

WESTERN AUSTRALIAN SEPTEMBER 2009 SUBMISSION

CAPITAL

Key Points

- We fully support the proposed 'direct' assessment of Capital.
 - This achieves the same aims as the existing Debt Charges approach, but is simpler and less data intensive, and hence more reliable.
 - A holding cost approach would be equally acceptable, if it includes a full population dilution assessment of Net Worth. However, it would require a judgement about the holding cost rate.
 - Whether a 'direct' assessment is any more 'contemporaneous' than other approaches is largely a matter of semantics.
- We consider that land held by PTEs should not be excluded from the population dilution assessment, as all financial assets should be treated consistently.
- We disagree with Tasmania's proposed equity holdings assessment.
 - Their argument that higher population growth increases public trading enterprise (PTE) profitability ignores the need for additional investment in PTE infrastructure to service the higher population.
 - Their view that revaluation of PTE assets is greater in higher population growth States is not justified by logic or data.
 - Their analysis (which is in any case not statistically significant) is distorted by policy differences among States, changes in accounting practice, the short data period, lack of account for net lending and the impact of lags in fiscal equalisation.
 - Using Tasmania's approach, with a longer time period and adjusting growth in net financial worth for net lending, Tasmania's conclusions are reversed.
 - Even if Tasmania's analysis of equity growth were valid, its method of implementing a needs assessment is not consistent with its analysis, resulting in vastly overstated needs.
- Arguments by Victoria and the ACT that part or all of equity holdings (e.g. revaluations) should be excluded from the assessments ignore the fact that revaluations are comparable to reinvested interest earnings, and that States derive revenue from their equity holdings, or can sell them, which can be used to fund service delivery or buy alternative equity (possibly in the same service delivery area).

- South Australia has not provided any derivation of its proposals from explicit underlying assumptions.
- We disagree with the proposed 50% discounting of recurrent use factors when they are applied to physical asset stocks.
 - There is no reason to expect stock quantity factors to be closer to one than expense use factors, which is equivalent to assuming that States with lower per capita recurrent service use have higher intensity of use of physical assets.
 - Discounting stock quantity factors would be inconsistent with not discounting Welfare and Housing socio-demographic composition factors.
- We support the Draft Report proposal to include capital-type expenditures in the weights for the recurrent Roads factors, and to apply these factors unchanged to capital stocks.
- We do not agree that National Network road (NNR) capital grants reflect needs that are not picked up by the proposed Roads factors.
 - If capital grants for NNR are to not affect the relativities, then road length and traffic on NNR will have to be removed from the disability factors when they are applied to capital stocks.

COMMISSION'S PROPOSED DIRECT ASSESSMENT APPROACH

We continue to fully support the Commission's proposal to use a 'direct' approach to assessing Capital.

The proposed assessment does not expand the scope of fiscal equalisation – it achieves the same aims as a debt charges assessment.

- However, the old Debt Charges assessment required data that was not available at the necessary accuracy and had technical flaws, so it failed to produce reliable results.

Compared to the existing Debt Charges assessment, the proposed 'direct' assessment:

- improves HFE - as it will produce reliable results; and
- is simpler - using very little data beyond the recurrent expense assessments.

The Commission is simplifying most assessments by doing similar calculations in less detail. However, the proposed Capital assessments are fundamentally simpler in nature.

As we have previously commented, we consider 'direct', holding cost (with net worth assessment) and debt charges approaches to be equally acceptable in principle, if implemented correctly. However, in practice, a valid debt charges assessment will always be complex and data intensive.

A holding cost/net worth assessment could be implemented just as simply as the proposed 'direct' approach.

- From our perspective, the only disadvantage of such a holding cost assessment (compared to the 'direct' approach) would be that the Commission would have to determine a standard for the holding cost expense assessments.
- However, other States have argued for a holding cost approach on the basis that they wish to discount or remove the population dilution assessment. A holding cost approach would only be valid if the population dilution assessment is fully implemented for all net assets.

We note the Commission's view that a 'direct' assessment is more contemporaneous than other approaches. However, this appears largely a matter of semantics.

- A 'direct' approach is more up-front in terms of individual asset purchases, but this does not make it more contemporaneous with respect to government finances.
- A holding cost approach would equalise holding costs in the year that they occur, and a debt charges cost would equalise interest costs in the year that they occur.

TASMANIA'S PROPOSED ASSESSMENT OF EQUITY GROWTH

In late August 2009, Tasmania circulated a submission in which it proposed that the Commission assess higher population growth States as having higher rates of revaluation of their equity holdings.

We do not agree with Tasmania's conceptual case, and do not think that its empirical evidence supports its proposition.

Furthermore, even if Tasmania's conclusions were correct, its proposed method of assessing needs for equity growth is incorrect.

Tasmania's conceptual case

Profitability of public trading enterprises (PTEs)

Tasmania has argued that population/economic growth increases the market for services from PTEs and hence their profitability.

It is true that a PTE can make a higher dollar profit if the State population or demand for PTE services is higher. However, this does not mean that the PTE can make a higher dollar per capita profit, or that it will make a higher percentage profit (relative to the equity value of the PTE).

To service a higher population or service demand, a PTE requires more infrastructure. The PTE can obtain the funds for purchasing this infrastructure by:

- an equity injection from the State government – this converts one asset type (cash) into another asset type (equity). Although it will increase PTE profits, it will also decrease the State government's interest earnings;
- retaining profits – this is done by paying lower dividends, so it also reduces the State government's interest earnings; or
- borrowing – this increases PTE profits, but the profits must be used to pay the interest cost of the borrowings.

If new infrastructure is funded by equity injections or retained profits, then higher population will result in higher equity,¹ but this only reflects a change in the mix of financial assets, rather than an increase in net financial worth.

Economic conditions can increase costs of factors of production (land, labour and capital). If these cannot be fully passed on, they will reduce returns on existing and new investment. They will also necessitate higher government subsidies for services that are not charged at full cost (e.g. public transport and public housing).

There are also a range of policy factors that affect PTE profitability, such as:

- impacts from underinvestment, overinvestment or efficiency of investment; and
- charging and subsidy policies.

However, policy factors should not influence equalisation.

We conclude that there is no conceptual basis for a link between population growth and increased profitability per head.

¹ When a PTE borrows to purchase infrastructure, the equity in the PTE is unchanged, as the value of the PTE's assets and liabilities increase by the same amount.

Increase in equity

Tasmania has tried to support its arguments by examining the relationship between growth in equity holdings and population growth for each State.

However, growth in equity in a PTE equals:

Revenue (including Community Service Obligation payments)
less Expenses (including tax equivalent payments to States)
plus Revaluation of assets owned by the PTE
plus Equity injections
less Dividends paid to States
less Sales of equity

Equity injections, dividends and equity sales are policy influenced. For example, over three years to 30 June 2008, Western Australia injected \$2.3 billion of equity into its public corporations.²

Revenue may also be policy influenced, through non-commercial limitations on the prices that PTEs may charge for their services, and requirements to fund Community Service Obligations internally.

Any analysis needs to remove all of these policy impacts from the change in equity before looking for a relationship with population growth.

Furthermore, because Tasmania has examined change in equity, its analysis is also distorted by changes in accounting practice, which we understand have had a significant impact on the equity holdings of at least two States, and possibly a third.³

Policy and accounting practices only impact on the Commission's proposed assessment through the standard, which always reflects average policy and accounting practice.

² For example, Western Australia injected \$1.3 billion equity into its Public Transport Authority in 2006-07, related to the expansion of the urban rail network.

³ We understand that a major contributor to the 28% fall in Tasmania's equity over 2004-05 and 2005-06 was a change in valuation method by one PTE, and a major contributor to the 52% fall in the Northern Territory's equity in 2006-07 was a change in classification of one PTE to general government. South Australia also recorded a 15% fall in equity in 1999-2000.

Revaluation of assets held by PTEs

Tasmania has argued that assets held by PTEs (particularly land) will increase in value by more in States with higher population growth, because the relative scarcity of these assets will increase.

However, abstracting from short term imbalances, this argument is not valid.

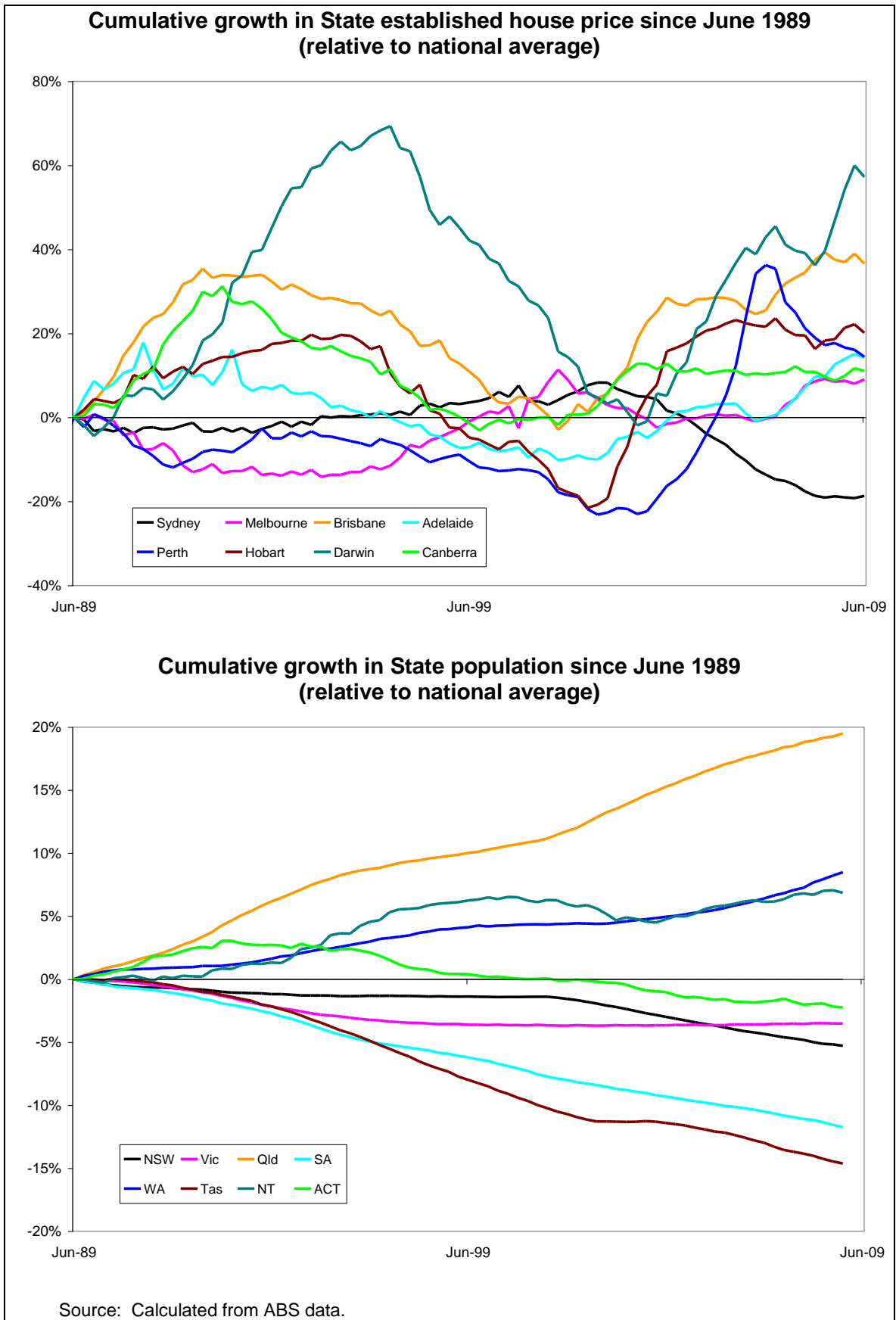
- In the case of capital, the supply of assets is not constrained. For assets manufactured locally, a growing population also means a growing workforce, and hence capacity for supply to increase. For assets manufactured interstate, any price increases will be national, so will affect every State's equity.
- In the case of land, the issue is not population growth, but the population size compared with land availability. Although the supply of land is ultimately fixed, all States have substantial amounts of unused or rural land of low value. As population grows, States release or zone more land for development. Where desirable land is plentiful around a population centre, large or small, prices will be moderate and growth need not significantly impact on prices (assuming appropriate land release and zoning policies). Where population size has outstripped available land, prices will be high regardless of growth.

Figure 1 compares shows growth in established house prices (of which a major component is the price of land) for each State compared to the national average, and growth in population compared to the national average.⁴ From this, it can be seen that prices are cyclical, and that there is no clear relationship with population growth. For example, Figure 1 shows that:

- Perth has recently experienced a significant correction in its prices, including relative to other States, despite continuing high population growth;
- over the course of the last twenty years, Perth price growth from the base year has usually been below average (despite high State population growth) while Hobart price growth from the base year has usually been above average (despite low State population growth); and
- over the full twenty year period, the relative price growth of five capitals has been similar (Hobart, Perth, Adelaide, Melbourne and Canberra) has been similar, despite very different State population growth rates.

⁴ Note that growth relative to the national average is shown by the slope of the lines.

Figure 1: Established house prices and population



Tasmania's empirical case

Tasmania has examined the relationship between growth in per capita equity holdings and population growth for each State. A similar analysis has also been done using net financial worth rather than equity. In each case, Tasmania has fitted a straight regression line through the data, and concluded, for example, that for each additional percentage point in population growth, States can achieve an additional 5.4 percentage points in equity growth.⁵

We have discussed above our concerns that the data are policy influenced.

We also have the following technical concerns with the analysis.

- The statistical relationship is very weak – the regression line has an r^2 of only 0.348 (equity)/0.099 (net financial worth). The slope of 5.4 (equity)/4.1 (net financial worth) has a standard error of 3.0/5.1. Within the uncertainty limits, these slopes could be negative.
 - Tasmania has suggested that the poor fit does not matter, as the slope can be heavily discounted and still give positive needs to low population growth States. However, this reasoning relies upon the slope being positive.
- The analysis only uses the average of five years' growth. This is far too short to establish a relationship.
- The analysis uses an arithmetic average of growth rates, but it is more appropriate to use a geometric average.
- The regression line should be constrained so that national equity growth corresponds to national population growth.

To some extent, analysing net financial worth overcomes some of the problems with equity holdings. For example, sales of PTEs and equity injections into PTEs will have no impact on net financial worth.

- However, many policy influences remain. Growth in net financial worth will be influenced by non-commercial pricing of PTE services, the magnitude of the general government surplus and level of investment in general government assets.

To address such issues, growth in net financial worth should be adjusted for net lending (although this still does not address the non-commercial pricing of PTE services), which Tasmania has not done.

We have analysed nine years' growth in net financial worth, removing net lending from the growth. We did this by calculating percentage growth in year t as:

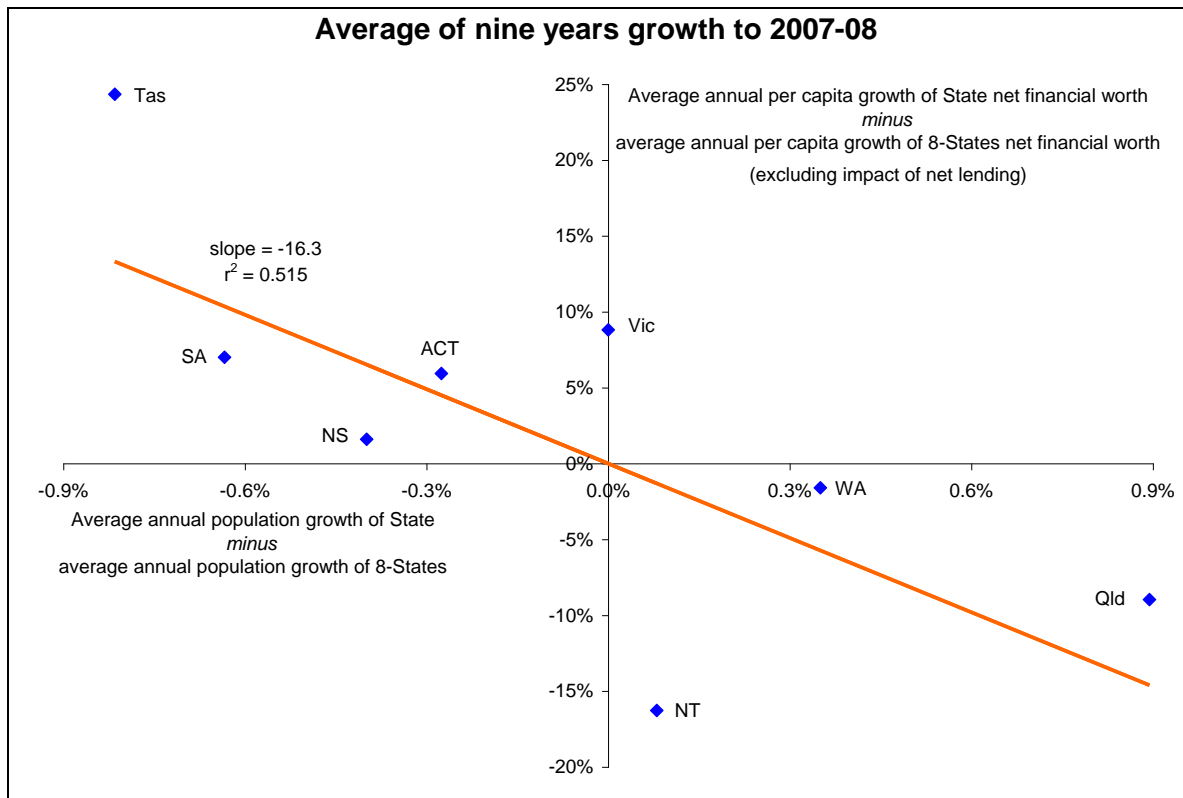
$$\left[\left(\frac{\text{Net financial worth at end of year } t - \frac{1}{2} \text{ net lending in year } t}{\text{Net financial worth at start of year } t + \frac{1}{2} \text{ net lending in year } t} \right) - 1 \right] \times 100\%$$

⁵ Tasmania suggests discounting this by half.

For each State, our analysis took a geometric average of these growth rates over nine years, and divided by the corresponding average of population growth rates, to convert to per capita terms. We then compared the results to population growth and fitted a line constrained to match national data.

The result is shown in Figure 2. Unlike Tasmania's fitted lines, the slope is negative (-16.3). It is still a poor fit, with an r^2 of 0.515 and a standard error for the slope of 5.7, but it is statistically significant at a 97% confidence interval.

Figure 2: Per capita growth in net financial worth (excluding contribution of net lending) versus population growth



The results in Figure 2 suggest that high population growth States have disabilities well in excess of the Grants Commission's proposed population dilution assessment (the reverse of Tasmania's conclusion).

However, due to the problems with policy contamination, and the poor fit,⁶ we do not support making an assessment on the basis of Figure 2. Rather, we support the Commission's proposed approach, in which the only impact of policy is on the standard, which reflects average policy.

⁶ The data used for Figure 2 also suffer from being net amounts, which in some instances are close to zero, making percentage growth volatile.

Time lags in HFE

Currently, HFE is applied with an average time lag of 2-6 years.

Therefore, in the boom years of 2006-07 and 2007-08, Western Australia had large revenue increases, which improved our financial position in those years, but are being equalised away to other States in later years.

In net present value terms, the time lag has no impact, as the redistribution is escalated by growth in the GST grant pool.

Effectively, Western Australia had a liability in 2007-08, which incurs interest at a rate equal to the growth in our population share of the GST grant pool. However, this liability is not recorded in the GFS accounts.⁷

Any analysis of growth in net financial worth that does not adjust for these liabilities (and corresponding receivables in other States) will be distorted.

This will have been a significant problem with Tasmania's analysis of net financial worth. It is also a problem with our analysis presented in Figure 2, although our longer time-frame will have partially moderated the distortion.

Tasmania's method of assessing equity needs

Even if Tasmania's conclusions were correct, its method of assessing needs is not consistent with its analysis.

Tasmania's implementation method assesses each State's percentage change in per capita equity as:

$$\begin{aligned} & \text{National per capita equity \% change} \\ \text{plus } & \left[\text{National per capita equity \% change} \text{ times } 2.7 \text{ times } \left(\text{State population \% change} \text{ minus } \text{national population \% change} \right) \right] \end{aligned}$$

However, to be consistent with Tasmania's derivation of the factor of 2.7, each State's percentage change in per capita equity should be assessed as:

$$\begin{aligned} & \text{National per capita equity \% change} \\ \text{plus } & \left[2.7 \text{ times } \left(\text{State population \% change} \text{ minus } \text{national population \% change} \right) \right] \end{aligned}$$

This means that, in Tasmania's method, each State's assessed equity per capita growth rate (step 9 in its paper) should be calculated by adding the weighted differences in population growth from the national average (step 7 in its paper) to the national equity per capita growth rate (step 3 in its paper).⁸

⁷ There are reasons for this, such as uncertainties in the size of the liability and the liability not formally existing until later years when the Commission's recommendations are accepted.

⁸ Tasmania's steps 5 and 8 are then unnecessary.

Relative to the numbers presented in Tasmania's submission, correcting the above error in Tasmania's method would improve Western Australia's 2007-08 needs by over \$1.5 billion and worsen Tasmania's 2007-08 needs by over \$450 million.

ACT/VICTORIAN ARGUMENTS TO EXCLUDE EQUITY FROM NET LENDING ASSESSMENT

In support of Tasmania's submission, the ACT has argued that a population dilution assessment should be restricted to equity contributions, and not to PTE value that has resulted from revaluations. They have provided data to show that, in 2007-08, the majority of the increase in equity for New South Wales and Queensland arose from revaluations. (Victoria goes further, arguing that all equity should be excluded from the population dilution assessment.)

However, revaluations of PTEs are similar in concept to interest returns on cash that are reinvested (although more lumpy in the short term). In both cases, the Commission needs to recognise the full asset value to achieve equalisation.

Financial assets, of whatever type, are available for generating further financial worth, which can fund service provision, and the value of these assets is subject to population dilution.

Financial assets can be sold (e.g. Victoria's sale of its electricity operations, future sale of land above Western Australia's undergrounded central city rail, sale of public housing land to finance new public housing).

While some financial assets provide services at less than full cost (public housing, transport), the appropriate way to recognise any resultant disabilities is through the assessment of government subsidies to PTEs.

The only issue is whether States can, at average policy, achieve different percentage returns on their financial assets.

The ACT's data suggests that, in 2007-08, the growth in New South Wales' equity in PTEs from revaluations and retained profits was 19%, compared to corresponding growth of 17% for Queensland. We do not consider this to indicate an advantage for New South Wales, as it is only one year of data. However, it certainly does not suggest a disadvantage for New South Wales.

However, States do receive revenue from PTEs, which is available for service delivery.

Also, States do treat PTEs as an investment, as evidenced by occasions when they have sold their equity in PTEs, often in order to reduce debt (which alters the mix of financial assets).

SOUTH AUSTRALIA'S PROPOSALS

South Australia has floated various other approaches, generally with a view to reducing the assessment of population dilution.

In particular, South Australia circulated a proposal in the lead-up to the August 2009 conference between Commissioners and Heads of Treasuries. Prior to that conference, we informally circulated a critique of this proposal. This critique (with a few clarifying amendments) is reproduced as Attachment 1.

A consistent failing of South Australia's proposals is that they do not include explicit assumptions and a derivation of the proposed methods from those assumptions.

By contrast, the Commission's proposed approach can be shown to achieve HFE on the basis of its assumptions that, under average policy:

- subject to physical asset stock disabilities, States require equal per capita physical assets to provide the average standard of service;
- spending required to maintain asset stock is proportional to the stock; and
- if States have equal per capita net financial assets, then they will achieve equal per capita returns on those assets.

TREATMENT OF LAND HELD BY PTEs

The Draft Report proposed that the value of land held by PTEs should be included in the Net Lending assessment, although at the August 2009 conference the Chairman indicated that this issue is being considered further.

We agree with the Draft Report that the full value of PTEs should be included in the Net Lending assessment. All that has been said above supports this view.

As the Draft Report notes, States can hold their financial assets in various forms. Some States have sold much of their equity in PTEs (which included the land held by those PTEs), converting it to other financial assets (commonly reducing debt, which is a negative financial asset).

- Consistency requires a common treatment of all financial assets.

As we argued in our February 2009 submission, the proposed assessment of financial assets is quite different from the recurrent assessments (based on the value of assets rather than service provision requirements). Also, it has a simple and robust methodology that captures the full scope of financial assets.

- The Net Lending disability (population dilution of net financial worth) is quite straightforward.

We remain firmly of the view that land held by PTEs should not be excluded from the assessment of financial assets.

DISCOUNTING OF PHYSICAL ASSET STOCK QUANTITY FACTORS

The Commission is proposing discounting expense use disability factors by 50% (towards equal per capita), before applying them to physical asset stocks.⁹

The rationale for this proposal is that “there is not a one to one relationship between expense use and stock disabilities”.

We have three concerns with this proposal.

- Discounting introduces a bias – there is no reason to expect the discounted factors to better reflect physical asset requirements, which may be further (rather than closer) to equal per capita than the expense use factors.
- It is not consistent with the proposal to use an undiscounted factor in Welfare and Housing, based on number of Commonwealth pension recipients. As discussed in our Welfare and Housing submission, there is not a one to one relationship between pension recipients and State clients. If lack of a “one to one relationship” is a criterion for discounting, then it must be applied consistently.
- It is equivalent to assuming that intensity of physical asset use in the provision of services¹⁰ is higher for States with lower per capita recurrent service use.

With regard to this third concern, the proposed stock quantity factor would be calculated as:¹¹

$$\frac{\text{State stock pc}}{\text{National stock pc}} = 1 + \left(\frac{\text{State recurrent use pc} - \text{national recurrent use pc}}{\text{National recurrent use pc}} \right) / 2$$

This rearranges to:

$$\frac{\text{State stock}}{\text{State recurrent use}} = \frac{\text{National stock}}{\text{National recurrent use}} \times \left(1 + \frac{\text{National recurrent use pc}}{\text{State recurrent use pc}} \right) / 2$$

⁹ The Commission is proposing to also take three-year moving averages of these factors and to also apply undiscounted, non-averaged expense “cost” factors to physical asset stocks.

¹⁰ Calculated as quantity of physical asset stock per unit of recurrent service use.

¹¹ For simplicity, we ignore the proposed three-year averaging.

CAPITAL ASSESSMENT OF ROADS

The Draft Report proposes applying the recurrent Roads factors to capital stocks in the Investment assessment. To enable this, it proposes including expenditure on pavement and bridge improvements in the calculation of the recurrent factor.

We agree with these proposals. The distinction between recurrent and capital expenditures is blurred in the area of roads, and alternative approaches would require judgements as to which data to use in each of the recurrent and capital assessments.

- The proposed Roads assessment is based on National Transport Commission (NTC) data regarding the cost drivers of different categories of road expenditure. It would be inconsistent to only take account of some of the NTC categories.¹²
- While visiting Western Australia in July 2009, Commission staff questioned the application of NTC data, which relates to flows of expenditure, to capital stocks.
- We accept that the NTC data may not be designed with capital stocks in mind. However, we also note that applying factors to capital stocks means that these factors will be applied to depreciation and new capital expenditure (which are both flows). The Secretary's concern is only an issue for the part of the Investment assessment covering movements in each State's share of capital stock requirements.
- We agree with the reasoning in the Draft Report that the influences on stocks will be similar to recurrent influences, and support the consistent application of the roads factors throughout the assessments.

Commission staff also suggested that the proposed Investment assessment gives an unrealistic result for roads because it will assess States as requiring investment in roads for each additional rural person.

This concern represents a misunderstanding as to how the proposed Investment assessment will operate.

- As the rural roads disability factors are calculated from States' per capita rural road lengths, population growth in the Investment assessment is offset by reductions in the disability factors.
- If national new capital expenditure occurs in the absence of growth in road length, this represents an increase in standards, which is appropriately assessed in proportion to States' road lengths.

¹² This does not preclude some NTC components being assessed equal per capita. For example, the NTC category of loan servicing is appropriately covered by the equal per capita assessment of interest costs in the Commission's proposed Other Expenses category. Likewise, land acquisition is appropriately covered by the equal per capita assessment of general government land.

We provide an algebraic analysis of this issue in Attachment 2 to this submission.

TREATMENT OF ROAD GRANTS

The Draft Report proposes that capital grants for National Network roads (NNR) should not affect the relativities because they meet needs which are not assessed by the proposed Roads factors. In particular, it refers to traffic on NNR that passes “through” States.

We disagree that the NNR capital grants reflect needs that are not captured by the proposed assessments.

- The length of NNR and the traffic on NNR (including “through” traffic) will be picked up in the Roads disability factors.
 - If capital grants for NNR are to not affect the relativities, then road length and traffic on NNR will have to be removed from the disability factors when they are applied to capital stocks.

Western Australian Department of Treasury and Finance

September 2009

**CRITIQUE OF SOUTH AUSTRALIA'S "DEBT CHARGES" POPULATION DILUTION
ASSESSMENT MODEL PROVIDED 8 AUGUST 2009**

(CRITIQUE ORIGINALLY CIRCULATED INFORMALLY ON 10 AUGUST 2009)

There are two main technical problems with the model.

The **first problem** is that South Australia has multiplied change in population share by national average per capita earnings, instead of by national total earnings. This can be most readily explained using some very simple algebra.

South Australia has per capita needs for State *i* in year *t* calculated as follows:¹³

$$\frac{N_{i,t}}{P_{i,t}} = \left(\frac{P_{i,t}}{P_t} - \frac{P_{i,b}}{P_b} \right) \frac{r W_t}{P_t} \quad (\$ \text{ per capita})$$

where $P_{i,t}$ = population of State *i* in year *t*

P_t = national population in year *t*

W_t = national net worth in year *t* (assumed by South Australia to remain unchanged since base year – see below)

r = rate of earnings on net worth
(so $r W_t$ equals national earnings on net worth in year *t*)

and $t = b$ indicates the base year (1960 in South Australia's spreadsheet)

In dollar terms, this is:

$$N_{i,t} = \left(\frac{P_{i,t}}{P_t} - \frac{P_{i,b}}{P_b} \right) \frac{P_{i,t}}{P_t} r W_t \quad (\$ \text{ million})$$

This is meant to reflect the differences in per capita net worth that arise if each State starts with equal per capita net worth, but then have differential population growth. However, the following derivation shows that the above formula is incorrect.

¹³ This formula ignores the scaling of the disability factors to an average of one.

	State <i>i</i>	National	
An equal per capita share of net worth in the base year is:	$\frac{P_{i,b}}{P_b} W_t$	W_t	(\$ million)
In year <i>t</i> , this amount in per capita terms is:	$\frac{P_{i,b}}{P_b} \frac{W_t}{p_{i,t}}$	$\frac{W_t}{P_t}$	(\$ per capita)
This gives per capita earnings of:	$\frac{P_{i,b}}{P_b} \frac{r W_t}{p_{i,t}}$	$\frac{r W_t}{P_t}$	(\$ per capita)

Therefore, needs for State *i* in year *t* are:

$$\frac{N_{i,t}}{p_{i,t}} = \frac{r W_t}{P_t} - \frac{P_{i,b}}{P_b} \frac{r W_t}{p_{i,t}} \quad (\$ \text{ per capita})$$

which rearranges to:

$$\frac{N_{i,t}}{p_{i,t}} = \left(\frac{1}{P_t} - \frac{P_{i,b}}{P_b} \right) r W_t \quad (\$ \text{ per capita})$$

or in dollar terms:

$$N_{i,t} = \left(\frac{P_{i,t}}{P_t} - \frac{P_{i,b}}{P_b} \right) r W_t \quad (\$ \text{ million})$$

This differs significantly from South Australia's formula, with very different results.

In the table above, if we divide per capita earnings for State *i* by national per capita earnings, we get a disability factor for State *i* in year *t* of:¹⁴

$$\left(\frac{P_{i,b}}{P_b} \right) \Bigg/ \left(\frac{P_{i,t}}{P_t} \right)$$

This disability factor does not require scaling.

¹⁴ States with stronger population growth have lower per capita capacity for earnings on net worth.

The **second problem** is that South Australia is calculating population dilution from a base year (1960 in their spreadsheet) to the current year, which would only be appropriate if national net worth had all been acquired in the base year. However, national net worth has been acquired over a number of years, rather than just in the base year.

Therefore, a correct assessment of the population dilution of net worth requires the disability factors that are applied to earnings from net worth in year **t** to be calculated for each past year **b**:

$$\left(\frac{P_{i,b}}{P_b} \right) / \left(\frac{P_{i,t}}{P_t} \right)$$

and a weighted average of these disability factors to be calculated over all the past years **b**. These weights will be the quantity of national net worth acquired in each past year **b**, valued at year **t** prices.¹⁵

This is what makes a Debt Charges approach so data intensive.

¹⁵ For cash and liabilities, which do not appreciate in value, quantity equals value, and latest year prices equal historical prices. However, under average policy, a large proportion of States' net worth is held in assets that do appreciate in value (i.e. physical assets and equity in corporations).

IMPACT OF ROADS IN CAPITAL ASSESSMENTS

We will use the following notation, which is consistent with that used in the Draft Report (footnote 177, page 444), but with some additions.

$N\hat{C}E_i$ = assessed new capital expenditure for State i for the year

NCE = national new capital expenditure during the year

time $t = 0$ denotes start of year, time $t = 1$ denotes end of year

K_t = national capital stock at time t , valued at end of year prices
(so $K_0 = K_1 - NCE$)

$p_{i,t}$ = population of State i at time t

P_t = national population at time t

$\delta_{i,t}^u$ = recurrent 'use' disability factor of State i at time t

$\delta_{i,t}^c$ = recurrent 'cost' disability factor of State i at time t

$l_{i,t}$ = assessed road length of State i at time t

L_t = assessed national road length at time t

$v_{i,t}$ = assessed vehicle-kilometres of State i at time t

V_t = assessed national vehicle-kilometres at time t

$\%L_t$ = weight of road length in recurrent use factor at time t

$\%V_t$ = weight of vehicle-kilometres in recurrent use factor at time t

Footnote 177 gives the formula for assessed new capital expenditure for State i , which can be rearranged as follows:

$$\begin{aligned} N\hat{C}E_i &= \left[\left(\frac{K_1}{P_1} \right) p_{i,1} \delta_{i,1}^u - \left(\frac{K_0}{P_0} \right) p_{i,0} \delta_{i,0}^u \right] x \delta_{i,1}^c \\ &= \left[\left(\frac{K_1}{P_1} \right) p_{i,1} \delta_{i,1}^u - \left(\frac{K_1 - NCE}{P_0} \right) p_{i,0} \delta_{i,0}^u \right] x \delta_{i,1}^c \\ &= \left[K_1 \left(\frac{p_{i,1} \delta_{i,1}^u}{P_1} - \frac{p_{i,0} \delta_{i,0}^u}{P_0} \right) + NCE \left(\frac{p_{i,0} \delta_{i,0}^u}{P_0} \right) \right] x \delta_{i,1}^c \end{aligned}$$

We apply this formula to Roads, and assume that the Roads 'use' factor is just the average of a road length factor (based on length, as per the proposed rural road length factor) and a vehicle-kilometre factor. Using the above notation, this Roads 'use' factor for State i at time t calculated as follows:

$$\begin{aligned}\delta_{i,t}^u &= \%L_t \left(\frac{l_{i,t}}{L_t} \right) / \left(\frac{P_{i,t}}{P_t} \right) + \%V_t \left(\frac{v_{i,t}}{V_t} \right) / \left(\frac{P_{i,t}}{P_t} \right) \\ &= \left(\%L_t \frac{l_{i,t}}{L_t} + \%V_t \frac{v_{i,t}}{V_t} \right) / \left(\frac{P_{i,t}}{P_t} \right)\end{aligned}$$

It then follows that:

$$\frac{P_{i,t}}{P_t} \delta_{i,t}^u = \%L_t \frac{l_{i,t}}{L_t} + \%V_t \frac{v_{i,t}}{V_t}$$

Inserting this into the above formula for assessed new capital expenditure gives:

$$\begin{aligned}& \hat{NCE}_i \\ &= \left[K_1 \left(\frac{P_{i,1} \delta_{i,1}^u}{P_1} - \frac{P_{i,0} \delta_{i,0}^u}{P_0} \right) + NCE \left(\frac{P_{i,0} \delta_{i,0}^u}{P_0} \right) \right] x \delta_{i,1}^c \\ &= \left[K_1 \left(\left(\%L_1 \frac{l_{i,1}}{L_1} + \%V_1 \frac{v_{i,1}}{V_1} \right) - \left(\%L_0 \frac{l_{i,0}}{L_0} + \%V_0 \frac{v_{i,0}}{V_0} \right) \right) + NCE \left(\%L_0 \frac{l_{i,0}}{L_0} + \%V_0 \frac{v_{i,0}}{V_0} \right) \right] x \delta_{i,1}^c \\ &= \left[K_1 \left(\left(\%L_1 \frac{l_{i,1}}{L_1} - \%L_0 \frac{l_{i,0}}{L_0} \right) + \left(\%V_1 \frac{v_{i,1}}{V_1} - \%V_0 \frac{v_{i,0}}{V_0} \right) \right) + NCE \left(\%L_0 \frac{l_{i,0}}{L_0} + \%V_0 \frac{v_{i,0}}{V_0} \right) \right] x \delta_{i,1}^c\end{aligned}$$

From this, we see that movements in population have no impact on assessed new capital expenditure – the driving factors are road length and vehicle-kilometres.

New capital expenditure will be assessed for changes in a State's share of road length or vehicle-kilometres, and for improvements in the national standard of stock (relative to national road length or vehicle-kilometres).