Tshwane socioeconomic capital productivity model

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Outline

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- Capex project selection
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- Results: an overview of the TRT
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- Future capex assessments and model adjustments to be effected
- Conclusion

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Socioeconomic impact assessment rationale

Rationale

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A systematic analysis of the socioeconomic effect of a proposed development

As Tshwane communities continue to grow, the Executive and the Administration are constantly challenged by the need to balance a number of goals.

Deciding upon the quantum associated with new developments based on its envisaged impact on the lives of citizens is a challenge.

Designed to assist government and communities in making decisions that promote long-term sustainability.

Rationale

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Requires both quantitative and qualitative assessments of the impact of a proposed development.	• For example, a proposed development may increase employment in the community and simultaneously create demand for affordable housing.
A quantitative measurement of such factors	• A crucial component of any socioeconomic impact assessment
This study is a quantitative assessment considering the following:	• Economic growth effects, direct and indirect within the short and long-run, including a sectoral effect • Employment effects, direct and indirect within the short and long-run, including sectoral employment disaggregation • Capital productivity model – socioeconomic IRR • LSM analysis

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Capex project selection

Capex project selection

TRT	Magnitude and envisaged radical spatially transformative effects
Replacement, Upgrade, Construction of Waste Water Treatment Works Facilities	Allows the inclusion of different sectors for evaluation
Mamelodi and Saulsville Hostels	Allows the inclusion of different sectors for evaluation

Associated capital expenditure per project

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Project	Year 1	Year 2	Year 3
TRT	R 867 571 000	R 800 000 000	R 812 300 000
Waste Water	R 145 992 062	R 159 722 437	R 213 094 153
Hostels	R 50 000 000	R 50 000 000	R 40 000 000

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Methodology and definitions

Methodology and definitions

- Social accounting matrix model
  - Relatively intuitive; input-output model – that's its beauty
  - Very few assumptions
  - Describes the total impact on the City of Tshwane economy from an initial exogenous increase / shock
  - Input-output multipliers obtained from input-output tables capture the direct and indirect effects

- Our analysis estimates the level of economic activity occurring because of the proposed (TRT) project

- Localised for Tshwane using sector industry classification codes (SIC)
  - Structure of an economy by describing inter-industry relationships
  - Includes the latest data and will be updated on a yearly basis

Methodology and definitions

Socioeconomic IRR (se-IRR): *a real rate of return, in other words,*	• Rate which equates the NPV of the CAPEX to the NPV of the wage income streams over different time horizons • Socioeconomic discount rate • ***Above zero implies a positive se-IRR;*** • IRR of an investment = discount rate at which: the NPV_{costs} = $NPV_{benefits}$
Short run impact is per year	• Considers the direct and indirect economic impact of actual construction activities
Long-run impact has been constrained to five years	• Considers the permanent economic impact of new economic activity

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Results: an overview of the TRT

TRT Results: a brief overview

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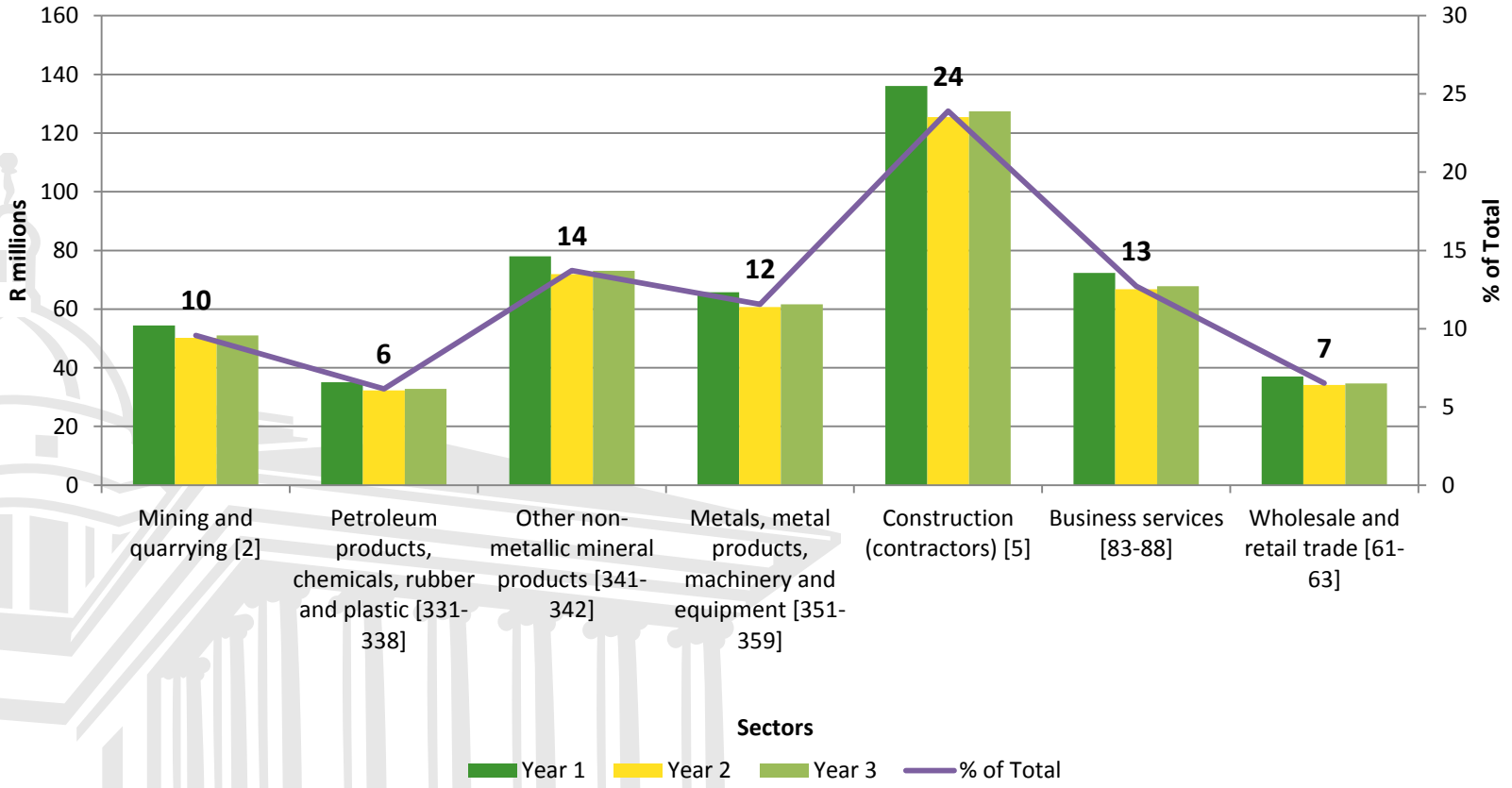
Indicator	Short-run			Long-run
	Year 1	Year 2	Year 3	
GGP (% change per annum) Rand Equivalent (R million)	0.397%-0.439% R 1 636 – R 1 809	0.366%-0.405% R 1 509 – R 1 667	0.372%-0.411% R 1 532 – R 1 693	0.135% - 0.149% R 555 – R 613
Total Employment	2 851-3151	2 629 - 2 906	2 670 – 2 951	818 - 904
Formal Employment	1911-2112	1762-1947	1789-1977	560-619
Highly Skilled	205-227	189-209	192-212	75-83
Skilled	640-707	590-652	599-662	329-363
Semi-unskilled	1066-178	983-1086	988-1103	156-173
Informal Employment	940-1039	867-959	881-873	257-284
Socio-economic IRR	8.31%	8.31%	8.31%	
Total socio-economic IRR	4.67%			

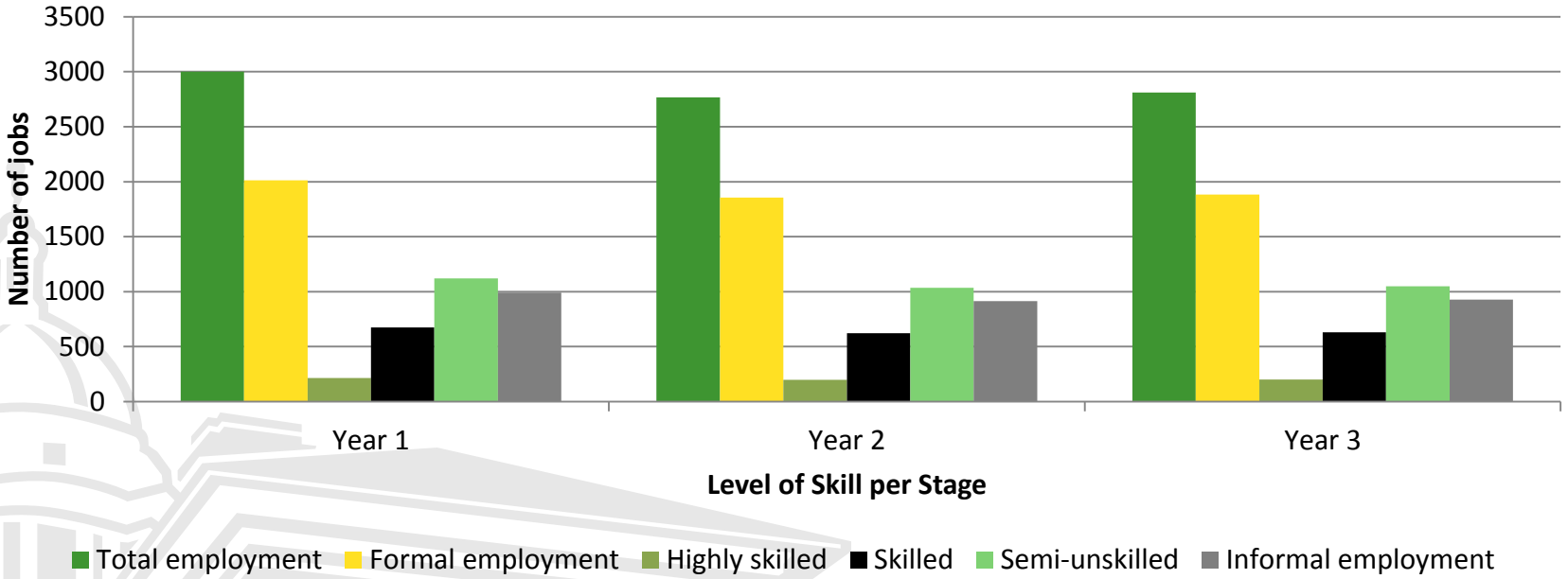
Results: a brief overview

Short run sectoral disaggregated growth effects on most impacted sectors



Results: a brief overview

Short-run employment effects, direct and indirect*



*Also available per affected sector

Results: a brief overview

Long-run employment impact: most important sectors

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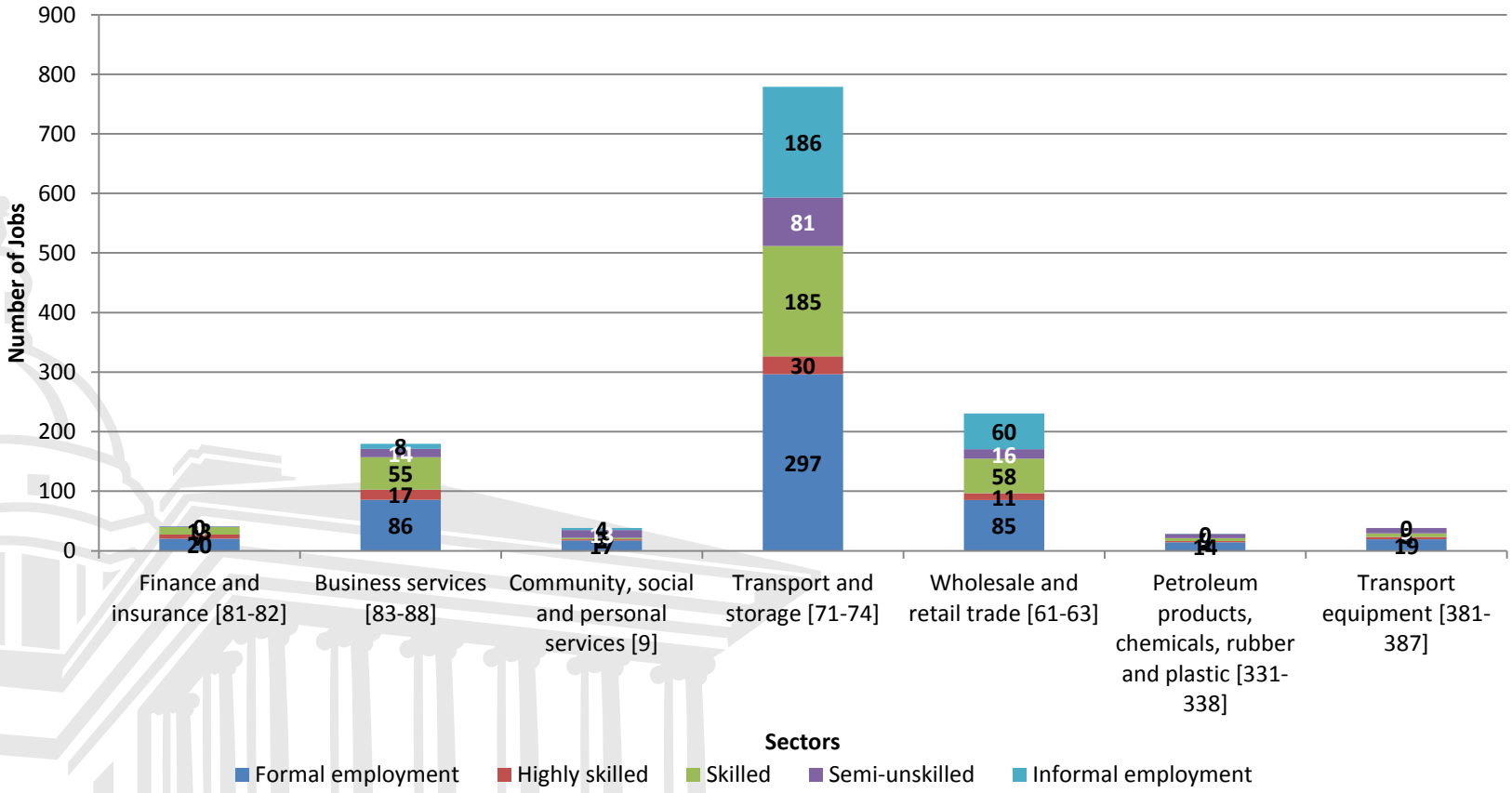

Results: a brief overview

Capital efficiency estimation

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Calculates the se-IRR by treating the capital expenses and the total wage income stemming from the new employment created by the TRT project, as negative and positive cash flows, respectively.

se-IRR distinct from an accounting IRR

The analysis takes full account of the impact of inflation on both the expenditure and the potential increase in total wages over different time horizons.

Results: a brief overview

Capital efficiency estimation

- Accounts for deprecation on public sector capital assets, as reported by Lockwood (2010)

- The return on capital (ROC) rate is the annual opportunity cost of capital rate, and is 8.5%.
  - This is consistent with the estimated cost of capital for the South African public sector of between 3% and 9%, as reported by Kantor (2013)

- The inflation rate has been chosen as the upper value of the inflation target (IT) band of 3% to 6%, managed by the South African Reserve Bank (SARB)
  - Annual rate set equal to 6.0%.

Results: a brief overview

Capital efficiency estimation

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Total wage effects per sector is estimated

Calculated for the combined short-run and long-run impact of the TRT project

Appraises capital efficiency by assessing the time-value of money spent and generated through the capital expenditure related to the TRT project and evaluates these flows at current (2013) Rands

Combined short-run and long-run total socio-economic internal rate of return of the CAPEX related to the TRT project is 4.67% with the yearly impact above 8 percent.

- It is important to again stress that this is a *real* rate of return

Results: a brief overview

LSM indicative analysis

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An indicative comparative static analysis of the distributional impact of the (TRT) project on the citizens of Tshwane

Reveals that the most new jobs will be created in the LSM1-4 income segmentation group over the duration of the project

The LSM5-7 and LSM8-10 segments see a marginal increase in the number of additional households

The CAPEX related to the TRT projects exhibits a strong redistributional impact in the local economy of Tshwane.

Results: a brief overview

LSM indicative analysis

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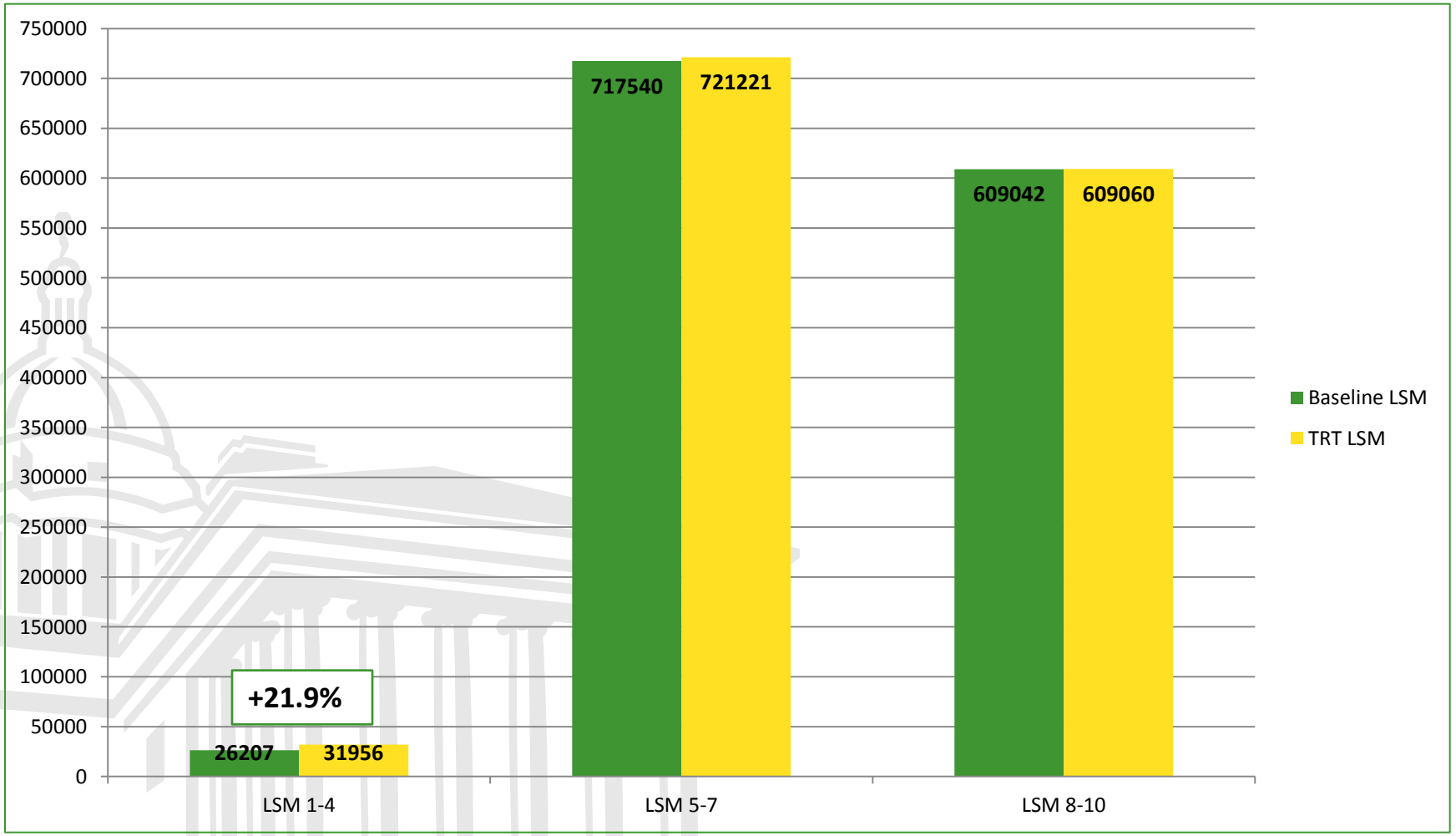

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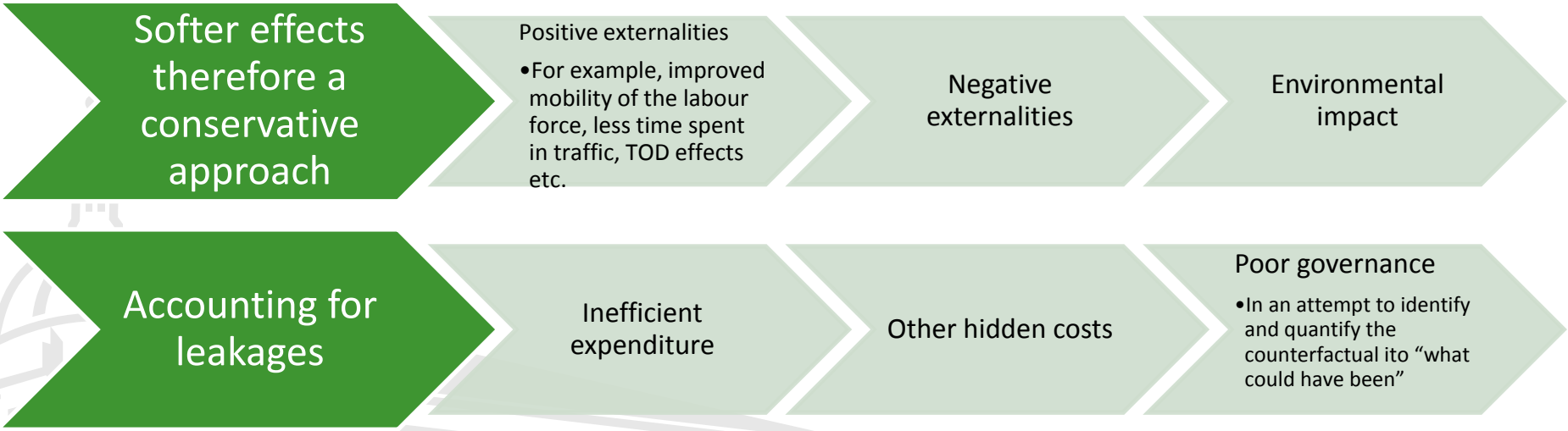
Model limitations

Model limitations



- Monitoring and evaluation in the period following the implementation of the proposed project
- Part of Phase 2

Model limitations

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Qualitative assessments

- Capturing community perceptions and other sociological effects
- Perceptions of community members regarding the effect of a proposed development forms a critical component of the assessment
  - Should contribute to any decision to implement a proposed project.
- Gaining an understanding of community values and concerns is, in fact, an important **first step**.
- The socioeconomic impacts of a proposed development on a community may actually begin the day the project is proposed.
- Changes in community social structures and interactions may occur once the new development is proposed.

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Future capex assessments and model adjustments to be effected

Future capex assessments and model adjustments to be effected

- Future assessments:
  - Free Wi-Fi
    - More complex
  - Power stations refurbishment
  - TOD effects of the Tshwane BRT (TRT)
  - Kwaggasrand waste recycling facility
  - Tshwane House
- Plug-ins to be developed
  - Leakages
  - Positive externalities
- Incentives framework and implementation

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Conclusion

Conclusion

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Eventual aims

- Fully fledged capital productivity model

Model can also be utilised to assess the effect of proposed private sector investments within the City

Assists in enhancing evidenced based policy decision making and fiscal sustainability

Similar details to that presented of the TRT are available for the Mamelodi and Saulsville Hostels project as well as the upgrading, maintenance and construction of waste water treatment works facilities

*Detailed model and methodology available upon request

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Annexure: Methodological overview

Model snapshot

If x represents the vector of industry outputs, y the vector of final demand and Z the matrix of inter-industry transactions, then the relationship between these is (Sporri*et al* 2007):

$$x = Z\begin{pmatrix}1\\.\\.\\.\\1\end{pmatrix} + y \qquad \text{Equation 1}$$

A matrix of technical coefficients (A) is then derived by dividing inter-industry transactions by output:

$$a_{ij} = \frac{z_{ij}}{x_j} \qquad \text{Equation 2}$$

The elements of A describe the direct, first round direct impact of any change in final demand. In other words, how much input from sector i is used per monetary output of sector j. When this is solved for production as a function of final demand, the Leontief inverse matrix ($L = (I - A)^{-1}$) is calculated.

The Leontief inverse matrix can then be used to calculate the output multiplier, the income multiplier and income effects (D'Hernoncourt, Cordier and Hadley 2011).

The output multiplier for a particular industry can be defined as the total of all outputs from each domestic industry required in order to produce one additional unit of output.

$$(Outputmultiplier)_j = \sum_i L_{ij} \qquad \text{Equation 3}$$

The income multiplier indicates the increase in income from employment as result of a change of R1 of income from employment in each industry.

$$(Incomemultiplier)_j = \sum_i \frac{v_i L_{ij}}{v_j} \qquad \text{Equation 4}$$

Where:

v is the ratio of employment to output for each industry.

Lastly, the income effects show the impact on income from employment throughout the economy arising from a unit increase in final demand for industry j's output.

$$(Incomeeffects)_j = \sum_i v_i L_{ij} \qquad \text{Equation 5}$$

Model snapshot

Localising the SAM for Tshwane

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This report follows the latter route. National technical coefficients a_{ij} are modified to yield local technical coefficients a_{ij}^{L} using regional purchase coefficients r_{ij}, such that:

$$a_{ij}^{L} = r_{ij} a_{ij} \quad \text{Equation 6}$$

To estimate r_{ij}, the Location Quotient method (Miller 1998) is used, where:

$$r_i = \begin{Bmatrix} 1\_if\_LQ_i^L \geq 1\_(\forall j = 1...n) \\ LQ_i^L\_if\_LQ_i^L < 1\_(\forall j = 1...n) \end{Bmatrix} \quad \text{Equation 7}$$

Model snapshot

Localising the SAM for Tshwane

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Employment impact

The Leontief inverse matrix together with employment data can be used to calculate the employment multiplier and employment effects (D'Hernoncourt, Cordier and Hadley 2011).

The employment multiplier shows the total increases in employment throughout the economy resulting from an increase in final demand.

$$(employmentmultiplier)_j = \sum_i \frac{w_i L_{ij}}{w_j}$$ Equation 8

Where:

w is equal to one full-time job per Rand of total output for each industry.

Employment effects calculate the impact on employment throughout the economy arising from a change in final demand for industry j's output of one unit.

$$(employmenteffects)_j = \sum_j w_i L_{ij}$$ Equation 9

Model snapshot

Capital efficiency

The NPV of each year's CAPEX is calculated, for that specific year. The formula to calculate the NPV is:

$$NPV_i = \frac{CAPEX_{Year\ i}}{(1+roc)(1+infl)}$$ Equation 10

where $CAPEX_{Year\ i}$ is the capital expenditure in years 1, 2 and 3, respectively; roc is the return on capital (which is 8.5%) and $infl$ is the inflation rate (which is 6.0%).

Model snapshot

Capital efficiency

The NPV of the wage income flows are calculated as an annuity, recurring over a regular interval (in this case, monthly) and in equal amounts.

The formula for an annuity is given by:

$$a_{n:i}^{m} = WAGE_{i}^{m} \times \left\{\frac{1-v^{n}}{i^{m}}\right\} \quad \text{Equation 11}$$

where $WAGE_{i}^{m}$ is the total monthly wage income, across all sectors, multiplied by the number of new jobs created per economic sector; $v = (1+i)^{-1}$ with i the return on capital, n is the number of periods over which the income stream is generated and m is the number of times the interest rate is compounded over the period.

In line with Pogue (2004), the rate which equates the NPV of the CAPEX to the NPV of the wage income streams over different time horizons, is the se-IRR.