

# **Horizontal Fiscal Equalisation: Modelling the welfare and efficiency effects**

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## Executive summary

The existence of separate states within a federation gives rise to a number of equity and efficiency concerns because states have different fiscal capacities due to factors beyond the control of state governments. They may have different capacities to raise revenue, different expenditure needs and different costs to provide government services.

- A state would have a lower revenue raising capacity per capita if it has a smaller tax base per capita. For example, the state may have a relatively small mining sector, or low property values. In general, individuals living in a state with a lower revenue raising capacity would need to pay higher tax rates to achieve a given target for government revenue.
- A state would have higher inherent expenditure needs per capita if it has a greater proportion of its population in high-need demographic categories, such as elderly or indigenous people. In general, individuals living in the state would need to shoulder these higher expenditures by paying higher taxes.
- A state would have higher government service costs per capita if it is more expensive to provide a given standard of government services, for example, because of higher public service wages or a higher proportion of the population living in remote areas. In general, individuals living in states with higher costs would face greater government expenditures for a given level of government services, and therefore pay higher taxes.

Since the seminal article by Buchanan in 1950, it has been generally accepted that equalising transfers between states can help to overcome concerns associated with different state fiscal capacities. Horizontal Fiscal Equalisation (HFE), a system of transfers between states, aims to place “all state units in a position which would allow them to provide the national average level of public services at average tax rates” (Buchanan 1950). Under this system, states with overall fiscal advantages make equalising transfers to states with overall fiscal disadvantages.

In Australia, the HFE system is implemented through the distribution of GST revenue to the states. As noted by Walsh (2011), the distributions to the states can be thought of as having two parts. Firstly, “donor States fund equalising transfers to recipient states out of their GST entitlements”. Second, “the remaining GST revenue is distributed on an equal per capita basis across States”.

The South Australian Department of Treasury and Finance (SADTF) has engaged Independent Economics (the new trading name for Econtech Pty Ltd) to undertake economic modelling of the welfare and efficiency impact of Australia’s HFE arrangements. This report is written in the context of the current Review of the Distribution of GST Revenues, which was announced by the Prime Minister and the Federal Treasurer in March 2011.

### The equity and efficiency aspects of HFE

The literature argues that HFE is one of the few areas where both equity *and* economic efficiency can be enhanced by the same government policy.

HFE addresses equity concerns by removing fiscal disadvantages that may arise because of a household's state of residence. For example, a household living in a state with a low per capita revenue raising capacity, say, because of a lack of mining resources, or high per capita expenditure requirements, say, because of a high share of the population in older age groups, would be fiscally disadvantaged. In the absence of HFE transfers, each household in the disadvantaged state would face higher tax rates to fund a given level of government services relative to comparable households living in other states. Transfers to states facing fiscal disadvantages would share the fiscal benefits of mining activity or the fiscal burden of providing services to high need groups across the national population, and enhance horizontal equity<sup>1</sup>.

Households move to improve their standard of living. Without equalising transfers, the migration decisions made by households would be unduly influenced by the fiscal capacities in each state, rather than by underlying economic opportunities. This distortion to household migration choices lowers the national standard of living, or welfare. Therefore, HFE also addresses efficiency concerns by removing the influence of state fiscal capacities on migration decisions. The differences between state revenue raising capacities in the mining sector provides a relevant example of how this occurs.

If a state experiences a mining boom, then it would be efficient for some households to move to that state to take advantage of higher mining prices. This will occur because greater demand for labour in the mining industry will lead to higher wages in the state, which will encourage migration from other states. However, as more labour moves into the state, labour productivity in that state falls. In addition, households living in the state may experience less amenity as it becomes more congested. Eventually, the benefits of moving to the state diminish. If inward migration stops when there are no more overall economic gains from moving to the state, then the welfare of the national population would be at its highest possible level, and migration would be said to be *efficient*.

However, the HFE literature points out that migration would not stop at this efficient level because the mining boom would also create an 'artificial' fiscal incentive to move to the state. The state would have a larger tax base per capita because it would be able to tax the mining resource rents. Therefore, the state would be able to provide any given level of government services at lower tax rates. This incentive of lower taxes than elsewhere would attract additional migrants to the state, only because they would "effectively acquire a share of regional rent revenues" (Boadway 2003, p12). This additional inward migration reduces national welfare for two reasons. First, the higher supply of labour reduces labour productivity and lowers real wages. Second, the higher population reduces the amenity from living in the state, because higher population is associated with adverse outcomes including increased commute times and more air pollution. Thus, differences between states in their ability to raise tax revenues interfere with migration decisions and reduce national welfare.

In general, migration is efficient, and leads to the highest possible level of welfare, when it is responding to underlying economic differences between states, such as differences in productivity and amenity levels. On the other hand, migration is inefficient, and reduces welfare, if it is responding to differences in the fiscal benefits in each state if these differences are beyond the control of state governments and are not related to the underlying economic factors in each state. For example, households may have an incentive to move away from a state with a relatively large population of

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<sup>1</sup> These transfers would aim to improve *horizontal* equity – a situation where "persons who are equally well-off before government policy should be equally well-off after it: equals should be treated equally" (Boadway, 2003, p2). In this case, differences between states would not impact on an individual's standard of living. This is a separate objective to vertical equity, which seeks to address inequalities between high and low income earners.

elderly people, simply to avoid paying higher taxes to fund their hospital care. Hence, it is well established in the literature that equalisation between states for differences in *revenue raising capacities* and inherent *expenditure needs* adds to both economic efficiency and horizontal equity.

There is also a third type of equalisation, which is for differences in *government service costs*. Horizontal equity would call for full equalisation for cost differences. However, efficiency would call for only partial equalisation for cost differences. This is because the optimal level of service provision will be lower in areas where costs are higher, and so the total government expenditure in these areas would not need to be higher by the full amount of the cost difference. This would indicate a trade-off between equity and efficiency when considering equalisation for cost differences.

The Australian HFE system fully, rather than partially, equalises for the primary driver of state cost differences, wage costs, reducing HFE transfers away from Western Australia as the main result. While this implies that the degree of equalisation for state differences in wage costs is greater than optimal from an efficiency perspective, in practice such payments are small in the overall context of HFE transfers. Thus, the bulk of equalisation payments made under the HFE system unambiguously promote both economic efficiency and horizontal equity.

More generally, HFE transfers that give states the ability to provide the average per capita level of services if they levy the national average tax rates would eliminate the incentives for migrants to move to a state simply because it may have a fiscal advantage. In the presence of such transfers, migration decisions would not be based on artificial incentives created by state borders, but instead would be based on underlying economic opportunities, and national welfare would be at the highest possible level.

There have also been assertions that HFE impedes structural adjustment. For example, if a state experiences a mining boom, HFE transfers distribute funds away from the state and could reduce its ability to attract labour and invest in infrastructure. However, these arguments ignore the long-term aims of HFE. Importantly, as discussed above, without HFE there would be *too much* migration to states experiencing a boom in mining activity.

## Estimating the efficiency gains from HFE

This study makes a significant contribution to understanding Australia's HFE system by estimating its economic impact. To do this, Independent Economics (IE) has constructed a computable general equilibrium (CGE) model of the Australian economy, the IE-HFE model. The model is based on the economic literature, and data from the Commonwealth Grants Commission. It takes into account the factors that affect household migration decisions, including a state's revenue raising capacities and expenditure requirements.

The IE-HFE model is first used to simulate a baseline scenario that reflects the existing situation in which the HFE system is in place. Under that system, GST revenues are distributed between states in a way that fully equalises for differences (on a per capita basis) in revenue raising capacity, expenditure needs, and government service costs.

The baseline scenario is based on the year 2009/10 with one exception. That year is not representative in that mining prices were relatively low because of the GFC, and have since recovered. To allow for this, the baseline scenario re-simulates 2009/10 using the latest assessment

from the Bureau of Resources and Energy Economics (BREE) on the outlook for real mining prices, under which they are forecast in 2011/12 to be 26 per cent above the low point of 2009/10. Notably this is still below Consensus Forecasts out to 2013/14. Therefore, the baseline scenario reflects the 2009/10 economy adjusted for the implications of a more contemporary outlook for mining prices.

The IE-HFE model is then used to simulate an alternative policy under which the equalisation system is removed, with one exception noted below. That is, under the alternative policy, GST revenues are generally distributed between states on an equal per capita (EPC) basis. The exception is that differences in state expenditure needs for indigenous populations continue to be fully equalised between the states. This is referred to as a **modified EPC** system of distributing GST revenues. This specification of a modified EPC system can be interpreted in various ways. The literal interpretation is that the HFE system is removed, except that equalisation for indigeneity is retained. An alternative interpretation is that HFE is fully removed, but that the Commonwealth Government takes over funding for indigeneity, which could have the same effect as retaining equalisation for indigeneity. Either way, the modified EPC scenario recognises that it would be quite unrealistic to simulate a situation in which government funding arrangements no longer recognise the differences between states in government expenditure needs arising from differences in the levels of indigenous populations. The modified EPC scenario is also as agreed with the SADTF.

The economic impacts of hypothetically moving from the existing HFE system of the baseline scenario to the modified EPC system can be assessed by calculating the differences in modelled outcomes between the latter and the former. Because a long-run economic model is used, these impacts reflect the long-run or ongoing impacts from moving from HFE to modified EPC.

If GST revenues are distributed using a modified EPC system in place of the existing HFE system, the impact on the finances of each state will depend on a comparison of its donor/recipient status under both systems.

- Under the existing HFE system (i.e. the baseline scenario), the donor states are Western Australia and Queensland (primarily because of their high revenue-raising capacities from mining) and Victoria (primarily because of its low indigenous population). In the CGC's recommendations for 2011/12, New South Wales is also a donor state, but the baseline scenario takes into account that strong mining prices are likely to soon make it a borderline recipient state. Other things being equal, a move away from the existing system would lead to a budget gain to the donor states.
- Under a modified EPC system, the recipient states would be those states with disproportionately high indigenous populations. Those recipient states would be the Northern Territory, Western Australia, Queensland and Tasmania. Other things being equal, a move towards a modified EPC system would lead to a budget gain to these recipient states.

It follows that the two states that would clearly receive a budget gain from a move from the existing system to a modified EPC system are Western Australia and Queensland. Both of these states would move from being donor states to being recipient states. In both cases these states are donor states in the baseline mainly due to their high revenue raising capacities from mining, but move to being recipient states under the modified EPC system due to their above-average indigenous populations. The other states all experience a budget loss. The impacts on HFE transfers are shown in Chart A.

Chart A. Impact on GST grant distributions of modified EPC compared to current HFE system, \$m



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

Three of the states, New South Wales, South Australia and the ACT, are all in the opposite situation to Western Australia and Queensland. That is, they are recipient states in the baseline mainly due to their lesser revenue raising capacities from mining, but move to being donor states under the modified EPC system due to their lesser indigenous population proportions.

Victoria experiences the largest overall budget loss. Victoria would become the largest donor state under a modified EPC system because of its low indigenous population. Under the existing HFE system, it is less of a donor state mainly because the fiscal disadvantage from its low revenue raising capacity from mining is taken into account.

Tasmania and the Northern Territory experience budget losses because, while they continue to be recipient states, they receive less under a modified EPC system than under the existing HFE system. This is mainly because the existing system allows for the Northern Territory's fiscal disadvantage from high population dispersion and Tasmania's expenditure needs from socio-demographic factors, while a modified EPC system would not.

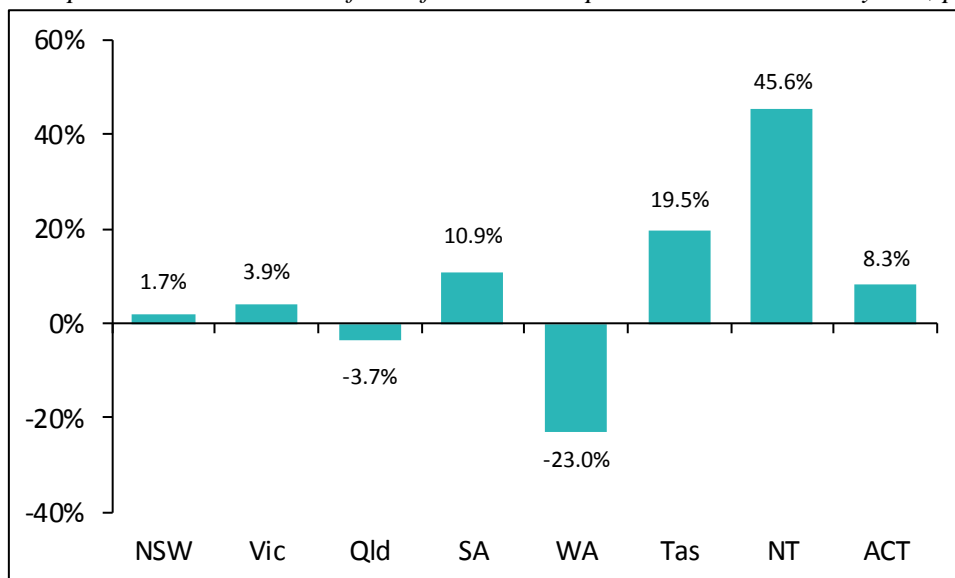
More generally, the states that experience a budget loss when HFE is replaced with a modified EPC system have fiscal disadvantages that could be due to any of the factors listed below.

- The state may have a lower revenue raising capacity, so to provide any given level of government services, it would need to have higher tax rates.
- The state government may need to spend more to provide the same level of services to its population because of demographic or governmental features of the state (other than the proportion of indigenous people in the population). For example, an above-average proportion of its population may be in high-need categories, such as elderly people.
- The state government may face higher costs to provide services, because of higher wages for public employees, or it has a large proportion of its population in remote areas.

When its revenue from HFE transfers changes, a state government would need to adjust either its expenditure levels or its tax rates to maintain budget balance. In the IE-HFE model, the state budget is set in an optimal way. This means that a reduction in HFE transfers is addressed partly by government spending cuts, but mainly by tax increases, which result in lower consumer spending. In this way, there is an optimal proportionate reduction in both consumer and government spending, which recognises that the base level of consumer spending is higher than the base level of government spending. In any case, the main results, including for economic welfare, are not much affected by the mix of fiscal adjustment between tax increases and government spending cuts.

Chart B shows the per cent change in the tax rates in the bundled ‘other’ tax that occurs in each state as the main way of maintaining budget balance<sup>2</sup>. Under the current HFE system in Australia, taxes are levied at broadly comparable rates across each of the states. However, Chart B shows that this would not be possible without HFE. For example, without equalising transfers, the Northern Territory raises its tax rates (on tax bases other than mining and land) by almost half, 45.6 per cent, to fund government service provision. On the other hand, Western Australia is able to lower its tax rates by 23.0 per cent, and Queensland is able to lower its tax rates by 3.7 per cent.

*Chart B Impact on state tax rates of modified EPC compared to current HFE system, per cent*



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

Note: these are not percentage point changes, but per cent changes. For example, a 45.6% impact in the Northern Territory indicates that, if the initial tax rate is 10%, then the tax rate in the modified EPC scenario would be 14.56% ( $10\% \times 1.456$ ).

Superficially, it may seem from this that, under the modified EPC system, the residents of the fiscally advantaged states, Western Australia and Queensland, would be better off, while the residents of the other states would be worse off. However, this ignores the crucial point that households are free to migrate between states. Following a move away from full equalisation, households can be expected to move from the fiscally disadvantaged states to the fiscally advantaged states. These population movements would be expected to continue until living standards across states re-equalise.

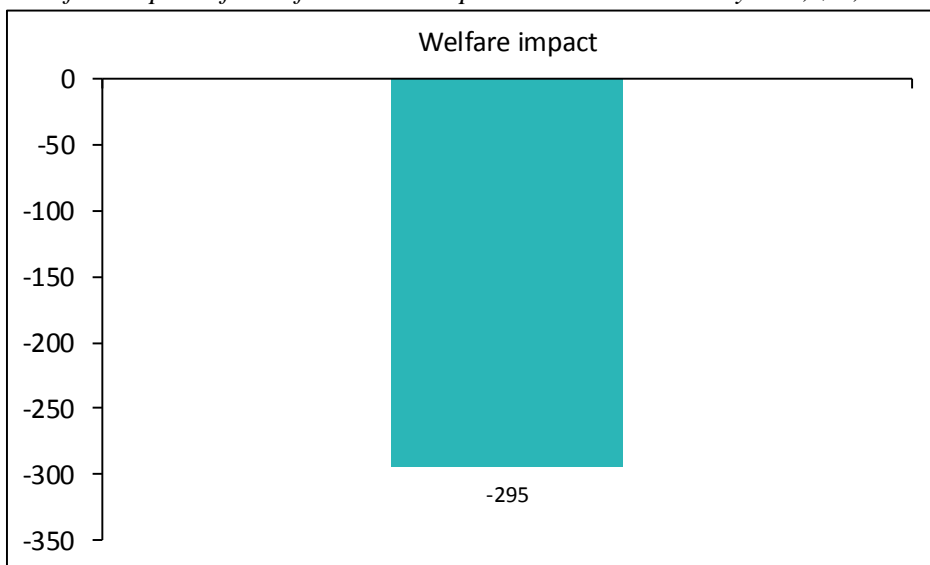
Further, this inefficient, fiscally-induced migration leads to a loss in living standards. Specifically, abolishing the current HFE system and moving to a modified EPC system is estimated to lead to a

<sup>2</sup> The bundled ‘other’ tax includes all state taxes other than those on mining and land.



permanent loss in annual living standards<sup>3</sup> of \$295 million in 2009/10 terms, as shown in Chart C. Further, with households are free to move between states, this loss will be shared across all states. The only apparent benefit to offset against this loss would be a saving in the costs of administering the HFE system. However, the annual cost of running the CGC is only \$7 million.

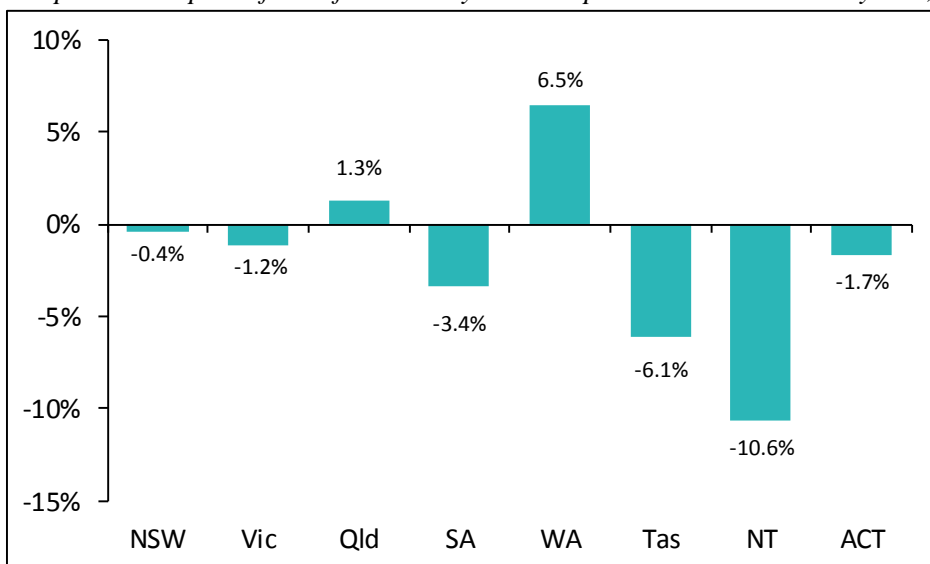
Chart C. Welfare impact of modified EPC compared to current HFE system, \$m, 2009/10 terms



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

The uneven landscape for tax rates (and government services) caused by the move away from HFE induces households to migrate away from the now high-taxing states, particularly Northern Territory, and toward the now low-taxing states, particularly Western Australia. The migration induced in this policy scenario can be seen in Chart D, which shows the long-run impact on population in each state.

Chart D. Population impact of modified EPC system compared to current HFE system, per cent



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

<sup>3</sup> The most appropriate measure of the effect of any government policy is its impact on household living standards. This is measured by its impact on consumer welfare, which takes into account changes in consumption of privately produced and government provided goods and services; and non-market amenity from population density.

In the long run, the Northern Territory population would be an estimated 10.6 per cent lower if the modified EPC system is implemented than if the current HFE system were in place. On the other hand, the population of Western Australia would be 6.5 per cent larger if the modified EPC system were implemented. This is because, without the current HFE system, the fiscal advantages of Western Australia (notably its high mining tax base) allow it to levy taxes at low rates and provide a high level of government services, resulting in population gain. This inter-state migration arises only from the withdrawal of some HFE transfers, and not from any change in economic fundamentals or productivity.

To summarise, welfare is lower in *all states* if the current HFE system were changed to a system that distributed GST revenue on a modified EPC basis (i.e. equal per capita except for needs relating to indigeneity)<sup>4</sup>. That is, all states contribute to the negative national welfare impact presented in Chart C. The free movement of population between states works to close inter-state gaps in living standards, so in the long-term living standards in all states move together.

In Western Australia and Queensland, it may appear that there would be a gain in consumer welfare because, in the absence of equalisation, the fiscal advantages from their large mining tax bases leads to lower taxes and higher levels of state government services. However, the population increase from the inward migration that this fiscal advantage attracts, lowers wages and household's amenity, resulting in a loss in consumer welfare that outweighs the gain from fiscal advantage. So if the objective of a policy to move away from HFE were to raise living standards in donor states, it can be expected to fail.

The inclusion of the amenity effect in the modelling means that the estimate of the welfare loss from moving to a modified EPC system (of \$295 million) is smaller than would otherwise be the case. The amenity effect makes the population less mobile. This leads to a smaller misdistribution of the population across states in response to distortions to locational choices from the presence of unequalised state fiscal advantages and disadvantages.

The only other Australian modelling of HFE is by Dixon et al. (2002), in which they model repealing the current HFE system and distributing the GST revenue on a purely EPC basis. This modelling has been a useful reference point for our modelling. However, we have also been able to make a number of improvements on their method. The most noteworthy of these improvements is that we correct an inconsistency in Dixon et al. in how they measure consumer welfare.

In modelling interstate migration decisions, Dixon et al. include an amenity effect under which consumer welfare is reduced by an increase in a state's population. However, when calculating the change in consumer welfare resulting from that interstate migration, they include no amenity effect. This leads them to report a welfare gain from abolishing HFE, contrary to the literature. If instead they had avoided this miscalculation by correctly and consistently applying the same measure of consumer welfare throughout, approximate replication of their modelling shows that they would have found a welfare loss from moving away from HFE of a similar amount to that estimated in this report.

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<sup>4</sup> In fact, the per capita welfare would be lower by the same amount in all states. As discussed in section 3.2, households distribute themselves between states until there is no gain from moving to any other state. In other words, the standard of living would be the same in all states in any given scenario. Therefore, the change in welfare between the scenarios must also be the same in all states.

The calculation in this Report of a substantial annual efficiency loss of \$295 million if full HFE were abandoned in favour of a modified EPC distribution of GST grants, relates to currently prevailing circumstances.

As circumstances change, the quantification of the efficiency loss would change depending on the scale of equalisation transfers. If the relative fiscal capacity of states converged somewhat, e.g. if additional mineral deposits were discovered and developed in Victoria, thereby reducing in scale the currently large mining revenue related transfer in its favour, the efficiency loss from modified EPC could be expected to be smaller than calculated here. Conversely, if equalisation transfers become larger, e.g. if mining prices rose further, increasing the differences between state fiscal capacities, the larger the efficiency loss from moving away from full HFE.<sup>5</sup>

Whether or not prevailing circumstances give rise to a smaller or larger efficiency effect calculation from time to time, the continuing operation of full HFE clearly contributes to economic efficiency systematically. The effect on equalization transfers from any departures from full HFE will be efficiency reducing (and adverse to equity in the standard analysis).

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<sup>5</sup> The implication of the statement in Commonwealth Budget Paper No 3 2011-12 (p106) that an efficiency case *against* full HFE emerges as the scale of equalization transfers increases, is aberrant. (This proposition seems not to be replayed or reflected in the Commonwealth Treasury submission to the Review).

*Horizontal fiscal equalization provides the necessary budget support so that all States have the capacity to provide services at a comparable standard, while ensuring that the interstate transfers are not so large that they would significantly distort economic behaviour and reduce productivity growth...*

# 1. Introduction

The existence of separate states within a federation gives rise to a number of equity and efficiency concerns because states have different revenue raising capacities and different expenditure needs. Since the seminal article dealing with these considerations, by Buchanan in 1950, it has been generally accepted that equalising transfers between states can help to overcome these concerns. In fact, this is one of the few areas in which equity and economic efficiency are not generally in conflict.

Horizontal Fiscal Equalisation (HFE) involves a system of transfers between states that aims to place “all state units in a position which would allow them to provide a national average level of public services at average tax rates” (Buchanan 1950, p586). In Australia, the HFE system is implemented through the division between the states of GST revenue raised by the Commonwealth. As noted by Walsh (2011), the GST transfers to the states can be thought of as having two parts. Firstly, “donor States fund equalising transfers to recipient states out of their GST entitlements”. Second, the “remaining GST revenue is distributed on an equal per capita basis across States”. Under this system, all states receive positive grants.

The South Australian Department of Treasury and Finance has engaged Independent Economics (which is the new trading name for Econtech Pty Ltd) to undertake economic modelling of the welfare and efficiency impact of Australia’s current HFE arrangements. This report is written in the context of the current Review of the Distribution of GST Revenues, which was announced by the Prime Minister and the Federal Treasurer in March 2011.

The report is set out as follows.

- **Section 2** is a review which explains the literature on HFE and provides a solid theoretical foundation for the modelling approach adopted in this report.
- **Section 3** sets out the modelling approach for the Independent Economics Horizontal Fiscal Equalisation (IE-HFE) model.
- **Section 4** presents and interprets the modelling results.
- **Section 5** summarises the findings of this report and their policy implications.
- **Appendix A** provides more detail on the modelling approach.
- **Appendix B** compares results from IE-HFE with the only previous Australian estimates of the economic impact of HFE, by Dixon et al. (2002).

## Disclaimer

While all care, skill and consideration has been used in the preparation of this report, the findings relate to the terms of reference of SADTF and are designed to be used only for the specific purpose set out below. If you believe that your terms of reference are different from those set out below, or you wish to use this report or information contained within it for another purpose, please contact us.

The specific purpose of this report is to estimate the welfare and efficiency effects of the current system of Horizontal Fiscal Equalisation used in distributing GST revenue between the states and territories.

The findings in this report are subject to unavoidable statistical variation. While all care has been taken to ensure that the statistical variation is kept to a minimum, care should be taken whenever using this information. This report only takes into account information available to Independent Economics up to the date of this report and so its findings may be affected by new information. Should you require clarification of any material, please contact us.

## 2. Literature review

This section reviews the literature on Horizontal Fiscal Equalisation (HFE), mainly focusing on two important papers, Buchanan (1950) and Boadway (2003). While Buchanan is the original work proposing HFE, Boadway provides a useful and more-up-to-date objective summary of the literature. In the Australian context, we discuss the only Australian modelling of the effects of HFE, by Dixon et al. in 2002. We also make reference to:

- reports and data from the Commonwealth Grants Commission (CGC);
- submissions to the current Review of the Distribution of GST Revenues (the Review); and
- other academic papers.

The aim of this section is to provide a solid theoretical foundation for the modelling approach that is adopted in this report. The implications of the literature for the design of the IE-HFE model are discussed in Section 3.

### 2.1 The equity and efficiency aspects of HFE

Horizontal fiscal equalisation involves a system of transfers between states which aim to place “all state units in a position which would allow them to provide the national average level of public services at average tax rates” (Buchanan 1950). These transfers are justified on both equity and efficiency grounds.

- **Equity** concerns can be addressed by removing any fiscal disadvantage that may arise because of a household’s state of residence.
- **Efficiency** concerns can be addressed by removing the impact that state borders have on a household’s decision about where to live.

These aspects of HFE are discussed in detail below.

#### The equity aspects of HFE

In the absence of equalising transfers, it would fall on the residents of a particular state to bear the costs of any inherent fiscal disadvantages from the location of the borders to that state. For example:

- if a state has less access to natural resources and the associated revenue streams than other states, then it would need higher tax rates on other sectors to fund any given level of services;
- if one state has a higher share of its population in demographic groups with high needs (such as elderly people who require greater hospital services) then it would face higher expenditures, and therefore higher taxes, in order to provide a given level of services to its population; and
- if it is more costly to provide government services in a state then it would face higher expenditure, and therefore higher taxes, in order to provide a given level of services to its population.

A useful benchmark for these considerations is the case of a unitary nation with no state boundaries inside it. In this case, the revenues from mining royalties and expenditure on health services would be shared across the national population. In this way, there would be ‘equal treatment for equals’ across the whole country<sup>6</sup>. To achieve this equity outcome in a federation with multiple states such as Australia, a system of transfers between states is needed. This is the aim of Horizontal Fiscal Equalisation (HFE).

### The efficiency aspects of HFE

Buchanan (1950) argues that, as well as enhancing equity outcomes, the implementation of HFE is not inconsistent with economic efficiency. In fact, there is a literature arguing that HFE *promotes* efficiency. This literature observes that, in the absence of HFE, migration decisions of households will be unduly influenced by the existence of state boundaries.

Individuals make migration decisions by comparing the standard of living (utility or welfare) that they would attain by living in each of the states. The welfare of a household living in any particular state can be affected by a number of factors:

- the consumption of private goods and services that they can achieve in that state, which in turn depends on state wage levels, prices and taxes;
- the non-market amenity of living in that state, which may vary inversely with the state’s population; and
- the state government services received in that state.

When the migration decisions of households lead to the highest possible level of welfare for the national population, then migration decisions are said to be *efficient*. In general, households will make migration decisions that work to maximise national welfare, because they will only move to another state if they judge that they will be better off by doing so. For example, they may be able to achieve a higher wage, or there may be better non-market amenity.

However, if there are factors distorting decisions to move, then households will make inefficient migration choices that do not maximise national welfare. In particular, the HFE literature concludes that the existence of state borders interferes with migration decisions in this way. The inherent characteristics of each state give rise to differences in state capacities to raise tax revenue, differences in state expenditure needs and differences in the costs of providing government services. That is, each state will have a different *net fiscal benefit* – the government services received less taxes paid in any particular state. These differences can affect household migration decisions, leading to a lower level of welfare than would otherwise be the case.

The mining sector provides a relevant example of how differences in net fiscal benefits can reduce national welfare. If a state experiences a mining boom, then it would be efficient for households to move to that state to take advantage of higher mining prices. This will occur because greater demand

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<sup>6</sup> This would entail *horizontal* equity – a situation where “persons who are equally well-off before government policy should be equally well-off after it: equals should be treated equally” (Boadway, 2003, p2). In this case, fiscal differences between states from the location of state borders would not impact on an individual’s standard of living. This is a separate objective to vertical equity, which seeks to address inequalities between high and low income earners. This is sometimes not well understood, and is explained in Hancock and Smith (2001, p. 97).

for labour in the mining industry will lead to higher wages in the state, which will encourage migration from other states. However, as more labour moves into the state, its productivity falls and non-market amenity falls as the state becomes more congested. Eventually, the benefits of moving to the state diminish. If inward migration stops when there are no more overall gains from moving to the state, then the welfare of the national population would be at its highest possible level, and migration would be efficient.

However, the HFE literature points out that migration would not stop at this efficient level because the mining boom would also create an ‘artificial’ fiscal incentive to move to the state. The state would now have a larger tax base because it would be able to tax the mining activity. Therefore, the state government would be able to provide any given level of services at lower tax rates. This fiscal incentive would attract additional migrants to the state, only because they would “effectively acquire a share of regional rent revenues” (Boadway 2003, p12). These additional migrants would reduce national welfare, because they further reduce the productivity of labour, along with the wage. They also reduce the amenity from living in the state, for example, commute times or pollution may be higher in the state when the population is larger. In this way, differences between states in their ability to raise tax revenues interfere with migration decisions and reduce national welfare.

In general, migration is efficient, and leads to the highest possible level of welfare, when it is responding to underlying economic opportunities, such as a mining boom or differences in amenity levels or productivity. On the other hand, migration is inefficient, and reduces welfare, if it is responding to differences in the fiscal benefits in each state. These differences are beyond the control of state governments, and are not related to the underlying economic factors in each state. For example, households may have an incentive to move away from a state with a relatively large population of elderly people, simply to avoid paying higher taxes to fund their hospital care.

Boadway (2003) and others argue that the HFE system can design a set of transfers between states that remove the incentives to move because of differences in net fiscal benefits. These transfers would give states the ability to provide the average per capita level of services if they levy the national average tax rates, and would eliminate the incentives for migrants to move to a state simply because it may have a fiscal advantage. In the presence of such transfers, migration decisions would not be based on artificial incentives created by state borders, but instead would be based on underlying economic differences between states, and national welfare would be at the highest possible level. The design and nature of these equalising transfers is described in the following sections of this report.

Importantly, the HFE literature does not argue that equalisation should aim for all state governments to have the same taxation or expenditure policies. Households in some states may have a preference for a higher level of government services and the requisite higher level of taxation. Therefore, allowing policy differences between states will be important for maximising national welfare and promoting efficiency. Boadway (2003) summarises the literature which contends that a decentralised system of government is better able to cater for the divergent needs and preferences of their populations, and at a lower cost. Boadway (2003) also notes that, to allow for differences between state preferences, the HFE system aims to equalise “the potential of regions to provide public services, while tolerating differences in regional fiscal behaviour” (Boadway 2003, p17). Consistent with this, the aim of HFE is put simply by Walsh:



*“If there are differences between States in the standards of services they provide to their citizens, it should be the result of differences in decisions by democratically elected governments, not the result of differences in their fiscal capacity to provide services of similar standards.” (Walsh 2011 p10)*

The method suggested in the literature for achieving this is to base equalisation on ‘representative’ or national average tax rates and expenditure behaviour. That is, transfers between the states should be calculated so that if the state levied the average tax rates, then it could provide the average level of services. In this case, the actual actions of all state governments combined set the benchmark for the standard policies that are equalised for.

As well as allowing for differences in preferences for government spending in each state, this method of equalisation also has the advantage that it dulls incentives for states to alter their behaviour in an attempt to maximise their grants. To the extent that any one state cannot affect the average tax rate or average level of service provision by changing their policies, nor can they affect their equalisation payments. There has recently been concerns about this effect in Australia, because the revenue base for mining is highly concentrated in a small number of states, which means that these states can more easily affect the average policy benchmark. This is discussed further in section 2.5.

In practice, implementing an effective HFE system is necessarily complex. For example, while full equalisation is optimal for most types of fiscal disadvantage, only partial equalisation is optimal for others. In considering this, it is useful to categorise equalisation policies into three different areas: revenue capacities; expenditure needs; and costs. In Australia, the Commonwealth Grants Commission (CGC) assesses each state in these three areas, across a number of discrete smaller categories. The following discussion considers each of the areas, and sets out the rationale for equalisation in each.

## 2.2 Revenue raising capacity

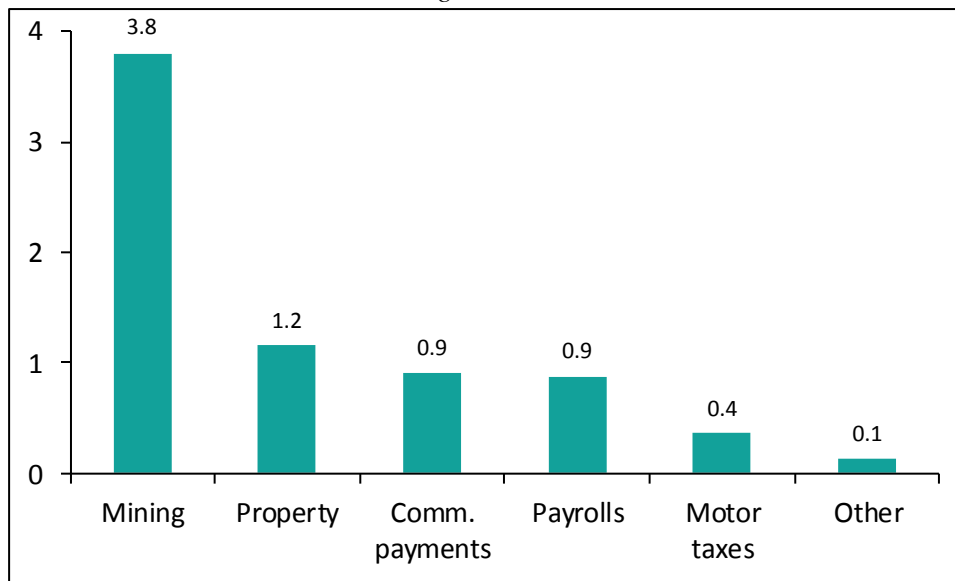
According to Boadway, there should be full equalisation for differences in revenue raising capacity. That is, if one state is fiscally disadvantaged because it has a smaller tax base per capita, then it should have a transfer toward it that would offset this disadvantage. To do this, the transfer would be calculated so that, if the state applied the national average tax rate to its base, then the transfer would be enough for the revenue to be at the national average per capita level<sup>7</sup>. This way, differences in per capita tax bases would not unduly influence migration patterns, and migration would be based on underlying economic factors such as productivity and amenity levels.

Chart 2.1 below shows the amount of funds recommended by the CGC to be redistributed in 2011/12 to correct for differences in revenue raising capacity between states. This is the amount of money that is effectively transferred away from states with a larger tax base per capita to states with a smaller tax base per capita.

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<sup>7</sup> Of course, the state could choose to have a tax rate that is lower or higher than the national average rate, in which case, they would have revenue that is lower or higher than the national average per capita revenue.

Chart 2.1 Recommended mining revenue redistributions, 2011/12, \$bn



Source: Commonwealth Grants Commission, 2011

By far the most important revenue base for redistribution was mining, for which it was recommended that \$3.8bn be redistributed. The next most important was property. These revenue bases, and the remaining revenue bases, are discussed below.

### 2.2.1 The Mining sector

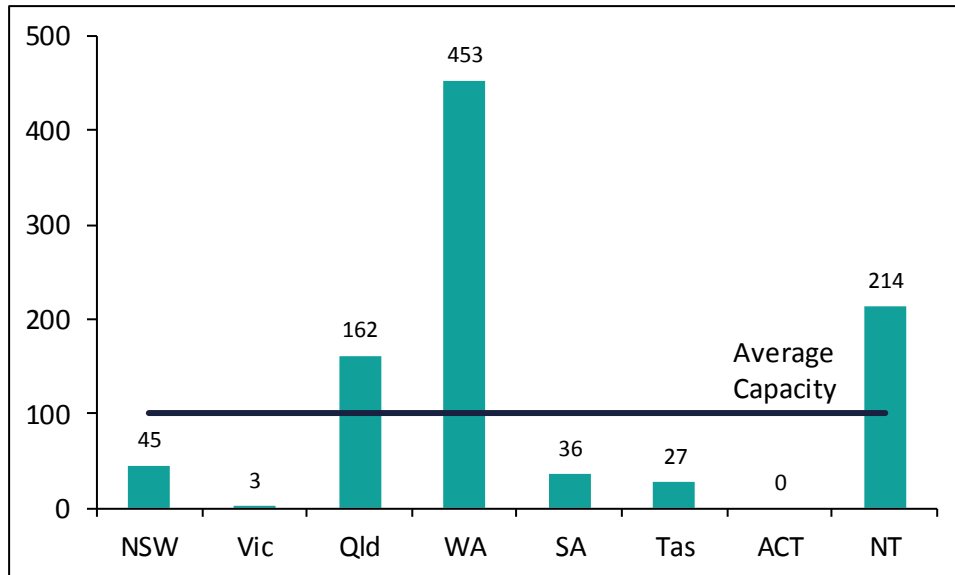
As the example in section 2.1 showed, it is important to equalise for differences in revenue raising capacity due to the uneven distribution between states of the mining sector. As noted by Queensland in its submission to the Review of GST Distribution, “mining revenue comprises around 7% of all State revenue in aggregate, yet represents 76% of the GST redistributed as a result of revenue assessments” (Qld Govt p6). This is an understandable outcome because mining is the area in which state abilities to raise revenue are the most divergent. Without this redistribution, there would be a fiscal incentive to move to the mining states, on top of the normal economic incentives. As discussed in section 2.1, when migration is caused by fiscal differences between states, rather than differences in underlying economic opportunities, this migration would be welfare-reducing.

A convenient way to see the differences in revenue raising capacity for each state are the *assessed revenue raising capacity ratios* estimated by the CGC. These are the *assessed* revenue per capita for a state relative to the national average revenue per capita. A value of 100 indicates that if the state applied the average tax rate to its tax base, then they would collect the average amount of revenue per capita. A value less than 100 indicates that the state has a below average revenue raising capacity because if they applied the average tax rate to their tax base, they would earn less than the average tax revenue per capita.

The assessed revenue raising capacities for mining in 2009/10 are shown in Chart 2.2. This is the most recent year for which the CGC have undertaken an assessment of state fiscal capacities. Under the CGC’s three-year averaging approach, the recommended GST distributions for 2011/12 were based on this 2009/10 assessment, as well as similar assessments for 2008/09 and 2007/08.

The 2009/10 revenue raising capacity ratio for mining royalties in Western Australia indicates that it has the capacity to collect 453 per cent of the average per capita mining revenue in Australia.

Chart 2.2 Assessed mining revenue raising capacity ratios, 2009/10



Source: Commonwealth Grants Commission, 2011

Chart 2.2 shows that Western Australia, Northern Territory and Queensland all have significantly higher mining revenue raising capacities than the other states. Therefore, to achieve equalisation, the CGC recommends that around \$3,800 million be redistributed away from these states in 2011/12. Although the Northern Territory has only a small share of total mining activity (around 2 to 3 per cent), its revenue raising ability from mining is assessed to be higher than average. This is because the mining resources in the Northern Territory are shared across a small population.

The importance of mining revenues in HFE have been increasing over time. As the value of mining activity has increased over the past decade, the difference in state revenue raising capacities have also increased. The CGC lists increases in mining activity as one of the main drivers of changes in HFE distributions between 2010/11 and 2011/12. Western Australia projects that this trend will continue, with the amount distributed away from it increasing over the next few years. In their submission to the Review, they note the following.

*Having regard for the lags in the equalisation process and recent growth in mining revenues...the amount that Western Australians contribute to...other States...is estimated to be \$1.4 billion in 2011-12, rising to \$4.0 billion in 2014-15. (WA 2011, p10)*

The current HFE system includes a lag in its equalisation because the CGC assessment of the fiscal capacities in each state is based on a weighted average of three years. Therefore, as the mining sector grows, and revenue raising capacities become more disparate, it takes time for this to filter through to the HFE distributions. Accordingly, South Australia (2011) estimate that “over the period 2005/06 to 2009/10, less than complete contemporaneity in the HFE process has resulted in Western Australia retaining in the order of \$3.0 billion in monies that would otherwise have been redistributed”. Of course, the lag in HFE would have the opposite effect if the mining sector begins to shrink.

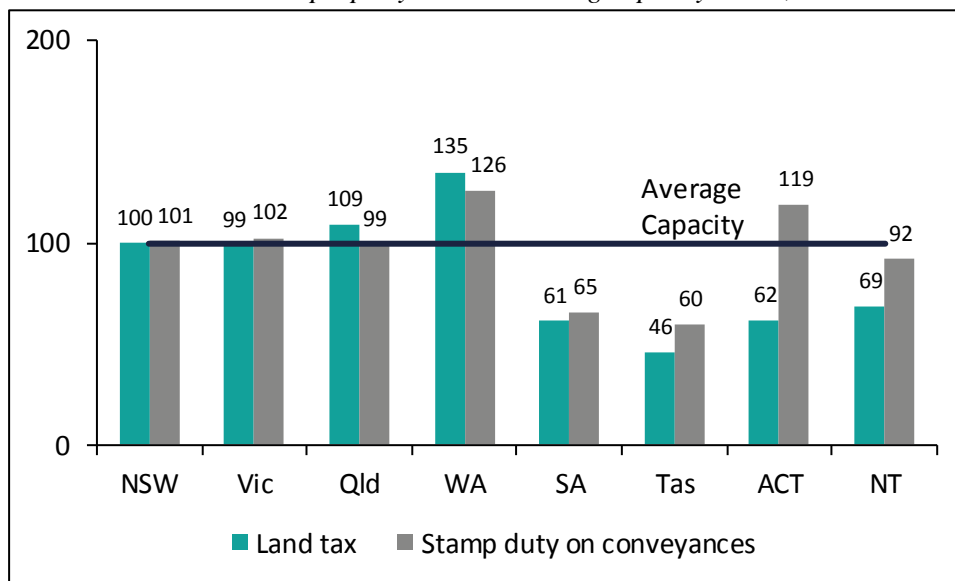
Since mining is an important driver of differences in state revenue raising capacities, the modelling of the mining sector for this report is carefully considered. The modelling abstracts from the lags in calculating HFE transfers, because we are focusing on the long-run issues surrounding equalisation. The most up-to-date data are used, along with reasonable assumptions on the long-run value of mining activity. This is discussed further in section 3.

### 2.2.2 The Property sector

Another important tax base is property, including both the value of land (for land tax) and the value of improvements to land (for conveyancing duties). A state with higher property values, or a higher inherent rate of turnover in properties, would have greater revenue raising capacity, and may attract excessive inward migration simply because it would have a larger net fiscal benefit. As discussed in section 2.1, this fiscally-induced migration would be welfare-reducing. Therefore, as with other tax bases, differences in revenue raising capacities per capita should be fully equalised under HFE.

Chart 2.3 shows the assessed revenue raising capacity ratios for property taxes in 2009/10. The states with ratios greater than 100 have above average revenue raising capacity on a per capita basis. For land tax, Queensland and Western Australia have above average revenue raising capacity. For conveyancing duty, Western Australia and Australian Capital Territory have above average revenue raising capacity, as do New South Wales and Victoria, to a smaller extent.

*Chart 2.3 Assessed property revenue raising capacity ratios, 2009/10*



*Source: Commonwealth Grants Commission, 2011*

Like natural resources, land is a special case since it cannot move between states. As people migrate into a state, they acquire a share of the revenue collected from land values, creating a fiscal incentive for migration.

### 2.2.3 Other sectors

Just as it finds that there should be full equalisation for differences in revenue raising capacity from mining and property, the literature also concludes that there should be full equalisation for differences in revenue raising capacity in other sectors of the economy. In the same way, larger tax bases per capita can also generate fiscal incentives for inefficient migration toward states.

Payroll tax, which is levied on large employers, is the most important tax in the 'other' sector, since it makes up a large share of state own-source revenues. Accordingly, the CGC recommended that \$0.9 billion be redistributed between the states in 2011/12 to take into account that some states have a greater payroll tax base per capita than others.

State governments also receive non-tax revenues in the form of Specific Purpose Payments (SPPs) from the Commonwealth Government. Generally, for the purpose of HFE, these payments can be thought of as equivalent to any other type of state revenue. Equalisation takes into account that sometimes the per capita distribution of these SPPs is not even between the states.

However, there are some types of SPPs for which equalisation is inappropriate, such as those for 'national' projects. For example, some roads could be considered as national assets, such as those used for inter-state transport. In this case, the States are acting as agents for the Commonwealth Government, and funding for such roads should be the responsibility of the Commonwealth Government, and outside the HFE system. On the other hand, roads for intra-state transport should be within the HFE system, because the state would otherwise need to spend their own revenue to provide these roads. For this reason, part of SPPs for roads is equalised for, while the other part is not.

## 2.3 Expenditure needs

As well as having different revenue raising capacities, states also have different inherent expenditure needs. These differences can arise because of *demographic* factors or *governmental* factors. The treatments of the expenditure needs related to demographic and governmental factors are discussed in turn below.

### 2.3.1 Inherent needs related to demographic features

States have a responsibility to provide services such as education and health, and these services are often targeted to specific demographic groups. Therefore, the demographic compositions of state populations affect the level of expenditure required to provide an 'average' level of service to the state populations. For example, a high proportion of elderly or indigenous people in a state would entail relatively high expenditures on health in that state. Boadway concludes as follows.

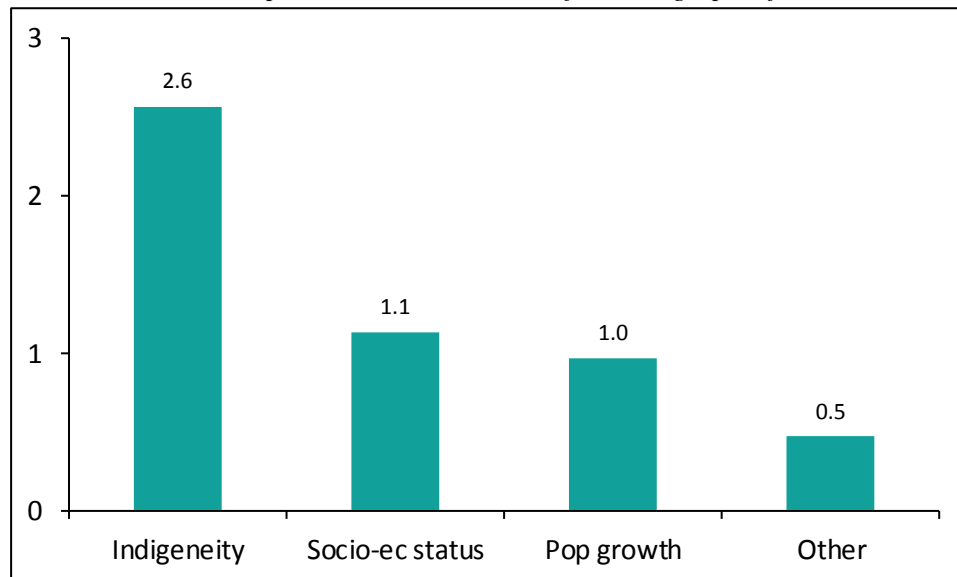
*In this case, fiscal equity and efficiency require that equalisation take account both of differences in the ability to raise revenues at national average tax rates, and also differences in the need for regional spending to provide national average levels of public services to targeted groups in all regions. (Boadway 2003 p21)*

That is, an efficient HFE system would equalise for expenditures associated with population demographics that are beyond the control of state governments. The transfers should be such that if states have expenditure requirements per capita greater than the national average, then this additional cost should be shared between the national population. If this were not the case, there would be an incentive for migration away from states with larger proportions of groups requiring higher

expenditures, to avoid paying higher taxes to cover the expenditures. This would lead to an inefficient distribution of labour between states, and therefore lower overall national welfare.

The HFE system in Australia equalises for a number of different types of expenditures related to the demographic features of each state. The amount of funds involved in equalisation for these categories is shown in Chart 2.4.

Chart 2.4 Recommended expenditure redistributions for demographic features, 2011/12, \$bn



Source: Commonwealth Grants Commission, 2011

While the impact of expenditures on indigenous populations is the main demographic driver of differences in state expenditure needs, expenditures related to socio-economic status and population growth are also important.

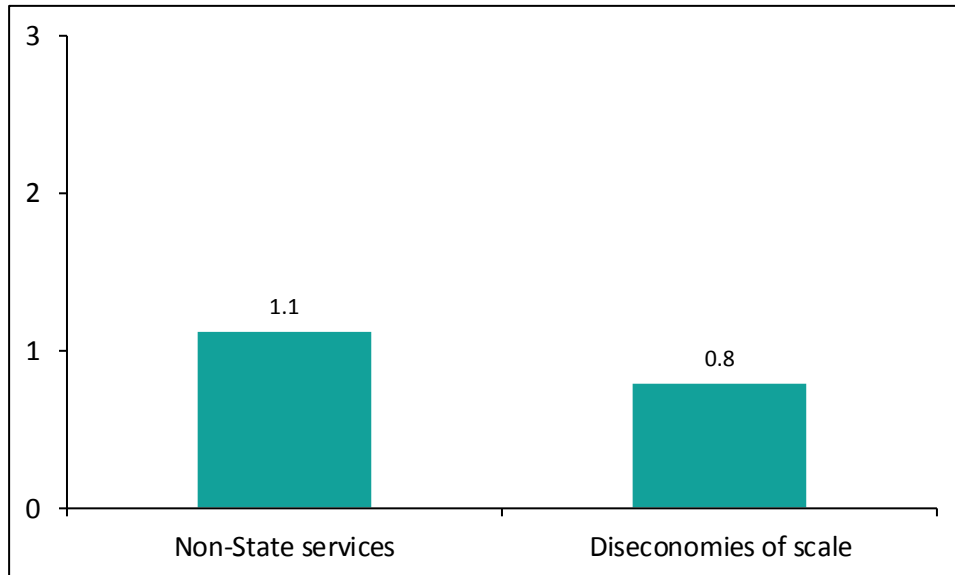
- **Indigeneity** – Per head, expenditure on indigenous populations is higher than expenditure on non-indigenous populations. In 2009, 30 per cent of the Northern Territory population was indigenous, compared to 2 per cent for the total Australian population. (Commonwealth Grants Commission, 2011)
- **Socio economic status** – State expenditure on people with low socio-economic status is higher than on people with high socio-economic status. Northern Territory, Tasmania, South Australia and New South Wales all have greater than the national average proportion of their populations in the most disadvantaged quintile for Socio-Economic Indexes for Areas (SEIFA). (Commonwealth Grants Commission, 2011)
- **Population growth** – States with high population growth require higher funds to maintain their level of infrastructure and net financial worth per capita. (Commonwealth Grants Commission, 2011)

### 2.3.2 Inherent needs related to governmental factors

Like demographic features of the population, there are some governmental factors that lead to states having different expenditure needs. Again, if these factors lead to higher inherent expenses for a state, then households would be encouraged to move away from the state. Therefore, since these

factors are also beyond the control of state governments, equity and efficiency would require that there should be full equalisation for these expenses. The governmental factors considered by the Australian HFE system, and the associated funds recommended for redistribution in 2011/12, are shown in Chart 2.5.

Chart 2.5 Recommended expenditure redistributions for governmental factors, 2011/12, \$bn



Source: Commonwealth Grants Commission, 2011

The following is a brief explanation of the governmental factors considered by the Australian HFE system.

- **Non-State service provision** – This takes into account that different states receive different levels of per capita services from the Commonwealth Government, because for some services there is state-to-state variation in the effective level of service provision by the Commonwealth (such as GP services). Equalisation recognises that the states receiving lower levels of services from the Commonwealth need to be compensated for this because it impacts on state expenditures.
- **Diseconomies of scale** – These are the fixed costs involved in running separate state governments. Given that Australia is a federation of a number of states, the fixed costs of administering each state can be considered as beyond the control of each government. Without equalisation, smaller states would need to levy higher tax rates because they have a smaller population to share these fixed costs.

## 2.4 Costs of service provision

The final category for consideration is the state-specific factors that lead to higher costs of service provision in some states. The main factors are the remoteness of the population and the wage costs in each state.

Boadway (2003) argues that, in an efficient system, lower service levels would generally be provided in regions that have higher cost levels. Again, the outcome of a unitary state provides a useful benchmark.

- **Population Dispersion** – If it is more expensive to provide services to people living in remote areas, then a unitary government focussing on economic efficiency would provide a lower level of services to these populations.
- **Wages** – If it is more expensive to provide government services in high wage areas, then a unitary government focussing on economic efficiency would provide a lower level of services to these areas.

Most state government services are of a basic or essential nature, such as schooling and hospital services. This implies that social demand for government services is likely to be only moderately sensitive to costs. That is, higher costs are likely to justify only a moderately lower level of service provision, so spending levels should be higher in higher cost areas than in lower cost areas. Because states facing higher costs would face somewhat higher expenditures, it follows that higher costs justify partial equalisation. However, they do not justify full equalisation, because service levels are lower when costs are higher, and expenditure will not be higher by the full amount of the cost difference.

For the case of cost differences due to population dispersion, Boadway suggests governments could “stratify locations in all regions by their costs and equalise among regions within comparable strata” (Boadway 2003, p22). This would amount to partial equalisation for cost differences, because it would take into account that governments would provide lower service levels in high-cost regions. In measuring the fiscal disabilities from population dispersion in Australia, the CGC take into account differences in the cost of providing services, as well as differences in service delivery practices in each region. However, the overall effect of this may not be closer to partial equalisation as proposed by Boadway (2003)<sup>8</sup> than to full cost equalisation.

Chart 2.6 below summarises the proportion of each state population that lives in less accessible areas - Moderately Accessible, Remote and Very Remote<sup>9</sup>. As might be expected, the Northern Territory, Queensland, Western Australia and South Australia all have above average proportions of the population in these high-cost areas<sup>10</sup>.

Similarly, if higher wages in some states raise the cost of service delivery, then efficiency would call for only partial equalisation for differences in wage costs between states. However, the Australian HFE system fully equalises for the wage differences between states. Pincus (2011) highlights this as a possible shortcoming from an efficiency perspective: “the main result is that little or no allowance should be made for interstate differences in the unit costs of public provision of goods and services”.

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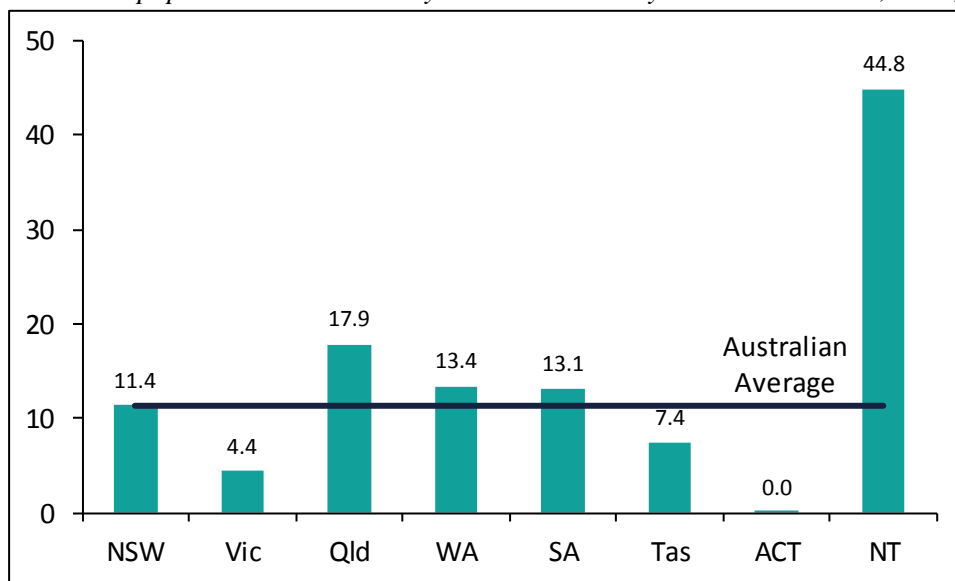
<sup>8</sup> The modelling assumes that cost differences from population dispersion are fully equalised.

<sup>9</sup> Remoteness is classified by the State-based index of accessibility and remoteness — SARIA

<sup>10</sup> In fact, the largest metropolitan areas are also assessed as having high costs for government services, because of the effect of congestion on service delivery costs, particularly in public transport.



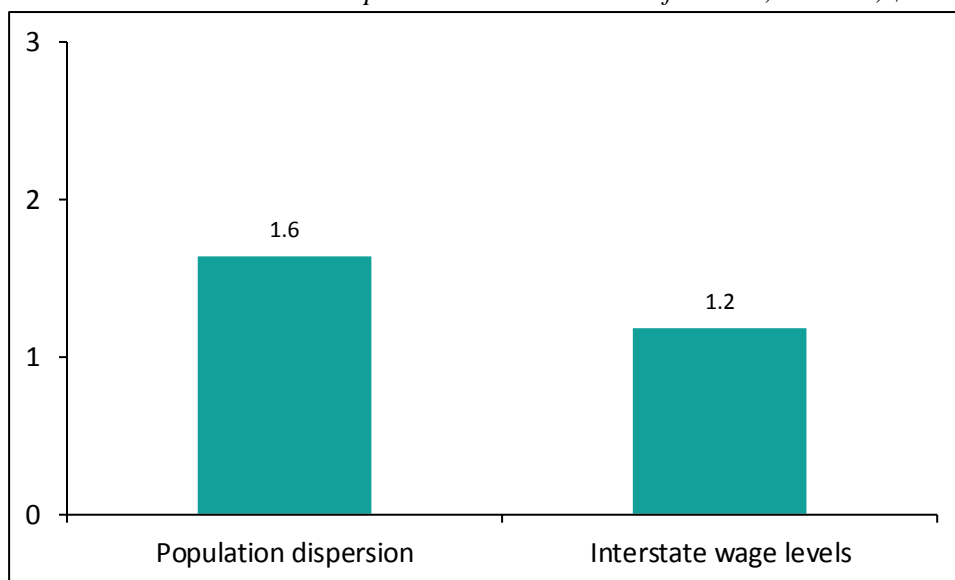
Chart 2.6 Per cent population in Moderately Accessible to Very Remote Locations, 2009, per cent



Source: Commonwealth Grants Commission, 2011

Although efficiency would call for partial equalisation for cost differences, horizontal equity would call for full equalisation, indicating a trade-off between equity and efficiency. However, the equalisation payments for cost differences are smaller than the equalisation payments for differences in expenditure needs and revenue raising capacity. Therefore, even though the Australian system fully equalises for wage cost differences, this trade-off for equity may not be of great significance. Chart 2.7 shows the funds recommended for redistribution due to cost differences in 2010/11.<sup>11</sup>

Chart 2.7 Recommended expenditure redistributions for costs, 2011/12, \$bn



Source: Commonwealth Grants Commission, 2011

<sup>11</sup> In a footnote, Pincus (2011, p.21) notes an observation that, with mobility, only points inside the Utilities Possibilities Frontier can be attained without HFE if there is a gain in efficiency of locational or settlement choices.

## 2.5 Policy incentive effects

While the literature argues that HFE is efficiency enhancing, some concerns have been raised regarding potential inefficiencies introduced by HFE. The literature acknowledges that HFE can potentially introduce incentives for state governments to change their behaviour in an attempt to maximise their grants. There have also been assertions that HFE impedes structural adjustment.

While both of these issues are raised as strong concerns by some states in submissions to the review, the discussion below shows that they are of relatively small importance.

### 2.5.1 State policy incentives

Boadway (2003) identifies four different “inadvertent incentive effects” on state policy decisions. While three of these have the potential to reduce the efficiency gains from equalisation, the fourth adds to the gain.

#### Incentives to influence the size of the tax base

The size of a state’s tax base (on a per capita basis) is a key determinant of the distributions that the state receives under HFE. If the state has a smaller tax base, then it has greater distributions toward it under HFE. Recognising this, Boadway notes two ways that states could reduce the size of their tax base in order to receive higher distributions.

- A state could put a high tax rate on a mobile base, such as labour or capital, thereby shrinking its own tax base and growing the tax base in other states.
- A state could restrain growth in a tax base more directly. For example, in the case of natural resources, it could limit mine approvals. For other tax bases, it could refrain from implementing policies that would encourage growth.

Ergas and Pincus (2011), along with Western Australia and Queensland, emphasise the second distortion as an offsetting factor to the efficiency gain from HFE. However, under HFE, there remain clear incentives for state governments to grant mine approvals. Taking the current mining boom as an example, the main economic motivation for the Western Australian and Queensland governments to encourage mining development is the large benefits to the private sector, including higher household incomes. Further, Western Australia and Queensland also obtain a fiscal benefit from the mining boom, since they retain a share of mining royalties that is in line with their population shares. So it is unsurprising that, as the Tasmanian submission points out, the Western Australia and Queensland governments have supported a continued expansion of mining activities in their states during the mining boom, despite this causing them to move from recipient to donor states under HFE.

#### Incentives to change tax rates

There may be an incentive for states to alter their tax rates to increase the size of their distributions.

- If a state reduces its tax rate, it may reduce the national average tax rate. This would reduce the size of distributions relating to that tax. Therefore, states may have an incentive to lower their tax rate on tax bases in which they have a high revenue raising capacity. This is because a lower national average tax rate would reduce the size of the distributions away from the state.

- Likewise, if a state increases its tax rate, it may raise the national average rate. This would increase the size of distributions relating to that tax. Therefore, states may have an incentive to raise tax rates on tax bases in which they have a low revenue raising capacity. This is because a higher national average tax rate would increase the size of the distributions toward the state.

In a practical sense, this incentive only applies to states that can substantially influence the average tax rate, for which they would need a large share of the tax base. Queensland and Western Australia make up more than 70 per cent of the mining tax base, and can therefore affect the average tax rate. However, it is notable that the incentive to increase HFE payments has not deterred a number of states (including Queensland and Western Australia) from recently announcing increases to royalty rates.

#### Incentives to influence 'needs'

Boadway also notes that states may have an incentive to distort their assessed expenditure needs to influence their HFE distributions. For example, they could increase the number of people eligible for a certain program, and therefore receive greater HFE distributions. However, this concern can be overcome by using purely demographic indicators for expenditure needs, which is the method used in Australia.

A related concern is that the HFE system may lessen the incentive for recipient states to pursue cost reductions in their service delivery. For example, Victoria argues that "the current system of HFE promotes and rewards inefficiency" (Vic 2011, p4). However, smaller states have little impact on national average cost levels, and even larger states still retain the majority of any efficiency saving that they make because they typically account for less than one-half of national expenditures.

#### Offsetting incentives

While the above mentioned incentive effects have the potential to reduce the welfare gain from HFE, some authors have argued that HFE can introduce incentive effects that add to the gain.

Specifically, in the absence of HFE, tax competition between state governments to attract economic activity in a beggar-thy-neighbour fashion can lead to tax rates that are too low in the sense that they result in below optimal levels of government services. HFE helps to lessen this tendency for below optimal revenue raising effort by compensating states for low revenue raising capacity, not for low revenue raising effort.

### 2.5.2 Impacts on structural adjustment

A number of authors, including Western Australia (2011) and Queensland (2011), raise concerns that HFE inhibits structural adjustment. They argue that, as these states experience a mining boom, HFE distributes funds away from them and reduces their ability to attract labour and invest in infrastructure. In line with this, the Treasury (2011) also suggests that the absence of HFE could be efficiency enhancing by encouraging workers to move to areas in which a mining boom is taking place.

However, these arguments ignore the long-term aims of HFE. Importantly, as discussed in section 2.1, without HFE there would be *too much* migration to states experiencing a boom in mining activity. Therefore, instead of dampening the effectiveness of HFE, a more appropriate means of assisting the

structural adjustment currently under way in Western Australia and Queensland would be to remove other impediments to the free movement of labour or investment in infrastructure.

In addition, Boadway argues that HFE plays a stabilising role, acting as insurance against economic shocks which affect regions differently. In line with this, the Treasury notes that:

*HFE also acts as a form of insurance (albeit with a lag) for States that are benefiting from the strong demand for Australia's non-rural commodities, but that are relatively more exposed if those conditions change rapidly or unexpectedly. (Treasury 2011, p5)*

That is, when the mining boom slows, HFE would cushion Western Australia and Queensland in their adjustment away from mining activity by raising their shares of GST revenue, although there would be a lag to this effect because of the way that GST distributions are calculated.

### 2.5.3 Size of costs from incentive effects

These incentive effects on state policy decisions are the main focus of some submissions to the Review. However, it is not clear that these potential distortions to policy decisions are large relative to the efficiency gains from HFE. This is particularly true when it is taken into account that governments generally act in accordance with the desires of the voting population. The state population will not only take into account the fiscal benefits from any particular reform, but also the private benefits. For example, even if an increase in mining activity has adverse effects on a state's HFE distributions, it will still lead to a net increase in revenues for the government, and more significantly will raise private incomes for the state's population. Recognising this, Walsh notes that:

*it is not obvious that State governments are, in some sense, "grant maximisers", especially given that to grant maximise would require States to behave in ways that would be difficult to explain to their residents/voters (Walsh 2011, p14)*

Likewise, the Treasury argues the following.

*The strength of any potential disincentive for economic reform will depend on the relative importance that individual State governments place on their GST share in comparison to other considerations. It seems unlikely that there are a large number of unambiguously efficiency enhancing reforms for which HFE is the marginal factor that is dissuading governments from pursuing reform. (Treasury 2011, p6)*

In addition, despite the potential for some adverse policy incentives, HFE in its current form broadly achieves what it sets out to do. For example, it moves revenue away from states that have large mineral resources and towards states with large proportions of their population in high need categories. Therefore, the actual outcomes of the Australian HFE process suggest that any policy incentive effects are of relatively small importance.

Thus, the main impact of HFE is to remove the distortions arising from the existence of state borders. Therefore, the modelling in this report focuses on these main impacts, drawing on empirical research as to economic drivers of interstate population mobility, and capturing the way that fiscal advantages and disadvantages and associated equalisation payments influence those drivers. Since the potential inefficiencies from distortions to state policy incentives are likely to be relatively small, modelling

these impacts can safely be left to future research in this area, which initially would require empirical research on the size of effects in practice (if any).

## 2.6 Previous estimates of gains from HFE

Before describing our estimates of the welfare impacts of HFE, this section considers estimates made by other authors. There is not a large body of work in this area, but this section first considers some work on the Canadian system, and then discusses the only estimates for Australia, by Dixon et al.

Watson (1986) estimates the efficiency gains from Canada's equalisation system. Although he agrees with the underlying theory that equalisation is efficiency-enhancing, he finds that the size of these gains are small. In his modelling, Watson assumes that migrants move until the welfare gain from doing so is zero. Making use of estimates of annual migration flows induced by equalisation payments, Watson finds that the efficiency benefits of changes to the Canadian equalisation system between 1971 and 1977 were \$1.4m (in 1971 dollars).

However, in a critique of Watson's work, Wilson (2003) concludes that Watson's estimates understate the benefits of equalisation. The reason is that Watson uses estimates of annual migration flows over a short time period. Since migration is long-term in nature, Wilson argues: "Using only one year's migration, as Watson did, seriously underestimates the full gains from our system of equalization payments." (Wilson 2003, p386) Wilson recalculates the benefits using Watson's method but instead basing the estimates on a measure of the "full migration" caused by changes to the equalisation system. This lifts the estimated annual efficiency benefit to \$60.3m (in 1971 Canadian dollars). Notably this only captures a part of the efficiency benefits of the Canadian system, because it refers to the efficiency gains from growth in the system in the mid 1970s, not the system as a whole. Further, Canada only practices partial equalisation. Hence, the efficient benefit of the entire Australian system expressed in today's dollars, and taking into account that it is based on full equalisation, would be expected to be considerably larger.

The only previous Australian modelling of HFE is by Dixon et al. (2002), in which they model repealing the current HFE system and distributing the GST on a purely equal per capita (EPC) basis. To do so, they use a "general equilibrium model that was tailor-made for examining the welfare effects of variations in the Commonwealth/State funding arrangements". This MONASH-CSF model is not directly related to the well-known multi-sector, dynamic MONASH model. The modelling by Dixon et al. has been a useful reference point for constructing our own model, and we have incorporated a number of features from MONASH-CSF into the modelling for this report. However, we have also been able to make a number of improvements on their method.

Surprisingly, rather than finding a welfare gain from equalisation, Dixon et al. (2002) estimate that there is a welfare *loss* from the Australian HFE system, which is contrary to the economic literature. In particular, they estimate that there would be a welfare gain of \$169 million, in 2000/01 terms, from moving from the HFE system to an EPC distribution of GST revenues. They suggest that "the major source of gain from reducing subsidisation in the allocation of Commonwealth grants is that it will take money away from State governments that do not spend it in accordance with household preferences" (Dixon et al. 2002, p19).

In fact, the most important driver of their surprising result is the inconsistent way that Dixon et al. estimate welfare. In modelling interstate migration decisions, Dixon et al. include an amenity effect

under which consumer welfare is reduced by an increase in a state's population. However, when calculating the change in consumer welfare resulting from that interstate migration, they include no such amenity effect. This leads them to report a welfare gain from abolishing HFE, contrary to the literature. If instead they had avoided this miscalculation by correctly and consistently applying the same measure of consumer welfare throughout, approximate replication of their modelling shows that they would have found a welfare loss, not a welfare gain, from moving away from HFE. This replication and correction to the Dixon et al. (2002) modelling is at Appendix B of this report.

There are also a number of other issues with the modelling in the Dixon et al. (2002) report to note.

1. They understate the extent of labour mobility through a strong effect that reduces households' standard of living as the population increases in a state. Specifically, if the population of a state is 1 per cent higher, then individual living standards are lower by 1 per cent. This is a much stronger effect on living standards from population gain than estimated by Glaeser and Gottlieb (2008).
2. As part of their production modelling, they assume that the share of mining revenue received by owners of mineral resources stays the same when mining prices rise. In reality, that share has risen considerably during the major rise in mining prices of the last decade. This implies that, in the production of minerals, labour and capital are less easily substituted for mineral resources than assumed by Dixon et al. (2002).
3. They ignore the rationale for partially equalising for differences in the cost of government service provision between states. Through the design of their welfare function, they implicitly assume that no equalisation is justified for differences in the cost of service provision, whereas partial equalisation would be justified under more reasonable assumptions.
4. They understate the extent to which equalisation is required for different expenditure needs in each state. The literature, including Dixon et al., generally agrees that differences in per capita government expenditure requirements due to demographic and governmental features of the state should be fully equalised for. However, Dixon et al. only take into account some of the differences in per capita spending needs assessed by the Commonwealth Grants Commission (CGC).
5. Mining royalty revenues are now much higher than they were at the time of the study of Dixon et al. (2002), which is based on data for the year 2000/01. This means that in the current circumstances, there would be much larger benefits from equalisation for differences in mining revenue raising capacities, because the differences between states are much larger than they were before.

The above issues with the Dixon et al. modelling are discussed in more detail in Appendix B. They are all addressed in the Independent Economics Horizontal Fiscal Equalisation model (IE-HFE model), developed for this report. The result is a more realistic estimate of the welfare gains from HFE, which is consistent with the literature described in this section. The following section discusses the features of IE-HFE. Additional information on the IE-HFE model is also included in Appendix A.

## 3. Modelling approach

This section describes the model used to estimate the economic impacts of the Australian HFE system. A purpose-built model of the Australian state economies has been constructed for this report, the Independent Economic Horizontal Fiscal Equalisation model (IE-HFE model). It incorporates a number of useful features from the Dixon et al. (2002) modelling, insights from the literature review in the previous section, and the conclusions from our review of the existing HFE system managed by the CGC. IE-HFE uses the most up-to-date set of data available, from 2009/10, and looks forward to take into account the medium-term effects on state budgets and HFE of the robust medium-term outlook for the mining industry.

This section first describes the general assumptions made in the model, before outlining the behaviour of each of the agents in the model – households, governments and producers. Additional detail on the IE-HFE model is available in Appendix A.

### 3.1 General assumptions

The IE-HFE model makes a number of general assumptions that are shared with most long-run CGE models.

#### Long-term model

The IE-HFE model is a long-term model, meaning that results from the model refer to the economy after it has fully adjusted to economic shocks. In keeping with this, all markets are assumed to have reached equilibrium.

As discussed in section 2.1, one of the main aims of HFE is to achieve efficiency in interstate settlement patterns, which is a long-run policy objective. Thus, a long-term model is an appropriate tool for modelling the impacts of HFE.

#### Optimising behaviour

The agents in the IE-HFE model optimise, while still remaining within the constraints of their budgets.

- Households choose their state of residence to maximise their standard of living, or utility. The level of private incomes, government services and amenity of each state affects utility levels.
- Governments in each state choose taxation levels and the supply of government goods and services to maximise household welfare, subject to the government's budget constraint.
- Businesses in each state choose the level of various inputs and outputs to maximise their profits.

More details on these decisions are included in sections 3.2 to 3.4.

### Budget constraints

In a sustainable equilibrium, governments and households must meet their budget constraints.

For simplicity, we assume that the government budget in each state is balanced in the long run. Governments choose their level of expenditure and taxation consistent with achieving this outcome.

In the private sector, a sustainable outcome is one in which households do not spend more than their after-tax income on the private good.

## 3.2 Household behaviour

Households derive well-being (or utility) from their consumption of the private consumption good and state government provided services. Their utility is also affected by the level of amenity in their state. Households choose a state of residence to gain the highest possible utility, after taking into account:

- household incomes and consumer prices in each state, which together determine the amount that can be purchased of a bundled ‘private consumption good’;
- the level of state government services in each state; and
- the population size and its effects on amenity in each state.

While households derive utility from government services, they are not able to choose the amount of these services that are provided. Instead, governments make this choice, but they are assumed to do this in line with household preferences.

In making their decisions, households must live within their means and cannot spend more than their budget allows. Household incomes are comprised of the following:

- ‘wage’ income – which is a combination of the return to labour and the return to capital, and depends on the wage available in their state of residence; plus
- other income – including the returns earned from their ownership of land and natural resources; less
- State and Commonwealth taxes paid on this income.

A single household utility function is used to ensure that the modelling is consistent. In particular, the utility function used by households to determine in which state they live is the same utility function used to measure the impact on their welfare of those location decisions. This is important for properly estimating the welfare effects of any changes to the HFE system, and contrasts with the modelling of Dixon et al. (2002). The utility function used in the IE-HFE model is explained in more detail in Appendix A. The household choices based on this function are discussed briefly below.

### State of residence

As noted in section 2.1, households make migration decisions by comparing the level of utility that they would attain by living in each of the states, and a household will move to the state where it would attain the highest level of utility. This will depend on the level of amenity in that state, and the consumption of both the private and government goods that can be attained.



When households move into a state attracted by a higher level of utility, they negatively impact on the utility of the other households who are already living there. The IE-HFE model takes account of this in a number of ways.

- Firstly, as households move into a state, the labour supply in that state would grow. With a fixed amount of land and natural resources, the productivity of labour would fall. In response, wages are lower in that state, and the level of household consumption achievable becomes smaller.
- Secondly, a term that relates the population size to the amenity from living in the state dampens the utility of all households in the state as the population grows. This captures the idea that households have lower amenity when they are required to share space with more neighbours because of factors such as higher pollution and longer commute times. The choice of parameter value for this term has been informed by the urban economics literature. More explanation of this term is included in Appendix A.

These aspects of IE-HFE mean that population movements triggered by an increase in the utility from living in a certain state cannot continue without limit. As the population of that state grows, lower wages and lower amenity will both work to reduce the utility from moving to that state. By the same logic, the associated population outflow from other states will cause the utility from living in other states to rise. Population movements will cease once population flows have equated utility levels across states.

Through this mechanism, over the long-term, households distribute themselves between states in such a way that there would be no gain from moving to any other state. This means that, in equilibrium, the level of utility for the representative household would be the same irrespective of the state they live in.

#### Consumption of goods

Households consume two 'goods' in IE-HFE – a privately-produced consumption good, and state government services. This consumption is funded out of state income. State income consists of private income from ownership of the factors of production, less taxes net of transfers that are paid to the Commonwealth, less net taxes paid to other states.

State governments choose the amount of state government services that they provide. They raise taxes to fully fund that spending, and the remainder of state income is available to households. Households then spend that household income on the privately-produced good.

Importantly, state governments are assumed to base decisions on the level of spending/taxation on household preferences between the private and government goods. This means that state income is allocated between the private and government goods to maximise the utility or welfare of households, taking into account the level of state income and the prices of the two goods.

#### Measuring changes in household welfare

To correctly measure the impact that a policy change has on welfare, the utility function used to model households' location decisions should be the same as the function used to measure the impact of those location decisions on welfare. This way, households make migration decisions to maximise

their own living standards, and the welfare results are consistent with this. IE-HFE takes this consistent approach to modelling location decisions and measuring the resulting changes in welfare<sup>12</sup>. This is one of the major differences between the IE-HFE model and the model used by the Dixon et al. in their 2002 study. Their approach is discussed further in Appendix B, while the utility function used in IE-HFE is described in detail in Appendix A.

### 3.3 Government behaviour

State governments provide services, and pay for these by collecting tax revenue. As noted above, they base their decision on the level of government services on household preferences between the private and government goods.

There are a number of factors that affect government expenditure levels. For example, state governments may face different expenditure requirements because of the demographic makeup of their population or because of the inherent costs of operating in a state. These have been discussed in section 2.3. The following section briefly summarises conclusions from the HFE literature on each factor that affects expenditure requirements, and describes the modelling approach used for these factors in IE-HFE. It also describes how in IE-HFE governments choose the level of services to provide to their population, after taking the costs into account.

The factors affecting a government's capacity to raise revenue are more straightforward, because it depends on the size of the tax base in each state. The modelling of this is discussed in section 3.3.2.

#### 3.3.1 Government service provision

As discussed in section 2.3, *demographic and governmental* factors which are beyond the state government's control may mean that certain states face higher expenditure requirements. For example, to provide a given level of hospital service, a state with a greater proportion of elderly people would need to spend a greater amount per capita. Effectively, they face higher costs to provide the same level of services. The literature concludes that there should be full fiscal equalisation for fiscal disadvantages generated by demographic factors.

On the other hand, higher expenditures may be due to a higher *cost* of service provision. For example, if a state has a greater proportion of its population living in remote areas, then it would cost more to provide each unit of government services. Efficiency in service provision would imply that high cost areas would lead to a lower level of service provision. Therefore, the literature concludes there should only be partial fiscal equalisation for fiscal disadvantages generated by cost factors.

Because of these different conclusions for the appropriate level of equalisation, it is important that the modelling distinguishes between the various drivers of fiscal disadvantage in government expenditures. Table 3.1 summarises the discussion in section 2.3, listing each of the drivers of government spending considered by the CGC, and the conclusions that can be drawn from the literature. In line with these conclusions, the final column in the table identifies the treatment of the expenditure in IE-HFE.

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<sup>12</sup> In this report, the impact of a policy on household welfare is measured using the *equivalent variation* (EV), which is the income transfer that would have to be given to households before the policy change to enable the same level of utility as they would have after the policy change. A similar concept is the *compensating variation* (CV). This is the income transfer that would need to be given to households after the policy change to return them to their initial utility level.

*Table 3.1 Equalisation treatment for different types of expenditures*

Item	Comment	Equalisation Conclusion	IE-HFE Treatment
Indigeneity	Determined by demographics	Fully equalise	CGC assessment of differences in spending requirements used to estimate disability
Population dispersion	After stratifying areas in each state according to remoteness, determined by population settlement patterns	Partially equalise / fully equalise for each 'strata'	CGC assessment cost factor for rural unit costs used in the price of government services only
Wage levels	Determined in the state labour market	Partially equalise (currently HFE fully equalises)	CGC assessment cost factor used in the price of government services only
Socio-economic status & demographic composition	Determined by demographics	Fully equalise	CGC assessment of differences in spending requirements used to estimate disability
Non-state services	Determined by Commonwealth government decisions	Fully equalise	CGC assessment of differences in spending requirements used to estimate disability
Population growth	Determined by population growth patterns	Fully equalise	CGC assessment of differences in spending requirements used to estimate disability
Diseconomies of scale	Expenditures on the fixed costs of state governments are essential	Fully equalise	CGC assessment of differences in spending requirements used to estimate disability

As displayed in Table 3.1, the literature concludes that there should be full equalisation for most of the costs identified above. There are two items for which there should be partial equalisation, and these are both related to the cost of providing a particular service level – population dispersion and wages.

Table 3.2 below shows the redistributions recommended by the CGC for 2011/12 for each expenditure driver, taken from the 2011 CGC update report. A negative entry indicates that funding is distributed away from the state because they have an advantage in that particular item. A positive entry indicates that funding is distributed toward the state because they have a fiscal disadvantage in that particular item.

*Table 3.2 Recommended expenditure redistributions for government expenses, 2011/12, \$m*

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Redist
Indigeneity	-551	-1695	527	521	-231	16	-87	1501	2565
Population dispersion	-549	-805	379	653	160	-89	-199	450	1642
Interstate wage levels	500	-500	-462	509	-128	-97	89	89	1187
Socio-economic status	381	10	-273	-525	538	202	-233	-100	1131
Non-State service provision	-767	-279	224	565	-68	35	26	264	1114
Diseconomies of scale	-393	-244	-152	48	99	198	206	238	789
Population growth	-583	46	521	384	-257	-107	-19	15	966
Other effects on expenses	-127	-238	239	-31	-70	160	61	6	466

*Source: Commonwealth Grants Commission, 2011*

*Note: 'Redist' refers to the total amount of payments to recipient states*

The IE-HFE reflects the CGCs assessment of the expenditure drivers in its modelling of the HFE system. Specifically, since the most recent CGC assessment is for 2009/10, the model has been calibrated so that it is consistent with the CGC's assessment of state fiscal advantages and disadvantages in government service provision in that year. The expenditure drivers have been divided into two categories, which are modelled differently.

#### Demographic and Governmental factors

Differences between state expenditure caused by *demographic and governmental* factors beyond state government control are modelled as a fixed item affecting state expenditure. Under this approach, if the CGC assesses that a state has above-average expenditures due to demographic and governmental factors, then this is modelled as a fixed additional expense that must be incurred to provide a given level of services<sup>13</sup>.

If these additional expenses (which in some cases are negative and sum to zero across states) are appropriately specified for each state, modelling them as a fixed expense would be consistent with the literature on equalisation. In a modelling scenario where there is no equalisation, the residents of each state would bear the cost of their state's additional expenditure requirements in full, because they would have to pay higher taxes to fund them. In this case, individuals will be encouraged to move away from states with higher spending requirements. On the other hand, if there is equalisation, then the decisions of migrants would not be affected by the amount of the fixed additional expenditures in any state, because the cost would be shared across the whole Australian population.

#### Cost of service provision

The cost of providing each unit of government services also varies between states due to factors beyond the government's control. As discussed in Section 2.4, the efficient outcome would be that fewer services are provided in areas where the cost of these services is higher. IE-HFE reflects this outcome through the modelling of household preferences for government services. In the model, if the cost of providing government services is higher, then households will demand lower service levels, and governments are assumed to act in accordance with this.

In IE-HFE, the sensitivity of household demand to the cost of government services is consistent with previous research, as described in Appendix A. This implies that an increase in cost of 1 per cent

<sup>13</sup> The use of CGC estimates is discussed further in Appendix A.

leads to a reduction in quantity demand of around 0.5 per cent. This means that, if the cost of providing services increases, then the reduction in demand will not be sufficient to fully offset the higher cost. Therefore, if a state government faces higher costs, it will need to spend more in dollar terms to keep service provision in line with household preferences.

This modelling of demand for government services means that IE-HFE takes into account how additional service delivery costs impact on the efficiency of migration decisions. Consider a state in which costs become higher. In response to these higher costs, this state would lower service levels, which would cause households to move away from the state. This migration would be efficient if it stops when there are no more overall gains from moving away from the state. In this case, the welfare of the national population would be at its highest possible level.

However, without equalisation, migration would not stop at this efficient level. As discussed above, if public service wages are higher, households prefer to have a higher nominal spending on government services. Thus, without HFE, the government would need to raise additional tax revenues from within the state to cover this additional cost. This fiscal disadvantage would artificially encourage further outward migration as households seek to avoid bearing the higher cost of public services.

On the other hand, if there is partial equalisation that covers the additional cost of higher nominal spending, taking into account that service levels are lower, then the cost would be shared among the national population, and would not affect migration decisions. Importantly, full equalisation would not be optimal in this case. This is because, nominal expenditures on government services are not higher by the whole amount of the wage differences, since the preferred level of service is lower when costs are higher. Pincus (2011) highlights this efficiency case for less than full equalisation for cost differences: “the main result is that little or no allowance should be made for interstate differences in the unit costs of public provision of goods and services”.

#### Household and government preferences

In IE-HFE, state governments know the preferences of their voting public, and follow these preferences. As discussed in section 3.5, there is little evidence that governments would act against the wishes of their constituents, particularly in the long run. According to Walsh, “both *a priori* reasoning and Albert Breton’s theory of competitive federalism suggest that State governments cannot and will not provide public sector services out of line with the preferences of their citizen-voters in the long-run” (Walsh 2011, p14).

Therefore, in the IE-HFE model, governments choose the level of service provision/taxation that maximises the utility of households living in their state. In doing so, governments weigh up the higher utility that households receive from more government services, against the lower utility households receive when the higher taxes to fund higher government services lead to a loss in households’ ability to purchase the private good.

#### 3.3.2 State government revenue

In our modelling, state governments collect revenue from five different sources, which impact on state economies in different ways.

- **Resource royalty** revenues are a tax on mining production volumes or values in each state. For the purposes of this modelling, they are treated as a tax on resource rents. This means

that the royalties would not have an impact on the amount of the resource in use in any state.<sup>14</sup>

- **Land taxes** are collected on the value of land. As for natural resources, land is immobile and in fixed supply, and so a tax on land values would not affect the amount of land in use in any state.
- **Other state taxes**, such as payroll tax, conveyance duty, and insurance tax are bundled together as a tax on the returns to labour and capital in the state. Unlike natural resources or land, labour and capital can move between states. Therefore, an above-average rate of tax will lead to less labour and capital in a state.
- **Specific Purpose Payments** are transferred from the Commonwealth Government to each of the State Governments. These are fixed on a per capita basis at their 2009/10 levels.
- **HFE distributions** are calculated using the HFE approach of the CGC. This can be divided into three parts.
  1. The first part is an adjustment for the assessed revenue raising capacity for the state. Revenue is either distributed toward or away from the state so that, after taking the revenue distribution into account, it would receive the average revenue if it levied the average tax rate on its tax bases.
  2. The second part is an adjustment for the assessed per capita expenditure needs of the state. Funds are either distributed toward or away from the state so that, after taking into account the funding from the revenue distribution, it can supply the average level of services to their populations of varied needs at the average cost to the state budget.
  3. The third part is an adjustment for the assessed costs of government service provision. Funds are either distributed toward or away from the state so that, after taking the saving from the revenue distribution, it can supply the average level of services at the average cost to the state budget.

The formula used to model HFE distributions is discussed in more detail in Appendix A.

In the long run, governments must be able to cover the costs of the services they provide. Therefore, IE-HFE assumes that each state government has a balanced budget. Hence, if an economic shock causes budget imbalance, there must be a tax that adjusts to make up the difference as the swing fiscal instrument.

For the scenarios in this report, the composite ‘other state taxes’ has been chosen as the swing fiscal instrument. That is, if expenditure is higher or tax revenue is lower in a scenario, then the tax rate on labour and capital will automatically rise to balance the budget.

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<sup>14</sup> In reality, because royalties are levied on the value or volume of production, they would have an impact on mining activity. However, we make the simplifying assumption that they are a tax on mining rents, since mining rents are an important component of the value of mining activity and the economic impact of royalties is not the focus of this report.

In principle, a state government could choose to use any of the three categories of taxes listed above as its swing fiscal instrument. However, in practice, ‘other state taxes’ is the most obvious choice since that is the main revenue raiser.

The per capita revenue raising capacity in any state will depend on the size of their three tax bases. To accurately estimate these capacities, the IE-HFE model uses the most up-to-date data available from the CGC, for 2009/10. As discussed in Section 2.2, the most important source of differences in state per capita revenue raising capacities is mining activity, where differences between the states have been increasing in recent years. Using up-to-date data means that the efficiency gains from the current system of revenue equalisation will be properly taken into account.

### 3.4 Producer behaviour

There are four goods produced in the IE-HFE model. The private sector produces mining output and the private consumption good, and the State and Commonwealth governments each produce separate government services. The following is an outline of how these goods are produced in the IE-HFE model. A more detailed discussion is included in Appendix A.

#### Production of the private good

Private firms in IE-HFE produce the private consumption good using two inputs – a labour and capital bundle, and land. These firms combine these inputs using a ‘constant elasticity of substitution’ production technology. That is, as the price of one of their inputs increases relative to the price of the other, they substitute towards the cheaper input.

The amount of land available for use in each state is fixed. Therefore, the amount of land available in a state reduces the flexibility of state output of the private consumption good. On the other hand, labour can move between states, when households have an incentive to do so, such as higher wages. As households move into a state, the greater amount of labour is combined with the same amount of land, leading to a lower level of labour productivity, and placing downward pressure on wages.

The privately produced good is traded internationally. It is assumed that producers in each state are price takers, meaning that they face the same price, which is set on the international market.

#### Production of mining output

Private firms in IE-HFE use two inputs to produce mining output – a labour and capital bundle, and mineral resources. Again, these firms use ‘constant elasticity of substitution’ production technology, and as the price of one of their inputs increases relative to the price of the other, they substitute towards the cheaper input.

Like land, the quantity of mineral resources available in any one state is fixed, as mineral resources cannot move from state to state. Therefore, states with higher endowments of mineral resources will have greater mining production.

It is assumed that producers in each state are price takers, facing the same price, which is set on the world market. However, the model includes a facility that allows the world price to be varied so that different levels of mining prices can be included in the modelling.

#### Production of state government services

State government services are produced using only the labour and capital bundle. These services are not tradeable between states, so production of state government services in a state matches the consumption of those services by the residences of that state. With only one input to production, the price of state government services is determined by the state wage and the efficiency of labour in the state government services sector.

#### Production of Commonwealth Government services

Like the States, the Commonwealth Government produces its services only using the labour capital bundle. The quantity of Commonwealth Government services is fixed and so its use of labour in each state will also be fixed, no matter the wage rate. In addition to producing services, the Commonwealth Government also funds SPP payments to States.

To fund its expenditure, the Commonwealth Government levies a tax on the labour and capital bundle. This tax rate adjusts so that the Commonwealth balances its budget.

### 3.5 The baseline scenario

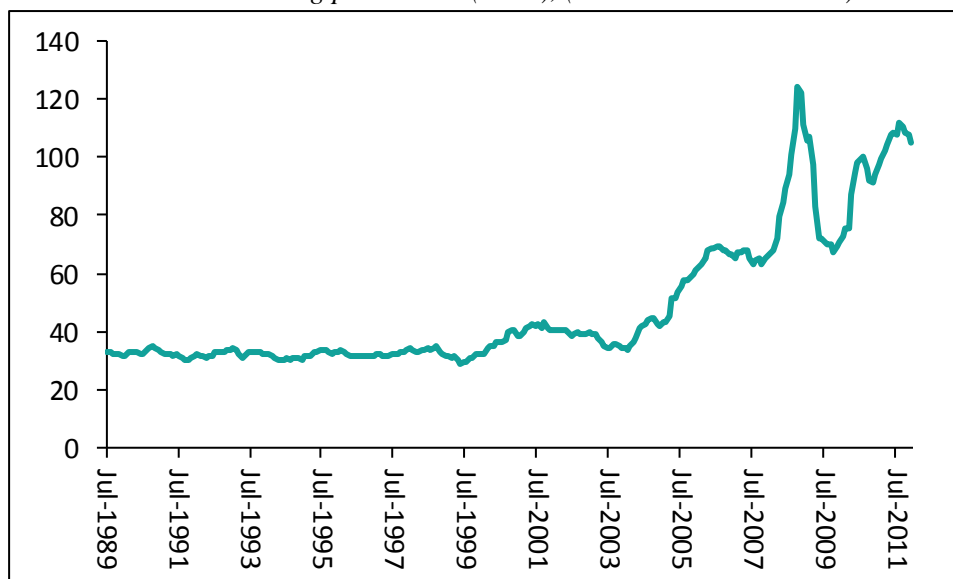
IE-HFE is based on data for 2009/10 because this is the most recent year for which the CGC have published its assessments. The baseline year of the model is a 'normalised' version of the 2009/10 state economies. It aims to represent a version of the 2009/10 economy that would be sustainable in the long-run. The model incorporates the fiscal advantages and disadvantages of each state assessed by the CGC. In doing so, it distinguishes between fiscal advantages and disadvantages arising from expenditure unit costs, indigenous needs, other expenditure needs, the mining resource tax base, the land tax base, other tax bases, and the amount of Special Purpose Payments received from the Commonwealth.

#### Mining prices in the baseline

While the IE-HFE is based mainly on data for 2009/10, that year was atypical in that mining prices were at a low-point. Chart 3.1 below shows the dip in mining prices around this time, which was associated with the global financial crisis (GFC).



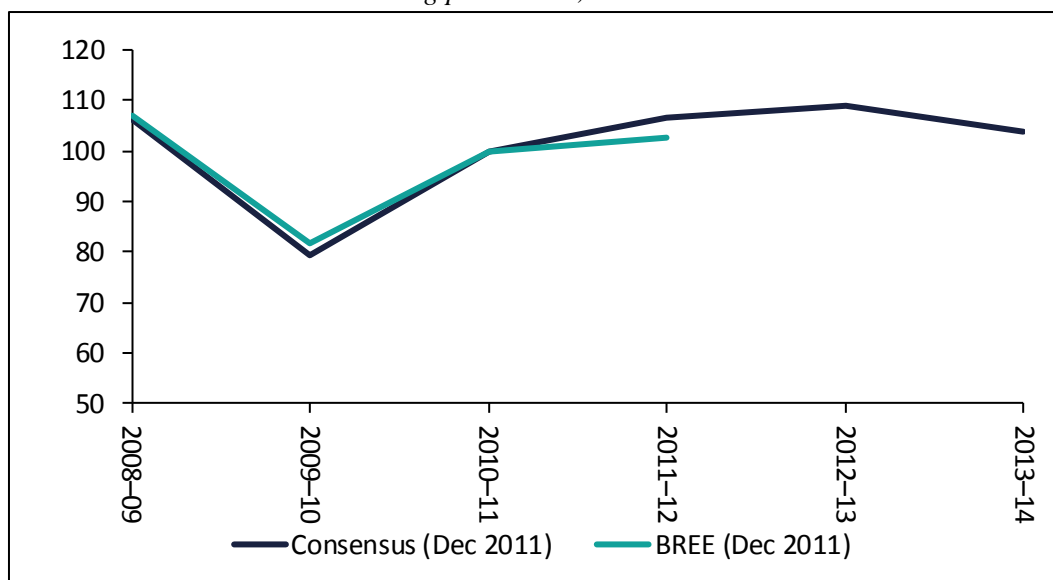
Chart 3.1 Mining price index (AUD), (non-rural commodities)



Source: RBA

Since the mining price level in 2009/10 was abnormally low by recent standards, the baseline scenario has been simulated to include a higher real price level for the mining industry. In December 2011, BREE released its latest forecasts for minerals export prices in its Resources and Energy Quarterly publication. The minerals prices, adjusted to remove the effects of general inflation, are shown in Chart 3.2 below. The adjusted BREE forecast indicates that they expect real minerals prices to be 26 per cent higher in 2011/12 than in 2009/10.

Chart 3.2 Mining price index, medium term outlook



Source: Independent Economics estimates based on BREE data, RBA data and Consensus Economics consensus forecasts/

In January 2012, consensus forecasts were published by Consensus Economics<sup>15</sup>. After adjusting to remove the effects of annual inflation, and rebasing so that the 2010/11 price index value is 100, the

<sup>15</sup> These forecasts are of the RBA Non-Rural Commodity Price Index, and so refer to a slightly different series to the BREE forecasts.

consensus forecasts show that real prices are expected to remain well above 2009/10 levels over the medium term. Compared to 2009/10 levels, the consensus is that real mining prices will be 34 per cent higher in 2011/12 and 31 per cent higher in 2013/14 than was the case in 2009/10.

To use a conservative assumption regarding mining prices, the prices used in this report are consistent with the BREE forecast for real mining prices in 2011/12. That is, mining prices 26 per cent higher than in 2009/10 are simulated into the baseline. This level for real mining prices is still conservative when compared to the medium-term consensus forecasts.

The distribution of mining royalty revenues between the states in the IE-HFE baseline are also similar to state budget estimates for the last year of the forward estimates, 2013/14. For example, Table 3.3 shows the share of mining revenues (as assessed by the CGC<sup>16</sup>) for each state. It shows that the shares in the IE-HFE baseline scenario are similar to the shares based on 2013/14 state budget projections<sup>17</sup>.

*Table 3.3 mining revenue shares*

	NSW	Vic	Qld	SA	WA	Tas	NT	ACT
Baseline (long run mining prices)	15%	1%	33%	3%	46%	1%	2%	0%
2013/14 state budget projections	18%	0%	29%	3%	48%	1%	1%	0%

However, mining prices are inherently uncertain. Therefore, to test whether the modelling results are different in the presence of lower mining prices, a sensitivity analysis is conducted in section 4. For this analysis, we consider a pessimistic view, using mining prices that are only 13 per cent (rather than 26 per cent) above 2009/10 levels. This compares to more optimistic consensus forecasts, which expect real prices to remain more than 30 per cent above their 2009/10 levels over the medium term.

#### HFE payments in the baseline

While the CGC recommendations for 2011/12 are used as the starting point for modelling HFE transfers, the HFE transfers in the modelling are not the same. The baseline has been adjusted so that it is consistent with the most recent expectations for real mining prices, so Western Australia and Queensland have higher revenue raising capacities relative to the other states. Therefore, in the baseline scenario, the HFE distributions away from these mining states are higher than the CGC recommendations for 2011/12. Accordingly, the distributions toward the other states are also larger. Also, the single year's assessment for 2009/10 is adopted to align with available state economic data for 2009/10.

Table 3.4 below starts with the recommendations for HFE distributions between states for 2011/12, taken from the 2011 Update Report. The table then shows the adjustments that have been made to obtain HFE transfers that are consistent with the modelling. A negative entry represents a distribution away from the state, and a positive entry represents a distribution toward the state.

<sup>16</sup> The WA and NT estimates include the payments received from the Commonwealth Government in lieu of royalties.

<sup>17</sup> The 2013/14 state budget projections are estimated using 2011/12 budgets from each state.

*Table 3.4 HFE redistributions under various scenarios, \$m*

		NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Redist
1	CGC recommended for 2011/12; uses assessments for 2007/08-2009/10	-664	-1,172	-718	990	-1,464	674	2,261	94	4,019
2	2009/10 CGC assessment	-312	-1,094	-152	732	-1,686	540	1,915	56	3,188
3	2009/10 CGC assessment, with higher mining prices (baseline scenario)	314	-131	-677	922	-3,097	619	1,922	128	3,777
4	2009/10 CGC assessment for indigeneity i.e. modified EPC	-464	-1,500	419	-199	461	12	1,328	-57	2,219
5	2009/10 CGC assessment, with higher mining prices, excl indigeneity (row 3 less row 4)	778	1,369	-1,096	1,121	-3,558	607	595	185	4,469

*Note: 'Redist' refers to the total amount of payments to recipient states*

The first row in Table 3.4 shows the total redistributions recommended by the CGC for 2011/12, which have been replicated from the 2011 CGC update report. These distributions are based on the assessments made for the three years, 2009/10, 2008/09 and 2007/08, and are scaled up for growth in GST revenue.

The second row in Table 3.4 is the CGC assessment for 2009/10, which is used as a starting point for the HFE distributions in the baseline scenario. The model abstracts from the issues associated with averaging assessments over three years, and uses the 2009/10 assessments to represent the 2009/10 HFE payments. Discarding the three-year averaging by moving from the first row to the second row changes the precise amounts of the transfers, but does not change the pattern of recipient and donor states.

The third row shows the estimated HFE distributions which correspond to the baseline scenario, where the current HFE system is in place. Compared to the second row, the higher mining prices have increased the per capita revenue raising capacities of Queensland and Western Australia relative to the national average, and caused corresponding reductions in the per capita relative revenue raising capacities of the other states.

- New South Wales is estimated to move from being a donor state to a recipient state as a result of the higher mining prices. This is due to its below average per capita revenue raising capacity from mining royalties.
- With higher mining prices, distributions away from Western Australia are \$3.1 billion. This is almost double the distributions according to the 2009/10 assessment, but is not out of line with the \$4.0 billion that Western Australia anticipates will be transferred away from it in 2014/15. (WA 2011, p10)

#### HFE payments excluding indigeneity

The next section of the report examines a scenario in which HFE transfers are abolished for everything other than expenditures related to indigeneity. The final row of Table 3.4 shows the HFE payments that are removed from such a policy change in the model. It is calculated as the equalisation payments in the third row, net of the indigenous needs assessment shown in the fourth row.

- Victoria moves from being a donor state to a recipient state as a result of excluding HFE distributions associated with indigeneity. Only a small proportion of the Victorian population is indigenous, so under the current HFE system it makes large payments to other states for equalisation associated with indigeneity. In fact, as shown in the table, for factors other than indigeneity, it is estimated that Victoria requires HFE \$1,369 million in transfers toward it. This is particularly because of its low per capita revenue raising capacity in mining.
- The Northern Territory receives \$1,922 million in the baseline scenario (third row of Table 3.4), but only \$595 million (final row of Table 3.4) is for fiscal disadvantages other than those associated with expenditures on its indigenous population.
- Queensland and Western Australia also have an above average indigenous proportion of their population, and so have distributions toward them for indigenous expenditure needs. This means that the transfers away from these states excluding the effects of indigeneity (final row of Table 3.4) are larger than the transfers taking into account the effects of indigeneity (third row of Table 3.4).

## 4. Results

This section presents estimates of the impact of Australia's HFE system on the standard of living of Australian households and the economy. To estimate this impact, IE-HFE has been used to simulate an alternative policy scenario under which the equalisation system is removed, with one exception. Removal of the equalisation system means that GST revenues are generally distributed between states on an equal per capita (EPC) basis. The exception is that differences in state expenditure needs for indigenous populations continue to be fully equalised between the states. This is referred to as a **modified EPC** system of distributing GST revenues.

This specification of a modified EPC system can be interpreted in various ways. The literal interpretation is that the HFE system is removed, except that equalisation for indigeneity is retained. An alternative interpretation is that HFE is fully removed, but that the Commonwealth Government takes over funding for indigeneity, which could have the same effect as retaining equalisation for indigeneity. Either way, the modified EPC scenario recognises that it would be quite unrealistic to simulate a situation in which government funding arrangements no longer recognise the differences between states in government expenditure needs arising from differences in the levels of indigenous populations. The modified EPC scenario is also as agreed with the SADTF.

The results presented in this section show the ongoing annual impact of having the modified EPC policy rather than the current HFE policy. They are long-term impacts – after the economy and migration have fully adjusted to the new policy. In each case, the results are shown as deviations from the baseline scenario, which has the current HFE policy in place. As explained in section 3.5, the baseline scenario is based on the year 2009/10, but with the economy re-simulated under higher mining prices, to take into account that mining prices were unusually low during the GFC year. Normalising mining prices in this way takes fuller account of the ongoing fiscal advantage to Western Australia and Queensland from the robust outlook for mining prices.

The results have been estimated using IE-HFE, a purpose-built model of the Australian state economies. IE-HFE was described in the previous section, and uses insights from the literature review in presented in Section 2. The direct impacts for HFE transfers are discussed first, followed by the impacts on state government taxes, consumer welfare, state populations and wages.

The impacts of modified EPC on HFE distributions and state government budgets

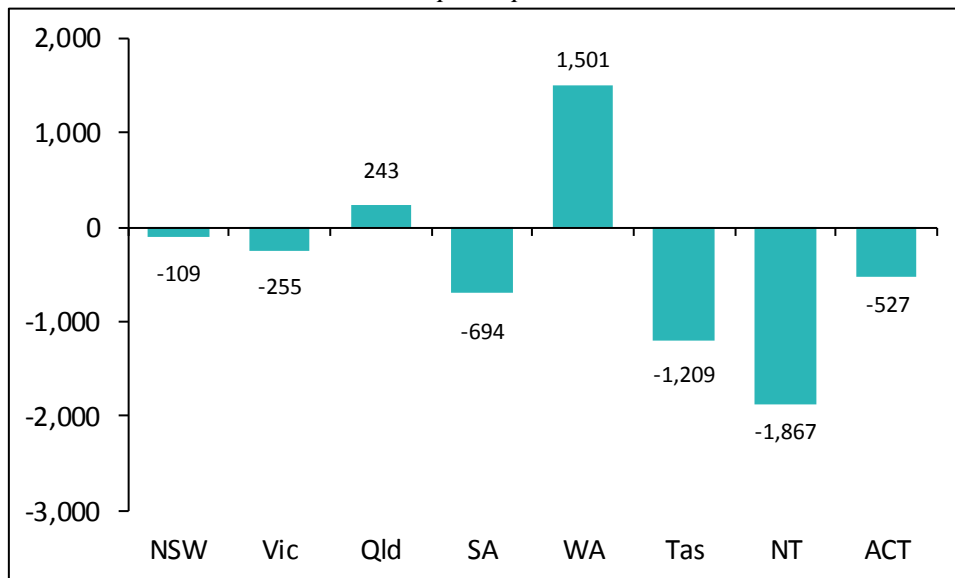
If GST revenues were distributed using a modified EPC system (i.e. an equal per capita basis, except for transfers relating to indigenous needs) in place of the existing HFE system, the impact on the finances of each state will depend on a comparison of redistributions under both systems.

- Under the existing HFE system of the baseline scenario, the donor states are Western Australia and Queensland (primarily because of their high revenue-raising capacities from mining) and Victoria (primarily because of its low indigenous population). In the CGC's recommendations for 2011/12, New South Wales is also a donor state, but the baseline scenario takes into account that strong mining prices are likely to soon make it a borderline recipient state. Other things being equal, a move away from the existing system would lead to a budget gain to the donor states.

- Under a modified EPC system, the recipient states would be those states with disproportionately high indigenous populations. Those recipient states would be the Northern Territory, Western Australia, Queensland and Tasmania. Other things being equal, a move towards a modified EPC system would lead to a budget gain to these recipient states.

It follows that the two states that would clearly receive a budget gain from a move from the existing system to a modified EPC system are Western Australia and Queensland. Both of these states would move from being donor states to being recipient states. In both cases these states are donor states in the baseline mainly due to their high revenue raising capacities from mining, but move to being recipient states under the modified EPC system due to their above-average indigenous populations. Chart 4.1 shows that the greatest positive impact on per capita distributions is for Western Australia, and amounts to an estimated \$1,501 per capita, in 2009/10 terms<sup>18</sup>, while the gain for Queensland is \$243 per capita. The other states all experience a budget loss.

*Chart 4.1 Impact on per capita HFE transfers of modified EPC compared to current HFE system, \$ per capita*



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

Three of the states that experience budget losses do so because they would move from being recipient states to donor states. Those states are South Australia, with an estimated loss in HFE grants of \$694 per capita, the ACT and New South Wales. These three states are all in the opposite situation to Western Australia and Queensland. That is, they are recipient states in the baseline mainly due to their low revenue raising capacities from mining, but move to being donor states under the modified EPC system due to their low indigenous populations.

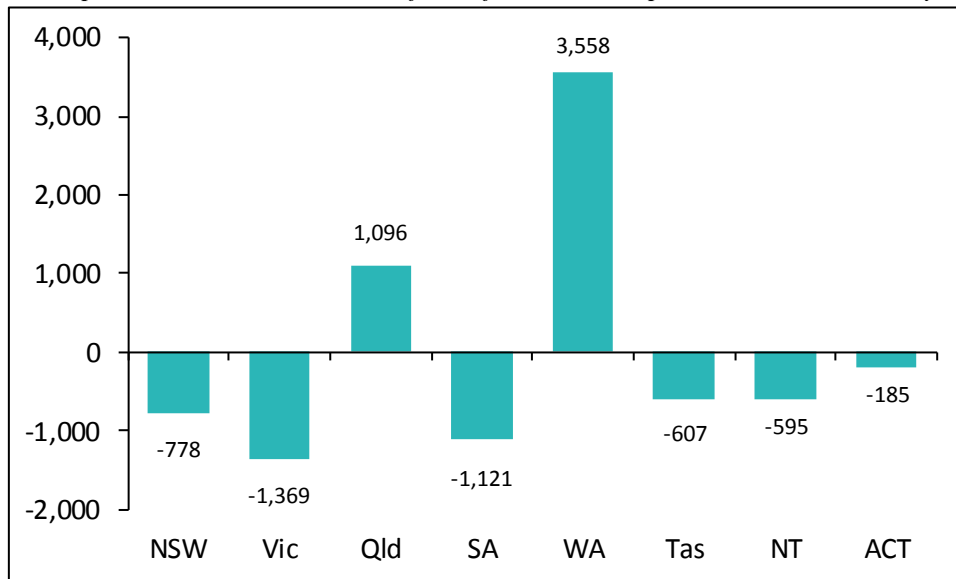
Victoria also experiences a budget loss from a move to a modified EPC system. Victoria is a donor state under a modified EPC system because of its low indigenous population. Under the existing HFE system, it is less of a donor state mainly because the fiscal disadvantage from its low revenue raising capacity from mining is taken into account.

<sup>18</sup> As explained in Section 3.5, in the baseline scenario, the size of the economy is at 2009/10 levels, except that higher mining prices have been simulated into the scenario, consistent with long-run expectations.

Chart 4.1 shows that the Northern Territory and Tasmania experience the largest budget losses in per capita terms. While they continue to be recipient states, they receive less under a modified EPC system than under the existing HFE system. This is mainly because the existing system allows for the Northern Territory’s fiscal disadvantage from high population dispersion (remoteness adds to the cost of providing government services) and Tasmania’s expenditure needs from socio-demographic factors.

The impact on overall HFE payments, in millions of dollars per year, is shown in Chart 4.2. It follows a similar pattern to the per capita HFE payments shown in Chart 4.1 above and can be understood in the same terms.

*Chart 4.2 Impact on HFE distributions of modified EPC compared to current HFE system, \$m*



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

**Note:** An analysis of the differences between the transfers recommended by the CGC in its 2011 Update report and the budget impacts shown in Chart 4.2 was presented in Section 3.5.

An alternative way of considering the results in Chart 4.2 is that they represent the impact on HFE distributions of removing equalisation for all factors other than indigeneity (after allowing for the strong outlook for real mining prices). In particular, they mainly reflect the effects of removing the two largest equalisation payments, those for differences in revenue-raising capacity from mining and for socio-demographic factors.

Western Australia and Queensland, as the key mining states, receive a large budget gain. This reflects the removal of the equalisation payments that recognise their high capacity for revenue raising from the mining industry. These budget gains are only partly offset by budget losses when they lose the equalisation payments that recognise their socio-demographic fiscal disadvantage.

The budget losses for New South Wales and Victoria are part of the flip side of the budget gains in Western Australia and Queensland. New South Wales and Victoria lose the equalisation payments that recognise their low capacity for revenue raising from the mining industry. These budget losses are only partly offset by budget gains from no longer making the equalisation payments that recognise their socio-demographic fiscal advantage.

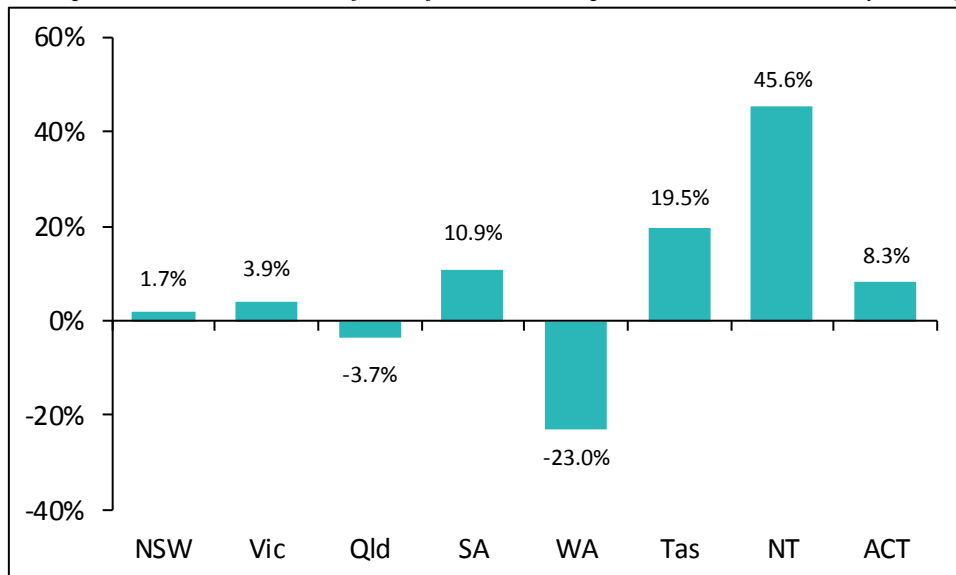
South Australia and Tasmania make budget losses from the withdrawal of both of the major equalisation payments. These two states have low capacity for revenue raising from the mining industry and a socio-demographic fiscal disadvantage, and so make budget losses when equalisation payments for these fiscal disadvantages are withdrawn.

Turning to the territories, the Northern Territory makes a budget loss when it loses the equalisation payments that recognise its socio-demographic fiscal disadvantage. The ACT makes a budget loss when it loses the equalisation payments that recognise its near-zero revenue raising capacity from the mining industry.

When its revenue from HFE transfers changes, a state government would need to adjust either its expenditure levels or its tax rates to maintain budget balance. In the IE-HFE model, the state budget is set in an optimal way. This means that a reduction in HFE transfers is addressed partly by government spending cuts, but mainly by tax increases that result in lower consumer spending. In this way, there is an optimal proportionate reduction in both consumer and government spending, which recognises that the base level of consumer spending is higher than the base level of government spending. Because the main fiscal adjustment to changes in HFE transfers is through tax rates, the following discussion focusses more on changes in tax rates than changes in government services.

Chart 4.3 shows the per cent change in the tax rates in the bundled ‘other’ tax that is used in each state to maintain budget balance. These estimated changes in tax rates take into account that, as just discussed, the optimal level of government service provision would also have changed as a result of the different HFE transfers.

*Chart 4.3 Impact on state tax rates of modified EPC compared to current HFE system , per cent*



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

Note: these changes are not percentage point changes, but per cent changes. For example, a 45.6% impact in the Northern Territory indicates that, if the initial tax rate is 10%, then the tax rate in the modified EPC scenario would be 14.56% (10%\*1.456).

Under the current HFE system in Australia, taxes are levied at broadly comparable rates across each of the states. However, Chart 4.3 shows that this would not be possible without HFE. For example, without equalising transfers, the Northern Territory raises its tax rates on tax bases other than mining



and land by almost half, 45.6 per cent. Similarly, the remaining states that experience a budget loss respond by raising their other tax rates to fund government service provision. On the other hand, Western Australia is able to lower its tax rates by 23.0 per cent, and Queensland is able to lower its tax rates by 3.7 per cent.

The uneven landscape for tax rates (and government services) caused by the move away from HFE induces households to migrate away from the now high-taxing states, particularly Northern Territory, and toward the now low-taxing states, particularly Western Australia. The implications of this fiscally-induced migration for household welfare and the economy are discussed in the following section.

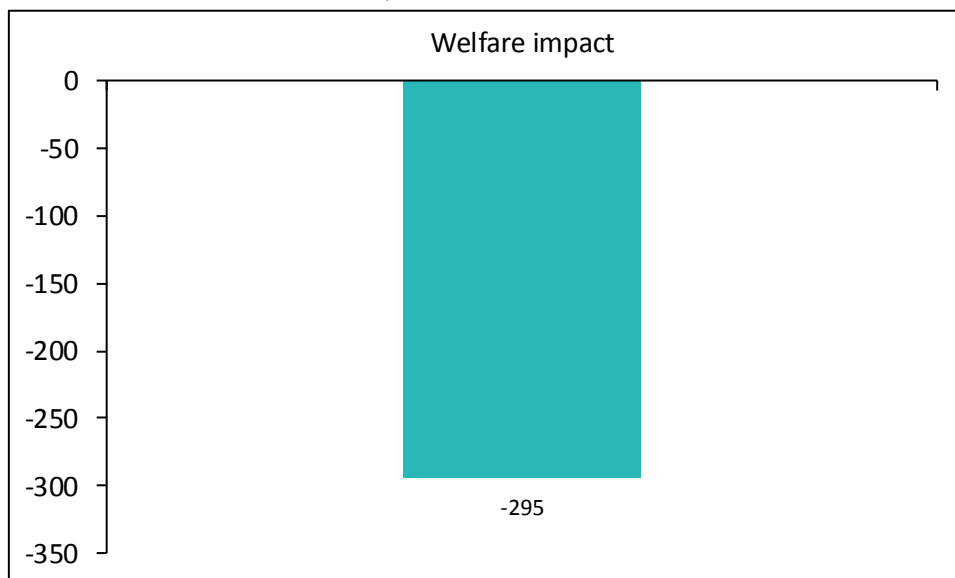
#### The impacts of modified EPC on welfare

The most appropriate way of assessing the effect of any government policy is its impact on household living standards. This can be measured by its impact on welfare. In IE-HFE, welfare takes into account changes in:

- consumption of privately produced goods and services;
- consumption of government provided goods and services; and
- non-market amenity related to population congestion.

Chart 4.4 shows that if the current HFE system were changed to a system that distributed GST revenue on an equal per capita basis, except that equalisation was maintained for indigenous needs, then national welfare would be permanently lower by \$295 million per annum in 2009/10 terms.

*Chart 4.4 Welfare impact of modified EPC system compared to current HFE system, \$m 2009/10 terms*



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

This result reflects the efficiency losses from removing equalisation for differences in revenue raising capacity (especially from the mining industry) and non-indigenous expenditure needs. With regard to equalisation for cost differences, Boadway (2003), Pincus (2011) and others point out that efficiency

would be maximised with less than full equalisation in that area. However, this does not change the result that moving to a modified EPC system would involve a net loss in efficiency. This is because any efficiency gain from moving away from full equalisation for cost differences is easily dominated by the efficiency losses from removing the other equalisation transfers, which are considerably larger.

Under a modified EPC system, the divergent fiscal capacities in each state are no longer fully equalised. Therefore, the state location decisions made by households would be unduly influenced by the fiscal disadvantages in each state associated with differences in revenue-raising capacity and non-indigenous expenditure needs arising from the location of state borders.

When a state incurs a budget loss because of a switch from the existing full HFE system to the modified EPC system, this is because it has fiscal disadvantages that are no longer equalised for.

- The state may have a lower revenue raising capacity than other states, so to provide any given level of government services, it would need to have higher tax rates. This was discussed in section 2.2.
- The state government may need to spend more to provide the same level of services to its population because of demographic or governmental features of the state (other than indigeneity). For example, an above average proportion of its population may be in high-need categories, such as elderly people. This was discussed in section 2.3.
- The state government may face higher costs to provide services, because it faces higher wages for public employees, or it has a large proportion of its population in remote areas. This was discussed in section 2.3.

These budget losses lead to higher taxes and lower government services in the affected states. Conversely, the budget gains in Western Australia and Queensland lead to lower taxes and higher government services in those states. For example, because Western Australia and Queensland no longer need to make equalising transfers to other states, they can use their advantage in raising royalties from the mining sector to lower tax rates.

Superficially, it may seem from this that, under the modified EPC system, the residents of the fiscally advantaged states, Western Australia and Queensland, would be better off, while the residents of the other states would be worse off. However, this ignores the crucial point that households are free to migrate between states.

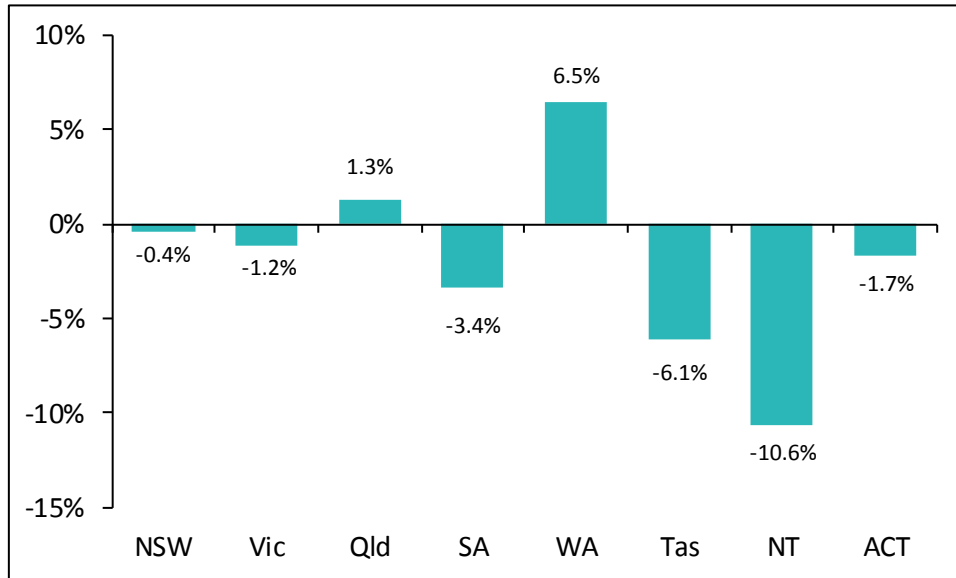
Following any move away from full equalisation, households can be expected to move from the fiscally disadvantaged states to the fiscally advantaged states of Western Australia and Queensland. This would be expected to continue until those population movements lead to a situation in which living standards are the same in all states. At that point the initial benefit to living in the fiscally advantaged states from lower taxes and higher government services will be fully offset by the costs from higher population in the form of lower wages and reduced non-market amenity.

This fiscally-induced migration is the driving force behind the loss in welfare shown in Chart 4.4. Removal of most forms of equalisation leads to a sub-optimal state distribution of the national population.

Further, because households are free to move between states until welfare levels are the same in all states, this loss in welfare will be shared across all states. So if the objective of a policy to move away from HFE were to raise living standards in donor states, it can be expected to fail.

The impact on state populations from the fiscally-induced migration is shown in Chart 4.5 below.

*Chart 4.5 Population impact of modified EPC system compared to current HFE system, per cent*



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

In the long run, the Northern Territory population would be an estimated 10.6 per cent lower if the modified EPC system is implemented than if the current HFE system were in place. Likewise, the population of Western Australia would be expected to be 6.5 per cent higher if the modified EPC system is implemented. Importantly, this inter-state migration only comes about because of the unevenness in state tax rates and government service levels caused by removal of equalisation for most fiscal disadvantages, and not because of any change in economic fundamentals.

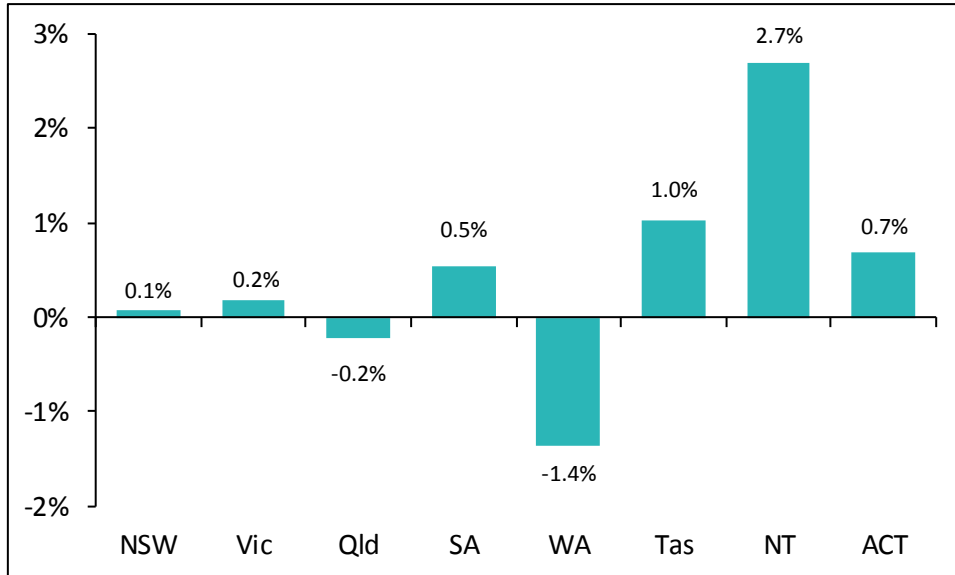
As explained in section 3.5, the baseline scenario already represents a version of the 2009/10 economy that would be sustainable in the long-term. For example, it models a long-term sustainable equilibrium, where the labour required by the mining industry in each state has already located where it is needed. The only difference between the baseline scenario and the modified EPC scenario is that the current HFE policy in the baseline has been replaced by the modified EPC policy.

As noted above, the fiscally-induced migration toward Western Australia and Queensland would lower the living standards of households in these states, even though they would experience a budget gain from the policy change. With more labour in the state, the productivity of labour becomes lower, and puts downward pressure on wages. In addition, the amenity of living in these states is lower, because of the larger population. If this amenity effect were not allowed for in the modelling, population impacts would be greater and the reduction in wages in Western Australia and Queensland would be correspondingly greater.

The impact that the migration has on before tax wages is shown in Chart 4.6 below. For example, if the modified EPC system were implemented, then wages in Western Australia are be estimated to be permanently 1.4 per cent lower than otherwise. On the other hand, the states which have a smaller

population under the modified EPC system have higher wages because there are less labour resources available in these states.

Chart 4.6 Wages impact of modified EPC system compared to current HFE system, per cent



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

Overall, per capita welfare is estimated to be lower in *all states* if the current HFE system were changed to a system that distributed GST revenue on an equal per capita basis, apart from equalising for indigeneity<sup>19</sup>. That is, all states contribute to the negative national welfare impact presented in Chart 4.4.

- In Western Australia and Queensland, welfare is lower because of lower wages and lower amenity due to the larger population.
- In the other states welfare is lower because of higher tax rates and lower government services.

#### Comparison with other Australian studies

The only other Australian modelling of HFE is by Dixon et al. (2002), in which they model repealing the current HFE system and distributing the GST on a purely equal per capita (EPC) basis. This modelling has been a useful reference point for our modelling. However, we have also been able to make a number of improvements on their method. The most noteworthy of these improvements is that we correct an inconsistency in Dixon et al. in how they measure consumer welfare.

In modelling interstate migration decisions, Dixon et al. include an amenity effect under which consumer welfare is reduced by an increase in a state's population. However, when calculating the change in consumer welfare resulting from that interstate migration, they include no such amenity effect. This leads them to report a welfare gain from abolishing HFE, contrary to the literature.

<sup>19</sup> In fact, the per capita welfare would be lower by the same amount in all states. As discussed in section 3.2, households would distribute themselves between states until there is no gain from moving to any other state. In other words, the average per capita standard of living would be the same in all states in both the baseline scenario and the modified EPC scenarios. Therefore, the change in welfare between the scenarios must also be the same in all states.

If instead they had avoided this miscalculation by correctly and consistently applying the same measure of consumer welfare throughout, replication of their modelling shows that they would have found a welfare loss from moving away from HFE of a similar magnitude to that estimated in this report, not a welfare gain. Under this approximate replication of their modelling with the welfare calculation corrected, a welfare loss of \$259 million per annum (in 2009/10 terms) is found when the current HFE system is repealed and GST revenues are distributed on a purely EPC basis.

Interestingly, this is similar to the estimate under our own assumptions of a welfare loss of \$295 million from moving away from HFE. However, this apparent similarity in results does disguise some important differences in the source of the welfare loss.

The welfare loss in the corrected, replicated Dixon et al. modelling would largely arise from removing equalisation for indigeneity. At the time of their modelling (2000/01), mining prices were relatively low, so equalisation payments for different revenue raising capacities from mining were relatively small.

The welfare loss in the IE-HFE modelling arises mainly from removing equalisation for revenue-raising capacities from mining, which are now very significant because of high mining prices. The IE-HFE modelling does not remove equalisation payments for indigeneity, and so those payments make no contribution to the estimated welfare loss from moving away from the HFE system.

Our broad replication of the Dixon et al. modelling, along with a more detailed comparison between the Dixon et al. (2002) study and our work, are presented in Appendix B.

#### Mining prices sensitivity analysis

As noted in section 3.5, the modelling for the scenario presented above uses the most recent expectations for mining prices from BREE, by assuming that real mining prices are 26 per cent above their 2009/10 level. However, mining prices are inherently uncertain. Therefore, to test whether the modelling results are different in the presence of lower mining prices, a sensitivity analysis has been conducted.

For the sensitivity analysis, mining prices half way between the low 2009/10 levels and the higher 2011/12 BREE forecasts have been simulated into all scenarios. This reflects a more pessimistic view of mining prices, at only 13 per cent above 2009/10 levels. Under lower minerals prices, removing the current HFE system and instead distributing GST revenues on a modified EPC basis would permanently lower annual living standards by an estimated \$191 million. This compares to the welfare loss presented in Chart 4.4 of \$295 million if mining prices are at the levels expected by BREE.

Although the welfare loss from abolishing HFE is smaller, the loss is still significant even when mining prices are lower. With lower mining prices, the differences in state revenue raising capacities are smaller. Thus, the incentive for fiscally-induced migration is still present, but the contribution of differences in royalties to that incentive is dulled. Of course, if mining prices are higher than the level expected by BREE, and more in line with the consensus forecasts (which expect real prices to remain more than 30 per cent above their 2009/10 levels over the medium term) then the welfare loss from abolishing HFE would be even larger than the estimate of \$295 million presented above.

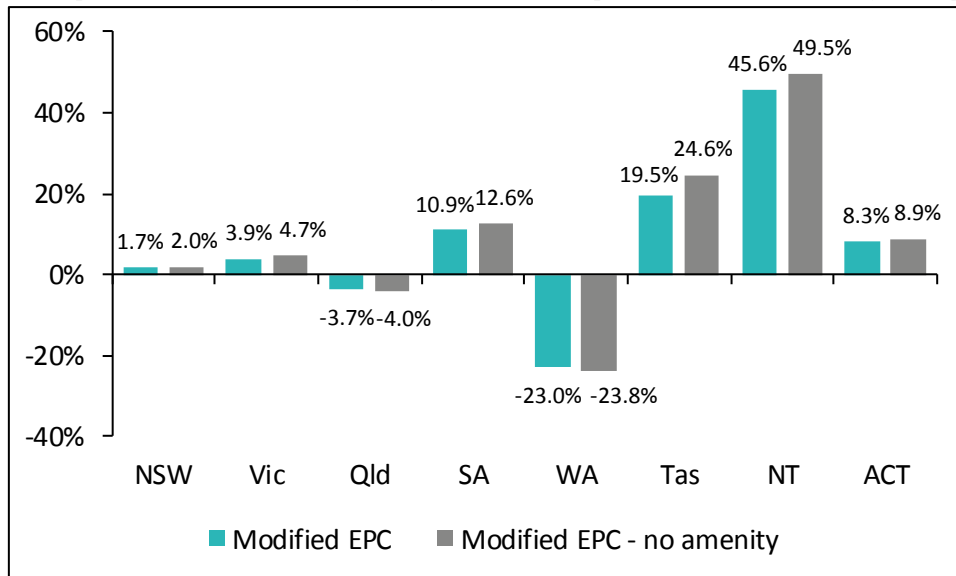
**Role of the amenity effect in the results**

As discussed in Section 3.2, the IE-HFE model takes into account that if the population in a state is larger, then the amenity from living in that state is lower. Larger populations may cause higher pollution and longer commute times. The effect of population on amenity is modelled so that if the population is 1 per cent higher, then the household utility from living in the state will be 0.25 per cent lower. This level of sensitivity has been informed by the urban economics literature, as explained in Appendix A.

This section aims to provide further economic insights into the modelling by showing the significant role of the amenity effect in the results. It does this by removing the amenity effect from the IE-HFE model, and re-running the scenarios. Comparing the effects of moving to a Modified EPC system under the two versions of the model – the standard version with an amenity effect and the “no amenity effect” version – shows the influence of the amenity effect on our results.

Chart 4.7 compares the impact on tax rates from moving to a modified EPC system under the two versions of the model. The results labelled **Modified EPC** are the same as the results presented in Chart 4.3 above (from the standard model), and the results labelled **Modified EPC – no amenity** are the same policy scenario, but where the effect on amenity from changes in population has been omitted from the model.

*Chart 4.7 Impact on state tax rates of modified EPC compared to current HFE system, per cent*



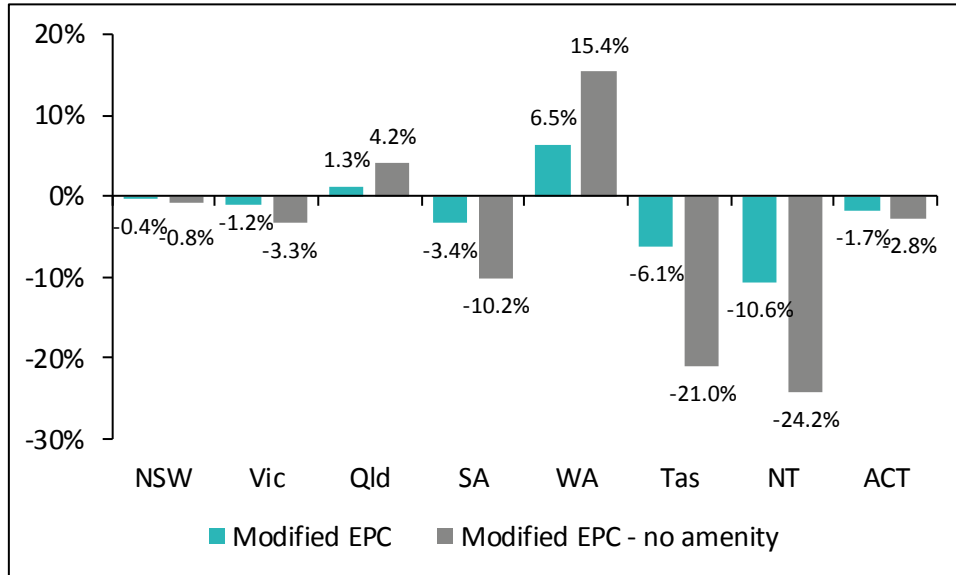
Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

Chart 4.7 shows that the impact on state tax rates from replacing HFE with a modified EPC system is similar whether or not the amenity effect is included in the model. This is because the tax rate changes reflect the need to re-balance state budgets following the removal of most equalisation payments. This is largely driven by the structure of the state budget, rather than the presence of an amenity effect on household utility.

However, when the effect of amenity is omitted from the modelling, the impact that these tax changes have on population movements is much larger. As shown in Chart 4.8, if the impact that population has on amenity is not included in the model, then moving to a modified EPC system would trigger migration to Western Australia until the population is 15.4 per cent higher than would be the case

under the current HFE system. This compares to an estimated impact of 6.5 per cent from the same policy, when the impact of population on amenity is included in the model.

Chart 4.8 Population impact of modified EPC system compared to current HFE system, per cent



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

When Western Australia and Queensland reduce their tax rates in response to the budget gain from the changes to HFE, households have a fiscal incentive to move to these states. In the standard modelling presented above, as the state populations increase there are two effects that work to reduce the incentive to move to these states.

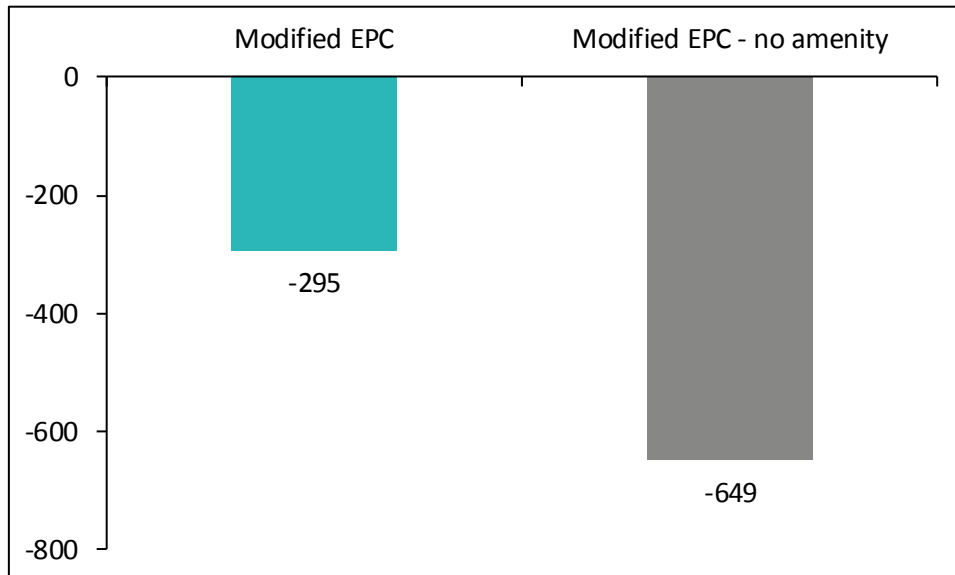
- Firstly, as households move into a state, the labour supply in that state grows. In response, the wages are lower in that state, and the level of household consumption achievable becomes smaller.
- Secondly, as the population in a state rises, households living in the state have lower amenity because of factors such as higher pollution and longer commute times.

In the standard modelling, these two effects reduce the incentive to move to Western Australia and Queensland as the population grows, which limits the overall population impact to 6.5 per cent and 1.3 per cent respectively. In the same way, as the populations of the other states become smaller, wages in these states are higher, and there is more amenity from living in these states. These two effects reduce the incentive to move away from the other states, limiting the negative population impacts.

When the amenity effect is excluded from the model, the only factor limiting the incentive to move is the impact that population movements have on wages. This makes the population more mobile between states. It leads to population movements that are generally more than twice as large from the same policy change, as shown in Chart 4.8. Hence, with no amenity effect in the modelling, removal of equalisation payments (other than for indigeneity) leads to more than twice as much economically-inefficient, fiscally-induced migration. The distortion to the distribution of the population across states away from the optimal distribution is more than twice as large.

This greater distortion to the state distribution of the national population is reflected in the welfare loss. Specifically, the estimated welfare loss when there is no amenity effect in the modelling is \$649 million in 2009/10 terms. This is more than double the estimated loss when the amenity effect is included.

Chart 4.9 Welfare impact of modified EPC system compared to current HFE system, \$m 2009/10 terms



Source: Independent Economics Horizontal Fiscal Equalisation Model (IE-HFE)

In summary, in the modified EPC scenario, there are state fiscal advantages and disadvantages that are not neutralised by equalisation payments. This distorts the choices that households make about the state in which they live. Removing the amenity effect removes a dampening influence on population movements, making the population more mobile. This leads to a greater misdistribution of the population across states in response to distortions from unequalised fiscal advantages and disadvantages.

Therefore, including the amenity effect in the modelling leads to a smaller and more conservative estimate of the welfare loss from moving to a modified EPC system. The amenity effect included in the IE-HFE model is consistent with the urban economics literature, and also gives more realistic estimates of the impact of changes to HFE on state populations.



## 5. Summary and policy implications

In general, migration leads to the highest possible level of welfare when it is responding to underlying economic differences between states, such as a mining boom or differences in amenity levels. For example, if a state is experiencing a mining boom, then it would be beneficial for households to move there to earn a higher wage.

On the other hand, this report has shown that migration reduces welfare if it is simply responding to differences in the fiscal benefits in each state. For example, simply because there is a mining resource within its borders, a state can tax this resource and provide any given level of government services at lower tax rates. This would artificially attract migrants to a state with a large mining sector (per capita). This type of inward migration reduces welfare because greater labour supply in a state puts downward pressure on wages. A larger population also reduces amenity because of developments such as higher rates of pollution and longer commute times.

Other than the capacity to raise mining royalties, there are three main areas in which states can have divergent fiscal capacities.

- A state would have a lower revenue raising capacity per capita if it has a smaller tax base. For example, a state may have low property values. In general, individuals living in a state with a lower revenue raising capacity, whether due to a small mining sector, low property values or other reasons, would need to pay higher tax rates to achieve a given target for government revenue.
- A state would have higher inherent expenditure needs per capita if it has a greater proportion of its population in high-need demographic categories, such as elderly or indigenous people. In general, individuals living in the state would need to shoulder these higher expenditures by paying higher taxes.
- A state would have higher government service costs per capita if it is more expensive to provide a given standard of government services, for example, because of higher public service wages or a higher proportion of the population living in remote areas. In general, individuals living in states with higher costs would face greater government expenditures, and therefore pay higher taxes.

These differences between states give households the incentive to move away from states that have a lower fiscal capacity to avoid paying the higher tax rates for any given level of services. To address this problem, the current HFE system in Australia aims to equalise fiscal capacities across all states. To do this, HFE transfers aim to give states the ability to provide the average per capita level of services if they levy the national average tax rates. In the presence of such transfers, migration decisions would not be based on fiscal incentives created by state borders, but instead would be based on underlying economic differences between states, and national welfare would be at the highest possible level.

This report has shown that if the current HFE system were to be abolished, except for the maintenance of equalisation for indigenous spending needs, then households in all states would be worse off.

This modified EPC system would mean that the mining states – Queensland and Western Australia – would move from being donor states under the current HFE arrangements to being recipient states. They are donor states under the current system primarily because of their strong revenue raising capacity from mining royalties. Removing equalisation for mining royalties as part of the move to a modified EPC system would lead to a budget gain for these states. At the same time, Queensland and Western Australia also have an above average indigenous proportion of their population. Therefore, maintaining equalisation for expenditure needs related to indigeneity means that these states would be recipient states under the modified EPC system.

All other states experience a budget loss from removing the current HFE system and equalising only for indigenous needs. However, the Northern Territory experiences the largest per capita loss because they no longer receive transfers to equalise for the fiscal disadvantages that the Northern Territory faces (other than those related to its high proportion of indigenous people). For example, due to the remoteness of the population, the cost of providing government services is high in the Northern Territory, and they would no longer receive equalising payments for this under the modified EPC system.

Such a change to the HFE system would lead to a lower standard of living, and national household welfare would be permanently lower by an estimated \$295 million per annum than if the current HFE system were in place. This is because removing most of the equalisation from the HFE system causes states to have different fiscal capacities, and populations migrate in response.

- The Northern Territory and the non-mining states would now have a fiscal disadvantage, and need to levy higher tax rates to provide any given level of services. This reduces the welfare of households living in these states, and some households choose to move away.
- Queensland and Western Australia would now have a fiscal advantage, and can provide any given level of services at lower tax rates. This gives households an incentive to move towards these states. However, the inward migration lowers the welfare of people living there. Greater labour availability puts downward pressure on wages and increased population size lowers the amenity of people in the state.

Therefore, per capita living standards are estimated to be lower in *all states* if the current HFE system is replaced by a system that removes all equalisation except for expenditure needs related to indigeneity.

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## A. Modelling Appendix

This section provides additional detail to support Section 3 of the report, which describes the model used, the Independent Economics Horizontal Fiscal Equalisation (IE-HFE) model. For a full understanding of the model, this appendix should be read alongside Section 3 of the report.

### A.1 Households

#### A.1.1 Household utility function

The utility function used in IE-HFE is for a representative individual in a given state who consumes two goods – a private consumption good and state government services. For functional form, a constant elasticity of substitution (CES) utility function is used, augmented by an effect of state population on utility.

$$(1) \quad U_s = \left[ \frac{N_s}{\widehat{N}_s} \right]^{-\delta} \cdot [(\beta_1 x_{s1})^\rho + (\beta_2 x_{s2})^\rho]^{\frac{1}{\rho}}$$

Where:

$U_s$  is the utility of a representative individual in state  $s$

$N_s$  is the population of state  $s$

$\widehat{N}_s$  is the notional carrying capacity of state  $s$

$-\delta$  is a parameter governing how utility levels are directly affected as population levels change relative to the notional carrying capacity; this is based on the literature that finds that higher population in a region reduces its amenity for households

$x_{si}$  is consumption of good  $i$  in state  $s$  by a representative individual of that state:  $x_{s1}$  is consumption of the private good and  $x_{s2}$  is consumption of state government services

$\beta_i$  is a parameter governing preferences for each of the goods; this is calibrated to fit the data for 2009/10, and is the same across all states

$\rho$  is related to the elasticity of substitution ( $\sigma_1$ ) between the two consumption goods. The relationship is  $\sigma_1 = \frac{1}{1-\rho}$

As can be seen from (1), the utility function is made up of two parts:

- The second bracketed term describes the utility gained by the representative individual from consumption of the two goods –private consumption and state government services. It is a standard CES utility function. Individuals substitute between the two goods as their relative prices change.
- The first term is an addition to the standard CES utility function that is taken from the urban economics literature and represents how the population level affects the utility of each person in the state. This is discussed in section A.1.2 below.

State governments choose the level of state government services, and levy taxes at the level needed to fund this expenditure. After paying these state taxes out of their incomes (as well as Commonwealth taxes), individuals choose the level of consumption of the private good that satisfies their budget constraint. Their incomes consist of:

- *after-tax* income from working, which depends on the wage, employment and tax rates in the state;
- a share of national *after tax* incomes from resources – it is assumed that each person owns the same share of national resources, and so this income is independent of state of residence;
- a share of national *after tax* incomes from land – it is assumed that each person owns the same share of national land, and so this income is independent of state of residence.

The aggregate private budget constraint for state  $s$  is as follows:

$$(2) \quad w_{s1}(1 - t_{s1} - t_c)q_{s1} + \frac{N_s}{\sum N_s} \sum_s w_{s2}(1 - t_{s2})q_{s2} + \frac{N_s}{\sum N_s} \sum_s w_{s3}(1 - t_{s3})q_{s3} \\ = p_{s1}x_{s1}$$

Where:

$q_{si}$  is the use of input  $i$  into production in state  $s$ :  $q_{s1}$  is the quantity of labour,  $q_{s2}$  is the quantity of land and  $q_{s3}$  is the quantity of mineral resources.

$w_{si}$  is the return to each of the factors of production. For labour, this is the wage, and for land and resources, it is the rental price.

$t_{si}$  is the state government tax rate on input  $i$  in state  $s$ :  $t_{s1}$  is the tax on the labour,  $t_{s2}$  is the tax on land and  $t_{s3}$  is the tax on natural resources. These are discussed further in section A.3.

$t_c$  is the Commonwealth government tax rate on labour. This is discussed further in section A.4.

$p_{s1}$  is the price that individuals face for the private consumption good.

The price of the private good,  $p_{s1}$ , is discussed in section A.2 and the price of state government services is discussed in section A.3.

Households supply labour according to equation (3). It models labour supply in state  $s$  as a fixed proportion of that state's population.

$$(3) \quad q_{s1} = \theta \cdot N_s$$

Where:

$\theta$  is a parameter governing the proportion of the population that works. It is set at close to 0.5, the national proportion of the population that is employed in 2009/10.

To clear the state labour market, the above labour supply must match the labour demand given later by equation (16). In the IE-HFE model, this occurs through adjustment of the state wage,  $w_{s1}$ .

As discussed in Section 3.2, in the IE-HFE model households move towards states where they can achieve higher utility. Migration equilibrium will be achieved when the utility of the representative household is the same in all states. That is, over the long run, households distribute themselves between states in such a way that there would be no gain from moving to any other state. Labour mobility is discussed in the following section.

### A.1.2 Labour mobility and congestion in IE-HFE

The urban economics literature emphasises that individuals will move while there is an incentive to do so. That is, individuals will move if they can attain a higher utility in a new location. This *perfect migration* assumption implies that households move until utilities are equal across all regions.

Therefore, the utility function used in the IE-HFE model needs to capture two aspects. First, it needs to capture the main factors that affect utility from living in a state, including those factors that may be influenced by fiscal advantages and disadvantages and equalisation payments. Second, the model also needs to take into account that population movements to a higher-utility location have negative feedback effects on utility in that location, so that utilities eventually equalise across locations and population movements do not continue without limit.

Knapp and Graves (1989) discuss both of these aspects. They consider the case of a location that offers higher utility because of location-specific amenities, and hence attracts migration from areas offering lower utility.

“As workers exit a relatively undesirable area, wages increase until out-migration is no longer desirable.” Further, as firms and households “relocate to the desirable areas, residential and industrial rents rise. This provides the built-in negative feedback mechanism (along with endogenous disamenities such as congestion or pollution) that reduces the likelihood of predicting that all human activity ultimately concentrates at the single most desirable location” (Knapp and Graves 1989, p79).

In the context of this report, a state with fiscal advantages that are not equalised through transfers, can offer higher utility through some combination of lower taxes and higher government services. From Knapp and Graves, we expect this to result in migration towards that state. However, it also follows that the extent of this state’s population gain will reach a limit, once its population has risen sufficiently to raise rents, lower wages and reduce the amenity of the location by enough to balance the benefit of the fiscal advantage. All three negative feedbacks from population gain are present in the IE-HFE model.

Glaeser and Gottlieb (2008) in a similar vein postulate an indirect utility function in which utility is positively affected by labour income, negatively affected by consumer prices, and positively affected by amenity. To describe amenity, they include a term that causes utility to be lower when the population of the area is higher, and this report follows the same approach. Using data from the United States, Glaeser and Gottlieb estimate how three different disamenities of urban living are affected by a rise in population of one per cent.

- The average commute time increases by 0.12 per cent.
- Air pollution rises by 0.14 per cent.
- The murder rate rises by 0.22 per cent.

These estimates imply that increases in population reduce the amenity of living in a city, although by a small amount.

As noted above, the utility function used in IE-HFE follows Glaeser and Gottlieb by postulating that amenity is negatively affected by the size of a region’s population. This can be attributed to the congestion-related factors studied by Glaeser and Gottlieb such as longer commute times and more air

pollution. This amenity effect is modelled in the first term of the utility function used in the IE-HFE model:

$$(4) \quad \left[ \frac{N_s}{\bar{N}_s} \right]^{-\delta} .$$

This term directly reduces the utility of all individuals in the state when the state population is higher, relative to a notional carrying capacity. This amenity effect dampens population movements in response to economic shocks because as migrants move to a state, the population grows and the utility that can be attained there is directly reduced. As noted above, population movements in IE-HFE are also dampened by indirect losses of utility as population gains reduce real wages and raise rents.

The value of  $-\delta$  governs the direct sensitivity of utility to population. As discussed above, for location amenities that are more sensitive to population in the USA, such as commute terms, air pollution and murder rates, Glaeser and Gottlieb estimate elasticities of amenities with respect to population ranging from -0.12 to -0.22.

This report uses a value for  $-\delta$  of -0.25, which is around the upper bound of the estimates by Glaeser and Gottlieb. This acts to provide some additional dampening of population movements, meaning that the estimated welfare impacts of changes to HFE will be conservative. The effect of including the amenity effect in the utility function was discussed in Section 4 of the report.

#### A.1.3 Elasticity of substitution between private consumption and state government services

The elasticity of substitution between private consumption and state government services,  $\sigma_1$ , governs how readily individuals would be willing to substitute between government-provided services and privately produced goods when their relative prices change. As explained in Section 3.3.3, this parameter is important because it influences the extent to which equalisation is necessary for differences in the cost of government services between states. This substitution elasticity has been estimated by a number of econometricians.

Kwan (2006) estimated the substitution elasticity between government and private goods in nine East Asian countries. The countries which are most like Australia – China, Hong Kong, Japan, and Korea – have substitution elasticities of around 0.5. They range from 0.41 in Hong Kong to 0.65 in China.

Brown and Wells (2008) undertake an empirical analysis of the relationship between state government and private consumption expenditure in Australia. They find that these two types of consumption are in fact complements, with an intratemporal elasticity of substitution of 0.17.

In constructing a general equilibrium model for the Australian economy, Piggott and Whalley (1991) use an elasticity of substitution of 0.5 between government and private goods. They use this value because it is in the mid-point of a range of studies which estimate the elasticity.

The own price elasticity of demand is related to the elasticity of substitution between public and private goods. Sanz and Velazquez (2007) use data from OECD countries to estimate the long-run price elasticity of demand for government services. They find that demand is relatively inelastic at -0.766. They note that “relative prices have indeed been a factor pushing up government spending. Results reveal own-price inelasticity for most of the functions and aggregate government spending.” (Sanz and Velazquez, 2007, p922). If the budget share of government services is not too large, then



the elasticity of substitution will be close to the negative of the own-price elasticity of demand. That is, the result from Sanz and Velazquez (2007) implies that the elasticity of substitution between government and private goods is around 0.8.

After taking all of these studies into account, we follow Piggott and Whalley (1991) and adopt an elasticity of substitution between private and public goods at 0.5. This is also consistent with Kwan (2006). Brown and Wells (2008) obtain a lower estimate, while Sanz and Velazquez obtain a higher estimate.

#### A.1.4 Consumer Demand functions in IE-HFE

In IE-HFE, state governments know the preferences (i.e. utility function) of individuals over the private good and state government services, and allocate state income accordingly. They do this by choosing the optimising rate of state tax on income from the labour/capital composite. The higher this tax rate, the higher will be the level of state government services that can be funded, but the lower will be the after-tax private incomes from which the consumption of the private good is funded. The optimal tax rate delivers the utility-maximising combination of state government services and private good consumption, out of a given level of state income.

As a result of this behaviour by state governments, the utility function of the representative individual in each state is maximised. This leads to the following demand equations, reflecting the underlying preferences of individuals.

$$(5) \quad x_{si} = \frac{1}{\beta_i} \left[ \frac{p_{si}/\beta_i}{P_s} \right]^{-\sigma_1} \cdot \frac{M_s}{P_s}$$

Where:

$p_{si}$  is the price faced by consumers for good  $i$  in state  $s$

$P_s$  is the ideal consumption price index for the state which combines the prices of the two goods

$M_s$  is state income per capita

The ideal consumption price index  $P_s$  is as follows.

$$(6) \quad P_s = \left\{ \sum_i \left[ (p_{si}/\beta_i)^{(1-\sigma_1)} \right] \right\}^{\frac{1}{(1-\sigma_1)}}$$

The determination of the prices of each of the goods is discussed in section A.2.

#### A.1.5 Labour Mobility and Household Welfare

As noted earlier, in IE-HFE migration equilibrium will be achieved when the utility of a representative individual is the same in all states. That is, over the long run, households distribute themselves between states in such a way that there would be no gain from moving to any other state.

The economic implications of this are most easily seen by considering the indirect utility function. The direct utility function was given earlier by equation (1), which is re-parameterised below by substituting out for  $\rho$  in terms of  $\sigma_1$ .

$$(1) \quad U_s = \left[ \frac{N_s}{\bar{N}_s} \right]^{-\delta} \cdot \left[ (\beta_1 x_{s1})^{\frac{(\sigma_1-1)}{\sigma_1}} + (\beta_2 x_{s2})^{\frac{(\sigma_1-1)}{\sigma_1}} \right]^{\frac{\sigma_1}{(\sigma_1-1)}}$$

The indirect utility function is then obtained by first using the demand relationships given by equation (5) to substitute for the consumer quantities, and then simplifying to obtain the following.

$$(1a) \quad V_s = \left[ \frac{N_s}{\bar{N}_s} \right]^{-\delta} \cdot \frac{M_s}{P_s}$$

This shows that utility can be thought of as real state per capita income adjusted for amenity. More precisely, the utility of a representative individual in a state is proportional to real state income per capita, and also depends on the amenity of the state, which is assumed to be inversely related to its population. As noted above, individuals move between states until the utility of a representative individual is the same in all states.

$$(1b) \quad V_1 = \dots = V_s = \dots = V_8$$

To take an example, suppose that, initially, utility is higher in state  $s$  than in other states, perhaps because of a fiscal advantage that is not equalised. This leads individuals to migrate from other states to state  $s$ . This reduces the indirect utility in state  $s$  given by equation (1a) in two ways. First, it directly reduces utility through the population-based amenity effect. Second, the higher population in state  $s$  reduces the market clearing state wage, causing real state income per capita to fall. Conversely, the out-migration from other states causes indirect utility to rise there by the same logic. Migration continues until utility of a representative individual is equated across states.

Using the indirect utility function of equation (1a), it can be shown that the change in aggregate economic welfare from an economic change, as measured by the equivalent variation (EV) from welfare economics, is given by equation (1c).

$$(1c) \quad EV = \frac{\Delta V}{V} \cdot \sum_s M_s^0 N_s^0$$

That is, the change in economic welfare from an economic change is given by the proportionate change in utility applied to the initial level of total state incomes, where a zero superscript is used to denote the initial levels of the variables before the policy change. This measure of welfare change is used frequently in this report. For example, the result that a move from the existing HFE system to a modified EPC system would result in a loss in economic welfare of \$295 million was calculated using equation (1c).

## A.2 Producers

Modelling for the production of the private consumption good and of mining output are similar from a theoretical perspective. To produce each good, private firms combine the labour/capital bundle, which can move between states, with a resource that is in fixed supply – land in the case of the private consumption good, and natural resources in the case of mining. Therefore, the following discussion is generalised to apply to the production of both of these goods.

### A.2.1 Private production function

The private consumption good and mining output are assumed to be tradeable between states and internationally. This means that production of the good in each state does not need to be equal to consumption of the good in that state. In fact, in the case of mining output, household consumption is zero. Given these goods are traded, it is assumed that the prices that producers and consumers face for them are the same in all states.

The approach to modelling production by the private sector in IE-HFE has been discussed in Section 3.4. Generally, production in each state has been modelled as simply as possible, while still picking up the main elements that are important for equalisation. As noted in Section 3.4, there are two inputs into the production of each good in each state. The private consumption good is produced using the labour/capital bundle and land, while mining output is produced using the labour/capital bundle and natural resources. The Constant Elasticity of Substitution (CES) production function is as follows:

$$(7) \quad Q_s = [(\alpha_{s1} q_{s1}^p)^\gamma + (\alpha_{s2} q_{s2})^\gamma]^\frac{1}{\gamma}$$

where:

$Q_s$  is the quantity of production in each state

$q_{si}^p$  is use of inputs into production in state  $s$ :  $q_{s1}^p$  is the labour/capital bundle (where  $p$  denotes labour use by private firms),  $q_{s2}$  is the quantity of land in the case of the private consumption good, and is the quantity of mineral resources in the case of mining

$\alpha_{si}$  is a parameter governing the technology with which each of the inputs is used, this is calibrated to fit the data for 2009/10

$\gamma$  is related to the elasticity of substitution ( $\sigma_2$ ) between each of the two inputs and  $\sigma_2 = \frac{1}{1-\gamma}$

As discussed in Section 3.4, producers use a labour and capital bundle. This is a feature that the IE-HFE model has in common with the MONASH-CSF model. It means that the ‘wage’ in IE-HFE encompasses both the return to labour and the return to capital.

It also means that labour is assumed to be used in fixed proportions to capital. It can be seen that this is a reasonable simplifying assumption for this report by considering the marginal product of capital condition for profit maximisation. Under constant returns to scale, the marginal product of capital will depend only on the ratio of labour to capital. Since the marginal product of capital should equal its user cost, it follows that labour will be used in fixed proportions to capital provided the user cost of capital is fixed. This will be the case under the reasonable simplifying assumptions that Australia is a price taker on world capital markets, and that the taxation of capital is fixed.

### A.2.2 Price of inputs into production

In equilibrium, perfect competition and constant returns to scale yield the zero pure profit condition under which the price that consumers pay for an output depends only on the price of the inputs. However, as mentioned above, because the private consumption good and the mining good are both tradeable internationally, their output prices ( $p_{si}$ ) are assumed to be already determined on world markets. This means that the zero pure profit condition is best thought of as determining the price of an input, rather than the price of output. Specifically, the rental price of each fixed factor of production (land and mineral prices) depends on the price of output and the wage ( $w_{s1}$ ), as follows (obtained by inverting the zero pure profit condition):

$$(8) \quad w_{s2} = \alpha_{s2} \cdot \left\{ p_{si}^{(1-\sigma_2)} - (w_{s1}/\alpha_{s1})^{(1-\sigma_2)} \right\}^{\frac{1}{(1-\sigma_2)}}$$

Where:

$w_{si}$  is the price of each of factor of production  $i$  in state  $s$ : For labour ( $w_{s1}$ ) the price is the wage, and for the fixed factors of land and mineral resources ( $w_{s2}$ ) the price is the rental price.

The demand for variable factors (i.e. the labour/capital bundle) by the private good industry is given by the following (obtained from the marginal product condition for the labour/capital bundle combined with the production function):

$$(9) \quad q_{s1} = \frac{1}{\alpha_{s1}} \cdot (\alpha_{s2} q_{s2}) \left\{ \left[ \frac{w_{s1}/\alpha_{s1}}{p_1} \right]^{(\sigma_2-1)} - 1 \right\}^{\frac{\sigma_2}{(1-\sigma_2)}}$$

The demand for variable factors by the mining industry is given by an analogous equation.

The price of the factor in any state multiplied by the quantity gives the incomes earned by each of the factors of production. These are the before-tax incomes of individuals and the state tax bases in the model.

## A.3 State Governments

### A.3.1 State Government objectives

As noted earlier, in IE-HFE, state governments know the preferences (i.e. utility function) of individuals over the private good and state government services. They choose the optimal tax rate on income from the labour-capital composite that delivers the utility-maximising combination of state government services and private good consumption, out of a given level of state income.

If individuals in different states have different preferences, then the federal system allows these individuals to have a different level of government services in each state (with corresponding different taxation levels). As noted in Section 2.1, HFE is designed so that states can have different government service levels if this reflects the preferences of state residents.

The modelling in IE-HFE has been simplified so that individuals in all states have the same preferences. This means that differences in per capita government service levels between states would only be driven by differences in the costs of providing these services, and in the incomes of residents. It also means that the model does not show the benefits from HFE related to allowing

different service levels when preferences differ. Instead, it focuses on the benefits from HFE allowing states to have the *capacity* to provide the same level of services, if they chose to do so.

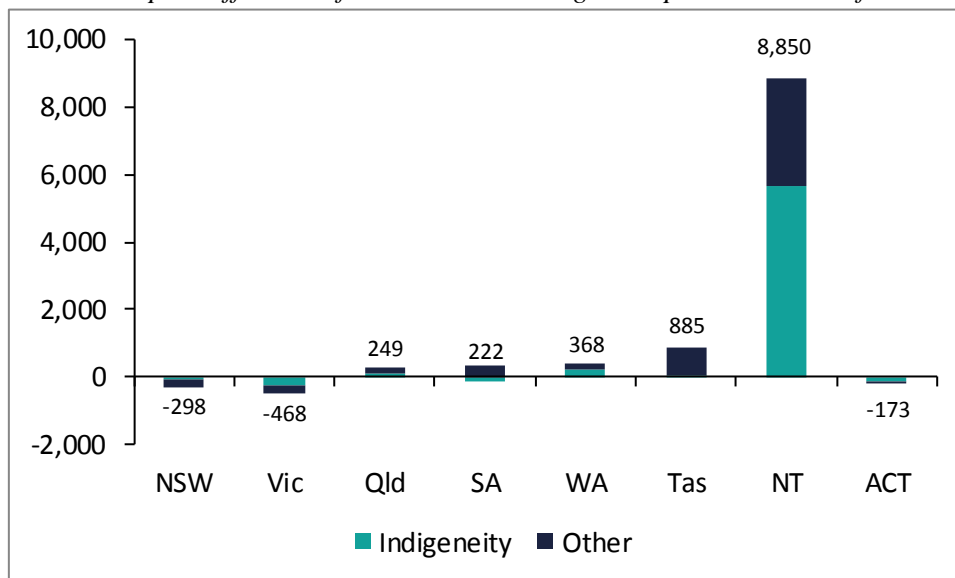
### A.3.2 State Government expenditure requirements

Appropriate modelling of state expenditures is important for correctly modelling the way that the current HFE system operates. The IE-HFE model is consistent with the 2009/10 CGC assessment<sup>20</sup> of government expenditures<sup>21</sup>.

The CGC assesses the expenditure that is needed in each state to provide the average service level per capita. As noted in Section 3.3, the drivers of differences between state government expenditure can be divided into two categories. These are: the *demographic and governmental* features of a state; and the *cost* of providing government services in a state.

Where *demographic and governmental* factors cause a state to have higher spending requirements to provide the average level of service, these requirements are modelled as a necessary additional expenditure in the state budget that delivers no additional utility.

Chart A.1 Per capita differences from national average in expenditure needs for 2009/10, \$



Source: Commonwealth Grants Commission, 2011, and IE calculations

Note: The data labels report the **total** per capita differences in expenditure needs, which is the sum of the needs related to indigeneity and other features of the population

The additional expenditure requirements per capita for 2009/10 are shown in Chart A.1. The chart shows that, to provide the average per capita level of service, the Northern Territory needs to spend \$8,850 dollars more per person because of the demographic make-up of its population and because of the governmental factors discussed in Section 2.3. On the other hand, it shows that the CGC estimates that New South Wales, Victoria and Australian Capital Territory need to spend less than the per capita average to provide the average level of services.

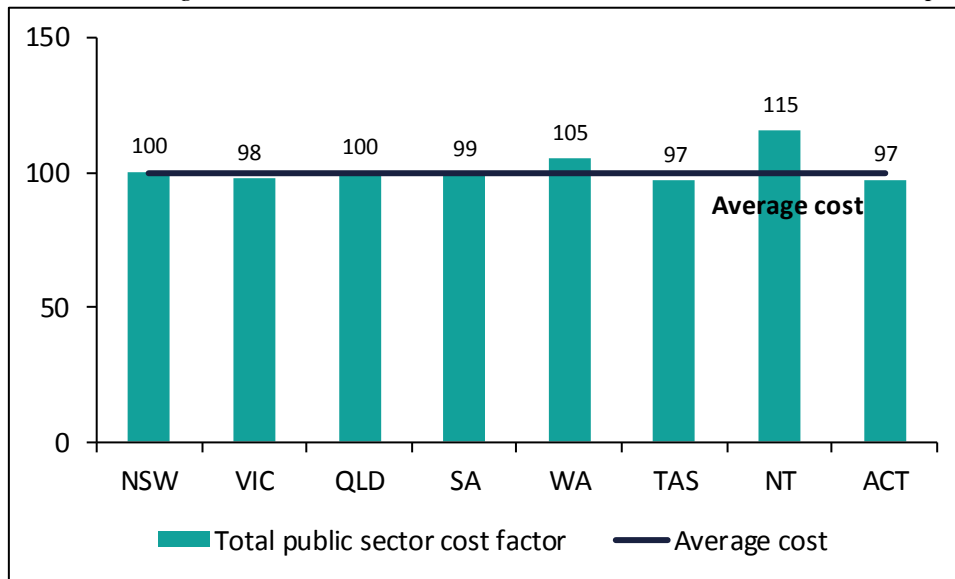
<sup>20</sup> The data used is related to the CGC 2011 Update report.

<sup>21</sup> In reality, the CGC takes a weighted average of assessments over three years to derive the recommendations for GST distributions. However, the IE-HFE model does not include this averaging because it is a long run model, where the economy is assumed to be in equilibrium.

Chart A.1 also shows the estimated contribution that indigeneity features of the population and other features of the population make to the overall differences in expenditure needs. Indigeneity is a significant contributor to the high expenditure needs of the Northern Territory.

The variation in state costs in the IE-HFE baseline is consistent with the CGC estimates of the cost of state government services. Chart A.2 shows the CGC assessment of the cost of government services in each state, relative to the national average (of 100). It shows that the Northern Territory and Western Australia both have above average costs in providing government services.

*Chart A.2 Relative government service costs, based on 2008/09 and 2009/10 data, per cent*



*Source: Commonwealth Grants Commission, 2011*

The costs shown in Chart A.2, and used in the IE-HFE model, are a combination of:

- cost factors that are related to population dispersion in a state – the most recent CGC assessment available for these costs is from the 2010 Review, Volume 2, for the year 2008/09; and
- cost factors that are related to the wage levels in each state – the CGC estimates for 2009/10 have been obtained from the CGC.

### A.3.3 State Government Service Production and Consumption

The technology for government production is modelled as follows:

$$(10) \quad G_s = \frac{1}{Ac_s} \cdot q_{s1}^G$$

$$(11) \quad p_{s2} G_s = p_{s2} \frac{1}{Ac_s} \cdot q_{s1}^G = w_{s1} q_{s1}^G$$

Where:

$G_s$  is the quantity of state government production in state  $s$

$q_{s1}^G$  is use of labour inputs in the production of state government services in state  $s$

$A$  is a parameter governing the technology with which labour inputs are used by state

governments

$c_s$  is an inefficiency factor in government production which is set equal to the public sector cost factor as estimated by the CGC – these were shown in Chart A2.

$p_{s2}$  is price of the state government service in state  $s$

$w_{s1}$  is price of labour, or the wage, in state  $s$ . This is determined in the state labour market.

The price of state government services,  $p_{s2}$ , is related to the cost factor that was discussed in the previous section, which depends on population dispersion and wages. In the baseline, prices are consistent with the CGC estimates for the cost of providing government services. Equation (11) above implies that:

$$(12) \quad p_{s2} = Ac_s w_{s1}$$

The implications of demographic and governmental influence for government service provision also need to be taken into account. The total consumption of state government services can be represented as follows:

$$(13) \quad N_s x_{s2} = G_s - N_s d_s$$

Where:

$d_s$  is the per capita impact of demographic and governmental factors on government spending requirements

Equation (13) introduces a fixed term that affects the level of government services,  $d_s$ . To provide a given level of government services per capita ( $x_{s2}$ ) the higher is  $d_s$ , the more  $G_s$  that the government needs to provide. Therefore, the  $d_s$  term acts in the same way as demographic or governmental factors that cause different expenditure requirements between states. In each state,  $d_s$  is modelled as a fixed proportion of total Australian state government expenditure, and so is outside of the control of the state government.

The  $d_s$  term can be either positive or negative. If it is positive, it implies that the state has a fiscal disadvantage in providing government services because of demographic and governmental factors. If it is negative, the state has an advantage in providing government services because of demographic and governmental factors. The model is calibrated so that the level of  $d_s$  in each state is consistent with the CGC assessments for 2009/10, which were shown in Chart A.1.

#### A.3.4 State Government revenues and budget constraint

State governments collect revenues from a number of sources:

- taxes on the income generated from natural resources within their state;
- taxes on the income generated from land within their state;
- taxes on the income generated from the labour and capital within their state;
- Specific Purpose Payments from the Commonwealth Government; and
- HFE distributions from the Commonwealth Government.

In the long run, governments must be able to cover the costs of the services they provide. Therefore, IE-HFE assumes that all governments have balanced budgets. To implement this, there must be a tax that adjusts to keep the budget in balance. For the scenarios in this report, the tax on income from labour and capital has been chosen for this. That is, if expenditure is higher or tax revenue is lower in the scenario, then the tax on labour and capital will automatically adjust to balance the budget.

The government budget constraint is as follows:

$$(15) \quad t_{s1}(w_{s1}q_{s1}) + t_{s2}(w_{s2}q_{s2}) + t_{s3}(w_{s3}q_{s3}) + SPP_s + H_s = p_{s2}G_s$$

Where:

$t_{si}$  is the state government tax rate in state  $s$ , on the incomes from the factor of production  $i$ :  $t_{s1}$  is the tax on the labour/capital bundle,  $t_{s2}$  is the tax on land and  $t_{s3}$  is the tax on natural resources

$SPP_s$  Specific Purpose Payment received from the Commonwealth in state  $s$

$H_s$  is the HFE payment to state  $s$ ; these are negative in some states and positive in others, summing to zero across the country

Note that  $q_{s1}$  is the total demand for labour in the state, by the private sector, the state government and the commonwealth government. That is:

$$(16) \quad q_{s1} = q_{s1}^p + q_{s1}^G + q_{s1}^C$$

#### A.3.5 Calculation of HFE distributions

The payments relating to HFE are a redistribution of funds between the states that sum to zero at the national level. That is, they are transfers from some states to other states. The amount distributed to each state per capita under the current HFE arrangements can be calculated in three parts:

- an amount equivalent to the fixed additional expenditure per capita due to demographic and governmental features;
- an amount equal to the average level of services per capita at state costs less the average level of services per capita at national average costs; and
- an amount equal to the revenue raised by applying the national average tax rate to the per capita tax base in the state less the national average tax rate applied to the national average per capita tax base.

This can be represented as follows.

$$(17) \quad h_s = d_s + (p_{s2} \cdot \bar{x}_2 - \overline{p_2 x_2}) + \sum_i [\bar{t}_i (w_{si} (q_{si} / N_s)) - \overline{t_i w_i (q_i / N)}]$$

$$(18) \quad H_s = h_s N_s$$



Where:

- $h_s$  is the per capita distribution to the state under HFE
- $d_s$  is the fixed distribution per capita for demographic and governmental factors, from equation (13)
- $\overline{p_2 x_2}$  is the national average per capita expenditure on government services
- $\bar{t}_i$  is the national average tax rate for tax base  $i$
- $\overline{t_i w_i (q_i / N)}$  is the average national per capita tax revenue from base  $i$

## A.4 Commonwealth Governments

### A.4.1 Commonwealth Government budget

Commonwealth Government expenditure comprises the provision of services and SPPs. The quantity of government services is fixed and the amount of SPP payments to each state is also fixed (at their 2009/10 level).

The production of Commonwealth Government services is modelled in a relatively simply way, as follows.

$$(19) \quad G_{sc} = \frac{1}{A^C} \cdot q_{s1}^C$$

$$(20) \quad p_{sc} G_{sc} = p_{sc} \frac{1}{A^C} \cdot q_{s1}^C = w_{s1} q_{s1}^C$$

Where:

- $G_{sc}$  is the quantity of Commonwealth Government production in state  $s$
- $A^C$  is a parameter governing the technology with which labour inputs are used by the Commonwealth Government
- $q_{s1}^C$  is use of labour inputs in the production of Commonwealth Government services in state  $s$
- $p_{sc}$  is price of the government services, in state  $s$
- $w_{s1}$  is price of labour, or the wage, in state  $s$

To fund this expenditure, the Commonwealth Government levies a tax on the labour and capital bundle, at the same tax rate in every state. This tax rate adjusts so that the Commonwealth balances its budget. However, this does not imply that the revenues collected from one state are the same as the Commonwealth expenditures in that state. The Commonwealth Government budget is specified as follows:

$$(21) \quad t_c \sum_s (w_{s1} q_{s1}) = \sum_s (w_{s1} q_{s1}^C) + \sum_s SPP_s$$

Where:

- $t_c$  is the Commonwealth Government tax rate levied on national labour/capital income
- $SPP_s$  Specific Purpose Payment paid to each state

## B. Comparison to previous studies

The only other estimate of the economic impact of HFE in Australia is from a study by Dixon et al. in 2002, based on data for 2000/01. The modelling by Dixon et al. has been a useful reference point for constructing our own model, IE-HFE, and we have incorporated a number of features from MONASH-CSF into the modelling for this report. However, we have also been able to make a number of improvements on their method.

On the surface, the Dixon et al. (2002) modelling appears to yield results that are the opposite to the results presented in this report. However, section B1 shows that, after correcting for a key inconsistency in the Dixon et al. (2002) work, their results are comparable with ours. In section B2, a number of other assumptions are discussed and the impact of revising these assumptions is estimated.

### B.1 Comparison of the Dixon et al. (2002) and IE-HFE results

Surprisingly, rather than finding a welfare loss from repealing the current HFE system, Dixon et al. (2002) estimate that there is a welfare *gain* from replacing the current system with a system that distributes GST revenues on an equal per capita (EPC) basis. They estimate that consumers would be better off by \$169 million annually, in 2000/01 terms, from such a policy change. This result relies on a number of assumptions, but the most important driver of their surprising result is the inconsistent way that Dixon et al. estimate welfare.

Both the Dixon et al. and IE modelling have used a population-related amenity term in the utility function to help describe individual incentives to move. Given that migration behaviour is modelled with this amenity effect on utility, it is inconsistent to then measure welfare without the amenity effect. However, this is the approach that Dixon et al. have taken. In their model, individuals make migration decisions using one set of preferences, but the welfare that they derive from these decisions is measured using a different set of preferences that removes the amenity effect. Because of this inconsistency, migration decisions are implicitly based on some criteria other than improving the welfare of migrants.

To confirm the impact that this inconsistency in measuring welfare has on the Dixon et al. results, we have used IE-HFE to model to replicate key aspects of their modelling. We have modelled the same scenario – replacing the current HFE with a system that distributes GST revenue on an EPC basis. We have simulated real mining prices to the 2000/01 levels of their baseline. Finally, we have also varied the key parameter values discussed in sections B.2.1-B.2.3 below so that they match those set out in the Dixon et al. paper. Replicating their miscalculation of welfare yields a welfare gain of \$113 million per annum, in 2009/10 terms, from the move away from the current HFE system<sup>22</sup>.

However, if Dixon et al. had correctly and consistently applied the same measure of consumer welfare throughout, our replication of their modelling shows that they would have found a welfare loss from moving away from HFE, not a welfare gain. In particular, if the welfare impact is calculated

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<sup>22</sup> Dixon et al. report an even larger welfare gain, but this can be explained by two other questionable aspects of their modelling that are not included in our replication. First, they assume, as discussed later in this section, that governments have a different set of preferences to households. Second, as discussed in section B.2.4, they have underestimated government expenditure needs related to the demographic and governmental features of each state. The sensitivity analysis conducted by Dixon et al. shows that these unrealistic assumptions work to inflate their estimates of the welfare gain from moving away from the HFE system.

correctly, the result becomes a welfare loss of \$259 million, in 2009/10 terms. That is, using similar assumptions to Dixon et al., but simply re-calculating the welfare impact so that it is correct, reverses their result to give a welfare loss from moving away from MFE. In fact, it yields a similar welfare loss from moving away from HFE to that estimated in this report of \$295 million.

Dixon et al. also used a third measure of utility in their model. In particular, besides using different utility functions for migration decisions and economic welfare, they use yet another utility function in modelling state government behaviour. However, this has less impact on their results.

Even after the welfare calculation is corrected, there are a number of differences between the Dixon et al. modelling and the modelling presented in this report. First, the policy considered is different – Dixon et al. (2002) model a pure EPC scenario, whereas we have modelled a policy that maintains equalisation for state expenditure needs associated with indigeneity. In addition, there are a number of important differences in modelling assumptions that are discussed in more detail in the following section.

## B.2 Comparison to the Dixon et al. (2002) assumptions

Besides the differences in policy scenarios and the calculation of welfare effects discussed above, there are other important differences in modelling assumptions between the Dixon et al. (2002) modelling and the IE-HFE modelling of this report. These differences are now discussed in more detail below. For more information on the IE-HFE modelling, see Section 3 and Appendix A.

### B.2.1 Understates labour mobility through overstated state amenity effect

In the IE-HFE model, the value of  $-\delta$  governs the direct sensitivity of utility to population. Dixon et al. include a similar term in their utility function for the purpose of modelling interstate migration (although, as discussed above, they are inconsistent in that they omit this amenity effect when using the utility function to measure the impact on economic welfare of that interstate migration). The value that Dixon et al. choose for their equivalent of  $-\delta$  is  $-1$ . The interpretation of this is that the elasticity of individual living standards with respect to population is  $-1$ . This is a much stronger effect on utility from population gain than estimated by Glaeser and Gottlieb (2008). As discussed above, for location amenities that are more sensitive to population in the USA, such as commute times, air pollution and murder rates, Glaeser and Gottlieb estimate elasticities of amenities with respect to population ranging from  $-0.12$  to  $-0.22$  i.e. nowhere near  $-1$ . As discussed earlier, the IE-HFE model uses the more plausible value of  $-0.25$ .

### B.2.2 Overstates labour substitutability with mineral resources

By adopting Cobb Douglas technology, Dixon et al. assume that the elasticity of substitution in production between mineral resources and the labour/capital bundle is 1. If this were true, factor income shares would stay the same when mining prices rise. In reality, the major rise in mining prices during the last decade has been accompanied by a large increase in the share of mining revenue received by owners of mineral resources. This indicates that the elasticity of substitution is well under unity. In IE-HFE, we use a more realistic value of 0.5.

### B.2.3 Excludes rationale for partially equalising cost differences

The preferences in the Dixon et al. (2002) modelling imply that both governments and consumers would like to spend a fixed share of state income on state government-provided goods<sup>23</sup>. They do this by using a Cobb-Douglas utility function that implies an elasticity of substitution of unity. The result is that, if the cost of providing government services is one per cent higher, then the MONASH-CSF model would imply that individuals and governments would like to consume one per cent less of these services, leaving their expenditure unchanged in money terms. This is an unrealistically high level of sensitivity to cost, particularly since many government services can be considered essential in some senses. As noted in section A.1.3, the literature on this subject points to a lower substitution elasticity of around 0.5, the value used in the IE-HFE model.

Under the higher Dixon et al. elasticity, even if wages are higher in one state, the preferred level of nominal discretionary spending is unchanged because the reduction in demand exactly offsets the higher wages. Therefore, in the MONASH-CSF model, there is no need for governments to raise additional tax revenues to cover the cost of higher wages, because the optimal total level of spending is unaffected. This means that there is no justification for equalisation payments related to wage differences, according to the Dixon et al. modelling approach. Therefore, the results of their modelling will indicate that the transfers made for costs under the current HFE system are welfare reducing. Under a more realistic elasticity assumption such as that used in the IE-HFE model, partial equalisation for cost differences would be optimal.

### B.2.4 Understates expenditure needs

The Dixon modelling does not fully take into account the extent of the different expenditure needs between states. Specifically, their model assumes that equalisation is justified only for state expenditure needs related to land and native title, national capital and Socio-demographic composition. This implies that equalisation payments made for needs related to other categories such as urbanisation, administrative scale, economic environment and physical environment<sup>24</sup> would be welfare reducing in the modelling by Dixon et al. (2002).

Dixon et al.'s decision to include only some of the state expenditure needs involves an implicit assumption that a large share of the actual HFE distributions related to expenditure needs are instead related to cost differences. This is inconsistent with the actual calculations from the CGC, which are mostly related to demographic features of the state. This misinterpretation further reduces the efficiency gain estimated by Dixon et al., because as discussed below, the set-up of the Dixon et al. modelling assumes that there should be no equalisation for cost differences.

### B.2.5 Pre-dates boom in mining prices

Mining royalty revenues are now much higher than they were at the time of the Dixon et al. (2002) study. According to the RBA, real mining prices (in AUD terms) were approximately 95% higher in 2010/11 than they were in 2000/01. This means that the mining prices used in IE-HFE are much higher than the mining prices that were current at the time of the Dixon et al. study.

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<sup>23</sup> This is because the functions are Cobb Douglas.

<sup>24</sup> These categories are identified by the CGC in their 2001 report, and do not correspond exactly to the categories in their most recent publication from 2011.

Under higher mining prices, the differences between state revenue raising capacities are greater, which means that the incentive for fiscally-induced migration would be greater. Therefore, with higher mining prices, there are larger benefits from equalisation for differences in mining revenue raising capacities. This is another major driver of the difference between the 2002 Dixon et al. modelling and the IE-HFE modelling.

#### B.2.6 Overall impact of assumptions

As discussed in section B.1, we have used the IE-HFE model to broadly replicate the Dixon et al. modelling. We found that if we correct their miscalculation of the welfare impact, the result is a welfare loss of \$259 million in 2009/10 terms from moving away from the existing HFE system. Interestingly, this is similar to the estimate under our own assumptions of a welfare loss of \$295 million from moving away from HFE. However, this apparent similarity in results does disguise some important differences in assumptions that were discussed above and have broadly offsetting effects on the welfare loss.

In the two sets of modelling, the major sources of welfare loss from moving away from the current HFE system are as follows.

- The welfare loss in the corrected, replicated Dixon et al. modelling would largely arise from removing equalisation for indigeneity. At the time of their modelling, mining prices were relatively low, so equalisation payments for different revenue raising capacities from mining were relatively small. However, the welfare loss from removing equalisation for indigeneity would be understated under the Dixon et al. assumptions, because of their understatement of labour mobility discussed in B.2.1 above.
- The IE-HFE modelling takes into account the boom in mining prices that has occurred since the time of the Dixon et al modelling. Its welfare loss arises mainly from removing equalisation for the major state differences that now exist in revenue-raising capacities from mining. The modified EPC scenario used in the IE-HFE modelling assumes that equalisation payments for indigeneity are retained, and so those payments play no role in the estimated welfare loss from moving away from the HFE system.