more negatively by health inequalities and also crime due to a lack of social capital caused by the breakdown in trust in community relationships (Barbier, 2005). While this is only an assertion and has not been measured entirely within this thesis, an important consideration for policy makers would be the measurement of distribution and the ability to ascertain which groups within society are benefiting the most or the least from savings. Depending on these distributions, many of the recurring policy conclusions may not be entirely correct for development; Pantin et al. (1999), Dixon et al. (2001), Di Stefano (2010) and Pyatt & Round (1980).

Figure 1.3 Adjusted Net Savings for T&T

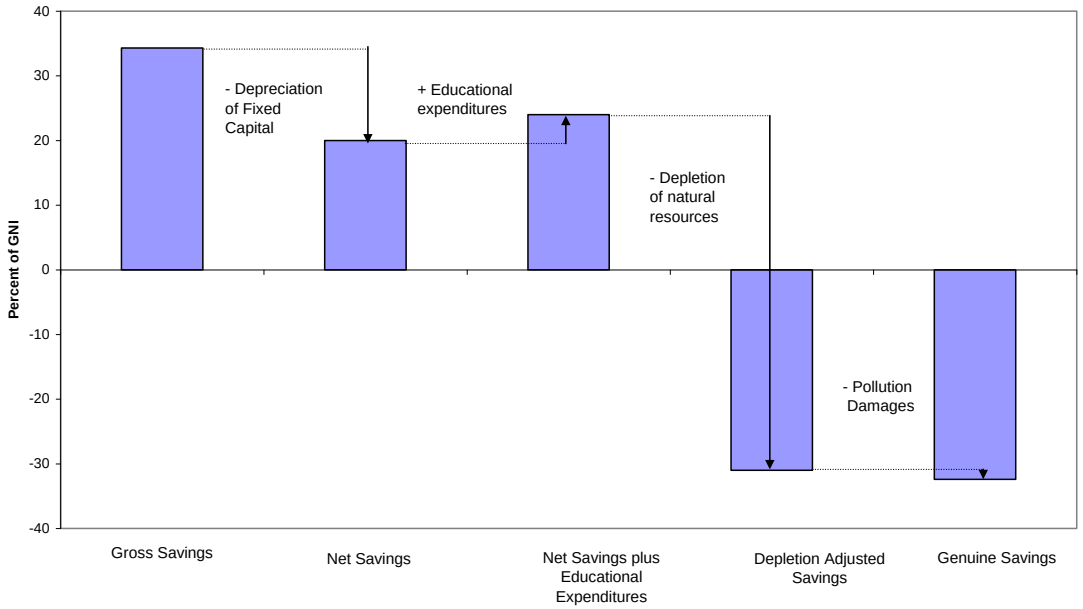


Source: World Bank

It is therefore safe to say that inequalities, despite savings, will have negative consequences for longer-term sustainability. Thus for a country like T&T, with an economy dependent on natural resource exploitation, adequate savings and investment of the proceeds from natural resource exploitation in other forms of capital is an imperative; not only at the macro level but also at the individual and household levels, DfID (1999). However, unless those savings and investments and the rents from natural resource exploitation, are equitably distributed or lead to a more equal distribution, it is likely that sustainable development will not be attained. Thus the measure of ANS or genuine savings on its own does not explain or provide enough guidance on the exact policy remedies to attain sustainable development. Even if a country is saving sufficiently and therefore on an apparent path towards sustainability, if gross inequalities still exist, then sustainability is threatened. The opposite may also be true; a country that is not saving enough and consuming too much of the rents from its natural wealth may be doing so due to its unequal distribution, which may affect consumption patterns, rent-seeking behaviour and political motivations for the spending or dissipation of those rents, see chapter four and six.

Figure 1.4 shows a stylised description of how ANS is calculated for T&T. The figure clearly shows, diagrammatically, how ANS is calculated by using gross savings as the base and then subtracting depreciation of fixed capital, adding educational expenditures, and then subtracting depletion of natural resources and pollution damages.

Figure 1.4 Calculating Adjusted Net savings for T&T, 2008



Source Data: World Bank

Figure 1.4 clearly shows that T&T had a negative genuine savings rate in 2008. However, from a policy perspective for individual countries, there would be gainers and losers. Therefore, knowing which societal groups are benefitting or not saving enough or contributing more to depletion of natural resources or pollution damages could lead to more refined policy responses to help achieve sustainable development. To do this, it would be necessary to have economy-wide input-output models with household distributions and resource flows to see how each of these factors or components of genuine savings are distributed among the different income groups within society. For example, how are educational expenditures and therefore human capital distributed, who are benefitting from expenditures on tertiary education and who are benefitting from depletion of natural resources and perhaps contributing most to pollution damages? This analysis could notify policy makers whether particular consumption patterns or the structure of the economy, unfair competition (such as monopolies) or leakages are having a negative impact on savings and what specific policies may be required to alleviate this. This thesis attempts to calculate some of these distributions for T&T in greater detail.

This analysis contained within this thesis examines the distribution of education expenditure and depletion of non-renewable natural resources. A proxy of pollution distribution can also be deciphered from an assessment of fuel subsidies conducted in chapter four.

Structure and contribution of thesis

The thesis begins with a literature review which first examines the literature on sustainable development and determines that there is a gap linking the concept (sustainable development) with development economics and that; furthermore, there has been little or no research on how inequalities may actually affect sustainable development. However, other literature on sustainable livelihoods, the environment-poverty nexus and social accounting matrices delves further into this topic. These literature strands are also reviewed but the review shows that the literature on sustainable development and its measurement does not necessarily account explicitly for distributional outcomes and what impact this may be having on sustainability.

Chapter Three then looks at different depletion estimates for T&T to determine if T&T has been saving adequately from the proceeds of the exploitation of the country's oil and natural gas resources. This chapter examines rents and depletion estimate of Trinidad's non-renewable energy resources (oil and natural gas). Estimates of the rents and magnitude of the depletion of T&T's energy resources are compared against Gross National Income (GNI) and investment as well as to other comparator countries. This chapter makes it clear that T&T has not been saving adequately and confirms the World Bank's estimates provided in Figures 1.3 and 1.4. From this, I then ask, how are these proceeds distributed and does this have an impact on depletion and savings rates? Is it possible to measure this distribution?

Chapter Four begins the process of examining the distribution of government revenues which are primarily made up of revenues from the petroleum sector. This chapter looks at how consumption opportunities financed by government revenues from the monetisation of oil and natural gas are distributed. This is done by examining the

distribution of fuel subsidies using household budget surveys and input output modelling. Within this chapter I examine the magnitude of the opportunity cost of fuel and energy subsidies within T&T and its distribution. These estimates have not been done previously for T&T and they show that fuel and electricity subsidies, which are meant to protect households' purchasing power, are regressively distributed since richer households benefit substantially more from these subsidies. Since subsidies are a 'bad' use of resource rents in terms of efficiency and fiscal imbalances, an important question that arises here; is why do governments still persist in providing them?

Chapter Five examines the distribution of investment by looking at the distribution of human capital. This has not been done previously for T&T and it uses a novel, adjusted Jorgensen & Fraumeni (1989) and Jorgensen & Fraumeni (1992) approach to show how investments of government revenues (here educational expenditure) are distributed and which income groups within society are benefitting most from it. Although the stock estimate is for one year, using an adjusted Jorgensen and Fraumeni approach along with household budget data provides a unique insight into the distribution of human capital across income groups. I also use a simple Mincerian approach to estimate human capital for two periods to assess trends in human capital accumulation.

Chapter Six examines the structure of the economy and how revenues from the oil and gas sector are distributed among different households and the government. To do this, I use partitioned matrices, a methodology first developed by Miyazawa (1976). This methodology allows for the tracking of consumption revenues and income throughout the economy and also allows for the construction of inter-industry and inter-relational multipliers to examine how income is accrued to one group (households and government) and how expenditures by these groups are distributed. It therefore allows for the observation of economy-wide distributions and leakages that may be leading to unequal outcomes and lower saving rates. The Miyazawa approach allows for a less data intensive assessment of how petroleum revenues are distributed without the need for the detailed assessments required by conventional social accounting matrices (SAMs).

Chapter seven is a concluding chapter that summarises the findings of the thesis. Although the analysis does not cover all aspects of government expenditure of rents, the evidence, calculations and estimates suggest that T&T's economic structure, consumption patterns, government spending, leakages such as imports and taxation and the distribution of human capital are all contributing to a legacy of maldistribution and which might lead to insufficient savings rates for the attainment of sustainable development. It is also evident that political economy considerations and institutional failures continue to play an important part in the underdevelopment of T&T.

Chapter Two: Literature Review

This thesis examines the relationship between intra-generational equity and sustainable development in resource rich economies. It focuses on the impact that inequality and poverty mighty have on sustainable development, thereby contributing to the debate about what is the best development path or transformation option for underdeveloped resource abundant economies. This literature review begins by examining the definitions of sustainable development and how sustainability is linked to economics. It then examines the current measures of sustainable development as well as a brief overview of the development theories related to resource rich economies and their development. There is also an examination of the relationship between poverty and the environment or the so-called 'poverty-environment nexus'. This review also examines the apparent lack of concern for the welfare of the least well-off in contemporary society and implies that the welfare of the impoverished or those living in poverty should be a pillar of sustainable development.[8] The review also examines the impact that political economy can have on developmental outcomes.

The next section outlines the background and motivation of the research. It begins with an overview of the main theoretical debates on sustainable development and the role of economics in that debate. Omissions or gaps in the literature with respect to intragenerational equity and the concern for the poor are also discussed. The apparent link between the poor and sustainable development is alluded to throughout the review.

2.1 Background and motivation: Empirical and theoretical debates on sustainable development

The concept of sustainable development is not new. This section provides an overview of the concept, from its historical roots to the economist's definition of sustainability. Since

[8] The Brundtland Commission did recognise the welfare of the least well-off in society.

the publication of the report by the Brundtland/World Commission on Environment and Development (WCED) in 1987, as well as the United Nations' Rio conference in 1992 on sustainable development, the term "sustainable development" has come to be associated primarily with balancing economic development with environmental preservation. The Brundtland Commission report at the time provided the best definition of what is sustainable development – "development that meets the needs of current generations without compromising the needs or ability of future generations to meet their own needs". However, to say that the concept or the pillars of sustainable development have only been in existence for about twenty years since the Brundtland report would be inaccurate. Economists have attempted to incorporate the environment into their models for many years. Early in the twentieth century, Pigou (1920) wrote about pollution and economic efficiency and by the 1960s there was a growing concern about conservation and the environment, and much of the disparate and different aspects have come together under the rubric of sustainability or sustainable development (Bromley, 1998).

For economists, the idea of sustainability was conceived from the notion of having growth without compromising or impoverishing future generations. Thus, many economists have attempted to answer the question of how growth can be accommodated without leaving a depleted or degraded stock of natural resources. Bromley (1998) suggests that many of the propositions about sustainability from leading economists are quite similar. Thus for Solow (1974) and Hartwick (1977), the problem is really one of intergenerational equity. Solow sees this primarily as the level of consumption of future generations not being less than the consumption levels of current generations. This can be assured if the total stock of capital; natural and man-made, is sufficient to provide this. Pearce and Atkinson (1993) also support a similar position. Pezzey (1989) sees the problem as non-declining welfare over time, and Howarth (1995) argues that it is the Kantian imperative, while Bishop (1978) advocates a safe minimum standard of conservation.[9]

[9] Cited in Bromley (1998).

2.2 Income, prices, utility and compensation in sustainable development

Of course, for many of these approaches, sustainable income is considered a measure of sustainable welfare. Solow states that "if we talk about the economy in a more sensible and accurate way, we might actually be able to conduct a rational policy in practice with respect to natural and environmental resources", Solow, (1992). He goes on to argue that traditional measures of Gross Domestic Product (GDP) and Gross National Product (GNP) are not bad for studying fluctuations in employment or analysing the demand for goods and services. However, these measures, because they pay little attention to capital depreciation, do not provide an accurate picture of welfare. Hence national statisticians also compile the Net National Product (NNP) which accounts for depreciation in fixed capital. For Solow (1992) this principle should also apply to natural capital and the environment. Thus true NNP measures the maximum current level of consumer satisfaction that can be sustained forever; it is therefore a measure of sustainable income Solow (1992). Therefore, net national product measured by the 'right prices' can be considered a proxy of human satisfaction or welfare in the current period. Investment would include depletion of natural resources and if participants in the economy are not myopic, then the "right prices" would reflect future productivity and would also make full allowances for future concerns. "Properly defined and properly calculated, this year's net national product can always be regarded as this year's interest on society's total stock of capital" ,Solow (1992). Capital must therefore be interpreted as all things tangible and intangible, which the economy can invest and disinvest in, including knowledge. Thus the interest rate that capitalises NNP will be the real discount rate.

Pezzey (1995) argues that, contrary to Solow, non-declining wealth is not a measure of sustainability. For even if society is accumulating and maintaining its capital using arbitrary prices or conventional optimal development path prices, this capital cannot be equated to knowing that society's welfare will be sustained forever.

Thus the traditional approach by economists to the issue of sustainability usually begins with utilitarianism. The focus is therefore on capital, consumption, utility and welfare, to

name a few, over time. The utilitarian approach has added clarity but sometimes not enough coherent operational solutions (Bromley, 1998).

Howarth (2007) argues that depletion of the natural resource stock is morally legitimate only when particular and well characterised steps are taken to compensate future generations for invasions of their just entitlements. Thus for Howarth, the issue of sustainability is a rights-based concept, and he argues that utilitarianism which focuses on a welfare function that balances the interests of each member of society is at odds with the rights-based framework of democratic governance and the pursuit of self-interest in markets.

Although Solow's approach is appealing to a framework of welfare economics which can be operationalised by charting the course of a utility index over generations, there may be, according to Howarth, some conceptual problems, the main one being that preferences of future generations cannot be known with certainty, due to technological evolution, institutions and cultures.

2.3 Net Investment Rule

The literature on natural resource accounting and subsequent additions to this literature have made some attempts to find solutions to this problem by suggesting that natural capital contributes to the production of market goods and services and that the Net Investment Rule should apply, Howarth (2007); Neumayer (1999); Hartwick (2000); and Pezzey 2004). The Net Investment Rule states that a dynamic economy will maintain a constant or increasing level of per capita utility only if investments in manufactured capital exceed the monetary value of natural resource depletion on an economy-wide basis, Howarth (2007).

However, Howarth dismisses the practicality of the Net Investment Rule since it only holds if economies satisfy the following three assumptions:

1. Population, technology and preferences must all be held constant.

2. The economy must be closed or terms of trade must be held constant.
3. Resources must be allocated in a totally efficient manner under conditions of perfect foresight.

For Howarth, it is apparent that the Net Investment Rule has some impracticalities since most societies have growing populations and the Rule would understate the required investment if per capita utility is to be maintained over time. He also points out Pezzey's[10] observation of a "Hedonic treadmill" whereby economic growth and the alteration of preferences means that increasing consumption levels are required to sustain wellbeing. This has been proven by other research in the USA, Europe and Japan which have shown that increases in material wealth have not been matched by the same level of growth in life satisfaction, Wilkinson and Pickett (2009), Kahneman (1999), Oswald (1997) and Easterlin (1974)

Thus from a policy standpoint, the issue may be how to sustain or improve opportunities. It seems that sustaining or improving human opportunities should come first and then manufactured capital will follow.

2.4 Sustainable development or optimal development?

Pearce (1993) attempts to provide an overarching definition of sustainability by first distinguishing between sustainable yields and sustainable economies. Sustainable yields refer to the management of resources in such a way that the output and the resource are maintained over time for future generations. For example, the sustainable exploitation of a fishery would require a level of harvesting that would not lead to the disappearance of fish stocks and would reduce or eradicate the need for moratoria on fishing. While one can also argue that extinction of a fish stock may not matter since fish can be exploited elsewhere, in many instances this would be impossible. Extending this argument to economies seems fairly logical, and we would simply need to ensure that the output of

[10] Pezzey (1992).

the economy and the underlying resource base that gives rise to that output is sustained. Pearce (1993) argues that economies are reliant on more than renewable resources; thus the link between sustainable yield and sustainable economies is insufficient for sustainability. Economies also rely on non-renewable resources like iron and oil to enhance human wellbeing. However, the requirement for sustainability would suggest their use but with substitution into renewable resources as reserves are depleted. It would also require their use in a manner that reduces their environmental impact.

However, is substitution of non-renewable resources the only requirement of sustainable development? According to Pearce, some opponents of this idea argue that substitution alone cannot compensate for scarcity. Instead, what is needed is a change in lifestyle so that we use fewer resources. Thus economic growth is not good for sustainability since increases in GNP leads to greater use of natural resources. However, Pearce suggests that this is an untenable solution since GNP and wellbeing are inextricably linked. Thus his definition or philosophy of sustainable development embraces economic growth and is really about reducing the ratio of resource use to GNP and encouraging greater use or transition to renewable resources. Therefore, technological change is important for sustainability.

Further arguments against encouraging sustainability come from free market economists, who would argue that prices would signal scarcity and alternatives or substitutes would be encouraged and new technologies would be phased in naturally over time. The problem with free-market approaches to sustainability is that many resources that are most threatened, such as capacities of the oceans and the atmosphere, are not traded in markets, and most markets are not environmentally benign, Pearce (1993). I would also add that, in cases where there are global prices for the resource, this global price may not adequately reflect local scarcity (particularly if the local supply contributes only a small per cent of global output), unless a net local price approach (say, market price less local cost of extraction) is used as the proxy of scarcity.

In circumstances where there is no apparent scarcity in the resources, then 'resource optimists' suggest that concern for sustainable development is unnecessary, since there are expanding resource discoveries and declining trends in prices. However, as Pearce notes, this again refers to marketed resources, and we are unsure how efficiently the market works.

Thus the notion of sustainable development is to be considered in a broad context, where both inputs and outputs are being sustained. Sustainable development's concern with output is broader than just GNP; it also embraces social goals. Equally, the concern for inputs is broader than natural resources; it also focuses on all forms of capital, Pearce (1993).

This notion of sustainable development according to Pearce (1993) is consistent with the Brundtland Commission definition of sustainable development; that is, as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' and in addition:

- the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs. (WCED, 1987).

This brings us to the idea of sustainable development versus optimal development. Pearce argues that optimal development which seeks to maximise present value wellbeing over a specific time may indeed be unsustainable as wellbeing may fall after the specified time. A sustainable path, on the other hand, may lead to a better future but may make current generations worse off. So how do we choose between the two, or is this choice unnecessary?

If we are concerned with the current living conditions of the poor, and the best way to lift people out of poverty is to engage in 'dirty industrialisation', how does this conflict with our concern for the state of the environment that is being left for future generations?

Would optimal development which maximises the sum of individual wellbeing achieve this? According to Pearce (1993) it would not, since there is no guarantee that the poor will not get poorer. However, if the objectives are changed so that we maximise wellbeing subject to the poor not getting poorer or that the poor in the future can be no poorer than they otherwise would have been, then there may be very little difference except in judgment between sustainable development and optimal development. See also Box 2.1 below adapted from Pearce (1993) which summarises some of the main arguments for and against sustainability. Those who argue for sustainability are primarily concerned with the welfare of future generations. Therefore, the current generation should not harm the prospects of future generations. However, these proponents of sustainable development are convinced that current generations are harming the wellbeing of future generations. However, the opponents of sustainability argue that the wellbeing of future generations should not be a primary concern and, if it is a concern, it is less important than the wellbeing of the poor in the current generation.

Box 2.1 Arguments for and against sustainable development

For and against sustainable development

Sustainability requires two assumptions:

1. FACT: Current generations are adversely and significantly affecting future generations' wellbeing.
2. VALUE JUDGEMENTS: We ought not to be unfair to future generations.

Opponents of sustainability require one of the following:

1. Current generations are not harming future generations (in which case a moral issue does not arise).
2. The wellbeing of future generations is not a moral concern.
3. The wellbeing of future generations is a moral concern but it is less important than the wellbeing of the poor now, and the two conflict.

Source: Adopted from Pearce (1993)

2.5 Measurement and policy relevance

For these arguments to have any policy relevance, how sustainability and depletion of natural resources are measured becomes extremely important from a policy perspective.

Atkinson and Hamilton (2007) were struck by the ambiguity of the early green accounting studies that were published in the late 1980s and early 1990s, for example, the pioneering study by Repetto et al. (1989). The studies did not appear to signal whether an economy was sustainable or not. Thus the work by Pearce and Atkinson (1993) tried to link assets with sustainability so that changes in asset values measured by net saving rates should signal if an economy is on a sustainable development path. While this work was rudimentary and was closely linked to the intuition of earlier theorists like Solow, refinement was needed so that a truly practical indicator could be defined. Hamilton (1994) coined the term "Genuine Savings" and this is the term, together with "Adjusted Net Savings" and "Comprehensive Wealth" that describe the most widely used methodologies that assess an economy's relative sustainability. These measures try to estimate the changes in overall wealth that occur during the economic transactions within an economy during the course of a year. These measures build on traditional economic estimates of welfare. Therefore, besides the conventional measures of savings, depreciation of man-made and natural capital are assessed and added along with investments in human capital and the impact on the environment from economic production and consumption. To augment traditional indicators of wellbeing, the measurements of the depletion of natural resources and environmental degradation are important if these overall measures are to become meaningful indicators. Atkinson and Hamilton (2007), in their review of the literature during the ten years from 1997 to 2007, suggest that progress has been made, particularly in measuring the depletion of non-renewable resources and valuing environmental degradation.

The genuine savings indicator is defined as:

$$G = \sum_{i=1}^{N} piK * i$$

Here Genuine Savings is measured as the change in real wealth, where K, the stock of assets in the economy, is valued at *pi* their shadow prices. Sustainability can be assumed if G encompasses as many assets as possible, even those with negative shadow prices. Hamilton and Clemens (1999) showed that Genuine Savings G, utility U, social welfare V, marginal utility of consumption λ and pure rate of time preference ρ are related:

$$V = \int_{t}^{\alpha} U(C,...) \cdot e^{-\rho(s-t)} ds$$

$$G = \lambda^{-1} \frac{dV}{dt}$$

This implies that social welfare V is equal to the present value of utility and that Genuine Savings G is equal to the instantaneous change in social welfare measured in money values. Hamilton and Clemens have shown that negative genuine savings implies unsustainability or that future utility will be less than current levels. However, positive savings at a point in time does not imply sustainability, so genuine savings is considered a one-sided test.[11]

For Atkinson and Hamilton (2007) the weak versus strong sustainability debate still exists, but they concede that if some amount of nature must be conserved (I would also add some amount of social capital as well) then the savings models need to incorporate the shadow price of the sustainability constraint, and there is still work to be done on the implications of ecological thresholds for measuring sustainable development. They also claim that genuine savings is not only a measure of weak sustainability.[12]

[11] Note that Hamilton and Withagen (2007) demonstrate that in a competitive economy, maintaining positive genuine savings rates that are growing less than the interest rate will lead to increasing consumption at each point in time.

[12] The 'constant capital rule' is also known as the 'weak sustainability rule'. This interpretation of the rule suggests indifference to the type and form of capital that is passed on. What becomes important for sustainable development is the total capital stock that is passed on and that it should be no less than what currently exists, which is similar to Solow's and Hartwick's notion of sustainability.

2.6 Poverty and sustainable development

This section outlines the link between poverty and the environment, and reviews the literature as it relates to the role of poverty in sustainable development. At the moment, there seems to be little consensus on the role or link between poverty and the environment. Some authors suggest that poverty is a major cause of environmental degradation and that, if it is not reduced, it will pose a serious risk to sustainable development. Others believe that it is the environment that contributes to poverty when people live in vulnerable natural conditions that do not foster stability or encourage sustainable livelihoods. Thus the linkage between the environment and poverty, and indeed between poverty and sustainable development (which is broader than simply concern for the environment), is a complex one and it is quite possible that the forces at work in this nexus operate in many directions and have various impacts on sustainable development. To examine this complex interaction and relationship, I begin by looking at how the poor interact with the environment and how their vulnerability may be exasperated by this interaction.

2.6.1 What is the real link between poverty, the environment and sustainable development?

As mentioned above, theorists and policy makers are uncertain about the exact relationship between poverty and the environment. Does poverty lead to environmental degradation or is the causal effect the reverse; i.e. do degraded environments lead to poverty? In many ways, I believe this dualism is too simplistic to understand this complex interaction, and I believe the real focus should be on the relationship between poverty and sustainable development, which encompasses more than concern for the environment, but which also encompasses concern for those living in the current generation but with unequal circumstances. Poverty, more often than not, is a symptom of unequal access to resources, which include wealth and opportunities, see also Bebbington (1999), DfID (1999) and World Bank (2003). This sometimes leads to poorer households having negative impacts on the environment. Although it is now widely known that the

poor have less impact on the wider environment than the rich do particularly when emissions and pollution are accounted for, Jehan and Umana (2003). This section therefore examines this complex relationship and its implications for sustainable development.

Should we even be concerned with the link between sustainability and distribution? Economists have always argued for the separation between efficiency and equity. However, according to Heal and Kristrom (2007), as far back as McGuire and Aaron (1969) and later Brown and Heal (1979), the assumption that these two parameters should be separated needs to be fully scrutinised. In terms of environmental degradation, Zimmerman (1986) found that environmental damage and the net cost of environmental policy are all regressively distributed. Further analysis by Maler (2007) on social accounting matrices (SAMs), DfID (1999), Bebbington (1999) and Adger & Winkels (2007) on sustainable livelihoods also adds interesting insights to the debate.

Barbier (2005) examines the so-called environment poverty trap and why it seems to be so entrenched in many poor rural areas. Barbier sees the problem as being associated with two types of dualism. The first dualism, the one that tends to get the most focus in poverty-environment studies concerns aggregate resource use and dependency in developing countries and is associated with widespread land conversion and environmental degradation caused by the rural poor. However, for Barbier, there is a second dualism which reinforces the first. This dualism concerns the tendency of resource-based development in low and middle income countries to be correlated with poor economic performance.

As mentioned previously, there have been alternative approaches used to assess the link between poverty and the environment and, by extension, sustainability. Green accounting through the use of SAMs has been one way of doing this. SAMs are a comprehensive economy-wide data framework for a country which represents the economy of a country. A SAM is really a square matrix with each account represented by a row and column. The incomes for each account appear along the row and expenditures down its columns.

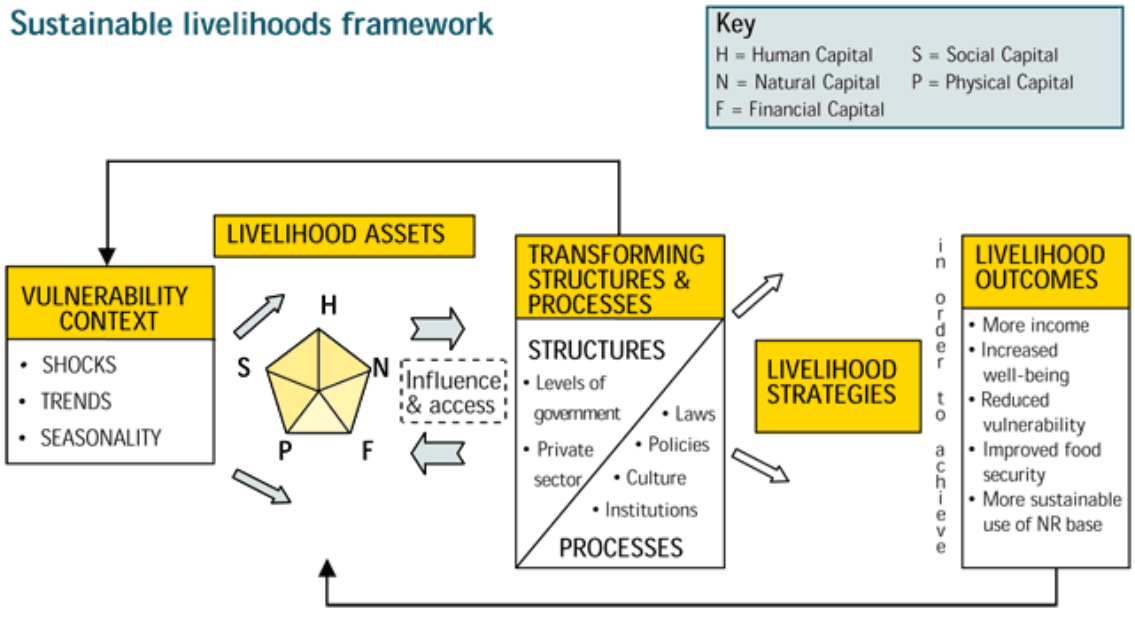
Double entry accounting is the main principle behind SAMs and ensures that total revenues (row totals) equal total expenditure (column totals). A SAM consists of various accounts which represent various activities performed in the economy by different sectors such as households and government. SAMs have been used more often to assess the level of poverty and distribution within an economy, such as Pyatt and Round (1988) and Thurlow and Wobst (2003). There have also been attempts to use SAMs to trace the flow of resources throughout the economy and to measure the impact on distributions (Maler, 1991; Horan et al., 2003). SAMs, through the use of computable general equilibrium models, have been a useful tool for analysing some of these impacts. Work by Lange and Motinga (1997) and Lange et al. (2003) on green accounting with southern Africa have shown that revenues associated with resource use can be unevenly distributed, with the poor reaping an insufficient proportion of resource rents.

The sustainable livelihoods debate has also provided some interesting insight into the links between poverty and the environment. This debate is linked closely with Sen's thesis on capabilities and opportunities. Much of the literature on livelihoods have suggested that where households have the incentive to invest in the natural environment, since there is an economic return, possibly through property rights, sustainable livelihoods can be an effective way of reversing any negative impacts that poverty might have on the environment (Bebbington, 1999). In fact, where vulnerability from the natural environment arises, sustainable livelihoods can also improve households' resilience. Adger and Winkels (2007) have argued that the distribution of income and access to resources represent fundamental determinants of capability and vulnerability. However, they have also stated that inequality plays a role in environmental degradation, particularly when wider concepts such as marginalisation and resilience are examined. They have found that global economic change and access to resources tend to undermine social resilience and create circumstances where the only response of the vulnerable is resistance. Social resilience can only be enhanced or undermined depending on the institutions of the state (formal), the outcomes of democratic governance and the legal framework of property rights. Reducing vulnerability and improving the resilience of the marginalised within society can have significant implications. Improving resilience and

improving sustainable development for the marginalised are, in the words of Adger and Winkels (2007), a moral and political imperative. The priority placed on poverty reduction and preservation of the natural environment within the millennium development goals may go some way in addressing this.

The sustainable livelihoods framework of the United Kingdom's Department for International Development (DfID) suggests that there are dynamic linkages between people's assets, their vulnerability to environmental change and the structures and processes surrounding them such as government, institutions and culture. This framework suggests that any analysis of the poverty and environment nexus should be people focused and begin with a simultaneous investigation of their assets, their objectives i.e. the outcomes that they seek and the livelihood strategies employed to achieve those objectives. The framework is shown in the following diagram, which shows that there are important feedbacks between the transforming structures and processes and overall vulnerability as well as between livelihood outcomes and livelihood assets.

Figure 2.1: Sustainable livelihoods framework



Source: DfID

In the wider context, peoples livelihoods and the availability of assets are affected by trends, shocks and seasonality over which they have limited or no control. Thus in analysing the relationship that the poor might have with natural assets, it is important to assess people's vulnerability since this might have a direct impact on their asset status and the subsequent options that are open to them in pursuit if beneficial livelihood outcomes. Vulnerability refers to vulnerability to trends such as population and resource trends and economic trends as well as shocks such as natural shocks, conflict and crop shocks and seasonality trends such as prices, health or employment opportunities. While the effects of shock might not always be negative it is important to remember that these complex influences are directly and indirectly responsible for many of the hardships faced by the poor.

In addition to people's susceptibility to shocks, trends or seasonality, the livelihoods approach seeks to gain an understanding of people's strengths; i.e. their assets and endowments and how they use these or convert them into positive outcomes. By examining the assets base of people we are able to assess whether particular types of initial asset endowments can help people escape poverty and provide guidance on where livelihood support should be given. This analysis also allows policy makers to assess if some assets can be substituted for others given circumstances, so there can be compensation if for example there is a lack of financial assets. There is therefore an asset pentagon that changes shape based on different endowments. There are five main capital assets identified by DfID and these are; human capital, social capital, natural capital, physical capital and financial capital. Human capital is seen as being important and of intrinsic value and is important for making use of the other four asset types and so necessary for the achievement of positive livelihood outcomes. Social capital is important for mutual trust and reciprocity and lowers the costs of working together. Therefore it can improve the efficiency of economic relations and reduce free rider problems associated with public goods and facilitate innovation and sharing of knowledge. Natural capital is extremely important for those who derive all or part of their livelihood from nature. However, it also has other important benefits for those who do not rely on it directly for their livelihoods such as people's interactions with complex

ecosystems and environmental services. Access to physical capital is seen as being important for breaking the cycle of poverty e.g. a lack of particular infrastructure is considered a core dimension of poverty, DfID (1999). Inadequate access to water and energy could lead to a deterioration of health and unproductive use of time in the collection of water and energy. Financial capital is the most versatile of the asset types since it is easily convertible into other types of assets. However, it is the form of capital that is least available for the poor. The lack of financial capital is also the reason that the other types of capital are so important for the poor.

The sustainable livelihood framework also shows that capital assets are important at the individual level for sustainability. The Hartwick rule reviewed earlier suggested that the total assets base was important if a country was to maintain consumption levels. However, it also seems that access to assets among people is also important for their livelihoods and consumption. Although the framework does not allow for the quantification of changes it still allows for the analysis of the indirect linkages between activities and assets, Ashley (2000) Bebbington (1999). It is clear from various analyses that natural capital plays an important part in sustainable livelihoods and equality. However, there are other forms of capital that play equal roles in achieving this outcome such as human capital, financial capital, social capital and physical capital. From a genuine savings perspective it is difficult to assess how each of these forms of capital are distributed primarily due to data availability and the resources to measure them. Since human capital is seen as the most integral for the use of the other types of assets, later in this thesis an attempt is made to measure human capital and its distribution in Trinidad and Tobago. Chapter six of the thesis also attempts to trace the flow of financial benefits coming from the primary sector to different household income groups.

Jehan and Umana (2003) are convinced that inequality is the major problem facing the poor and hence their relationship with the natural environment. Examining the environment-poverty nexus, they have found that achieving the United Nations' Millennium Development Goals (MDGs) and sustainable development are mutually reinforcing, particularly as poverty reduction is key to achieving the MDGs. They have

found that inequality and its negative consequences affect primarily the poor. Thus productive resources are dominated by the rich and the poor lack access to cleaner and efficient energy, such as kerosene and electricity; for example, about two billion people in the developing world are without access to electricity. Social exclusion which primarily affects the marginalised and the poor can also have implications for sustainable development by;

- Denying groups of people the ability to contribute to the development process.
- Excluding people from participating in decisions that affect their lives.
- Raising the fear of human insecurities.

Thus the relationship between the poor and the environment is complex. While the environment affects the poor by contributing to their livelihoods, impacting upon their health and their vulnerability, the poor may impact upon the environment by encouraging countries to promote economic growth at the expense of the environment and by inducing societies to downgrade environmental concerns; Jehan and Umana (2003). This can be considered if the political class in resource abundant countries tries to appease the poor (if the poor are not receiving an adequate share of resource rents) by turning a 'blind eye' to land degradation on frontier lands that the poor might be engaged in for their livelihoods. However, it should be noted that such a phenomenon might be as a result of insecure property rights and general lack of opportunities in the labour market for the poor or when productive landholdings might be monopolised by wealthier income groups, Demas (1971) and Barbier (2005). Thus Jehan and Umana agree with Barbier's assessment that the poor are sometimes pushed to the periphery, the most ecologically fragile of lands, and this may increase their vulnerability further. They also agree that the poverty-environment nexus does not only stem from low incomes but also property rights, the strength or weakness of local communities, the way people cope with risk, the use of scarce time and poor people's entitlements that also affect the environmental behaviour of the poor. It is also clear that, irrelevant of income, in fragile ecosystems, people minimise risk and do not maximise output.

Boyce (2003) posits that there are many dimensions between inequality and environmental degradation. From his three main questions asked he elicits some useful conclusions. He asks three questions:

1. Who benefits from economic activities that degrade the environment?
2. Who bears the cost of environmental degradation?
3. Why are winners able to impose environmental costs on the losers?

He finds that this depends significantly on the relative power of winners and losers so that social decisions on environmental protection favours the more powerful, which suggests that greater inequality in the distribution of power leads to lower environmental protection and therefore greater environmental degradation. Boyce (1994) also successfully argues this point by suggesting that inequality tends to raise the valuation of the benefits reaped by the rich and powerful relative to the costs imposed on the poor and less powerful. This inequality also raises the rate of time preference for both the losers and winners by increasing their poverty and insecurity respectively.

A report by Oxfam (2012) suggests that environmental degradation intensifies social inequalities since the impacts of degradation fall mostly on the poor. This sequence of events occurs by impacting negatively on the livelihoods of poor people who depend on natural resources and social conflict over resource use through the lack of secure property rights which tends to over time limit their use of resources such as land, water, forests and fishing grounds since elites eventually secure the rights and access.

These arguments also therefore suggest that reducing inequalities could reduce environmental degradation by not only limiting the impact that the poor might impose on the environment but also limiting the impact that the powerful can wield and therefore foist greater environmental burdens on the less powerful and the poor.

Related to many of these arguments is the relationship that population growth has on economic growth. Das Gupta et al. (2011) review of the evidence have confirmed that while policy and institutional settings are important for economic growth and poverty reduction, the rate of population growth is also an important factor. Lower dependency

ratios particularly as fertility rates decline can enhance productivity, savings and investment for future generations. Lower fertility rates are also associated with better child health, child education and provide women with more opportunities to participate in the labour market. Das Gupta et al. (2011) have also found that rapid population also places pressures on the natural environment as market forces, innovation and human ingenuity might not keep pace with its growth. The impact on common property resources could be particularly worrying as they are impacted by activities that support rising consumption for growing populations. Their review of the World Bank (2010) found for example that estimates "to meet the growing demand for food between 2005 and 2055, agricultural productivity will need to rise by 64 percent under the assumptions of the ―business as usual scenario and by a further 80 percent under the assumptions of projected stresses arising from climate change . Yet the model indicates that if population remained constant at the 2005 level, agricultural productivity would need to rise only 25%", Das Gupta et al. (2011). They have argued that managing global environmental problems which have been exacerbated by rising consumption and growing populations might be easier managed by reducing humans' ecological footprint by reducing fertility rates.

Scott (2006), however reconfirms the multidimensional relationship between poverty and the environment, she identifies that while environmental vulnerability is an important factor when looking at the dynamics of poverty; "environmental factors though, do not operate in isolation". Scott suggests that there are also social, economic and political dimensions which, when operating together, produce chronic disadvantage for some people. Therefore some in society are more susceptible to the adverse impacts of environmental hazards because of their position within society. 'They are more exposed to these hazards and also have lower sensitivity and resilience because of the unequal distribution of assets, access to natural resources, and of information and knowledge across social groups. Whether the aim is to reduce poverty or to ensure environmental sustainability, the 'environment' and 'society' cannot be treated as separate entities' Scott (2006).

For Barbier, there is a ‘cumulative causation’ that links the two dualisms referred to earlier, and he refers to this as a ‘dualism within dualism’ pattern of resource use. Thus entrenched policies and the status quo reinforce a pattern of resource exploitation in low and middle income countries, where resource exploitation for commercial and export oriented economic activities is mainly carried out by wealthier members of society. I would also add that in the case of resource exploitation that requires substantial capital investment, such as mining and oil exploitation, the major beneficiaries are relatively wealthier households with better access to education, formal credit markets, higher incomes and accumulated wealth.

Although it is a commonly held view that the rural poor are responsible for resource degradation such as conversion of forests, wetlands and other natural habitats, Barbier believes that it is inequalities in wealth between households even at the rural level that has an important impact on resource degradation processes. Government policies that favour wealthier households in key resources such as land also worsen the problem. These complex interactions are also reinforced by the sustainable livelihoods framework, DfID (1999).

The pattern of resource exploitation in low and middle income countries and the benefits from resource conversion that are inequitably distributed do not necessarily lead to sustainable economic growth and poverty alleviation. In fact, unequal distribution of benefits leaves the poor on marginal lands and exasperates the conditions for ‘frontier’ resource expansion and degradation (Barbier, 2005).

Barbier shows that this ‘dualism within dualism’ is present in many developing low and middle income countries. As an indication of resource dependency, he uses a measure of the share of primary products in total exports. Thus a country with a share of primary products in excess of 50% of total exports would be considered to be highly resource dependent and susceptible to the dualism of resource dependence and poor economic performance.

The second dualism of aggregate resource use and dependency, and thus the uneven distribution of resource use benefits, can be indicated by the share of total population living on fragile lands and the share of rural population living in absolute poverty. Barbier combines these two measures to give an indication of the degree of rural poverty resource use dualism. He calls this the 20–20 rule, whereby if a country has 20% or more of its population living on fragile land, and if 20% or more of the rural population is living in absolute poverty then this country exhibits signs of the poverty and resource use dualism.

The following table adapted from Barbier (2005) shows 72 low and middle income countries, with 56 having a high dependence on primary products as a percentage of exports (in excess of 50%). All 72 countries have 20% or more of the rural population living on fragile land and all but 7 have 20% or more incidence of absolute poverty in rural populations. Therefore, almost all the countries exhibit Barbier's 20–20 rule and satisfy the dualism of high poverty-resource degradation linkage within the economy. Strikingly, all but 2 of the 56 highly resource-dependent countries satisfy the 20–20 rule and thus have the 'dualism within dualism' characteristics.

Table 2.1 Selection of Countries Displaying Barbier's 'Dualism with Dualism'

1990/1999	Share of population on fragile land ≥ 50%	Share of population on fragile land 30–50%	Share of population on fragile land 20–30%
Primary product export share ≥ 90%	Burkina Faso (61.2), Chad (67.0), Congo Dem. Rep (NA), Laos (53.0), Mali (72.8), Niger (66.0), Papua New Guinea (NA), Somalia (NA), Sudan (NA), Yemen A.R. (19.2)	Algeria (30.3), Angola (NA), Benin (33.0), Botswana (NA), Cameroon (32.4), Comoros (NA), Eq. Guinea (NA), Ethiopia (31.3), Gambia (64.0), Guyana (NA), Iran (NA), Mauritania (57.0), Nigeria (36.4), Rwanda (51.2), Uganda (55.0),	Ecuador (47.0), Congo, Rep. (NA), Liberia (NA), Zambia (88.0)
Primary product export share 50–90%	Egypt (23.3), Zimbabwe (31.0)	Central Ad. Rep (66.6), Chad (67.0), Guatemala (71.9), Guinea (40.0), Kenya (46.4), Morocco (27.2), Senegal (40.4), Sierra Leone (76.0), Syria (NA), Tanzania (51.1)	Bolivia (79.1), Burundi (36.2), Cote d' Ivoire (32.3), El Salvador (55.7), Ghana (34.3), Guinea-Bissau (48.7), Honduras (51.0), Indonesia (15.7), Madagascar, (77.0), Mozambique (37.9), Myanmar (NA), Panama (64.9), Peru (64.7), Togo (32.3), Trinidad & Tobago (20.0)
Primary product export share < 50%		Costa Rica (25.5), Haiti (66.0), Lesotho (53.9) Nepal (44.0), Pakistan (36.9), South Africa (11.5), Tunisia (21.6)	China (4.6), Dominican Rep. (29.8), India (36.7), Jamaica (33.9), Jordan (15.0), Malaysia (15.5), Mexico (10.1), Sri Lanka (20.0), Vietnam (57.2)
1990/1999	Share of population on fragile land ≥ 50%	Share of population on fragile land 30–50%	Share of population on fragile land 20–30%

Source: Barbier, E.B. (2005). "Natural Resources and Economic Development". Cambridge University Press. New York.

Key: Parenthesis indicates level of rural poverty.

The obvious questions arising out of this is why resource-based development does not yield widespread benefits? If natural capital is important for sustainable development, why is development that is dependent on resource exploitation seemingly a failure for low and middle income economies? The answers to these questions stem from the failure of resource-based economies to adequately capture the rents from resource exploitation, particularly where the rents are low, and to reinvest these rents in other productive activities in the economy. Another aspect of this apparent failure is that frontier land seems to serve as an outlet for the rural poor. Thus the type of marginal mainly agricultural activity performed by the poor on frontier lands generates very little rents and provides limited opportunities to improve their livelihoods.

Buccellato and Mickiewicz (2008) examine the case of hydrocarbons and regional inequality in Russia and have also posited that 'local economic structures that are dominated by oil rents endowed business elites with enormous resources for state capture and for the corresponding distortion of democratic processes. This state capture tends to affect income distribution through its detrimental effects entry and entrepreneurship. This in turn crowds out entry by entrepreneurs and closes a critical route out of poverty and low income traps. If big new players were allowed to enter the market this could also be beneficial for the labour market and for wages. Furthermore, their analysis shows that within Russian regions, oil and gas continue to play a significant role in explaining inequality, with oil and gas enriching the highest quintile of the population the most.

Berry (2006) also seems to confirm that unequal income distributional outcomes tend to follow high mineral rents partly because they widen the possible growth outcomes and rents can be channelled in ways that could worsen or improve distribution. Freije (2006) examination of the Venezuelan economy has found that over three decades income distribution and redistribution have not changed fundamentally because the production structure and tax system has not changed. In fact he finds that the tax system is moderately progressive and the social security system is mildly regressive in Venezuela. It is therefore apparent that existing institutions and political economy challenges such as rent seeking, economic structures and historical legacies such as plantation economy also

play a significant role. Although a country like Kuwait according to El-Katiri et al. (2011) seem to suggest that there are mechanisms available such as generous public services and the provision of public employment to redistribute the benefits of oil income so that the entire population benefits.

2.6.2 The dangers of rent-seeking behaviour

Rent-seeking behaviour by wealthier households might also exasperate a negative economic outcome. A policy climate and lack of governmental controls that are conducive to rent-seeking means that wealthier households, with greater access to credit and education tend to exploit natural resources but ignore the resource degradation problems inflicting poorer households. Rent-seeking behaviour can ensure that natural resource assets including land are not managed for the benefit of all and may only benefit wealthier households. Thus rent-seeking exasperates the problem of unequal distribution of the benefits of resource-based development and shows that lack of proper policies to limit it tend to reinforce the linkages between inequality, rural poverty and resource degradation.

In a situation where resource rents are available and rent-seeking activity is not regulated by proper government policies, there are greater incentives for the wealthy to engage in rent-seeking to the detriment of economic development and deepen inequalities within society. This reinforces the 'dualism within dualism' structure of many poor economies. Inferior policies tend to foster the capture of resource rents by wealthier households. The poor are unable to compete in markets and are also unable to influence policy decisions as it relates to the distribution of resource rents. This, in turn, confines poorer households to marginal lands to eke out their existence and livelihoods (Barbier, 2005; Seers, 1964; Pantin, 1980; and Pantin, 2005).

Inequality and poverty can have severe consequences for the environment and hence sustainable development. Barbier (2005) suggests that the reasons for this negative

consequence on the environment by the poor are not the obvious ones but rather are due to the anomalies of resource dependence and economic underperformance as well as the glaring inequalities faced by poorer households which forces them to live on marginal lands and degrade frontier territories. Inequality of opportunities for poorer households tends to manifest itself through their lack of ability to compete with wealthier households in land markets, lack of property rights to sustain ownership in frontier lands (also related to lack of access to formal credit markets) and poorer households' inability to influence resource management policies that are favourable to them.

The lack of access to formal credit markets tends to play an important role in this relationship. Their inability to access credit means that poorer households are unable to invest in more productive inputs and are unable to secure property rights to their land, meaning that they are currently forced to move to frontier and marginal lands leading to more environmental degradation. Unequal distribution of assets or endowments has been shown to play a crucial role in whether or not citizens of an economy have their basic needs met. Thus as Dasgupta (1993) confirms, if there is a significant proportion of the population that are assetless then markets on their own would be incapable of providing people with an adequate diet. Dasgupta (1993) refers to this phenomenon as 'economic disenfranchisement' or the inability to participate in the labour market, and suggests that it is a direct result of inequitable distribution of assets in the economy. By consequence, this economic disenfranchisement leads more and more of the assetless poor to exploit common property natural resources, which leads to overexploitation of environmental resources and problems of land degradation in marginal frontier lands. Thus inequalities manifest in limited education, inadequate institutional and physical infrastructure, inefficiencies in labour, land and financial markets means that poorer households are forced to rely on less productive forms of agriculture on ever-increasing marginal lands to eke out a livelihood. So lack of outside economic opportunities particularly in the labour markets may exasperate the problem of environmental degradation and hence sustainable development. Although this is important for sustainability, the impact that the poor might have on the environment or the impact that the environment has on life outcomes of the poor, have not been explicitly measured in this thesis. Only in chapter

six when resource rents are traced through the economy to help understand which income groups benefit from non-renewable resource exploitation in Trinidad and Tobago are these links indirectly examined.

What are some of the reasons driving perverse outcomes in resource abundant countries and why are many poorer household not benefitting from resource exploitation?

2.6.3 Political Economy considerations and the peculiarities of the Caribbean Economy

Transformation of resource abundant countries like Trinidad and Tobago into sustainable economies requires more than just an understanding of the prerequisite economic conditions. This transformation also requires an understanding of the political economic inertias that might be present. Some of these have been hinted at previously, however Caribbean theorists have also provided narrations that are specific to the Caribbean context. These and other relevant theories are reviewed in the following section.

The English speaking Caribbean has a unique history and a commonality that stems from its past, in particular the plantation economic system that the region's inhabitants have inherited from their colonial past. Beckford (1972)13 speaks of the misallocation or resources in plantation economies which for various reasons lead to the underutilisation of resources alongside under consumption and poverty. There is an inherent problem in plantation economies where land owners monopolise land to deprive the majority of workers access to independent livelihoods which ensures a supply of labour for the plantations. However, the nature of plantation work is such that labour cannot be fully utilised all of the time. This combined with the land monopoly situation prohibits independent work by labourers. This therefore leads to a situation where there is limited economic advancement for the majority of people; leading to under consumption and perpetual poverty. The plantation economy therefore leads to the following diseconomies:

1. Persistent and expanding unemployment

[13] Republished in 2005.

2. Relatively low levels of national income
3. A most unequal distribution of what income is produced
4. Gross underutilisation of land and
5. Extreme under consumption generally.

For Beckford, unemployment and underutilisation of land are structural phenomena of the system and are areas that should be focussed on more, when under employment and unemployment are being analysed across developing countries. So the usual explanations of unemployment; low economic growth, high population growth or low absorptive capacity of industry to name a few are according to Beckford superficial explanations. Beckford asks the question of why do people in plantation economies have nothing better to do with their time even when their consumption falls short of what is desirable from their point of view and why is peasant agricultural productivity low even though they aspire to higher incomes? The plantation system ensures that the supply of resources is structurally unadjusted to the demand for their use. Thus the supply of land is largely limited to the small planter class and the demand for the use of the land is concentrated among the landless peasant class. Likewise the demand for labour resides with the planter class and the supply of labour is with the peasant class. Thus the structure of the plantation economy leads to low productivity levels among the peasant class since they are denied an opportunity to exercise their managerial and entrepreneurial abilities due to the lack of available land and capital. For Beckford, there is excessive entrepreneurship in the peasant sector since there was evidence that productivity was respectable although they cultivated marginal land with limited capital. Because of these structural deficiencies in plantation economies even policies that aim to provide credit and to modernise the peasant farming sector will fail since additional capital inputs will yield close to zero return on the poor quality of land then held by peasants. Furthermore in plantation economies, government policies are geared to maintaining the status quo. Subsidies provided by the government tend to help the rich and inflict social costs on those least able to afford it, Beckford (1972). Although Beckford's work on the plantation economy referred to colonies around the world before they gained

independence, Demas (1971)14 found that many of the structural characteristics of the plantation economy were maintained after independence particularly in the English speaking Caribbean. Demas therefore thought that per capita income growth was an insufficient measure of development. He therefore articulated a distinction between growth and development; arguing that neither growth nor development can be defined in 'value free' technical terms. For Demas economic growth can only be measured if we make certain assumptions about income distribution, since it is distribution of income that determines the relative prices associated with the weights to be attached to different goods and services making up national product. For Demas, development does not only mean growth, but economic growth that is driven from within a country and growth that results in economic diversification and interdependence between industrial sectors and domestic activities. This issue is examined further for Trinidad and Tobago in chapter six.

Demas also goes further and adds three other elements that are important for development;

1. A satisfactory level of employment,
2. A fairly equal distribution of income and
3. The greatest possible participation by the people of the country in the economy.

Institutional and attitudinal deficiencies tend to negate against transformation in the English speaking Caribbean. For Demas, reliance on international corporations for investment and development is a flawed paradigm. Penetration of international corporations into key sectors of underdeveloped countries leads to growth accompanied by continued underdevelopment, Demas (1971). These corporations tend to be located in key sectors and control the use and allocation of the resources of the economy and integrating it into a worldwide production and distribution of goods. This domination by international corporations leads to cramped economic initiative and entrepreneurship,

[14] Republished in 2005.

forward and backward linkages are not created and inappropriate capital intensive technology is used ensuring that the country fails to develop its own technology or that it fails to adapt imported techniques to wages and salaries levels that are unrelated to productivity in other sectors of the economy. Demas also identified the trade union movement as engaging in activities that while represented the struggle for economic emancipation they also restricted the capacity of employment opportunities by inhibiting agricultural and rural development by bidding up wages in all sectors without consequent increases in productivity. The mass media was also identified by Demas as an institution that needed reforming if there was to be meaningful development in the English speaking Caribbean. For Demas since the mass media was an instrument for selling "metropolitan" goods, they were vehicles for promoting foreign tastes and therefore fostering a lack of backward and forward linkages in the economy. The fourth institutional failure according to Demas refers to the educational system, that although it produces high literacy rates, it produces graduates that have an orientation to the metropolitan and not toward the local environment, who shy away from agriculture and self-employment. For Demas there is as much a problem with what is taught and how it is taught, which leads to; not necessarily to the lack of the wrong skills but the incorrect values. At the bottom, the educational system fails to impart a new value system appropriate to a society seeking economic and cultural independence, Demas (1971). Birdsall et al (2001) have also alluded to this wider problem in resource abundant countries and why education becomes a consumption good and not investment, which leads to a breakdown in the virtuous circle of development. This theory and the educational system in Trinidad and Tobago are examined further in chapter 5, when human capital estimates are provided. However, for Birdsall et al. (2001), education expenditure by the political class is seen as a means of appeasing the masses in resource abundant countries. Blanket spending on education without regard for the quality of the education being taught is meant to be like an insurance against discontent by those in society who might feel that they are not receiving their fair share of resource rents. Education therefore becomes a consumptive good and is not seen as investment for the future since the incentives for a good education are not available such as adequate well-

paid jobs. This together with Dutch Disease effects lead to a break down in the developmental virtuous circle, see chapter five.

Demas also postulated that the history of a country tends to lead to certain attitudes and values which influence the behaviour of people as producers and consumers. This also tends to influence government's perception of problems and opportunities. This mixture leads to a peculiar Caribbean attitude towards consumption and production which hinders independent economic development. This attitude leads first and foremost to consumer tastes that are aligned to those in metropolitan countries particularly in North America. This tends to weaken balance of payments and reduces the potential for capital formation. This can also lead to unrest as the rural and urban dispossessed seek to emulate the consumption patterns of richer households. For Demas this was an interesting problem since economic growth could only be achieved through progressive integration of the economy into the North American economy. Thus Caribbean people were trying the emulate the consumption and production patterns of the North American economy without understanding that the consumption patterns of the American economy were not only a technical necessity of the functioning of that country's economic system but also 'the product of centuries of hard work derived from the Puritan ethic', Demas (1971). This overall problem of attitude has a particularly crippling effect on the production side and hampers overall productivity. For Demas the economic alienation of some workers is derived from historical and cultural factors such as colonialism and slavery and the control of savings by international corporations. This therefore leads to a situation where some workers do not see work as something that benefits one's self, one's family or one's country but rather 'work' means toiling for someone else's benefit. This lack of Puritan ethic and the premium placed by lower income groups on a lack of steady effort led Demas to comment at the time that the Co-operative could be a relevant instrument of economic organisation. Interestingly Wilkinson and Pickett (2009) in their work on the benefits of equality have also suggested the merits of Co-operatives as vehicles for greater equality albeit in more advanced economies.

Many of these political economic problems become magnified in petroleum type economies as discussed by Seers (1964). A normal feature of petroleum economies is the

fast rise in exports as the price of crude oil rises and the relative inelastic demand for energy in importing markets. Thus wage increases in the primary sector can be conceded by the exploiting companies since labour costs are a small component of overall costs. However, as wages in the petroleum sector rise, unions in other sectors also seek higher wages and in an expanding economy, neither the government nor other domestic producers offer any great resistance. Therefore the impetus of rising exports is absorbed mainly by higher wages by those already in employment rather than an increase in employment. As rural folk move to the cities in search of work attracted by higher wages, disguised unemployment becomes real. However, real wage rates become high by international standards and the relative productivity of the workforce. This aggravates the problem of unemployment as imports become relatively cheaper. Income inequality rises as only part of the population benefits from the boom. For Seers, the usual policy prescriptions were not available such as devaluation since many sections of society who are politically powerful are opposed to devaluation. This includes the employed, importers and shopkeepers. While industrialists who might favour devaluation are weak since their income is relatively small compared to the primary sector. Thus in petroleum economies, many of these problems do not show up immediately as balance of payment crises but rather as unemployment, Seers (1964).

Many of these problems eventually manifest themselves as growth collapses particularly if the price of the resource falls and expenditures that were agreed to during boom times are ‘sticky’ and difficult to reduce when revenues begin to fall off, Auty (2001) and Auty and Kiiski (2001).

The underperformance of resource abundant countries and the subsequent inequality within these societies are therefore intrinsically linked to political economy. Van der Ploeg (2011) suggests that countries with a large share of primary exports in GNP have bad growth records and high inequality, see also Auty and Evia (2001), Auty and Gelb (2001) and Auty (2001). While this is not a new conclusion some of the reasons articulated by van der Ploeg are. He suggests that negative genuine savings rates of resource abundant countries are as a result of poor institutions, badly functioning capital markets, corruption or the anticipation of better times. It is this anticipation of better

times that can induce negative saving rates. Van der Ploeg, finds that a nation saves less if it expects world interest rates or the price of the resource to increase in the future. The country saves less and postpones extraction. The nation also saves less if it expects advances in extraction technology. In cases where extraction costs are close to zero and the resource price follows the Hotelling rule, the country should save marginal rents less the imputed interest on the value of natural resource reserves, this sustains a constant level of consumption. For van der Ploeg (2011) countries with abundant resources and where resource rents are less than the imputed rent on the value of the resource reserves, these countries should run current account deficits. Therefore the problems of political economy and the perceived values of imputed rents in relation to better times means that achieving sustainable development and greater equality requires more than simple savings rules and policy fixes, it also requires the shifting of attitudes and the promotion of productive and shared ownership organisations such as Co-operatives to provide the correct incentives for educational investment among the poor, see also chapter 5. I return to many of these themes and additional literature in subsequent chapters.

2.7 Lesson from the Literature Review and Concluding Remarks

The literature review on the definitions and economics of sustainable development has shown that there is disagreement about what is meant by 'sustainable development' and therefore what is important for achieving this. It is immediately apparent that the concept of sustainable development is not new, but the definitions and what is important for achieving it is still ambiguous. However, sustainable development seems to be focused primarily on the welfare of future generations without explicit concern for the welfare of current generations. Of course, the economists' definition of non-declining welfare implies that current welfare is important since we would like to maintain this into the future. Although the welfare of the current generation is implied in the definitions, there is very little to suggest that we may need to lift the welfare of some members of the current generation or those living in poverty today. It is very difficult for some societies

to invest for the future if a significant proportion of the current generation is living in poverty and subsequently have high discount rates.

There are disagreements about how societies could achieve sustainable development and the two major approaches are the capital approach and the rights-based approach to sustainable development. By proposing the capital approach to sustainable development, some economists argue that, ultimately, welfare is associated with the 'interest' earned from its wealth, i.e. the capital imbedded within society. Thus for sustainability to occur (not guaranteed), each generation should leave a set of wealth or assets that would allow future generations to sustain their wellbeing. Those opposing the capital approach to sustainable development have argued that a rights-based approach is more practical, that each generation should have a right to certain forms of capital thus ensuring that sustainability occurs.

Similarly, there are disagreements between those advocating weak sustainability or the substitutability of assets and those who suggest that substitution is not possible or the strong sustainability approach. All of the intellectual positions have merit and seem to apply at different stages of development paths as well as to different assets. It is easy to conceive that there are critical forms of capital that provide services that could never be replicated in full by other forms of capital. These may include localised capital, such as ecosystem services provided by ridge to reef watersheds e.g. flood protection and habitat maintenance. There may also be globalised forms of critical capital, such as the earth's atmosphere which helps to regulate the global climate. Just as important as critical natural capital, there may be some forms of critical social and human capital, which may include the rule of law, property rights and an educated workforce. It is possible that some societies may experience unsustainable development if there has been insufficient investment in critical forms of social and human capital, even though there was substantial investment in man-made and natural capital. This has been alluded to by Pearce (1997).

Since there is merit to each reviewed definition of sustainable development, it is conceivable that the development path that provides the greatest probability of sustainable development is one that allows for adequate investment in all forms of capital and that places special emphasis on critical forms of capital which are both unique to individual societies and shared among all ("global commons"). This definition allows us to also focus on the 'rights' of future generations, since we will ensure that critical forms of capital are left intact for the benefit of their livelihoods and welfare. However, another emphasis should also be on raising the welfare of the least well-off in contemporary society. This would be quite pertinent to Solow's argument that, for some countries, welfare maintenance is an insufficient goal of sustainable development; there needs to be an increasing level of welfare. Therefore, sustainable development should also focus on inequality within society and of raising the welfare of the marginalised within society. It also seems to be an issue that is ignored in the mainstream definitions of sustainable economic development. Unless this is explicitly stated in the sustainable development definition, we are at risk of having development that is unequal and even confirming that poverty is sustainable.

Additionally, recent estimates of genuine savings (GS) rates by the World Bank in 2006 and 2011, build on the work done by Pearce and Atkinson (1993) and Hamilton (1994). The results show that GS rates vary by country and region. The GS rates can also be used as a useful policy tool, particularly as an indicator of sustainability and to incorporate environmental and resource issues in a manner understandable by finance ministers. It is evident that resource-rich countries have the potential to achieve sustainable development if resource rents are invested wisely. However, too many countries and governments are not reinvesting sufficiently.

Some criticisms of GS have already been presented. However, as an indicator of sustainability it lacks a connection with intragenerational equity, in particular poverty reduction in the current period as well as implicit assumptions or measures that show that some assets are unsubstitutable. Perhaps many of these issues that are overlooked by GS are preordained by the definition of sustainability which it satisfies. This is an area of the

literature which can be built on since GS is an excellent starting point, but its social relevance must be improved if it is to be taken seriously by decision makers.

Previously, it was made clear that sustainable development would necessitate the investment or maintenance of 'critical capital'. The point has been reemphasised by Dasgupta (2008) when he speaks about a country's inclusive wealth and the heterogeneous nature of similar assets depending on location and prevailing economic circumstances. Thus sustainable development will be location specific but more importantly will depend on where along the development path the country may be.

However, Maler's thought-provoking thesis on substitution may yet signal that further refinements to user cost approaches may also be needed. User cost estimates provide policy makers with useful guidance on what should be invested for the future from the current use of the natural resource. If we need to compensate future generations for non-use of the resource, we must be clear about what services are currently provided by the resource so we can be sure what substitution is required. Understanding the true value of the resource's input in the social utility function would therefore be critical to understanding what compensation would be required and hence what level of user cost would be acceptable. Where poverty exists in the current generation, current use of resource rents to alleviate poverty might increase the probability that the welfare of future generations would ultimately be higher.

The 'dualism within dualism' concept put forward by Barbier shows clearly that the assetless poor (rural) are dependent on frontier land conversion or outside economic opportunities for sustenance. If the outside economic opportunities are not available then they are forced to overexploit available natural resources, migrate to other areas (perhaps urban) or move to 'frontier' regions. This bizarre situation tends to exist in many resource-dependent low and middle income economies because of inappropriate policies that foster rent-seeking behaviour and ensure that resource rents benefit mainly the wealthier households of society and do not contribute towards sustained economic growth or poverty alleviation. It is therefore likely that sustainable development will be

hampered because of inequality in opportunities and the particular problems faced by the assetless poor. While a combination of policies are required to deal with this problem, a concerted effort is required to reduce inequalities and poverty and to improve opportunities for the poor, which may include increasing their access to and acquisition of assets. Dealing explicitly with inequality may have a very direct impact on a society's ability to attain sustainable development. The research on SAMs and sustainable livelihoods also project similar concerns for the poor.

These complex interactions between the poor and the environment therefore dispute other theoretical connections between affluence and the environment, which include the concept of the Environmental Kuznets Curve (EKC), which suggests an inverted 'U' relationship between some environmental 'bads' and economic growth. However, the evidence from the above may suggest that changes in policies such as internalisation of externalities, fostering property rights for the poor and removal of harmful subsidies could change the relationship between levels of income (economic growth) and levels of environmental degradation.[15] However, disputing the EKC hypothesis and other similar theories does not imply that growth is not needed for sustainable development, but rather it should be pro-poor and resource efficient and ensure that benefits are equitably distributed.

It is clear that resource-based economic development by its nature can lead to many economic problems for these types of economies. The problems are typical of the Dutch Disease and Resource Curse phenomenon where resource boom revenues can lead to massive fiscal and inflationary pressures. These inflationary pressures, in turn, can make domestic manufacturing and their exports uncompetitive. This may lead to labour and entrepreneurs moving away from innovative industries and into rent-seeking activities which become more profitable during resource booms (Auty, 2007). Seers (1964) has also indicated that higher wages in the resource sector, particularly in petroleum exporting countries, leads to the request for higher wages from workers in other sectors of the economy, which in turn fuels inflation and its negative consequences on export

[15] Assessment of the Beckerman (1992) hypothesis also leads to similar conclusions.

competitiveness. Despite these problems, Botswana in southern Africa, a resource-based economy, has been able to implement many fiscal and other governmental policies to help deal with excessive revenues during resource booms. These policies, which include expenditure controls, sterilisation of excessive foreign exchange revenue in offshore accounts as well as strict parliamentary approval for government projects, have been proven to help reduce possible Dutch Disease impacts in Botswana. However, while the fiscal measures have been successful and Botswana invests in other types of capital to satisfy the Solow and Hartwick rules of reinvestment and improves its genuine savings rate, the country has intolerable inequalities in terms of poverty and unemployment (Sarraf and Jiwanji, (2001) and Barbier, (2005). Lange and Wright (2003) have indicated that in the mid-1990s approximately 38% of households lived in poverty[16] and Table 2.1 showed that half of the population lived in rural areas and 30–50% of the population lived on fragile landscapes.

Botswana undoubtedly has economic success but structural imbalances exist, such as its reliance on public sector investment and ill-fated attempts of government investment in agriculture; Lange & Wright, (2003) and Barbier, (2005). Since agricultural employment accounts for 70% of the labour force, there will be significant implications for welfare as indicated by the statistics shown above. While Botswana has managed to avoid the 'resource curse', it still possesses the characteristics of Barbier's 'dualism with dualism', which is worrying to say the least and suggests that inequality should be considered a vital sign of sustainable development. Lop-sided development that may have economic success but where the benefits, particularly the benefits associated with resource rents, are not shared evenly, should be a concern for policy makers wanting to provide their societies and countries with the best opportunity for achieving sustainable development. Achieving the UN's MDGs, where poverty reduction is essential, means that our current measures of sustainable development (SD) that ignore the problems for SD emanating from unequal rights, access and opportunities may indeed be portraying an incomplete picture of SD. Poverty on its own is simply a symptom of inequality. Therefore, the

[16] Equivalent to 47% of the population living in poverty.

essential challenge for this thesis is how to include inequality reduction as a central component of SD.

It seems that most mainstream definitions of sustainable development and subsequent attempts to measure it ignore the challenges of intragenerational equity and the possible impact this can have on intergenerational equity. Thus even for a country like Botswana with a relatively good genuine savings record, suggesting that it is on a sustainable development path but at the same time having relatively high income inequality and unemployment is an odd description of success. Therefore the current definitions and measures of sustainable development would suggest that poverty, income inequality and unemployment are sustainable.

Even the measures of user costs associated with the current use of natural resources attempt to only measure costs incurred by future generations with little or no relevance or connection to the prevailing social conditions. As a result, as with the measures of sustainable development, user costs measures have no link to intragenerational equity and to the needs of the least well-off in current generations.

Thus since the implication (intentionally or not) is that poverty is indeed sustainable, these measures ignore the three pillars of sustainable development; economic, environmental and social longevity and fairness, put forward by the Brundtland report (1987) and Pearce (1993). Many of the mainstream measures of sustainable development are based around the capital basis approach with an implicit assumption of weak sustainability i.e. the substitution of different forms of capital for one another. However, it is abundantly clear that some forms of capital, particularly some natural and social capital, have no substitutes. Thus as Maler (2007) suggests, there are some resources that have no substitutes in consumption or the consumption utility function. Therefore, if the good being produced by the unsubstitutable resource has no substitutes in the consumption utility function then there can be no substitute for these factors.

Political economy implications particularly among resource abundant economies are also important to consider if we are to provide meaningful solutions to these problems. Sustainability rules that do not account for political considerations such as policies that favour the wealthy or well connected, the breakdown in the virtuous circle associated with educational incentives and the inadequate outcomes of current institutions are bound to lead to inadequate outcomes.

A revised definition of sustainable development and subsequent measure must therefore explicitly state that some forms of capital have no substitutes and should receive stable investment flows to ensure their sustainability. It seems to follow that if some forms of capital are critical, then future and current generations should be entitled to or have entitlements as a right. Thus if we are concerned that we have no less entitlements enjoyed by the current generation for the next, we should also be seeking to improve the allocation of the least well-off in the current generation as this would imply that we are leaving a better world for the next generation. As a result, sustainable development in developing economies dependent on natural resource exploitation must invest in the welfare of the least well-off in society to be assured that these societies leave economies and environmental assets that are better for future generations. This fits in well with Solow's notion that sustainability is hardly a useful concept for developing countries, and that we should be striving for welfare improvements along the way, particularly where poverty levels may be high. In instances where discount rates may be high and thus saving for future generations seems to be a luxury and thus avoided, a policy of reducing income inequality and poverty may thus reduce discount rates making investments for the future more viable. Sustainable development must also account for political economy inertias that could easily reverse initial policy gains.

A derived definition of sustainable development would be: S*ustainable development is current status dependent; it depends on where the particular society is on the development path. Sustainable development means that welfare is dependent on all forms of capital, but there should be greater emphasis on investing in 'critical' capital which is unique to each society and 'critical' capital that is of global importance. Equitable*

distribution of the proceeds from development is also important for development, thus a reduction in numbers of the marginalised within contemporary society is important if we are to ensure that the welfare of all members of future society have a right to a meaningful life. Political economy inertias must also be reformed in order to maintain the sustainability outcomes.

Chapter Three: Natural Resource Depletion and user costs

3.0 Introduction

This chapter examines the sustainability of the rate of extraction of non-renewable resources in T&T. To do this, rents as defined below are measured as well as the user costs or depletion estimates associated with this extraction.

Accounting for user costs is an important economic factor in determining the sustainability of current resource extraction patterns along with the fiscal regime associated with the resource and the use of the revenue emanating from the exploitation of the resource. Estimating user costs or "Hotelling rent" is also known as "depletion" costs. This assumes that non-renewable resources are an important asset for the economy and therefore its depletion, while contributing to consumption also contributes to asset depreciation or user costs. According to the Hartwick rule, estimating depletion gives policy makers an indication of sustainability since it is important that savings or investments match the level of depletion if the economy is to be on a sustainable path. Therefore, over a set period of time, usually a year, the reason for estimating depletion is to provide evidence about the rate of extraction, the amount of resource stock remaining and what proportion of revenues or rents associated with the extraction could be safely consumed and what proportion should be reinvested or saved to ensure that the economy's total wealth is non-declining due to the extraction of the resource.

Depletion estimates are integral to assessing whether a country is on a sustainable development path. For many natural resources dependent countries it is an integral component of genuine savings since it is a measure which determines how much of a country's natural resources have depreciated over the course of one year. A review of the methodologies used to estimate depletion is given in section 3.2. Besides being able to measure user costs or depletion correctly, another important problem that policy makers

must deal with is the insufficient reinvestment of user costs in many resource abundant economies. Thus the Genuine saving estimates calculated by the World Bank (2006), shows that countries with a high percentage of mineral and energy rents in GNI, also have lower genuine saving rates. Thus as Van der Ploeg (2011) states, many resource rich countries become poorer each year despite the presence of large natural resources. For example, Nigeria and Angola which are heavily dependent on natural resources have genuine savings of minus 30 per cent. This signals that these countries are impoverishing future generations despite having some economic growth. This is also true for the Russian Federation, Azerbaijan, Kazakhstan, Uzbekistan and Turkmenistan. Thus many countries are consuming too much of their natural resource rents rather than reinvesting the rents in alternative forms of productive assets. A positive saving rate takes on even greater significance in the face of population growth. Van der Ploeg (2011) argues that countries with population growth can have positive genuine saving rates but wealth per capita still declines. These countries therefore need to create new wealth to maintain existing levels of wealth per capita. Many countries because there is significant depletion of their natural resource stock are facing substantial saving gaps, which usually range from 10 to 50 per cent of GNP. For Nigeria and Congo the savings gap is as high as 71 per cent and 110 per cent respectively, Van der Ploeg (2011).

Admittedly saving alone might be insufficient. Gelb (1988) found that during the periods after the oil price hikes of 1973 and 1979, six oil producing countries including Trinidad and Tobago, Algeria, Ecuador, Indonesia, Nigeria and Venezuela invested about half of the windfalls domestically, but this did not stop prolonged periods of exchange rate appreciation and negative growth. What the rents are invested in is also important and so many of these early mistakes were due to governments investing in socially undesirable public investment projects. Van der Ploeg (2011) however, suggests that even without poor public investment decisions it might be optimal for resource abundant countries to save less than their resource rents if world resource prices are expected to increase and there are anticipated improvements in exploration technology. He calls this the 'anticipation of better times' and says that this might also induce negative savings. Van der Ploeg (2011) models this process and finds that like the Hotelling rule, marginal

resource rents must increase at a rate equal to the world interest rate. Likewise an anticipated positive rate of increase in the world resource price or in the rate of technical progress in extraction technology induces resource depletion to be postponed. He finds that resource abundant countries will exhaust their resources slowly if interest rates are low and the rate of increase in the world price is high. His results suggest that marginal resource rents which are measured as the world resource price minus the marginal cost of extraction are saved, so that depletion of natural reserves must be compensated by increases in foreign assets. The anticipation of better times in his model suggests that the nation saves less if it expects the interest rate or the price of the resource to increase in the future. The nation saves less and postpones extraction. The nation also saves less if it expects positive technical progress in extraction technology. Saving marginal resource rents minus imputed interest on the value of natural resource reserves can sustain a constant level of consumption, Van der Ploeg (2011). The catch line here is that countries with abundant reserves of exhaustible resources should run current account deficits if resource rents are less than the imputed rent on the value of the resource reserves, this leads to a negative genuine savings rate, Van der Ploeg (2011). Thus countries with large natural resource reserves should save less than a country with almost no reserves because it makes sense to sell more of the reserves in the future when the price will be higher. Thus for Van der Ploeg (2011) he is unclear if negative genuine saving rates are due to poor institutions, badly functioning capital markets, corruption, general mismanagement or anticipation of better times.

Thus political economy considerations of user costs are also very important to understanding this. For a county like Trinidad and Tobago with relatively low level of resource reserves, particularly of natural gas since the country began exporting liquefied natural gas in 1999, it is important to understand the level of user costs and what the country should be saving to help maintain per capita wealth and to boost sustainable growth.

In addition to the reasons put forward by Van der Ploeg, political economy and the need to appease voters could also be a major reason why resources are depleted quickly.

Seers' theory on MOPE suggests that governments and companies push for quick extraction to boost revenues to spend on wages and inefficient public investments. If however, we are concerned with sustainability in a resource abundant country, knowing how much of the resource has depreciated throughout the course of one period is important. Knowing this depreciation provides an indication of the amount that re must be reinvested to maintain future consumption. This also begins the process of understanding why insufficient rents are reinvested.

There are many approaches to estimating depletion. However, the literature on depletion is ambiguous about which methodology is correct, since they all give different levels of estimates. This chapter therefore examines depletion estimates for T&T's natural gas and oil exploitation using a variety of methodologies.

The chapter begins with a brief review of what are rents, including a review of Ricardian and Hotelling rents. A review of depletion methodologies then follows along with a discussion about the suitability of the different methodologies. Estimates of depletion for T&T using four depletion estimate methodologies are then provided. Estimates of depletion in three other countries; the Bolivarian Republic of Venezuela, Barbados and Indonesia are also calculated as comparators for T&T. The chapter then ends with a look at alternative measures of wealth and welfare to gauge how these countries are comparing and whether depletion and the use of the revenues from depletion are having any impacts on these alternative indicators.

3.1 What are rents?

The production and sale of commodities, in particular mineral and hydrocarbon commodities, can be marginally profitable and at times can be very profitable. Profits referred to here are revenues less costs. This profitability of mines tends to raise questions about how these riches associated with natural resources should be distributed, particularly when they are based on a country's geology. According to Otto et al. (2006), these issues are closely related to the economist's concepts of economic rents, equity and their distribution.

Here, economic rents refer to payments or monetary returns to the owners of factors of production that will not alter their economic behaviour. Typically, firms earn rents when the prices they receive for the goods or services that they produce exceed the price that initially attracted them to the industry or the price that allows them to maintain their level of output. Therefore, economic rent is the difference between the price that is actually paid and the price that would have to be paid in order for the good or service to be produced, Stiglitz (1996). Economic rent may also be referred to as the price that is over and above the reservation price that owners of the goods or services are willing to accept, or the difference between an existing market price for a commodity and its opportunity cost (Otto et al., 2006).

Since economic rent is a surplus, Cordes (1995) suggests that this additional financial return is not required to motivate desired economic behaviour. For Cordes (1995), this implies that the issue of economic rent is one of distribution and not resource allocation. Therefore, all rents could be taxed away and this would not alter the pattern of consumption or production. Cordes (1995) highlights the fact that owners would still get acceptable returns so output and consumption levels would not change since producers are unable to shift the tax burden under competitive conditions.

3.1.1 Ricardian rent

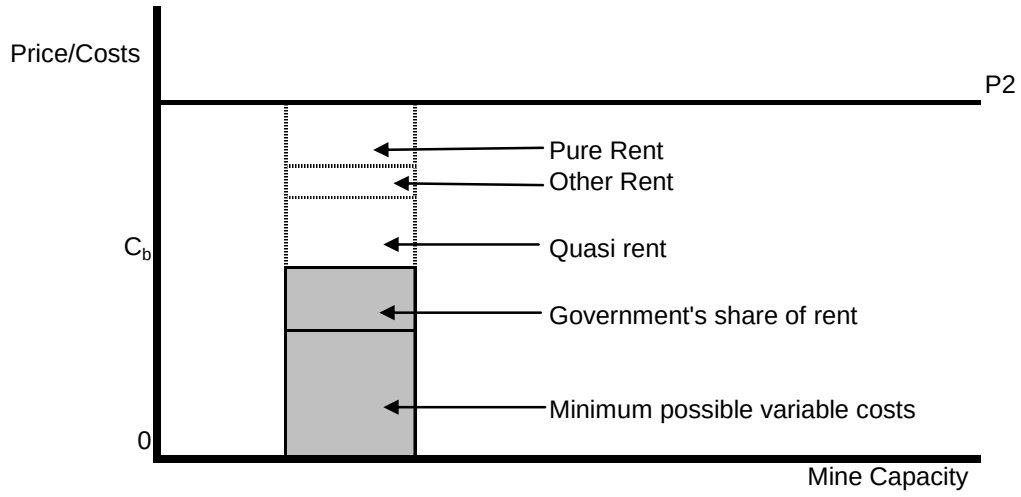
One type of economic rent is Ricardian rents, named after the British economist David Ricardo, who wrote about rents in the 19th century. Ricardo wrote about agricultural production and population growth to highlight the fact that more fertile soil will attract economic rents as less fertile tracts of land are brought into production as population grows. For Ricardo, the most fertile tracts of land are cultivated first. However, as population grows, less fertile tracts of land must be cultivated in order to feed the growing population. Prices must therefore rise in order to cover the costs of production on the least productive land. As a result, the owners of the most productive land will enjoy economic rents, or what is now referred to as Ricardian rents. It is easy to see that mineral mines or oil wells may also be ranked according to production costs and hence

the level of Ricardian rents they accrue. Economic rents or, by extension Ricardian rents, are 'gifts' to which the recipients contributed nothing, particularly when it is associated with mineral deposits. Thus Ricardian rents are used to justify special taxes on mining (Otto et al., 2006).[17] Figure 2.1 shows the different types of rents that make up Ricardian rents. Costs represented by OCb are the minimum variable costs associated with this mine. As long as price is at or above this, the mine managers have an incentive to keep the mine open at least in the short run. If price is at P2, then the mine is earning substantial Ricardian rents, which according to Tilton (2004), can be divided into three categories:

- Quasi-rents reflect the mine's costs of capital and other fixed inputs; these exist in the short run. If the mine does not recover its cost of capital and a competitive rate of return, it will not invest for the long run and will cease to operate in the long run.
- Other rents are created for a number of reasons including business cycle fluctuations in the price, which provide additional rents in the short term. However, these rents are required to offset low prices and revenues during recessions.
- Pure rents occur since the mine is exploiting a low-cost or high-quality deposit, when compared to the marginal mine (which may have higher costs as per Ricardo's explanation). It is argued that pure rents can be taxed away without distorting impacts.

[17] Otto et al. (2006) also refer to long run rents (the difference between price and average costs) which may be different to short run rents. Therefore, taxation methods need to be aware of this to ensure sustainability of the mine.

Figure 3.1 Rent categories associated with a mine



Source: Tilton (2004)

3.1.2 User costs, Hotelling rent and scarcity rent

Harold Hotelling, writing in 1931, referred to the opportunity cost that firms incur while mining for mineral commodities. Due to the non-renewable nature of mineral resources, producing an additional unit of output today reduces the amount of output that is available for production at a later date. Hotelling identified the opportunity cost as the net present value of future profits that are lost because mineral resources are reduced by an additional unit of output. This is commonly referred to as "scarcity rent", "user costs" or "Hotelling rent". Therefore, if prices do not cover user costs plus current costs of production, the owners of the mine will have an incentive to leave the mineral in the ground for future use (when prices should have risen). User costs are true costs and not economic rents. Therefore, according to Otto et al. (2006), their confiscation may alter economic behaviour and lead to undesirable outcomes. It is perhaps worthy to note that user costs may have more of a social significance than a private one, hence empirical evidence suggests that most mine managers take little account of it when making decisions about extraction. Some studies have even suggested that user costs are

negligible and may never enter the decision-making matrix, or should not be considered a goal of revenue capture mechanisms.

3.2 Depletion estimate methodologies

The literature on depletion has resulted in many different methodologies for estimating the monetary value of depletion when a country's exhaustible natural resources are exploited or taken out of the ground. These depletion estimate methodologies are now discussed.

Recent literature by Atkinson and Hamilton (2007) provides some useful analysis about the practicalities of valuing natural assets and in particular subsoil assets, an area that is integral to the sustainable development debate, since the value of these asset bases and their depletion is critical.

The present value of economic profits over the life of the resource is the asset value and depreciation should be measured as user cost. Atkinson and Hamilton claim that if there were markets for these values then they would be observed in market transactions, but since most subsoil assets are owned by governments and contracted out to companies who pay royalties to the owners, these market transactions cannot be observed. However, it is not clear that even these market prices or transactions would provide the right accounting prices or shadow prices to accurately measure scarcity or provide the right signals for sustainability. Nonetheless, their overview of the different approaches to measuring user costs is useful and provides an insight on the relative pros and cons of each.

Estimating user costs

If there is a homogenous resource discovered in a single deposit of known extent, furthermore, if the resource will be exploited over N+1 years and there is extraction

quantity, qi, extraction costs C(qi) and a constant discount rate r, then the value, V, of the resource is the present value of the sequence of profits,

$$Vt = \sum_{i=0}^{N} \frac{piqi - c(qi)}{(1+r)^{t}}$$

c(qi) is economic cost of extraction in period i, which includes a normal return on investment. Thus, total stock, St, is:

$$St = \sum_{i=0}^{N} qi$$

The user costs to be deducted from genuine savings are:

UCt = Vt – Vt-1

According to Atkinson and Hamilton (2007), these expressions are fraught with difficulties, (these are primarily the need to forecast prices and quantities). There are five main approaches, and three of them (the total rent approach, the marginal rent approach and the exhaustion approach) all assume that the extraction path of the resource is optimal. A sixth approach, the real asset value approach, has since been formulated. This method is also reviewed below.

The different approaches to estimating user costs are now examined.

Total rent approach

The total rent approach or net price method used by Repetto et al. (1989) requires little data, but assumes that extraction costs are fixed and that the Hotelling rule[18] applies

[18] The Hotelling rule implies a rising resource price: $\Delta p/(pt - c^*t) = r$.

(which empirical data does not support since even petroleum prices have been flat over time).

Thus user costs become equal to total rents:

$UCt = pqt – c^*qt$

Where:
UCt – User Costs
p – price
q – quantity extracted
c* – costs

Therefore, for the total rent approach to work, optimality is required via the assumption of rising prices. Hence the ability to forecast future prices is an important impediment to calculating user costs using the total rent approach.

Marginal rent approach

The marginal rent approach tries to overcome the assumption of rising prices by assuming instead that there are constant prices, but with rising extraction costs, thus the application of the Hotelling rule implies that user costs are:[19]

$UCt = pqt – c'(qt)qt$

This is the marginal rent for a fixed price. Once again, the problem with this approach is that it requires an optimal extraction path, which is not necessarily true in real life.

Exhaustion method approach

[19] See Hartwick and Hageman (1993).

The exhaustion method uses the same assumptions as the marginal rent approach; i.e. of optimality, constant prices and rising extraction costs. This variant has the following equation: (p-c'(qt))(1+r)N = p where N is number of years. With an optimal extraction path user costs are:

$$UCt = \frac{pqt}{(1+r)^N}$$

El Serafy or the simple present value approach

The simple present value method developed by El Serafy (1989) avoids the problem of forecasting prices and quantities and also has no optimality constraint. It is assumed that total rents in each period are constant at level pq-c and thus the user cost is calculated as:

$$UCt = \frac{pq - c}{(1+r)^N}$$

Where:
N – Time to exhaustion
r – Discount rate

Atkinson and Hamilton (2007) call El Serafy's approach the simple present value method, where N declines as in each period as the resource is extracted if there are no discoveries. El Serafy's simple present value approach does not require the assumption of optimisation. This is a major problem since it implies that resource owners are holding assets with no value suggesting that maximum liquidation of the asset in the current period would be a rational extraction option.

Vincent's quasi-optimal approach

The fifth approach, Vincent's quasi-optimal approach adds an isoelastic extraction cost function assumption. In this assumption there are increasing marginal costs defined as;

$$c(q) = \frac{a}{\varepsilon} q^{\varepsilon}$$

User costs are defined as:

$$UC = \frac{\varepsilon(pq - c)}{1 + (\varepsilon - 1)(1 + r)^{N}}$$

Where:

ε – elasticity, for a > 0 and elasticity ε >1.

The only quantity assumed to vary over time is the quantity extracted, q. Thus marginal extraction cost is c'(q) = εc/q. Note that c/q is average extraction costs.

Vincent's acknowledged inconsistency of constant resource prices, the Hotelling rule and increasing marginal extraction costs imply that quantities extracted must fall over time. Since Vincent defines N as reserves to production ratio, the lifetime of the reserve is understated and therefore the user cost is overstated (Atkinson and Hamilton, 2007).

Real asset value

Hamilton and Ruta (2009) have built on ideas explored by Atkinson and Hamilton (2007) to derive yet another depletion estimate methodology. Atkinson and Hamilton (2007) had questioned the usefulness of using marginal rental values since mines in the real world are not managed optimally. Atkinson and Hamilton (2007) have also argued that the El Serafy approach gleans low asset values since there is no attempt within that approach to maximise the value of the resource asset, thus leading to low depletion estimates. Hamilton and Ruta (2009) have therefore suggested that the real asset value approach should be used as the measure of depletion since it is measuring the change in the value

of the stock in real terms and is rooted in the theory of wealth and social welfare. The traditional theories of measuring the depreciation of exhaust extraction measure the change in total asset value as the appropriate measure of depletion. However, for Hamilton and Ruta (2009), these approaches do not answer another important question which is, how has social welfare changed with the resource extraction? The real asset value method tries to measure the change in real wealth and not the change in total wealth associated with extraction since the wealth accounting and social welfare literature (Hamilton & Clemens, 1999 and Pezzey, 2004) shows that it is the change in real wealth[20] which has welfare significance.

The change in real asset value using accounting prices becomes:

$$p \cdot \dot{S} = -p \cdot \bar{R} = -\frac{\bar{n}\bar{R}}{T-t} \cdot \frac{1}{r}(1 - e^{-r(T-t)}) = -\frac{N}{T-t}$$

Where

P – accounting price

$\dot{S}$ – change in resource stock (S)

$\bar{n}$ – constant unit rent

$\bar{R}$ – constant per period extraction

r – discount rate

T-t – time to exhaustion

N – p.S – value of the resource stock

Hamilton and Ruta, in effect, derive a hybrid formulation which measures the change in real wealth using the accounting price. They find that commonly used methods, such as the El Serafy method and those presented above, are measuring the change in total value of the resource asset when the resource is extracted and this is lower than the change in the value of the stock in real terms. If traditional approaches to resource accounting are measuring savings as $\Delta K + \Delta N$, then these approaches are overstating the change in

[20] Usually measured as adjusted net saving or genuine saving.

social welfare (ΔK is change in capital stock and ΔN is the change in value of the resource stock). Their estimates show that using the El Serafy and real asset value approaches gives very different results; e.g. T&T in 2005 had depletion estimates of 23 per cent and 37 per cent of GNI using the El Serafy and real asset value approaches respectively. In 2005, using the El Serafy method leads to a positive 2 per cent of GNI genuine savings rate compared to negative 12 per cent using the real asset value approach.

Tables 3.1 and 3.2 summarise that main assumptions, strengths and weaknesses of each depletion method described earlier.

Table 3.1 Summary of methods to estimate depletion or user costs

Method	Formula	Assumptions
Total Rent	$UC_t = pqt - c^*qt$	Constant unit extraction cost c*, Hotelling rule: Δp/(pt – c*t) = r
Marginal Rent	$UC_t = pqt - c'(qt)qt$	Constant price, increasing marginal extraction cost, Hotelling Rule
Exhaustion	$UC_t = \frac{pqt}{(1+r)^N}$	Constant price, increasing marginal extraction cost, Hotelling Rule
Simple Present Value (El Serafy method)	$UCt = \frac{pq - c}{(1+r)^N}$	Constant total rent
Quasi-Optimal (Vincent method)	$UC_t = \frac{\varepsilon(pq-c)}{1+(\varepsilon-1)(1+r)^N}$	Constant price, isoelastic cost function with increasing marginal costs, 'near-optimal' path for extraction and marginal rents
Real Asset Value	$p\cdot\dot{S} = -p\cdot\bar{R} = -\frac{\bar{n}\bar{R}}{T-t}\cdot\frac{1}{r}(1-e^{-r(T-t)}) = -\frac{N}{T-t}$	Accounting prices, constant unit rent

Source: Adapted from Atkinson and Hamilton (2007) and author's analysis.

Table 3.2 summarises the main benefits and weaknesses of each of the user cost methodologies discussed above.

Table 3.2 Summary of main strengths and weaknesses of user cost methods

Method	Strengths	Weakness
Total Rent	Simple to calculate	Estimates tend to be very high and are unrealistic
Marginal Rent	Simple to calculate, theoretically correct	Marginal costs are difficult to estimate
Exhaustion	Simple to calculate, theoretically correct	Marginal costs are difficult to estimate
Simple Present Value (El Serafy method)	Simple to calculate and avoids the need to forecast prices	Provides low estimates
Quasi-Optimal (Vincent method)	Theoretically refined approach that uses a good proxy for cost increases	Assumes optimality, which is unlikely in the real world
Real Asset Value	Has some relation to prevailing welfare conditions of country	Determining the accounting or shadow prices could lead to some ambiguity.

3.3 Evaluation and discussion of user cost methodologies

Hamilton and Atkinson (2007) have evaluated the various approaches by examining the different results from each method in a number of oil-extracting countries. They calculated user costs for the year 2000 for 21 oil-producing countries using the World Bank's genuine savings database, British Petroleum's geological data and current world prices. Using each of the methodologies they found that each provided different results for user costs. They are convinced that the exhaustion approach gives the most erratic results and given that empirical evidence suggests that the total rent approach and the simple present value approaches provide divergent results, it is the quasi-optimal approach that provides estimates closest to the median. The quasi-optimal approach provides estimates that are in the middle of the total rent and simple present value approaches.

It is evident that there is little or no consensus on how natural resources should be valued and this poses a serious problem for any policy maker trying to measure sustainable

development, particularly in resource-dependent economies. Atkinson and Hamilton (2007) clearly show that each technique provides differing results. However, they concede that Vincent's quasi-optimal approach provides the most intuitive results since its estimates normally lie in between the total rent and El Serafy measures, the measures considered to be on the high and low end respectively of the user cost estimation approaches.

Hamilton and Ruta (2009) have since attempted to value the stock of the remaining reserves in real terms and to ensure that their estimates are rooted in both wealth accounting and social welfare economics.

However, it is apparent that these measures of user cost are not providing practical guidance to policy makers in resource-dependent countries since they seem to have little or no connection to the social realities in these countries. While the discount rate may provide the social link to intergenerational equity, there seems to be very little focus on intragenerational equity within any of the measures since the user cost estimates can help societies determine what proportion of rents should be consumed, invested or saved. To determine the amount of rents that should be consumed, invested or saved, there needs to be an understanding of the present needs within society, such as poverty alleviation, dependence on the resource for foreign exchange earnings and therefore the need for diversification as well as possibly what vision is held for future society. It is certainly true that most societies are concerned with the level of poverty that currently exists, since it impacts directly on their conscience as well as having indirect economic, environmental and social impacts. Thus the level and type of investment or savings from natural resource rents must in some way deal with this issue. Most definitions of sustainable development are concerned with future wellbeing and this seems to suggest that we should leave a stock of capital or entitlements that are not less than those enjoyed by the current generation. Now, while the current stock of wealth or entitlements may be a sufficient minimum level as a bequest in some societies for their future generations, it is also true that the level of current entitlements for some members of societies, primarily in poorer countries (but not limited thereto), may be insufficient to leave as a bequest to

future generations. It seems only reasonable that to achieve sustainable development, we would like to have non-declining utility over time and, as Solow (1992) suggests, even increasing utility in developing economies. Thus improving the wellbeing of the least well-off in current society by improving their entitlements could lead to higher wellbeing in the future, since the level of bequest is higher. The apparent disconnect with intragenerational equity in the current measures of sustainable development, including user cost measures, could actually be improved if these social considerations are explicitly taken into account. This is an area of focus which has been neglected within the sustainable economic development debate and an area, if included, that will help bridge the gap between theory, policy implications and implementation by in-country decision makers.

Therefore, it seems appropriate that the method used to estimate depletion should have a connection with the level of 'wants or needs' within society ideally measured by the poverty rate as a measure of societal deprivation. As a result, depending on the level of poverty within a country, it makes sense for that country to exploit its natural resources for immediate consumption and not be overly penalised by wealth accountants. The reason being that for individuals within society who have current consumption needs i.e. measured by the relative poverty level, their current consumption should not be at the expense of depleting natural assets. Therefore, the suggestion is for depletion estimate purposes, that user costs be adjusted based on the needs within society. These needs specifically refer to the needs of those individuals living in poverty. If, for example, the EU's measure of poverty threshold is used, i.e. 60 per cent of median income measure of poverty is used as the poverty threshold, then user costs adjusted for current consumption needs becomes:[21]

Depletion = UCt - PTCt

UCt – user costs in period t
PTC – Poverty Threshold Consumption rate in period t

[21] www.ec.europa.eu.

With:

PTC = Ppov * (WPov – Ypov)

Ppov – Total population living on less than poverty threshold income.

Wpov – Per capita 60% median income wage.

Ypov – Average per capita income of individual living in poverty i.e. below 60 % of median income.

Thus for a country exploiting natural resources with conventional user costs of, say, $100 million in year t, if 20% of population or 100,000 people are living on income less than the poverty threshold, the poverty threshold wage is $1000 per annum and the average wage for someone living in poverty is $400 per annum. The adjusted user cost estimate becomes:

100 million – {100,000 *(1000 – 400)} = $40 million

Thus user costs are adjusted based on the prevailing poverty rates and the consumption needs of those living in poverty within the country. Conversely, if the poverty rate was 0 per cent then the country must account for all of the resource depletion in its adjusted accounts.

A simple estimate of this for Trinidad and Tobago is now presented for the year 2007. Using data from the latest available household budget survey of the Central statistical office of Trinidad and Tobago, it is possible to determine that about 27 per cent of households are living on incomes that are less than 60 per cent of the median income. The median income was TT$7,427 per month. With 60 per cent of the median income being TT$4,456 per month. This gives a consumption gap of TT$2,971 per month or TT$35,652 per annum. If it is assumed that this is the average income required by the households living below the poverty threshold then this means that ‘consumption

investment' in the least well off would amount to about TT$3.7 billion or US$588 million in 2007. These estimates are presented in the table below.

Table 3.3 User cost poverty component estimates for Trinidad and Tobago

Poverty User Cost calculations	2007
median income	7,427
60% of median	4,456
Consumption gap	35652
Total households	384,879
Households below median income (27 %)	103,917
Consumption user cost component TT$ million	3,705
Consumption user cost component US$ million	588

The measure of poverty represented in this formula is simple and easy for policy makers to comprehend but is designed to be relative and reflective of the prevailing social conditions within the economy. Besides political economy considerations or anticipation of better times presented by Van der Ploeg (2011) another important reason why countries do not save sufficiently is the prevailing level of want within the society. High levels of poverty or needs within society might negate against the need to invest or save. Boosting the level of consumption of the least well off in society might be considered a form of investment, since it is possible that this might eventually improve the productivity of this cohort of the population. This amendment to the user cost methodology does not deny that there needs to be a reinvestment of the rents in productive assets, but rather in some societies a productive use of the rents might be to use some of the rents to improve the living standards of the poorest members.

This provides an indication of which countries are justified in exploiting their resources for consumption and which should be saving or conserving more depending on their immediate social needs.

3.4 Depletion estimates

The rest of the chapter focuses on estimates of depletion for T&T and three comparator countries. For the purpose of this chapter, four methodologies have been used to provide a range of estimates of depletion in T&T. These are:

- Total rent approach
- El Serafy method (simple present value)
- Quasi-optimal approach
- Real asset value

Actual estimates for T&T and some comparator countries are now provided. Table 3.4 shows the estimates of depletion of the oil and gas resources of T&T for the period 1970 to 2007. Not surprisingly, the total rents approach provides the highest estimates. However, the estimates from the El Serafy method (which is a relatively popular methodology for estimating rents and depletion) are the lowest – which could have serious implications when estimating the relative sustainability of T&T, which will be discussed later on.

Figure 3.2 provides visual evidence of the trends in depletion for the period of analysis. All of the depletion estimates have shown increased depletion from 1970 to the early part of the 1980s when resource depletion was primarily dominated by oil, and this also coincided with the oil boom of the 1970s and early 1980s. However, depletion remained flat for the rest of the 1980s and 1990s until about 1999/2000 when production of natural gas increased significantly with the start of liquefied natural gas (LNG) processing in 1999. LNG production led to an increase in gas production in 1999 of 36 per cent over the 1998 level.

Figure 3.3 clearly shows that depletion during the early years of the analysis was dominated by oil extraction and rising prices. However, the sudden increase in depletion during the latter years of the analysis has coincided with an average annual increase of 19

per cent in gas production and extraction for the period 1999 to 2007. The sudden increase in natural gas production for LNG has resulted in a sharp decline in the time to exhaustion of natural gas reserves, which in turn have increased depletion significantly. Figure 3.4 shows these changes in time to exhaustion. It is worth noting that over the analysis period, the time to exhaustion has stayed fairly constant for oil, whereas for gas, the time to exhaustion has decreased tremendously. By examining the period 1998 to 2007, the contrasting depletion of oil and gas can be shown. Although in 2007 oil production increased by 15 per cent over the 1998 level, the time to oil exhaustion remained at 15 years, indicating that discoveries of oil were matching extraction. However, the case of gas is rather different. In 1998 and at then current production levels there were 65 years of production left. This has since fallen to 12 years in 2007 as natural gas production increased by 351 per cent from 1998 to 2007. This significant reduction in the time to exhaustion of natural gas is the single largest driver of the increase in depletion estimates in recent years. This suggests that the user costs associated with LNG production in T&T are high; see Ram (2007).

Table 3.4 Oil and gas depletion estimates for T&T (1970-2007) US$ millions

	Total Rent	El Serafy	Quasi-Optimal	Real Asset Value
1970	109	9	40	35
1971	124	9	44	39
1972	148	15	63	51
1973	224	35	122	92
1974	842	183	550	406
1975	953	277	695	519
1976	1,043	325	775	583
1977	1,231	451	954	736
1978	1,279	501	986	778
1979	2,631	1,105	2,107	1,673
1980	3,031	1,370	2,443	1,982
1981	2,674	1,077	2,049	1,638
1982	2,366	782	1,656	1,308
1983	1,975	655	1,337	1,081
1984	2,023	679	1,379	1,117
1985	1,942	637	1,325	1,065
1986	995	299	606	507
1987	1,106	314	721	573
1988	889	231	540	439
1989	1,063	281	668	536
1990	1,420	401	935	747
1991	1,253	342	790	646
1992	1,148	321	735	600
1993	1,031	233	589	489
1994	984	233	552	466
1995	1,042	212	551	459
1996	1,405	233	654	555
1997	1,263	196	559	477
1998	876	102	308	290
1999	1,189	152	489	437
2000	2,770	275	1,026	967
2001	2,551	191	836	830
2002	2,399	216	943	847
2003	4,498	735	2,636	1,999
2004	5,493	1,022	3,455	2,570
2005	9,522	2,103	6,452	4,760
2006	11,099	3,227	8,418	6,220
2007	11,387	3,234	8,534	6,311

Figure 3.2 Depletion estimates US$ million

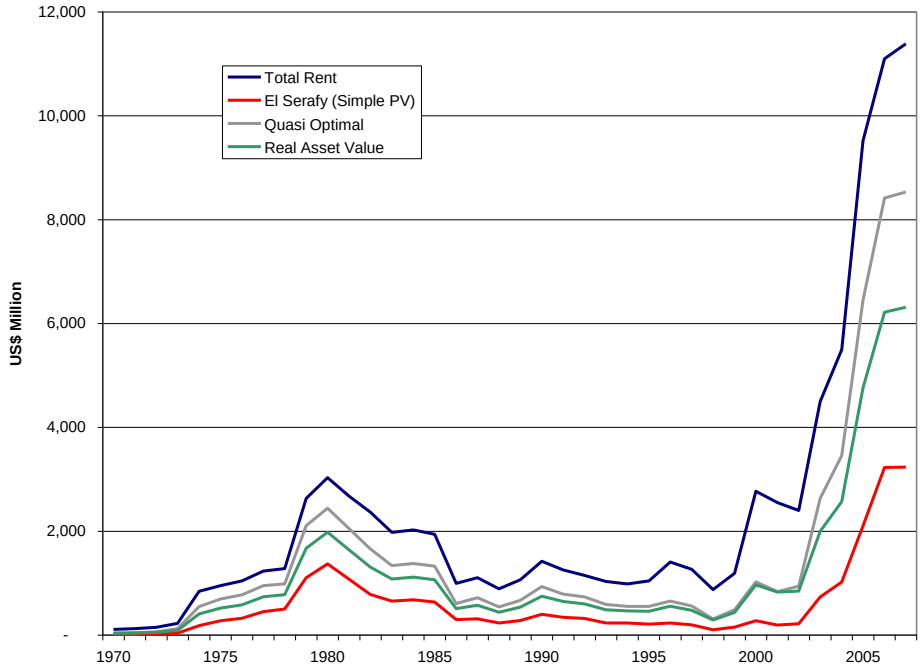


Figure 3.3 Production of oil and gas in T&T

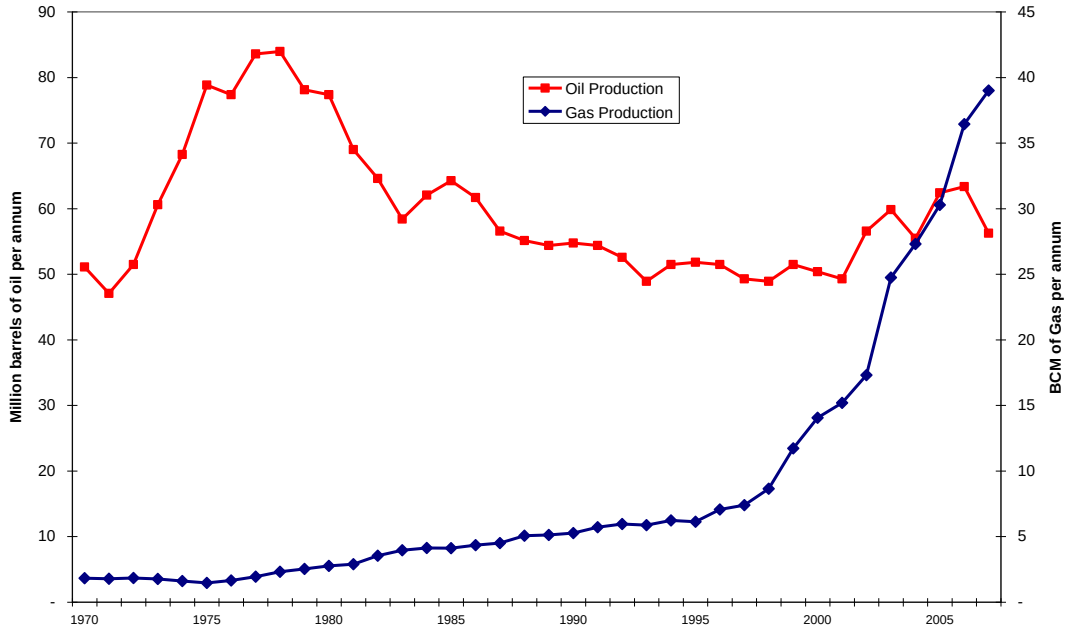
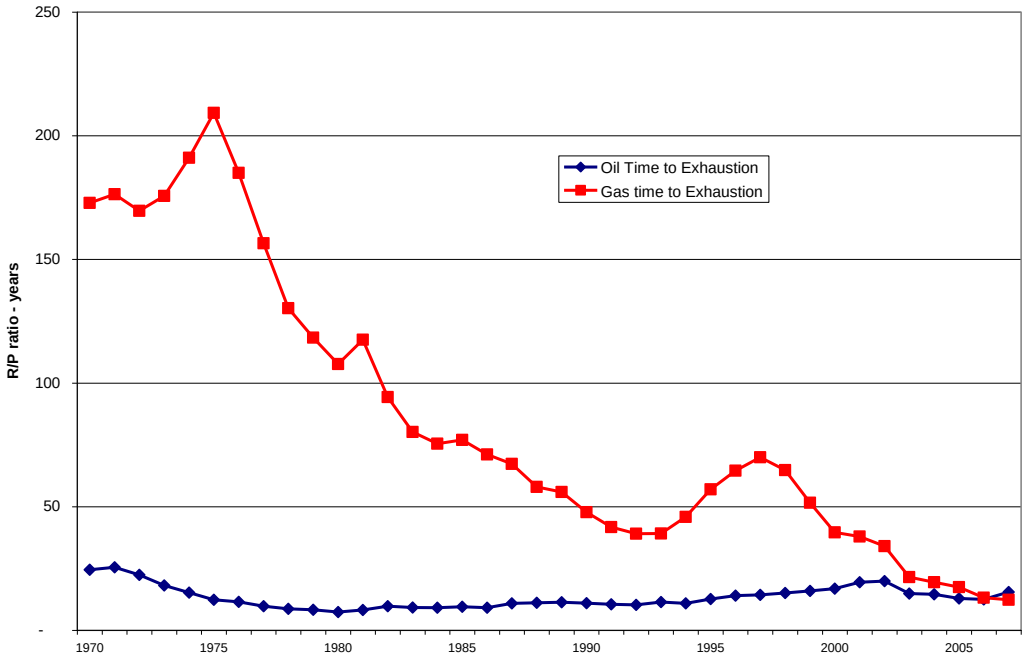


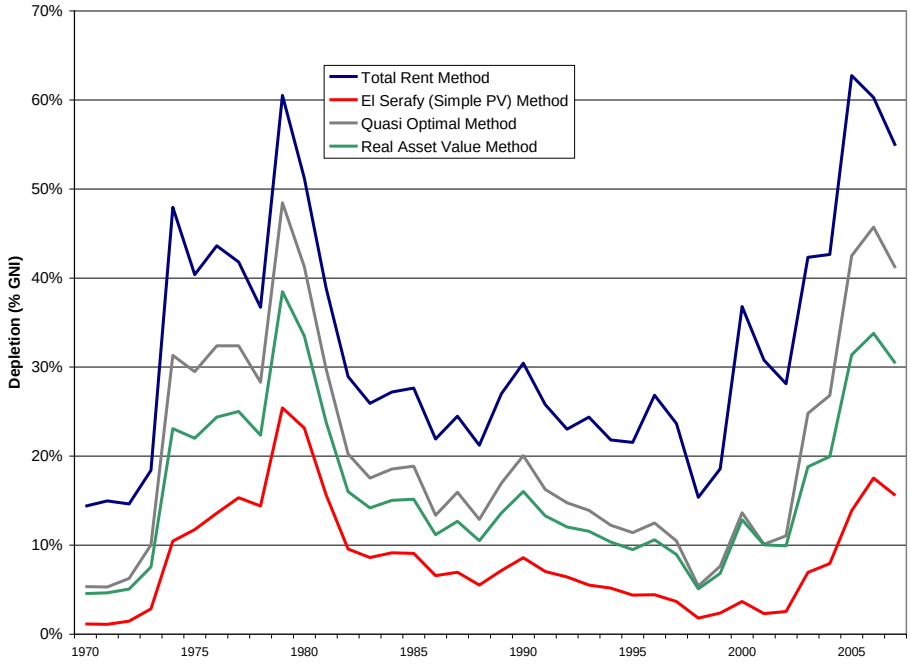
Figure3.4 Time to exhaustion for oil and gas in T&T (R/P ratio)



Pearce and Atkinson (1993), Hamilton and Clemens (1999) and many other theorists have argued the significance of depletion to sustainability. Of course, the significance of this depletion depends extensively on the depletion methodology used for the sustainability calculations as well as the general relationship between depletion and national income indicators. Figure 3.5 shows the relationship between total oil and gas depletion and gross national income (GNI). All of the depletion estimates as a per cent of GNI have the same trend. However, the magnitudes are different. In 2007, depletion as a per cent of GNI ranged from 16 per cent under the El Serafy methodology to 55 per cent under the total rent approach. These methodologies have consistently provided the lower and upper boundaries respectively. However, the quasi-optimal and real asset value methodologies provide 'middle-ground' estimates. In 2007, as a per cent of GNI, the quasi-optimal and real asset value estimates of depletion were 41 per cent and 30 per cent respectively. Each of the depletion estimates suggest that the extraction of oil and gas is at a level that will quickly erode the stock of total wealth in the economy unless a significant amount of the revenues generated are reinvested or saved.

Table 3.5 shows depletion as a per cent of Gross Capital Formation (GCF) which is used as an indicator of investment for the whole economy. With the exception of the total rents methodology, GCF has on average exceeded depletion in the three decades beginning in 1970 and ending in 1999. However, for the period 2000 to 2007, the quasi-optimal and real asset value estimates suggest that, on average, depletion has exceeded investment measured by GCF, suggesting that most of the revenues from the recent boom in oil and natural gas prices were consumed rather than saved or invested, with possible downside risks to long-term sustainability.

Figure 3.5 Depletion as a per cent of GNI



3.5 Discussion on depletion estimates

It is clear from the evidence provided in Figure 3.5 that all of the depletion methodologies used in this chapter tend to follow the same trend and are affected in the same way by extraction rates, prices and the varying times to exhaustion. The real difference between each is the magnitude of the estimates provided. The range of estimates falls between the low estimates provided by El Serafy's simple PV method and

the high estimates provided by the total rent method. It is therefore safe to assume that the real value of depletion lies in the middle, therefore discounting the applicability of the total rent and El Serafy estimates. However, I think these estimates are still useful since they could give an indication of the range of depletion possibilities.

This brings me to the central estimates provided by the quasi optimal methodology and the real asset value methodology. Atkinson and Hamilton (2007) have argued previously that the quasi-optimal approach seems to provide the most realistic assessment of depletion given that it is does not assume that resources are optimally extracted and that the estimates provided by this method have been mid-range estimates even for values provided in their paper. What's also interesting about the quasi-optimal approach, as Atkinson and Hamilton (2007) have suggested, is that the estimates of depletion are inversely related to deposit size, which is more or less intuitively correct.

This brings me to the real asset value methodology derived by Hamilton and Ruta (2009). They have argued convincingly that most of the estimates of natural resource depletion used in the green national accounting literature tend to value the change in the value of the resource stock after depletion – interpreted as the change in total asset value when a resource is extracted. However, according to Hamilton and Ruta, one glaring omission by most of the literature has been the lack of clarity on not only how the value of the asset has changed but also on how social welfare has changed with the extraction of the natural resource. The authors have shown with simple models that the change in total wealth will exceed the change in real wealth at each point in time. Conversely, they have also argued that the commonly used methods, like the El Serafy method, tend to measure the change in the total value of the asset when it is extracted and that these estimates tend to be lower than the change in the value of the stock in real terms, which tends to underestimate depletion and hence overstate the change in social welfare. Therefore, using an approach that attempts to combine changes in the value of the asset with changes in social welfare associated with extraction seems to be reasonable and the most appropriate way to value depletion. However, the only concerns I have with the real asset value method are the assumptions associated with welfare that are incorporated with the calculations and

whether these are correct and whether these make the results more uncertain or less factual.

To summarise, the methodologies used to provide estimates of depletion give a range of values that are applicable for policy. However, the range can be large and may even change the sign of the genuine savings indicator for a particular country depending on which estimate of depletion is used. It is reasonable to assume that the real asset value and quasi-optimal estimates, due to their mid-range values, provide a better gauge of real life depletion. The quasi-optimal approach seems to be the most practical. However, the association that the real asset value method, as with social welfare, may be more meaningful, albeit with some level of uncertainty.

Table 3.5 Depletion as a per cent of Gross Capital Formation

	Total Rent	El Serafy (Simple PV)	Quasi Optimal	Real Asset Value
1970	51%	4%	19%	16%
1971	41%	3%	14%	13%
1972	44%	4%	19%	15%
1973	66%	10%	36%	27%
1974	189%	41%	123%	91%
1975	143%	42%	104%	78%
1976	170%	53%	126%	95%
1977	147%	54%	114%	88%
1978	119%	47%	92%	72%
1979	197%	83%	157%	125%
1980	159%	72%	128%	104%
1981	137%	55%	105%	84%
1982	100%	33%	70%	55%
1983	99%	33%	67%	54%
1984	109%	36%	74%	60%
1985	140%	46%	96%	77%
1986	96%	29%	59%	49%
1987	119%	34%	78%	62%
1988	151%	39%	92%	75%
1989	148%	39%	93%	75%
1990	203%	57%	134%	107%
1991	145%	39%	91%	75%
1992	153%	43%	98%	80%
1993	157%	35%	90%	74%
1994	98%	23%	55%	47%
1995	94%	19%	50%	41%
1996	101%	17%	47%	40%
1997	73%	11%	32%	28%
1998	43%	5%	15%	14%
1999	83%	11%	34%	31%
2000	202%	20%	75%	71%
2001	108%	8%	35%	35%
2002	118%	11%	46%	42%
2003	158%	26%	93%	70%
2004	249%	46%	156%	116%
2005	407%	90%	276%	203%
2006	450%	131%	342%	252%
2007	408%	116%	306%	226%

Table 3.6 Depletion as a per cent of total savings

	Total Rent	El Serafy (Simple PV)	Quasi-Optimal	Real Asset Value
1970	135%	11%	50%	43%
1971	120%	9%	43%	37%
1972	222%	22%	95%	77%
1973	110%	17%	60%	45%
1974	167%	36%	109%	81%
1975	112%	33%	82%	61%
1976	155%	48%	115%	87%
1977	167%	61%	130%	100%
1978	149%	59%	115%	91%
1979	260%	109%	208%	165%
1980	160%	72%	129%	105%
1981	138%	55%	105%	84%
1982	197%	65%	138%	109%
1983	544%	180%	368%	298%
1984	313%	105%	214%	173%
1985	306%	100%	209%	168%
1986	0%	0%	0%	0%
1987	691%	196%	450%	358%
1988	0%	0%	0%	0%
1989	617%	163%	388%	311%
1990	226%	64%	149%	119%
1991	565%	154%	356%	291%
1992	684%	191%	438%	357%
1993	1851%	418%	1057%	877%
1994	138%	33%	78%	66%
1995	115%	23%	61%	51%
1996	167%	28%	78%	66%
1997	239%	37%	106%	90%
1998	127%	15%	45%	42%
1999	188%	24%	77%	69%
2000	274%	27%	101%	96%
2001	143%	11%	47%	46%
2002	228%	21%	90%	81%
2003	193%	32%	113%	86%
2004	189%	35%	119%	88%
2005	201%	44%	136%	101%
2006	136%	40%	103%	76%
2007	175%	50%	131%	97%

Note: Total savings = private savings + public savings

3.6 How do other countries compare?

This section of the chapter compares T&T's depletion with three comparator countries with respect to the depletion of their oil and natural gas reserves. Depletion estimates have been calculated for Barbados, the Bolivarian Republic of Venezuela and Indonesia

and compared against the estimates provided earlier for T&T. The depletion estimates for the comparator countries have been calculated using the same methodology used for T&T. The comparisons show depletion as a per cent of GNI and Gross Capital Formation. The countries have been chosen as comparators for the following reasons:

- Barbados – Small island Caribbean state similar to T&T. However, oil and gas extraction accounts for a relatively small proportion of GDP.
- The Bolivarian Republic of Venezuela is a Latin American country and at its closest point is just seven miles from Trinidad. However, like T&T, the Bolivarian Republic of Venezuela's economy is highly dependent on oil and gas extraction. The Bolivarian Republic of Venezuela is, however, a much larger producer of oil and gas responsible for 3 per cent of world production and is a member of the oil cartel, Organization of Petroleum Exporting Countries (OPEC), and its reserves are much larger than those of T&T.
- Indonesia is a relatively large producer of oil and gas. However, it has a much larger and more diversified economy than T&T.

For the comparisons, two methods of depletion have been analysed: the El Serafy and real asset value methodologies. The depletion estimates from both of these have then been compared to GNI and GCF respectively. Figures 3.6 and 3.7 show depletion as a per cent of GNI for the El Serafy and real asset value methodologies respectively. Both the Bolivarian Republic of Venezuela and Barbados depletion as a per cent of GNI are negligible at about zero per cent per annum. This result is quite surprising for the Bolivarian Republic of Venezuela since it produced about 3 per cent of world crude oil output and 1 per cent of natural gas output in 2008. However, the Bolivarian Republic of Venezuela's relatively large reserves and current production levels translate into about 91 years of crude oil production and 181 years of natural gas production remaining which means that depletion is not a significant problem for the Bolivarian Republic of Venezuela.

The charts, however, show that Indonesia's depletion as a per cent of GNI is above zero per cent, although much less than T&T. Under the El Serafy calculations, Indonesia's depletion averages about 2 per cent of GNI compared to about 8 per cent for T&T, while the real asset value approach produces average estimates of about 5 per cent for Indonesia and 16 per cent for T&T.

Figure 3.6 El Serafy depletion as a per cent of GNI

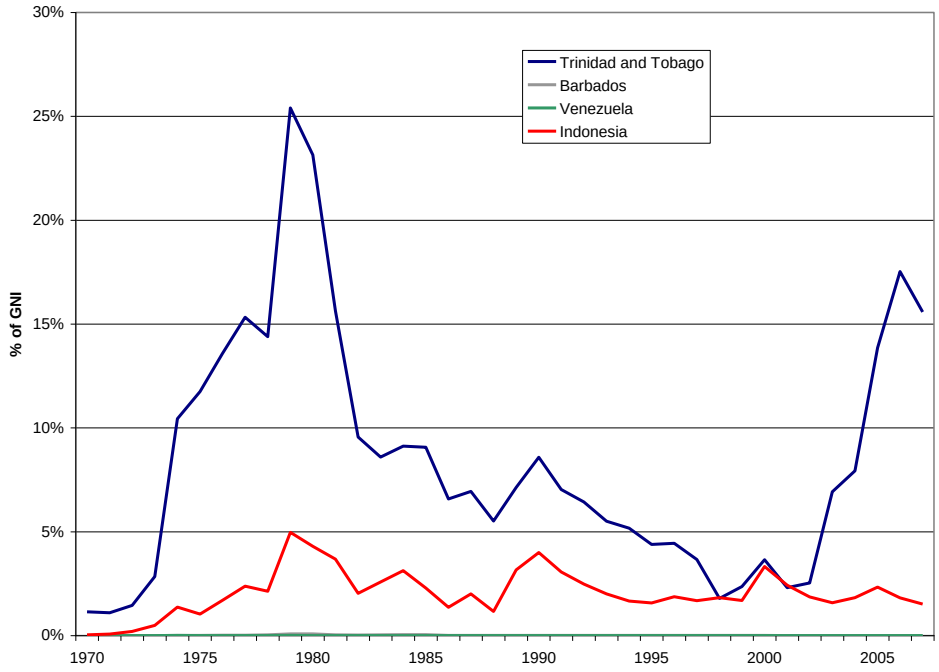
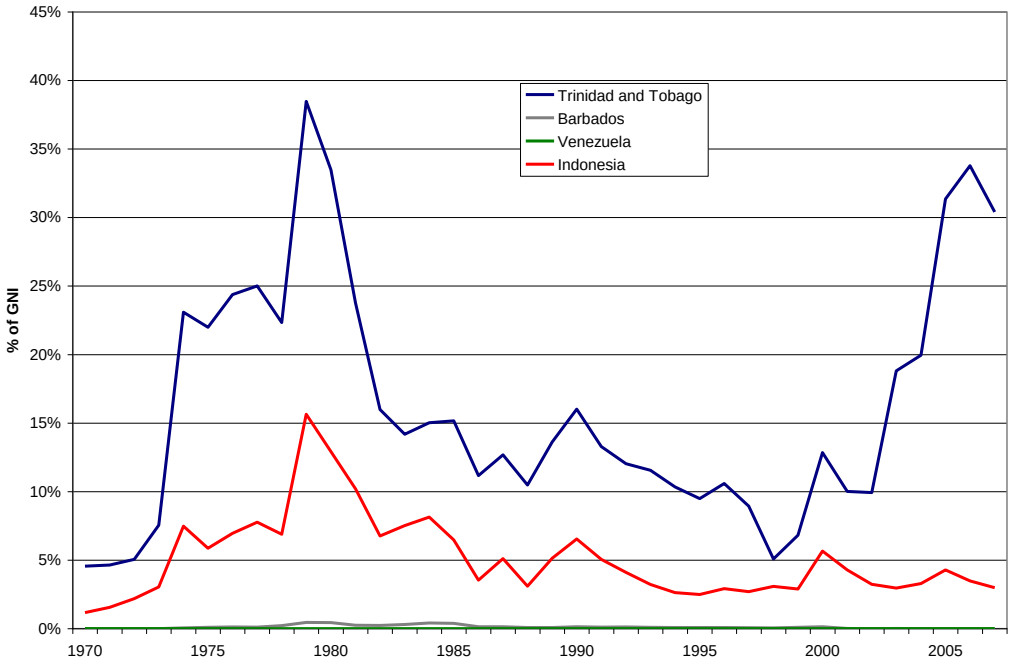


Figure 3.7 Real asset value depletion as a per cent of GNI



Figures 3.8 and 3.9, which show depletion as a per cent of GCF, have similar trends to those of the GNI except at different magnitudes. Once more, depletion as a per cent of GCF for both Barbados and the Bolivarian Republic of Venezuela are negligible and close to zero. Examining the El Serafy and real asset value depletion estimates as a per cent of GCF reveals that over the period 1970 – 2007, T&T's depletion is much higher than Indonesia. For example, over this period the highest ratios of depletion to GCF recorded for Indonesia have been in 1979, when depletion was 23 per cent and 71 per cent for the El Serafy and real asset value methods respectively. In contrast, T&T has recorded depletion in excess of investment measured as GCF. For example, in 2006, the depletion ratio as a per cent of GCF was 131 per cent and 252 per cent under the El Serafy and real asset value approaches respectively.

When compared to the three comparator countries, T&T seems to be performing less well against countries with varying economic structures. T&T as a country has been depleting its resources very rapidly. However, it has not been saving or investing enough of the revenues to meet the Hartwick or genuine saving rules for sustainability. T&T's depletion

estimates ratios are consistently higher which immediately raises questions about the country's fiscal regime and its ability to deal with windfall revenues from oil and gas exploitation as well as the incentives the current governing structure provides for expenditure and savings.

Figure 3.8 El Serafy depletion as a per cent of GCF

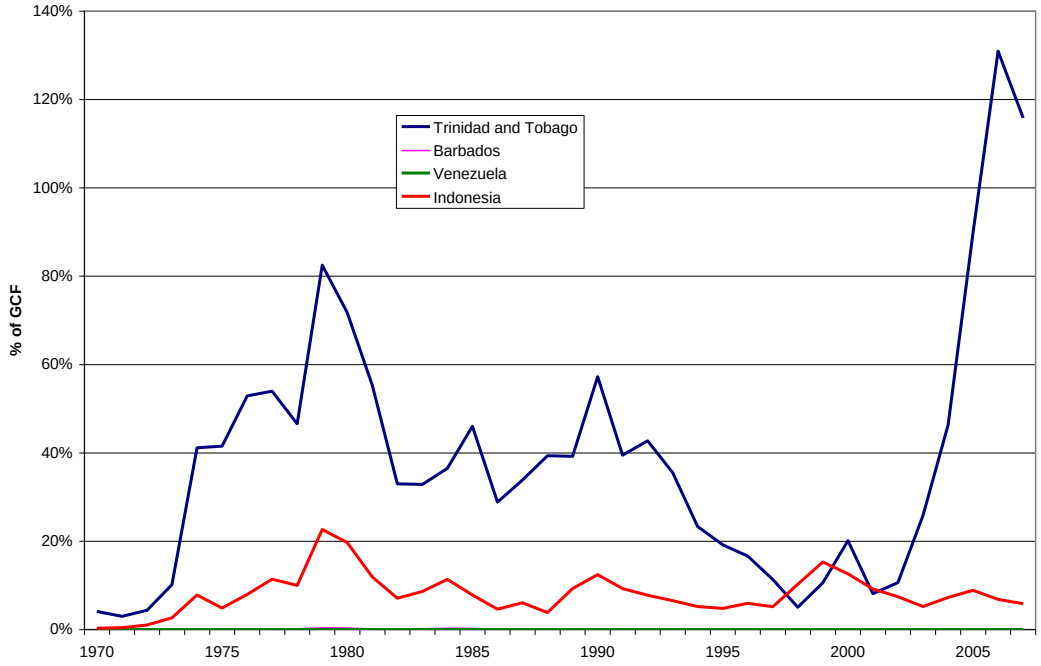
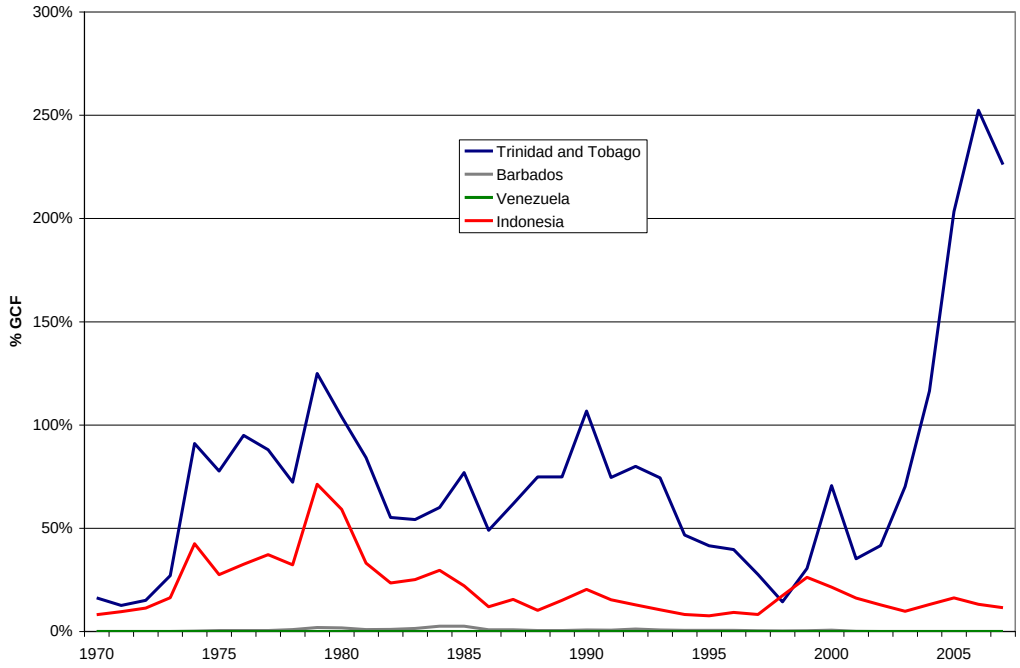


Figure 3.9 Real asset value depletion as a per cent of GCF



3.7 Alternative Indicators of Wealth and Welfare

In this section, alternative indicators of welfare and wealth are provided to give comparisons to the depletion estimates given earlier. The United Nations (UN) ranks countries according to its Human Development Index (HDI). The HDI attempts to provide an indicator of development that goes beyond measures of income by incorporating measures of life expectancy, education and income. According to the UN's HDI report for 2007, T&T is considered to be a High HDI country ranked 64th with a score of 0.837 out of 182 countries. Norway is the top-ranked country with a score of 0.971. Incidentally, Barbados was the highest ranked Caribbean country; it was ranked 37th, while the Bolivarian Republic of Venezuela was ranked 58th and Indonesia was ranked 111th. T&T has experienced annual growth of 0.19% in its HDI over the period 1980 to 2007.

The UN also produces the Human Poverty Index which tends to focus on the proportion of people who are below certain thresholds for each of the HDI indicators. T&T had an overall HPI rank of 27 out of 135 countries and this compares to a rank of 4 for Barbados, 28 for The Bolivarian Republic of Venezuela and 69 for Indonesia. Examining the HPI further and looking at the proportion of people that may not survive to age 40, the proportion in T&T was 8.4%, while in Barbados it was 3%, and in the Bolivarian Republic of Venezuela and Indonesia it was 6.7%.

The World Bank's 2006 report on the Wealth of Nations also gives an indication of the general welfare of countries. Table 3.7, with data extracted from World Bank (2006) for the year 2000, shows per capita wealth in US dollars for the comparator countries.

Table 3.7 Per capita wealth USD (year 2000)

	Subsoil Assets	Timber Resources	NTFR	PA	Cropland	Pastureland	Natural capital	Produced capital and Urban Land	Intangible capital	Total Wealth
T&T	30,279	42	46	112	444	54	30,977	14,485	12,086	57,549
Barbados	988	0	0	0	190	210	1,388	18,168	127,181	146,737
The Bolivarian Republic of Venezuela	23,302	0	464	1,793	1,086	581	27,227	13,627	4,342	45,196
Indonesia	1,549	346	115	167	1,245	50	3,472	2,382	8,015	13,869

NTFR – Non-Timber Forest Resources

PA – Protected Areas

Table 3.7 shows that Barbados has considerably more wealth, although its natural capital wealth is much less than the other countries. Intangible capital in Barbados is much more prominent in the wealth estimates when compared to the other countries including T&T.

Genuine Savings (GS) indicators for 2000 show a stark contrast to the other indicators and tend to corroborate the earlier depletion estimates. Genuine savings is an overall indicator of savings within the economy and accounts for gross national savings and depreciation within the economy including natural resource and environmental depletion as well as fixed capital depreciation and investment in human capital. In the year 2000,

Indonesia had a GS rate of 1.3%, while T&T had a rate of -11.4% and the Bolivarian Republic of Venezuela had a rate of -2.7%.

3.8 Conclusion

The following chapters take a closer look at the T&T economy to discern how government expenditure is distributed and determine if this has any bearing on overall sustainable development and saving rates. The depletion estimates calculated in this chapter show that Trinidad has been extracting too much of its non-renewable resources and not investing or saving sufficiently the rents from these resources. The subsequent analyses begin the process of determining why T&T has not used its resources wisely, why with all of its natural capital wealth, it is considered to be an unsustainable economy and why the inequalities present within society tend to linger despite these resources?

However, an important question raised by the analysis of depletion estimate methodologies is whether they are accounting for the social and economic realities of countries. Based on these realities, what proportion of rents should be consumed and what proportion should be attributed to asset depletion, given the possible immediate need for consumption if poverty levels are high? This particular question has not been answered entirely; however, a modification of the user cost methods has been suggested whereby countries with high poverty rates are not penalised for using their resource rents for current consumption. The distribution of resources rents via government expenditure will be examined in the following chapters.

Conventional estimates of user costs or depletion that are used for resource planning and measures of genuine savings, while useful from an intergenerational perspective ignores the current consumption needs of the least well off in society. Figures 3.7 and 3.8 clearly show that Trinidad and Tobago has been saving or investing an insufficient amount of the rents from the exploitation of its oil and natural gas reserves. This implies that the country has been consuming too much of the rents. However, although the country has

consumed too much of the rents according to the Hartwick rule, there are still high levels of poverty as much as 27 per cent of the population in 2008 according to Sookram (2008). While it is clear that political economy considerations, such as rent seeking and the resource curse (Seers, 1964 and Auty, 2009) are important reasons behind why there is insufficient savings of resource rents, the high levels of poverty could also justify using rents for satisfying some consumption. It is this basic point that user cost methodologies have failed to grasp and which sometime makes it a policy mechanism that is disconnected from reality and therefore ignored by politicians and policy makers in their decision making.

An important improvement that could be made to these methodologies is to incorporate a distributional component that accounts for current generational needs and that makes user costs or depletion estimates sensitive to reinvestment (the intergenerational component) and to consumption of the poorest members of society (intragenerational component). If this is accounted for, then it could also go a long way to explain why resource rents are sometimes not saved. Earlier an estimate for Trinidad and Tobago was given as US$588 million for 2007. This represents about 9% of total user costs (US$6311 million) if the real asset value estimate of depletion for 2007 is used.

It is likely that savings do not occur due to political economy, anticipation of better times and current consumption needs. If user costs account for current consumption needs, then it is likely to be a policy mechanism that is adhered to by resource abundant country policy makers.

An area of further research would be to test this hypothesis for resource abundant countries to see if poverty also drives low saving rates, and if depletion estimates that account for poverty reduction is better gauge of true depletion.

The next chapter examines the distribution of the rents produced by the oil and gas sector with particular focus on energy subsidies. There is an examination in greater detail of how rents are distributed within the economy via energy subsidies to determine whether

this may be having an impact on the level of savings and depletion (as shown in this chapter) and the overall sustainability of the economy.

Chapter Four: Calculating the distributional impacts of savings and expenditure in T&T: the case of fuel subsidies

3.0 Introduction

This chapter examines the scale and distribution of energy subsidies within T&T. The focus of the analysis will be on the opportunity costs and distribution associated with petroleum products subsidies within the economy. Fuel subsidies because they are usually untargeted and lead to over consumption of a scarce resource are sometimes an inappropriate use of resource rents. Angel-Urdinola et al. (2006), Keener & Ghosh Banerjee (2006) and Coady & Newhouse (2006) have all suggested that energy subsidies should be reformed since they lead to unsustainable fiscal expenditure items and the benefits of untargeted subsidies can be regressively distributed.

Government control of domestic petroleum prices commonly occurs in developing countries. Governments sometimes control domestic distribution, prices and import levels. Often there is a pricing formula which anchors domestic prices to levels that are less than the import prices. Fuel subsidies are the difference between a reference price, usually the border price, and the actual price paid by consumers for each petroleum product. For oil-exporting countries, domestic petroleum subsidies are sometimes seen as a way for governments to protect household incomes and to distribute rents associated with the export of the resource. Governments often control prices by imposing fuel subsidies which reduces domestic prices to below the border price. Coady et al. (2006) have shown that fuel subsidies often exceed 2 per cent of GDP in 2005 in a number of countries, including Bolivia (3.1 per cent), Ecuador (3.6 per cent) and Yemen (9.2 per cent). A more recent IMF paper by Baig et al. (2007) gives a break down by a number of selected countries of projected fuel subsidies in 2006. They provide estimates of explicit and implicit subsidies. Explicit subsidies are compensation to the national energy company for the difference between the wholesale domestic price and the world price.

Implicit subsidies according to Baig et al. (2007) are more difficult to measure since they are often not reported. They include costs borne by public entities, such as national oil and energy companies that are not reported in the budget, tax expenditures, such as tax exemptions for oil products and the difference between retail prices and import parity prices. Table 4.1 shows explicit fuel subsidies as a per cent of GDP. The selected countries show that the level of fuel subsidies ranges from a low of 0.2 per cent of GDP for Argentina and to as high as 8.5 per cent for the Republic of Yemen. Implicit subsidies which are more difficult to measure mostly account for a higher percentage of GDP. For example the implicit subsidies in Azerbaijan and Cameroon were 10.4 per cent of GDP and 6.6 per cent of GDP respectively this contrasts with explicit subsidies of 1.9 per cent and 0.3 per cent for Azerbaijan and Cameroon respectively.

Table 4.1 Fuel Subsidies as a per cent of GDP

Country	2006 Explicit	2006 Implicit
Argentina	0.2	
Armenia		1.0
Azerbaijan	1.9	10.4
Bolivia	1.3	6.6
Cameroon	0.3	6.6
Cong, Republic of	1.0	
Dominican Republic	0.4	0.3
Egypt		6.2
Gabon		2.8
Ghana	0.7	
Honduras	0.6	
Indonesia	2.0	
Jordan	1.2	
Lebanon	0.1	
Nigeria	1.0	
Senegal	0.8	
Yemen, Republic of	8.5	

Source: Granado, Coady and Gillingham (2010)

Often, subsidies can be as large as or larger than public expenditure of education or health.

Although fuel subsidies are politically popular, they can impose severe strains on government budgets and often provide little incentive for fuel efficiency. Fuel subsidies also redirect public expenditure away from more productive uses.

Furthermore, since the demand for fuel is often inelastic and there are negative consumption externalities associated with its use, taxation of petroleum subsidies can be

an efficient way to raise government revenues. Moreover, for petroleum-exporting countries, fuel subsidies impose an opportunity cost on the subsidising country and are often not a cost-effective way of protecting the real incomes of poorer households since fuel subsidies lead to substantial benefit leakages to higher-income households. If fuel subsidies are removed, the effects can often be regressive; however, the savings generated by the removal of the subsidies could be targeted at lower-income households through subsidies, transfers and social expenditures (Coady et al., 2006).

The literature on the resource curse also suggests that countries with windfall resource revenues do not utilise the resources appropriately and rent-seeking behaviour could also lead to inefficient uses of the rents, such as that used on subsidies – see, for example, Auty (2009), Auty (2007) and Seers (1964).

Furthermore rent seeking behaviour encourages the government to spend resource rents on items that lead to an accumulation of resource rents among higher income groups. Research by Birdsall et al. (2001) and Birdsall et al (1999) also finds that governments in resource abundant countries try to pacify poorer members of society who might not be gaining directly from a resource boom by spending on consumptive goods which could include fuel subsidies. This entire virtuous circle as discussed earlier and in the next chapter where countries invest for the future and ensure there is productive growth could be disrupted by un-productive consumptive uses of the resource rents.

The focus in this chapter is therefore to examine the opportunity cost associated with fuel subsidies particularly for an energy exporting country and to estimate the distributional outcomes associated with these subsidies.

3.1 The case of T&T

T&T as with other oil and gas producing nations has a fiscal budget that is heavily reliant on the revenues from the oil and gas sector. The overall premise of the fiscal and economic policy is to extract as much revenues as possible from the oil and gas sector,

provide a reasonable level of public goods, subsidised energy products, imports of essential goods and services and a fairly low level of domestic taxation, World Bank (2003). Energy revenues in T&T were approximately 21 per cent of GDP in 2008 and 58 per cent of total government revenues, compared to 2.7 per cent of GDP in 1999. The intervening decade has seen a sharp rise in crude oil, natural gas and by-product prices and together with large increases in natural gas production (235% increase from 1999 to 2008). This has led to windfall energy revenues for the government. These increases in revenue have led to a massive expansion in government expenditure including on transfers and subsidies. If T&T is to be transformed into a sustainable economy it requires a different fiscal policy with a sustained fiscal surplus where funds are channelled into effective savings and investment. World Bank (2003) explains, this is important since much of the islands' revenues come from the oil and gas sector, which is exhaustible therefore optimal management of resource revenues are essential to ensure a sustainable flow of income. This requires limiting consumption from this wealth and shifting savings towards investment. With the oil and gas sector accounting for approximately 46 per cent of GDP in 2008, optimal management of the oil and gas resources are also important for overall economic growth and multiplier employment effects. Therefore the optimum use of the rents from natural resources is extremely important for sustainable development, as suggested by Hartwick (1977), Hicks (1946), Solow (1992) and Pearce and Atkinson (1993).

Energy subsidies, which encourage over consumption of energy products and that have previously been shown (in other countries) to be unevenly distributed, may be possible sources of savings for economic reform and investment and for efficiency gains from deadweight losses associated with energy subsidies; Coady and Newhouse (2006) and World Bank (2003). In developing countries where poverty is still endemic and might lead to downside risks for development, regressively distributed benefits such as from untargeted subsidies may also hamper prospects for sustainable development. Therefore who benefits from savings and investments associated with the expenditure of resource rents and the subsequent intergenerational economic growth might also be an important considerations for sustainable fiscal policy, sustainable development and political

institutions as suggested by Barbier (2005), Best (2007 republished), Lange & Motinga (1997) and Seers (1964).

What has been the trend in subsidies? Transfers and subsidies (T&S) as a per cent of T&T's GDP have been on an upward trend since 1999. Table 4.2 shows the increase in T&S since 1999 along with other economic data for T&T.

Table 4.2 T&T: Aggregate economic data as % of GDP

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Revenue	23.6	23.7	25.8	24.6	24.4	25	29.5	31.9	29.1	36.7
Of which: Non-energy	20.6	17.2	16.7	18.7	14.9	14.7	14	12.2	12.6	15.5
Energy	2.7	6.4	9	5.8	9.4	10.3	15.5	19.7	16.5	21.2
Expenditure	24.5	23.5	25.2	24.8	22.6	22.8	24.1	25.5	27.5	30.2
Current	23.3	21.1	23.8	23.5	21.1	20.9	21.3	21.8	21.8	23.6
Transfers and subsidies	7.6.	7.7	8.5	8.9	8.3	7	10.3	12.2	12.2	13.6
Capital expenditure	0.7	2.8	1.9	1.7	1.4	2.2	3.1	4	5.7	6.6

Source: IMF

Table 4.2 shows that T&S as a per cent of GDP has increased from 7.6 per cent in 1999 to 13.6 per cent in 2008. At the same time, government revenue as a per cent of GDP from the energy sector (oil and natural gas) has increased from 2.7 per cent in 1999 to 21.2 per cent in 2008, while non-energy revenue has been in decline. This chapter examines one component of the T&S budget item; energy subsidies, which includes a detailed examination of petroleum subsidies and their distribution as well as a general review of electricity subsidies. These assessments are meant to show how effective government expenditure is in distributing natural resource rents and its impact on savings distribution within the economy.

The chapter will therefore focus on two important considerations of subsidies: opportunity costs and distribution. For a small open petroleum-exporting country like T&T, subsidies for domestic consumption of petroleum products could impose an opportunity cost on the economy, since the subsidy could encourage higher domestic

consumption of petroleum products that otherwise could have been exported to earn foreign exchange revenue.

Internationally domestic petroleum prices are set in three main ways. The first is by the market where it is completely liberalised, secondly it can be set by the government on an ad hoc basis and finally it can be set by the government using automatic price formulas. Of the 44 countries surveyed by Baig et al. (2007), 21 used ad hoc pricing policies, while 8 countries and 15 countries used automatic price mechanism and liberalised pricing mechanism respectively.

The fuel subsidy regime in T&T operates as a constant price set by the government. This pricing mechanism could be considered to be ad hoc since there is no formula to calculate the price. The ad hoc price mechanism used in Trinidad and Tobago has led to long periods where the price does not vary. Prolonged price freezes are symptomatic of ad hoc pricing regimes, for example in Indonesia prices were frozen from the end of 2002 to March 2005 and in Ecuador prices were frozen since mid-2003, Baig et al. (2007). The policy rationale in Trinidad and Tobago is for there to be stable domestic fuel prices, although international prices may be fluctuating. Consumers therefore benefit when international prices rise since their fuel expenditure remains constant. However, since the domestic prices are not tweaked often, when international prices fall below the domestic price, consumers do not benefit from these reductions or savings unless the government lowers the official price. However, it is seldom that international prices fall below the official fuel price. The analysis shows that this has only happened twice since 1990: in 1992 and 1999.

Subsidies are meant to smooth the consumption of households within society by protecting their real income from price volatility within the market. As the price of crude oil is highly volatile, it can have a significant impact on real incomes via the related prices on petroleum products and other products that require petroleum products as an input. However, since petroleum subsidies are usually not targeted at any particular household type, their distribution may be less than ideal. By examining this line item of

expenditure, which will inevitably increase as the price of crude oil increases and therefore as rents and government revenue also increase, this analysis would allow an examination of the beneficiaries of government expenditure, savings and investment within the economy and to help discern policy implications, if any.

Therefore, the first step of the analysis is to examine the extent and scale of the opportunity cost of petroleum subsidies within the T&T economy.

4.2 Calculating the opportunity cost of petroleum subsidies in T&T

Both the IMF and World Bank have been responsible for most of the research that assesses the economic impacts of fuel subsidies. An IMF staff working paper (WP/07/71) found that only half of developing and emerging market economies allowed for international price increases to fully pass through to domestic prices. Their survey found that this limited price pass through reflected controls on retail prices and reductions of fuel taxes which resulted in explicit and implicit fuel price subsidies.

Baig et al (2007) define price pass through as the ratio of absolute changes in retail price of fuel and the local currency price of the relevant fuel import product over a period of time.

$$Pass-through = \frac{\Pr ice_{DomesticT2} - \Pr ice_{DomesticT1}}{\Pr ice_{WorldT2} - \Pr ice_{WorldT1}}$$

Where $P_{Domestic}$ and P_{World} are the domestic and world prices respectively and T1 and T2 refer to the years of analysis.

Baig et al. (2007) analysis of the pass thorough for the period 2003-2006, found that in general the pass through was less in oil exporting countries, at the time averaging 0.46, while in oil net importing countries it was 1.09.

Coady et al. (2010) present estimates of pass-through for different country groupings. Their definition of pass-through is similar to the formula above. However they define pass-through as the absolute change in the domestic retail (tax inclusive) price to the absolute change in the benchmark price. Table 4.3 gives a break-down of these results which covers the period end of 2003 to mid-2008. The results show that there is considerable pass-through of price changes among advanced countries and oil importers. Not surprisingly oil exporters heavily subsidise domestic petroleum consumption.

Table 4.3 Median pass-through, end 2003 to Mid-2008 (in per cent)

	Gasoline	Diesel	Kerosene
All Countries	85	95	53
Advanced	102	120	
Emerging	57	70	19
Developing	77	78	59
Net oil importer	96	106	79
Net oil Exporter	35	46	11

Source; Coady et al. (2010)

The analysis of fuel subsidies in T&T does not use the pass-through formula to assess the extent of fuel subsidies. Instead a variation of the pass-through formula to estimate the absolute opportunity cost of domestic price subsidy is used. This is explained further later on in the chapter. However using the above formula for the period 2000-2008 and data presented in table 4.6, T&T had an estimated price pass-through of 0.51 for all petroleum products. This implies that almost half of the price is subsidised.

To examine the possible opportunity cost of petroleum subsidies, an important first question is: how does T&T's fuel consumption compare to other countries with similar incomes since income is an important factor which determines consumption rates?

When compared to all countries, T&T does not have very high consumption rates of road fuel. However, where data are available and when compared to other countries with

similar income per capita, residents of T&T tend to consume more fuel. For example, in 2007, the per capita consumption of gasoline for road vehicles was 0.32 litres in T&T, while in other countries with similar per capita incomes (where data are available) such as Malta and Croatia the per capita consumption of gasoline were 0.16 litres and 0.19 litres respectively. In Jamaica, a Caribbean country for which data are available, but with per capita GDP in Jamaica less than in T&T, its gasoline fuel consumption was also lower. Table 4.4 shows statistics on road fuel usage for countries with comparable per capita GDP statistics in 2006. Data on income comparator Caribbean countries are very limited and therefore Jamaica has been included in the Table, since data are available for Jamaica, although its income per capita is much less than T&T. If we look at the data in Table 3.2 and compare T&T with countries for which comparable data is available, most countries have lower per capita gasoline usage (gasoline prices are also higher in these countries). In Czech Republic, for example, gasoline fuel consumption is about one third less than in T&T (the price is three times as high in Czech Republic). However, in countries where fuel subsidies are evident, such as Oman, Saudi Arabia and T&T, fuel consumption is relatively high. Although there may be many other factors that contribute to the level of per capita fuel consumption, such as the availability of alternative modes of transport, non-fuel costs associated with driving and physical geography of the nation, using income as the main factor contributing to fuel use is relevant as showed by Uusitalo and Djerf (1983).

Table 4.4 Gasoline fuel consumption and prices of countries with similar incomes per capita (2006 unless stated)

Country	Current US$ per capita GDP	Per capita Gasoline Consumption (litres)	Price of Gasoline US$ per litre	Motor vehicles per 1000 people (2007)
Antigua and Barbuda	11,859		0.97	-
Barbados	12,568		1.11	405.9
Croatia	11,045	0.16	1.34	377.1
Czech Republic	13,887	0.20	1.3	469.9
Estonia	12,360	0.23	1.23	444.4
Hungary	11,220	0.15	1.3	383.9
Malta	15,733	0.19	1.38	557.6
Oman	13,784	0.44	0.31	225.3
Saudi Arabia	15,061	0.57	0.16	-
Slovak Republic	12,809	0.11	1.35	281.5
T&T	13,916	0.30	0.43	351.3
Jamaica	4,502	0.20	0.82	-

Source: World Bank

In a small open economy like that of T&T, export earnings of foreign exchange are important for the purchase of imports since many products are not made domestically. Therefore, foregone export earnings should be avoided at all costs. If there is domestic overconsumption of fuels in T&T, the opportunity costs are foregone foreign exchange revenues and the use of government expenditure on subsidies rather than on other goods and services. Therefore, subsidies lead to both economic and allocative inefficiencies.

4.3 Opportunity costs of petroleum product usage in T&T

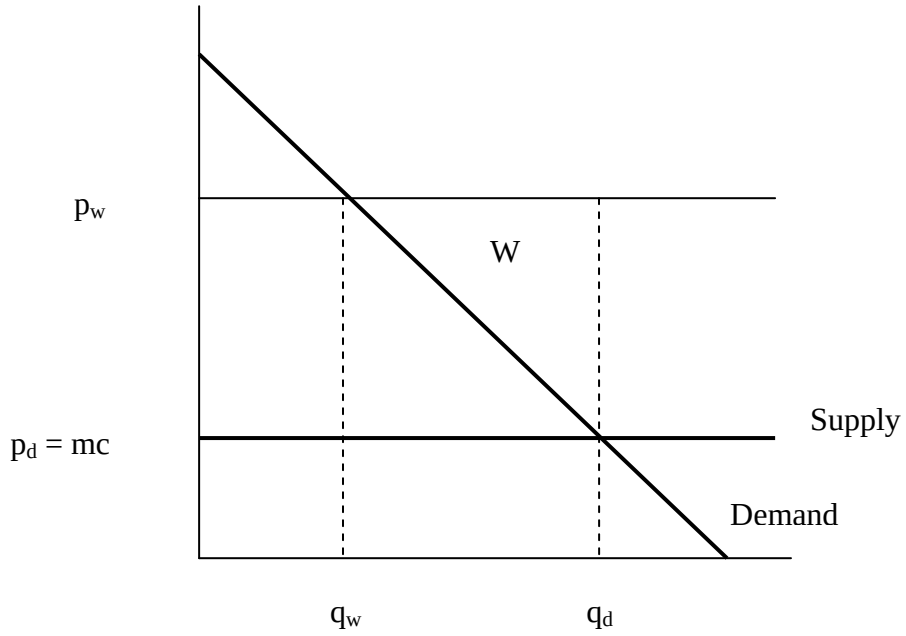
The methodology to assess the opportunity costs of petroleum product subsidies is taken from World Bank (2003). The economics associated with the analysis is best described diagrammatically as shown in Figure 4.1. It is assumed that T&T sets the domestic price *pd* at the marginal cost of production *mc* (assumed to be constant). This results in demand *qd* in the domestic market. Resource rents on oil destined for the domestic market are equal to zero.

If the price were set at the world price *pw*, two things would happen: (i) domestic demand would fall to *qw*, and (ii) the quantity *qd – qw* could be exported. Therefore, the total increase in resource rents from pricing reform would be *(pw – pd)*qd*. Since *(pw – pd)*qw* of these rents are simply transferred from consumers to the producer, the opportunity cost of subsidised energy is,

OC = (pw – pd)(qd – qw).*

The total welfare gain associated with moving to world prices and increasing exports is the triangle *W*.

Figure 4.1 Economics of subsidised petroleum products usage



To calculate the opportunity costs of petroleum products usage in T&T, we need to compare the fuel usage and prices in the domestic market with the petroleum products usage in similar income countries at international prices. The rationale for this calculation is that there are foregone foreign exchange earnings in T&T if petroleum products are over consumed in the domestic market, which otherwise could have been exported at international prices. The methodology for the assessment is adapted from World Bank

(2003), which sets out the calculation of the opportunity costs of fuel subsidies in Iran. The adopted methodology for T&T is described below.

The steps in the analysis for T&T are:

1. **Identify the per capita use of petroleum products in T&T and other similar income countries.** Data on petroleum products usage and population have been collected for T&T and other countries. Petroleum products refer to refined petroleum products. In T&T, domestic use of refined petroleum products include: liquefied petroleum gas, motor gasoline, aviation gas, kerosene/jet fuel, diesel, lubes and waxes, fuel oil, naphtha and asphaltic products. Four petroleum products; LPG, motor gasoline, kerosene and diesel, typically make up over 95 per cent of domestic use of petroleum products. Total annual usage of petroleum products (mboe)[22] is divided by total population to get annual per capita usage of petroleum products. Comparable data from the International Energy Agency (IEA) for annual petroleum product usage and UNSTATS data on mid-year population estimates have been used. These products will therefore be the focus of the analysis.
2. **Determine price differential of petroleum products in domestic market and international prices.** Data was collected on domestic and international retail prices for the four petroleum products that are the focus of this analysis. A weighted average domestic and international price of petroleum products based on the refined output from a barrel of crude oil was assessed. From these weighted prices, annual ratios of international to domestic prices have been determined. Since the majority of petroleum products usage is concentrated in the above four focus products, an international price of petroleum products per barrel of oil equivalent (boe) based on the weighted average of these prices has been estimated. It is also assumed that if these products are not consumed domestically then the unrefined barrel of crude oil would be exported. The ratio of domestic to international prices gives a domestic yield price compared to if the barrel of crude

[22] Barrels of oil equivalent (millions).

oil was exported. For example, in the year 2000, the international crude import price was US$28.13, while the ratio of international to domestic prices was 1.24, which therefore gives a domestic yield price of US$22.64 (28.13/1.24). The difference, US$5.49 per boe, between the international price and the domestic yield price is the opportunity cost of domestic overconsumption. The international price for T&T's crude oil has been calculated as an average of the crude oil import prices in major metropolitan markets.[23] It should be noted that the nature of the fuel subsidy in T&T is a flat price set by the government in the annual national budget. The domestic price of fuel has sometimes remained constant for many years, e.g. the price of unleaded gasoline remained at TT$2.85/litre from 1997 to 2002. The fuel subsidy is therefore meant to maintain predictable prices within the economy. This, however, implies that during years when the international price of fuel is very low (1992 and 1999), the price of domestic fuel may be higher than international prices. This results in a 'negative' subsidy where consumers do not benefit from lower fuel prices and the government does not have a large fuel subsidy bill. Table 4.5 shows the difference between domestic prices and international prices for petroleum products during the study period.

3. **Determine implied elasticity.** If prices in T&T were to increase to international prices, then there will be an expected adjustment in domestic demand to the higher prices. Therefore, it is assumed that demand in T&T would adjust to a per capita level that is comparable to other countries with similar income levels. It is assumed that the demand would adjust to the average of Lower Middle Income countries (LMC). Although income per capita in T&T has increased significantly within the last five years of the analysis, this has been due primarily to an increase in commodity prices and windfall revenues from petroleum and natural gas exports. This increase in GDP per capita does not necessarily reflect an increase in real purchasing power for the entire population. It is therefore assumed that demand would be similar to those in LMC. Given these assumptions, it is possible to calculate implied demand elasticities within the T&T domestic market {(Change in demand/Original demand) divided by (Change in price/Original

[23] Source: IEA and includes import prices in France, Germany, Italy, Spain, UK, Canada and USA.

Price)}. For example in 2008 this gives an implied price elasticity of -1.24. This compares to estimates in the US since 1990 of between -0.5 and -1.1.

4. **Opportunity cost.** The implied crude oil savings in domestic consumption of petroleum products are now assumed to be exported at the international price. These possible additional revenues represent the opportunity cost of subsidies in the domestic petroleum products market. This is shown as actual US$ amounts in Tables 4.6a and 4.6b below and as a per cent of government oil revenues in figure 4.2.

Table 4.5 Weighted average of domestic and international prices of petroleum products (USD/litre)

	Domestic	International	Ratio
1990	0.28	0.36	1.28
1991	0.28	0.35	1.25
1992	0.36	0.35	0.99
1993	0.33	0.35	1.04
1994	0.30	0.34	1.13
1995	0.31	0.35	1.10
1996	0.31	0.36	1.17
1997	0.31	0.36	1.17
1998	0.31	0.33	1.08
1999	0.31	0.29	0.94
2000	0.31	0.38	1.24
2001	0.31	0.37	1.18
2002	0.31	0.34	1.11
2003	0.32	0.39	1.22
2004	0.34	0.47	1.37
2005	0.34	0.60	1.74
2006	0.34	0.67	1.96
2007	0.34	0.72	2.12
2008	0.35	0.59	1.69

Petroleum products refer to: petrol (gasoline), diesel, kerosene and LPG

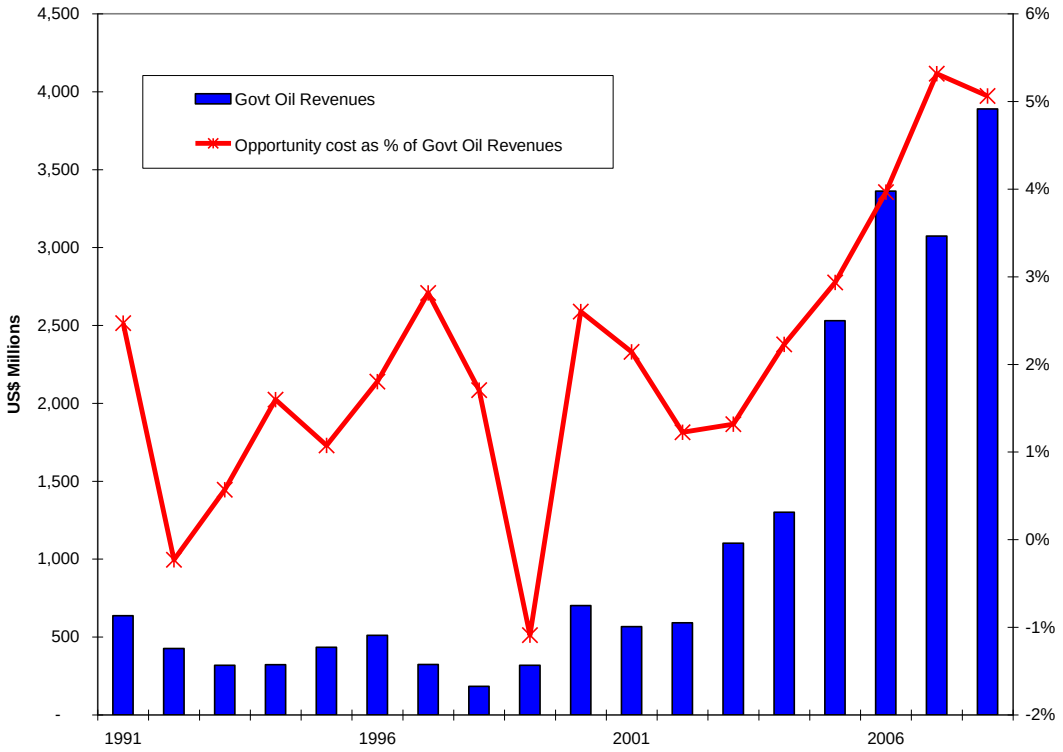
Table 4.6a Opportunity cost of petroleum products usage in T&T (1990 – 1999)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
GNI USD Billion	**4.7**	**4.9**	**5.0**	**4.2**	**4.5**	**4.8**	**5.2**	**5.3**	**5.7**	**6.4**
Price (USD/b)	**22.7**	**19.6**	**18.7**	**16.4**	**15.7**	**17.2**	**20.7**	**19.3**	**12.6**	**17.4**
Ratio of Domestic prices to World prices (%)	**1.28**	**1.25**	**0.99**	**1.04**	**1.13**	**1.1**	**1.17**	**1.17**	**1.08**	**0.94**
Implied Domestic Price USD/b)	**17.74**	**15.66**	**18.93**	**15.75**	**13.95**	**15.63**	**17.73**	**16.46**	**11.66**	**18.49**
Price difference	**4.98**	**3.95**	**-0.28**	**0.63**	**1.79**	**1.6**	**2.96**	**2.8**	**0.89**	**-1.07**
Petroleum Products Consumption (Mboe)	**4.99**	**5.5**	**5.34**	**4.65**	**4.71**	**4.84**	**5.13**	**5.37**	**5.66**	**5.41**
Petroleum Products Consumption (boe per capita)	**4.1**	**4.48**	**4.31**	**3.73**	**3.75**	**3.83**	**4.03**	**4.2**	**4.41**	**4.19**
Petroleum Products Consumption (boe per capita)	**1.23**	**1.24**	**1.47**	**1.44**	**1.46**	**1.52**	**1.59**	**1.66**	**1.67**	**1.67**
Opportunity cost M USD	**17.43**	**15.73**	**-0.98**	**1.81**	**5.16**	**4.66**	**9.21**	**9.1**	**3.13**	**-3.48**
Opportunity cost as % of GNI	**0.40%**	**0.30%**	**0.00%**	**0.00%**	**0.10%**	**0.10%**	**0.20%**	**0.20%**	**0.10%**	**-0.10%**
Opportunity cost as % of Government Oil Revenues		**2%**	**0%**	**1%**	**2%**	**1%**	**2%**	**3%**	**2%**	**-1%**

Table 4.6b Opportunity cost of petroleum products usage in T&T (2000–2008)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
GNI USD Billion	7.5	8.3	8.5	10.6	12.9	15.2	18.4	20.8	23.1
Price (USD/b)	28.1	24.0	24.4	28.7	36.9	51.7	62.9	70.4	97.8
Ratio of Domestic prices to World prices (%)	1.24	1.18	1.11	1.22	1.37	1.74	1.96	2.12	1.69
Implied Domestic Price (USD/b)	22.64	20.29	22.00	23.54	26.88	29.73	32.00	33.18	57.86
Price difference	5.49	3.69	2.42	5.16	10.02	21.96	30.87	37.24	39.96
Petroleum Products Consumption (Mboe)	5.56	5.56	5.33	5.21	5.35	5.90	6.90	7.03	7.63
Petroleum Products Consumption (boe per capita)	4.30	4.28	4.08	3.98	4.07	4.48	5.21	5.29	5.72
Petroleum Products Consumption (boe per capita)	1.73	1.76	1.79	1.83	1.87	1.91	1.95	1.99	2.03
Opportunity cost M USD	18.26	12.12	7.24	14.51	28.97	74.23	133.28	163.38	196.84
Opportunity cost as % of GNI	0.2%	0.1%	0.1%	0.1%	0.2%	0.5%	0.7%	0.8%	0.9%
Opportunity cost as % of Government Oil Revenues	3%	2%	1%	1%	2%	3%	4%	5%	5%

Figure 4.2 Opportunity cost of petroleum subsidies as a per cent of government oil revenues



On average, the calculated opportunity cost of petroleum products subsidy due to domestic overconsumption has been US$37.4 million or 0.3 per cent of GNI over the period 1990 to 2008. However, the opportunity cost has varied significantly with a standard deviation of about US$ 58.3 million. The range has been from US$(3.5) million to US$196.8 million. Although the calculated opportunity costs have risen significantly by about 1000 per cent from 1990 to 2008 in current values, as a per cent of GNI, it has only doubled since GNI has risen by five-fold in current value terms from US$4.7 billion to US$23.1 billion. There have been some years when the opportunity cost has been negative, particularly in 1992 and 1999 when the price of crude oil was very low, which meant that the government effectively did not have to provide a subsidy to the State oil company (Petrotrin) for the supply of fuels to the domestic market.

As a per cent of government revenues from the oil industry, the subsidy has risen significantly since 1991. In 1991 the estimated opportunity cost of the subsidy was approximately 2 per cent of government oil revenues and rose to 5 per cent in 2008.

Although the opportunity cost as a per cent of government oil revenue undulated over the study period, from 2002 to 2008 there was a steady increase each year, reflecting the rise in international oil prices. Admittedly, the opportunity cost as a per cent of GNI does not appear to be significant, but when opportunity costs are compared to government oil revenues, which can be used as a proxy for the proportion of oil sector rents collected by the government, the level of dissipation of oil rents via fuel subsidies becomes clearer. Total subsidies (which are greater than the opportunity costs – price differential multiplied by total consumption) as a per cent of total government oil revenues are also very high – as much as 8.5 per cent in 2007[24].

As comparators, the World Bank has also produced opportunity cost estimates for Iran and Ecuador. With respect to Iran, the Bank estimates that the opportunity cost of energy subsidies equate to about 10 per cent of GDP per annum, with electricity subsidies accounting for about one third or up to about 3 per cent of GDP. This is primarily the result of domestic prices being relatively low when compared to border prices. In Ecuador, petroleum product subsidies have been estimated to be about 2.6 per cent of GNI in 2005.

4.4 Opportunity costs associated with subsidised domestic electricity consumption

Energy subsidies extend beyond the direct consumption of petroleum products and also include electricity consumption. In T&T, electricity use is also subsidised. The following brief section provides an evaluation of the opportunity costs of domestic electricity consumption in T&T. To calculate the opportunity cost of electricity usage in T&T, World Bank data on per capita electricity consumption are used. There is also an assumption that without electricity subsidies per capita electricity assumption would be similar to that in Jamaica and Venezuela (countries within close proximity of T&T and with similar climates). The average electricity usage of both countries has been used as the reference. Electricity in T&T is generated using natural gas. To estimate the natural

[24] Author's estimates.

gas that could be sold externally if electricity usage was at the reference points for Jamaica and Venezuela, data on natural gas consumption for the generation of electricity in T&T was gleaned from the Regulated Industries Commission of T&T.

If electricity consumption was lower and closer to that of the reference countries, it is estimated that over the period 1995 to 2002 (available data points), per capita electricity consumption would have been on average 32 per cent less. It is assumed that less electricity consumption would have released excess natural gas to be sold on the international market. It is assumed that this gas would have fetched an international price based on the Henry hub prices in the United States. The summary calculations are shown in the table below. The analysis using the limited data available on electricity consumption and gas used for electricity generation shows that for the period 1995 to 2002, the domestic overconsumption of electricity (due to price subsidies) ranged from 0.5 per cent to 1.7 per cent of GNI. When these estimates are added to the previous opportunity cost estimates for petroleum products for these years, total opportunity cost of energy subsidies ranges from 1 per cent to 2.2 per cent of GNI. Petroleum product subsidies increased significantly over the period 2005 to 2008. Unfortunately, data was not available for these years to estimate the opportunity cost of electricity subsidies. However, if it is assumed that electricity subsidies increased by the same magnitude as petroleum subsidies from 2002 to 2008, then total energy subsidies in 2008 could have been as much as 11 per cent of GNI.

Table 4.7 Opportunity costs associated with domestic electricity overconsumption due to price subsidies

	1995	1996	1997	1998	1999	2000	2001	2002
T&T per capital electricity usage kWh	3,077.60	3,216.20	3,587.60	3,698.80	3,735.90	3,907.00	4,012.30	3,998.10
Reference per capital electricity consumption kWh	2,366.80	2,402.30	2,445.30	2,468.40	2,451.80	2,487.60	2,529.00	2,594.30
% Difference	23.10%	25.30%	31.80%	33.30%	34.40%	36.30%	37.00%	35.10%
Population	1,264,623	1,272,004	1,278,582	1,284,486	1,289,934	1,295,100	1,299,999	1,304,624
Total GWh savings	899	1,035	1,460	1,580	1,656	1,838	1,928	1,831
Henry Hub prices / mmbtu	1.69	2.76	2.53	2.08	2.27	4.23	4.07	3.33
Opp cost US $ m	24.3	43.8	52.7	43.2	52.5	128.3	121	88.8
Opp cost as % of GNI	0.50%	0.84%	0.99%	0.76%	0.82%	1.70%	1.46%	1.01%

Table 4.8 Opportunity cost of total energy subsidies (% of GNI)

	1995	1996	1997	1998	1999	2000	2001	2002
Petroleum product	0.10%	0.20%	0.20%	0.10%	-0.10%	0.2%	0.1%	0.1%
Electricity	1%	1%	1%	1%	1%	2%	1%	1%
Total Energy	1.1%	1.2%	1.2%	1.1%	0.9%	2.2%	1.1%	1.1%

The analysis has shown that the opportunity cost of subsidised petroleum products consumption in T&T's domestic market has risen significantly. This has correlated with rising petroleum prices and hence rising government revenues. As a percentage of GNI, the opportunity cost stood at close to 1 per cent of GNI in 2008 and 5 per cent of government oil revenues. These subsidies are meant to smooth the real purchasing power of domestic households when there are rising fuel prices, effectively protecting the most vulnerable in society. Subsidised electricity prices also result in domestic overconsumption leading to high opportunity costs. The limited data on electricity consumption and natural usage for electricity generation show that the opportunity costs associated with subsidised electricity prices are higher than the opportunity costs associated with petroleum product usage, e.g. in year 2000, the opportunity costs associated with petroleum products and electricity were 0.2 per cent and 2 per cent of GNI respectively.

However, since subsidies impose an opportunity cost in terms of foregone foreign exchange earnings and utilised resource rents which could be invested elsewhere in the economy and are not targeted, the question becomes: who is benefiting from the government's untargeted expenditure decisions? Total subsidies expended on petroleum products were on average estimated at 6 per cent of government oil revenues between 2004 and 2008. These are significant uses of revenues which could otherwise have been invested or saved. However, these expenditures on fuel subsidies would provide household budgetary benefits, but which households have benefited may provide a clue as to their relative welfare efficiencies. The following section examines the distributional impacts of petroleum products subsidies in T&T and why do governments subsidise fuel use, which is a less than ideal use of resource rents.

4.5 Fuel subsidies and distributional impacts

The remainder of this chapter is dedicated to assessing how fuel subsidies are distributed in T&T. Using the methodology set out in Coady et al. (2006), El Said and Leigh (2006), Coady and Newhouse (2006), and IMF (2006) this section attempts to show the fiscal distributional allocation of fuel subsidies in T&T. Fuel subsidies are used as a case study to examine the distribution of government expenditure of resource rents which are not targeted. The steps are set out below. However, it should be noted that this is a static analysis that examines current household budget benefits of the subsidy. By doing this it is possible to determine the amount that each household would lose if fuel subsidies are removed.

The steps in the analysis are as follows:

1. **Identify the price increases to be analysed for each petroleum product**. Price changes should reflect the necessary increases to bring domestic fuel prices to international prices and cost recovery prices or formula prices that add taxes to the formula price. For the purpose of this chapter, the relevant price increase

necessary in order to bring prices to international prices and to remove the subsidy will be calculated. This will be consistent with the earlier analysis. From the previous analysis in Section 4.3, during the period 1990 to 2008, on average the ratio of international prices to domestic prices was 1.3 with a standard deviation of 0.33. It therefore means that on average prices need to rise by 30 per cent to be at international levels. However, in the main years of analysis, years 2000 and 2008, the ratios were 1.24 and 1.69 respectively.

2. **Estimate the direct impact on each household as a result of these price increases.** Depending on the data, this can be done separately or for a group of products. The analysis will once more focus on four products; gasoline, diesel, kerosene and LPG. The use of these products comprises the majority of household consumption of petroleum products in T&T excluding electricity. For example in 1997/98 , the consumption of these four products accounted for 99 per cent of the consumption of fuel products (excluding electricity) in households.

The impact of the resulting price increases on different household income groups will then be analysed based on income distribution data. This data is taken from the Household Budget Survey 1997/1998. The focus will be on fuel and light (excluding electricity) and gasoline and oil for cars expenditure. Table 3.7 shows the percentage of total monthly household expenditure spent on these fuels. The simple average amount spent on these fuels based on the household budget survey data is 2.92 per cent with a standard deviation of 0.01 and a weighted average of 2.5. Table 4.9 shows the distribution of households within the different income brackets.

Table 4.9 Monthly expenditure on fuels for different types of households

	Total monthly Expenditure	Kerosene	Progas (LPG)	Gasoline & Oil for cars	Total monthly expenditure on petroleum products
All Income Groups	3157	0.02%	0.35%	2.63%	2.99%
<500	943	0.12%	0.68%	0.79%	1.59%
500–999	914	0.09%	1.00%	0.51%	1.59%
1000–1999	1436	0.04%	0.52%	1.11%	1.66%
2000–2999	2154	0.02%	0.55%	1.60%	2.17%
3000–3999	2847	0.02%	0.34%	2.42%	2.78%
4000–4999	3191	0.01%	0.35%	2.65%	3.01%
5000–5999	3886	0.03%	0.40%	2.69%	3.11%
6000–6999	4558	0.00%	0.27%	2.90%	3.17%
7000–7999	5253	0.00%	0.36%	3.11%	3.47%
8000–8999	5515	0.00%	0.21%	3.13%	3.34%
9000–9999	5564	0.13%	0.15%	3.48%	3.76%
10000–10999	6366	0.00%	0.19%	2.89%	3.09%
11000–11999	6377	0.00%	0.14%	2.16%	2.30%
12000–12999	6902	0.00%	0.34%	4.28%	4.62%
>12999	10847	0.00%	0.14%	3.96%	4.10%

Source: Central Statistical office of Trinidad and Tobago.1997/1998 Household Budget Survey

Table 4.10 Distribution of Households by income groups

Income Group of Household	Per cent distribution of households	Average size of households
All Income Groups	100	3.76
<500	2.98	2.69
500–999	7.53	2.4
1000–1999	19.01	3.18
2000–2999	18.29	3.77
3000–3999	13.53	4.23
4000–4999	9.74	4.24
5000–5999	6.68	4.03
6000–6999	5.57	4.31
7000–7999	3.57	4.39
8000–8999	2.98	4.44
9000–9999	1.96	4.04
10000–10999	1.45	4.09
11000–11999	1.36	4.19
12000–12999	0.94	4.95
>12999	4.42	3.98

Source: Central Statistical office of Trinidad and Tobago.1997/1998 Household Budget Survey

For the purpose of this chapter, the distributional impacts in year 2000 and 2008 are examined. It is assumed that the income distribution in year 2000 remains constant since the available household budget data refers to 1997/98. The year 2000 scenario shows the direct impact of a price increase of 24 per cent since it was found that the price ratio between international and domestic prices were 1.24 in 2000 (see Table 4.6). Table 4.11 shows the direct distributional impacts of a 24 per cent increase on different income

groups and this is calculated by multiplying the monthly expenditure on fuels (excluding electricity) by the price increase required.

An increase in fuel prices and its impact on household incomes can be estimated by multiplying the budget shares of each fuel product by its percentage price increase.

Direct impacts of increasing fuel prices by the 24 per cent (removal of subsidies) means that real incomes for the lowest income group (<TTD500 per month) would decrease by 0.7 per cent and the highest income groups' real incomes would decrease by 1.0 per cent. These percentages suggest that, in monetary terms, the direct fuel subsidy was worth about TT$3.60 per month for the lowest income household group and TT$106.80 per month for the highest income household groups. The direct real income distributional impacts of the subsidy in per cent and monetary equivalents have been shown to be regressive.

Table 4.11 Direct distributional impact of removal of fuel subsidies

	Total Monthly Expenditure	**Direct Real Income Effects Total monthly exp on petroleum products (24 per cent price rise)**
All Income Groups	3,157	0.7%
<500	943	0.4%
500–999	914	0.4%
1000–1999	1,436	0.4%
2000–2999	2,154	0.5%
3000–3999	2,847	0.7%
4000–4999	3,191	0.7%
5000–5999	3,886	0.7%
6000–6999	4,558	0.8%
7000–7999	5,253	0.8%
8000–8999	5,515	0.8%
9000–9999	5,564	0.9%
10000–10999	6,366	0.7%
11000–11999	6,377	0.6%
>12999	10,847	1.1%

3. **Estimate the indirect impact on each household income group due to the resulting price increases on other goods and services**.

Distributional impacts have two components: the direct impact calculated above and an indirect impact, which assesses how the prices of all other goods and services are affected by an increase in fuel prices and what impact this has on real household incomes.

To do this, a price-shifting model is required, which shows how higher fuel costs are passed on to other prices within the economy. The indirect impacts will then be added to the direct impacts to show how the total impact varies across different household groups.

Indirect impacts

To calculate the indirect impacts of the removal of fuel subsidies a price-shifting model must be constructed. This model utilises an input output matrix for T&T. The latest available I-O matrix is for the year 2000, so any analysis from year to year would assume that the structure of and technologies within the economy have remained unchanged. A compressed I-O table for T&T is shown in Annex 4.1. Using the technical coefficients based on the entries within the I-O table, it is possible to determine the energy intensity of different sectors and how an increase in energy prices would affect the prices in all other sectors.

Coady et al. (2006) have suggested that the implications for higher costs associated with increased fuel prices depends on the structure of the economy and whether commodities are traded internationally or non-traded, the nature of commodity taxes, and whether prices are controlled by government. They suggest that economic sectors should be grouped into three broad categories which reflect the relationship between higher production costs and output prices.

These groups are:

Cost push sectors, where higher production costs are pushed fully onto output prices. These can be considered as non-traded commodities.

Traded sectors, where outputs compete against internationally traded goods and whose output prices are determined by world prices and the import or export tax regime. Producers are therefore unable to pass on the full cost increase to consumers and must bear the brunt of higher costs associated with the removal of the subsidy.

Controlled sectors, where prices are controlled by the government and therefore the relationship between prices and costs depends on how the government adjusts controlled prices. If controlled prices are not adjusted then the burden of higher costs are borne by factor prices, profits or government revenue.

Coady et al. suggest that, for modelling purposes, one must assume that within aggregate commodity categories (those in I-O tables), that each is made up of fixed proportions of cost push, α, traded, λ, and controlled, β, commodities. These proportions when summed, would obviously equate to 1.

To examine the effect of higher costs on all other prices, the technology of domestic firms are captured in an input-output coefficient matrix, A, where the typical entry a_{ij} denotes the cost of input I in producing one unit of output J. It is assumed that unit prices are normalised to unity, so that price changes can be interpreted as percentage changes. The basic premise is that A captures the underlying Leontief fixed coefficient production technology, so that entries (a_{ij}'s) can be interpreted as the change in the cost of producing a unit of j due to a price change in input i.

Using the input output coefficient matrix, A, and assuming factor prices are fixed, the change in producer prices are derived as follows:

$$\Delta \overset{c}{p} = \Delta \overset{c}{q} \alpha A + \Delta \overset{*}{q} \lambda A + \Delta \overset{c}{\rho} \beta A$$

where:

$\Delta \overset{c}{p}$ – change in producer prices

$\overset{c}{q}$ – change in cost-push prices

$\overset{*}{q}$ – change in traded prices

$\hat{q}$ – change in controlled prices

Δ – 1xn column price change vectors

α, λ, β – nxn diagonal matrices

For the purpose of the analysis and for ease of calculation, the model is transposed and column vectors are used. It is also assumed that all price increases are affected through the value added component of the model via an increase in taxes (removal of subsidies) that brings the controlled prices in the fuel sectors to international prices. Using the method outlined in Miller and Blair (2009) this gives:

$$\overset{c}{p} = p\overset{c}{A} + v'_c$$

which leads to:

$$\overset{c}{p}(I - A) = v'_c$$

$$\overset{c}{p} = v'_c (I - A)^{-1} = v'_c L$$

where

$(I - A)^{-1} = L$ is the Leontief Inverse Matrix and v'_c is the price vector of value added.

If the model is transposed and expressed in terms of column vectors it becomes:

$$\overset{c}{p} = (I - A')^{-1} v_c = L' v_c$$

It is assumed that all changes occur through changes in value added components of the sector i.e. taxes. Furthermore, it is also assumed for the purpose of this paper and following the logic of Coady et al. (2006), that all price changes occur in the controlled sector and that all other sectors are cost-push sectors. This seems to be a reasonable assumption since most effects are through distribution and transport costs.

It is also assumed that fuel prices (excluding electricity) would need to increase by 24 per cent per cent maintaining the earlier assumption for year 2000 and 69 per cent for 2008.

The price-shifting model predicts the following changes in aggregate sector prices in Table 3.10 for the price increase scenario in year 2000. Besides petroleum products and oil and gas distribution which have been used as proxies for the increase in prices, the most notable shift in prices within other sectors have occurred in; fishing, sugar manufacturing, meat processing, fish processing, fruit and vegetables processing, paper converters, construction materials, iron and steel, petrochemicals, water construction and transport. The price-shifting model predicts that the sector with the largest price impacts would be the transport sector, which seems obvious given the high level of petroleum products used by this sector. The Direct Requirements Matrix, shows that within the

transport sector, for every TT$1 of output, petroleum products account for about 27 per cent of costs. Transport costs are also a significant proportion of costs for many other sectors. Given the shift in prices predicted by the model, it is possible to calculate the distributional impacts of these price increases by examining the spending habits of different household groups.

Table 4.12 Changes in aggregate prices due to an increase in selected petroleum product prices

Sector	Petroleum products price increase = 24 %
Agriculture	0.2%
Forestry	0.2%
Fishing	3.3%
Oil & Gas Production	0.3%
Service Contractors	0.6%
Quarries & Asphalt	0.9%
Sugar Factories	1.2%
Meat Processors	0.7%
Poultry Processors	0.4%
Dairy Factories	0.6%
Fruit & Vegetable Processors	0.3%
Fish Processors	2.5%
Feed & Flour Mills	0.1%
Bakeries	0.3%
Misc. Food Manufacturers	0.6%
Alcohol/Soft Drinks/Tobacco	0.8%
Textiles	0.5%
Printing	0.6%
Paper Converters	1.5%
Wood	0.2%
Construction Materials	1.7%
H/hold Chemicals	0.1%
H/hold Appliances	0.3%
Iron & Steel	1.2%
Petroleum Products (proxy)	24.3%
Gas Processing	0.3%
Petrochemicals	1.1%
Plastic Products	0.3%
Other Manufacturing	0.6%
Electricity	0.1%
Water	1.0%
Construction	1.4%
Oil & Gas Distribution (proxy)	24.7%
W/sale & Retail Distribution	0.1%
Restaurants	0.1%
Hotels & Guest Houses	0.6%
Transport	6.9%
Communication	0.3%
Finance	0.3%
Insurance	0.2%
Business Services	0.3%
Government	0.1%
Education	0.0%
Health	0.2%
Personal Services	0.4%

Once more, using the data from the household budget survey for T&T, it is possible to predict how various price increases throughout the economy will affect real incomes. Tables 4.13a and 4.13b show the approximate percentage expenditure by various

households on different products. The next step, therefore, is to map the predicted price increases of the price-shifting model to the household expenditure table to estimate the indirect impact on real incomes caused by the removal of petroleum product subsidies and an implied petroleum products price increase of 24 per cent in 2000.

Table 4.13a Household spending categories as a percentage of total monthly household expenditure

Income Group of Household	Total	Food	Meals Out	Alcoholic Drinks	Tobacco	Clothing and Footwear	Accommodation	Fuel and Light	Households Supplies	Transport-ation
All Income Groups	3,157	16%	3%	1%	1%	7%	22%	5%	10%	17%
<500	943	28%	2%	2%	2%	7%	18%	8%	7%	8%
500–999	914	26%	1%	1%	2%	5%	24%	9%	8%	10%
1000–1999	1,436	23%	2%	1%	1%	7%	23%	7%	8%	11%
2000–2999	2,145	22%	2%	1%	1%	7%	21%	6%	9%	13%
3000–3999	2,847	18%	3%	2%	1%	8%	19%	6%	11%	13%
4000–4999	3,191	17%	3%	2%	0%	8%	21%	6%	11%	14%
5000–5999	3,886	16%	3%	2%	1%	7%	21%	5%	9%	16%
6000–6999	46	14%	3%	1%	0%	7%	23%	4%	10%	20%
7000–7999	53	14%	3%	1%	0%	7%	22%	4%	10%	19%
8000–8999	5,515	13%	3%	1%	0%	7%	24%	4%	9%	16%
9000–9999	5,564	10%	3%	2%	0%	7%	24%	4%	10%	20%
10000–10999	6,366	9%	3%	1%	0%	7%	28%	5%	9%	19%
11000–11999	6,377	13%	2%	1%	0%	8%	21%	4%	14%	19%
12000–12999	6,902	14%	3%	1%	1%	5%	29%	5%	9%	16%
>12999	10,847	8%	3%	1%	0%	5%	24%	4%	11%	24%

Table 4.13b Household spending categories as a percentage of total monthly household expenditure

Income Group of Household	Total	Medical Goods and Services	Foreign Travel	Entertain-ment	Education	Personal Care Hygiene and Services	Miscellaneous goods and services	Home grown Food	Gifts Received
All Income Groups	3,157	5%	2%	4%	3%	2%	2%	1%	1%
<500	943	6%	2%	3%	2%	2%	4%	1%	0%
500–999	914	4%	0%	2%	2%	3%	1%	2%	1%
1000–1999	1,436	5%	0%	3%	2%	2%	2%	2%	1%
2000–2999	2,145	5%	0%	4%	2%	2%	2%	2%	0%
3000–3999	2,847	5%	1%	4%	2%	3%	2%	2%	1%
4000–4999	3,191	4%	1%	4%	3%	3%	2%	1%	1%
5000–5999	3,886	5%	2%	5%	2%	2%	2%	2%	1%
6000–6999	46	5%	1%	4%	3%	2%	1%	1%	0%
7000–7999	53	4%	2%	3%	3%	2%	3%	1%	0%
8000–8999	5,515	6%	1%	5%	3%	2%	3%	1%	0%
9000–9999	5,564	3%	2%	4%	5%	2%	2%	1%	0%
10000–10999	6,366	3%	1%	5%	5%	2%	2%	1%	1%
11000–11999	6,377	4%	1%	3%	2%	2%	2%	1%	2%
12000–12999	6,902	6%	1%	4%	2%	3%	2%	1%	0%
>12999	10,847	3%	5%	4%	4%	2%	2%	0%	1%

Central Statistical office of Trinidad and Tobago.1997/1998 Household Budget Survey

The mapping of price-shifting categories to household budget expenditure categories is shown in annex 4.1. The increase in food prices based on the price-shifting model was

calculated as a weighted average of food purchases for the mean of all households. All other consumer products were matched as closely as possible to the price-shifting model categories. The price shifting model then translates what the impact of an increase in petroleum product prices would be on all other prices. For example, in 2000 it was estimated that a 24 per cent increase in the price of petroleum products would increase alcohol, tobacco and soft drinks by 0.8 per cent and household appliances by 0.3 per cent. These are based on the share of costs that petroleum products account for in each of these consumption items. The price shifting model predicts this for all household consumption items. Based on the percentage share of expenditure that all household income groups spend on each of the consumption items, it is then possible to estimate what the real income effect of the subsidy is for each of the consumption items and aggregate this to the total household consumption level. The price model therefore estimates how prices of the goods and services consumed by all households will rise with the removal of the subsidy. For example the removal of the subsidy in year 2000, would have equated to a 24 per cent increase in petroleum product prices. This increase leads to an increase in the prices of other products and services consumed by households. This means that all income groups would have spent an additional TT$48 per month or TT$576 per annum on all goods and services excluding direct consumption of petroleum products, this equates to 1.5 per cent of total consumption expenditure and therefore 1.5 per cent of real income indirect effects of the subsidy in 2000. This is shown in table 4.14. The percentage real income effect varies by household income group, e.g. the lowest income group experiencing an indirect benefit of 1 per cent and the highest income group experiencing an indirect benefit of 2.2 per cent.

Table 4.14 shows the indirect impact on real incomes of different household income groups from an increase in petroleum prices in year 2000.

Table 4.15 shows the total real income effects of the subsidy in year 2000, when the direct benefits and the indirect benefits are added together. The lowest income group received income benefits of 2.2 per cent and the highest income group benefit received real income benefits of 3.2 per cent.

Table 4.14 Indirect real income effects (24% increase in the price of petroleum products) (year 2000)

		24% increase in petroleum product prices	
Income Group of Household	Total Monthly Exp	Percentage Real income effect of Subsidy	TT$ Real Monthly income effect of Subsidy
All Income Groups	3,157	1.5%	48
<500	943	1.0%	10
500–999	914	1.0%	9
1000–1999	1,436	1.1%	15
2000–2999	2,145	1.2%	26
3000–3999	2,847	1.3%	36
4000–4999	3,191	1.3%	43
5000–5999	3,886	1.5%	57
6000–6999	4,558	1.7%	76
7000–7999	5,253	1.7%	88
8000–8999	5,515	1.5%	81
9000–9999	5,564	1.8%	99
10000–10999	6,366	1.6%	102
11000–11999	6,377	1.7%	106
12000–12999	6,902	1.4%	95
>12999	10,847	2.2%	240

Evaluate the targeting efficiency of fuel subsidies.

IMF (2006) states that one of the major motivations of fuel subsidies is to protect the real incomes of low-income households within the economy. However, it is important to understand the 'targeting efficiency' of the subsidy, i.e. how much of the total subsidy actually accrues to low income groups. The importance of this idea is stated by the authors in IMF (2006); they show that, even if the distribution of the subsidies are progressive in terms of percentage of household incomes (i.e. as a per cent of income the benefits are higher for lower-income households than for higher-income households), the subsidies can still be badly targeted, in the sense that lower-income households receive less than their population share.

Table 4.15 shows the total real income effects on households from an increase in petroleum price subsidies. The estimates suggest that the benefits of petroleum subsidies are regressively distributed. The lowest-income household group (<TT$500 per month) received between TT$13 per month (TT$156 per annum) in real income benefits from the subsidies, while the highest-household income group received about TT$348 per month (TT$4,176 per annum) of real income benefits. It is clear that untargeted expenditure of rents can be regressively distributed and this may, in the long term, have impacts on the sustainability of development in T&T. The expenditure of rents should be targeted

towards an increase in investment in alternative forms of capital as the natural capital is depleted. While subsidies are meant to smooth real incomes and hence contribute to household savings (a form of capital), untargeted subsidies may not be delivering an accumulation of wealth that is evenly or equitably distributed.

Table 4.15 Total real income effect of an increase in petroleum product prices in T&T

		24% increase in petroleum product prices	
Income Group of Household	Total Monthly Exp	Percentage Real income effect of Subsidy	TT$ Real Monthly income effect of Subsidy
All Income Groups	3,157	2.21%	70
<500	943	1.42%	13
500–999	914	1.41%	13
1000–1999	1,436	1.46%	21
2000–2999	2,145	1.72%	37
3000–3999	2,847	1.98%	56
4000–4999	3,191	2.03%	65
5000–5999	3,886	2.17%	84
6000–6999	4,558	2.47%	113
7000–7999	5,253	2.48%	130
8000–8999	5,515	2.28%	126
9000–9999	5,564	2.68%	149
10000–10999	6,366	2.30%	146
11000–11999	6,377	2.26%	144
12000–12999	6,902	2.47%	171
>12999	10,847	3.21%	348

Distributional effects in 2008

Similar calculations were also conducted for 2008. Using the same input-output table[25] and 2008/2009 household budget survey data, Table 4.16 shows the comparison of the income effects between 2000 and 2008. In 2008, the ratio between international and domestic prices was 1.69 (as shown in Table 4.6). Therefore as before, in 2008 fuel prices needed to rise by 69 per cent to eliminate the subsidy. The direct and indirect effects of this price adjustment have been calculated and these are shown juxtaposed to the 2000 estimates for ease of comparison. The year 2000 income groups have been aggregated for comparison with the year 2008 data. The 69 per cent increase in fuel prices in 2008 equates to approximately TT$132 per month in real income benefits for

[25] There has not been an updated I-O table since 2000, however, officials at the Central Statistical Office have verified that the structure of the economy has not changed significantly since 2000. Therefore, using the existing I-O model to calculate indirect income effects in 2008 is justifiable.

the lowest income groups and TT$638 per month in real income benefits for the highest income groups. In 2008, fuel subsidies had a much higher impact on household real incomes, increasing real incomes between 3.6 per cent and 7.3 per cent compared to 1.4 per cent to 2.5 per cent in 2000. This increased impact on real incomes is due mainly to the higher level of subsidies in 2008 due to higher international prices for fuel products.

This comparative analysis between the year 2000 and 2008 show the greater regressive distributions of rents via subsidies when fuel prices and government rent receipts are higher. Thus energy revenues as a per cent of GDP were 6.4 per cent and 21.2 per cent in 2000 and 2008 respectively. This has coincided with the distribution of subsidies regressing further over this period (see Figure 4.3 and Table 4.16 below). It should be noted that there are two effects driving the analysis. The first is a price increase from year 2000 to 2008 and the second is the difference in distributions between the years of analysis.

Figure 4.3 Household income group subsidy distribution 2000 and 2008 (constant 2000 prices)

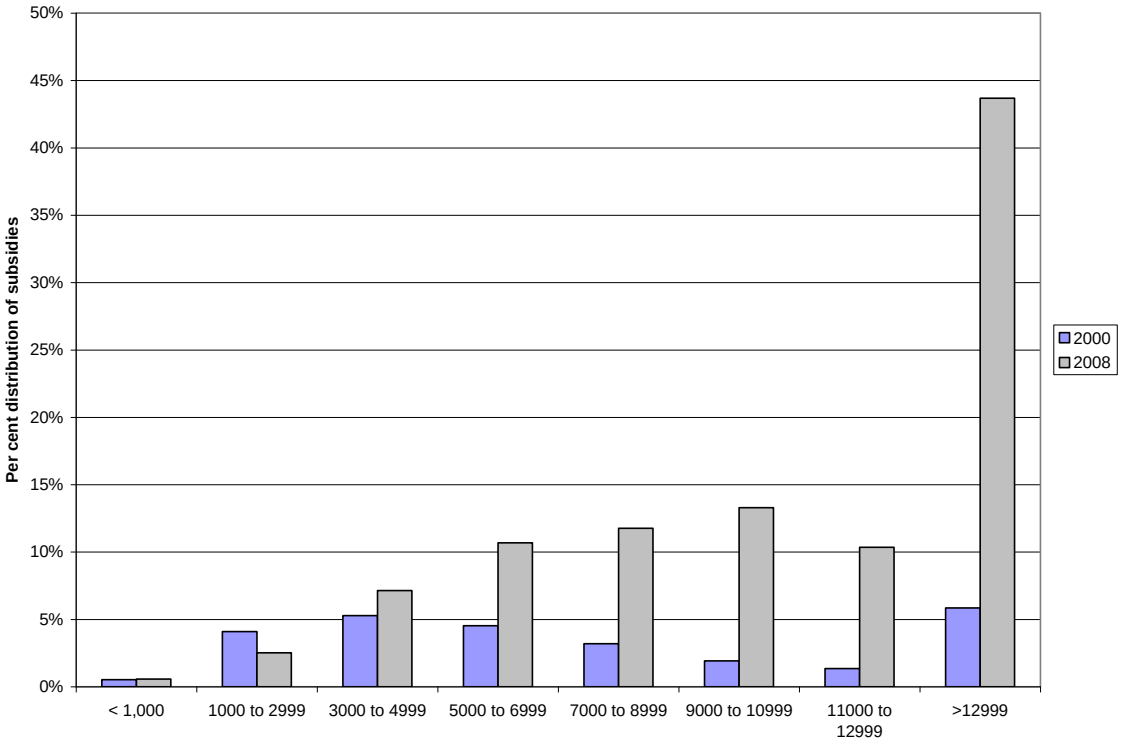


Table 4.16: Total real income effect of an increase in petroleum product prices in T&T (2000 & 2008)

	2008			2000		
Income Group of Household per month	**Total Monthly Exp TT$**	**69% increase in Petroleum Products Price**		**Total Monthly Exp TT$**	**24% increase in Petroleum Products Price**	
		Total Percentage Real Income Effect	**TT$ Real Income Effect per month**		**Total Percentage Real Income Effect**	**TT$ Real Income Effect per month**
All Groups	7,049	6.7%	469	3,157	2.2%	70
< 1,000	3,637	3.6%	132	922	1.4%	13
1000– 2999	2,850	4.0%	114	1,784	1.6%	29
3000– 4999	3,968	5.0%	197	2,991	2.0%	60
5000– 6999	5,174	5.6%	291	4,192	2.3%	97
7000– 8999	6,440	6.1%	394	5,372	2.4%	128
9000– 10999	7,898	6.7%	532	5,905	2.5%	148
11000– 12999	8,781	7.3%	638	6,592	2.3%	155
>12,999	13,022	7.8%	1,018	10,847	3.2%	348

4.5 Discussion

The methodology used to estimate the opportunity cost of petroleum products consumption and electricity consumption in Trinidad and Tobago has followed the approach set out in World Bank (2003), where the opportunity cost of fuel subsidies was estimated for Iran. The opportunity cost estimates assume that lower energy domestic prices due to subsidies leads to over consumption. To account for this it is assumed that if prices were allowed to rise to world prices then consumption of petroleum products would decrease to the average level of lower middle income countries. This is a shortcoming of the analysis which needs further researched in the future. The analysis

could be improved if an actual assessment of the price elasticities was conducted. This would have provided more accurate estimates for T&T energy reform.
The omission of actual price elasticities for T&T is also a short coming of the distributional analysis. However, the analysis of the distributional impacts of energy subsidies is meant to be static and in many ways only accounts for the static real income effects. It is possible that the analysis could include a dynamic component to account for demand elasticities as prices increase with the removal of subsidies. However, for the purpose of this analysis the results are meant to show the status quo real income effects on different household income groups, so the static analytical approach allows us to this.

Another improvement in the analysis could be the inclusion of price assumptions for different sectors of the economy to accurately account for controlled, traded and cost-push sectors of the economy. Further research on these sectors and the price implications is required.

4.6 Conclusion and policy implications

Price subsidies for energy can impose significant opportunity costs and when they are untargeted also have regressive distributions. The governments of petroleum and energy-exporting countries like T&T tend to provide energy subsidies for domestic consumption as an avenue for distributing energy rents and for supporting household real incomes. Unfortunately, the benefits and costs of fuel subsidies are seldom evaluated. The analysis of this chapter has examined the opportunity costs of fuel subsidies and found that there are considerable opportunity costs associated with fuel subsidies and electricity. Furthermore, the benefits associated with fuel subsidies are skewed towards higher income households. By looking at domestic fuel use and prices and comparing these to international use and prices, opportunity costs of petroleum products and electricity have been estimated. In addition to this, the relative distributional benefits of petroleum product subsidies have been assessed for household income groups over two periods.

The analysis has shown that the estimated opportunity cost of fuel subsidies can be significant. As a percentage of total government revenues from the oil sector, petroleum product subsidies rose 5 per cent in 2008. Total subsidies as a per cent of total government oil revenues were also high. From 2000 to 2008 the total subsidies have been estimated to be on average 5 per cent of government oil revenues, rising to 8.5 per cent in 2007 and almost 1 per cent of GNI in 2007 and 2008. The opportunity costs associated with subsidised electricity prices are even more significant. In year 2000, electricity subsidies resulted in an opportunity cost close to 2 per cent of GNI. The overall objective of the subsidy has been to smooth the consumption paths of households within T&T and to have predictable domestic fuel prices despite international fluctuations. If it is assumed that electricity subsidies grew at the same pace as petroleum subsidies, then total energy subsidies in 2008 could have been as high as 11 per cent of GNI. These estimates are comparable to the World Bank's study of energy subsidies in Iran. That study found that the opportunity cost of energy subsidies was approximately 10 per cent of GDP. The estimates presented for Trinidad and Tobago are also comparable to the estimates of other countries showed in table 4.1. However it is worth noting that future research is needed to estimate the different component of the subsidies, i.e. implicit and explicit subsidies.

Subsidies are thought to be mechanisms whereby governments are able to distribute oil and gas rents to the population, thereby benefiting households' real income. However, the distribution analysis has shown that wealthier households gain greater benefits from subsidies than their poorer counterparts. In 2008, the poorest households received real income benefits of 3.6% of income or TT$132 per month while the wealthiest households received real income benefits equivalent to 7.8 per cent of income or TT$1,018 per month. Where there is income inequality and wealthier households can use more fuel than poorer households, untargeted subsidies may not benefit the most vulnerable in society. The real income household impacts and hence household savings from the untargeted distribution of rents may allow wealthier households to save more than their poorer counterparts.

These results are comparable to distributional analyses conducted by other authors. Coady et al (2010) found that petroleum subsidies globally are highly regressive and most of the benefits accrue to high-income households. They found that the benefits of gasoline subsidies are the most regressive with 80 per cent of total benefits accruing to the richest 40 per cent of households. Similarly for diesel and LPG respectively, 65 per cent and 70 per cent of total benefits accrue to the 40 per cent of wealthiest households. On average in Latin America the wealthiest 40 per cent of households receive 62.6 per cent of the benefits for all petroleum product subsidies, while the poorest 20 per cent receives only 6.3 per cent. In Latin America, the richest 20 per cent receive 37.7 per cent of total benefits. It is similar in Africa, where the richest 20 per cent of households receive 44.2 per cent of total benefits and the poorest quintile receives only 7.8 per cent. In Africa, the richest 40 per cent of households reap 65.4 per cent of total benefits, Coady et al. (2010)

However, it is worth noting from a joint report by the IEA, OPEC, OECD and World Bank for the G20 summit of June 2010 reports that subsidy removal had a greater impact on expenditure and real income of the poorest households. For example in Bolivia it was estimated that the removal of subsidies on hydrocarbon derivatives would reduce real income by 5.4 per cent for the bottom quintile but only by 4.1 per cent for the top quintile. In Ghana removal of subsidies on petrol, kerosene and LPG would result in an income reduction of 9.1 per cent for the 20 per cent of poorest households and a reduction of 8.2 per cent in income for the top income quintile.

This analysis of subsidies shows that expenditure on subsidies is a poor use of resource rents, which benefits the wealthiest households more than the poorest. This research provides distributional estimates of fuel subsidies for Trinidad and Tobago which have not been estimated before. However, if wealthier households are receiving relatively more of the benefits of the subsidy than others, then it is also possible that there are interest groups which might oppose any change in energy pricing. Poorer households unaware of how the benefits are shared may also be opposed to any changes. However,

this analysis should shed new light on this topic and perhaps open the debate to greater scrutiny.

The analysis of this chapter therefore leads to further research questions on the distribution of all subsidies financed by oil and gas rents. Furthermore, the overall benefits and costs subsidies should be assessed to glean the true social rate of return from government expenditures.

However, further research questions and recommendations have arisen from this analysis and are now presented:

1. Research on price elasticity of fuel subsidies is required to improve the analysis
2. There should be annual or routine reporting of the level and distribution of subsidies to assist the government in assessing the efficacy of their subsidy regimes.
3. Research is needed on what policy responses might be the most appropriate to help mitigate the impact on the poor if subsidies are removed.
4. Research on what is the best public information campaigns that can be used to overcome any vested interests in maintaining the subsidy; this could be related to reporting as suggested in recommendation 2.
5. Alternative mechanisms for reducing the subsidy should be examined. If for example high price volatility is unwelcome by the government, then an automatic pricing mechanism could be used to avoid wild fluctuations in the price which could have extremely negative impacts on the real incomes of the poorest in society

In the next chapter, human capital accumulation will be examined. The major motivation here would be to show who benefits from the expenditure, savings and investments generated by resource rents on human capital formation (which is considered a better use of resource rents). Should there be alternative uses of the savings or natural resource rents that are targeted towards low income households, such as targeted social safety nets, or more desirable public expenditures that could directly impact upon low-income household groups such as education, health and infrastructure in the poorest communities? The next chapter will focus specifically on human capital accumulation and its distribution and education expenditure.

Annex 4.1 Direct Requirements Matrix

	Agriculture	Forestry	Fishing	Oil & Gas production	Service Contractors	Quaries &Asphalt	Sugar Factories	Meat Processors	Poultry processors	Dairy factories	Fruit & Vegetable processors	Fish processors	Feed & flour mills	Bakeries	Misc. Food Mfgrs.	Alcohol/Soft Drinks / Tobacco	Textiles	Printing	Paper Converters	Wood	Construction Materials	Hifhold Chemicals	Hifhold Appliances	Iron & Steel	Petroleum & Gas	Refineries / Refined Petroleum Products	Gas Processing	Petrochem - icals	Plastic Products	Other Mfng	Electricity	Water	Construction	Oil & Gas Distribution	W/sale & Distribution
Agriculture	0.02	-	-	-	-	-	0.73	0.09	0.92	0.22	0.03	-	0.02	0.01	0.06	0.02	-	-	-	-	-	0.00	0.01	-		-	-	-	-	0.00	-	-	0.00	-	
Forestry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.12	-	-	-	-		-	-	-	0.02	-	-	-	-	-	
Fishing	0.00	-	-	-	-	-	-	0.04	-	-	-	0.70	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Oil & Gas production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.24	-	0.09		0.79	0.36	0.37	-	-	0.23	-	-	-	
Service Contractors	-	-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Quaries &Asphalt	-	-	-	0.00	0.01	0.06	-	-	-	-	-	-	0.00	-	0.00	0.00	-	-	-	-	0.01	0.00	0.00	0.00		-	-	0.00	-	0.00	0.00	-	0.02	-	
Sugar Factories	-	-	-	-	-	-	0.13	-	-	0.03	0.00	-	-	0.04	0.07	0.09	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Meat Processors	0.00	-	-	-	-	-	-	0.19	-	-	0.00	-	-	-	0.00	-	-	0.00	-	-	-	-	-	-		-	-	-	-	0.00	-	-	0.00	-	
Poultry processors	0.00	-	-	-	-	-	-	0.13	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-		-	-	-	-	0.05	-	-	-	-	
Dairy factories	0.00	-	-	-	-	-	-	0.00	-	0.16	-	-	-	0.03	0.02	-	-	0.00	-	-	-	0.00	-	-		-	-	-	-	0.00	-	-	0.00	-	
Fruit & Vegetable processors	0.00	-	-	-	0.00	-	-	0.00	-	0.01	0.05	-	0.01	0.05	0.10	0.01	-	-	-	-	-	0.00	-	-		-	-	-	-	0.00	-	-	-	-	
Fish processors	0.00	-	-	-	-	-	-	0.00	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	0.00	-	-	-	-	
Feed & flour mills	0.42	-	-	-	-	-	-	-	-	0.02	-	-	0.16	0.36	0.03	0.01	-	-	-	-	-	0.00	-	-		-	-	-	-	0.00	-	-	0.00	-	
Bakeries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Misc. Food Mfgrs.	0.00	-	-	-	-	-	-	0.02	0.00	0.04	0.00	-	0.00	0.02	0.06	0.00	-	-	0.00	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Alcohol/Soft Drinks / Tobacco	-	-	-	-	-	-	-	-	-	0.13	-	-	-	-	0.00	0.05	-	-	0.00	-	-	-	0.00	-		-	-	-	-	-	-	-	0.01	-	
Textiles	0.00	-	-	0.00	0.00	-	-	-	-	0.00	-	-	-	-	0.00	0.00	0.18	0.00	-	0.00	0.00	0.00	0.00	0.00		-	-	0.00	-	0.00	-	0.00	0.00	-	
Printing	-	-	-	0.00	0.00	-	0.00	-	-	0.00	-	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	0.00	0.00	-		-	-	0.00	-	0.00	-	-	0.00	-	
Paper Converters	0.00	-	-	0.00	0.00	0.00	0.00	0.10	-	0.00	0.00	-	0.00	0.00	0.03	0.01	0.00	0.25	0.82	0.00	0.00	0.00	0.00	-		-	-	0.00	0.00	0.06	-	-	0.00	-	
Wood	-	-	-	0.00	0.01	0.01	0.00	0.00	-	0.00	-	-	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.15	0.00	0.00	0.04	0.00		0.00	-	0.00	0.01	0.01	-	-	0.07	-	
Construction Materials	0.00	-	-	0.00	0.00	-	0.00	-	-	0.08	0.00	-	0.00	-	0.00	0.03	0.00	0.00	0.00	0.00	0.22	0.00	0.01	0.03		-	-	0.00	0.01	0.00	0.00	0.00	0.15	-	
Hifhold Chemicals	0.01	-	-	0.01	0.07	-	0.01	0.00	-	0.00	0.00	-	0.00	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.02	0.12	0.04	0.01		-	0.01	0.05	0.04	0.04	0.00	0.02	0.04	-	
Hifhold Appliances	0.00	-	-	0.01	0.01	0.00	-	0.00	-	0.00	0.00	-	0.00	-	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.01	0.02	0.00		-	0.00	0.00	0.00	0.01	-	0.01	0.05	-	
Iron & Steel	-	-	0.00	0.03	0.02	0.00	0.00	-	0.00	0.00	0.00	-	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.02	0.01	0.00	0.10	0.48		0.00	0.00	0.00	0.02	0.00	0.00	0.11	0.01	-	
Refined Petroleum Products	0.01	0.01	0.14	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.01	-	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.04	-	0.00	-		0.00	0.01	0.02	0.01	0.02	-	0.03	0.03	0.02	
Gas Processing	0.00	-	-	0.00	0.00	0.00	0.00	0.01	-	0.00	0.00	-	0.00	0.00	0.02	0.01	-	0.01	-	0.01	0.00	0.02	0.00	0.00		0.00	0.00	0.01	0.00	0.00	-	0.00	0.00	-	
Petrochem -icals	-	-	-	0.00	0.00	-	0.00	-	-	0.00	-	-	0.00	0.00	0.00	0.00	-	-	-	0.00	0.00	0.01	0.02	0.00		-	0.00	0.00	0.01	-	-	0.00	0.00	-	
Plastic Products	-	-	-	0.00	0.00	-	-	0.01	0.00	0.00	0.01	-	0.00	0.00	0.04	0.00	0.00	0.06	0.01	0.01	0.00	0.00	0.00	0.00		0.00	-	0.00	0.01	0.07	-	0.01	0.00	-	
Other Mfng	0.00	-	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	-	0.00	0.02	0.22	0.03	0.02	0.01	0.00	0.00	0.00	0.01	0.03	0.00		-	0.00	0.00	0.01	0.02	0.00	0.00	0.00	-	
Electricity	0.00	-	-	0.00	0.00	-	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.04	0.01	0.01	0.07		0.01	-	0.02	0.01	0.00	-	0.05	0.01	-	
Water	-	-	-	0.00	0.00	-	-	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01		0.00	0.00	0.01	0.00	0.00	0.00	-	0.00	0.00	
Construction	-	-	-	0.01	0.03	0.01	-	0.01	0.01	0.00	0.02	-	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.00	0.01	0.02		0.00	0.00	0.01	0.00	0.02	0.02	0.07	0.08	0.08	
Oil & Gas Distribution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
W/sale & Retail Distribution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Restau-rants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Hotels & Guest Houses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Transport	-	-	-	0.01	0.02	-	0.11	0.01	0.01	0.01	-	0.02	-	-	0.02	0.06	0.01	0.00	0.02	-	0.05	-	-	0.07		0.00	0.00	0.08	-	-	-	-	0.02	0.03	
Communi- cation	-	-	-	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Finance	-	-	-	0.01	-	-	-	-	-	-	-	-	-	-	0.11	-	-	-	-	-	-	-	-	0.06		0.01	0.03	0.02	-	-	0.07	0.27	0.02	-	
Insurance	-	-	-	0.00	0.01	0.00	-	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00		0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.01	
Business Services	-	-	-	0.01	0.05	0.00	-	0.01	0.00	0.01	0.02	0.01	0.00	0.02	0.04	0.02	0.03	0.03	0.01	0.01	0.01	0.00	0.04	0.01		0.00	0.00	0.04	0.01	0.02	0.01	0.05	0.02	0.03	
Govern -ment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Educa -tion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Health	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
Personal Services	-	-	-	0.00	0.01	-	-	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-	0.00	0.00	0.00	0.00	-	-	-	0.02	

Annex 4.2 Mapping of price increase indirect impacts

Food Weighting

Price shifting model category	Household food expenditure items	Weighting
Bakeries	Bakery products	7%
Miscellaneous	Cereal products	12%
Miscellaneous	Breakfast foods	1%
Miscellaneous	Prepared cereal mixes	0%
Meat processors	Beef	2%
Meat processors	Pork	1%
Meat processors	Mutton	1%
Meat processors	Other meat	0%
Meat processors	Preserved meats	3%
Poultry processors	Poultry	15%
Fishing	Fish	4%
Fish processors	Fish salted etc.	2%
Dairy factories	Milk products	9%
Dairy factories	Butter	1%
Dairy factories	Cheese	3%
Agriculture	Eggs	1%
Miscellaneous	Fats and oils	6%
Agriculture	Fresh fruits	3%
Fruit and vegetable processors	Canned fruits	0%
Miscellaneous	Dried fruits	1%
Miscellaneous	Fruit juices	1%
Miscellaneous	Juice concentrate	0%
Miscellaneous	Packed juices	2%
Agriculture	Green and other vegetables	8%
Agriculture	Vegetables	0%
Fruit and vegetable processors	Dried vegetables/pulses	1%
Fruit and vegetable processors	Tea/cocoa/coffee	2%
Miscellaneous	Condiments and sauces	3%
Miscellaneous	Prep and partially prep foods	4%
Alcohol/soft drinks and tobacco	Non-alcoholic	8%

Annex 4.3 Expenditure item (excluding food) mapping

Price Shifting Model category	Household expenditure item
Restaurants	Meals out
Alcohol/soft drinks and tobacco	Alcoholic drink
Alcohol/soft drinks and tobacco	Tobacco
Textiles	Clothing and footwear
	Accommodation
	Fuel and light
Other manufacturing	Households supplies
Transport	Transportation
Health	Medical goods and services
Transport	Foreign travel
Personal services	Entertainment
Education	Education
Personal services	Personal care hygiene and services
Other manufacturing	Miscellaneous goods and services
	Home grown food
	Gifts received

Chapter Five: Education expenditure, human capital accumulation and distribution with resource abundance

5.0 Introduction

Given the need to save or invest rents from natural resources for sustainable development, important questions are: Who benefits from these savings or rents, and does this matter for sustainable development? What is/are the major factor(s) influencing distributional outcome? Undoubtedly expenditure in education should be considered a good use of resource rents unlike expenditure on fuel subsidies. However, is expenditure on education alone enough for sustainable and equitable growth? This chapter examines in detail the accumulation of human capital and its distribution in T&T in an attempt to answer these questions.

Differences in human capital accumulation not only between countries but also between groups within countries play an important part in distributional outcomes and also lead to the perpetuation of poverty traps. Many theorists such as Matsuyama (1995) and Acemoglu (1997) also predict that multiple equilibria occur within society due to differences in human capital investment. Ravallion (1998) found that in China, initial asset distribution had a significant impact on individuals' consumption growth. Birdsall (1997), and Deininger & Squire (1998) have also suggested that growth is more negatively affected by unequal distribution of assets such as human capital than by income inequality.

Furthermore, Santos (2009) has provided evidence which suggests that poverty traps will persist when unequal initial income and human capital distribution exists and in particular when the quality of education received by poorer and wealthier individuals differ.

This has significant policy implications for sustainable development. The poverty trap lowers current and steady state output as well as the growth rate and this, in turn, hinders the ability of the economy to lift individuals and households out of poverty. Therefore, human capital is an important household asset, which has a direct bearing on the size of household income.

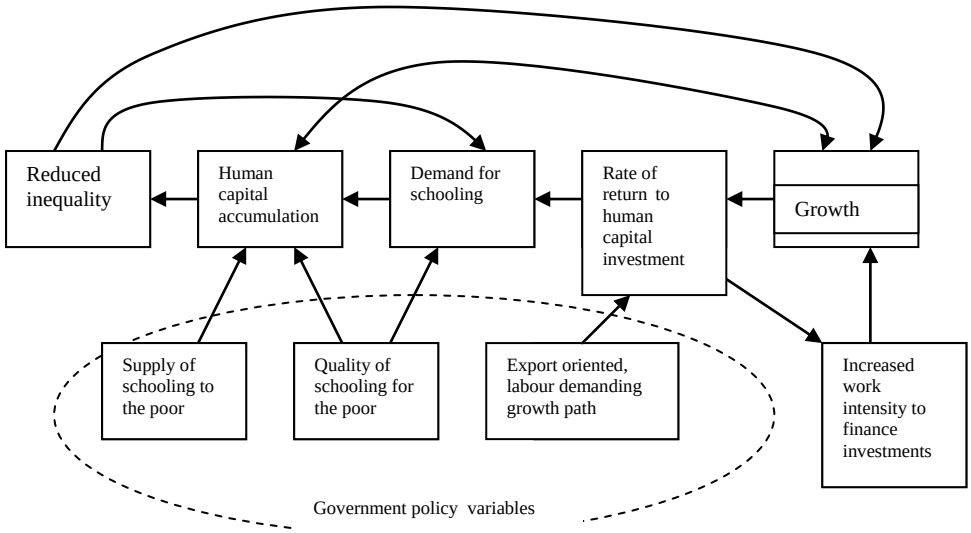
Birdsall et al (2001) provide a framework and proof of the negative effects that resource abundance, inequality and low quality human capital accumulation can have on growth. Birdsall et al. (1999) have also argued that countries can achieve more equitable and faster growth if the poor are encouraged to invest in the assets they control, which includes their human capital. They argue that if returns on human capital are increased, then this leads immediately to increased work effort, higher savings higher investment, higher productivity and lower inequality in the future. It is this virtuous circle of human capital accumulation, with equitable growth that helps explain the rapid development of most East Asian countries. Figure 5.1 shows what this virtuous circle looks like. Unfortunately in resource abundant countries this virtuous circle is broken as Dutch disease effects and rent seeking reduce the rate of return on agriculture and human capital investments that are available to the poor. Thus where resource rents are accumulated by the government and a small number of business men, this leads to higher inequality and lower growth. Birdsall et al. (2001) then argue that in this environment, the government attempts to assuage the poor by directing some of the resource rents to populist programmes including education. However, in this context education becomes a consumption good and not an investment good since the quality of education is likely to be inferior.

Resource abundance has several impacts on the virtuous circle. In resource abundant countries, governments focus on development strategies that are capital intensive and are not dynamic outside of the natural resource sector. The level of inequality tends to be higher due to Dutch disease effects and rent seeking impacts. There are also few incentives for investment in education and the government builds a welfare state to support this. This is very important for Birdsall et al. (2001) since if the poor have no incentives to invest in education due to low returns then the virtuous circle is broken. For the poor with only few assets under their control, primarily labour and agricultural

land, then investing in these might be limited due to low rates of return or lack of capital. For poor households considering investing in education, two variables are important, the rate of return, r, and the discount rate, d. Since households prefer to consume today rather than save or invest for the future, if d > r, then they will not invest for the future. To encourage poor household to invest for the future, r must be greater than d. This could come about from an improvement in local schools, or changes in agricultural pricing policy.

However, if poor household cannot borrow, how are they expected to invest for the future even if r>d? Reducing consumption to fund savings and investment might not be viable for many poor households that already consume a limited basket of goods and services. Thus for this to happen, poor households must reap significant returns from working harder. For policy makers, this means that the marginal product of labour must rise rapidly as labour supply increases. Thus governments must raise the return on the assets held by the poor and continually increase the returns to both labour and skills investment, Birdsall et al. (2001). Figure 5.1 shows what positive impact the government could have on the virtuous circle. If the government provided quality education for the poor and at the same time pursues an export driven growth strategy that is labour demanding then this provides the necessary incentives for investment that leads to equitable development in the future.

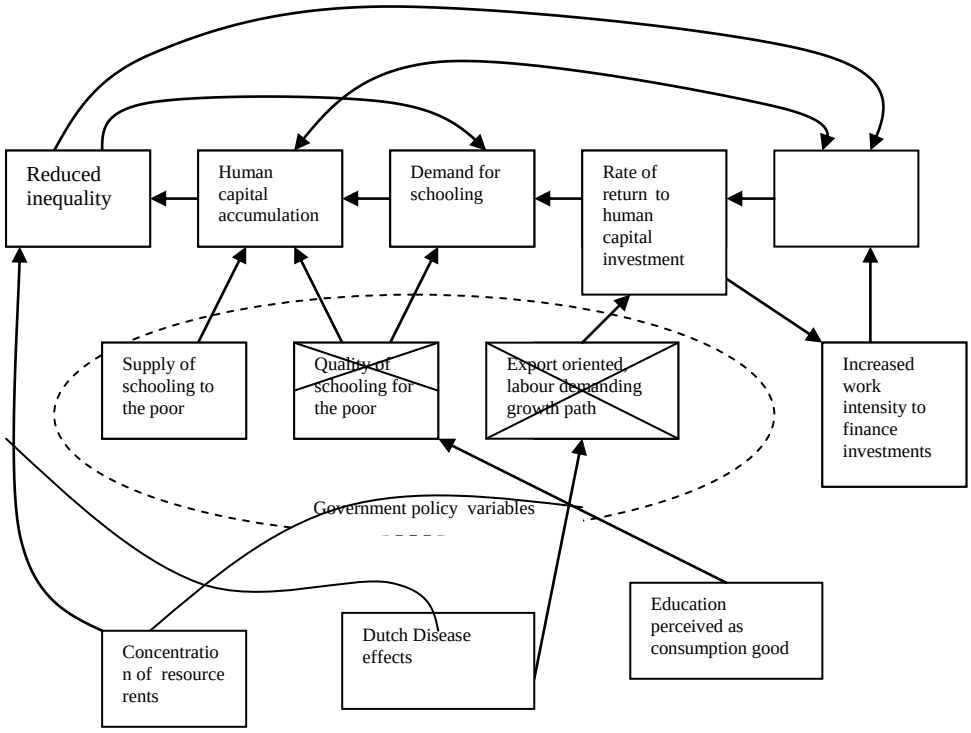
Figure 5.1 Government's impact on the virtuous circle



Source: Birdsall et al. (2001)

However, in resource abundant countries these incentives may not exist, primarily because rents are concentrated particularly if it is point source, Dutch disease effects take hold and reduces the export driven dynamism of the economy. At the same time education is perceived as a consumption good and not an investment. These effects are shown in Figure 5.2, which shows how typical political economy considerations erode human capital investment incentives, by reducing returns on this type of investment and the export driven nature of the economy and equitable growth of the future are sacrificed.

Figure 5.2 Impact of resource abundance on virtuous circle



Source: Birdsall et al. (2001)

I now examine T&T's experience of human capital accumulation and to assess the distribution of this asset and the applicability of the virtuous circle to T&T.

Since T&T gained independence from Great Britain in 1962, successive governments have given precedence to educational attainment. The first Prime Minister, Dr. Eric Williams, famously said in 1960 (before becoming PM) that the future of the nation was carried in the school bags of children.[26] Although expenditure on education has always been seen as a priority and as critical for development, relative educational attainment measured as mean school years is on average only about 9 years.[27] Adult literacy, another crude measure of educational attainment, was fairly high at 98.8 per cent in 2008. However, these crude measures of educational attainment tell us very little about labour market outcomes and the links between education and income.

[26] On August 30th, 1962, the eve of T&T's Independence from Britain, Williams famously exhorted: "You, the children, yours is the great responsibility to educate your parents…you carry the future of [the Nation] in your school bags."
[27] See Section 4.2.

Human capital measurement attempts to understand these linkages. In T&T, income distribution is unevenly distributed and wealthier households tend to benefit disproportionately more from untargeted government expenditure such as fuel and energy subsidies. Does the accumulation of human capital by different household income groups contribute to these disparities and what of the virtuous circle? To answer this question, policy makers need to know the levels of human capital accumulated by different household groups. However, explicit estimates of human capital have not been calculated previously for T&T. Furthermore, the distribution of that human capital has not been estimated previously.

There has been no previous estimate of human capital for Trinidad and Tobago. There are numerous methodologies that have been articulated for assessing human capital. This chapter uses two methodologies to estimate the level of human capital for Trinidad and Tobago. These methods are modifications of conventional approaches for estimating human capital. The methods are less data intensive and are applicable to developing economies where all of the required data might not be available. However, by using modified approaches, that are less data intensive, estimates of human capital can be produced where there were none previously.

This chapter will therefore explore the links between human capital investment and distributional outcomes and assess the level of human capital investment being made by the Government and its overall impact on the distribution of resource rents, investment benefits and savings. This chapter will therefore also explore the relationship of T&T's resource abundance on the virtuous circle discussed earlier. The quality of human capital and investments will be discussed later in the chapter. The following section examines general government expenditure and expenditure on education.

5.1 Government expenditure and analysis of education expenditure

Given the arguments presented above, the government's expenditure on education could therefore provide an important opportunity for the accumulation of human

capital assets in households throughout the economy. This section examines trends in government expenditure over the period 1997 to 2010 [28] and, in particular, education expenditure and what impact this might have on human capital accumulation.

During the period 1997 to 2010, T&T's current government expenditure rose by 250 per cent. The largest percentage increases occurred in general public services (329 per cent), health/social security welfare affairs and services (229 per cent) and other economic services (355 per cent), while expenditure on education and transport & communication affairs and services increased by only 144 per cent and 115 per cent respectively.

Table 5.1 Selected expenditure items as a share of current expenditure (constant 2000 prices)

	1997	2000	2005	2010[29]
Education Affairs	15%	14%	14%	15%
Health/Social Security Welfare Affairs and Services	18%	19%	22%	24%
Other	68%	66%	65%	61%
Total TT$ billions (current)	10.4	11.2	18.0	26.0

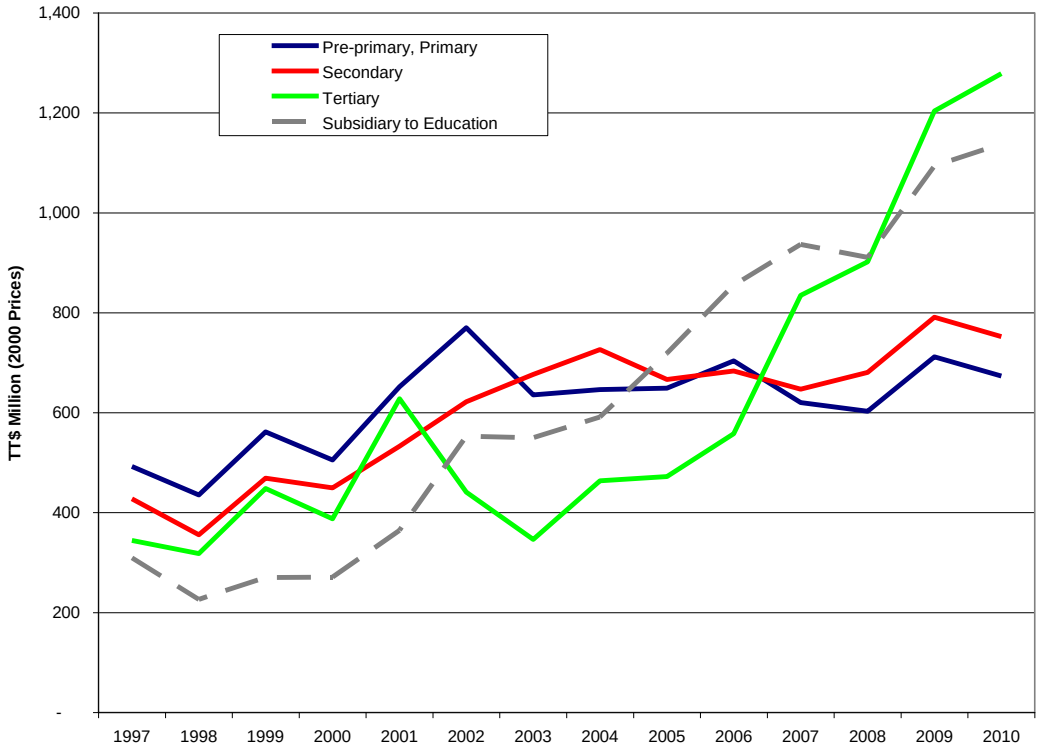
Source: Ministry of Finance

On average, total expenditure increased by 9 per cent per annum. However, the composition of expenditure has changed from 1997 to 2010. There have been considerable increases in the share of spend on general public services and health and social welfare services, while expenditure on education increased by 8 per cent per annum, with the largest increases occurring in tertiary education at 14 per cent per annum. However, the increases in primary and secondary education were on average only 4 per cent and 5 per cent per annum, with major increases occurring during the years 2001 and 2002. However, since 2002 expenditure in constant dollars on primary and secondary education has since levelled off, with large percentages being spent on tertiary education. In fact, current account expenditure on primary education has fallen on average in real terms by 1 per cent per annum.

[28] 1997–2010 detailed data on expenditure is available for this period and it covers the period of analysis.
[29] Estimate.

The share of primary and secondary education has also fallen, e.g. primary education expenditure has fallen to 19 per cent of total education expenditure in 2010, down from 33 per cent in 1998. Secondary education expenditure has also fallen, e.g. from a high of 31 per cent in 2003 to an estimated 21 per cent in 2010.

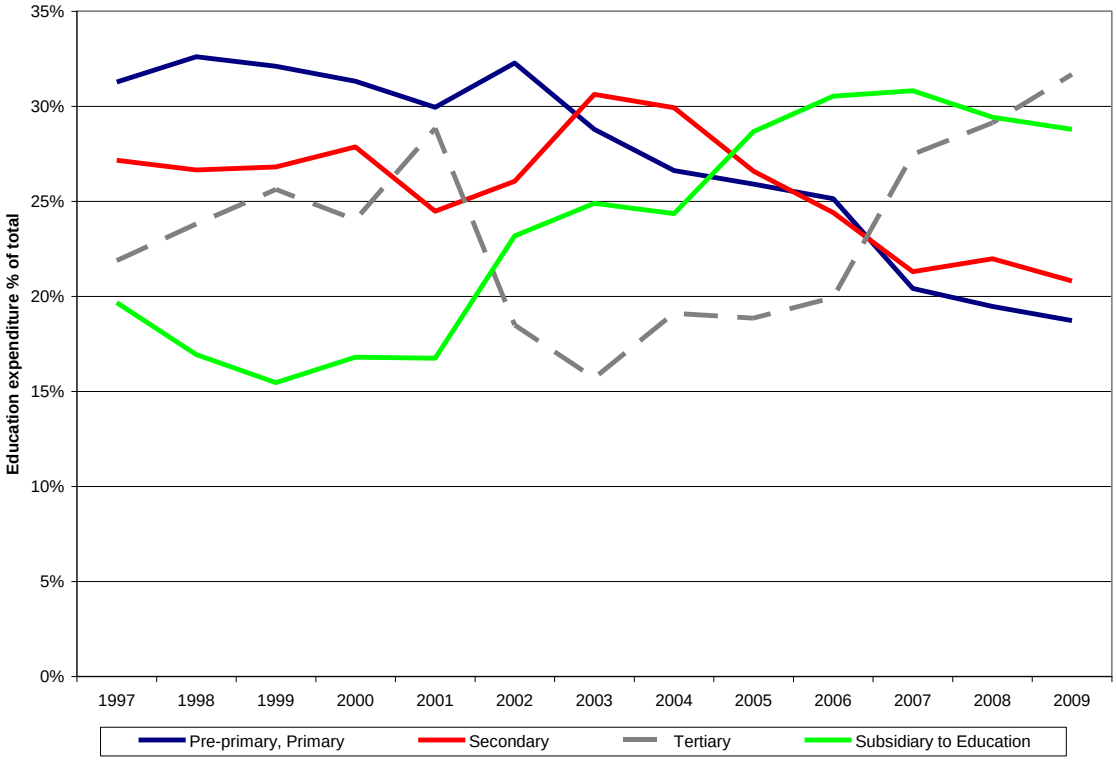
Figure 5.3 Education expenditure (2000 prices)



However, it should be noted that current expenditure in real terms per student enrolled in primary school has increased by 110 per cent from 1997 to 2006, since there were significant declines in the number of children enrolled in primary school. In 1997 there were 181,030 students enrolled in government and government-assisted primary schools and this fell to 123,199 in 2006 (the latest period for which data are available) which is a 32 per cent reduction. The reasons for this decline in enrolment are unclear since enrolment in private primary schools also fell from 8,654 in 1998/99 to 6,217 in 2005/06 (periods for which relevant data are available). There was also a decline in secondary school enrolment from 105,994 in 1998/99 to 96,046 in 2005/06. Exploring the reasons for the declines in pupil enrolment is not the focus of this chapter,

although these are trends that need to be explored against the backdrop of a growing population and the future competitiveness of the economy.

Figure 5.4 Education expenditure items as a per cent of total education expenditure



Capital expenditure (2000–2008)

Using capital formation expenditure as a proxy for investment expenditure, education seems to have benefited significantly from government capital investment, although investment expenditure on education did not grow at the fastest pace of all government functional areas. For the period 2000 to 2008, investment in the education sector grew at an annual pace of 34 per cent. However, investment in all other categories except public order and safety and transport & communication grew faster. As a share of total investment expenditure, education expenditure rose by 8 percentage points from 14 per cent in 2000, to 23 per cent in 2008. However, the housing, social security and social services functional area increased from 7 per cent in 2000 to 16 per cent in 2008. Interestingly, although crime and anti-social behaviour has risen over this period, capital expenditure on public order and safety fell from 41 per cent of total capital formation in 2000 to 18 per cent in 2008.

The analysis of expenditure has shown that the spend on education has increased on a per capita basis due to significant declines in enrolment. The pace of increase in tertiary level education expenditure has been the fastest. However, an important policy question is how are the benefits of this expenditure distributed? This question will hopefully be answered by measuring human capital accumulation later in the chapter.

Table 5.2 Capital formation percentage of total

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Education	14%	16%	28%	31%	34%	14%	15%	24%	23%
Health	0%	1%	7%	10%	11%	6%	2%	3%	5%
Other	86%	84%	65%	60%	55%	80%	83%	73%	73%
Total TT$ M (2000 prices)	971	641	802	998	1,343	1,563	1,137	1,986	1,789

5.2 Comparing T&T's basic educational measures with that of other countries

Another pertinent question is how does T&T's educational attainment compare to other countries with similar national income, location and/or economies? Table 4.3 shows data taken from the UN's Human development report (UNHDR 2009) with 2008 data for countries with similar levels of GNI per capita and which are either Caribbean or petroleum-based economies. Data from the UNHDR allows for easy comparisons between countries by using data from one source. The table refers to data for 2008 and shows data comparing T&T with seven countries with similar GNI per capita. The indicators compared are adult literacy rates, expected school years and mean school years.

While T&T has superior adult literacy rates compared to the average of the group (98.8 compared to 92.8), T&T lags behind in expected school years and mean school years. The average expected school years are 12.6 while in T&T the score is 11.4. Mean school years in T&T in 2008 were 9.1 compared to the average of 9.3. Direct comparisons with comparator countries that are also exporters of oil and natural gas (Oman and Saudi Arabia) show that T&T has performed better than these countries in

adult literacy but is on par with Oman on expected school years and is less than Saudi Arabia. Data on mean school years are not available for Oman. However, mean school years in T&T were higher than in Saudi Arabia by about 1.5 years.

A further comparison of T&T with another Caribbean country, Barbados, shows that T&T lags in educational attainment. Although Barbados' GNI per capita, US$22,711, was less than T&T's US$24,245 in 2008, that country has outperformed T&T in expected school years and is on par on adult literacy and mean school years, despite having fewer natural resources.

Table 5.3 Basic education data of comparator countries (2008)

Country	Adult literacy rates	Expected School years	Mean school years	GNI per capita US$ (2008)
Antigua and Barbuda	99			19,661
Bahamas		11.6	11.1	26,649
Bahrain	89.2	14.3	9.3	33,427
Barbados	99	13.4	9.3	22,711
Oman	85	11.1		24,821
Saudi Arabia	85.6	13.5	7.6	24,504
T&T	98.8	11.4	9.1	24,245
Average	92.8	12.6	9.3	25,145
Standard Deviation	6.9	1.3	1.2	4,246

Source: UN

Although T&T has experienced a boom in revenues from its main natural resource sectors (oil and natural gas), gaps remain in human capital attainment and the labour force is still relatively unskilled since there have been labour force shortages in energy and finance, although labour surpluses exist elsewhere (Auty, 2009). The following section examines these outcomes and the interaction between human capital distribution, education, the virtuous circle and sustainability.

5.3 Measuring human capital

Given the levels of government education expenditure in T&T over the last decade and a half, what impact has this had on human capital formation?

Measuring human capital is a notoriously difficult task and usually involves many assumptions. The least complicated estimates rely on years of schooling for the working age population and multiply this number by a mean estimate value of human capital. The World Bank uses an approach based on its wealth of nation estimates which calculates human capital as part of intangible capital, a residual component of total capital. The theory underlying these conclusions is the same as Hicksian theory of wealth and income, whereby income is assumed to be a rate of return on comprehensive wealth/capital within society. According to the World Bank's 2006 report on "Where is the wealth of nations?", comprehensive wealth is measured as the present value of future consumption and intangible capital is, in effect, the residual that is derived when physical wealth, natural wealth and financial assets are subtracted from total wealth. Thus comprehensive wealth could either be derived by adding up the individual components of wealth or by measuring the present value of consumption along a competitive development path, meaning that future consumption must be bound by current wealth.

Since intangible capital is measured as a residual of total wealth, there are many missing asset values bound up within intangible wealth including, for example, human capital, the rule of law and some missing natural resource values. The authors of the World Bank's 2006 report attempted to dissect intangible capital by examining the other factors that may explain the total variation in intangible capital namely social capital or the rule of law and human capital. They used a simple measure of human capital – average years of schooling per capita – but this measure had admitted flaws, namely that it did not account for the quality of education received and the apparent decline in marginal returns to education. A later World Bank report in 2011 attempts to address these shortcomings by using a more consensus approach to measuring human capital, which uses a log-linear relationship between years of schooling and earnings.[30]

The alternative methods for calculating human capital can be categorised into three distinct approaches according to Greaker (2008). These are:

[30] First formulated by Mincer (1974).

1. The cost-based method which measures human capital from the input side.
2. The revenue-generating method which measures human capital from the output side.
3. The current stock characteristics method.

The input side approach measures human capital by summing all expenses that contribute to human capital, such as public and private direct expenses related to education and foregone income while individuals are engaged in education. A comprehensive input side approach should also include employer-financed training and on-the-job training. Greaker, however, explains that the input side methodology should include a component for depreciation of human capital, since this would prevent the measure from becoming bigger and bigger with time. This deprecation component should include allowances for the long-term unemployed, people leaving the labour force and people beginning new careers, which all imply a reduction in the stock of human capital.

The output side methodology estimates human capital based on the expected wages that a person with a particular level of education could expect to receive in the future. Becker (1964) calculated the rate of return on education by examining wage differentials between workers of different education levels. The Jorgensen and Fraumeni method, which is adapted and used later in this chapter, takes Becker's approach further by calculating the stock of human capital through an expected wage approach. The Jorgensen and Fraumeni approach is discussed below with modifications for its adaptation to T&T's data availability. Greaker (2008) suggests that the output side approach does not separate adequately human capital from social capital, since he assumes that a country with higher social capital may presumably have higher wages obtainable in the labour market. Greaker also suggests that the output side approach does not quantify the non-market benefits of education, such as the intangible yields related to higher education which are resistant to measurement.

The current stock characteristics approach attempts to construct a comprehensive measure for the current state of human capital by including metrics on average years of schooling, literacy rates, unemployment rates and the health status of the general population. Unfortunately, an index of this type, which measures human capital, is

difficult to convert into a monetary measure and this makes it difficult to use with national wealth estimates according to Greaker (2008).[31]

However, Arrow et al. (2010) use a simple Mincerian method adapted from Klenow and Rodriguez-Clare (1997). They calculate the amount of human capital per worker as proportional to exp(rT), where r is the appropriate rate of interest and T is the average number of years of educational attainment.

In theory, all three approaches should yield the same result, i.e. the cost approach should equal the present value sum of expected wages/returns and this should be equal to an estimated value of current characteristics. Greaker suggests that there are many reasons why this might not occur, including the intangible non-market benefits of education. Most measures of human capital within the sustainable development literature have tended to use the input side approach, such as World Bank (2006), while the economic growth literature has used the output side approach (Becker, 1964 and Jorgensen & Fraumeni, 1989 and 1992). The analysis of this chapter attempts to use the more conventional growth theory approaches for the sustainable development debate and to show the trends in human capital accumulation in T&T.

Two approaches are used due to data availability. The simple Mincerian approach is used to assess the trends in human capital accumulation from 2000 to 2008, while a modified Jorgensen-Fraumeni approach is used to estimate the size and distribution of human capital in 2008. To estimate the distribution of human capital requires more data such as educational attainment amongst different household income groups. The 2008 household budget survey was the first time this level of data was collected by the Central Statistical Office of T&T. Therefore, trends in distribution cannot be estimated. The simple Mincerian approach is less data intensive and allows for the examination of aggregate human capital trends from one period to the next (here 2000 to 2008). Estimating human capital using two methodologies also allows for a comparison of estimates between methods.

[31] However, a monetised stock approach is used later in the chapter to estimate the trends in human capital accumulation due to the relatively fewer data requirements of this method and the lack of data for T&T.

5.4 Human capital estimates

A human capital account for T&T is now presented along with an estimate of the distribution of human capital.

Some capital stocks can be given an economic value more easily than others. In Chapter 3, an attempt was made to estimate the asset value of oil and natural gas resources of T&T, and this was done using market prices and available data on resource stock and utilisation values. However, placing an economic value on human capital, one component of national wealth, is difficult and is very data intensive. In addition to ascertaining the level of human capital in T&T, an additional reason for calculating human capital is to assess how this critical component of capital is distributed, and whether the current policy of converting natural resource capital into human capital is having the desired outcome on sustainable development.

Two methods are used to calculate estimates of human capital in T&T. The first method is that proposed by Arrow et al. (2010) and the second is the Jorgensen-Fraumeni lifetime income approach. The Jorgensen-Fraumeni lifetime income approach is very data intensive and requires data on educational attainment and expected income levels for different age groups (data which has not been routinely collected for T&T). The first method is less data intensive than the second method and therefore allows for comparison of human capital accumulation over two periods using available data.

Arrow et al. (2010) first assume that there is a steady state and, as discussed earlier, that the amount of human capital per worker is proportional to exp(rT). Like Arrow et al. (2010), it is assumed that the appropriate rate of interest, r, is 8.5 per cent per annum and T is average number of years of educational attainment.[32] The stock of human capital is simply the per worker human capital multiplied by the total number of workers in the economy. This is a simplification of the Mincer model,[33] so that the stock of human capital, H, is:

[32] This is based on global estimates on the return on education estimated by Klenow and Rodriguez-Clare (1997).
[33] Mincer (1974).

$$H = HCW \times L = \exp(EA \times r) \bullet L$$

Where HCW is human capital per worker, EA is the weighted average years of educational attainment and r is rate of interest {which is taken as 8.5 per cent as per Klenow and Rodriguez-Clare (1997)} and L is the working age population.

The human capital per worker estimate is then multiplied by the total population of the country that is old enough to have obtained the average level of education. According to Arrow et al., all adults, irrelevant of whether they are working or not, have human capital. For this method, the total stock of human capital increases if the average level of education increases or the adult population increases.

The shadow price of human capital can also be calculated as the discounted sum of the wages that the stock of human capital would receive over the expected number of working years remaining. According to Arrow et al. (2010), this is the rental price of human capital and is calculated as the total wage bill divided by the stock of human capital. For the current analysis, the wage bill is taken as the compensation of employees from the national accounts. This figure is divided by the stock of human capital for the employed labour force to get an average rental price of human capital for each year. The average rental price is then multiplied by the total stock of human capital for the 15+ population to get estimates of the value of human capital.

Using the Klenow and Rodriguez-Clare simple Mincer approach, estimates of human capital are provided for 2000 and 2008. Human capital has increased by 85 per cent from 2000 to 2008 in current prices. This increase has been driven mainly by the significant rise in average educational attainment (19 per cent) and the increase in the rental price of human capital (43 per cent) and to a lesser extent by the 4 per cent increase in population over the period.

Table 5.4 Human capital estimates 2000 and 2008

	2000	2008	% change
Average educational attainment (years)	9.8	11.7	19%
15+ population	942,429	976,936	4%
Rental Price (USD)	6,027	8,684	43%
Human Capital (USD billions)	13.2	24.4.0	85%

The second method uses an adjusted version of the Jorgensen-Fraumeni lifetime income approach measure of human capital for a given education/age group within society. This method is used to assess the distribution of human capital in 2008, the only year for which sufficient data is available to calculate human capital and its distribution using the Jorgensen-Fraumeni approach.

The lifetime labour income approach, as set out by Jorgensen and Fraumeni (1989) and Jorgensen and Fraumeni (1992), measures human capital embodied in individuals as total discounted present value of expected income that could be generated in the labour market over their lifetime. This is considered an 'output-side' method of measuring human capital.

There are three major steps in the calculation:

1. A database is constructed of the economic value of market labour activities for different categories of individuals. This database contains information on various categories such as labour income, labour market participation rates, survival rates, school enrolment rates and the number of people in each category all cross-classified by age, sex and educational attainment level.
2. An algorithm is constructed to calculate the lifetime incomes for representative individuals for each classified category in the database. The major assumption behind the algorithm is that an individual with a certain age, sex and educational attainment level will in the next year obtain the same labour income and have similar other characteristics (such as labour participation rates, survival rates and school enrolment rates) as an individual

who is one year older this year but with the same age, sex and educational attainment level.

3. Representative per capita human capital for each category of individuals is applied to all individuals in that category. This is then summed to estimate the aggregate human capital stock.

To utilise the Jorgensen-Fraumeni approach for T&T, the methodology has been adjusted for data availability.

The modifications and the adjusted Jorgensen-Fraumeni approach are detailed below:

1. Expected income streams are derived using current cross-sectional information from the latest available household budget survey and labour market surveys as well as demographic and mortality data for T&T. These data sources provide the required data on labour incomes, educational attainment, employment rates and expected mortality/survival rates from year to year depending on an individual's age.
2. Lifetime labour incomes are projected by backward recursion. Thus an individual's present value lifetime income is equal to the current period income plus the present value of income in the next period. However, since data on next period income is not readily available, it has to be estimated. The approach therefore works backward from the lifetime income of individuals with the highest level of education and oldest working age to derive the next period income of an individual.
3. For T&T, the retirement age is 60 as opposed to 75 in the Jorgensen and Fraumeni example. Thus by holding age and educational attainment constant, for example, the lifetime income of an individual aged 59 is just his or her current period's labour income.[34] Then this individual's present value of lifetime labour income can be used to estimate the next period's present value of lifetime labour income for a 58-year-old with the same age and educational attainment. By working backward in this way, it is possible to calculate all

[34] Human capital by sex has not been estimated.

combinations of next period's labour income for all age groups and educational attainment.

4. Due to the reliability of the data, these estimates are not gender differentiated. Further modifications to the Jorgensen and Fraumeni method have been made to adopt it to T&T and data availability. Some of these modifications follow those undertaken by Wei (2008) in his estimation of human capital for Australia and include:

- The estimates focus on working age population. The justification for this is that this component of human capital has the most important impact on market economic activities. By confining the study to working-age population does not imply that other age groups have no human capital, but that the working-age population is most directly related to economic activities. The working-age population also has different age cohorts and educational attainment which allows the analysis to show how human capital has been distributed from one generation to the next and what policy conclusions can be drawn for achieving the desired outcomes in the future.
- The current analysis has excluded non-market activities and focused only on labour market incomes. Valuing non-market activities has raised many contentious issues with the Jorgensen-Fraumeni model, such as how it should be valued and that it might not add value to the current analysis.
- Educational attainment is measured as highest qualification completed and for this analysis it refers to "none", "pre-primary", "primary", "secondary", "university" and "other".
- The analysis uses a cohort-based estimation of future earnings. This is similar to the approach used by Wei (2008). However, for each age cohort with similar educational attainment it is assumed that there is a moving average age and lifetime incomes are derived by current labour market incomes and current labour incomes of older age groups plus a uniform real income growth rate of 5.9 per cent which is the annual average growth rate in the weekly earning index for the period 1996 to 2009, all calculated to present value incomes.

- Unlike the Jorgensen-Fraumeni model which tries to determine the likelihood of an individual enrolling in an additional year of education, the current model for this analysis assumes that the current educational attainment remains constant.

The lifetime labour income for a representative worker becomes:

$$PLI_{age}^{edu} = EMPR_{age}^{edu} \bullet W_{age}^{edu} + \sum_{t=1} \{ EMPR_{age+t}^{edu} \bullet SR_{age+t} \bullet W_{age+1}^{edu} \left\{ (1+r)/(1+\delta) \right\}^{t+1} \}$$

where:

PLI_{age}^{edu}	Present value of lifetime labour income for a representative individual with educational attainment level edu (none, pre-primary, primary, secondary, university and other) and age (17–60).
$EMPR_{age}^{edu}$	Employment rate by age and educational attainment level
W_{age}^{edu}	Annual market wage rate
SR_{age+t}	Survival rate age + t
r = 5.9%	Annual growth rate in wages[35]
δ = 8.75%	Annual discount rate[36]

Therefore, the stock of human capital, HK, becomes:

$$HK = \sum_{age} \sum_{edu} PLI_{age}^{edu} \bullet \left\{ WPOPLN_{age}^{edu} \cdot PLM_{age}^{edu} \right\}$$

[35] 5.9 per cent, which is the average annual increase in the weekly earnings index from 1996 to 2009.
[36] Discount rate: 8.75 per cent, which is the average government borrowing cost on bonds from 1991–2009

where:

$WPOPLN_{age}^{edu}$	Working age population in labour force
PLM_{age}^{edu}	Probability of participating in the labour market at a given age and educational attainment level

How are the HC estimates calculated?

Given disaggregated household data on educational attainment and earnings for each age group (15–29, 30–39, 40–49 and 50–59), the model calculates an expected income for individuals in each age group and educational attainment for 2008. As mentioned previously, the focus is only on working-age population, which in T&T is 15–60 year olds since the retirement age is 60. The estimates of expected income in 2008 for each age group and educational attainment level (shown in Table 55) are adjusted for each year in the future assuming that incomes grow by 5.9% per annum given the assumptions above.

Table 5.5 Market labour income in year t=0 (2008) by age group and educational attainment

	None	Pre-school	Primary	Secondary	University	Other
15–29	32,851	21,026	28,436	31,464	53,992	47,874
30–39	13,624	60,188	36,669	49,791	116,844	72,118
40–49	26,784	29,125	36,240	52,462	141,917	90,264
50–59	25,702	27,823	34,281	52,396	148,068	79,384

Estimates of the working population for each age group are calculated using 2008/2009 data on working-age population and labour force participation rates. These figures are adjusted to get population forecasts into the future using average mortality rates as survival rates. Given the data, those individuals aged 15–44 have a 0.998 chance of surviving to the next year and from age 45–60 the survival rate decreases slightly to 0.990. Therefore, the population estimates are only for those participating in the labour force and of working age and assumed to be still alive based on average survival rates. Thus, for example, as individuals get older their probability of participating in the labour market changes. Therefore, for 15–19 year olds the labour force participation rates are low at first and then increases as these individuals get

older (the appendix shows these estimates for each age cohort). The years of calculation are 2008–2051. The model uses age groups and not individual ages so a reference median year for each age group is used to help calculate the population numbers. Thus, for example, for 15–19 year olds the median age is 17 so it is assumed on average the working population for this age group are aged 17 and will retire at age 60, which is in year 2051.

The population estimates are then multiplied by the appropriate year of expected earnings, given age and qualifications. These estimates are then discounted to get the final expected incomes over their lifetime.

Human capital estimates are now provided for 2008. The estimated per capita human capital of T&T is TT$433,754 or US$68,850. Total human capital of the working age population is TT$567.6 billion or US$90.1 billion. This compares to GNI of TT$157.7 billion (US$25 billion) in 2008.[37] The following table shows the human capital estimates broken down by age group and educational attainment. Over half of human capital is within the youngest three age groups since, as to be expected, they have the most amount of working years ahead of them. The majority of human capital, 62 per cent, is within secondary school attainment level and 11 per cent is of primary school attainment, while 19 per cent is university. Although this may suggest that the population is relatively unskilled, this is a marked improvement from the oldest age cohorts (50–54 and 55–59), where only 37 per cent of human capital is of secondary attainment and 35 per cent is of primary school educational attainment. However, while it would seem that progress has been made in improving the educational attainment levels of human capital through the generations, the percentage of university level human capital has been stagnant at around 19 per cent of total human capital across all age groups.

[37] Source: Central Statistical Office.

Table 5.6 2008 human capital by age group and educational attainment (TT$ billion)

	None	Pre-school	Primary	Secondary	University	Other	Total
15–19	0.1	0.1	5.2	58.6	16.4	7.4	87.7
20–24	0.1	0.1	6.3	72.5	20.7	9.2	108.9
25–29	0.1	0.1	5.9	69.2	20.4	8.8	104.4
30–34	0.1	0.1	7.4	49.3	14.7	6.9	78.4
35–39	0.1	0	6.2	42.5	13.1	6.1	68.1
40–44	0.1	0.1	10.2	26.5	8.8	4.3	50.1
45–49	0.1	0.1	8	21.1	7.1	3.3	39.8
50–54	0.1	0.1	8	8.4	4.5	1.7	22.8
55–59	0	0	2.6	2.7	1.4	0.5	7.3
Total HC	**0.8**	**0.7**	**59.8**	**350.8**	**107.1**	**48.2**	**567.6**
Percentage of Total	**0%**	**0%**	**11%**	**62%**	**19%**	**8%**	**100%**

Further analysis of the distribution of human capital by income group of head of household[38] suggests an uneven distribution in human capital. Most income groups have per capita human capital levels above the national average (TT$433,754). However, the lowest two income groups (by head of household) have on average about 60 per cent of the national average.

Given the earlier discussion on the virtuous circle described by Birdsall (2001), how does the rate of return on education compare across different income groups? The virtuous circle theory suggests that the poor need to invest and education must not be considered a consumption good. Government must also ensure that the marginal product of labour is not falling. The debilitating effects of rent seeking and Dutch disease type effects must also be limited. An estimate of the returns on human capital measured as household income from employment (since this aspect of employment is closely linked to human capital) divided by per capita human capital shows that households on incomes of less than TT$13,000 per month have less than the simple national average of 14 per cent rate of return. However, these figures show some significant disparities; with the four highest income groups (representing 1.7 per cent of households) having returns on human capital of about 28 per cent on average. The two lowest income groups, by contrast, have on average less than 60 per cent of the national average of human capital and an average rate of return of just 1 per cent. This suggests that, although some income groups have significant human capital, the

[38] The population distribution by income groups of head of household is used since the human capital refers primarily to working age population and those in employment.

quality of the human capital, or the ability of the individuals within the income groups to transform their human capital into income and wealth via the labour market, is uneven. This suggests that uneven distribution in other forms of wealth and the quality of the education and educational attainment of lower income groups needs to be examined in greater detail. The structure of the economy might also be affecting these outcomes, a topic discussed and analysed in the next chapter.

The rate of return on human capital estimated in table 5.7, should be taken as indicative since it only refers to income from employment and does not account for other incomes such as property income. However, there are low rates of return associated with human capital at low income groups

Table 5.7 Distribution and rate of return of human capital

Income group of head TT$ per month	Average Household Income from employment per annum TT$	TT$ Human capital per capita	Rate of return on human capital
Less than 1,000	116	272,888	0%
1,000–2,999	6,494	235,697	3%
3,000–4,999	18,985	448,601	4%
5,000–6,999	33,128	583,665	6%
7,000– 8,999	49,398	736,919	7%
9,000–10,999	66,190	753,813	9%
11,000–12,999	81,287	677,492	12%
13,000–14,999	98,980	700,854	14%
15,000–16,999	120,604	927,906	13%
17,000–18,999	128,050	970,603	13%
19,000–20,999	150,000	572,637	26%
21,000–22,999	162,602	616,021	26%
23,000–24,999	174,815	548,627	32%
25,000 and Over	255,152	899,668	28%

5.5 Discussion and conclusions

The trends in educational expenditure and human capital have been assessed in this chapter. In real terms over the period 2000 to 2008, government current account education expenditure has almost doubled and capital expenditure on education has more than tripled. Over the same period, there were large real increases in expenditure on pre-primary/primary education (19 per cent) and on secondary (51 per cent). However, the largest real term increase was on tertiary level education (133 per cent). Over the period there seems to have been a concerted effort by the government to

transform additional revenues from the oil and gas sector into human capital via its expenditure on education, particularly on tertiary education.

To examine the possible outcome from the additional expenditure on education, two estimates of human capital have been assessed using two approaches. The first approach is a simple Mincerian method outlined in Klenow and Rodriguez-Clare (1997) and Klenow and Rodriguez-Clare (2005) which assesses human capital for the years 2000 and 2008 using average educational attainment, population and labour force data and a rental price of human capital. The second uses an adapted version of the Jorgensen-Fraumeni lifetime income approach to mainly assess the distribution of human capital among household income groups in 2008.

The simple Mincerian method estimates that human capital increased by about 85 per cent during the period 2000 and 2008 in current values. Much of the increase was a result of the rise in years of education and the increase in population. In current values, the rise in the rental price of human capital (compensation of employees) rose by 43 per cent.[39] However, if the rental value is converted to constant 2000 prices, the rental price falls by 15 per cent and human capital in constant values increases by only 4 per cent over the period despite the rise in schooling years. In constant terms, the rental value or shadow price of human capital decreased significantly over the period resulting in a less than expected rise in human capital. If these numbers are credible, then transforming natural capital into human capital requires not only heavy investment in education but also simultaneous policies that improve educational quality and protection against wage erosion from inflation.

The second approach at estimating human capital using the Jorgensen-Fraumeni lifetime income approach was conducted for 2008, and assesses the distribution of human capital among household income groups. Only one year of analysis is possible due to the data intensity of this method and the availability of this data for T&T. This approach gives an estimate in 2008 of human capital (USD92.2 billion) that is approximately 3.8 times the estimate of the simple Mincerian approach (USD23 billion). It should be noted that the Mincerian approach was used to give an indication

[39] 2008 is an estimate based on trends in compensation of employees from 2000–2006

of the trend in human capital since it requires less data than the Jorgensen-Fraumeni lifetime income approach.

The Jorgensen-Fraumeni lifetime income approach estimates for 2008 show that most of the human capital embedded in the T&T population is comprised of secondary school level education (62 per cent) and most human capital (80 per cent) resides within the 15–39 age group. Tertiary level human capital accounts for only 19 per cent of total human capital. However, most of this university education resides with the younger age groups. Human capital of individuals with only primary school education accounts for about 4 per cent of the total, but most of this resides with older individuals. The results for 2008 which show human capital estimates by age groups for that year suggest that the level of human capital is improving from older age groups to younger age groups, suggesting that educational attainment and labour market outcomes may be improving with each generation.

Although estimating the distribution of human capital for only one year does not allow for the analysis of distributional trends over a period of time, the human capital distribution for 2008 still gives a worrying outcome. Lower-income households have considerably less human capital than the richest households in T&T. However, an estimate of the rate of return associated with human capital using income from employment (the source of income most closely related with human capital accumulation) shows that the rates of return diverge remarkably from higher-income households to lower-income households. The average rate of return for the three lowest income groups was about 2 per cent, while the rate of return for the three highest income groups was about 29 per cent. The median rate of return was about 13 per cent for all households. Lower-income households seem to have two problems, the first being an inability to accumulate sufficient quality human capital and the second being to make human capital pay or provide a meaningful return.

The two approaches used to estimate human capital provide diverging outcomes. The Jorgensen-Fraumeni approach provides an estimate of human capital in 2008 that is about four times (3.8) higher than the estimate provided by the simple Mincerian approach for the same year. The Jorgensen-Fraumeni approach uses more detailed survey-based data to produce an estimate of human capital, while the simple

Mincerian approach uses average international and national estimates, particularly on rates of return and rental values respectively. For this reason, the Jorgensen-Fraumeni approach should provide a more accurate description of human capital in T&T. It is possible that if the simple Mincerian approach used actual weighted rental values and actual weighted interest rates for T&T then the estimate of human capital could be higher and closer to the estimate provided by the Jorgensen-Fraumeni approach. However, for the purpose of this chapter, the levels of human capital determined by the simple Mincerian is not important but rather the trends. If, as mentioned previously, human capital has only risen by 4 per cent in real terms then it is possible that human capital distribution might not have changed drastically over this period.

Due to the methodological adjustments required to gain the human capital estimates, comparison of the results from other countries might not be entirely feasible. However, it is worth noting Greaker and Liu (2008) have also produced human capital estimates for Norway for one year. They produced an estimate for 2006 using the lifetime labour income approach in order to provide an indication of how statistics available at Statistics Norway could be used to estimate human capital. Similarly, Li, Fraumeni, Liu and Wang (2009) have also produced estimates of human capital for China for the years 1985 – 2007 also using the lifetime labour income approach. Wei (2009) has also used an adjusted lifetime labour income approach to estimate human capital for Australia.

The following table gives an indication of the level of per capita human capital estimates for different countries including those estimated for Trinidad and Tobago. As to be expected the estimate of human capital for Trinidad and Tobago is lower than that for Australia and Norway but more than China's. The estimates of human capital for Trinidad and Tobago using the adjusted lifetime labour income approach seem reasonable given the estimates for other countries and the comparison of per capital GNI figures. It should be noted that the estimates provided in table 5.8 are for different years and the data used for each estimate are not exactly the same. However, the estimates for Trinidad and Tobago seem reasonable and would be within in the range of what would be expected for a country of its income level. There are improvements that could be made regarding these estimates and these are discussed below. However, future research should focus on constructing annual

human capital accounts to compare these with annual accounts of fixed assets accumulation.

Table 5.8 Comparison of human capital estimates

Country	Per capita US$	GNI per capita US$	Year of estimate
Australia	263,318	19,719	2001
China	13,990	2,711	2007
Norway	513,048	72,176	2006
Trinidad and Tobago	68,850	18,839	2008

The results of this chapter also suggest that the negative effects of resource abundance have 'broken' the virtuous circle of equitable growth for Trinidad and Tobago. Although, there has been significant expenditure on education by the government, lower income households do not seem to benefit significantly from their human capital accumulation, indicating that the quality might not be high and that there might be a concentration of rent among high income groups (this is examined in greater detail in chapter six). It is also possible that Dutch disease effects are having a negative impact on export driven labour intensive growth, with subsequent impacts on human capital returns for the poorest in society.

A prerequisite for sustainable development among natural resource-exploiting economies is to transform the wealth from natural resources into alternative forms of capital such as human capital to ensure that the level of total capital is rising or remains constant. This analysis has shown that simply increasing expenditure on education does not translate into an immediate and like-for-like increase in human capital. The quality of education attained is also important. Improving the return on education is also important for the incentive to accumulate human capital. Therefore, access to the labour market and the protection of real wages from inflation are also important policy considerations. Therefore, policies that target human capital development amongst lower-income households might also be an important policy implication since the distributional analysis has also shown that lower human capital accumulation and lower rates of return for poorer households are a particularly

worrying problem for T&T. The analysis raises further research questions that may be explored in the future such as:

1. Examine the possibility of constructing a simple human capital model for resource-dependent economies and explore the linkages with the expenditure of natural resource rents on education.

2. Explore the importance of the quality of education and the protection of real wages on human capital accumulation.

3. Identify the number of human capital asset poor households and the level of human capital accumulation required to reduce the disparity in asset and capital wealth among different households.

4. Determine a human capital poverty threshold, which may be a percentage of the median or average human capital.[40] A similar measure for human capital may be required for resource dependent countries like T&T where disparities across income groups affect human capital accumulation and income levels directly. There should then be appropriate policies formulated to raise all households to or above this threshold.

5. Explore the theoretical construction of a model with more equal human capital distribution and how this might be related to sustainable development.

6. Examine the returns on human capital for the poorest within the context of the virtuous circle hypothesis and whether rent seeking and Dutch disease impacts need to be mitigated to encourage investment and not consumption in human capital to help drive equitable export driven growth led development.

7. Furthermore accounting for education expenditure alone in genuine saving calculations might say very little about sustainable growth. More detailed

[40] This would be similar to the official income poverty thresholds used in Europe, which is currently 60 per cent of median income.

measures of human capital and its return especially for the poor might be a better indicator for sustainability.

Annex 5.1 Working population estimates (at current age in 2008 to retirement age of 60)

Current Age	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59
2008	23,438	84,760	93,215	75,422	74,686	71,644	72,872	62,569	38,322
2009	23,392	84,591	93,029	75,271	74,536	71,500	72,151	61,950	37,942
2010	23,345	84,422	92,843	75,120	74,387	71,357	71,437	61,337	37,567
2011	72,288	94,912	93,113	75,072	73,460	68,031	64,554	54,125	37,195
2012	72,144	94,722	92,927	74,922	73,313	67,357	63,915	53,589	
2013	71,999	94,532	92,741	74,772	73,166	66,690	63,282	53,059	
2014	71,855	94,343	92,555	74,623	73,020	66,030	62,656	52,534	
2015	71,712	94,154	92,370	74,474	72,874	65,376	62,036	52,014	
2016	80,622	94,429	92,311	73,545	69,476	59,078	54,742	51,499	
2017	80,461	94,240	92,127	73,398	68,788	58,493	54,200		
2018	80,300	94,051	91,942	73,251	68,107	57,914	53,664		
2019	80,139	93,863	91,759	73,105	67,433	57,340	53,132		
2020	79,979	93,676	91,575	72,959	66,766	56,773	52,606		
2021	80,212	93,616	90,433	69,557	60,333	50,098	52,085		
2022	80,052	93,429	90,252	68,869	59,736	49,602			
2023	79,892	93,242	90,072	68,187	59,145	49,111			
2024	79,732	93,055	89,892	67,512	58,559	48,625			
2025	79,572	92,869	89,712	66,843	57,979	48,143			
2026	79,522	91,711	85,530	60,403	51,163	47,667			
2027	79,362	91,528	84,683	59,805	50,656				
2028	79,204	91,345	83,844	59,213	50,155				
2029	79,045	91,162	83,014	58,627	49,658				
2030	78,887	90,980	82,193	58,047	49,167				
2031	77,904	86,738	74,274	51,222	48,680				
2032	77,748	85,879	73,539	50,715					
2033	77,592	85,029	72,811	50,213					
2034	77,437	84,187	72,090	49,716					
2035	77,282	83,354	71,376	49,224					
2036	73,679	75,323	62,984	48,736					
2037	72,950	74,578	62,361						
2038	72,228	73,839	61,743						
2039	71,513	73,108	61,132						
2040	70,805	72,385	60,527						
2041	63,983	63,874	59,928						
2042	63,350	63,242							
2043	62,723	62,616							
2044	62,102	61,996							
2045	61,487	61,382							
2046	54,258	60,775							
2047	53,721								
2048	53,189								
2049	52,662								
2050	52,141								
2051	51,625								

Chapter Six: Economic structure and the distribution of natural resource rents

6.0 Introduction

Disparities in the apparent rate of return on human capital between low-income, middle-income and higher-income households seem to suggest that there are discrepancies in the quality and level of human capital accumulated at different household income groups. However, the literature review on the relationship between growth and inequality also suggests that disparities in household wealth (other than human capital) may also have a negative impact on labour market outcomes and national growth rates.

During the early development phases of countries, there is an expectation for some increase in inequality. Early work by Kuznets (1955) confirmed that there was a relationship between inequality and rising per capita income. Kuznets found that there was an inverted U-shape relationship which suggested that inequality at first increases with rising per capita income but then declines at higher income levels. The usual explanation is that inequality results from the workforce moving away from agriculture, which tends to provide relatively egalitarian income outcomes and into other sectors which are characterised by far greater income variations. However, as countries get richer there is an apparent narrowing of income differences as workforce productivity between sectors converges, property income as a share of household income declines. Governments also aim for full employment and provide greater social security.

Although some research has since confirmed the existence of the Kuznets curve such as Adelman and Morris (1973) and Williamson (1965) there have been others that have rejected the results. Auty and Kiiski (2001) identified that cross sectional data for some countries used by Williamson and Adelman and Morris rather than time-series data may have been the reason for the confirmation of the Kuznets curve. Thus studies that have used inter-temporal data such as Fields (1989) and Bowman (1997) and others that have used cross sectional data such as Anand and Kanbur (1993) and

Deininger and Squire (1996) have rejected the Kuznets curve hypothesis. The research by Fields shows that income inequality is just as likely to increase as it is to decrease. However, Fields confirms that income inequality is associated with natural resource abundance. Auty and Kiiski (2001) also suggest that Fields' conclusions confirm the Kuznets-curve among resource abundant countries since at the time of its construction, mid-income countries were dominated by Latin America which was a resource abundant region with high income inequality.

There is therefore an acknowledged presence of income inequality within resource abundant countries. Auty (1997) sees the persistence of income inequality in resource rich countries when compared to resource-poor countries since there is no early redistribution of land or the rapid elimination of surplus labour as labour intensive manufacturing expands. In resource-poor countries this leads to rapid accumulation of human capital, which eventually narrows the wage premium of skilled labour, Londono (1996). In resource abundant countries, there is a lag in land reform and later urbanisation maintains surplus labour longer and reduces the incentive for skill accumulation. Resource abundant countries also follow a more capital intensive industrialisation trajectory which leads to higher income inequality. A World Bank report of 1993 shows that resources abundant Southeast Asian countries skipped the labour intensive manufacturing phase of development, which helped to reduce income inequality in less resource dependent Southeast Asian countries.

However the work by Seers (republished in 2005) drawing upon his research in Venezuela until 1958, found that higher wages in the petroleum sector drives the demand for higher wages in the rest of the economy although productivity in these higher sectors may not be as high as in the petroleum sector. So it is likely that in petroleum economies like Trinidad and Tobago, unemployment will be found side by side with high wages. Seers found that changes in employment depend on trends in exports but also equally trends in wage rates; 'the pace at which employment grows depends in fact on the difference between the trends in exports and wage rates', Seers (2005). Thus there is a 'wages fund' financed primarily from export revenues and the level of employment depends on the level of wages and salaries with the higher the average wage rate the smaller the number employed primarily by the government.

For Seers, the mechanism of the open petroleum economy comprises of foreign owned companies exploiting domestic resources. These companies, because they feel politically vulnerable pay high wages when they are demanded. Higher wages in the petroleum sector causes envy in other sectors and this leads to higher wage demands which are met by the government and other sectors. So that increased revenue from the export sector is absorbed by higher wages of those already in employment rather than by increase in employment. Disguised unemployment is revealed as rural workers are attracted to urban areas in search for work. Wages in the country become high by international standards, making imports fairly cheap; increasing the propensity to consume imports and at the same time eroding competitive advantages. Inequality tends to increase as only part of the population benefits from petroleum booms. The pattern of consumption weighs heavily in favour of imports even for items that could easily be produced locally. More over, developing new exports becomes increasingly difficult as costs rise.

During the late 1990s there was a resurgence of interest in the relationship between growth, equity and inequality. The literature at the time pointed to the negative impact that inequality could have on growth and the persistence of poverty traps. Even the multilateral institutions such as the Inter American Development Bank and the World Bank began to focus on polices that could foster growth and equity at the same time (see, for example, Birdsall (1997) and Solimano, Aninat & Birdsall (1999). This concern has since led to the establishment of national poverty reduction strategies promoted by the World Bank.

Imperfections within the insurance and capital markets mean that the poor are very susceptible to risk and volatility. Safety nets could therefore play an important role to help prevent irreversible losses in times of crises. A minimum level of ownership of assets could also provide self-insurance against idiosyncratic risk.

While human capital is a growth enhancing asset, the negative interaction between education and asset ownership "also suggest[s] that educational expansion alone may not be sufficient to achieve the social transformation needed as a basis for sustainable development" (Deininger and Olinto, 2000). Therefore, along with education enhancement, policy makers must also focus on innovative programs that target the

acquisition of productive assets that provide investment incentives and encourage the poor to utilise their labour in a more productive way. The authors suggest that more research is required on the feasibility of such programs and their scope to replace recurrent transfers may be desirable.

As mentioned previously, the analysis by Birdsall and Londono (1997) of asset inequality in Latin America suggests that the effect of income inequality on growth reflects differences in a fundamental element of economic structure – the access of different groups to productive assets. Birdsall and Londono's analysis, including regressions of the factors affecting growth, have shown that asset inequality effects on growth tend to dominate income inequality effects and that the effects of education distribution tend to persist even when other traditional variables affecting growth are included. Furthermore, in natural resource intensive countries, where growth has lagged, natural resource intensity is positively correlated with land inequality. Deininger and Olinto (2000) have also suggested, where the link between growth and inequality has been confirmed, the policy implications arising out of the link between growth and inequality will differ depending on whether inequality of income or inequality of assets is the underlying factor. Thus for Deininger and Olinto (2000), if inequality of assets is the underlying factor, policies should focus on ex-ante equality of opportunity, such as incentives for the creation of new physical and human capital assets, definition, protection and enforcement of property rights to assets held by the poor, and one-time measures of redistribution. By contrast, they suggest that if income inequality is to be blamed, then more direct redistribution of current income or consumption might be appropriate.

Income inequality seems to be a perennial problem of resource abundant countries, although the exact mechanism that causes it is still in some dispute. However, unequal distribution of assets and of income could have negative consequences for sustainable development. Governmental efforts, therefore, at using resource rents for investing and saving for sustainable development should also be mindful of how the benefits of these investments are distributed if there is to be meaningful sustainable development. This chapter therefore attempts to examine the distribution and how the structure of the economy may be leading to the maldistribution of rents from the natural resource sectors (oil and gas) via payments to central government in the form of taxes and

backward and forward linkages within the local economy. I will also examine how the disbursements of rents from central government to business and households are distributed and suggest scenarios to improve these outcomes. The previous chapter has shown that human capital and the return on human capital is unevenly distributed Earlier research on resource abundant countries showed these countries experience higher income inequality than their resource-poor counterparts for a number reasons including political economy and the 'leapfrogging' of the labour intensive manufacturing phase of development. However, it is not entirely clear if income inequality is a symptom some of the ills that affect resource abundant countries or if income inequality is actually a major reason for some the negative political economy consequences of resource abundance. This is a valid question since although Trinidad and Tobago's has achieved increases in per capita income, significant income inequality and poverty still exists and much of the political economy considerations that are expected with resource abundant countries still exist. Although inequality in Trinidad and Tobago persists measured by the Gini coefficient of 40.3 in 2007[41], it is unclear what the level of uneven distribution of resource rents are as the rents are passed through the economy. Is this 'rent pass through' symptomatic of human capital accumulation, and what does it actually mean for the distribution of revenues from the resource sector?

If Trinidad and Tobago is compared against other resource abundant countries, its level of income inequality is relatively not high. As mentioned above, Trinidad and Tobago's Gini coefficient was 40.3 this compares to 52.1 in Chile and 51.7 in Mexico for example. Table 6.1 shows a comparison of income inequality among selected resource abundant countries. The Gini index and quintile income ratio (ratio of income going to the first quintile and the last quintile) show that Trinidad and Tobago performs relatively well when compared to other countries. However, these measures alone do not tell us about the pass through mechanisms of resource rents and its actual utility to different income groups. The answer to income inequality may not only be about government transfers to the least well off but also require policies that tweaks the structure of the economy and encourages more domestic linkages

[41] Source: UNDP

Table 6.1: income distribution in selected resource abundant countries

Country*	Gini Index	Quintile income ratio
Angola	58.6	31
Argentina	45.8	12.3
Bolivia	57.3	21.8
Chile	52.1	3.6
Cote d'Ivoire	46.1	11
Ecuador	49	12.8
Ghana	42.8	9.3
Iran	38.3	7
Jamaica	45.5	9.8
Mexico	51.7	14.4
Nigeria	42.9	9.5
Norway	25.8	3.9
Peru	48	13.5
Russia	37.5	8.2
Trinidad and Tobago	40.3	8.3
Uzbekistan	36.7	6.2
Venezuela	43.5	8.9

Source: UN HDI

*Latest available year of data

Although the Gini coefficient provides some indication of the level of income inequality, the analysis of this chapter is an attempt to trace the actual usage of resource revenues from the petroleum sector, to the government and to households and to assess if structural changes to the economy are required or if some households' ability to capture rents needs to be augmented

The next section examines in greater detail how oil and natural gas revenues are distributed throughout the economy

6.1 Tracking the distribution of rents through the economy

The analyses of excessive depletion of oil and natural gas resources, distribution of the benefits of fuel subsidies, and the uneven distribution of quality human capital measured as returns on human capital suggest that the economic structure does not allow for greater equity in savings distribution. The analysis of the distribution of jobs and income group multipliers also points to structural inequalities within the economy. The analysis now focuses on tracing how rents from the oil and gas sectors are distributed to the various income groups.

To track how rents from the oil and gas sectors are distributed, the incomes of household income groups and the government sector from all industrial sectors, including the petroleum sectors, are modelled within the input-output framework introduced in chapter four. To do this, households and the government sector which are usually part of final demand and value added of input-output tables are endogenised within the input-output matrix, using Miyazawa's methodology first set out by Miyazawa (1976) and summarised in Hewings et al. (1999). The derivation set out in Miller and Blair (2009) is used to build the model.

The model consists of augmenting the year 2000 45x45 matrix of coefficients by adding government and disaggregated household sectors. The disaggregation of households uses the household budget survey (HBS) 2008 data on household income and consumption so the model makes the assumption that the structure of the economy remains constant from 2000 to 2008, an assumption confirmed by the Central Statistical Office of T&T to be valid in 2010.[42] Household income and consumption have been disaggregated into 14 household income groups based on the income groups provided in HBS 2008. The aggregated amount paid to households is taken as compensation of employees in 2000 and disaggregated among income groups using the employment multipliers for all forty-five industries and 14 income groups. Details of how output and employment multipliers have been calculated are provided in the Appendix. The general assumption is that 14 distinct household income groups are paid wages by producers from each of the 45 industrial sectors as compensation of

[42] Personal communication in April 2010 with Mr. Clifford Lewis Director of National Accounts at the Central Statistical Office, T&T.

employees. The total compensation of employees indicated in the national accounts for each of the forty-five sectors is therefore distributed among the fourteen income groups. Compensation of employees is usually considered to be exogenous to the main matrix of coefficients as a value added component, but here it is being endogenised within the model to assess distributional activity within the economy.

This therefore leads to the addition of a 14 x 45 matrix of wage earners or compensation of employees matrix:

$$\underset{14x45}{V} = \lfloor v_{gj} \rfloor$$

where v_{gj} is the income paid to wage earners in income bracket or household income group, g (g=1,……14) per dollar's worth of output of sector j (j=1,….45). Thus a single row of household input coefficients usually represented as compensation of employees is now generalised to 14 household income group rows.

Similarly, household final consumption expenditure is endogenised by generalising the column (total household final consumption) to 14 household income groups. Thus a 45x14 household consumption matrix is added:

$$\underset{45x14}{C} = \lfloor c_{jg} \rfloor$$

where c_{jg} is the amount of sector j's (j= 1,…..45) product consumed per dollar of income of households in income group g (g = 1,……14). Consumption is disaggregated into household income groups using consumption data from HBS 2008.

Similarly, government income as taxes and duties and government final consumption expenditure are endogenised to the model as 1x45 and 45x1 matrix respectively.[43]

[43] Although the general structure of the economy has not changed considerably, for the purpose of this analysis, I have updated the model to reflect the higher levels of income that the government received from the oil and gas sector in 2008. Since 2000, there have been three further LNG trains commissioned together with new tax policies which have increased government revenues from the oil and gas sector.

$$\underset{1x45}{GI} = \lfloor gi_j \rfloor$$

where gi_j is government income as taxes and duties from sector j (j=1…..45) and

$$\underset{45x1}{GC} = \lfloor gc_j \rfloor$$

where gc_j is government final consumption expenditure on goods from sector j (j=1,…….45)

By incorporating government coefficients into the household sector, thus adding a row and column to V and C respectively, the augmented partitioned matrix of coefficients becomes:

$$\bar{A} = \begin{bmatrix} \underset{45x45}{A} & \underset{45x15}{C} \\ \underset{15x45}{V} & \underset{15x15}{0} \end{bmatrix}$$

The Miyazawa system for extending the input-output formulation is derived as follows:

$$\begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} A & C \\ V & 0 \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} + \begin{bmatrix} f \\ g \end{bmatrix}$$

where X is a vector of output, Y is a vector of total income for 15 groups (14 income groups of households and 1 group for government), A is the matrix of direct input coefficients, V is the 15x45 matrix of value added for (14 income groups plus government) and C is a corresponding matrix of consumption coefficients, f is a vector of final demands without household consumption and for the purpose of this chapter without government consumption since the government sector has also been endogenised within the model and g is a vector of exogenous income for the 14 income groups and the government sector.

Solving the system according to Miyazawa leads to:

$$\begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} 1-A & -C \\ -V & 1 \end{bmatrix}^{-1} \begin{bmatrix} X \\ Y \end{bmatrix} + \begin{bmatrix} f \\ g \end{bmatrix}$$

and this is denoted as:

$$\begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} B(1+CKVB) & BCK \\ KVB & K \end{bmatrix} \begin{bmatrix} f \\ g \end{bmatrix}$$

where:

$B=(I-A)^1$ is the usual Leontief inverse matrix.

BC is a matrix of production-induced consumption.

VB is the matrix of endogenous income earned from production.

VBC is a matrix of endogenous income from production that is induced by expenditure.

$K=(I-VBC)^{-1}$ is a Keynesian multiplier matrix or the Miyazawa interrelational income multipliers. K represents the total increase of direct, indirect and induced impacts. This is the increase of direct and indirect impacts on the income of one income group as a result of the expenditure from an additional unit of income by another group (see Miller and Blair, 2009 and Trinh et al., 2008).

Miyazawa's methodology is used to calculate the inverse of $\bar{A}$ to get an inverse partitioned matrix. The elements of each of the matrices in the aggregate partitioned matrix provide useful interpretations, which describe how income and output are distributed throughout the economy. Using Miyazawa's notation, the inverse partitioned matrix is depicted as:

$$(I-\bar{A}) = \begin{bmatrix} B(I-CVB)^{-1} & BCK \\ {\scriptstyle 45x45} & {\scriptstyle 45x15} \\ KVB & K \\ {\scriptstyle 15x45} & {\scriptstyle 15x15} \end{bmatrix}$$

The interesting and additional insight provided by the Miyazawa inverse matrix is the interpretation of the elements in K, which becomes the 'interrelational income multiplier' matrix. $K= (I-L)^{-1}$ and L is described by Miyazawa as the matrix of 'inter-income group coefficients' so that the typical element of L shows, for example, the direct increase in the income of group 1 resulting from the expenditure of an additional unit of income by group 2. Thus the elements in matrix K indicates the total increase (direct, indirect and induced) income of one group that results from expenditure of an additional unit of income by another group (Miller and Blair, 2009).

Miyazawa further denotes that KVB is the 'multi-sector income multiplier' matrix,[44] which indicates the direct, indirect and induced incomes for each income group generated by the initial final demand.

Furthermore, from the above derivation, B of course is the usual (I-A) Leontief inverse matrix and BC is a matrix of production induced by consumption. Thus BCK is an amalgamation of the Keynesian multiplier matrix, K, described above, and the production-induced consumption of BC. Annex B provides further details of the Miyazawa partitioned matrix system.

6.2 Indicative results of the Miyazawa distributional outcomes

The results and their interpretation are now presented for T&T, mainly with respect to the output from the main natural resource sectors; oil and natural gas. The results of the KVB matrix, the 'multi-sector income' matrix gives the direct, indirect and induced income associated with an increase in final demand for the products of a particular sector.

Table 6.2 gives the total income distribution predicted by the model for output of TT$45.7 billion[45] in the oil and gas production sector for 2008. The output of TT$45.7 billion is the actual output of the sector for 2008 and is introduced to the model as a positive shock via a column vector. The entire Miyazawa matrix is

[44] Also referred to as the matrix multiplier of income formation.
[45] The output of the oil and gas production sector in 2008 is consistent with the actual output of the sector in 2008.

multiplied by the positive shock which then produces the incomes associated with this positive shock. The results show that for the oil and gas production sector, the total revenues generated for the government is about TT$17 billion.[46]

Table 6.2 Total income distribution from TT$45.7 billion in 2008 output from the oil and gas production sector

	Oil and Gas Production sector TT$ million
< 1,000	104
1000 – 2999	271
3000 – 4999	700
5000 – 6999	1,361
7000 – 8999	1,695
9000 – 10999	2,402
11000 – 12999	2,684
13000 – 14999	3,321
15000 – 16999	3,196
17000 – 18999	3,753
19000 – 20999	5,132
21000 – 22999	4,363
23000 – 24999	6,275
25000 and over	6,475
Government	17,043

However, the outcome throws up some surprising results, in particular the low levels of incomes received by lower income groups compared to that received by higher income group households. For example, from the TT$45.7 billion output from the oil and gas production sector, the richest income group receives in aggregate 62 times the income of the poorest households. For example, the 2008 output of TT$45.7 billion in the oil and gas production sector leads to an estimated compensation income of TT$104 million for the lowest income group and income of TT$6,500 million for the highest income group. Using the latest available population estimates and household distribution data from the HBS, it is estimated that the highest earning income households receive approximately 35 times more income per household than the lowest income households from the oil and gas production.

[46] Total petroleum sector output was TT$70 billion and government revenues from the sector was TT$34 billion.

Examining earnings in the K matrix ("interrelational income multiplier" matrix) gives an indication of how income is distributed throughout the economy when one income group spends an extra unit of income. Expenditures by each income group and the government are also introduced in to the model via a column vector matrix which multiples the Miyazawa matrix by indicative expenditures for each income group or the government sector. The model then produces the economy-wide outcomes associated with the indicative expenditures. Expenditures by the lowest income groups generate significant multiplier incomes for the government and higher income groups, while at the same time expenditures by the highest income groups generate very little income for lower income groups and proportionally less income for the government than that generated by additional expenditure from the lowest income groups. Interestingly, an additional unit of expenditure by the government generates fairly low income for lower income groups and considerably more income for higher income groups. Table 6.3 shows the "interrelational" income multipliers if each household income group and government spends an additional TT$100 million.

Table 6.3 "Interrelational" income multipliers (shows effects of additional expenditure of TT$100 million by each household income group and government)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Govt
A	104.5	4.4	2.5	3.0	1.9	1.3	1.2	0.7	0.6	0.4	0.2	0.2	0.1	0.4	0.6
B	11.2	111.0	6.4	7.5	4.8	3.3	3.0	1.8	1.6	1.1	0.6	0.5	0.2	1.0	1.6
C	26.1	25.7	115.1	17.9	11.3	7.9	7.3	4.4	3.8	2.6	1.5	1.3	0.5	2.6	4.2
D	50.2	49.6	29.0	134.4	21.8	15.2	13.9	8.4	7.2	4.9	2.9	2.5	1.0	4.9	8.0
E	55.5	55.0	32.3	38.5	124.4	17.1	15.7	9.5	8.2	5.6	3.3	2.8	1.1	5.6	10.1
F	77.2	76.7	45.0	53.7	34.1	123.9	21.9	13.3	11.4	7.8	4.5	3.9	1.6	7.8	14.2
G	82.8	82.6	48.5	57.9	36.8	25.7	123.6	14.3	12.2	8.4	4.9	4.2	1.7	8.4	16.2
H	103.4	102.8	60.3	72.2	45.9	32.2	29.6	117.9	15.3	10.6	6.1	5.3	2.1	10.6	19.5
I	73.2	73.4	43.4	52.3	33.4	23.5	21.6	13.2	111.2	7.9	4.5	3.9	1.5	7.8	15.6
J	87.9	88.3	52.1	62.7	40.1	28.2	26.0	15.8	13.5	109.4	5.4	4.7	1.9	9.3	17.5
K	118.2	118.4	69.8	84.0	53.5	37.6	34.6	21.0	17.9	12.5	107.2	6.3	2.5	12.4	24.3
L	106.9	106.8	63.0	75.8	48.5	34.1	31.3	19.1	16.3	11.3	6.5	105.7	2.2	11.1	18.6
M	177.3	176.7	104.0	125.0	79.8	56.0	51.6	31.3	26.8	18.5	10.8	9.4	103.7	18.6	36.1
N	169.1	169.5	99.7	120.0	76.8	54.1	49.9	30.3	25.9	18.0	10.5	9.0	3.6	117.9	30.6
Govt	339.3	355.1	207.3	247.8	153.7	106.2	96.5	58.0	49.6	34.2	19.5	17.5	6.3	32.9	142.1

Key: (Monthly Income TT$)
A: < 1,000

B: 1000 to 2999

C: 3000 to 4999

D: 5000 to 6999

E: 7000 to 8999

F: 9000 to 10999

G: 11000 to 12999

H: 13000 to 14999

I: 15000 to 16999

J: 17000 to 18999

K: 19000 to 20999

L: 21000 to 22999

M: 23000 to 24999

N: 25000 and over

Govt: Government

The results shown in Table 6.3 show the disparities in the "interrelational" multipliers. Column A of Table 6.3 shows the additional expenditure of TT$100 million by the lowest income group (those households with incomes less than TT$1,000 per month) generates income of TT$169.1 million for the highest income group and TT$339.3 million in income for the government. This expenditure also generates income of TT$104.5 million for the income group making the initial expenditure. Contrast this

with additional expenditure by the highest income group shown by column N in Table 6.3. TT$100 million in additional expenditure by the highest income group (those with monthly income in excess of TT$25,000 per month) generates TT$0.6 million in income for poorest households and only TT$32.9 million in income for the government. This additional expenditure by the richest households leads to multiplier income of TT$117.9 million for the highest income earners.

The beneficiaries of additional government expenditure (column labelled "Govt" in Table 6.3) are also skewed towards the richest households. TT$100 million in expenditure by the government generates only TT$0.6 million in income for the lowest-income households but TT$30.6 million for the highest-income households. Table 6.4 shows the outcomes if the government spends the TT$17,043 million additional income it earned from the oil and gas production sector's output in 2008. This generates income of TT$5,220 million for the highest-income households and additional income of TT$103 million for the lowest-income group households, and multiplied income of TT$24,219 million for the government. Thus the structure of the economy suggests that higher-income groups have a larger accumulation of higher quality assets such as human capital, greater access to resource rents and possibly the government which allow them to earn higher rates of returns and to collect a larger share of the direct income benefits from government expenditure.

Table 6.4 Estimate of the interrelational income effects, from government expenditure of TT$17,043 million in 2008

	Interrelational income effects from government expenditure
< 1,000	103
1000 -2999	276
3000 – 4999	710
5000 – 6999	1,368
7000 – 8999	1,716
9000 – 10999	2,425
11000 – 12999	2,769
13000 – 14999	3,326
15000 – 16999	2,661
17000 – 18999	2,985
19000 – 20999	4,139
21000 – 22999	3,178
23000 – 24999	6,149
25000 and over	5,220
Government	24,219

6.3 Discussion and conclusion

The Miyazawa approach used in this chapter to help account for the distribution of resource rents within the domestic economy assesses how government expenditure is distributed and how household incomes are impacted by the resource sector. The analysis examined the direct, indirect and induced domestic petroleum sector rents, and how it is distributed among household given the structure of the economy. The Miyazawa partioned matrix method provides policy makers with a less data intensive method that can easily assess the outcomes of policy and the impacts of economic production on the entire economy by incorporating the necessary factors of production given the current structure of the economy. The alternative approach would have been to construct a social accounting matrix (SAM) for Trinidad and Tobago, which is more data intensive and costly to construct.

Although a SAM, could have provided details of other impacts within the economy such as the relationship that the domestic economy has with the rest of the world and the distribution of savings and investment as well as the impacts of transfers and subsidies, the Miyazawa approach was sufficient for the analysis under consideration for this chapter. It is also possible that the Miyazawa model developed for this thesis could be expanded to include the rest of the World, transfers and subsidies and all of the interactions of welfare state and capital accounts to develop a fuller picture of the economy. The assumptions associated with leakages with the current model such as taxation, and imports could have been better analysed had these accounts been included in the Miyazawa model. This is an area for further research, to expand the Miyazawa model developed for T&T so it provides a fuller picture of the economy.

Another possible improvement to the model could have been the inclusion of welfare payments or transfers from government to the neediest in society. This account could give a fuller picture of the actual benefits that all household income groups receive from government and by extension the petroleum sector. Admittedly these are improvements that could be made to the model but which are areas for future research.

However, the above analysis still clearly shows that higher-income groups gain proportionally more direct and indirect income from additional expenditures by different social groups including government expenditure. The Miyazawa partitioned

matrix constructed for the analysis, suggests that lower-income households are at considerable disadvantage from the distribution of incomes and wealth within the economy. The sectoral direct, indirect and induced incomes generated by the oil and gas sectors are unfortunately regressive due to the structural and household linkages to the sectors.

Figure 6.1 below gives a graphical representation of the "interrelational income" associated with the constructed Miyazawa portioned matrix of the economy. The outcomes shown in Figure 6.1 are for the lowest and highest income groups and the government sector. The "interrelational" income multipliers for each of these income groups (including government) shows that additional income spent by lower-income groups delivers much higher multipliers, meaning that the entire economy and all income groups benefit substantially more from additional expenditure by lower-income households. Thus the "interrelational" income multipliers for households earning less than TT$1,000 per month, greater than TT$25,000 per month and government is 15.2, 2.1 and 2.5 respectively. Figure 6.1 shows that expenditure by lower-income groups leads to higher overall economy-wide income multipliers, which suggests that lower-income groups spend on items that have greater linkages within the economy and therefore generates more income for other groups within the economy. By contrast, expenditure by higher income groups seem to lead to greater leakages, do not have significant linkages to other parts of the economy and therefore do not lead to substantial benefits for other income groups.[47] This is also true for government expenditure, which benefits higher-income groups more than lower-income groups, which in turn leads to greater leakages and therefore the multiplied effect is not as large as policy makers might hope.

These results are significant for a natural resource-based economy like T&T where the government collects most of the domestic revenues from the exploitation of natural resources. The model estimates that the government collected TT$17 billion in revenues in 2008 from the oil and natural gas production sectors. The government then disburses this revenue to the rest of the economy either directly via wages, transfers and subsidies or indirectly through capital investment including

[47] It has not been examined here, but richer households may spend additional income on imports and on savings, which constitute leakages from the domestic economy.

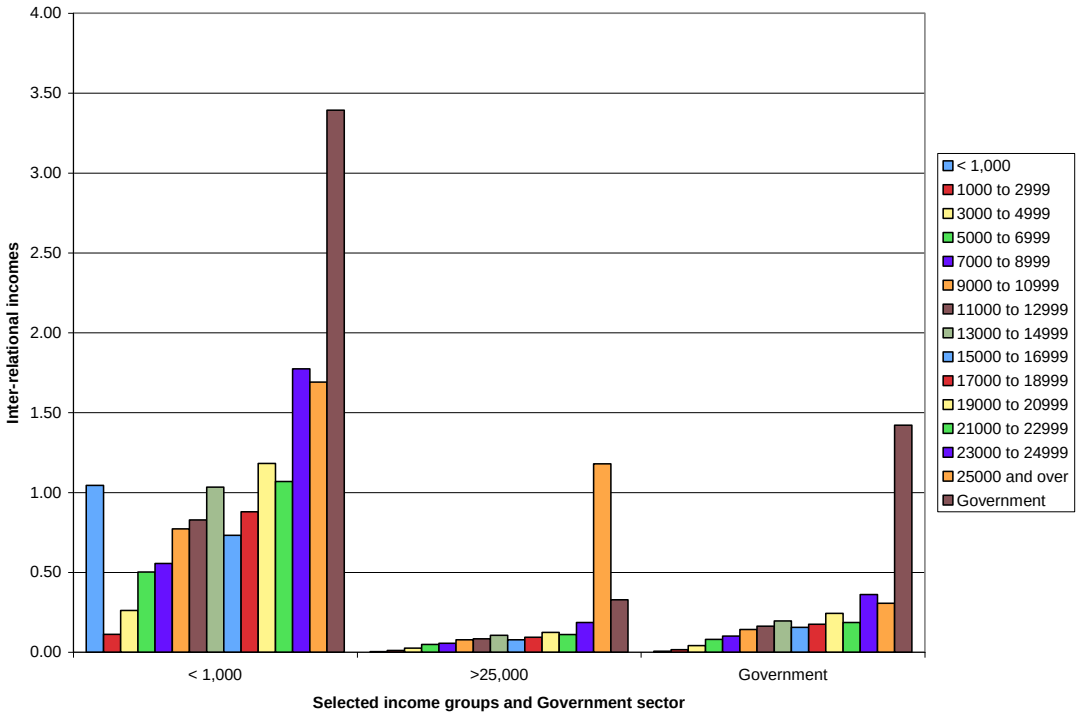
infrastructure and education, to name a few. However, the analysis shows that when the government spends an additional unit of revenue, the beneficiaries are predominantly the wealthier households in society. The current structure of the economy, the government's expenditure patterns and the negligible returns from the human capital accumulated by poorer households are likely to continue the regressive distributions revealed by this analysis. Therefore, if government is the largest re-distributor of rents from the natural resource sector, its current expenditure patterns are not going to have the desired impact of stimulating sustainable growth, income and savings that benefit a wider distribution of the population.

These results are similar to the conclusion drawn by Buccellato and Mickiewicz (2008) who found that in Russian regions that oil and gas have benefited the highest quintile of the population the most. Freije (2006) has also confirmed that wealthier households have benefitted more from the hydrocarbon resources in Venezuela. However, Berry (2006) assessments have found the results to vary for countries. Indonesia has been relatively successful in securing growth and equity. This was due primarily to good luck in the form of available new agricultural technology which improved productivity and created jobs and in good management which allowed for a stable macro economy and the investment of much of the oil rents in infrastructure rather than on consumption. Major devaluations of the currency also allowed Indonesia to move into a manufactured exports phase. This is in contrast to Nigeria where it seems that 'oil has impoverished' the society according to Berry (2006). In Nigeria, inequality has increased alongside no increase in per capita income meaning a significant rise in poverty. Nigeria's fate was sealed by the discouragement in agricultural production and manufacturing caused by the oil bonanza. A high degree of exchange rate appreciation would also have been a death knell for other industrial activities. Furthermore, industries chosen for favourable treatment in both Nigeria and Venezuela were bad choices and their management ineffective.

The example of Kuwait as analysed by El–Katiri et al. (2011) have also shown that an unequal outcome is not the only fate of an oil producing or resource abundant country. Significant government policies aimed at reducing inequality are also feasible in helping to spread the benefits of the hydrocarbon rents. These policies include generous social programmes and public employment. However, it is worth

noting that the policies undertaken by Kuwait might not be sustainable in other countries with less natural resource wealth per capita. However, the Kuwaiti system is not merely about adjusting existing income distribution but ensuring that all Kuwaitis benefit from the oil rents. This could sometimes lead to regressive subsidies for utilities but which overall has led to a relative egalitarian economic structure, El-Katiri et al. (2011).

Figure 6.1 "Interrelational" income distribution for selected income groups and government



The analysis of this chapter has shown that most of the rents from the oil and gas sector that are spent domestically are distributed towards higher-income groups. In addition to this, the structure of the economy means that government expenditure of rents benefits higher-income groups disproportionately more than lower-income groups. If the expenditure of rents is to improve intragenerational equity, then inevitably there needs to be a shift in what the rents are spent on and on whom.

However, there are additional research questions emanating from this analysis. Expenditure by lower income households lead to higher interrelational income multipliers, suggesting that their expenditures have greater linkages to the domestic

economy, thus benefiting the economy more as opposed to the expenditures by higher income groups and the government. The economic linkages associated with lower-income group expenditures needs to be examined so that the mechanisms of these linkages can be replicated throughout the economy to improve economic benefits associated with expenditures of rent from the natural resource sectors, all income groups and the government.

The analysis has also revealed that lower income groups derive relatively few benefits from the expenditures of higher income groups and the government. This suggests that the ability of lower income groups to capture income from the expenditure of other groups needs to be analysed. The inability of lower income groups to capture rents from the oil and gas sector may be related to their low accumulation of human capital and their inability to earn a significant rate of return on their human capital as shown in chapter 5.

Further research on extending this type of analysis to other resource abundant economies might also reveal some useful insights. Table 6.1 and earlier research has shown that generally income inequality is a problem for these types of economies. Theories of the rentier state and political economy have attempted to explain this phenomenon. However, in order to improve genuine saving rates in resource abundant countries, the pass through mechanisms of resource rents should also be examined further. The analysis of this chapter shows that in order to improve saving rates, policies that directly boost savings, such as investments in other forms of productive assets and structural reforms of the economy might also be needed that reduce leakages from the economy and foster greater linkages.

Conventional measures of sustainable development, such as genuine savings rates, suggest that T&T is on an unsustainable path, since the country is consuming and not saving enough of the proceeds from the exploitation of its natural resources. However, these measures tell us nothing about how the rents from natural resources are distributed. The results of the partitioned matrix show that the allocation of these rents throughout the economy may also have an impact on the level of savings and ultimately the possibility of attaining sustainable development. A significant proportion of the domestic rents from the oil and gas production sectors are collected

by wealthier households. The “interrelational” multipliers and matrix shows that when wealthy households spend additional income, the rest of the economy does not benefit considerably, suggesting that this expenditure leads to many leakages rather than domestic economic linkages. Further research is required to determine why there is an apparent weak linkage between the spend of higher-income households and the domestic economy and to ascertain if this is having a negative impact on genuine savings.

For the country to achieve sustainable development, the distribution of savings may be just as important as the level of savings. The analysis of the distribution of rents from the oil and gas sector directly and by the government shows that the allocation is fairly regressive. The lack of domestic economic linkages by expenditures of the wealthy with the rest of the economy, measured by the inter-relational matrix and the share volume of the rent accumulated by these household groups, suggests that distribution may also be a cause for the lack of adequate savings and investment within the economy. Measures of sustainable development should therefore not only be concerned with intergenerational equity but also with intragenerational equity, since ultimately the intragenerational distribution may play a pivotal role in the ability of the economy to save for the longer term.

Appendix 6A Structure of the economy and distribution of rents and opportunities

Type I multipliers and distributional profiles of jobs within the economy were constructed. The calculations involve using the 45 x 45 industry Leontief inverse matrix (L) as set out in Chapter 3 to construct estimators of output and employment effects and multipliers when an economic shock confronts the economy. These shocks may be malign or benign. However, for the purpose of this analysis, I am interested in positive shocks to the economy, which are examined to see how, for example, natural gas or petroleum output affects the economy and how these effects, including jobs, are distributed among different income groups. The educational outcomes in Chapter five may help explain, in part, the distribution of savings. However, the structure of the economy may also explain relative distribution outcomes. The model uses the L matrix to calculate the direct and indirect output effects to the economy. To calculate the output effects, the L matrix is multiplied by a column vector S to get the output effects from a shock or output effect to one sector in the economy.

Output Effect = L X S

where:

S – 45 x 1 shock column vector and

$(I - A)^{-1} = L$ or the Leontief inverse 45 x 45 matrix of coefficients.

Employment effects are then calculated by multiplying the output effects by estimates of output/employment ratios for each of the 45 industrial sectors.

The model then calculates total type I employment and output multipliers. Type I multipliers estimate the multiplied effect of the output or shock by dividing the total employment effects and total output effects by the direct employment effect and output effect respectively.[48]

[48] Total effects refer to direct and indirect effects.

The model then predicts the distribution of employment among different income groups using employment distribution among industry of household members 15 years old and over from the Household Budget Survey (HBS) 2008. Separate income group employment multipliers are also calculated within the model.

An example is now examined. Using actual industrial data for 2008, where it was estimated that the output from the oil and gas production sector was TT$45.7 billion, the model predicts that this led to an overall economy-wide output multiplier of 1.44 and overall economy-wide employment multiplier of 4.6. The 1.44 output multiplier means that TT$45.7 billion in output within the oil and gas industry leads to a total economy-wide increase of TT$65.7 billion and the employment multiplier of 4.6 means that for every direct job created in the oil and gas industry, 4.6 times jobs are created throughout the economy. Given the structure of the economy, this output produces about 22,000 direct jobs and total jobs of about 101,000 within the economy distributed among aggregate industries as shown in Table A6.1.

Table A6.1 Aggregate industrial sector jobs from $TT45.7 billion output from the oil and gas production industry in 2008

Industry	Jobs
Sugar	18
Other Agriculture	2,307
Petroleum and Gas	30,726
Other Mining and Quarrying	68
Other Manufacturing	41,888
Electricity and water	2,376
Construction	8,467
Wholesale and Retail	-
Transport Storage and communication	5,193
Financing Insurance Real Estate and Business Services	7,701
Community Social and Personal Services	2,446
Total	101,192

These jobs are then distributed among income groups based on the distributions from HBS 2008. Individual income group distributional employment multipliers are also calculated. The distribution of jobs among household groups is shown in Table 2. As expected, most of the direct jobs within the oil and gas industry are distributed among high- and middle-income households. Lower-income households benefit from indirect jobs, which lead to very high multipliers for these groups (since direct jobs are very low). However, those households with

incomes less than TT$5,000 per month (23 per cent of total population) gain about 16 per cent of total jobs, while the higher-income groups with incomes TT$23,000 and higher per month (6 per cent of total population) gain about 19 per cent of jobs.

Table A6.2 Employment distribution and multiplier distribution from TT$45.7 billion output from the oil and gas production sector in 2008

	Total Jobs	Direct Jobs	Multiplier	Job Distribution
All Groups	101,192	22,011	4.60	100%
< 1,000	4,338	88	49.3	4%
1000 - 2999	5,281	75	70.0	5%
3000 - 4999	6,360	239	26.6	6%
5000 - 6999	6,390	390	16.4	6%
7000 - 8999	6,077	779	7.8	6%
9000 - 10999	5,852	817	7.2	6%
11000 - 12999	5,154	1,018	5.0	5%
13000 - 14999	7,218	1,119	6.5	7%
15000 - 16999	6,874	2,916	2.4	7%
17000 - 18999	8,220	3,143	2.6	8%
19000 - 20999	9,592	3,645	2.6	9%
21000 - 22999	10,670	3,432	3.1	11%
23000 - 24999	9,302	1,571	5.9	9%
25000 and over	9,866	2,778	3.6	10%

Appendix 6B Miyazawa generalised Keynesian income multiplier in the form of interrelational income multipliers

The following explanation of the Miyazawa generalised Keynesian income multiplier in the form of interrelational income multipliers was provided by Sonis and Hewings (2000).

To recap, the Miyazawa matrix model has the following form:

$$\begin{pmatrix} X \\ Y \end{pmatrix} = \begin{pmatrix} A & C \\ V & 0 \end{pmatrix} \begin{pmatrix} X \\ Y \end{pmatrix} = \begin{pmatrix} f \\ g \end{pmatrix} \tag{1}$$

As usual, A is a matrix of direct input coefficients; X is gross output, f is the final demand, the vector Y represents total income, the matrix V is the value added ratios of households, vector g is exogenous income and the matrix C represents the consumption expenditures.

How does the Miyazawa matrix model work?

Miyazawa considered a 2x2 block matrix:

$$M = \begin{pmatrix} A & C \\ V & 0 \end{pmatrix} \tag{2}$$

This means that the Leontief inverse for the Miyazawa matrix (2) has the following form:

$$B(M) = (I - M)^{-1} =$$

$$= \begin{pmatrix} I & BC \\ 0 & I \end{pmatrix} \begin{pmatrix} I & 0 \\ 0 & K \end{pmatrix} \begin{pmatrix} B & 0 \\ VB & I \end{pmatrix} = \begin{pmatrix} B + BCKVB & BCK \\ KVB & K \end{pmatrix} = \begin{pmatrix} I & 0 \\ V & I \end{pmatrix} \begin{pmatrix} \Delta & 0 \\ 0 & I \end{pmatrix} \begin{pmatrix} I & C \\ 0 & I \end{pmatrix} = \begin{pmatrix} \Delta & \Delta C \\ VB & I + V\Delta C \end{pmatrix} \tag{3}$$

Where $B = (I-A)^{-1}$ is the Leontief inter-industrial inverse matrix, L= VBC is the matrix of inter-income groups coefficients, and:

$$K=(I-L)^{-1} = (I-VBC)^{-1} = I+V\,\Delta C \tag{4}$$

is the Miyazawa interrelational income multiplier or generalised Keynesian multiplier, and:

$$\Delta = (I-A-CV)^{-1} = B+BCKVB \quad (5)$$

is an enlarged Leontief inverse.

There are also Miyazawa fundamental equations of income from capital:

$$\begin{cases} V\Delta = KVB \\ \Delta C = BCK \end{cases} \quad (6)$$

Sonis and Hewings (2000) add that while there are some differences between the Miyazawa approach and the social accounting matrix approach as set out in Pyatt and Round (1985), such as the latter containing a more inclusive form of income such as non-wage and salary sources, the Miyazawa approach can still handle these differences. However, these differences are not relevant for this chapter.

Sonis and Hewings also note that Pyatt (1998) raised the distinction between factor income as in the Miyazawa model and institutional income as used in social accounting models. It is often not clear in the Miyazawa system what types of other income are included in g in equation (1) which is usually referred to as exogenous income. However, for this analysis I have endogenised compensation of employees and government income within the model.

Chapter Seven: Conclusion

The analyses contained in the previous chapters have indicated that T&T is on an unsustainable path, since it is consuming too much and not investing enough of the proceeds from the depletion of its non-renewable natural resources; oil and natural gas. The analyses of chapters four, five and six have also shown that proceeds channelled to the domestic population, either through fuel subsidies, education expenditure or general government expenditure have distributions that are regressive. Figures 1.3 and 1.4 of chapter one showed World Bank estimates of adjusted net savings rates for Trinidad and Tobago. These showed that ANS rates for T&T have consistently been negative. Why are these savings rates negative? How are savings distributed? Using the distributional estimates obtained in the previous chapters, this concluding chapter provides a partial distribution adjusted 2008 ANS rate for Trinidad and Tobago and overall conclusions drawn from the thesis. It is also apparent that simply trying to redistribute savings to bring about greater equality will not bring about the desired benefits unless political economy inertias or providing the correct incentives for individual investment in for example education are also addressed.

7.1 Partial Distributional adjusted ANS rate for Trinidad and Tobago

In chapter one it was shown that the ANS rate for T&T was negative 19 per cent of GNI in 2008 based on World Bank estimates, World Bank (2011). This was approximately US$4.4 billion or US$3,427 per capita[49].

Table 7.1 shows the composition of this estimate, which for the purpose of this analysis excludes pollution from particulate matter. This measure of ANS, consists of gross national savings, which comprises of public and private savings. Gross national

[49] Based on population estimates of the T&T household budget survey 2008/2009.

savings were about 42 per cent of GNI in 2008. Consumption of fixed capital is then added (subtracted if negative). This represents the depreciation of capital throughout the economy for that year, such as depreciation of buildings and infrastructure as well as the depreciation of private assets. For 2008, this was about 13 per cent of GNI. Next education expenditure is added. This represents investment in human capital for that year and was 4 per cent of GNI in 2008. Energy depletion is then subtracted (added if discoveries are more than the stock extracted). This is the extraction of non-renewable resources in Trinidad and Tobago for 2008. This shows the extent that extraction has reduced the stock of non-renewable wealth in 2008. This was approximately 51 per cent of GNI in 2008. Next an estimate of the CO_2 produced by the economy is subtracted. This is a proxy measure of the level of pollution produced throughout the year from economic activity. This was approximately 1 percent f GNI in 2008.

When all of these components are added together for 2008, the conventional measure of savings (gross national savings) of positive 42 per cent of GNI is transformed into negative 19 per cent of GNI using the ANS estimates. This composite measure gives a better indication of the sustainability of the economy and suggests that more positive savings/investment is required as per the Hartwick rule.

Table 7.1: Composition of 2008 ANS estimate for Trinidad and Tobago

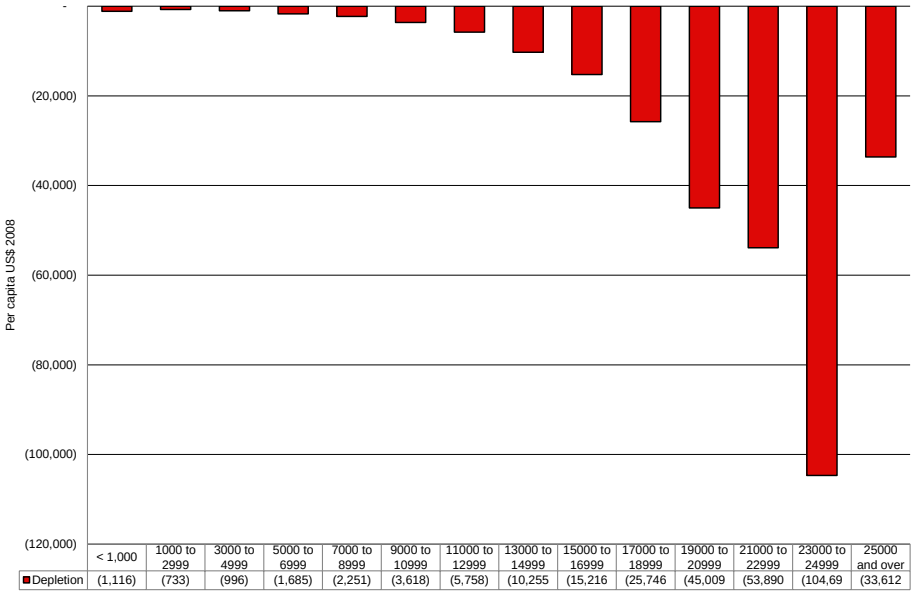
	US$ million	**Per cent of GNI**	**Per capita US$**
Gross National Savings	9,727	42%	7,540
Consumption of Fixed capital	(3,055)	-13%	(2,368)
Education Expenditure	932	4%	722
Energy Depletion	(11,753)	-51%	(9,111)
CO2	(272)	-1%	(211)
ANS	(4,421)	-19%	(3,427)

7.2 Estimating the Partial Distribution of Adjusted Net Savings (ANS)

To calculate an estimate of how adjusted net savings may be distributed for Trinidad and Tobago, the distributions that are most closely associated with each of the above components of ANS should be applied to the estimates in table 7.1. However, distributions for each of the components of ANS were not estimated in this thesis. Only the distribution of components where applicable distributions were estimated in the previous chapters are now presented; resource depletion and education expenditure.

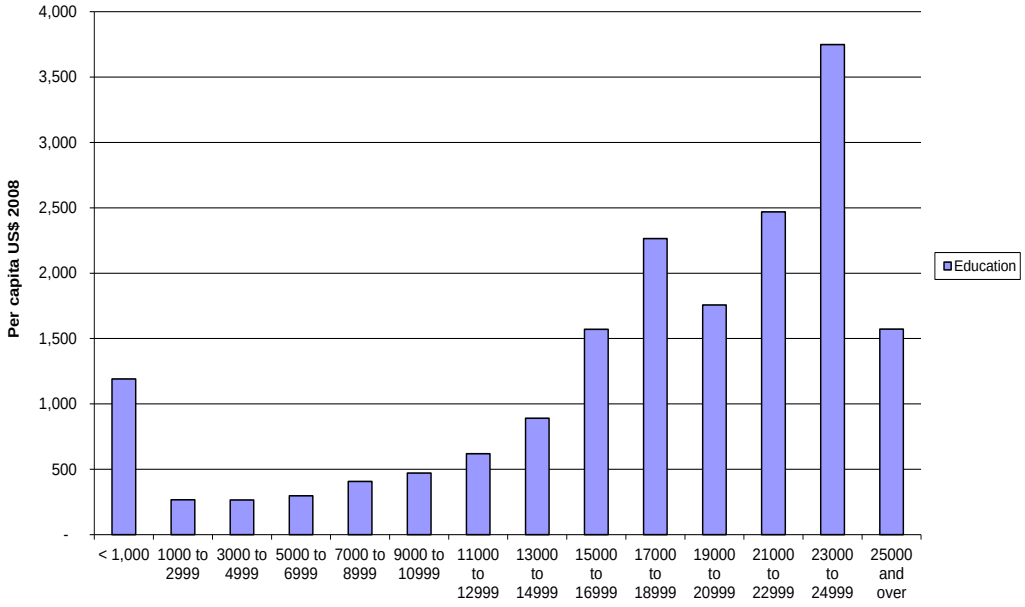
To estimate the distributions for depletion, the general distributions associated with government expenditure are combined with the direct distributions from the oil and gas industry to households as estimated in chapter six. Government distributions are important since the majority of the domestic rents from the petroleum sector are captured domestically by the government and then redistributed via its general expenditures. How these general expenditures are distributed determine how depletion and consumption of the rents are distributed between the different households. This analysis shows that wealthier household are benefitting more from the depletion of the country's hydrocarbon resources and so a greater proportion of the depletion can be attributed to their consumption patterns or ability to capture the rents associated with resource extraction.

Figure 7.1: Per capita Distributions of Depletion for Trinidad and Tobago (2008)



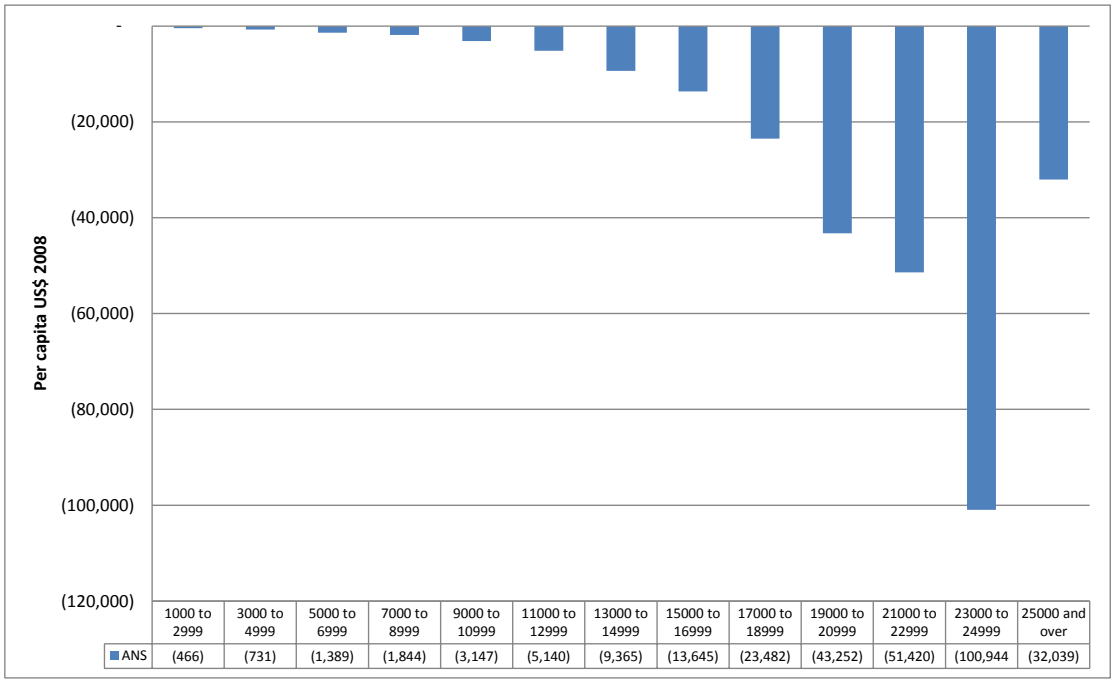
In the ANS calculations, expenditure on education is used as a proxy for investment in human capital. Although it is difficult to assess fully the distributional beneficiaries of education expenditure in 2008, for the purpose of this analysis it is assumed that the human capital distributions calculated for 2008 in chapter five are also the beneficiary distributions that will arise from the education expenditure in 2008. These distributions are in figure 7.2.

Figure 7.2: Per capita Education expenditure distribution (2008)



Combining the individual distributions for each of the components presented above, a partial distributional adjusted per capita ANS estimate for 2008 can be produced. This is shown in figure 7.3.

Figure 7.3: Per capita ANS distributions based on household income Groups (2008), (depletion and education only)



7.3 Conclusion

Figures 7.3 shows that all household income groups contribute negatively to the combination of depletion and education components of ANS. However, high income households contributed significantly more to negative ANS via their consumption patterns and entitlements or command of the domestic rents from the exploitation of the country's natural resources. Lower income and middle income group shares of negative savings were far less, mainly due to the fact that they do not command a large share of the proceeds from the oil and gas sector and therefore their consumption does not contribute significantly to depletion. Their relative investment in education has tended to mainly counter their share of depletion on a per capita basis.

This is only a partial assessment of the distribution of the ANS rate for Trinidad and Tobago and it only portrays part of the ANS distribution story. Further research on the relative distributions associated with savings, depreciation and pollution are necessary in order to get a clearer picture of how savings or comprehensive wealth are distributed.

However, these estimates suggest that not only is greater investment and savings necessary if T&T is to be placed on a sustainable path, but also how these investments and savings are distributed might also be important. The distributions also show that while growth may be important to improve the livelihoods of poorer households, their emulation of the consumption and saving patterns of richer households may not be the desired result.

In fact the structure of the economy, including the existence of monopolies may need to be dismantled or reformed. The consumption and savings patterns of richer households may also need to be regulated, to ensure that these household groups contribute less to social dis-savings as measured by the ANS. The analysis also suggests that there may be structural and consumption/savings patterns within some lower and middle income household income groups, which could be replicated to improve the sustainability of the economy.

To improve the prospects for sustainability at a macro level, the optimal policy might require more than the usual policies that try to break the link between lower income households, deprivation and negative incentives for household investment. It will also require policies that tweak or regulate the consumption/savings patterns of the better off. Since the consumption and savings patterns of the richer groups within society are having negative impacts on the sustainability of the entire economy and society.

These conclusions also seem to mesh with the earlier review of political economy considerations, particularly the review of the plantation economy which suggested that growth alone might not be an optimal policy unless inter linkages within the economy are fostered and where the incentives for greater investment in education by lower income households must be encouraged.

The review of depletion estimates for Trinidad and Tobago has shown that the country is exploiting its non-renewable resources at a very fast pace. While from a policy perspective all of the user costs associated with this depletion cannot be saved since there are also immediate consumption needs,. However, if some of these

proceeds are used for poverty alleviation i.e. the most pressing consumption needs articulated in chapter three, then the vast majority should be saved or reinvested to help maintain the overall capital stock at the macro level and to improve access to capital at the micro level.

The assessment of fuel subsidies, which can be considered a poor use of the resource rents, has shown the benefits of these subsidies to be regressively distributed. This is a particular area of policy where expenditure can be retargeted towards individuals requiring the most help or towards savings and investment that could help maintain the stock of capital.

The analysis of human capital distributions and the rate of return on this human capital have also shown this to be regressively distributed. There is considerable scope for government policy to address this by among other things encouraging human capital investment by poorer households and providing the incentives for that investment such as the mechanisms to ensure that quality jobs are available for individuals who have invested in education and human capital accumulation. This is particularly important to avoid the breakdown in the virtuous circle alluded to by Birdsall et al. (2001) and to improve the quality of education received by poorer households as suggested by Demas (1971).

The literature on resource abundant countries by for example Auty and Kiiski (2001), Birdsall (2001) and van der Ploeg (2011) have all identified income inequality as a problem affecting these types of economies. Work on the plantation economy by Beckford (1972), and Demas (1971) and the theory espoused by Seers in (1964) have also indicated this to be a problem. Unfortunately the analysis of the distributions of resource rent flows in chapter six has shown that this particular problem still exists in Trinidad and Tobago. This is despite the efforts of governments to spend on education and social programmes and to seek full employment through the expenditure of resource rents. The question that arises from this analysis is; why the expenditure of resource rents which has contributed to negative ANS rates for Trinidad and Tobago not provided lasting benefits for many households in the form of their own endowments such as quality human capital, which the sustainable

livelihoods framework[50] suggests is the most important asset for sustainable livelihoods. The answers seem to lie away from simple policies of redistribution and more towards structural reforms of the economy and the lingering political economy legacies that favour the wealthy and connected over the poor and relatively dispossessed. There is also an urgent need to improve the rate of return on education for the poorest households and to also improve the quality of education that these households receive, ultimately providing the incentive for quality human capital accumulation at all levels. The policy implications of this thesis are all areas for future research including a comprehensive assessment of the distribution of ANS to ensure that the correct policies can be articulated and implemented. The consumption patterns of some groups which tend to have greater linkages with the domestic economy should be emulated and the disproportionate share of negative savings that is attributable to some groups should also be regulated.

It is also evident that there should be a separate line of analysis in ANS estimates to account specifically for political institutions and to assess their relative effectiveness at managing overall wealth for sustainability. 'Political capital' should therefore be considered for further analysis and research from a sustainability, resource management and equity perspectives.

[50] DfID

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