USAID
FROM THE AMERICAN PEOPLE

ECONOMIC IMPACT AND PORT ASSET PACKAGING STUDY

PHASE 1 – ECONOMIC IMPACT ASSESSMENT (MILESTONE 4)

Originally Produced on 24 March 2003

Subsequently Revised on May 1, 2003

This publication was produced for review by the United States Agency for International Development.

EMERGING
MARKETS
GROUP

ECONOMIC IMPACT AND PORT ASSET PACKAGING STUDY

PHASE 1 — ECONOMIC IMPACT ASSESSMENT (MILESTONE 4)

Prepared by:
CPCS Transcom

In association with:
The Cornell Group
Shipping and Transport College/Dynamar Consultancy
Expeditor Management Services
Phathani Consulting (Pty) Ltd

Under contract to:
Emerging Markets Group, Ltd.
(f/k/a Deloitte Touche Tohmatsu Emerging Markets, Ltd.)

Submitted to:
USAID

Contract No.:
PCE-I-00-97-00016-00
SEGIR Privatization IQC
Delivery Order #809

Table of Contents

EXECUTIVE SUMMARY (revised April 2003)

Terms of Reference and Approach

The Terms of Reference of this study called for an assessment of the economic impact of the restructuring of the port sector in South Africa through concessioning of terminal operations. The original vision of this Task was two-fold. Firstly, it would provide a demonstration that the positive impact on the economy of improving port efficiency is bigger than the negative impact of port reform (essentially reduction in labour required within the port). Secondly, it was envisaged that the impact analysis could be used to drive a 'de-bottlenecking' model, providing a formal mechanism for determining sequence and packaging of terminals to be concessioned after DCT (the first wave). At the meeting of the PRSC held December 5 2003 in Pretoria it was agreed, after some discussion, that a macro-economic impact analysis would not provide data at a level that could assist in intra-port or even inter-port comparisons of terminals, and therefore could not serve as a 'driver' for a formal terminal concessioning sequencing and packaging model. Since the measure of the potential overall macro-economic impact of terminal restructuring was regarded as the prime output of this Task, work has been limited to development of those macro-economic measures.

This Report therefore concentrates on the first task – the estimation of the magnitude of the macro-economic impact (at a national level) of reductions in the overall cost of transportation of South Africa's imports and exports. We have focussed the analysis on two terminals, DCT and the Richards Bay Multi-purpose terminal. DCT was chosen due to its dominant status in the South African port system, since it handles by far the largest quantity of cargo in value terms. DCT is also the first candidate for private sector participation within the DPE concessioning strategy. The Richards Bay MPT was chosen because it is large enough to be immediately attractive to an international operator, has the physical space to permit significant expansion, and also has significant upside potential in terms of traffic growth.

The measured impact on the national economy of a reduction of (for example) ZAR 100 per TEU in the cost of handling a container through DCT will be very similar to the impact for a similar container handled through a different port. At a macro-economic level, the only change form one port to another would be a result of the difference in cargo mix. A national input-output model simply does not provide sufficient detail to differentiate further. Thus we can use the multiplier measured for DCT as a reasonable estimate applicable to all container terminals in South Africa, although the estimates of value of cargo etc are unique to Durban. Since the impact to the economy depends on both the value of the benefit to users and the relationship between that value and of the cargo that is being assisted, we have also examined the potential benefits for a specific multi-purpose terminal, where the value of cargo per tonne is much lower than in a container terminal. This also provides an appropriate measure for all such terminals in South Africa.

There are two aspects to this study. Firstly, the importance of each of the terminals to the South African economy is assessed, on the basis of trade flows through each port, i.e. the contribution of port users (exporters and importers) to the domestic economy. Secondly, we assess the economy-wide impact of reduced cargo costs arising out of terminal restructuring.

A composite measure of cargo charges associated with terminal operations is calculated. This includes port handling charges, National Port Authority (NPA) tariffs and the costs associated with the turn around time of vessels related to terminal operations. The sum of these terminal associated charges is a direct cost to cargo owners and therefore impacts on the ultimate price and competitiveness of their products. At the same time, the cargo charges are a source of revenue for the organizations associated with terminal operations. These include terminal management, black empowerment groups, terminal employees and the National Ports Authority, all of whom stand to gain or lose depending on the outcomes of negotiations around the terminal concessions.

The analysis shows the overall impact on the South African economy of a reduction in cargo charges, based on a series of reasonable assumptions about the functioning of the economy and the response of port users to these changes. The distribution of benefits between service providers, users, and the Government will be directly affected not only by the structure of the financial bidding process but also by agreed upon for key parameters, particularly tariffs charged users and annual fixed and variable concession fees. However, the benefits to the economy as measured by the impact mutliplier is a direct function of the benefits which flow through to port users.

Economy-wide modelling

Restructuring of the Durban container terminal and the Richards Bay MPT is expected to reduce the costs associated with use of the terminal facilities, including both out-of pocket (cash) costs and the cost of delays. The primary impact on the economy is thus through **price linkages**. Lower costs feed into improved export growth, increases in domestic demand as real wealth increases, and increases in domestic production as input costs decline. Through inter-sectoral linkages these demand changes filter down into the rest of the economy. However, lower import prices will also have a negative impact on import local production. Employment will be affected through the direct and indirect output responses to price changes. Income generated through increased employment will further stimulate the economy through increased consumption. New investment in the terminals will also stimulate domestic production.

The approach applied here is to use a Supply-Use (Input-Output) or Social Accounting Matrix (SAM) based model. Essentially, a Supply-Use (S-U) table offers a snapshot picture of the economy at hand, focusing on relationships between production activities and production factors. The Supply matrix provides information regarding the supply of commodities by domestic firms (activities) and foreign imports. The Use table provides information on the use of intermediate goods in the process of producing final output. Payments to labour and the return to capital are also included.

The Social Accounting Matrix extends the S-U tables by including resource flows between the production sphere of the economy and final demand institutions such as households, the public sector and the foreign sector. The SAM therefore enables a more economy-wide analysis than the inter-industry perspective of the S-U table. SAM-based modelling attempts to quantify the backward and forward linkages of an impulse in the economy at hand.

The modelling is performed in two stages.

- We first use the price model to estimate the direct and indirect price effects arising from lower import prices;
- We then use these price changes to estimate demand responses by domestic consumers and export markets (wealth effect).

In the second stage, the quantity model is used to assess the direct and indirect economy-wide impact on production, household income and employment arising from:

(a) the wealth effect;
(b) increased exports;
(c) a reduction in domestic production from increased import penetration; and
(d) increased investment.

These models are of course based on a large number of simplifying assumptions. These assumptions are set out in detail in the text. Furthermore, the accuracy and indeed reasonableness of the findings depends on the accuracy and consistency of the data used. The port-related data used in this study were obtained from the National Ports Authority (NPA). Considerable difficulties were encountered in constructing a data set sufficiently robust for such a study. The results can be regarded as a reasonable measure of the actual throughput of tonnage and its value in the year under investigation (2001/02). Details of data sources and methods are set out in the balance of the Report and the Appendices.

Multipliers for Durban Container Terminal (DCT) and Richards Bay Multi-purpose Terminal (RBMPT)

The Table below shows that a 10% reduction in overall harbour charges at DCT would generate a direct saving to users of ZAR 43 million, while a similar reduction at RBMPT would yield savings of ZAR 18 million. It is clear that the measured impact on output and employment is dominated by the impact of additional investment associated with the terminal restructuring at DCT. However this impact would occur whether the investment takes place inside or outside a concessioning framework. We therefore exclude it from the calculation of multipliers.

NET IMPACTS OF REDUCED HARBOUR CHARGES ON OUTPUT, INCOME AND EMPLOYMENT (Rands millions)

Reduction in harbour charges	DCT 10%	DCT 50%	RBMPT 10%	RBMPT 50%
User savings	**43**	**217**	**18**	**89**
Output				
Trade impact	168	840	86	432
Investment impact	4504	4504	0	0
Wealth impact	490	2450	4	22
Total output impact	**5162**	**7794**	**90**	**454**
Income	**1636**	**2890**	**25**	**135**
Employment				
Trade impact	682	3412	327	1637
Investment impact	20463	20463	0	0
Wealth impact	2163	10814	20	100
Total employment impact	**23308**	**34689**	**347**	**1737**

The positive impact on the economy of a reduction in the cost of transporting cargo) is substantial. Even after exclusion of the investment impact on output, the overall output multiplier for DCT is 15.3 (43/(168+490). That is, the benefit to the economy of a reduction in handling costs at DCT exceeds the direct benefit to users by more than 15:1. For 'neo-bulk' cargo handled at RBMPT, the multiplier, while lower, exceeds 5:1.

It should be noted after exclusion of investment, the multiplier is independent of scale. Whatever the direct savings to port users, the benefits to the economy of such real cost reductions are 5 to 15 times greater. On the other hand, if concessioning in fact leads to higher overall charges assessed against cargo (for example through a liner surcharge or imposition of a high fixed annual concession fee by Government) the multipliers will be identical in absolute value but in the opposite direction. A liner surcharge of $75 per TEU, as threatened for 15 November 2002, would have had a direct impact on importers and exporters of more than ZAR 750 per TEU at the exchange rate then in effect. However the negative impact on the South Africa economy would have been at least 750 x 15 or ZAR 11,250 per TEU. For an annual throughput of 1.1 million TEU, the negative impact on the economy would have exceeded exceed ZAR 3 million per day, or 12 billion if sustained for a year. It must be kept in mind that the surcharge was threatened precisely because of declining quay productivity – that is, handling rates of less than 16 per hour.

The positive impact on employment beyond the port is also substantial. SAPO presently has 1,020 employees working at DCT. The maximum reduction in employment (at current throughput) likely to result from restructuring would be 200 people, and could be less. Again excluding the employment impact, the additional employment generated throughout the South African economy as a result of ZAR 43 million reduction in costs at DCT would be 2,845, for a multiplier in excess of 14. SAPO employment at RBMPT is presently 562. Given the nature of multi-purpose terminal operations, opportunities for labour force reduction are likely to be much less in Richards Bay, where cost reductions of ZAR 18 million will generate 347 new jobs elsewhere.

This analysis clearly shows that the positive impact on the economy of reduction in port costs far exceed the direct benefits to port users. It also shows that the positive impact of these cost reductions on employment throughout the economy will substantially exceed any short-term reduction in employment within the port that may occur. At projected traffic growth rates of 6% for DCT, a maximum job loss of 200 positions would be offset by increase in employment because of traffic growth within 3 years. While the cost of reduced employment is temporary, the savings to port users and the benefits to the economy are permanent and continuing.

1 Approach

The terms of reference call for an assessment of the economic impact of the restructuring of the port sector in South Africa. The workplan states that the "Economic Impact task will produce a clear measure of the overall impact of the recommended concessioning program but it will also be used as a major tool to support the development of the concessioning strategy itself".

The economic impact assessments reported in the literature are port-wide analyses that examine the static multiplier effects of port activity on economies. The main question they pose is "What contribution does port activity make to the economy?" While these studies provide useful insights into ways of conducting port impact assessments, the methodologies adopted could not be directly employed in the present project.

The central question for the present study is "What will be the economic impact of the concessioning of SAPO terminals on the wider economy?" There are two important differences with the conventional port assessments. The first is the focus on terminals, as against the full range of port activities. The second is the focus on concessioning of operations. These considerations called for the development of a tailor-made methodology for this study.

A number of approaches to the economic impact assessment were considered, based on international practice, as well as consideration of the availability of information for such approaches. These included a port-wide study focussing on Durban, an exclusive focus on the Durban Container Terminal (DCT) and a focus on all SAPO terminals taken together.[1]

Consideration of the state of the existing data sources, the difficulties of obtaining survey information, and the time constraints available for the study led to a case study approach being adopted. The DCT and Richard's Bay MPT were chosen to illustrate the impact of concessioning of container terminals and multi-purpose terminals respectively on the wider economy.

The DCT has been chosen due to its dominant status in the South African port system, as handling by far the largest quantity of cargo in value terms. It is also the first candidate for private sector participation within the Department of Public Enterprises's concessioning strategy. The Richards Nay MPT has been chosen because it is big enough to be immediately attractive to an international operator, has the physical space to permit significant expansion, and also has significant upside potential in terms of traffic growth.

This report presents an economy-wide analysis of the impact of the restructuring of the Durban container terminal (DCT) and the Richard's Bay multi-purpose terminal (MPT). The information analysed is for the financial year 2001/2. This is the most recent full year for which cargo statistics are available. It was also chosen because it is the last year in which information on cargo values was maintained, a source of information that was needed to enable analysis of at a terminal level.[2]

[1] See *Appendix 1: Approaches to port impact assessment* for an overview of the different approaches
[2] It should be noted that considerable difficulties were encountered in assembling a data set sufficiently robust for the analysis and the results should be treated not as an exact measure of

The empirical methodology is based on a Social Accounting Matrix framework that captures the direct and indirect effects of restructuring on the national economy. In this approach the focus is on the contribution of port users, particularly those that engage in international trade, to the domestic economy. This approach provides a much broader notion of 'contribution towards the domestic economy' than the conventional port impact assessments in the literature.

There are two aspects to this study. Firstly, the importance of each terminal to the South African economy is assessed on the basis of trade flows through each port, i.e. the contribution of port users (exporters and importers) to the domestic economy. As result the study does not focus on the micro-level interactions within each terminal (as in Jones, 1997). Rather the focus is on the aggregated linkages between the terminals and the South African economy. [3]

Secondly, we assess the economy-wide impact of reduced cargo costs arising out of terminal restructuring. A composite measure of cargo charges associated with terminal operations is calculated. This includes port handling charges, National Port Authority (NPA) tariffs and the costs associated with the turn around time of shipping stemming from terminal operations.[4] The economy-wide impact of a 10 % and 50 % reduction in these cargo charges is then simulated.

These terminal associated charges represent a cost to cargo owners and therefore impact on the ultimate price and competitiveness of their products. At the same time the cargo charges are a source of revenue for the actors associated with terminal operations. These would include terminal management, black empowerment groups, terminal employees and the National Ports Authority, all of whom stand to gain or lose depending on the outcomes of negotiations around the terminal concessions.

It is important to stress that this methodology does not in itself provide a case for terminal concessioning. The analysis shows what the impact would be of a reduction in cargo charges on various assumptions about the functioning of the economy and the response of port users to these changes. Changes in cargo charges will be influenced by a number of factors not examined in this study. Cargo handling charges are influenced by the efficiency of operations and the bargaining power of the main terminal actors – management and employees. Costs associated with ship turnaround time are a function of the speed of operations, itself influenced by operational efficiency as well as capacity limitations, where these exist. Cargo tariff levels are determined by the NPA. They fund the operations of the NPA, including provision of maritime services, expenditures on maintenance and upgrade of infrastructure. Historically, these revenues have also been used within Transnet to cross-subsidise railway transportation on certain routes.

---

impacts, but rather as a broad indication of the direction of impacts. The most serious problem encountered was the inconsistency between the cargo tonnage data assembled by SAPO and the cargo value data assembled by the NPA. These problems and they way they were addressed in the study are discussed in Appendix 7.3 on "Data sources and methods of estimation".

[3] Thus transhipment cargo and transhipment activities are not included in this study. They constitute a substantial component of terminal work, but only a minute component of national economic activity. The rest of port activity is included only insofar as it appears in the national accounts through linkages to cargo producing activity.

[4] A discussion of the composite cargo charges is provided in *Appendix 4:Data sources and methods of estimation*

The future magnitude of cargo charges – the degree to which they fall – will depend on all the above factors, but also, and crucially, on the terms of the concessions the NPA negotiates with private operators. In terms of current national policy, the NPA's concession strategies will be strongly influenced by the desire to promote economic efficiency on the terminals and export-oriented economic growth in the wider national economy. However, it will also be influenced by a number of specific policy concerns. These include adherence to national labour legislation, the three-year ban on retrenchment at DCT, black economic empowerment and environmental sustainability. As the responsible authority for port planning and development, NPA will be concerned to ensure that tariffs cover planned infrastructural investment and maintenance, subject to the investment inputs by concessionaires. As landlord, it will seek to ensure that market-related rentals are received from private sector operators.

The aim of this study is not to analyse the determinants of cargo charges and how they are likely to change with the concessioning of terminals. Nevertheless, the analysis presented below provides a tool to examine the impact that different concessioning packages would have on the wider national economy through the cargo charge regimes that they installed. It enables assessment of the implications for the national economy of accommodation of the various interests that draw their revenues directly or indirectly from the cargo charges. These include the NPA, the concessionaires, black economic empowerment groups drawn into the concessioning process, and labour.

The structure of the report is as follows. Section 2 presents a theoretical discussion of the economy-wide impacts arising from terminal restructuring. Section 3 discusses the empirical methodology used in the analysis. Section 4 illustrates the relative importance of the DCT and RBMPT in the national ports system. The results for the DCT and Richards Bay MPT are presented in Section 5 and Section 6, respectively. A conclusion ends the report.

2 Economic Impact of Terminal Restructuring

This project assesses the economy-wide impact of the restructuring of the Durban container terminal and the Richard's Bay multi-purpose terminal. The restructuring of the port is expected to affect the cost and speed of freight handling within each of these terminals. In addition capacity to handle freight is expected to increase. As shown in Table 1 approximately 40 % of manufacturing firms find that the reliability, speed and cost of freight handling services at harbours is an obstacle to their operations. This data is drawn from a national firm survey conducted in 1999.

Figure 1.1: Impact of harbour related activities on export-orientated manufacturing firms' operations (% firms)

	Obstacle	Neutral	Benefit	Not relevant	Total
Reliability & speed of freight handling services at harbours	39.70	31.76	7.94	20.60	100.00
Cost of freight handling services at harbours	40.35	36.88	2.48	20.30	100.00
Cost of sea freight	36.82	40.30	3.73	19.15	100.00

Source: National Enterprise Survey data

Improvements in the efficiency of providing port services will have a number of economy-wide impacts. These impacts, which will direct the empirical methodology followed, are briefly discussed.

2.1 Export prices

Reductions in the cost of freight handling (either through lower tariffs or shorter delays) have a number of effects on the economy. Firstly, the returns to exporters increase as the costs associated with exporting their products diminish. These firms may transfer some of the cost reductions onto the international price of their products, thus increasing their cost competitiveness. International demand for South African goods will increase as a result. Further, in response to the increased profitability associated with export production, firms may supply more products to the international market. Both the supply and demand impacts are expected to increase total exports.

The extent to which exports respond to changes in cargo charges will depend on

- the share of harbour costs in the price of the traded products, and
- the price elasticity of export demand and supply.

The larger the share of harbour charges in total costs, the greater the impact restructuring will have on export growth. Similarly, the greater the price elasticity of export demand (or supply) the greater the export response.

Port restructuring may also encourage export growth even if cost competitiveness does not change. If capacity constraints limit export sales, then an increase in capacity through new investment will encourage export growth. Increasing the reliability & speed of freight handling services at harbours may provide access to the international market to firms that otherwise would not export.

Improved export growth will have important demand repercussions for the rest of the economy. As export production increases, so will demand for labour and intermediate inputs. As the intermediate good sectors increase production of inputs for the export sectors, they too will demand more labour and production inputs. Through inter-sectoral linkages export growth will filter into the rest of the economy resulting in an increase in output and employment that exceeds the initial increase in export production. These indirect effects can be considerable and should be captured if the full economy-wide impact of restructuring is to be assessed.

2.2 Import prices

Lower cargo charges will also reduce the cost of imported products. This will have a number of impacts on the domestic economy. Firstly, lower import prices will reduce the competitiveness of import competing industries. These industries include labour-intensive-industries such as the clothing & textile and footwear sectors. If many of these industries close then the negative impact on employment could be severe. Further, because these industries utilise intermediate inputs from other sectors, the negative indirect effects could be substantial.

The extent to which imports substitute domestic products depends on the size of the decline in import prices as well as the elasticity of substitution between domestic and imported products. Homogenous products (very similar products) are expected to have high substitution elasticities. Specialised products are expected to have low substitution elasticities.

Lower import prices also have a positive impact on the competitiveness of domestic production. Intermediate and capital goods account for over 70 % of total South African imports.[5] A reduction in the price of intermediate and capital goods increases the competitiveness of domestic producers, which will stimulate production. The impact of lower import prices will extend to all sectors of the economy that utilise imports from the restructured port terminals. If cost reductions are passed on to downstream industries the price repercussions may extend to sectors beyond those that directly import intermediate and capital goods. Import competing firms are also expected to reduce prices in response to greater import competition. These price reductions will help reduce inflation.

2.3 Wealth effect

Lower import and domestic prices have a further positive impact on the domestic economy. Consumers respond to lower import and domestic prices by increasing consumption of these products. Lower prices also raise the real income of consumers, i.e. the cost of their consumption bundle declines. In response to the increase in real wealth, households will demand more domestic and imported products. The increased demand for domestic products will positively affect production and employment. If the decline in prices is large, these **wealth effects** can be substantial.

[5] Source: Input-Output tables provided by Central Statistical Services Reports nos. 04-02-02 (1984), 04-02-03 (1988), 04-02-04 (1993).

2.4 Investment

Port restructuring may also raise investment in new facilities. This will have a demand stimulus effect on the domestic economy, particularly if a high proportion of the investment demand is for domestic produced products. If most of the investment is in high-tech imported products, the impact on the economy through increased demand will be small. The investment effect can be large, but is a one-off effect, unlike the effect of reduced charges (itself partially a consequence of investment) which continues through time.

2.5 Increased capacity

Increased capacity is crucial if future growth in trade is to be facilitated. The DCT experienced unprecedented traffic growth rates during the mid to late 1990s. It is estimated that container traffic will continue to grow at an annual average rate of around 4.5-6% (Working Paper 3). This will place severe pressure on existing facilities within the DCT. The team has found that physical capacity constraints are not limitation on current cargo throughput. However, the economy-wide repercussions of capacity not being increased within the terminals are likely to be substantial over time. This impact is not studied in this report. A dynamic model with information on the ability to substitute between harbours as an outlet or inlet for traded products is required for a full assessment of the capacity effects.

It must, however, be emphasised that future growth in capacity through restructuring will potentially have the greatest positive impact on production and employment growth. This study will, therefore, underestimate the overall benefit of restructuring to the South African economy.

3 Economy-wide Modelling

In designing an economy-wide model it is important that features unique to the industry and the deregulation process are explicitly incorporated. Restructuring of the Durban container terminal and the Richards Bay MPT is expected to reduce the costs associated with using the terminal facilities. The primary impact on the economy is thus through **price linkages**. Lower costs feed into improved export growth, increases in domestic demand as real wealth increases, and increases in domestic production as input costs decline. Through inter-sectoral linkages these demand shocks filter down into the rest of the economy. Lower import prices will, however, also have a negative impact on import competing firms.

Employment will be affected through the direct and indirect output responses to price changes. Income generated through increased employment will further stimulate the economy through increased consumption. New investment in the terminals is also expected to stimulate domestic production. Finally, because the DCT is located within KwaZulu-Natal (KZN) region, and is the major outlet for containerised cargo from Gauteng, much of the impact of restructuring will be concentrated within these two regions. The impact of the Richards Bay MPT is also confined mainly to Gauteng, Mpumulanga, and KZN.

Ideally, a regional computable general equilibrium (CGE) model ought to be used to analyse the impact of port restructuring within the economy. CGE models endogenously solve for the export growth, import penetration and wealth effects arising from the exogenous reduction in cargo charges. However, given the time available for the study this was not feasible. The alternative approach, applied here, is to use Supply-Use (Input-Output) or Social Accounting Matrix (SAM) based models.

3.1 Supply-Use tables and Social Accounting Matrices

Essentially, a Supply-Use (S-U) table offers a snapshot picture of the economy at hand, focusing on relationships between production activities and production factors. The Supply matrix provides information regarding the supply of commodities by domestic firms (activities) and foreign imports. The Use table provides information on the use of intermediates goods in the process of producing final output. Payments to labour and the return to capital are also included. The Social Accounting Matrix extends the S-U tables by including resource flows between the production sphere of the economy and final demand institutions such as households, the public sector and the foreign sector. The SAM therefore enables a more economy-wide analysis than the inter-industry perspective of the S-U table. As such, a SAM presents a database to analyse the economy. In its simplest form it is possible to use the SAM to describe the South African economy. More relevant for our purposes, SAM-based modelling attempts to quantify the backward and forward linkages of an impulse in the economy at hand.

For the purpose of this study we make use of a social accounting matrix (SAM) for the year 1998 estimated by Thurlow & van Seventer (2002). This SAM is constructed from the 1998 S-U table produced by Statistics South Africa. The SAM consists of 42 industrial sectors and 42 commodity lines (see Appendix 0). Labour is disaggregated into three categories: high skilled, medium and low skilled. The household income and expenditure accounts are disaggregated according to income decile, with the highest income decile separated into 5

further sub-sections. The model is national in scope and thus does not capture the very important regional implications. Regional based SAMs are currently not available.

We also considered using the 1998 SAM recently made available by Statistics South Africa. This SAM has fewer sectors, but has more detail regarding occupational employment (10 occupations) and household income categories. Employment and household income categories were also broken down by race. This SAM was not used, as the factor incomes are not directly linked to household income categories. Relative differences in the returns to skill categories were not reflected in relative changes in household income. For example, the fact that relatively high returns to skilled labour increase the relative income of high-income households could not be modelled using the Statistics SA SAM.

To simulate the export growth, import penetration and investment impacts arising from port restructuring we use a simple output based model. To capture the wealth effects arising from lower import and domestic prices we use a price based model. These models are briefly discussed. See Appendix 0 for a more detailed discussion of the methodology.

3.2 Export Growth, Import Penetration and Investment Model

We model the economy-wide impacts of export growth and import penetration in two stages. Firstly, using cost data and substitution elasticities we estimate export growth and import penetration arising from a reduction in the costs associated with using the relevant terminals. Secondly, to capture the indirect effects we use a *quantity model*, which models the impact of changes in final demand on the direct and indirect *output* of industries in the economy. A change in demand for a particular product affects upstream industries via changes in demand for intermediate goods. These are the *direct effects*. As these intermediate good sectors adjust production to realise the change in demand, they demand inputs from their suppliers. In this way a demand shock filters through the economy via the *backward linkages*. These effects are called the *indirect effects*.

The standard approach to modelling the direct and indirect output responses to a demand shock is the Leontief fixed production coefficient model. This is written as

(1) $$X = (I - A)^{-1} F$$

Where X is a column vector of commodity and activity outputs, A is the matrix of column coefficients and F a column vector of aggregated final demand. Changes in final demand arising from increased exports, household consumption or investment boost output via the Leontief inverse $(I-A)^{-1}$:

(2) $$\Delta X = (I - A)^{-1} \Delta F$$

The total effect on production is generally a multiple of the initial demand shock. Changes in taxes, imports and employment can be linked to changes in sectoral output estimated using the model.

One shortcoming of the standard S-U model is that income generated via increased production does not re-enter the system in the form of changes in final demand. As output changes, so income is generated in the form of factor payments. Households use this income to purchase goods & services thus providing a further source of demand for

industrial products. Because SAMs provides data on income and expenditure for various households we can incorporate the income-expenditure loop (*income multiplier*) into the model. Because income generated through changes in production are re-introduced into the system via changes in final demand, the multiplier effect is greater than in the standard S-U (and I-O) model. The SAM model solves for changes in production, household income and employment endogenously.

3.3 Wealth Effect

The wealth effect is included in the results, to take into account general price changes in the economy and the impact these may have on a person's purchasing power. With the import prices falling, local firms will be forced to drop their prices to maintain their competitiveness. On the one hand this will dampen the market share that is lost to imports. On the other hand this general fall in prices will increase spending power in the economy. With increased spending power, more will be demanded, causing output to adjust accordingly.

The wealth effects arising from lower product prices are modelled in two stages. Firstly, the impact of lower import prices (and domestic import competing prices) on prices in downstream industries is modelled using a simple Leontief price model. This model assumes inputs in the production process are used in fixed proportions and that any cost reductions arising from cheaper inputs are fully transmitted to downstream industries (see Roland-Holst and Sanch, 1995). Lower prices raise the real wealth of consumers who respond by increasing consumption. In the second stage, we estimate the direct consumption effect arising from lower product prices using price elasticities of demand. Both the increase in demand by domestic and international consumers is estimated. The direct output responses are then run through the output model in order to obtain the indirect impacts on output and employment.

The price model makes use of the dual of the conventional Leontief input-output model as described by Millar & Blair (1985). This model is expressed as

(3) $$P' = V'(I - A)^{-1}$$

where P is a vector of activity and commodity prices, A is the matrix of direct input coefficients and V' is the row vector of primary input coefficients. Note that we are using a Supply-Use table format instead of the familiar industry-by-industry Input-Output format. This allows us to determine the impact of exogenous changes in prices on activities (production sector) as well as commodities. Assuming that the structure of the economy, as captured by the coefficient matrix A remains constant, a change in the primary input prices per unit of gross output, following a reduction in import prices, gives rise to a decrease in commodity and activity prices, ΔP. This is represented as

(4) $$\Delta P' = \Delta V'(I - A)^{-1}$$

in which $\Delta V'$ is the change in primary input prices per unit of gross output and $\Delta P'$ the change in the commodity or industry prices. The model is based on the assumption that price changes are pushed forward in a cost-push fashion. This means that demanders are assumed to be price takers. Moreover, in the case of an initial price reduction following the lowering of import prices, it is assumed that this will indeed be offered as lower costs to the

intermediate client, instead of being absorbed in the form of higher surpluses. This implicitly assumes full competition such that the suppliers have no market power to extract higher prices than the marginal cost of production.

The model further assumes that firms do not respond to changes in relative prices by substituting between intermediate inputs. The model imposes fixed production coefficients (as reflected in the *A* matrix). For small price shocks this assumption is realistic.

Using this model we can capture the first round price impact of a reduction in the price of imports on downstream industries (*forward linkages*). These can be termed the *direct effects*. We also capture the subsequent effect that price reductions in the downstream industries will have on the rest of the economy (as revealed by the Leontief inverse). These effects are the *indirect effects*.

3.4 Assumptions and limitations

Economic modelling involves the use of simplified models to capture the complex interactions between economic agents within an economy. By necessity these models are highly stylistic and require numerous simplifying assumptions. A good understanding of these assumptions is important as they define the limitations of the modelling results. In this section we briefly discuss the implications arising from the assumptions made in the models. The key assumptions in the *output model* are:

- Inputs are used in fixed proportions;
- Constant returns to scale;
- Prices are fixed and do not respond to demand shocks;
- Excess capacity with no supply constraints; and
- Consumer expenditure allocated towards commodities in fixed proportions.

The key assumptions made in the *price model* are:

- As in the output model, production is characterised by fixed input coefficients and constant returns to scale;
- Perfect competition which drives the full transfer of input cost reductions to output price reductions; and
- No cross price elasticity of substitution. Firms do not shift towards substitutes in response to relative price shocks.
-

These assumptions are potentially severe, particularly for large shocks in the economy. An important assumption of SAM based modelling is that the production structure remains constant. Thus, our analysis is comparative static by nature and ignores any dynamic effects, such as substitution between labour and capital and between domestic and imported intermediates.

The price and output models impose the assumption of fixed coefficients by assuming either prices are constant (output model) or that output is constant (price model). As a result these models do not model simultaneous changes in *prices* and *outputs*. In the output model prices do not respond to changes in demand while in the price model output does not respond to changes in prices. In reality we expect a combination of both *price* and *output* effects. For example, an increase in investment arising from the construction of new port facilities will stimulate demand for investment intensive sectors such as construction and

machinery & equipment. These sectors will generate further demand through backward linkages. However, in sectors where supply is constrained, prices may rise in response to increased demand. Firms and consumers will respond to these price increases by (a) reducing overall use of these products and (b) shifting towards relatively cheaper products. This will change the production structure assumed fixed in the model.

The assumption that there is sufficient capacity available in the backward linkages to satisfy any demand required by the downstream industries may be true for most secondary and tertiary sectors, but not necessarily for primary sectors. For example, it is possible that agriculture or coal will *not* expand their production to meet additional demand for those products that are directly or indirectly related to public sector infrastructure investment or any other injection into the economy. A similar problem is that of excess supply of labour. The assumption of excess supply is valid for less skilled labour given the high unemployment level in South Africa, but is not valid for highly skilled labour. Unless highly skilled labour responds by increasing their productivity in order to produce increased output, the output response will be muted. If the shocks are large and supply constraints are binding then alternative modelling approaches are required or these constraints need to be directly incorporated into the existing model.

If domestic price increases are restricted by foreign prices, the excess demand will be sourced from the international markets. In both cases the economy wide impact will be substantially less than if excess capacity existed in all sectors of the economy. The output model is thus likely to over-exaggerate the impact of demand shocks arising from port restructuring. This is particularly the case if these shocks are large. The shock effect of concessioning can be considered as small.

Similar biases are evident within the price model. Firstly, the price model assumes perfect competition and that cost reductions in production are fully transferred to users of these products. In reality, markets are not characterised by perfect competition. Prices are often sticky downwards and cost reductions are taken in the form of higher profits. This is particularly the case in highly concentrated industries where competition is limited. The assumption is more valid in highly competitive markets characterised by a large number of firms.

A second problem is that price changes give rise to both *substitution* and *income* effects. While the decline in import prices is expected to reduce the prices in all sectors of the economy, they will reduce prices of imported products the most. In response consumers and producers will shift towards imported products changing the production and consumption structure that is assumed fixed in the model. In addition, the overall decline in prices will raise the real wealth of consumers inducing increases in the consumption of all products (income effect). The substitution and income effects are not fully captured in the price model, although an attempt is made to proxy the income effect in the output model.

A further problem with these models is that they do not maintain the key macroeconomic balances such as the balance of payments and saving-investment equilibrium. For example, restructuring is expected to give rise to increased imports (ignore export effect for the purpose of this example). This will have a negative effect on the balance of payments, which will place upward (depreciation) pressure on the exchange rate. A depreciation of the exchange rate will in turn affect export competitiveness and may enhance export growth. On the other hand, a depreciation of the currency will raise production costs particularly in

those sectors that are dependent on imports as inputs in the production process. These important macroeconomic effects are not captured in the models.

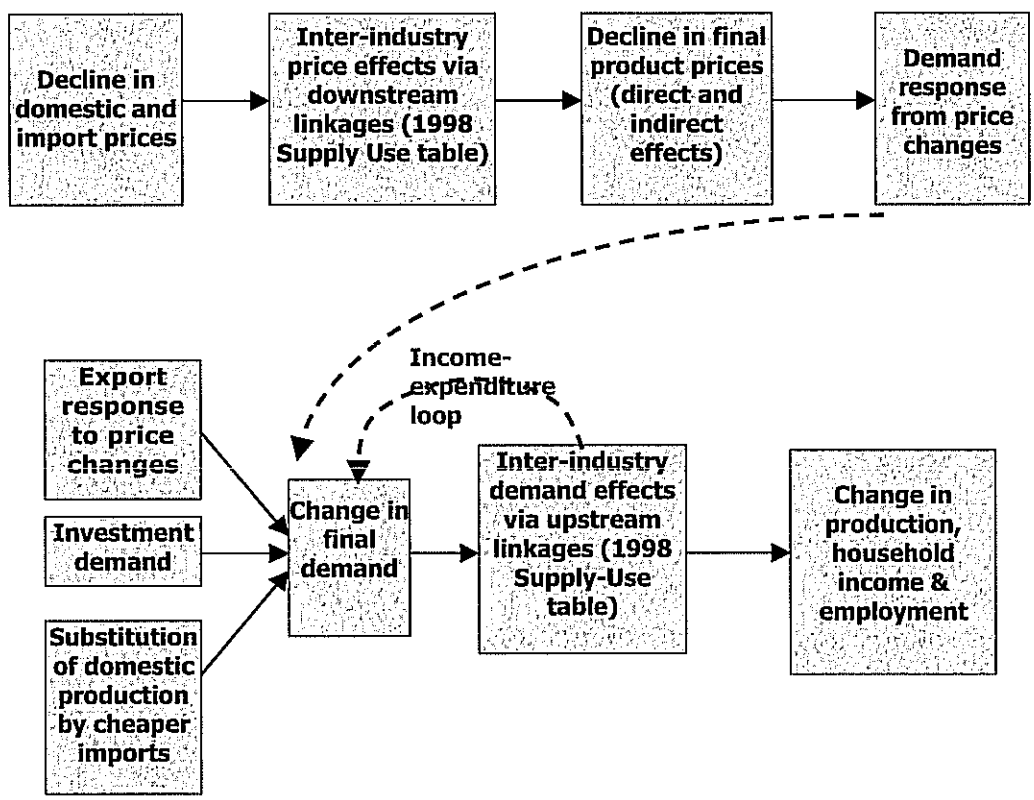
A further limitation of both models is that they are based on national data. Many of the upstream and downstream linkages will be concentrated within Kwazulu-Natal and Gauteng. Although the initial shocks are scaled to national data, the models implicitly assume that the economic structure within Kwazulu-Natal and Gauteng is similar to the rest of the economy. Given the assumptions in the models, all results must be treated with **caution**. The results give some indication of the direction and magnitude of the impacts. However, a wide confidence interval surrounds each point estimate, i.e. the actual impact may vary substantially from the estimated impact.

3.5 Model calculation flow and data related assumptions

The modelling is performed in two stages. We first use the price model to estimate the direct and indirect price effects arising from lower import prices. We then use these price changes to estimate demand responses by domestic consumers and export markets (wealth effect). In the second stage the quantity model is used to assess the direct and indirect economy-wide impact on production, household income and employment arising from: A0 the wealth effect; b) increased exports; c) a reduction in domestic production from increased import penetration, and d) increased investment.

The chain of events are represented in Figure 3.1:

Figure 3.1: Logic Chain for Direct and Indirect Impacts



Details relating to the data used are now presented.

Export growth and import penetration

Data on actual export prices are not available. However, export and import values and the number of teus and harbour tons were available for 96 commodity categories. This data was converted to the 42 industrial sectors used in the SAM which is based on the 5th edition Standard Industrial Classification (SIC 5) system. Many of the 96 commodity categories were omnibus categories that included a diverse range of products. These often did not map cleanly to the SIC 5 based categories in the SAM. The values in the omnibus categories were allocated to the relevant sub-sectors using proportions obtained from national trade data. The allocation procedure may bias the trade values within some of the categories.

To estimate the impact on export growth arising from port restructuring, data on (a) port costs, (b) export prices and (c) export price elasticities (η) are required. The percentage change in exports can be calculated as $\eta * \%\Delta P_E$ where P_E is the export price. $\%\Delta P_E$ is estimated as the change in port costs divided by the export price. To ensure common units we estimate port costs and export prices per teu or harbour ton.

Disaggregated price data are not available. We, therefore, approximate export prices per unit (teu or ton) for each sector by dividing the value of exports through the terminal by the number of teus or tons. These estimates proved highly volatile, particularly where tonnage/teu amounts were low, so we aggregated import and export data to obtain an average value per ton or teu. This process assumes that import and export values are equivalent. Further, the process assumes a high degree of homogeneity between products within each of the 42 sector classifications. (Appendix

To calculate the costs associated with using the terminals the following costs were included:

- port handling charges
- SAPO tariffs
- Interest charges (15 %) associated with a 4.5 day delay period
- Ship delay costs for 4.5 days at an estimated cost of $21.57 per teu per day

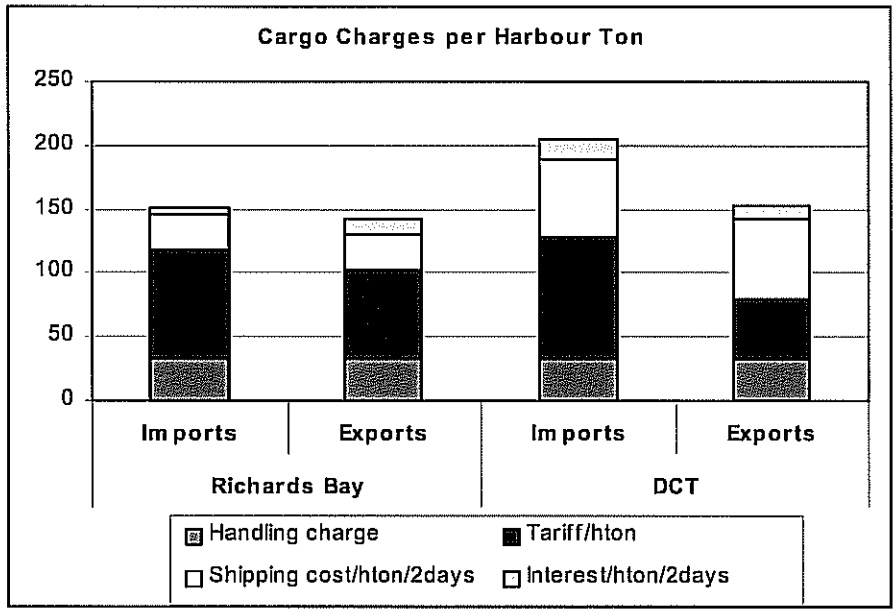
This process assumes a broader definition of harbour costs than simply the port handling charges and SAPO tariffs. The composite cargo charges used in this analysis explicitly recognise the costs associated with harbour delays. These costs can account for up to 50 % of the total cost associated with shipping goods through the harbour. It is expected that reductions in the cost associated with trading through the terminals will be achieved through increased efficiency, i.e. lower delay times.

The average costs per harbour ton for the Richards Bay MPT and the DCT are presented in . (For details of the estimation of cargo charges see Appendix 7.3 on "Data source and methods of estimation") Cargo charges range between R150 to R200 per harbour ton. Average port costs for imports are lower in Richards Bay, but the costs for exports are roughly similar.[6] These cargo charges range between 1 % and 9 % (with an average of 3

[6] Exact information needed to calculate cargo charges in Richards Bay was sought but has not yet been received (17/02/03). The figure above is based on information taken from the Durban DCT and adapted to the composition and tonnage of cargo in the RBMPT.

%) of the total value of exports and imports. A 50 % reduction in cargo charges will on average reduce the international price of exports and the domestic price of imports by 1.5 %.[7]

Figure 3.2: Cargo charges per harbour ton



Long-run export demand elasticities for each sector are drawn from Edwards and Golub (2002).[8] These elasticities are only for broad aggregated industrial sectors so much of the variation in export responsiveness at the sector level is lost. The average elasticity (η) is 1.17. This implies that the average increase in export production in response to a 50 % decline in cargo charges is approximately equal to 1.76 % (η*% price = 1.17*1.5 = 1.76 %).

Estimating the substitution effects arising from lower import prices is more complex. In response to a decline in the relative price of imports, consumers and firms substitute imports for domestic products. However, domestic firms also respond to increased competition by

[7] In the model, it is assumed that exporters take advantage of the decreased costs, by lowering export prices and increasing export volumes to meet the increased world demand. In reality this course of events may not occur and a reduction in costs at a port may not lead to an increase in exports. Instead, exporters may maintain their export volumes at the original price and increase their profit margins, rather than reducing the export price and increasing their export volumes. Thus, the increased efficiency of the ports may not generate increased exports, but may translate into increased profits for exporters. In this event only the owners and current employees of export factories will benefit. In the long-run, however, these profits will attract new firms into the sector and export supply will increase.

[8] These elasticities are based on costs, not prices. Nevertheless, they provide some indication of the relative responsiveness of exports to changes in prices.

lowering their product prices, which also lowers the degree of import penetration. To estimate the substitution effect, we draw upon short-run Armington elasticities obtained from research contracted by the Trade and Industrial Policy Strategies. Armington elasticities reflect the substitution between domestic and imported products in response to changes in the relative price of imported products.[9]

In calculating the import displacement effects we made the following assumptions:

- The percentage change in import prices is estimated as the change in cargo charges divided by the value of imports per teu or harbour ton.
- The long-run import demand elasticities are estimated at 2.4 times the short-run elasticities. International empirical evidence (see Goldstein and Kahn, 1985) suggests that the long-run elasticity is approximately 2.4 times the short-run elasticity.

Domestic producers respond to increased import competition and reduce domestic prices by 50 % of the decline in import prices. The decline in domestic prices reduces the extent to which imports substitute domestic products by 50 %.[10] The simple average elasticity of substitution was 0.87. This implies that a 1 % rise in the price of domestic goods relative to imported goods (PD/PM) raises the ratio M/D by 0.87 %. By virtue of the assumptions made this implies a 0.435 % rise in imports and a 0.435 % percent decline in demand for domestic products. The output model was then used to obtain the negative indirect impact on the economy arising from this decline in demand for domestic products.

Wealth Effect

The impact of price changes on domestic demand form the central linkage in estimating the wealth effect arising from lower import prices. Lower cargo charges reduce the price of all imported products. In addition, we assumed (see above) that some domestic prices also decline.[11]

Price reductions have two effects on consumers. Firstly, changes in relative prices cause a substitution towards the relatively cheaper products (substitution effect). Secondly, a

---

[9] The armington elasticity is calculated as $\varepsilon = \%\Delta(M/D) / \%\Delta(P_D / P_M)$ where M, D, P_D and P_M are imports, domestic products, price of domestic products and price of imported products, respectively. Taking logs the percentage change in the ratio of M/D can be estimated as $\hat{M} - \hat{D} = \varepsilon(\hat{P}_D - \hat{P}_M)$ where the '^' reflects percentage change.

[10] More specifically, using $\hat{M} - \hat{D} = \varepsilon(\hat{P}_D - \hat{P}_M)$ in footnote 9, we assumed that $\hat{M} = -\hat{D}$. An example of the procedure is as follows. Assume P_M falls by 10 % and the elasticity of substitution (ε) is equal to 2. According to the procedure followed we assume that P_D falls by 5 %. This implies that the ratio *M/D* must rise by 2*(-5+10) = 10 %. This is achieved through a 5 % reduction in *D* and a 5 % increase in *M*.

[11] In standard trade theory models that impose the small country assumption, domestic prices will decline by the full reduction in import prices. In this model we impose a degree of substitutability between imported and domestic products. The domestic price will therefore not decline by the full reduction in cargo charges. To map the port terminal level data onto the national SAM, the vector ΔP' in equation (4) was weighted downwards by the port terminal's share of imports in national imports. Further adjustments were made to account for the increase in imports through the terminal. Finally, the adjusted ΔP' was raised by 30 % to account for domestic price reductions through increased international competition.

reduction in prices raises the overall wealth of the consumer by reducing the cost of living (income effect). The income effect positively affects the consumption of all products that have income elasticity greater than zero. In order to estimate the price impact on demand, we need to take into account both the substitution and income effects. Because this is not a general equilibrium model we approximate the impact in the following manner.
Price elasticities of demand are used to estimate the direct demand response to changes in commodity prices. Price elasticities of demand reflect the responsiveness of demand to changes in that product's prices while holding all other prices constant. Although this does not fully capture cross price elasticity of demand or substitution effects, it is an approximation of the combination of these effects. Price elasticities are obtained from empirical estimates obtained from Barr (1983), Bitsakis (1986), Contogiannis (1982) and Case (1998) (See appendix 0).

In the model, consumers maintain their level of nominal expenditure. Because prices decline households' real expenditure increases. The income effect is measured as the difference between households' original nominal expenditure and their original consumption including the price elasticity induced consumption measured in the 'new' prices. The additional income is allocated to all products on a pro-rata basis, which implicitly assumes an income elasticity of 1.

A decline in commodity prices also positively affects South Africa's export competitiveness. To capture the export response to lower product prices we use long-run export price elasticities derived from Edwards and Golub (2002). The export response effect is included in the wealth effect in the analysis that follows.

Investment

Investment of R1.8 billion is estimated to take place during the restructuring of the Durban container terminal. Included in this figure is only that amount of the total investment that would generate demand within the domestic economy.[12] No substantial investment is modelled for the Richard's Bay MPT.

Increased Capacity

The positive benefit that increased capacity will have on the economy in the future is not measured.

[12] The total estimated investment needed at DCT is R3,5 billion. Source: Bob Goethe, Working paper 1.

4 The DCT and RBMPT in the National Ports Context

Information assembled from NPA records indicates that a total of 196 million harbour tons (imports and exports) representing a value of R255 billion was handled by South African Ports in 2001/2. The ports included in this analysis are Durban, Cape Town, East London, Port Elizabeth, Richards Bay and Saldanha.[13] These figures exclude the transhipped cargo, which, as explained earlier, is not treated in this study. They also exclude liquid bulk petroleum imports, the information on which was withheld.

The share of SAPO and the private sector in the handling of this cargo is illustrated below in Figures 4.1 and 4.2. It can be seen that SAPO accounts for the lion's share of cargo on the South African port system, particularly in value terms. In tonnage terms the private sector was responsible for just under 40% of cargo handled, whereas in cargo value terms, the private sector accounted for only 15% of the total. Inclusion of petroleum bulk imports would substantially alter this picture in favour of the private sector.

Figure 4.1: SAPO Share – Harbour Tons

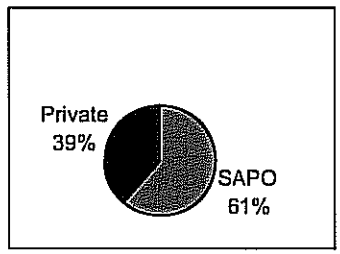


Figure 4.2: SAPO Share - Value

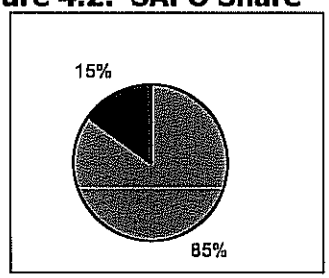
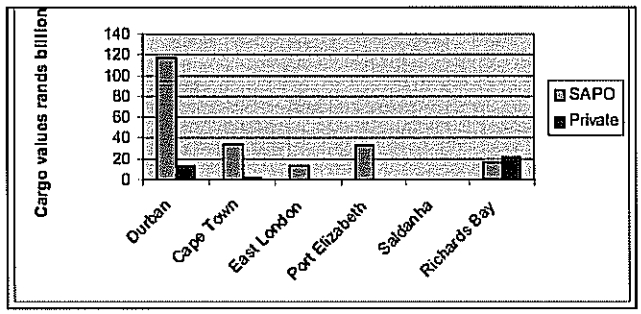


Figure 4.3 shows the share of SAPO and the private operators in the different ports, in terms of the value of cargo handled. Richards Bay, Durban and Cape Town are the only ports with significant private sector participation. The dominance of SAPO activities in Durban stands out, with Cape Town and Port Elizabeth well below Durban's level, followed by Richards Bay, East London and Saldanha (the value of cargo in the latter is too small to show on the figure).

[13] Mossel Bay, which handles very little cargo, was excluded from the concessioning study.

Figure 4.3: SAPO Share by Port



Figures 4.4 and 4.5 show the DCT and RBMPT respectively within their port contexts. In Durban, the DCT stands out as South Africa's giant terminal, with cargo value throughput of some R93 billion, comprising 37% of cargo value handled in South African Ports (excluding bulk petroleum). The private sector operators, most on Maydon Wharf, handled the second largest throughput of freight in value terms, an amount of over R 10 billion.

Figure 4.4: Durban Terminals

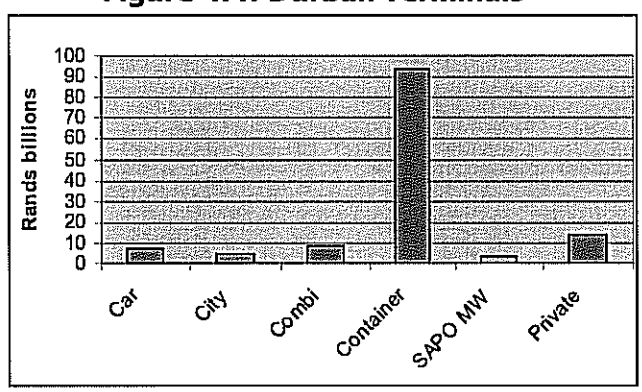
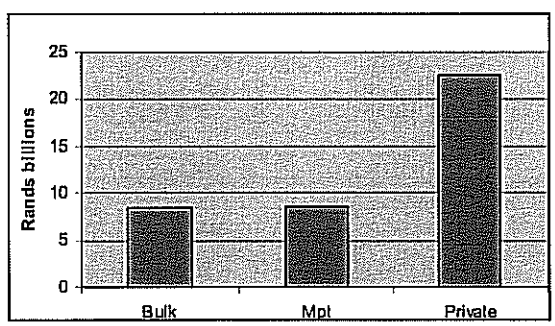


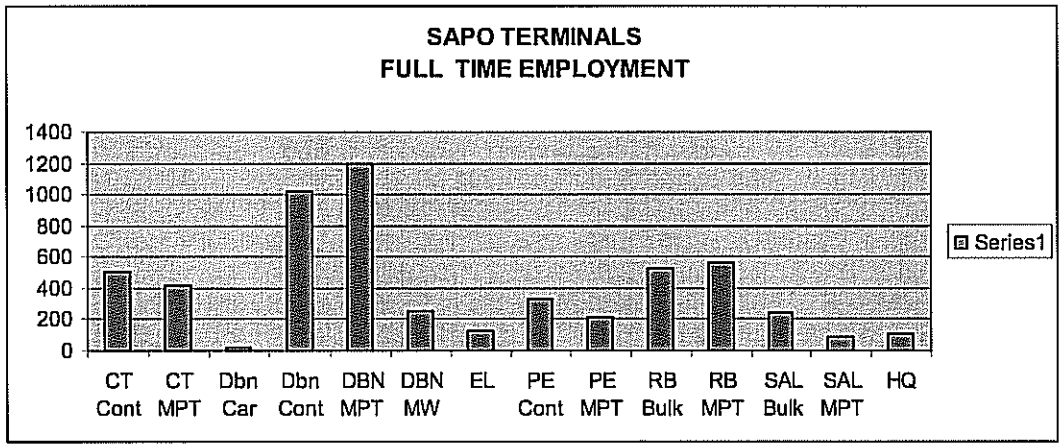
Figure 4.5: Richards Bay Terminals



Richards Bay is the only port in which the private sector dominates. This reflects the importance of the purpose-built coal terminal serving the mines in Mpumulanga and Northern KwaZulu Natal. The RBMPT, which has been chosen as the second case study handles just less than 10 billion. Some 95% of this represents cargo shipped.

Employment data for SAPO terminals was collected by the team. These are shown in Figure 4.6. The total full time SAPO workforce was 5,616. This figure excludes casual workers and stevedores.[14] Despite its small cargo value throughput relative to the DCT, the largest terminal is the Durban MPT, with a full time staff of 1194. The DCT is the second largest, with 1,020 full time workers. The Richards Bay MPT emerges as the third largest employer with 562 full time staff. These figures will be of interest when examining the impact of terminal concessioning on employment within the wider economy, which is done below.

Figure 4.6: SAPO Employment by Terminal



Source: Workng Paper 2.

In summary, the two case studies, taken together cover a very significant proportion of total cargo value handled through South African ports and a substantial number of SAPO employees. Analysis of the DCT provides insights into the likely economic impacts of concessioning South Africa's most important container terminal, which has presented some of governments most pressing concerns in terms of operational efficiency. The RBMPT, while much less significant in terms of the freight handled than the DCT, presents some of the features that are common to the multi-purpose terminals operated by SAPO in all the ports.

[14] The numbers of casual workers and stevedores are substantial. In the case of the DCT the former number is 179 and the latter 339, both estimated as full time equivalents. The sources of this information and methods of estimation are given in Appendix 4.

5 Results: Durban Container Terminal

In this section we present the simulated results of restructuring within the Durban container terminal. The contribution of DCT users (exporters and importers) to the domestic economy is first presented. This is followed by a presentation of the economy-wide impacts of a 10 % and 50 % reduction in cargo charges.

5.1 Contribution of DCT Users to the Domestic Economy

Share of Total Trade

Table 5.1 presents the value of exports and imports transported through the DCT during 2001/2. The total value of exports equalled R41 182 million while the total value of imports equalled R53 356 million.[15] Export values are not evenly distributed across sectors. Sectors accounting for large shares of total exports through the DCT are:

- Other industries (R 5 877 mill)
- Chemicals (R 4 913 million)
- Basic iron & steel (R 3 820 million)
- Metal products (R 3 516 million)
- Beverages & tobacco (R 3 431 million)
- Paper & paper products (R3 319 million)
- Together these sectors account for 60 % of total exports through the DCT.

Table 5.1: Export and import trade transported through the DCT, 2001

Sectors	Value of imports (R mill)	% of National Imports through Durban	Value of exports (R mill)	% of National Exports through Durban
Agriculture, forestry & fishing	1,786	53.8%	1,928	20.2%
Coal	9	0.6%	24	0.1%
Gold	0	0.0%	0	0.0%
Other mining	408	1.3%	808	1.6%
Food	1,938	25.9%	1,222	13.3%
Beverages & tobacco	578	53.2%	**3,431**	66.5%
Textiles	**2,986**	75.3%	2,020	80.3%
Wearing apparel	752	35.0%	948	41.0%
Leather	380	40.3%	438	39.2%
Footwear	637	35.0%	48	41.0%
Wood & wood products	293	21.3%	761	37.2%
Paper & paper products	1,256	39.2%	**3,319**	47.4%
Printing, & publishing	0	0.0%	0	0.0%
Coke & refined petroleum products	411	6.4%	275	2.8%

[15] See Appendix 4 for details on data sources, problems and methods of estimation.

Basic chemicals & other chemicals(1)	**7781**	27.6%	**4913**	25.9%
Rubber products	1,002	41.7%	457	32.8%
Plastic products	498	22.1%	171	16.9%
Glass & glass products	305	36.4%	68	12.8%
Non-metallic minerals	333	11.7%	172	12.7%
Basic iron & steel	1,118	37.2%	**3,820**	19.2%
Basic non-ferrous metals	315	10.5%	2,694	27.3%
Metal products excluding machinery	**3,753**	74.6%	**3,516**	68.7%
Machinery & equipment	**5,266**	13.8%	933	4.6%
Electrical machinery	1,019	13.8%	133	4.6%
Television, radio & communication	2,322	13.8%	113	4.6%
Professional & scientific equipment	**5,618**	71.2%	1,022	70.0%
Motor vehicles, parts & accessories	**3,784**	10.7%	215	1.3%
vOther transport equipment	1,051	10.7%	443	18.6%
Furniture	451	40.3%	1,414	39.2%
Other industries(2)	**7,307**	91.5%	**5,877**	90.6%

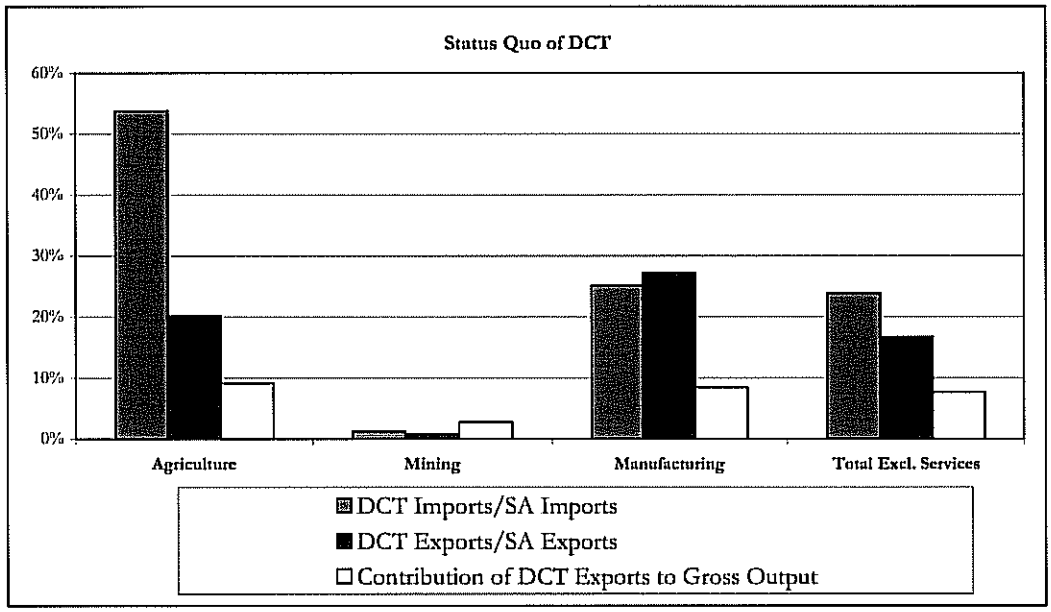
Note: (1) Basic chemicals [SIC 334] is combined with other chemicals & man-made fibres [SIC 335-336] as it was not possible to separate out these sectors from the trade data provided.
(2) the value for 'Other industries' is biased upwards as it was not possible to allocate certain sectors. In addition, many of the omnibus categories included products which belonged to this category. The process of allocating trade values in the omnibus categories may have biased trade values in the 'other industries' sector upwards.

Using South African trade data obtained from the Trade and Industrial Policy Strategies (TIPS) it is possible to estimate the contribution of trade through the DCT towards total South African trade. As shown in
Figure exports and imports transported through the DCT account for approximately 15 % and 24 % of total (excluding services trade) South African exports and imports, respectively.[16] ,

At a broad sectoral level products shipped through the DCT account for 20 % and 27 % of South African exports of agriculture, forestry & fishing products and manufacturing products, respectively (see
Figure). Very low shares of South African mining trade passes through the DCT. Within manufacturing, high shares of SA exports of beverages & tobacco (66.5 %), professional & scientific equipment (70 %) and 'other industries' (90.6 %) are shipped through the DCT. Low shares are found in motor vehicles (1.3 %), mining (less than 2 %) and electrical and non-electrical machinery & equipment (4.6 %). Because of an imperfect mapping between the SAM commodity categories (based on SIC 5th edition) and the trade data provided by the port authorities, there may be some biases in these shares. This is particularly problematic for the category 'other industries', and may also account for the very high share of the DCT in agricultural imports[17].

[16] Some of the import trade may be for the SACU region. It is not possible to separate out imports destined for SACU from the data provided.
[17] An additional factor in assessing agricultural imports is that these are often subject to strong swings from year to year depending, for example, on drought.

Figure 5.2: Imports, exports and contribution to gross output of DCT users



Imports are concentrated within the following sectors:

- Chemicals (R 7 781 million)
- Other industries (R 7 307 million)
- Professional & scientific equipment (R 5 618 million)
- Machinery & equipment (R 5 266 million)
- Motor vehicles and accessories (R 3 784 million)
- Metal products (R 3 753 million)
- Textiles (R 2 986 million)

Together these sectors account for 68 % of the total value of products imported through the DCT.

A very high share of South African agricultural imports (54 %) is imported through the DCT. However, the value of agricultural imports is small and only accounts for 3.3 % of the total value of imports through the DCT. Manufacturing products imported through the DCT account for 25 % of South African manufacturing imports. Within manufacturing, approximately 70 % of South African imports of textiles, professional & scientific equipment and metal products pass through the DCT.

Contribution towards domestic production and employment

Through the production of exports, domestic firms employ labour and purchase intermediate products. Using the output model it is possible to estimate the total (direct + indirect) contribution towards the economy of export production that is transported through the DCT. This procedure, however, will underestimate the importance of the DCT towards the

domestic economy as it fails to account for the important contribution of imported products towards production.

Figure 5.3 shows the total contribution towards gross output for the broad industrial sectors. Exports through the DCT account for 8.41 % and 9.13 % of total production within the agriculture and manufacturing sectors, respectively. In value terms this translates into R5 billion and R45 billion for agriculture and manufacturing, respectively. R44 billion worth of services are also provided through the production of DCT exports. Although services are not directly exported, indirect demand for services generated through the production of exports is high.

Figure 5.3: Contribution of exports to gross output

Sectors	Contribution of DCT Exports to Gross Output	Value of Gross Output (R mill)
Agriculture	9.13%	5085
Mining	2.77%	4052
Manufacturing	8.41%	45496
Services Excl. Government	5.11%	44187
Total	**6.30%**	**98820**

The contribution of exports transported through the DCT to employment is presented in Figure 5.4. The employment data used to obtain these estimates are obtained from the 2002 Labour Force Survey. The labour force survey estimates that there were approximately 10 million formal and informal workers in the South African economy in 2002. Exports transported through the DCT directly and indirectly account for 4.36 % of this total. This translates into 435 791 workers. A slight bias towards high skilled labour is evident where DCT exports account for 5.22 % of total employment (or 128 3111 employees). These results suggest that 1002 jobs are directly and indirectly created per 1000 teus that are exported through the DCT. It must be emphasised that these jobs are **not** directly generated by the DCT. The values reflect employment generated through export production in firms that ship their products through the DCT.

The bias towards skilled labour is also reflected in the share of household income accounted for by DCT exports.[18] Exports through the DCT account for just under 5 % of income for households in the top income decile (last 5 columns). In contrast DCT exports account for approximately 3 % of household income for households in the lowest income deciles. The differences are, however, minor. These results suggest that changes in exports through the DCT will have a slight bias towards benefiting relatively wealthy households.

Figure 5.4: Contribution of DCT exports to employment (formal + informal)

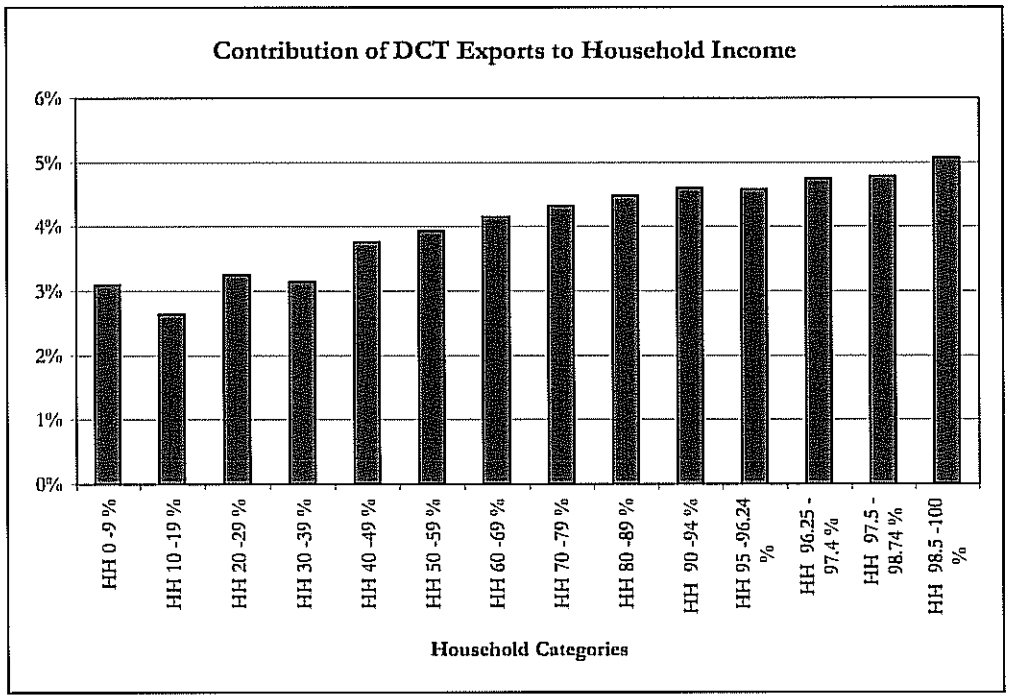
	Percentage total	Employment	jobs/1000 teus
Low Skilled Labour	3.66%	115166	265

[18] These values exclude savings and taxes on firms and remittances by labour.

Medium Skilled Labour	4.37%	192314	442
High Skilled Labour	5.22%	128311	295
Total	**4.36%**	**435791**	**1002**

Total factor incomes generated through the provision of factor services account for 4.8 % of total GDP at factor costs. This is equivalent to R41 billion in 2001 or R48 of every R1000 of income generated. This value reflects the national average. Clearly much of the benefit will accrue to regions that utilise the port intensively: Gauteng and Kwazulu-Natal, in particular. The contribution towards household income will be substantially larger within these regions.

Figure 5.5: Contribution of exports transported through the DCT to South African household income



5.2 Economy-wide impact of DCT restructuring

This section presents the economy-wide results of a 50 % (**sim 1**) and 10 % (**sim 2**) reduction in the costs associated with using the DCT. The results include the effects of R1.8 billion of investment, namely, that part of the estimated total new investment associated with restructuring of the terminal that would generate demand in the domestic economy.

Contribution towards gross output

Error! Reference source not found.5.6 presents the percentage change in South African production within agriculture, mining, manufacturing and services arising from a 50 % and 10 % reduction in cargo charges.

Figure 5.6: Change in Gross Output

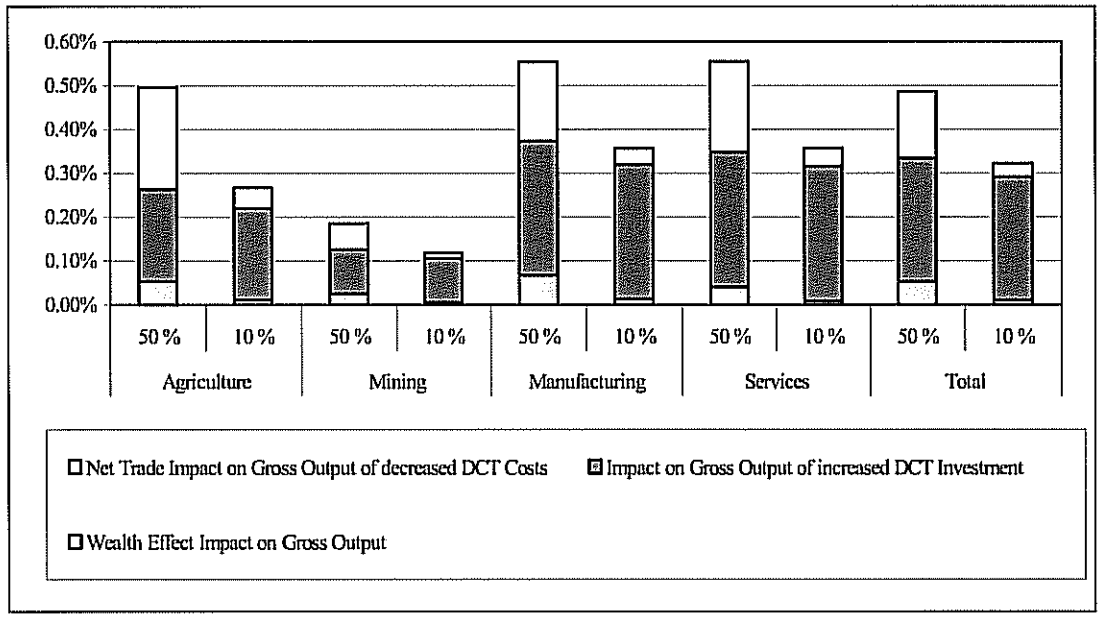


Figure 5.7 presents the rand value of the change in production. In both cases the net trade effect, the investment effect and the wealth effect are shown. The **net trade effect** is the sum of the positive economic impacts arising from increased exports, and the negative economic effects from increased import penetration. The values reflect the direct and indirect effects on gross output within each economic sector arising from changes in production within all other sectors of the economy. In other words, the rise in gross output within agriculture includes the impact on demand for agricultural products arising from changes in production within **all** sectors of the economy, not just the agricultural sector.

Figure 5.7: Impact on South African production arising from a reduction in cargo charges and increased investment, R million

Sectors		Net Trade Impact	Investment Impact	Wealth Effect	Total Impact on Gross Output
Agriculture	50 % reduction	30	117	130	277
	10 % reduction	6	117	26	149
Mining	50 % reduction	30	126	73	229
	10 % reduction	6	126	15	147
Manufacturing	50 % reduction	381	1732	1017	3130
	10 % reduction	76	1732	203	2011
Services	50 % reduction	342	2639	1776	4757
	10 % reduction	68	2639	355	3062
Total	**50 % reduction**	**840**	**4504**	**2450**	**7794**
	10 % reduction	**168**	**4504**	**490**	**5162**

Note: construction is included in services

A reduction in port user costs has a positive impact on production within the economy. This impact rises the more port user costs decline, as is shown in the relatively large output growth associated with the 50 % decline in cargo charges.

In all cases the direct and indirect impact on output from positive export growth exceeds the losses due to increased import penetration. However, the net trade effect is small and raises national gross output by only 0.5 % or R840 million in sim 1. In the simulation with a 10 % reduction in cargo charges the net trade effect is R168 million. According to international trade theory low net trade effects are expected. In response to lower import prices and increased export prices, the economy restructures production towards export sectors. Growth in output and employment within export sectors is matched by declining output and employment in import competing sectors. This relationship has been evident in South Africa since the 1980s (see Edwards, 2001).

Much of the gains from lower cargo charges arise from lower import and domestic prices. Lower prices increase the real wealth of consumers who then increase consumption of products. Further, lower prices improve competitiveness leading to further increases in export production.[19] In the results the wealth effects are 3-4 times larger than the net trade effects. The wealth effects result in a R2 450 million and R420 million increase in gross output in simulations 1 and 2, respectively.

Investment also has a large impact on the economy through its demand-stimulus effect. Investment raises gross output by R4.5 billion in both simulations yielding a multiplier of 2.5 (4.5/1.8). However, this is a one off effect.

Looking at the sectoral breakdown, the **services** and **manufacturing** sectors are the biggest gainers with a 0.56 % and 0.55 % increase in gross output, respectively, in sim 1. This represents a R3 130 million and R4 747 million increase in production within manufacturing and services, respectively. For both these sectors there is an especially large contribution through the investment impact and a large contribution via the wealth effect. Although no services are directly exported, services are utilised in the production of goods within other sectors. The impact on the services sector largely reflects the indirect impacts arising from growth in other sectors of the economy. This highlights the importance of including the indirect effects.

The **agricultural** sector experiences an increase in gross output of abut 0.5 % or R276 million in sim 1. Much of this change in gross output is attributable to the large impact of the wealth effect, which reflects the large share of South African agricultural imports transported through the DCT.

Mining only shows an increase in gross output of about 0.19 % or R229 million in sim 1 and R46 million in sim 2. This partly reflects the very low values of mining products exported and imported through the DCT.

[19] The relationship between improved export performance and lower tariffs is shown by Tsikata (1999). Lower tariffs reduce the anti-export bias of protection and through this increase export production.

These changes in gross output imply a 0.36 % (R3 147 million) and 0.24 % (R2 056 million) increase in GDP measured at factor costs in response to a 50 % and 10 % decline in cargo charges, respectively.

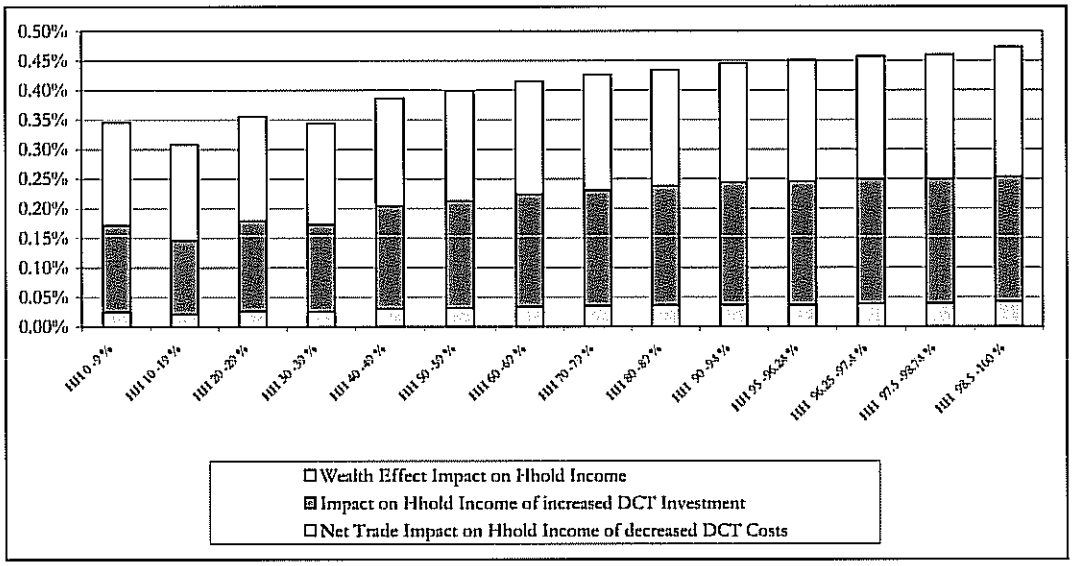
Contribution towards household expenditure and income

Figures 5.8 and 5.9 show the proportionate changes in South African household incomes as a result of the two cost reduction simulations. **Error! Reference source not found.** presents the net change in the value of income in 2001 prices.

Figure 5.8: Net impact on households according to income deciles, R million

Household Categories	50 % reduction in cargo charges	10 % reduction in cargo charges
HH 0 -9 %	29	16
HH 10 -19 %	36	19
HH 20 -29 %	58	32
HH 30 -39 %	75	41
HH 40 -49 %	112	63
HH 50 -59 %	150	85
HH 60 -69 %	222	126
HH 70 -79 %	331	188
HH 80 -89 %	526	301
HH 90 -94 %	429	245
HH 95 -96.24 %	145	83
HH 96.25 -97.4 %	172	98
HH 97.5 -98.74 %	200	114
HH 98.5 -100 %	405	226
Total	**2890**	**1636**

Figure 5.9: Increase in household income (Simulation 1)

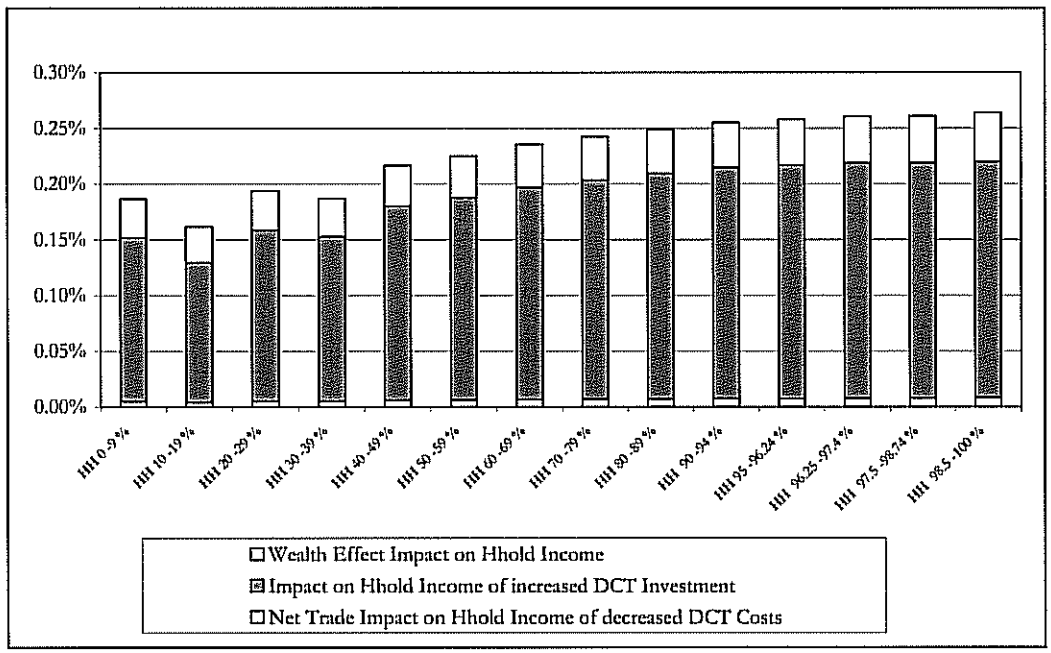


As expected, given the earlier results wealthier households benefit the most. In simulation 1 households in the wealthiest category find their income increasing by about 0.47 % compared to 0.35 % for the lowest income households. In value terms this is equivalent to a

R379 million and R27 million increase in total income within the highest and lowest income categories, respectively. This bias is attributed to the relatively large increases in the returns to skilled labour and gross operating surplus (return to capital) shown in Figure . In the 50 % reduction in cargo charges simulation the total national income of capital and high skilled labour rose by 0.39 % and 0.4 %, respectively. The increase in income of low skilled labour rose by just over 0.2 %. Generally income earned by higher skilled labour and capital is channelled to wealthier households.

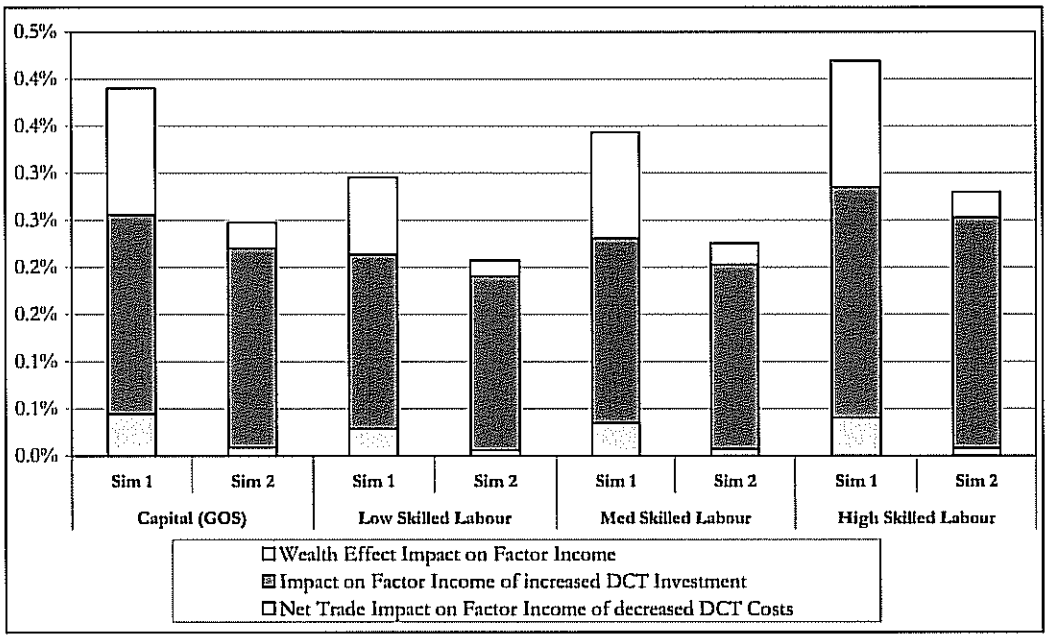
Once again the net trade impact contributes a minimal amount to the change in household income. The contribution to household income is split evenly between the wealth effect and the increased investment impact.

Figure 5.10: Increase in household income (Simulation 2)



The effect of a 10 % reduction in port user costs on household income follows much the same pattern as earlier, except that the magnitude of the results are lower. Total income of the wealthiest household category increases by only 0.27% as opposed to 0.47% in sim 1. The income of low-income households increases by approximately 0.18 %. In this scenario the increase in household income is primarily driven by new investment in DCT facilities. The wealth and net trade effects are small.

Figure 5.11: Increase in factor income

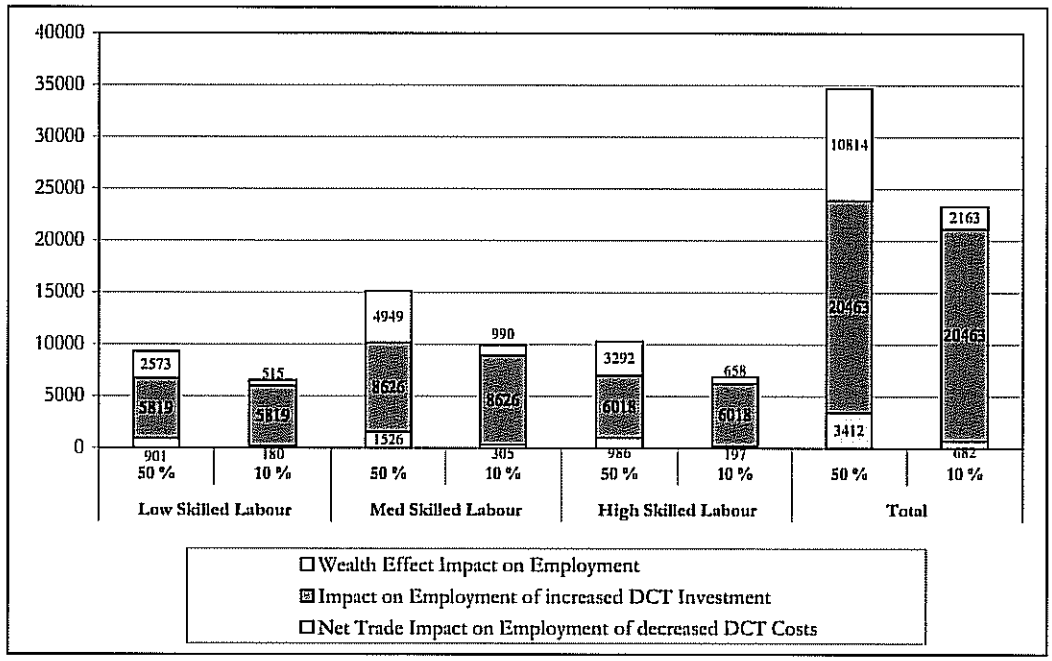


Employment impact

Figure 5.12 presents the impact on total (formal + informal) employment of the two restructuring simulations. 34 690 new jobs are created in the simulation where cargo charges are reduced by 50 %. This figure may be compared with the possible loss of some 200 jobs tentatively suggested in working paper 2. Over half of these jobs, 20 463, are due to the increase in investment. 10 814 jobs are created through the output response to increased real wealth and competitiveness of domestic producers as prices fall. Net trade contributes positively towards employment growth (3 412), but by a small amount. The situation is starker in the case of a 10 % reduction in cargo charges. 23 309 jobs are created but almost all of this is due to increased investment spending (20 463).

In the first simulation, of the 34 690 jobs created, 15 100 are created for medium skilled workers, 10 297 for high skilled workers and 9 293 for low skilled workers. The skill categories benefit in much the same way for the 10 % reduction in cargo charges simulation. High skilled labour increases by 6 874, medium skill by 9 921 and low skilled by 6 514. In each case more than 90% of the jobs are created through increased investment spending.

Figure 5.12: Employment changes



6 Results: Richards Bay MPT

In this section the result for the Richards Bay MPT are presented. The structure follows the format of the previous section.

6.1 The contribution of Richards Bay multi-purpose terminal (RBMPT) to the domestic economy

Share of total trade

Table 2.1 presents the value of exports and imports transported through the RBMPT during 2001. The value of trade flowing through the Richards Bay MPT is small compared to the DCT. The total value of exports equalled R14 571 million while the total value of imports equalled R694 million.

Table 2.1: Export and import trade transported through the RBMPT, 2001

Sectors	Value of imports (R mill)	% of National Imports through Richards Bay	Value of exports (R mill)	% of National Exports through Richards Bay
Agriculture, forestry & fishing	0	0.0%	0	0.0%
Coal	0	0.0%	0	0.0%
Gold	0	0.0%	0	0.0%
Other mining	198	1.6%	**417**	1.4%
Food	0	0.0%	3	0.0%
Beverages & tobacco	0	0.0%	0	0.0%
Textiles	0	0.0%	0	0.0%
Wearing apparel	0	0.0%	0	0.0%
Leather	0	0.0%	0	0.0%
Footwear	0	0.0%	0	0.0%
Wood & wood products	0	0.0%	384	24.1%
Paper & paper products	18	0.6%	**490**	12.3%
Printing, & publishing	0	0.0%	0	0.0%
Coke & refined petroleum products	0	0.0%	71	1.9%
Basic chemicals & other chemicals	92	0.3%	**1476**	7.8%
Rubber products	0	0.0%	3	0.5%
Plastic products	2	0.1%	0	0.0%
Glass & glass products	0	0.0%	0	0.0%
Non-metallic minerals	24	1.9%	0	0.0%
Basic iron & steel	13	0.7%	**8856**	59.2%
Basic non-ferrous metals	8	0.3%	**1774**	18.5%
Metal products excluding machinery	14	0.5%	774	31.2%
Machinery & equipment	194	0.6%	162	2.2%
Electrical machinery	37	0.8%	23	1.2%
Television, radio & communication	85	0.9%	20	1.7%
Professional & scientific equipment	0	0.0%	0	0.0%

Motor vehicles, parts & accessories	0	0.0%	0	0.0%
Other transport equipment	2	0.0%	116	7.0%
Furniture	0	0.0%	0	0.0%
Other industries	6	0.1%	1	0.0%

Note: the value for 'Other industries' is biased upwards as it was not possible to allocate certain sectors. In addition, many of the omnibus categories included products which belonged to this category. The process of allocating trade values in the omnibus categories may have biased trade values in the 'other industries' sector upwards. This problem may also account for the very high percentage of wood products. The RBMPT exports large quantities of wood chips, a category that is normally placed under Forestry.

The value of exports is not evenly distributed across sectors. Sectors accounting for large shares of total exports through the RBMPT are:

- Basic iron & steel (R8 856 million)
- Basic non-ferrous metals (R1 774 million)
- Chemicals (R1 476 million)
- Metal products (R774 million)
- Paper & paper products (R490 million)
- Other mining (R417 million)

Together these sectors account for 94% of total exports through the RBMPT.
Exports and imports through the RBMPT account for approximately 4.6 % and 0.3 % of total (excluding services trade) exports and imports in South Africa, respectively.

The importance of the RBMPT to the South African economy is reflected in the share of national exports that are transported through the RBMPT. These exports are almost entirely manufacturing products. As shown in Figure 6.2 exports of manufacturing products through the RBMPT account for 11 % of total South African exports of manufacturing products. High shares are found in wood & wood products (24 %), basic iron & steel (59 %) and metal products (31 %). Very low shares of agricultural and mining products are exported through the RBMPT.

Figure 6.2: Imports, exports and contribution to gross output of RBMPT users

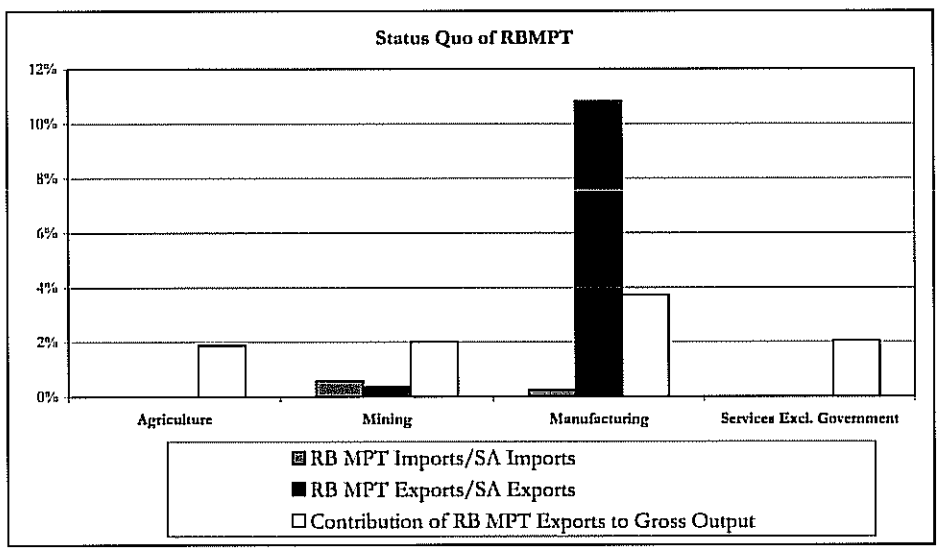


Figure 6.2 highlights the low share of South African imports that flow through the RBMPT. Imports through the RBMPT are concentrated within the following sectors:

- Other mining (R 198 million)
- Machinery & equipment (R 194 million)
- Chemicals (R 92 million)
- Television, radio & communication (R 85 million)

Together these sectors account for 82 % of the total value of products imported through the RBMPT.

Contribution towards domestic production and employment

Figure Figure 6.3 shows the total contribution towards gross output for the broad industrial sectors. Exports through the RBMPT account for 1.89 %, 2.01 % and 3.72 % of total production within the agriculture, mining and manufacturing sectors, respectively. In value terms this translates into about R1 billion, R3 billion and R21.3 billion for agriculture, mining and manufacturing, respectively. R17.8 billion worth of services are also provided through the production of RBMPT exports.

Figure 6.3: Contribution of exports to gross output

Sectors	Contribution of RBMPT Exports to Gross Output	Value of Gross Output (R mill)
Agriculture	1.89%	1051
Mining	2.01%	2926
Manufacturing	3.72%	21372
Services Excl. Government	2.06%	17790
Total	**2.65%**	**43139**

The contribution of exports transported through the RBMPT to employment is presented in Figure 6.4. Exports transported through the RBMPT directly and indirectly account for 1.83 % of total employment in South Africa. This translates into 183 294 workers: 54 356 high skilled, 80 253 medium skilled and 48 687 low skilled. These results suggest that 182 jobs are directly and indirectly created per 1000 harbour tons that are exported through the RBMPT. The values reflect employment generated through export production in firms that export their products through the RBMPT.

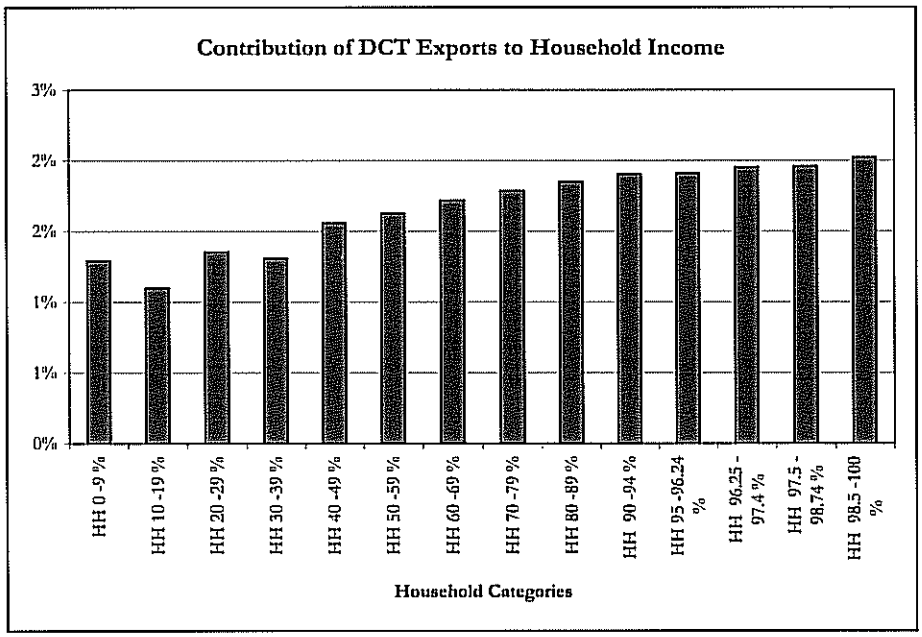
Figure 6.4: Contribution of RBMPT exports to employment (formal + informal)

	Percentage total	Employment	jobs/1000 tons
Low Skilled Labour	1.55%	48687	48
Medium Skilled Labour	1.82%	80252	80
High Skilled Labour	2.21%	54356	54
Total	**1.83%**	**183294**	**182**

Exports through the RBMPT account for just under 2 % of income for households in the top income decile (last 5 columns) and 1.2 % of income for households in the lowest income deciles. However, the differences are minor. Total factor incomes generated through the

provision of factor services account for 1.93 % of total GDP at factor costs. This is equivalent to R16.6 billion rand in 2001. Alternatively, exports through the RBMPT on average account for about R19 of every R1000 of income generated in South Africa.

Figure 6.4: Contribution of RBMPT exports to S A household income



6.2 Economy-wide impact of RBMPT restructuring

This section presents the simulation results of the 50 % (sim 1) and 10 % (sim 2) reduction in cargo charges scenarios. No investment changes are simulated.

Contribution towards gross output

Figure6.5 shows the percentage increase in South African **gross output** as a result of the increased efficiency and the fall in cargo charges at the RBMPT. **Error! Reference source not found.** presents the rand value of these changes in production.

The increases in gross output for a 50% decline in cargo charges exceed those for a 10% decline in cargo charges. As no new investment in the RBMPT is simulated, the contribution to gross output from investment changes is zero. The net trade impact contributes almost all of the increase in gross output across the sectors, with the wealth effect having a negligible impact. The wealth effect is low because the value of imports coming in through the MPT is negligible. As a result there will be little price alterations from cheaper imports.

Figure 6.5: Impact on Production of a reduction in cargo charges, R million

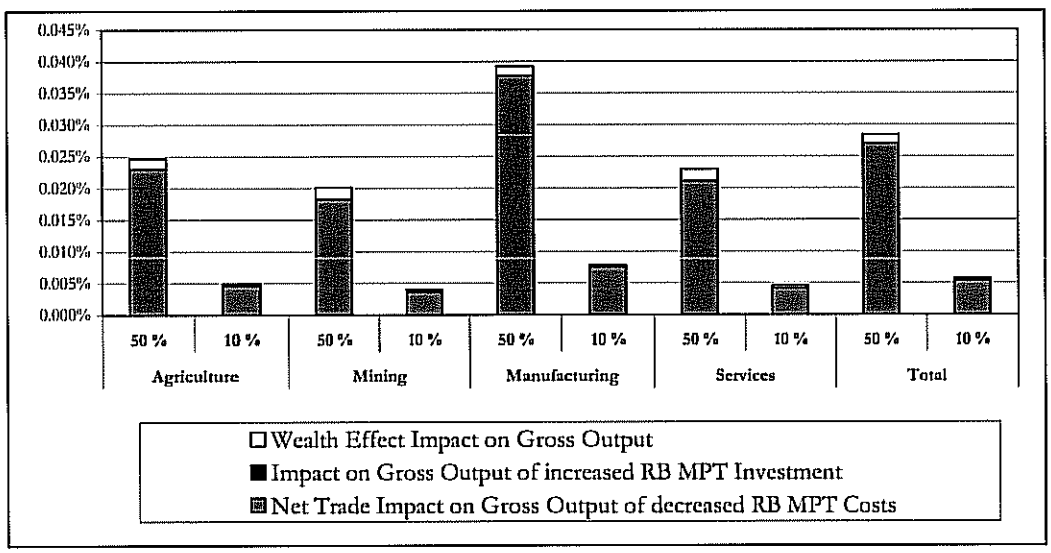
Sectors		Net Trade Impact	Wealth Effect	Total Impact on Gross Output
Agriculture	50 % reduction	13	1	13
	10 % reduction	3	0	3
Mining	50 % reduction	23	2	25
	10 % reduction	5	0	5
Manufacturing	50 % reduction	213	8	222
	10 % reduction	43	2	44
Services	50 % reduction	181	16	196
	10 % reduction	36	3	39
Total	**50 % reduction**	**432**	**22**	**454**
	10 % reduction	**86**	**4**	**91**

Note: the sum of the net trade impact and the wealth impact may not equal the total impact due to rounding up.

A 50 % reduction in cargo charges raises South African gross output by R454 million, which is equal to 0.03 % of total SA gross output in 2001. Of this value R432 million is generated through improved export growth. Most of the increase in gross output occurs within the manufacturing sector, which experiences close to 0.04% increase in production (R222 million). Most of the growth occurred within the wood, paper, iron & steel and non-ferrous metals sectors. Relatively large shares of South African exports of these products are exported through the RBMPT. Mining experiences the lowest percentage increase in gross output of about 0.02% (R25 million). Gross output within the services sector rises through indirect demand by R196 million.

The change in gross output arising from a 10 % reduction in cargo charges is very small. Gross output rises by R 91 million. Of this R44 million is due to the manufacturing sector and R39 million is due to the services sector.

Figure 6.6: Increase in gross output across aggregated sectors (Simulation 1 & 2)



These changes in gross output imply a 0.02 % (R155 million) and 0.004 % (R31 million) increase in GDP measured at factor costs in response to a 50 % and 10 % decline in cargo charges, respectively.

Contribution towards household expenditure and factor income

Figure 6.7 presents the percentage change in national income according to households as well as the rand value of these changes. The results for both simulations are presented.

Figure 6.7: Returns to household income (Simulation 1 and 2)

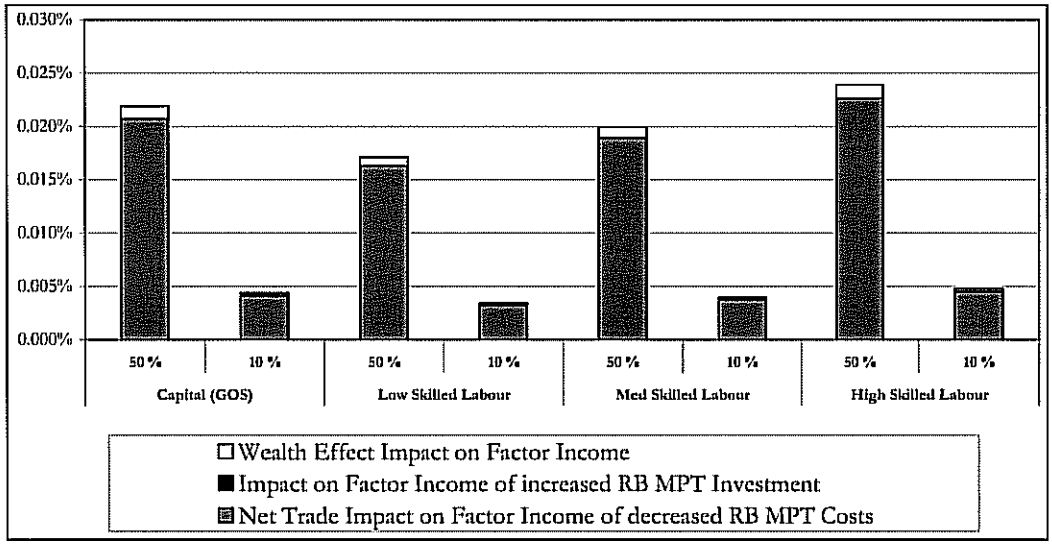
Household Categories	50 % Reduction in Cargo Charges		10 % Reduction in Cargo Charges	
	% Change in Household Income	R million Change in Household Income	% Change in Household Income	R million Change in Household Income
HH 0 -9 %	0.01%	1.2	0.00%	0.2
HH 10 -19 %	0.01%	1.5	0.00%	0.3
HH 20 -29 %	0.02%	2.5	0.00%	0.5
HH 30 -39 %	0.01%	3.2	0.00%	0.6
HH 40 -49 %	0.02%	5.1	0.00%	0.9
HH 50 -59 %	0.02%	6.9	0.00%	1.3
HH 60 -69 %	0.02%	10.3	0.00%	1.9
HH 70 -79 %	0.02%	15.5	0.00%	2.9
HH 80 -89 %	0.02%	25.0	0.00%	4.6
HH 90 -94 %	0.02%	20.4	0.00%	3.8
HH 95 -96.24 %	0.02%	6.9	0.00%	1.3
HH 96.25 -97.4 %	0.02%	8.2	0.00%	1.5
HH 97.5 -98.74 %	0.02%	9.5	0.00%	1.7
HH 98.5 -100 %	0.02%	19.0	0.00%	3.5
Total	**0.02%**	**135.2**	**0.00%**	**24.9**

As is clear from the table, the impact on household income is very small. In total household income rises by 0.02 % of R135 million in response to a 50 % reduction in cargo charges. A 10 % decline in cargo charges increases household income by R24.9 million. A slight bias towards wealthy households is evident, but this is negligible. The net trade impact is the real contributor to the changes in household income, as import penetration is very low. Imports through the RBMPT are small.

Figure 6.8 shows the effect on **factor incomes** of increased efficiency in the RBMPT. Capital and high skilled labour benefit the most in both simulations. The income of capital increasing by about 0.022% and that of high skilled labour by about 0.024% in 50 % cost reduction simulation. These values are not significantly greater than the return to low skilled labour (0.017 %). Total factor incomes increased by approximately R170 million in 2001 prices. The percentage increase in South African factor incomes is very low for all factors (less than 0.005 %) in the 10 % cost reduction simulation. The total increase is approximately R34 million.

The gap between the two simulations is larger for Richards Bay than for Durban DCT because of the lack in investment spending in the former. The investment spending at the Durban terminal contributed substantially to factor incomes, as has already been discussed.

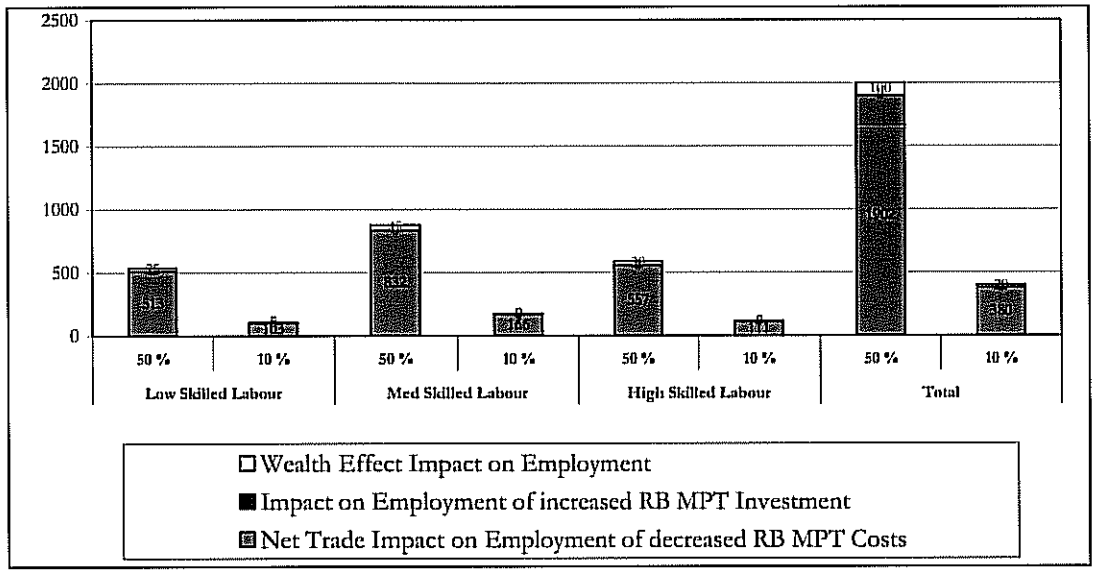
Figure 6.8: Increase in factor income



Employment

Figure 6.9 presents the change in employment arising from restructuring within the Richards Bay MPT. Given the low output response (relative to total SA output) large employment responses are not expected. When cargo charges drop by 50 % 2001 new jobs are created, of which 877 are medium skilled, 538 low skilled and 587 high skilled. Once again the primary driver of these employment increases is the net trade impact, with a negligible contribution being made by the wealth effect. In the 10 % cost reduction scenario only 400 jobs are created.

Figure 6.9: Employment Changes



7 Conclusion

This report produced an economy-wide analysis of restructuring within the Durban DCT and the Richards Bay MPT. For both ports the following aspects were analysed:

- The direct and indirect contribution of the terminal users (exporters and importers) to domestic production, income and employment.
- The economy-wide effects of a 50 % and 10 % reduction in cargo charges.

The analysis finds that exports shipped and imports landed through the DCT account for 15 % and 24 % of South African exports and imports, respectively. Richards Bay MPT is substantially smaller and accounts for 4.6 % of total South African exports and a negligible share of South African imports. This implies that export production shipped through the DCT generated R98 billion worth of gross output or 6.3 % of total SA production. This translates into 4.8 % of total GDP measured at factor costs. In total, the terminal users directly and indirectly created 435,791 jobs.

The values for RBMPT are substantially lower. Export production generated directly and indirectly R43 billion worth of output (2.65 % of SA production), R16 billion towards GDP (1.93 % of total GDP at factor costs) and 183,294 jobs.

A reduction is costs associated with using the terminals boosts economic activity, particularly in the case of the DCT. A 50 % reduction in DCT cargo charges raises SA production by R7 794 million, GDP by R 3 147 million and employment by 34 690.

A 50 % reduction in RBMPT cargo charges increases production by R454 million, GDP by R155 and employment by 2 001. The 10 % reduction in cargo costs yields results approximately 5 times lower.

Appendix 1: Approaches to Port Economic Impact Assessment

There are a number of ways to evaluate the contribution of activities supplied within ports to the national economy. A common approach is to determine the value added generated through activities related to the provision of port services (see Martin Associates, 1996, Jones, 1997). In this approach it is essential to clearly define the scope of port related services. The provision of services extends beyond ship-related activities (marine services, bunkering services, ship chandlers, ship repairs, etc.) and cargo-related activities (cargo services, stevedoring, clearing and forwarding agents, terminal operators, etc.) and includes legal, financial and transport services. In addition, businesses use the port facilities to export and import cargo for manufacturing purposes and for the distribution to wholesale and retail outlets. These firms can be termed **port users** but are not necessarily dependent on the particular port as an outlet (or source) of their product.

This highlights the difficulty in ascertaining the degree of dependence of activities on the port, which is crucial if one wishes to estimate the port's contribution towards the economy. Because the counterfactual of 'no port' is not observed, decisions have to be made with regards to the boundaries of 'port activities' as well as the degree to which these activities are dependent on the existence of the port. This process is further complicated by the narrow distinction between port services and other services incidental the operations of the port. A primary example is the surface transportation section, which consists of railroad and trucking industries. These sectors are often included in studies analysing the economic impact of ports to the domestic economy and account for upwards of 20 % of total employment generated (Morison and Jensen, 1987, Martin Associates, 1996, Jones, 1997). However, these services are not necessarily port activities, but are services demanded by industries or businesses engaging in international trade. It is not clear whether these activities should be included as 'port activities' or services demanded by port users.
The process of defining the parameters of what constitutes 'port activities' is further complicated if one wishes to analyse the contribution towards an economy of particular terminals within a port (as this study wishes to do). Many maritime services provided are not specific to any one terminal. Detailed information is then required to isolate the terminal specific services provided.

In addition to the direct employment and output generated in the provision of 'port services' one needs to also take into account the indirect effects on the economy through intermediate demand. In the provision or port services intermediate goods from other sectors of the economy are demanded. Further, income earned by labour within 'port activities' is spent on goods & services in the rest of the economy. Both these effects have a positive impact on output and employment in sectors outside of the port sector. The overall contribution of the port to the domestic economy is thus a multiple of the value of port services. To estimate these indirect effects, output and employment multipliers are used to enlarge the direct effects. For example, Jones (1997) raises income generated through direct employment in the Durban port by 2.4 to obtain the change in local expenditure within the region.

An alternative approach to these micro level port studies, and one that is used in this study, is to assess the share of total trade accounted for by the port or terminal. In this approach

the focus is on the contribution of port users, particularly those that engage in international trade, to the domestic economy. It is also possible to estimate using multipliers the indirect output and employment generated through the production of exports that are transported through the port terminal. This approach provides a much broader notion of 'contribution towards the domestic economy' than the micro level studies by illustrating the positive impacts that port restructuring may achieve through both increasing the capacity and lowering the costs of terminal operations.

It should be borne in mind that because no account is taken of the ability of firms to ship their products through alternative ports or to substitute the domestic market for the export market, the approach tends to exaggerate the importance of the terminal to the domestic economy. This would apply especially to Richards Bay terminals. In the case of the Durban, and especially the DCT, the short run competitiveness of other ports is limited by the additional costs of transportation and from the port, and most importantly in the short run, their limited capacity to handle containers, relative to Durban.

Appendix 2: Social Accounting Matrix

Table 3 presents the industrial sectors and commodity lines within the 1998 SAM used in this analysis.

Table 3: Industrial sectors and commodity lines

SIC code vs. 5	Sector & commodity names	SIC code vs. 5	Sector & commodity names
11-13	Agriculture, forestry & fishing	353-355	Metal products excluding machinery
21	Coal	356-359	Machinery & equipment
25	Gold	361-366	Electrical machinery
29	Other mining	371-373	Television, radio & communication equipment
301-304	Food	374-376	Professional & scientific equipment
305	Beverages	381-383	Motor vehicles, parts & accessories
306	Tobacco	384-387	Other transport equipment
311-312	Textiles	391	Furniture
313-315	Wearing apparel	392	Other industries
316-317	Leather & footwear	41	Electricity, gas & steam
321-322	Wood & wood products	42	Water supply
323	Paper & paper products	51	Construction
324-326	Printing, publishing & recorded media	52-53, 61-62	Wholesale & retail trade
331-333	Coke & refined petroleum products	63	Catering & accommodation services
334	Basic chemicals	71	Transport & storage
335-336	Other chemicals & man-made fibres	72	Communication
337	Rubber products	81-82	Finance & insurance
338	Plastic products	83	Business services
341	Glass & glass products	93	Medical, dental & other health & vet services
342	Non-metallic minerals	97-99	Other producer services
351	Basic iron & steel		Government services
352	Basic non-ferrous metals		

Industrial sectors

The SAM consists of 43 industrial sectors classified according to the Standard Industrial Classification (SIC) coding system. The same 43 categories have been used to define

commodity output. The Supply table imbedded within the SAM captures the allocation of commodities from industry accounts to the commodity accounts. The Use table captures intermediate good requirements of activities.

Labour categories

The SAM consists of three labour categories broadly defined in the following way:
High-skilled personnel (HLP) is defined as workers with at least two years of education and training (usually formal) after Standard 10 and includes all professional and semi-professional workers, management and administrative workers and technicians.
Medium-skilled personnel (MLP) comprise workers in occupations for which at least a number of weeks or months of training is required in or outside the work environment. In most cases an educational qualification of at least Standard 7 or 8 is required for appointment in these occupations, which usually include clerical, sales and service workers, artisans, apprentices and supervisors.

Semi-and low skilled occupations are those for which the required expertise is acquired after a short training period (a few days or weeks). Candidates must possess basic literacy and numeracy skills prior to training, while primary education is sufficient as an entry requirement for training. *Unskilled occupations* are those for which no formal education or training is required. In these occupations induction or orientation courses are not regarded as training. Semi-skilled and unskilled occupations are usually lumped together under the heading *low-skilled personnel.*

A breakdown of wages and salaries into these three skill levels allows for some notion of impact on income distribution to be included along side a distribution of factor incomes amongst capital and labour.

Appendix 3: Price and Output Models

In this section we briefly present an overview of the price and output models used for the economy-wide analysis of port restructuring.

A SAM is a system of accounts capturing resource flows between various sectors of the economy in a given period. The SAM extends the traditional Input-Output table framework by integrating data from the national accounts with data on transactions between industries, households, government and the rest of the world. Thus the SAM provides detailed information at a disaggregated level while maintaining the key macroeconomic balances. This is more clearly reflected in the simple SAM represented in the table below:

Table 4: Simple SAM for illustrative purposes (values in Rands)

		Payments from						
		Manufacturing	Agriculture	Household expenditure	Government	Investment	Exports	Total
Receipts by	Manufacturing	150	500	100	70	30	50	900
	Agriculture	200	100	330	70	120	180	1000
	Household income	300	300					600
	Taxes	80	40	50				170
	Savings	0	0	120	30			150
	Imports	170	60					230
	Total	900	1000	600	170	150	230	

The above SAM consists of two commodity/industry accounts (manufacturing & agriculture), a household income-expenditure account, a savings-investment account, a government tax income-expenditure account and a rest of world account. By convention incomes or receipts are shown in the rows of the SAM while expenditures or outlays are shown in the columns. Thus nominal values flow from the column (expenditure) to the rows (income). For transactions involving goods and services, there are corresponding real flows of assets from rows to columns.

Looking along the rows of the production sectors, manufacturing and agricultural output are used as intermediate goods in the production process or are consumed by the household, government, investment and export accounts. In order to produce output the production sectors purchase intermediate goods from within the production sector as well as factor services (labour and capital) from households. In addition, firms pay taxes to the government and import other intermediate goods from the international market. The SAM is fully balanced with the total demand (row total) for manufacturing (R900) and agriculture (R1000) equalling the respective total supply (column totals). These inter-industry flows are equivalent to the standard Input-Output table. Supply and Use tables differ in that the production/activity accounts are separated from the commodity accounts. The use of Supply and Use tables as opposed to Input-Output tables is that a one-to-one relationship between industries and commodities produced is not imposed.

The Social Accounting Matrix extends the S-U tables by including resource flows between the production sphere of the economy and final demand institutions such as households, the public sector and the foreign sector. The SAM therefore enables a more economy-wide analysis than the inter-industry perspective of the S-U table.

In the table above households earn income in the form of factor payments from industry. Households can also earn income from government transfers or foreign remittances (not shown in above table). Looking down the household expenditure column, this income (R600) is spent in the consumption of agriculture and manufacturing goods, income taxes and savings.

Government tax revenue earned through VAT, direct taxes on firms and income is shown in the "*taxes*" row. The government (government column) in turn spends tax revenue on final goods with the remainder allocated towards government savings (R30). In the SAM the macroeconomic savings-investment balance is maintained. National savings obtained from households, government and the foreign sector (equals zero in this SAM) are used to finance investment expenditure.

Finally, the SAM also maintains the balance of payment equilibrium. Payments to the rest of the world in the form of imported goods, remittances, dividends and foreign debt payments are equal to inflows generated through exports or other foreign currency inflows.
As such a SAM provides a comprehensive and consistent record of the interrelationships of an economy at the level of individual production sectors, factors, and general public and foreign institutions.[20] In its simplest form it is possible to use the SAM to describe the South African economy. More relevant for our purposes, the data within a SAM enable the construction of models that can quantify the backward and forward linkages of an impulse in the economy at hand. In order to do this, however, it is necessary to impose functional forms to the inter-activity resource flows discussed above. The form of these interactions depends on the behavioural assumptions made in the modelling process. To assess the strength of the model as a tool for policy analysis a good understanding of these assumptions is imperative.

We follow the conventional Leontief approach to model building. By separating data flows within the SAM into their constituent price and output effects the SAM can be represented as a system of equations. This is shown in equation A for an economy characterised by *n* sectors, 1 factor and 1 household.

(A)

$$
\begin{array}{l}
P_1X_{11} + \ldots + P_1X_{1n} + HD_1 + FD_1 = P_1X_1 \\
\ldots\ldots\ldots \\
P_nX_{n1} + \ldots + P_nX_{nn} + HD_n + FD_n = P_nX_n \\
HY_1 + \ldots + HY_n + 0 = HY_{tot} \\
other_1 + \ldots + other_n + 0 = other_{tot} \\
\hline
P_1X_1 + \ldots\ldots + P_nX_n + HD_{tot} + FD_{tot}
\end{array}
$$

[20] Reinert, K. and Roland-Holst, D. 1997. Social Accounting Matrices. In Francois, J. and Reinert, K. (eds). *Applied Methods for Policy Analysis: A Handbook*, Cambridge University Press.

X_{ij} is the quantity of good *i* used in the production of good *j* while X_j is total output of sector *i*, HD_i is expenditure by households on good *i*, FD_i is investment, government and export demand for good *i*, HY_i are household factor payments for services provided in the production of good *i*, and $other_i$ is other payments (taxes, imports, etc.) by sector *i*. P_i reflects the price of good *i*.

Because the SAM is balanced total household income (HY_{tot}) equals total household expenditure (HD_{tot}) and total other income ($other_{tot}$) equals FD_{tot}.

Output model

The objective of the output model is to measure the economy wide impact of shocks in demand for goods and services. As shown in the SAM an economy is made up of a number of interrelated industries. A rise in demand for a particular product (agriculture) has a direct effect on *upstream* industries that supply intermediate inputs. Changes in production within these industries will in turn have upstream impacts on output and employment within their intermediate input suppliers. Thus a demand shock in one sector of the economy has both a *direct* an *indirect* effect on output and employment within the rest of the economy. Because these indirect effects can be sizeable it is necessary to utilise economy wide models that explicitly incorporates the upstream (or backward) linkages of sectors within the economy.
We follow the standard Leontief approach in building an output model.[21] In the standard Input-Output model a fundamental assumption is that inter-industry flows from *i* to *j* depend entirely on the total output of sector *j*. More importantly, input demand is assumed to be a fixed fraction of total output and increases in *proportion* to output demand (a Leontief production function). The model thus also assumes production is characterised by constant returns to scale. This constraint implies that output of a product can only increase by a proportion if the availability of the required inputs also increases in the same proportion.
By assuming a Leontief style production function where inputs are used in fixed proportions we are able to model the production process. The technical coefficients of production (input requirement coefficient) are calculated as

$$a_{ij} = \frac{X_{ij}}{X_j}.$$

a_{ij} thus reflects the quantity of *i* used in the production of good *j*. The total quantity of intermediate good *i* used in the production of good *j* is represented as $a_{ij}X_j$.
A limitation of the standard Input-Output model is that income generated in the production process is not re-injected into the system in the form of expenditure on goods and services. By extending the fixed coefficient assumption to income generated in the production process and by assuming that consumers purchase goods and services in fixed proportions, we are able to endogenise household income and expenditure. The share of consumption of each good *i* in total consumption (the direct consumption coefficient) is represented as:

$$h_i = \frac{HD_i}{HD_{tot}}.$$

[21] Leontief, W. 1986. *Input-Output Economics*, Oxford: Oxford University Press.

Total consumption of good i equals $h_i HD_{tot}$. Export, government and investment demands for each good, FD_i are exogenously given.

Interactions between industries and factors within the output model are based on flows of physical units and not in value terms as are provided in the SAM. To convert the values within the SAM a further assumption that prices are fixed is made. By re-calibrating output units within the SAM such that all prices are set equal to one (enabled by the constant returns to scale assumption), the values in the SAM reflect real values. The model in equation A can thus be re-written as:

(B)

$$\begin{array}{llll} a_{11}X_1 + \ldots + a_{1n}X_n & + h_1 HD_{tot} & + FD_1 & = X_1 \\ \cdots \quad \cdots & \cdots & \cdots & \\ a_{n1}X_1 + \ldots + a_{nn}X_n & + h_n HD_{tot} & + FD_n & = X_n \\ h_{11}X_1 + \ldots + h_{1n}X_n & + \ 0 & & = HY_{tot} \\ o_{11}X_1 + \ldots + o_{1n}X_n & + \ 0 & & = other_{tot} \\ \hline X_1 \ + \ldots + X_n & + HD_{tot} & + FD_{tot} & \end{array}$$

Where h_{11} and o_{11} reflect the input requirement coefficients for factors and other payments. Focussing on the endogenous variables (X_i and HY_i) we can write the system of equations in matrix notation:

(C) $$AX + F = X$$

Where A is a ($n+1$ x $n+1$) matrix of technical input-output coefficients, X is a ($n+1$ x 1) column vector of gross output and household income and F is a ($n+1$ x 1) column vector of exogenous final demand. Equation (C) can be rearranged as

$$(I-A)X = F$$

Where I is an identity matrix. This can be further rearranged as

(D) $$(I-A)^{-1}F = X.$$

Equation (D) gives us the gross output and income vector that it will be necessary to produce in order to satisfy some exogenously given set of final demands. Through Leontief inverse $(I-A)^{-1}$ both the *direct* and *indirect* output and income requirements are captured.

We are also able to capture the impact of a final demand shock on other exogenous inputs, imports or taxes by pre-multiplying the gross output vector by the relevant input requirement coefficients:

(E) $other_{tot} = O'X$

Where O' is the row vector $[o_{11} \ldots\ldots o_{1n}]$.

Because the above model imposes the assumption of fixed production coefficients, constant returns to scale and constant prices, the model implicitly assumes that domestic intermediate suppliers have excess capacity and are capable of supplying the requisite inputs. This is an oversimplification of the economy as many sectors will be supply constrained, at least in the short run. In these circumstances the required inputs will be sourced from the international market. This reduces the downstream effects of the demand shock resulting in substantially lower output, employment and tax responses to the demand shock. If important, these supply constraints need to be explicitly incorporated into the model.

Price model[22]

We are also able to use the above simple representation of a SAM to construct a *price model.* Changes in product prices affect the cost of production in downstream industries. This will have further cost implications in the rest of the economy if the price changes are passed on *downstream.* Because the SAM structure captures the inter-linkages between different industries it provides a useful framework with which to build a *price model.*

In building a price model we are essentially interested in the input structure of production, i.e. the columns of the production/activity accounts. The unit price of a product is dependent on the prices (P_i) and quantities of inputs (a_{ij}) used in the production process, the factor payments and other payments. The input requirement data per unit output has already been calculated in the construction of the system of equations (B). Maintaining the Leontief production function and assuming a ***competitive*** environment we can construct a system of equations representing the price structure of output:

(F)
$$\begin{aligned} a_{11}P_1 + \ldots + a_{n1}P_n + V_1 &= P_1 \\ a_{12}P_1 + \ldots + a_{n2}P_n + V_2 &= P_2 \\ \ldots \quad \ldots \quad \ldots & \\ a_{1n}P_1 + \ldots + a_{nn}P_n + V_n &= P_n \end{aligned}$$

Where V_i consists of factor payments, taxes, import costs, etc. per unit of gross output. In matrix notation this can be written as

$$P'A + V' = P'$$

In which P is a vector of activity and commodity prices, A is the matrix of direct input coefficients and V' is the row vector of primary input coefficients. Rearranging we have

$$P(I-A) = V'$$

Which can be rewritten as

(G) $$P' = V'(I-A)^{-1}.$$

Note that we are using a Supply-Use table format instead of the familiar industry-by-industry Input-Output format. This allows us to determine the impact of exogenous changes in prices on activities (production sector) as well as commodities. Assuming that the structure of the economy, as captured by the coefficient matrix A remains constant, a change in the primary input prices per unit of gross output, following a reduction in import prices, gives rise to a decrease in commodity and activity prices, ΔP. This is represented as

(H) $$\Delta P' = \Delta V'(I-A)^{-1}$$

In which $\Delta V'$ is the change in primary input prices per unit of gross output and $\Delta P'$ the change in the commodity or industry prices.

[22] See Miller, R. and Blair, P., 1985. *Input-output analysis: Foundations and extensions,* Prentice Hall.

Appendix 4: Domestic, Export and Import Price Elasticities

Table 5 presents the price elasticities of demand for domestic and export goods. The table also presents the import price elasticities used in the analysis.

Table 5: Domestic, export and import price elasticities

Sector	Domestic demand elasticity	Export price elasticity	Import price elasticity
Agriculture, forestry and fishing	-0.42	0.87	0.87
Coal mining	-0.27	0.50	0.00
Gold and uranium ore mining	0.00	0.50	0.00
Other mining	0.00	0.50	0.50
Food	-0.86	0.87	1.19
Beverages	-0.77	1.00	0.50
Tobacco	-0.77	1.80	1.24
Textiles	-0.35	1.80	1.35
Wearing apparel	-0.26	1.80	1.71
Leather, leather products and footwear	-0.26	1.80	1.35
Wood and wood products	-0.68	1.80	1.40
Paper and paper products	-0.90	0.87	0.92
Printing, publishing and recorded media	-0.90	1.02	0.92
Coke and refined petroleum products	-0.16	0.24	0.24
Basic chemicals	-0.30	1.71	0.78
Other chemicals and man-made fibres	-0.30	1.71	0.89
Rubber products	-0.98	1.71	1.31
Plastic products	0.00	1.71	0.55
Glass and glass products	-0.90	0.87	0.87
Non-metallic minerals	0.00	0.87	1.00
Basic iron and steel	0.00	0.87	0.58
Basic non-ferrous metals	0.00	0.87	1.00
Metal products excluding machinery	-0.68	1.02	0.86
Machinery and equipment	-0.66	1.02	0.92
Electrical machinery and apparatus	-0.66	1.02	1.10
Television, radio and	-0.66	1.02	0.51

Sector	Domestic demand elasticity	Export price elasticity	Import price elasticity
communication equipment			
Professional and scientific equipment	-0.66	1.02	0.71
Motor vehicles, parts and accessories	-0.99	1.02	0.63
Other transport equipment	-0.99	1.02	1.08
Furniture	-1.01	1.80	1.24
Other manufacturing	-1.06	1.51	0.64
Electricity, gas and steam	-0.20		
Water supply	-0.90		
Construction	0.00		
Wholesale and retail trade	-0.80		
Catering and accommodation services	-0.20		
Transport and storage	-0.86		
Communication	-0.38		
Finance and insurance	-0.76		
Business services	-0.76		
Medical, dental and veterinary services	-1.52		
Other producers	-1.06		
General government services	0.00		

Sources: Case (1998), Contogiannis (1982), Barr (1983), Edwards and Golub (2001), TIPS.

Data sources and methods of estimation

Cargo tonnages and values per terminal and commodity

A number of difficulties had to be surmounted in order to obtain a useable set of data on the tonnage and value of cargo passing through SAPO terminals.

Data on the value of cargo was last collected in the financial year 2001/2. Since then a new tariff system has been introduced that is based on tonnage. For the purposes of this study, use was made of the 2001/2 data to generate figures for cargo value for the 96 commodity categories maintained by SAPO and the NPA. The only commodity excluded is petroleum, the information on which the NPA were was not willing to release to the team.

Two separate sources of data were used to construct tables of cargo value for the EIA. Physical tonnage and teus are recorded by SAPO operations at each terminal. This tonnage and teu data is measured at the point where it is physically handled by the operators and is, according to the IT people at the NPA, reasonably accurate. The value and tonnage of cargo are recorded separately by the NPA section that used to collect wharfage. With respect to this set of data, the tonnage and teu information tends to be inaccurate, particularly in the case of containers. This is because it is recorded on the manifest before it is physically off loaded. Comparison of the tonnage information from the operations and wharfage sides revealed considerable differences between the two sources, especially in the case of containers. However, NPA officials feel that the value data itself is more reliable. As the source of wharfage fees, this information is collected with more care than the tonnage and teu data. More confidence was expressed by these officials in the wharfage information from Durban than for other ports. Thus, In order to obtain reasonably accurate data on both tonnage and value, it was decided to splice the value data obtained from wharfage collection to the tonnage data obtained from the operations section for each commodity category, a process explained below.

The data sourced from both the operations and wharfage side of port activities gives a breakdown into 96 commodity categories. The operations data is disaggregated to terminal level, but the container data only to the level of ports. However each set provides a "package" code which enables identification of bulk, break-bulk and container cargo. Since the vast majority of containers are handled through SAPO-run container terminals, this made it possible to estimate values of container cargo through SAPO terminals in each port for the 96 cargo categories. In the case of break-bulk cargo, it had to be assumed that the composition of cargo was the same between private and public terminals in a particular port. On this assumption the value of cargo moving through the Richard's MPTs was estimated, splicing tonnage figures from the MPT terminal to value figures from the wharfage data set. The resulting estimates of average values for commoditiy categories proved to be volatile in some cases. To deal with this problem, export and import data were aggregated to obtain average values. This assumes that import and export prices for commodity categories are the same or similar. These procedures clearly introduces a degree of uncertainty as to the accuracy of the data that cannot be quantified.

Cargo tonnage and values per terminal and port

A different method was used to obtain value data per terminal and port. Here the package code was used to sort information. The package codes refer to the manner in which cargo is handled at the terminal as these give a rough approximation to the terminal type. The following codes are used:

BBAP – bulk by appliances
BBCR – bulk by crane
Cont – containers
Conv – conventional

Pall - palletised
Ro-Ro – roll-on roll-off

Values for cargo by pack code were generated. These were then applied to tonnage by pack code to derive average tonnages per pack code. These averages were then applied to terminals in terms of the tonnages for the different package forms applied at each terminal. In two cases a value was found for a package code where no tonnage figures existed from the operations source (East London BBAP Imports and Exports). Here the tonnage data from the wharfage source was applied.

This method enables tonnage and value figures to be generated per terminal and port in South Africa. Its accuracy depends on the accuracy of the original and the assumption that package modes at different terminals handle cargo throughput of similar value. It should be noted that NPA officials expressed scepticism regarding the tonnage and teu information associated with the collection of value data. However they expressed reasonable confidence in the value data itself and in the tonnage and teu data collected from the operations side. The methodology has put these two "reliable" sources together.

Cargo costs associated with terminal operations

The handling of cargo between the time it arrives at the terminal and the time it leaves on a ship incurs a number of costs, all of which are influenced by the efficiency and speed of terminal operations. These costs are borne by the cargo owner, or in some instances, the shipping line. They are sources of revenue for actors involved with terminal operations. The charges are a critical variable in determining the impact of terminal operations on the wider economy, through price and production relations.

The components of the overall cargo costs are made up as follows:

- Handling charges
- Interest paid on value of cargo in transit
- Costs associated with shipping delays
- Tariffs

The **handling charge** is a cost to the cargo owner and the source of revenue for the terminal operator, and hence all those involved in operations – management, labour, shareholders. The length of stay of cargo within the terminal incurs a cost to the cargo owner. This can be estimated as equivalent to the **interest paid on the value of the cargo** per day of its stay on the terminal. There are costs associated with **shipping turn around time**, namely the length of time a ship has to spend between arriving at (or outside) the port and leaving it. These costs would normally be included in the charter and container charges imposed on the cargo owner by the shipping line. Currently they are being absorbed by the shipping lines due to over capacity on routes in and out of Durban, with the exception of those to the United

States of America. This cost is determined by the daily costs of operating a ship while waiting to enter the port or while in it. The **tariffs** are a levy on the cargo owner and a source of revenue for the National Ports Authority. In the past they have been used to cover the running expenses of the NPA, as a source of revenue to cover expenditure on infrastructure and maintenance in the ports and as a source of revenue for cross-subsidising rail transport activities.

One of the main ways of decreasing the effective cost of cargo passing through the terminal is to improve the efficiency of terminal operations. Handling charges, which are currently low by international standards, could be reduced by improvements in efficiency either with or without a reduction in numbers of workers and labour costs. Shipping delays, which are currently high by international standards, could also be reduced by means of efficiency improvements, as could interest charges that derive from stationary cargo on the quay. Tariffs have a more indirect relationship to terminal efficiency. These are a source of revenue for the NPA. They are used to construct and maintain infrastructure and marine services such as pilotage and dredging, both of which influence the efficiency and cost of port operations. They are also used to cover the operating costs of the administration. Historically they were also used to cross-subsidise other services, notably rail infrastructure and fares. With the introduction of private sector participation in the ports the infrastructure and maintenance costs may be met by private operators and the same logic could apply to the railway sector. In principle, the tariff could shrink to a level necessary to cover only the running of the NPA administration and the provision of marine services.

The cargo **handling charges** used in this study were applied under the new system introduced from April 2002 that replaced the wharfage system. In the case of the DCT, the list of terminal charges was obtained from SAPO. An average charge per teu was obtained by applying the relevant charges to each category of box and multiplying by the number of boxes to obtain the numberator. Boxes of different types were reduced to teus to provide the denominator.

Efforts were made to obtain equivalent information for the RBMPT. To date (27/02/03) this information has not been forthcoming. To circumvent this problem, the rates used for the DCT were reduced to tonnage rates and then applied to cargo tons and values through the MPT.

The cargo **tariffs** were obtained from the NPA. They are now based on teus and tonnage. They differ for imports and exports. These tariff rates were applied to the teu and tonnage data to obtain an average for cargo through the terminals.

The estimation of the **costs of shipping turn around time** was done on the basis of information from Mr Dave Rennie, Chairperson of the Container Liners Operating Forum. It is based on the charges vessel owners incur between the time of arrival at the port and the time of departure. The turn around time is made up of the following: waiting time outside the port, berthing, operations, unberthing (unroping).

It should be emphasised that the figure of 4.5 days for the DCT represents "yard" time only. That is, the time during which operations are occurring while the ship is berthed. It does not include waiting outside the port, which has been very considerable in Durban during the last few years. The costs taken into consideration are only direct costs, namely charter and containe/tonnage charges. There are further charges that could be included, for example fuel consumption etc. that when taken together would add up to an estimated further 50%. The actual assumptions are as follows: assume charter charges per day = $18000, container charges per day = $2.5, containers per vessel = 1000. Therefore container charges per vessel per day = $2500. Thus total daily cost for an idle ship is $18000+$2500 = $21570 . Therefore total daily cost per teu/day is $21570/1000 = $21.57. This means that total cost/tue for 4.5 days is then $21.57 x 4.5 = $97.07.

Casual employment

The SAPO head office Finance Department maintains records of full time employees with full details of wages, salaries and other benefits. In the case of casuals, it provides only the globular figure allocated to casuals. In order to complete the information on employment, it was necessary to obtain a full time equivalent for casual workers, namely 178 casual full time equivalents. These were classified into the three skill categories produced by SAPO (skilled, semi-skilled and unskilled) and then added into the total employment figure. The wage bill of each of the three skill categories of casual workers was estimated as a proportion of the total casual wage bill allocation to casuals, based on the average wages applied to each skill category.

Stevedores

Stevedores used on SAPO terminals are hired directly by the shippers from private stevedoring companies. As their work constitutes an integral part of the terminal operation they had to be included in the analysis. Estimates of full time stevedore equivalents were obtained from the managing director of the largest stevedoring company. The average wage for full time unskilled workers plus 22% for the administration and management costs of the companies was divided into the total allocation for stevedoring for 2001/2, namely R28/teu (or R30800000 for all teus) to obtain a figure of 339 full time equivalent stevedores for the DCT. This figure includes the full time equivalent of casual stevedores. These figures were added in to the total SAPO employment and wage cost figures.

Skill levels

SAPO has recently coded its employment in terms of three skill categories – skilled, semi-skilled and unskilled. Skilled workers include artisans and employment categories above this level. Unskilled workers include a wide range of people operating machinery on the terminals, including operators of cranes and a range of other transport equipment. The category unskilled labour refers to workers

undertaking elementary manual work. It should be noted that the proportion of semi-skilled labour makes up the great majority of the workforce.

Appendix 5: References

Case, A., 1998. Income distribution and expenditure patterns in SA. Unpublished paper

Central Statistical Services, Reports nos. 04-02-02 (1984), 04-02-03 (1988), 04-02-04 (1993).

Contogiannis, E., 1982. Consumer demand functions in SA: An application of the Houthakker and Taylor model. *South African Journal of Economics*, 50, 2: 125-35.

Barr, G., 1983. Estimating a consumer demand function for SA. *South African Journal of Economics*, 51,4: 53-129.

Bitsakis, J., 1986. Aspects of energy: Economy interactions in SA. *South African Journal of Economics*, 54, 2: 172-179.

Edwards, L. and Golub, S., 2002. South Africa's International Cost Competitiveness and Productivity: A Sectoral Analysis. Paper presented to the National Treasury, 15 Oct 2002.

Edwards, L., 2001. Trade and the structure of South African production, 1984-97. *Development Southern Africa*, 18, 4: 471-492

Martin Associates. 1996. The local and regional economic impacts of maritime activity at the port of Oakland, 1995. Report prepared for the Port of Oakland.

Morison, J. B. and Jensen, R. C., 1987. The Economic Impact of the Port of Brisbane, Department of Economics, University of Queensland, January 1987.

Jones, T., 1997. *The port of Durban and the Durban Metropolitan economy.* Economic Research Unit Research Monograph No. 10, University of Durban.

Goldstein, M. and Khan, M., 1985. Income and price effects in foreign trade. In Jones, R. and Kenen, P. *Handbook of International Economics*, vol. II.

Miller, R. and Blair, P., 1985. *Input-output analysis: Foundations and extensions*, Prentice Hall.

Roland-Holst, D. and Sanch, F., 1995. Modeling prices in a SAM structure. *The Review of Economics and Statistic*, 77, 2: 361-371.

Statistics South Africa, 2001. *Final Supply and Use Tables, 1998, an input-output framework.* Report No. 04-04-01.

Thurlow, J & van Seventer, A Standard Computable General Equilibrium Model for South Africa, Trade and Industrial Policy Strategies, South Africa, 2002.

Van Seventer, D The Estimation of a System of Provincial Input-Output Tables for South Africa, unpublished paper, WEFA Southern Africa, Private Bag X12, Menlo Park, 0102, Republic of South Africa.

Appendix 6: People Interviewed and Contacted

		Email address	Cell	Land line	Company	Position
Craig	Anderson	Manager	832788449	031 3616980	DCT	
Pamy	Arora	parora@thecornellgroup.com		703 934 0214	Cornell Group Washington	Executive Vice President Corporate Management
Bradley	Augustine	bradleyau@portnet.co.za		031 3088334	NPA	Accountant
Joshua	Bhengu	jbemghu@intekom.co.za	083 4009543	011 803444	Pathani Consulting	
Cheryl	Booth	cherylb@npa.co.za		227014323	NPA SAL	IT
Dirk	Botes	dirkb@npa.co.za		043 7001200	NPA EL	IT
Mervin	Chetty	mervinc@portnet.co.za	083 256 4243	031 308 8345	SAPO	Executive Manager
Johan	Cilliers	agriport@iafrica.com		27 11 675 0733	Agriport	General Manager
Jurgen	Cobarg	jurgenc@sa-shipyards.co.za		031 2043570	SA Shipyards	
Frank	Dedekind	Land and rentals	083 2864250	031 3618511	NPA	Assistant Property Manager
Roy	Dhaver	Royd@portnet.co.za		359053106	SAPO Richard's Bay	Accounts
Andy	Dijkerman	adijkerman@deloitte.co.za	083 4564428	012 4820007	Deloitte and Touche	Director
Lawrence	Edwards	ledwards@commerce.uct.ac.za	083 2863543	021 6502722	Home	Lecturer
Kobus	Ehlers	kobus@ivstorage.co.za	082 469 8591	27 31 466 4241	Island View Storage	Managing Director
Mike	Ellis	michaell@npa.co.za		031 3618561	NPA	Statistics Manager
Steve	Geenan	steve@greenafrica.co.za		021-419-9726 /7/8/9	Evergreen Uniglory	Branch Manager
Robert	Goethe	rgoethe@thecornellgroup.com		(703) 934-0214	Cornell Group, The	Regional Director
Richard	Goode	richard.goode@dpe.gov.za		012 3427111	DPE	Director
Ester	Goosen	esterg@npa.co.za		041 5071885	NPA	Port Manager
Sinjay	Govern	sinjayg@npa.co.za		021 4493617	NPA Cape Town	Port Manager
Mark	Gregg-Macdonald	markg@portnet.co.za	083 442 6455	031 308 8327 /8386	SAPO	Chief Financial Officer
Murray	Grindrod	murrayg@grindrod.co.za	083 309 0555	031 304 1451	Grindrod	Manager New Business
Alex	Hill	ahill@mo!rsa.infonet.com		021-402-8900	Mitsui	Marketing
Ronnie	Holtshausen	ronnieh@portnet.co.za	083 283 3489	031 3088312	SAPO	Commercial Manager
Raymond	Horner	raymondh@portnet.co.za	834630729	031 3354009	SAPO Durban	
John	Joint	jjoint@dynamar.net	06 533 13398	+31 (0) 72 515 1397	Dynamar	Deputy Managing Director
Trevor	Jones	Jones@nu.ac.za		031 2601079	UND	Professor
Eugene	Kens	eugenek@npa.co.za		022 7014304	Saldhana	Port Manager
Peter	Kieran	pkieran@cpcstrans.com		613 2372500	CPCS Transcom	President
John	King			031 - 3027009	Grindrod	Personnel
Warren	King	warrenk@unicornshipping.co.za		031 2744770	Unicorn Shipping	
Alastair	Lax	alastair@bidterm.co.za	083 277 9252	031 274 2508	Rennies Cargo Terminals	Director
Mike	Lloyd	secretary@asabosa.asl.org		031 2661384	ASSABOSA	
Justice	Luthuli	justicel@portnet.co.za		035 9053203	SAPO Richards Bay	Terminal Manager MPT
Marius	Luyt	mariusl@transnet.co.za	083 2864820	011 3082509 /2510	Transet	Corporate
Colin	Macrae		083 448 7463	27 31 250 9400	P&O Ports Nationwide	Captain and Executive Director
Nyameka	Madikizela	nyamekam@npa.co.za	083 3808749	011 2424351	NPA	Executive Director Property
Mike	Martin	mmartin@sacd.co.za		031 4661581	SACD	MD
Petrus	May	petrus@npa.co.za	083 2864285	031 3618747	NPA	Assistant Property Manager
Piet	May		083 2864285	031 3618747	NPA	Leases
John	McPherson	jmcpherson@cpcstrans.com	082 8588454	012 4311134	CPCS Transcom	
Max	Modise	maxm@npa.co.za		041 5071934	NPA PE	Marketing
Anan	Moodliar		083 2979284	011 7736927	Spoornet	
Anand	Moodliar	AnandM@Transnet.co.za	832979284	011 77336929	Spoornet	Chair Maydon Wharf
Dennis	Moran	dennis.moran@rct.co.za	083 233 0027	27 31 274 2511	Bidvest	Leaseholders Association
Tebogo	Moremi	tebogo@npa.co.za	083 709 1482	011 242 4023	NPA	Executive Director Marketing
Tau	Morwe	taum@portnet.co.za		031 3088300 /1	SAPO	CEO
Deena	Naidoo	deenan@transnet.co.za	083 2862157	031 3613145	Spoornet	Human Resources
Basil	Ndlovu	basiln@npa.co.za	082 3530089	035 9053202	Richards Bay	Port Manager
Zeph	Ndlovu	zephn@portnet.co.za	833068367	031 - 361 6980	Phathani Consulting	Consultant

ADDENDUM – JUNE 2003

The Section headed Export growth and Import Penetration, beginning on page 13 and continuing through the end of p. 16, should be replaced by the text that follows. This takes account of the revisions to Appendix 4 that follow on p. 4 below.

Export growth and import penetration

Actual data on export prices are not available. However, export and import values and the number of teus and harbour tons were available for 96 commodity categories. This data was converted to the 42 industrial sectors used in the SAM which is based on the 5th edition Standard Industrial Classification (SIC 5) system. Many of the 96 commodity categories were omnibus categories that included a diverse range of products. These often did not map cleanly to the SIC 5 based categories in the SAM. The values in the omnibus categories were allocated to the relevant sub-sectors using proportions obtained from national trade data. The allocation procedure may bias the trade values within some of the categories.

To estimate the impact on export growth arising from port restructuring, data on (a) port costs, (b) export prices and (c) export price elasticities (η) are required. The percentage change in exports can be calculated as $\eta * \%\Delta P_E$ where P_E is the export price. $\%\Delta P_E$ is estimated as the change in port costs divided by the export price. To ensure common units we estimate port costs and export prices per teu or harbour ton.

Disaggregated price data are not available. We, therefore, approximate export prices per unit (teu or ton) for each sector by dividing the value of exports through the terminal by the number of teus or tons. These estimates proved highly volatile, particularly where tonnage/teu amounts were low, so we aggregated import and export data to obtain an average value per ton or teu. This process assumes that import and export values are equivalent. Further, the process assumes a high degree of homogeneity between products within each of the 42 sector classifications.

To calculate the costs associated with using the terminals the following costs were included:

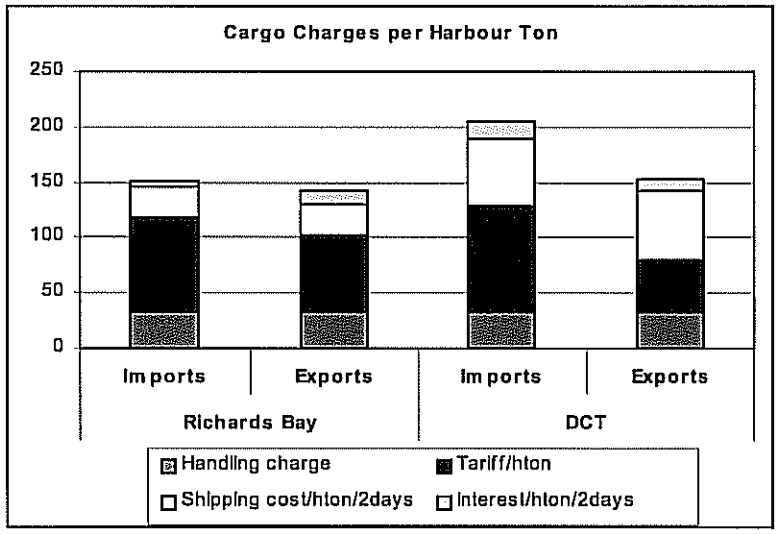
- port handling charges
- SAPO tariffs
- Interest charges (15 %) associated with a 4.5 day delay period
- Ship delay costs, at an estimated cost of $21.57 per teu per day

It should be noted that the ship delay costs assumed in the model simulations were very conservative. Detailed records of port and berth turn around times are given in appendix This process assumes a broader definition of harbour costs than simply the port handling charges and SAPO tariffs. The composite cargo charges used in this analysis explicitly recognise the costs associated with harbour delays. These costs can account for a very large proportion ~~up to 50 %~~ of the total cost associated with shipping goods through the harbour. It is expected that

reductions in the cost associated with trading through the terminals will be achieved through increased efficiency, i.e. lower delay times.

The average costs per harbour ton for the Richards Bay MPT and the DCT are presented in Figure 3.2 In the absence of data from RBMPT, it was assumed that vessel turn around time was the same as at DCT. Data subsequently obtained from the terminal indicate that this is a very conservative estimate. (For details of the estimation of cargo charges see the Appendix on "Data source and methods of estimation") Cargo charges range between R150 to R200 per harbour ton. Average port costs for imports are lower in Richards Bay, but the costs for exports are roughly similar. These cargo charges range between 1 % and 9 % (with an average of 3 %) of the total value of exports and imports. A 50 % reduction in cargo charges will on average reduce the international price of exports and the domestic price of imports by 1.5 %.[1]

Figure 3.2: Cargo charges per harbour ton



Long-run export demand elasticities for each sector are drawn from Edwards and Golub (2002).[2] These elasticities are only for broad aggregated industrial sectors so much of the variation in export responsiveness at the sector level is lost. The average elasticity (η) is 1.17.

[1] In the model, it is assumed that exporters take advantage of the decreased costs, by lowering export prices and increasing export volumes to meet the increased world demand. In reality this course of events may not occur and a reduction in costs at a port may not lead to an increase in exports. Instead, exporters may maintain their export volumes at the original price and increase their profit margins, rather than reducing the export price and increasing their export volumes. Thus, the increased efficiency of the ports may not generate increased exports, but may translate into increased profits for exporters. In this event only the owners and current employees of export factories will benefit. In the long-run, however, these profits will attract new firms into the sector and export supply will increase.

[2] These elasticities are based on costs not prices. Nevertheless, they provide some indication of the relative responsiveness of exports to changes in prices.

This implies that the average increase in export production in response to a 50 % decline in cargo charges is approximately equal to 1.76 % (η*% price = 1.17*1.5 = 1.76 %).

Estimating the substitution effects arising from lower import prices is more complex. In response to a decline in the relative price of imports, consumers and firms substitute imports for domestic products. However, domestic firms also respond to increased competition by lowering their product prices, which also lowers the degree of import penetration. To estimate the substitution effect, we draw upon short-run Armington elasticities obtained from research contracted by the Trade and Industrial Policy Strategies. Armington elasticities reflect the substitution between domestic and imported products in response to changes in the relative price of imported products.[3]

In calculating the import displacement effects we made the following assumptions:

- The percentage change in import prices is estimated as the change in cargo charges divided by the value of imports per teu or harbour ton.
- The long-run import demand elasticities are estimated at 2.4 times the short-run elasticities. International empirical evidence (see Goldstein and Kahn, 1985) suggests that the long-run elasticity is approximately 2.4 times the short-run elasticity.
- Domestic producers respond to increased import competition and reduce domestic prices by 50 % of the decline in import prices.
- The decline in domestic prices reduces the extent to which imports substitute domestic products by 50 %.[4]

The simple average elasticity of substitution was 0.87. This implies that a 1 % rise in the price of domestic goods relative to imported goods (PD/PM) raises the ratio M/D by 0.87 %. By virtue of the assumptions made this implies a 0.435 % rise in imports and a 0.435 % percent decline in demand for domestic products. The output model was then used to obtain the negative indirect impact on the economy arising from this decline in demand for domestic products.

[3] The Aarmington elasticity is calculated as $\varepsilon = \%\Delta(M/D)/\%\Delta(P_D/P_M)$ where M, D, P_D and P_M are imports, domestic products, price of domestic products and price of imported products, respectively. Taking logs the percentage change in the ratio of M/D can be estimated as $\hat{M} - \hat{D} = \varepsilon(\hat{P}_D - \hat{P}_M)$ where the '^' reflects percentage change.

[4] More specifically, using $\hat{M} - \hat{D} = \varepsilon(\hat{P}_D - \hat{P}_M)$ in footnote 3, we assumed that $\hat{M} = -\hat{D}$. An example of the procedure is as follows. Assume P_M falls by 10 % and the elasticity of substitution (ε) is equal to 2. According to the procedure followed we assume that P_D falls by 5 %. This implies that the ratio *M/D* must rise by 2*(-5+10) = 10 %. This is achieved through a 5 % reduction in *D* and a 5 % increase in *M*.

In Appendix 4, the Section beginning on p. 51 headed *Cargo Costs Associated with Terminal Operations* and continuing through the first paragraph on p. 54 should be replaced by the following. This provides updated information on vessel delays, as forwarded by SAPO in June 2003. The implication for the impact analysis that flows from this information is that the modelling undertaken in this March 2003 Report very substantially underestimates the impact of shipping delays on current costs of shipping cargo out of the DCT and RBMPT. While it may be argued that these delays are impacted to some degree by factors that lie outside the realm of terminal operations, inefficiencies at the terminals appear to be the major determinant of the observed vessel turn around times.

Cargo costs associated with terminal operations

The handling of cargo between the time it arrives at the terminal and the time it leaves on a ship incurs a number of costs, all of which are influenced by the efficiency and speed of terminal operations. In addition to these direct handling costs, operations at the terminal can impact on vessel charter costs by imposing delays in the wait time outside the port or in the period getting to and leaving the berth. All these costs are borne by the cargo owner, or in some instances, the shipping line. They are also the sources of revenue for actors involved with terminal operations. The cargo handling charges and charter costs are a critical variables in determining the impact of terminal operations on the wider economy, through price and production relations.

The components of the overall cargo costs are made up as follows:

Handling charges
Interest paid on value of cargo in transit
Costs associated with shipping delays (vessel costs)
Tariffs

The handling charge is a cost to the cargo owner and the source of revenue for the terminal operator, and hence all those involved in operations – management, labour, shareholders. The length of stay of cargo within the terminal incurs a cost to the cargo owner. This can be estimated as equivalent to the interest paid on the value of the cargo per day of its stay on the terminal. There are costs associated with shipping turn around time, namely the length of time a ship has to spend between arriving at (or outside) the port and leaving it. These costs would normally be included in the charter and container charges imposed on the cargo owner by the shipping line. Currently they are being absorbed by the shipping lines due to over capacity on routes in and out of Durban, with the exception of those to the United States of America. This cost is determined by the daily costs of operating a ship while waiting to enter the port or while

in it. The tariffs are a levy on the cargo owner and a source of revenue for the National Ports Authority. In the past they have been used to cover the running expenses of the NPA, as a source of revenue to cover expenditure on infrastructure and maintenance in the ports and as a source of revenue for cross-subsidising rail transport activities.

One of the main ways of decreasing the effective cost of cargo passing through the terminal is to improve the efficiency of terminal operations. Handling charges, which are currently low by international standards, could be reduced by improvements in efficiency either with or without a reduction in numbers of workers and labour costs. Shipping delays (vessel turn around times), which are currently high by international standards, could also be reduced by means of efficiency improvements, as could interest charges that derive from stationary cargo on the quay. Tariffs have a more indirect relationship to terminal efficiency. These are a source of revenue for the NPA. They are used to construct and maintain infrastructure and marine services such as pilotage and dredging, both of which influence the efficiency and cost of port operations. They are also used to cover the operating costs of the administration. Historically they were also used to cross-subsidise other services, notably rail infrastructure and fares. With the introduction of private sector participation in the ports the infrastructure and maintenance costs may be met by private operators and the same logic could apply to the railway sector. In principle, the tariff could shrink to a level necessary to cover only the running of the NPA administration and the provision of marine services.

The cargo handling charges used in this study were applied under the new system introduced from April 2002 that replaced the wharfage system. In the case of the DCT, the list of terminal charges was obtained from SAPO. An average charge per teu was obtained by applying the relevant charges to each category of box and multiplying by the number of boxes to obtain the numberator. Boxes of different types were reduced to teus to provide the denominator.

Efforts were made to obtain equivalent information for the RBMPT. To date (27/02/03) this information has not been forthcoming. To circumvent this problem, the rates used for the DCT were reduced to tonnage rates and then applied to cargo tons and values through the MPT.

The cargo tariffs were obtained from the NPA. They are now based on teus and tonnage. They differ for imports and exports. These tariff rates were applied to the teu and tonnage data to obtain an average for cargo through the terminals.

The information used to estimate the costs of shipping turn around time was obtained from the Chairperson of the Container Liners Operating Forum. These calculations are based on the charges vessel owners incur between the time of arrival at the port and the time of departure. The port turn around time is made up of the following: waiting time outside the port, berthing, operations, unberthing (unroping). The costs taken into consideration are only direct costs, namely charter and container/tonnage charges. There are further charges that could be included, for example fuel consumption etc. that when taken together would add up to an estimated further 50%.

The actual assumptions are as follows: assume charter charges per day = $18000, container charges per day = $2.5, containers per vessel = 1000. Therefore container charges per vessel

per day = $2500. Thus total daily cost for an idle ship is $18000+$2500 = $21570 . Therefore total daily cost per teu/day is $21570/1000 = $21.57.

It should be noted that the assumed shipping turn around times obtained from the Chairperson of the Container Liners Operating Forum used in the modelling are very conservative estimates. Information subsequently obtained from DCT and RBMPT is provided below:

Port and Berth Vessel Turnaround Time 2001-3 in hours			
	2001/2	2002/3	2003/4*
DCT			
Port	62.7	77.3	73.4
Berth	38.7	38.2	43.1
RBMPT			
Port	no data	100.0	109
Berth	no data	no data	41.5