

**Temporal Disaggregation of the
Gross Domestic Product (GDP)
for
an Island-Region Economy:
The Case of Tobago.**

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ABSTRACT

Prior to the Tobago Census of Establishments 1997, no formal attempts were made to compile Gross Domestic Product (GDP) estimates for the Island-Region economy of Tobago. As a result, Tobago lacks critical data on the activities of the resident economic agents and productive units in its local jurisdiction and for strategic planning. This paper seeks to develop consistent annual estimates of GDP for the Island-Region of Tobago using data from the Value Added Tax (VAT) Information System, sample surveys and other secondary sources for the period 1997 to 2004. These annual sets are combined with leading indicators from the tourism and government sectors to derive quarterly GDP estimates using the Chow-Lin method. The preliminary results of this study point to the important contribution that services (especially General Government, Construction, Distribution and Hotels and Guest Houses) make to the island-region economy of Tobago. This may serve as an important platform for greater diversification of the Trinidad and Tobago economy.

Background

Trinidad and Tobago were fully united to form a single colony on January 1st 1899. During the early years of their union, demographic statistics and data on the actively employed working population were obtained from the decennial population censuses. Limited statistics on the exports of Tobago were published for certain years in the annual reports of the *Wardens*, and of the Departments of Agriculture and Customs and Excise. From those sources, records of trade in such agricultural products as cocoa, copra and lime oil, consigned to agents in Trinidad for transshipment to European markets, could be retrieved. These departments also recorded the quantum of poultry, livestock and fresh vegetables exported to Trinidad for domestic consumption (Craig-James 1999).

During the period of plantation agriculture, the colonial establishment collected information on the exports and production for Tobago. The collection of trade data for Tobago ended with the establishment, in 1951, of the Central Statistical Office (CSO) as the official agency responsible for collecting, compiling, analyzing and disseminating statistical information relating to the economic and social conditions of the people of Trinidad and Tobago. Following the unification of Trinidad and Tobago in 1889, no further attempt was made to continue the process of compiling separate export and import data for Tobago.

Because the population¹ of Tobago comprises a very small fraction of the national population, it appears that the CSO devoted more resources to the collection of information for Trinidad, rather than for Tobago as a whole, despite the fact that the structural differences between the two islands would have suggested the need for specific national accounts data for Tobago.

The unrepresentative sample size allocated to Tobago effectively means that estimates of the size and structure of the national economy have been based mainly on sample surveys of establishments in Trinidad. To the extent that the data on Tobago cannot be disaggregated, it is often difficult to assess the contribution of Tobago to the national output.

The first data-collection initiative of the Policy Research and Development Institute (PRDI) was the Tobago Census of Establishments (1997), which was intended to provide comprehensive information on the operations of firms in Tobago. Prior to this survey, no attempt was made to compile Gross Domestic Product (GDP) estimates for the island-region economy of Tobago. As a result, Tobago lacks critical data on the activities of the resident economic agents and productive units in its local jurisdiction and for strategic planning.

In the absence of an Establishment Business Survey, the computation of the annual GDP estimates for the Tobago economy is based largely on information

¹ In 1951, the population of Tobago comprises 29,433 persons. The population as at December 2002 was 56,500 which represent 5.3 percent of the national population.

obtained from the Value Added Tax (VAT) Information System, sample surveys and other secondary sources. It is important to note that in 1997, the PRDI derived benchmark GDP figures for Tobago using data from the Business Establishment Survey. It was estimated that the GDP of Tobago using this survey data amounted to TT \$850.2 million or approximately 2.3 percent of national output. However, this survey was discontinued and in order to continue deriving annual estimates, the value-added approach was adopted using data from the Value Added Tax (VAT) Information System, sample surveys and other secondary sources.

The main aim of this paper is to develop consistent annual estimates of GDP for the Island-Region of Tobago using data from the Value Added Tax (VAT) Information System, sample surveys and other secondary sources for the period 1997 to 2004. These annual sets are combined with leading indicators from the tourism and government sectors to derive quarterly GDP estimates using the Chow-Lin method. The paper is divided into three sections. Section I briefly describes the approach used to develop annual estimates while section II discusses how quarterly estimates are developed using the chow-lin procedure. Section III outlines the limitations and policy implications of the study and makes an overall assessment of the paper.

Section I

Developing Annual Estimates

A country's Gross Domestic Product is the market value² of the final goods³ and services produced over a specified period of time, usually a year or a quarter, and can be measured using one of the following three methods: - the Expenditure method, the Income method and the Value Added method. The Expenditure approach measures GDP by adding Consumption, Investment, Government Purchases and Net Exports while the Income approach estimates GDP by adding up all income earned within an economy for a period of one year. The Value Added approach measures the value added of producers by deducting the value of goods and services used up in production from the total value of good and service produced. Whereas these various methods should yield the same estimate in theory, from a practical standpoint, a number of adjustments have to be made before equivalent estimates could be obtained. In this paper, the value-added method was utilized to develop annual estimates of GDP for various institutional sectors and activities in the Tobago economy.

In calculating GDP by this method, value added is obtained by subtracting intermediate cost from gross output. Hence, the baseline equation for the value added method is: -

² The price as determined dynamically by buyers and sellers in an open market.

³ Final goods and services are those that are actually used or consumed by individuals, households, firms or the government.

GDP = Gross output – Cost of Intermediaries – Subsidies + Indirect Taxes

This computation yields GDP at basic prices⁴, which does not include net taxes on production. This approach is consistent with the production account methodology that is used by the Central Statistical Office (CSO) to calculate the country's output. It therefore allows for meaningful comparison of estimates of Tobago's GDP with the national figures.

The value-added method was utilized to estimate Tobago's GDP for the following reasons:

- Discontinuation of the Business Establishment Survey because of the lack of human resource.
- The lack of a comprehensive Tobago-specific GDP data infrastructure since data on Tobago cannot be disaggregated from Trinidad.
- The difficulties associated with collecting revenue data from firms/establishment because of suspicions surrounding the use of the data.
- The availability of a significant portion of the VAT data on establishments/firms from the national VAT information system.

The preliminary results of this study point to the important contribution that services (especially General Government, Construction, Distribution and Hotels

⁴ The basic price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, and plus any subsidy receivable, on that unit as a consequence of its production or sale. It excludes any transport charges invoiced separately by the producer.

and Guest Houses) make to the economy of Tobago. Service-based activity emerged as the dominant sector in Tobago with value added amounted to TT \$884.3 million or 98.68 percent of GDP in 1997. In 2004 services output amounted to TT \$1.5 billion or 99.12 percent of GDP (**Table I**).

Table III presents the ranking of sectors based on their contribution to overall GDP. The results show that the four (4) leading sectors in the Island-Region of Tobago economy are General Government, Construction, Distribution and Hotels and Guest Houses. The data also reveal that only three sectors have been the highest leading sector in Tobago in terms of their contribution to overall GDP over the period. That is, Construction, Distribution and General Government.

The **General Government sector** continued to be the highest ranked in terms of overall economic activity and the largest contributing sector for the period 2001 to 2004 with value added ranging from TT \$252.4 million or 22.25 percent in 2001 to TT \$321.8 million or 21.45 percent in 2004.

Table I: Preliminary estimates of GDP for Tobago by sector grouping

Sector Name	GDP (\$TT)							
	1997	1998	1999	2000	2001	2002	2003	2004
<i>Domestic Agriculture</i>	1,701,250	2,173,436	1,816,602	854,938	401,073	423,060	165,130	1,634,859
Petroleum Industries	1,654,133	1,527,626	1,441,204	1,171,628	1,506,674	2,198,406	2,364,035	2,910,808
Manufacturing	8,501,612	8,149,458	9,042,060	8,754,784	7,085,359	7,505,736	7,950,575	8,731,722
Services	884,372,695	1,003,468,248	1,063,984,742	1,066,064,977	1,125,172,510	1,226,040,211	1,238,335,955	1,487,294,414
Gross Domestic Products, Tobago	896,229,690	1,015,318,768	1,076,284,608	1,076,846,327	1,134,165,616	1,236,167,413	1,248,815,696	1,500,571,803

Table II: Preliminary estimates of GDP by sector

Sector Name	GDP (\$TT)							
	1997	1998	1999	2000	2001	2002	2003	2004
<i>Domestic Agriculture</i>	1,701,250	2,173,436	1,816,602	854,938	401,073	423,060	165,130	1,634,859
Petroleum Industries	1,654,133	1,527,626	1,441,204	1,171,628	1,506,674	2,198,406	2,364,035	2,910,808
Manufacturing	8,501,612	8,149,458	9,042,060	8,754,784	7,085,359	7,505,736	7,950,575	8,731,722
Electricity and Water	82,194,961	79,331,991	54,421,510	56,361,345	54,700,846	25,829,799	28,129,675	38,781,871
Construction	176,589,989	241,910,299	263,206,236	214,552,173	191,420,886	253,339,618	208,457,874	214,863,487
Distribution	184,728,601	203,696,721	221,638,253	227,750,462	238,475,547	238,548,308	255,364,651	305,008,631
Hotels and Guest Houses	161,201,866	175,710,034	191,523,937	208,761,091	212,237,949	231,339,365	246,388,570	290,379,425
Transportation, Communication and Storage	65,219,652	77,259,818	86,837,582	97,397,183	112,630,217	128,121,684	142,086,757	213,923,090
Finance, Insurance, Real Estate and Business Services	29,940,460	31,181,882	44,076,667	48,041,408	60,162,348	80,301,551	90,065,388	94,838,866
General Government	181,745,019	190,868,709	197,855,543	208,843,460	252,387,277	265,005,008	261,211,846	321,842,148
Education and Cultural Community Services	151,179	159,136	167,512	638,057	142,047	850,246	2,712,722	3,234,973
Personal Services	2,600,968	3,349,658	4,257,502	3,719,798	3,015,394	2,704,633	3,918,472	4,421,922
Gross Domestic Products, Tobago	896,229,690	1,015,318,768	1,076,284,608	1,076,846,327	1,134,165,616	1,236,167,413	1,248,815,696	1,500,571,803

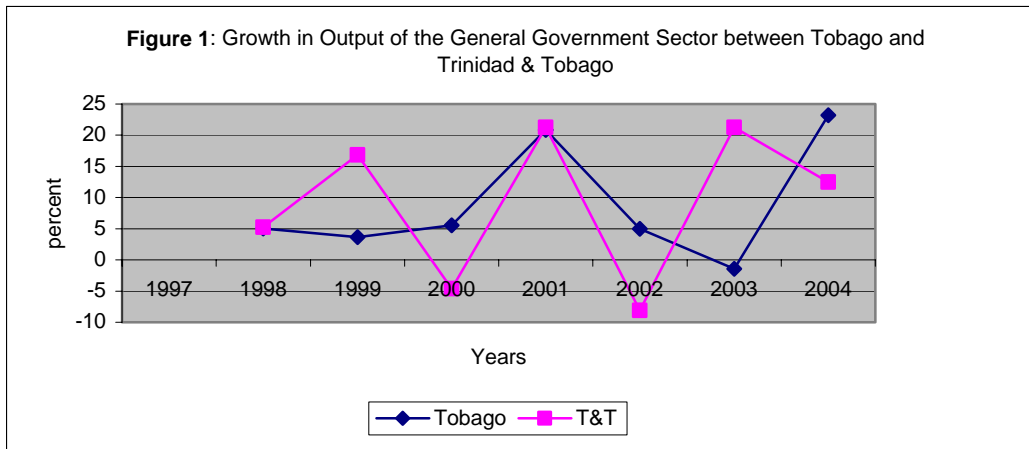
Table III: Ranking of sectors based on contribution of GDP

Sector	1997	1998	1999	2000	2001	2002	2003	2004
<i>Domestic Agriculture</i>	10	10	10	11	11	12	12	12
<i>Petroleum Industries</i>	11	11	11	10	10	10	11	11
<i>Manufacturing</i>	8	8	8	8	8	8	8	8
<i>Electricity and Water</i>	5	5	6	6	7	7	7	7
<i>Construction</i>	3	1	1	2	4	2	4	4
<i>Distribution</i>	1	2	2	1	2	3	2	2
<i>Hotels and Guest Houses</i>	4	4	4	4	3	4	3	3
<i>Transportation, Communication and Storage</i>	6	6	5	5	5	5	5	5
<i>Finance, Insurance, real Estate and Business Services</i>	7	7	7	7	6	6	6	6
<i>General Government</i>	2	3	3	3	1	1	1	1
<i>Education and Cultural Community Services</i>	12	12	12	12	12	11	10	10
<i>Personal Services</i>	9	9	9	9	9	9	9	9

The General Government sector grew by 20.85 percent in 2001, compared to 5.55 percent in 2000. The growth in this sector could be attributed to the increased participation of the State (Tobago House of Assembly) in economic activity in Tobago. Since 2001 there has been a sizeable increase in budgetary allocations for Tobago and by extension a significant increase in the share of the government sector in the Tobago economy.

Figure 1 shows the growth in output of the General Government sector in Tobago compared with that of the national economy. The Government sector in Tobago grew by approximately 23 percent in 2004, compared to approximately 12 percent for the national economy. The conclusion from the preliminary data is

that the Government sector has been growing more rapidly in Tobago than in Trinidad.



However, the share of output at the national level far outweighs that for Tobago since the contribution of the General Government sector in Tobago is approximately 5 percent of the contribution at the national level (see **Figure II**).

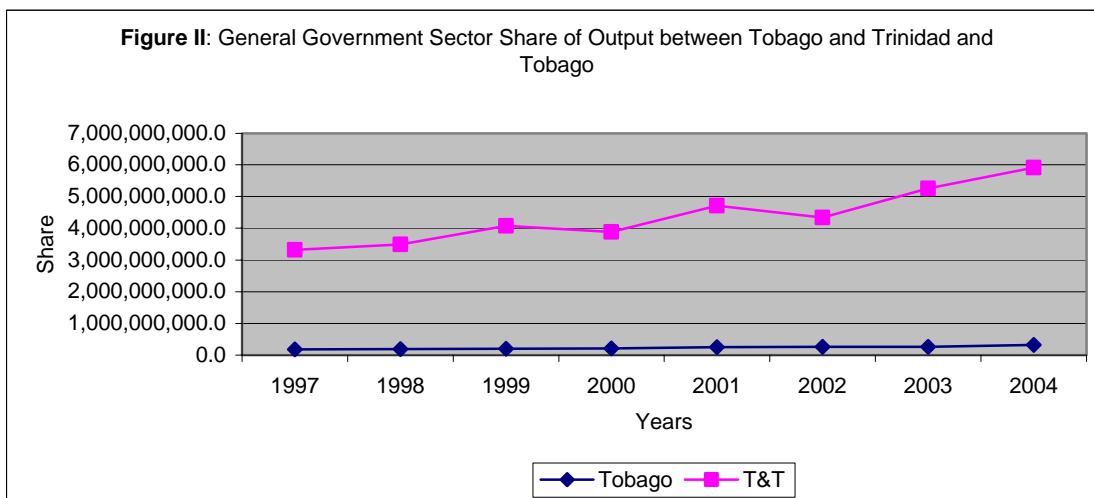
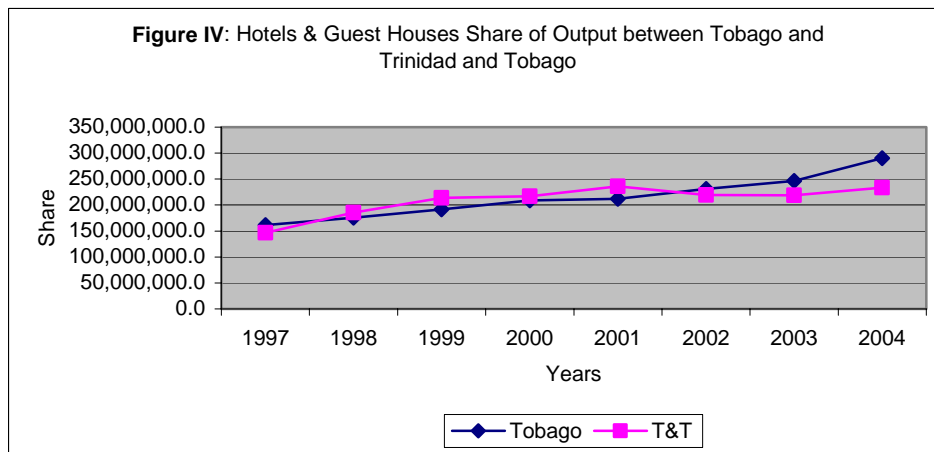
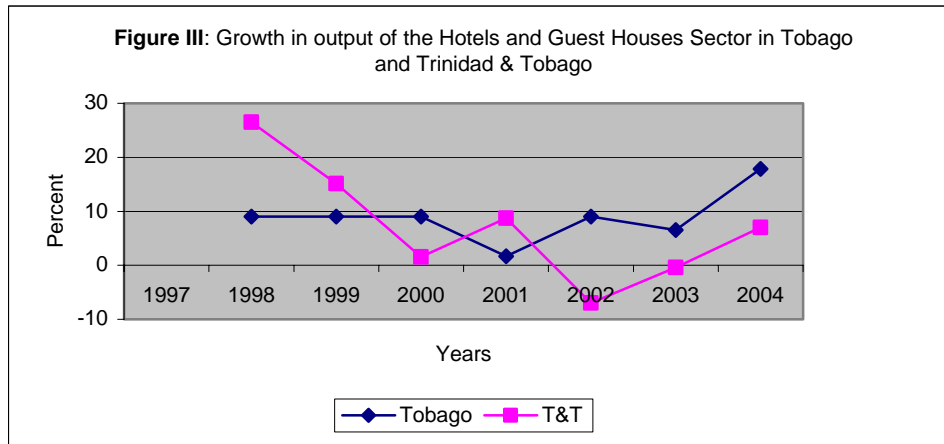
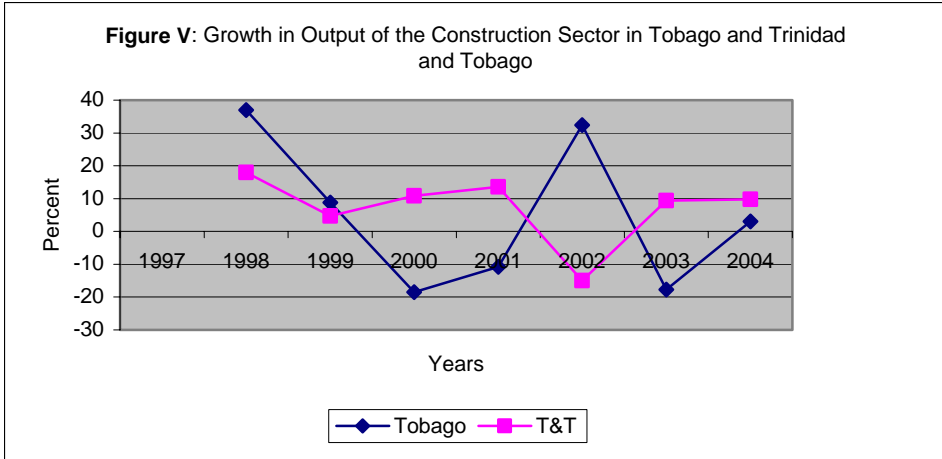


Figure III suggests that activity in the **Hotels and Guesthouses** sector in Tobago has been growing at a faster pace than at the national level. The share

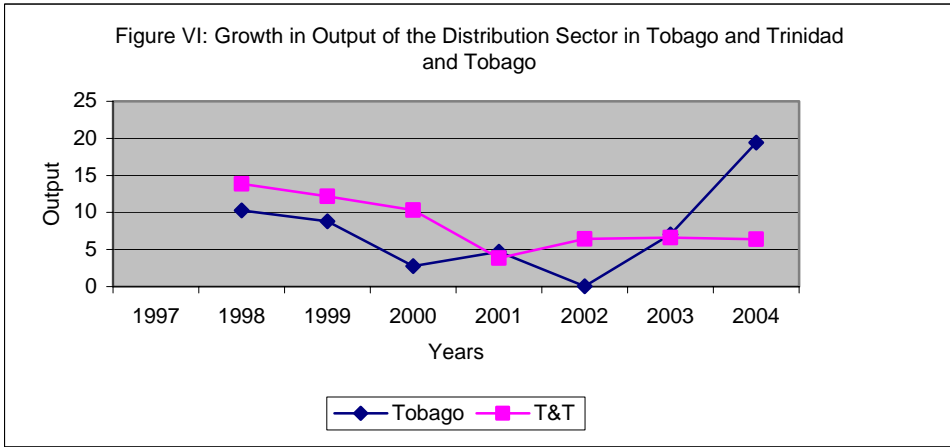
of output for this sector in Tobago is also larger than that at the national level (Figure IV).



The Construction sector in Tobago continued to decline in the last two years of this study after a peak growth rate of 36.99 percent in 1998. This decrease could be attributed to the delays in some major construction projects such as the Scarborough Hospital, the Housing projects at Roxborough, Blenheim, Castara and Plymouth and Crown Point international airport terminal and tarmac expansion (Figure V).



Activity within the Distribution sector grew by 19.44 percent in 2004 compared to 7.05 percent in 2003. The sharp pick-up in activity in this sector reflects increased activity by many small retailers and shops catering to the tourist sector.



Section II

Developing Quarterly GDP Estimates for Tobago

Annual estimates are generally computed from detailed information obtained from the business establishment surveys and from administrative records. In the context of the current statistical infrastructure in Tobago, the collection of this comprehensive set of information from respondents on a quarterly basis is likely to impose a substantial burden not only on respondents in Tobago but also on the statistical agency.

Methods of temporal dis-aggregation⁵ can assist in the development of quarterly GDP estimates especially where it is difficult or expensive to conduct quarterly business surveys. One of the more popular methods in use is the Chow-lin technique (Chow-lin 1971), which is primarily utilized to convert annual GDP estimates into quarterly values using leading economic indicators. More specifically, the Chow-Lin procedure⁶ uses a vector of low frequency data, Y ; a matrix of high frequency indicators, x ; and an aggregation matrix, C , to convert annual GDP estimates into quarterly estimates.

⁵ Temporal dis-aggregation refers basically to the decomposition of a time series data vector of a low order periodicity into a new vector of a higher order periodicity.

⁶ $res = chowlin(Y, x, ta, s, type)$

The technique finds a statistical transformation to allow the researcher to use available quarterly economic indicators together with annual GDP estimates to derive quarterly nominal GDP values⁷.

Chow-lin (1971) characterizes the relationship between the annual observations on the variable of interest and the related variable by the following regression:

$$y = X\beta + u$$

$$E(u) = 0$$

$$E(u'u) = V$$

y is the unobserved series and X is a matrix of observations on K related variables. Let C be defined as a matrix that converts annual flows into quarterly ones. Then the vector of n quarterly observations will satisfy:

$$y = CY = CX\beta + CU = X\beta + U$$

$$\text{where } E(U'U) = CVC'$$

In the context of the Chow-Lin formula, the matrix V is associated with the unobserved error U . The BLUE estimator $\hat{\beta}$ is:

$$\hat{\beta} = [X'C(CVC')^{-1}CX]^{-1} X'C'(CVC')^{-1}Y$$

⁷ See Nicholls, Forde and Coker (1995) for an application of this method in Trinidad and Tobago.

In this method, each quarterly flow is estimated by applying the Generalized Least Squares (GLS) estimator $\hat{\beta}$ derived from the annual model to quarterly data on the explanatory variables and by adding the result to an estimate of the quarterly prediction error.

The chow-lin procedure was used to construct quarterly estimates of Gross Domestic Product (GDP) for the island-region economy of Tobago for the period 1997 to 2004. In constructing these estimates, the annual estimates of GDP derived from the value-added method were combined with core leading indicators from the Tourism and Government sectors to derive quarterly nominal GDP estimates. In the case of Tobago, relatively reliable indicators exist for tourism and government expenditure on a monthly and quarterly basis.

The methodology assumes that there is a strong relationship between the dependent variable (GDP) and a number of regressors. The first step in the procedure therefore involves the estimation of the following linear relationship:

$$y = x\beta + u$$

where y represents nominal GDP and x is a vector of regressors consisting of data on tourism and government expenditure.

The quarterly economic indicators, the residuals from the regression performed with the annual data and the aggregation matrix C are then utilised to derive quarterly estimates using the generalized least squares procedure. In this analysis, the aggregation matrix takes the following form:

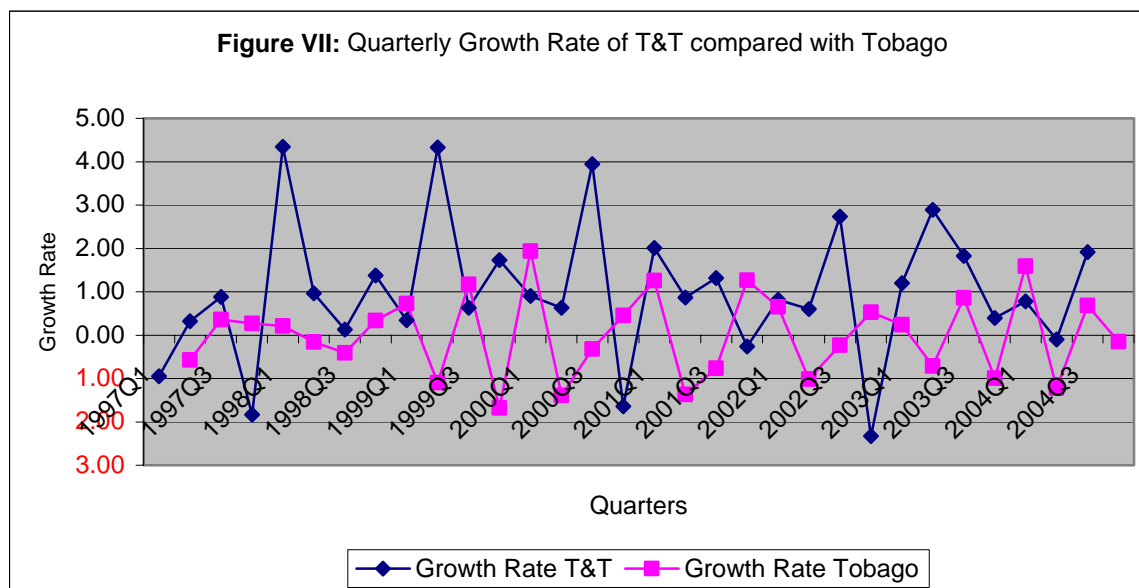
$$C = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & . & . & . & . & . & . & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & . & . & . & . & . & . & 0 \\ . & . & . & . & . & . & . & . & . & . & . & . & . & . & . \\ 0 & . & . & . & . & . & . & . & . & . & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

where C is a $(N \times 4N)$ matrix that converts $4N$ quarterly observations into N annual observation and for this matrix to be generated, the value of \mathbf{ta} , \mathbf{N} and \mathbf{s} must be known.

Table IV presents quarterly nominal estimates for the island-region of Tobago using the Chow-Lin method. In order to benchmark these estimates against the quarterly index of Real GDP compiled by the Central Bank of Trinidad and Tobago, the nominal GDP estimates for Tobago were deflated by the Retail Prices Index (RPI) to enable the computation of real GDP growth rates for Tobago. **Figure VII** compares the quarterly growth rates at the national level with those derived from the Chow-lin procedure for Tobago. The results indicate that despite the buoyancy of tourism activity, economic activity in Tobago has been growing at a much slower pace than activity at the national level. This finding is not entirely surprising given the strong growth performance of energy-based activity in Trinidad.

Table IV: Quarterly GDP estimates for the Island-Region of Tobago

Quarter	1997	1998	1999	2000	2001	2002	2003	2004
1st	235.12	266.14	323.51	361.32	381.26	378.45	343.07	430.73
2nd	191.48	258.31	230.15	241.07	255.77	280.32	275.09	308.71
3rd	222.65	229.81	332.26	213.72	187.44	261.17	365.04	385.13
4th	246.98	261.06	190.36	260.74	309.7	316.24	265.61	376
Total	896.23	1,015.32	1,076.28	1,076.85	1,134.17	1,236.18	1,248.81	1,500.57



Section III

Limitations and Policy Implications

In developing the annual GDP estimates for Tobago, several challenges were experienced. Firstly, several firms in Tobago were unable to provide relevant information to allow for more complete estimation of gross output and intermediate cost. Secondly, although the VAT database proved to be an

important source of information, it failed to capture the activity of several small micro-enterprises in Tobago. The estimates of annual GDP are therefore quite preliminary in nature and may be subject to major revisions as additional information becomes available.

From a policy standpoint, the preliminary estimates from this study can go a long way in helping policy makers in Tobago and the national community to get a better handle on the contribution that is being made by the island economy of Tobago to national income. Given the relatively rapid growth of the tourism sector within recent years, the results indicate that greater specialization by Tobago in service-based activity could assist in the overall diversification of the national economy away from the energy sector. This may provide a platform for sustainable development in the future when the resources from oil and gas are depleted.

Conclusion

Three methods were available for the estimation of the annual Gross Domestic Product (GDP) for the island-region of Tobago and the value-added method was used for the computation of Tobago's GDP for practical reasons. Even though a significant portion of the data used in this method was available from the national VAT information system, this data must be complemented with other surveys and secondary sources to capture the economic activity of all enterprises in Tobago.

As countries or regions within a country increase their economic links with the rest of the world, the need for reliable, accurate and timely data becomes very important. Obtaining quarterly estimates would not only provide vital quarterly indicators of the island-region of Tobago's economic performance but it will also ensure that as this island-region develops rapidly, there is sufficient data to measure its progress and contribution to the national economy.

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