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Locations of Indigenous Population Change: What Can We Say?

J. Taylor and N. Biddle

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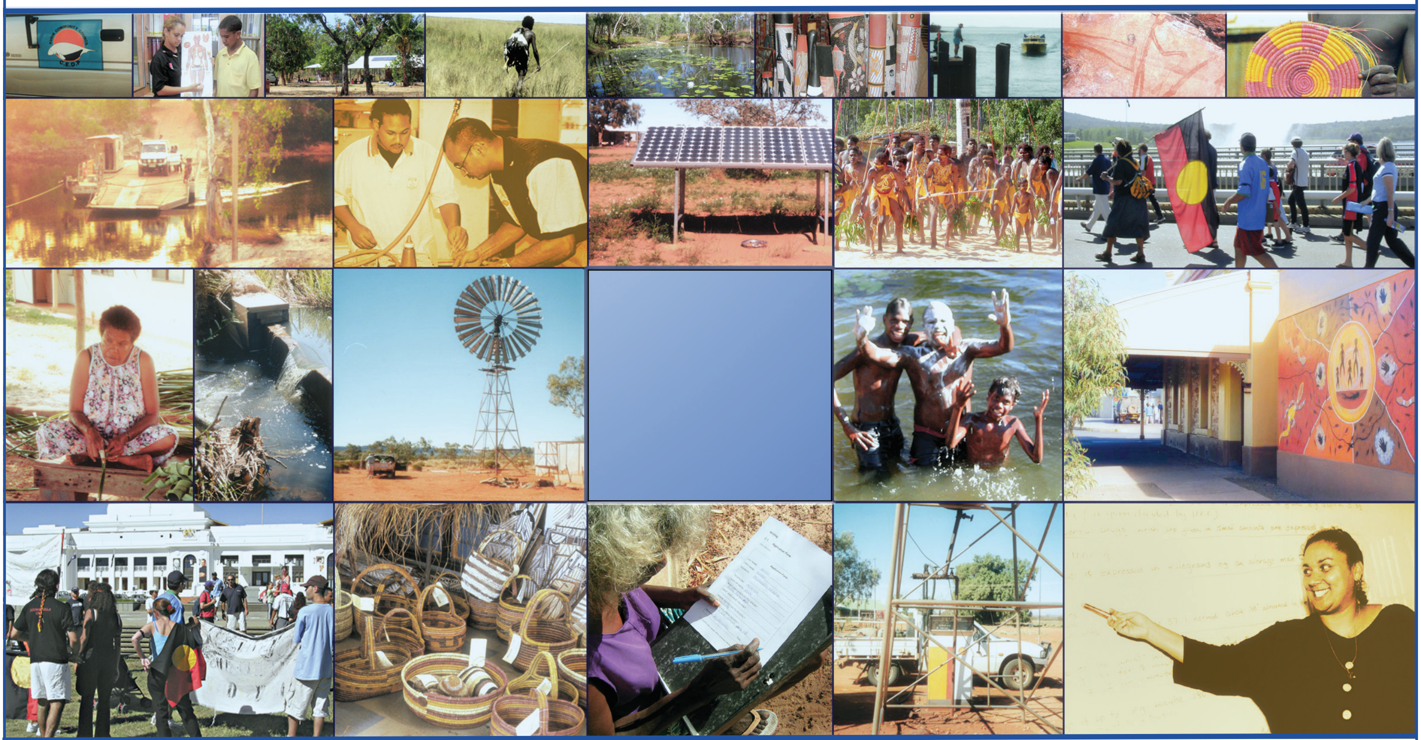

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June 2008

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Ministerial Council for Aboriginal and Torres Strait Islander Affairs

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Locations of Indigenous Population Change: What Can We Say?

J. Taylor and N. Biddle

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ABSTRACT

The ABS 2006 Post Enumeration Survey was extended to include a sample of localities from the whole of Australia, thereby providing an estimate of census net undercount reflective of the enumeration in remote Indigenous settlements for the first time. The results revealed substantial undercounting of the Indigenous population in certain jurisdictions. The analytical and policy issues that arise from this revolve around a simple question: how can we be sure that we are measuring the same population over time? This paper seeks to provide an answer to this question by modelling the contribution of net migration to small area population change. In doing so, it also seeks to address the concerns of population analysts in Australia who have long argued that the use of administrative units for the spatial presentation of census data is sub-optimal in representing meaningful social and economic regions. Accordingly, we examine intercensal population change using a non-jurisdictional typology of Indigenous settlement reflective of different residential arrangements. This reveals that the 2006 Census count of Indigenous population was deficient in many remote towns, many Indigenous towns, and many outstation areas, but was higher than expected in regional country towns and many city suburbs. These findings have implications for the analysis of change in population characteristics over time. This is the inaugural paper in what will become a series of CAEPR Working Papers co-badged with the Ministerial Council for Aboriginal and Torres Strait Islander Affairs.

Keywords: Indigenous population, Indigenous population change, typology of place, census, demography.

CAEPR INDIGENOUS POPULATION PROJECT

This project has its genesis in a CAEPR report commissioned by the Ministerial Council for Aboriginal and Torres Strait Islander Affairs (MCATSIA) in 2005. The aim of the paper (published as *CAEPR Discussion Paper No. 283*) was to synthesise findings from a wide variety of regional and community-based demographic studies. What emerged was the identification of demographic 'hot spots'—particular Indigenous population dynamics in particular regions that give rise to issues of public policy concern. These trends spatially align with specific categories of place that transcend State and Territory boundaries. The 'hot spots' coalesce around several structural settings including city suburbs, regional towns, town camps, remote Indigenous towns, and outstations, as opposed to the more formal regionalised or jurisdictional spatial configurations that have tended to guide and inform Indigenous policy development.

Recognising that the structural circumstances facing Indigenous populations are locationally dispersed in this way, MCATSIA has established an enhanced research capacity at CAEPR over three years to further explore the dynamics and regional geography of Indigenous population and socioeconomic change.

This research activity commenced in late 2007 and is constructed around four discrete yet overlapping projects:

- a detailed regional analysis of relative and absolute change in Indigenous social indicators
- an assessment of social and spatial mobility among Indigenous metropolitan populations
- case-study analyses of multiple disadvantage in select city neighbourhoods and regional centres
- the development of conceptual and methodological approaches to the measurement of temporary short term mobility.

Working Papers related to these projects are co-badged with MCATSIA and released as part of the CAEPR Working Paper Series. It should be noted that the views expressed in these publications are those of the researcher/s and do not necessarily represent the views of MCATSIA as a whole, or the views of individual jurisdictions.

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EXECUTIVE SUMMARY OF KEY FINDINGS AND RELATED ISSUES

1. We know that substantial undercounting of the Indigenous population occurred at the 2006 Census. This certainty arises from the fact that the 2006 Post Enumeration Survey (PES) was extended for the first time to include a sample of localities in remote areas. Nationally, the net undercount rate was estimated to be 11.5 per cent, but in Western Australia and the Northern Territory it was as high as 24 per cent and 19 per cent respectively. The analytical and policy issues that arise from such high levels of undercount revolve around one key foundation question for users of census data: can we establish reliable measures of Indigenous population change? This inaugural paper—in what will become a series of co-badged Centre for Aboriginal Economic Policy Research and Ministerial Council for Aboriginal and Torres Strait Islander Affairs (MCATSIA) outputs—attempts to provide an answer.

PES: Post Enumeration Survey

MCATSIA: Ministerial Council for Aboriginal and Torres Strait Islander Affairs

2. In addressing this issue, we are conscious of a need to add a spatial dimension to our analysis. For some time now, and especially since the abolition of the Aboriginal and Torres Strait Islander Commission, Council of Australian Governments (COAG) reporting frameworks in relation to Indigenous Affairs have been structured on a jurisdictional basis with the likelihood that this will continue on into the development of indicators for the newly-established Indigenous Reform and other COAG Working Groups. However, earlier work sponsored by MCATSIA (Taylor 2006) as well as the current paper argue the case for a more spatially-aware framework that is reflective of the actual circumstances/milieu in which Indigenous people live in different types of places. Thus, a key initiative tabled by the present paper is the development of a preliminary typology of such places. This is used here to explore the geography of intercensal change in Indigenous population counts and provide an assessment of the quality of that change data. For this purpose, the paper uses a regression model of the contribution of net migration to intercensal changes in census counts.

COAG: Council of Australian Governments

3. What this modelling exercise basically tells us is that in many remote towns, and in some Aboriginal towns and outstations, the change in the census count of Indigenous population between 2001 and 2006 was substantially deficient. In contrast, in most regional towns, and in particular suburbs of major cities, the change in the count was greater than expected after considering the contribution to population change from net migration and natural increase.

4. As a consequence of (3) above, in many remote locations (these are specified in the analysis) we cannot use 2006 Census counts at face value. In such places, the census is more like a sample survey of the Indigenous population. Accordingly, current population levels, changes in levels since 2001, and levels of census characteristics, such as numbers employed, will need to be carefully adjusted to assist informed policy-making. One drawback for this adjustment is the fact that we have no data on the characteristics of those not counted. All we can do is infer these from the pattern of Australian Bureau of Statistics (ABS) age-adjustments to various census counts in the form of post-censal estimated resident populations.

ABS: Australian Bureau of Statistics

5. For many places in regional Australia we have the opposite problem of higher counts than expected in 2006. Here, we can only accept 2006 counts as the newly-revealed levels of Indigenous population. This excess growth compared to 2001, combined with patterns of net migration relative to the rest of the population, means that Indigenous people comprise a steadily rising share of local town and country populations across almost all of regional Australia. Such a scenario has been sketched out before in regard to the Murray-Darling Basin (Taylor & Biddle 2004), but the message here is that the phenomenon is now widespread across the agricultural zone and is structural in its formation.

Aside from rising census capture and higher Indigenous natural increase, a key underlying dynamic is differential net migration with Indigenous net gain in many country towns, often contrasting with non-Indigenous net loss. The significance of this dynamic derives from the fact that regional areas represent the single largest grouping of the Indigenous population, accounting for 43 per cent of the total.

6. Aside from the nuts and bolts of demographic accounting, the geography of the 2006 Census Indigenous count and its broad regional polarity of undercount and 'overcount' areas is highly instructive for policy-thinking. In particular, it points to a need to reassess the nature of the population bases used as input in determining the quantum of fiscal resourcing for Indigenous policies and programs. This reassessment should consider implications for the both the historic adequacy of population-based funding and programs and for future demand in these.

7. On the issue of historic adequacy, the extension of the PES sample to include remote Indigenous communities for the first time in 2006 finally uncovered the 'true' extent of undercounting. Does not the revelation of very high undercount rates—in Western Australia, the Northern Territory, and to a lesser extent in Queensland—raise a substantial question regarding historic levels of funding for remote Indigenous communities and the means by which these have been established to date? Simply put, if we now know that thousands of Indigenous people are not enumerated, and that they are unlikely to have been adequately accounted for in previous post-censal estimates, then can we conclude that fiscal settings based on such estimates have been commensurately undervalued over the past 35 years?

8. If we can draw the above conclusion, then does this imply that services and programs provided to remote communities on the basis of official population estimates have been chronically inadequate? Is this one of the reasons we encounter chronic infrastructure backlogs in many remote communities, as well as a manifest mismatch between settlement size and basic service provision? More broadly, at the jurisdictional level, what does this imply for the strength of disability weightings due to remote Indigenous population shares that have historically been applied by the Commonwealth Grants Commission in estimating fiscal redistributions?

BACKGROUND

In 2006, a synthesis of findings from a wide variety of regional and community-based Indigenous population studies identified emergent demographic 'hot spots' (Taylor 2006). These reflected the fact that particular Indigenous population dynamics in particular regions and locations were giving rise to particular issues of public policy concern. The trends that emerged from this analysis were seen to spatially align with categories of place that transcended State and Territory boundaries. In particular, they were found to coalesce around several structural settings including city suburbs, regional towns, town camps, remote Indigenous towns, and outstations, as opposed to the more formal regionalised or jurisdictional spatial configurations that had tended to guide and inform Indigenous policy development.

Recognising that the structural circumstances facing Indigenous populations are locationally dispersed in this way, the Ministerial Council for Aboriginal and Torres Strait Islander Affairs (MCATSIA) moved to establish an enhanced research capacity at CAEPR to delve further into the dynamics and geography of Indigenous population and socioeconomic change.

MCATSIA: Ministerial Council for Aboriginal and Torres Strait Islander Affairs

This research activity is constructed around four discrete yet overlapping projects: a detailed regional analysis of relative and absolute change in Indigenous social indicators; an assessment of social and spatial mobility among Indigenous metropolitan populations; case-study analyses of multiple disadvantage in select city neighbourhoods and regional centres; and the development of conceptual and methodological approaches to the measurement of temporary short term mobility.

The Australian Censuses of 2001 and 2006 provide key sources of data for many of these projects. Not only do these yield the most comprehensive statistical coverage of the Indigenous population, they report characteristics of that population according to a more or less consistent set of definitions over time, and they also allow for direct comparison with the rest of the Australian population—a basic measurement requirement to support the current Council of Australian Governments (COAG) Indigenous Reform process. While these data are therefore ideally suited to the measurement of absolute and relative change in Indigenous circumstances, it is also true that they are fraught with analytical traps and deficiencies, most importantly in relation to basic population counts.

COAG: Council of Australian Governments

Indeed, we are now more certain than for any other census round that substantial undercounting of the Indigenous population occurred at the 2006 Census. This certainty arises from the fact that the 2006 Post Enumeration Survey (PES) was extended to include a sample of localities from the whole of Australia, thereby providing an estimate of net undercount reflective of the enumeration in remote Indigenous settlements for the first time. Not surprisingly, given accounts of this latter exercise in some such locations (Morphy 2007a), the Indigenous net undercount rate in Western Australia was estimated to be 24 per cent, while in the Northern Territory it was 19 per cent (ABS 2007b). The analytical and policy issues that arise from this revolve around a simple question: how can we be sure that we are measuring the same population over time? Providing an answer to this question represents an important foundation task for the MCATSIA-sponsored project work outlined above because of the key role played by census data in much of the related analysis. This inaugural paper in what will become a series of co-badged CAEPR/MCATSIA outputs attempts to provide it. We start with a discussion of appropriate geography.

PES: Post Enumeration Survey

WHICH GEOGRAPHY?

Population analysts in Australia and other OECD countries have long argued that the use of administrative units for the spatial presentation of census data is sub-optimal in representing meaningful social and economic regions. Foremost amongst these in Australia is the population geographer, Graeme Hugo. For many years he has advanced the very valid (though frequently ignored) point that for policy-related research it is important to use spatial units that are meaningful to the particular issue (and population) under investigation (Hugo 2007: 336). Sophisticated attempts to achieve this have included proposed redesigns of the ABS Australian Standard Geographical Classification (ASGC) to allow greater discrimination of areas below the level of administrative units (ABS 2007a; Hugo 2007: 343-46) as well as the idea of 'social catchments', defined as 'the territory occupied by a group of households and individuals who are in some form of regular interaction and which the inhabitants identify as 'their' community or region' (Hugo 2007: 337).

ASGC: Australian Standard Geographical Classification

This latter idea is interesting in the context of Indigenous affairs policy because just such an attempt was made by the Commonwealth government in the late-1980s in deciding on the original 60 Regional Council boundaries of the Aboriginal and Torres Strait Islander Commission (ATSIC). These sought to provide a reasonable representation of Indigenous population distribution and followed extensive consultations with Indigenous groups regarding spatial commonalities of cultural, social and economic factors in relation to specific areas (Commonwealth of Australia 1993: 3). With some manipulation to match the ASGC, these original boundaries have in many ways underpinned the subsequent evolution of the ABS Australian Indigenous Geographical Classification (AIGC) which itself has attempted to incorporate some sensitivity to social catchments, for example by configuring boundaries to allow the identification of outstation groups associated with particular towns or by isolating certain town camps and populations in towns with relatively large Indigenous populations (Taylor 1992, 1993; ABS 2007b: 72-5). The other innovation of the AIGC was to produce a set of spatial units reflective of the distribution of the Indigenous population.

ATSIC: Aboriginal and Torres Strait Islander Commission

AIGC: Australian Indigenous Geographical Classification

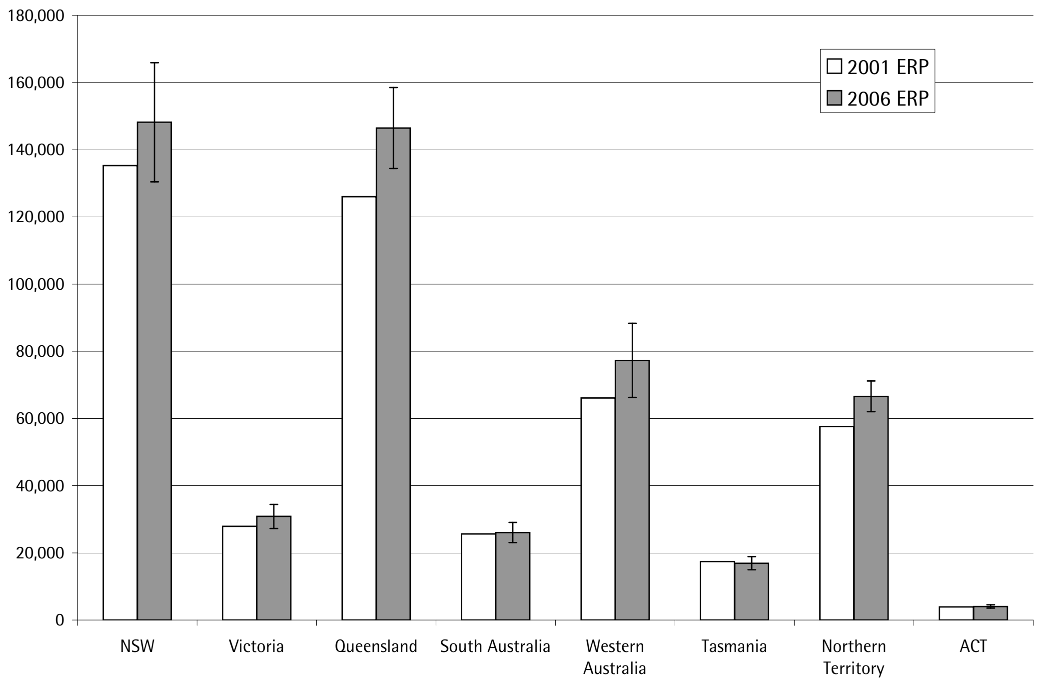
A proposal for customised spatial units to address the particular concerns of Indigenous policy has also emerged empirically from a recent synthesis of regional and community-based studies of Indigenous population change (Taylor 2006). This identified the emergence of demographic 'hot spots' in the sense that the spatial redistribution of the Indigenous population relative to that of other Australians was highlighting particular categories of place as the most meaningful sites for public policy focus and concern (Taylor 2006). Significantly, in line with the general call from population analysts for less reliance on administrative units as the spatial focus of research (Hugo 2007), these emerging locations of interest were shown to transcend State and Territory boundaries and other jurisdictional configurations that have typically provided the framework for reporting and analysing Indigenous outcomes, as for example in the work of the Steering Committee for the Review of Government Service Provision (SGRCP 2007). In particular, they drew attention to distinct spatial/structural settings that offer quite variable constraints and opportunities for Indigenous social and economic participation. These included the poorest neighbourhoods in all major cities, many of the larger service towns and associated small localities across regional and remote Australia, town camps in central and northern Australia, emerging Indigenous towns in remote areas, and dispersed outstations or homeland centres.

To the extent that such a typology of locational settings provides for a more realistic assessment of the range of circumstances facing Indigenous populations in their everyday lives, then a substantial analytical issue immediately presents itself in terms of profiling population levels and characteristics for these sorts of customised categories. This is because they have to be constructed using small area census geography, specifically the Indigenous Area (IA) level of the AIGC which is the lowest level geography for which population numbers are sufficient to use the full array of census characteristics. In 2001 (the base year for our analysis of change) there were 562 such units across Australia (excluding migratory special-category IAs) while in 2006 there were 532.

IA: Indigenous Area

A number of analytical issues arise at this fine-grained scalar level. First of all, post-censal estimates of Indigenous population are not constructed for this geography and so we are forced to use raw census counts with all their attendant errors, specifically those related to undercount, 'overcount'[1] and non-response to Indigenous status. Second, substantial boundary changes occurred between the 2001 and 2006 AIGC and a concordance therefore needs to be established in order to calibrate measures of change over

Fig. 1. Indigenous estimated resident populations by State and Territory, 2001 and 2006



Source: ABS 2007b.

time. Finally, the inherent volatility of raw census counts of the Indigenous population is exacerbated at the small area level. This therefore requires that we establish some prior means of assessing the validity (and therefore, the utility) of intercensal change in IA census counts before drawing any conclusions about the dynamics of observed population change.

In theory, at least, components of each of the locational categories referred to above can be identified using IA-level data and so basic questions concerning their relevant population dynamics can be addressed. Thus, for the most recent intercensal period (2001-06), we can establish in some detail where, and in what category of place, the Indigenous population is rising or falling, and to what extent. We can show how this compares with change in the non-Indigenous population and what the impact of these relative changes is in terms of local Indigenous population shares. However, we cannot comment on any of these outcomes with any degree of certainty without a sense or measure of the reliability of census counts for each IA. This paper seeks to establish such a measure.

USUAL RESIDENCE COUNTS

To assess the reliability of Indigenous census counts we focus on usual residence counts. These represent the key output from each national census because they establish the base from which population estimates are subsequently derived and they produce the levels at which population characteristics are established. Since 1971, census counts have also provided a measure of change in the size and composition of a self-identified Indigenous population. However, a notable feature of successive Indigenous census counts since that time has been their volatility and unpredictability (Gray 1997, 2002; Kinfu & Taylor 2005; Ross 1999; Taylor 2002, 2003)—with numbers invariably greater each time than explained by natural increase alone (although the 1981 count was actually lower than that for 1976). Indigenous population change recorded over the most recent intercensal period (2001-06) provides no exception to this pattern with an increase in the raw count of 11.0 per cent, which is far higher than the underlying rate of Indigenous natural increase of around 2.0 per cent per annum (ABS 2004).

While there has been some consideration of the implications of continuing volatility in census counts, so far the focus has been on problems that this causes for the current round of post-censal population estimation. Wilson and Barnes (2007), for example, have raised questions about the consequences for establishing estimates of geographic distribution and how this has changed in recent years, while Biddle and Taylor (2007) have highlighted the untenable situation whereby standard errors around ABS estimates of Indigenous population for most jurisdictions indicate probable change ranging from a slight decline to a substantial increase, as shown in Fig. 1.

In this paper we return to basics and consider the reliability of census counts themselves. We do this by establishing spatial associations between changes in census counts and census measures of net migration. In this way we seek to provide a statistical assessment of the reliability of IA-level usual residence counts. We include in this assessment some controls for census error and natural increase. Our approach is based on the well-established observation in Australia and elsewhere that net inter-regional migration is the main demographic contributor to population change at the small area level (Bell & Hugo 2000). By this measure, population change should increase, decline and display relative magnitude in a predictable manner. Where it does not, we deduce one of two possible causes—either that the 2006 population was undercounted relative to 2001, or that the 2001 population was undercounted relative to 2006.

In the former case, we are now more certain than for any other census round that substantial undercounting of the Indigenous population did occur at the 2006 Census. This certainty arises from the fact that the 2006 PES was extended to include a sample of localities from the whole of Australia, thereby providing an estimate of net undercount reflective of the enumeration in remote Indigenous settlements for the first time. Not surprisingly, given accounts of this latter exercise in some such locations (Morphy 2007a), the Indigenous net undercount rate in Western Australia was estimated to be 24 per cent while in the Northern Territory it was 19 per cent (ABS 2007). However, while we now have comprehensive net undercount estimates at State level, these are not available at IA-level and so an alternative measure of census reliability needs to be established.

As for the second possibility, that the 2001 population of an IA was undercounted relative to 2006, this arises in situations where Indigenous numbers counted in 2006 compared to 2001 are substantially higher than can be attributable to change in demographic factors alone. Such an outcome is quite common and explanation for this non-demographic contribution to change is uncertain. Suggestions have included higher propensities for individuals to identify as an Indigenous person on census forms (Ross 1999: 54), as well as changes in census coverage (Gray 1997, 2002: 109-114). As Kinfu and Taylor (2005) point out, the first of these suggests behavioural change while the latter alludes more to administrative factors. Either way, explanation is confounded by a lack of data, although comparison of age-specific Indigenous growth rates for successive intercensal periods does tend to undermine the idea that behavioural factors are prominent (Kinfu and Taylor 2005: 242-5). A final explanation may be a relatively accurate count in 2006 but a substantial undercount in 2001.

CHANGE IN INDIGENOUS COUNTS AND ESTIMATES, 2001-06

Between 2001 and 2006 the national count of the Indigenous population increased by 11.0 per cent from 410,003 to 455,031. However, the distribution of this population increase was very uneven at the broad regional scale. There are several ways in which we can demonstrate this diversity and we start by considering the different State and Territory jurisdictions.

Table 1. Indigenous usual residence counts by State and Territory, 2001 and 2006

	2001	2006	Change (%)
New South Wales	120,047	138,506	15.4
Victoria	25,059	30,141	20.3
Queensland	112,575	127,578	13.3
South Australia	23,377	25,557	9.3
Western Australia	58,467	58,711	0.4
Tasmania	15,856	16,767	5.7
Northern Territory	50,845	53,662	5.5
ACT	3,548	3,873	9.2
Australia	410,003	455,031	11.0

Source: ABS 2007b.

Table 2. Indigenous preliminary estimated resident populations by State and Territory, 2001 and 2006

	2001	2006	Change (%)
New South Wales	134,888	148,178	9.8
Victoria	27,846	30,839	10.7
Queensland	125,910	146,429	16.3
South Australia	25,544	26,044	1.9
Western Australia	65,931	77,928	18.2
Tasmania	17,384	16,900	-2.8
Northern Territory	56,875	66,582	17.1
ACT	3,909	4,043	3.4
Australia	458,520	517,174	12.8

Source: ABS 2007b.

STATE AND TERRITORY COUNTS

Table 1 shows the change in Indigenous usual resident counts in each jurisdiction and reveals that the highest rates of increase occurred in the more populous states of Victoria, New South Wales and Queensland. This pattern of growth sustains a trend of steadily rising Indigenous census counts in the eastern States relative to other jurisdictions that has been observed since the introduction of the census question on self-identified Indigenous status in 1971. However, what these figures also show is that Western Australia, the Northern Territory and Tasmania reported increases in recent Indigenous counts that were substantially below average national growth of 11 per cent. This was especially so in Western Australia, where the count was only barely positive.

Table 3. Indigenous usual resident counts by remoteness classification, 2001 and 2006

	2001	2006	Change (%)
Major cities	123,008	147,295	19.7
Inner regional	81,832	99,312	21.4
Outer regional	91,979	98,654	7.3
Remote	33,963	39,409	16.0
Very remote	71,065	68,752	-3.3
Australia	410,003	455,028	11.0

Source: ABS 2003, 2008.

Table 4. Indigenous estimated resident populations by remoteness classification, 2001 and 2006

	2001	2006	Change (%)
Major cities	138,494	164,274	18.6
Inner regional	92,988	108,207	16.4
Outer regional	105,875	113,301	7.0
Remote	40,161	49,478	23.2
Very remote	81,002	81,914	1.1
Australia	458,520	517,174	12.8

Source: ABS 2003, 2008.

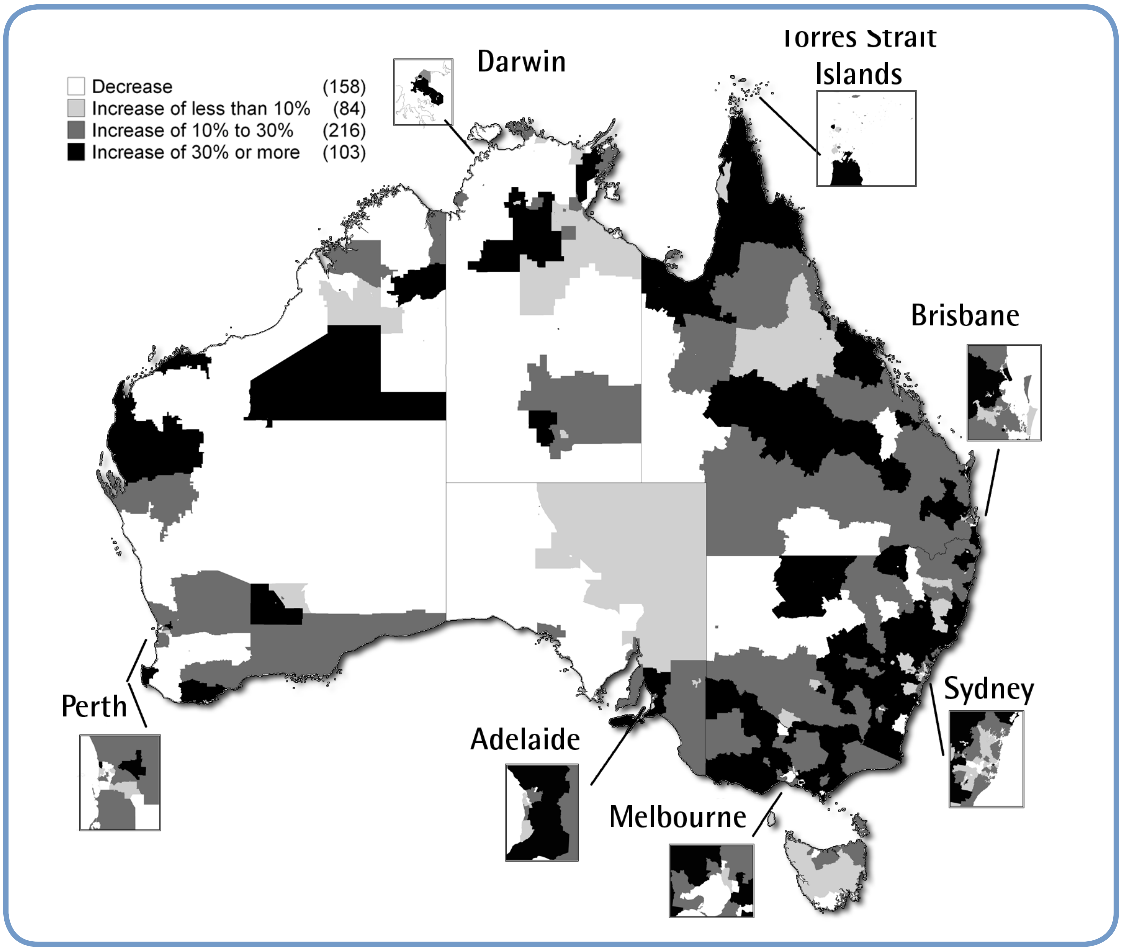
Adjustment for net undercount and other census error in the calculation of preliminary ABS post-censal population estimates produces a more even spread of population change as shown in Table 2, although it also creates some dramatic shifts. Thus, while Queensland retains a relatively high growth rate, growth is now highest in Western Australia, followed by the Northern Territory. Elsewhere, growth in New South Wales, Victoria and especially South Australia is more subdued, while Tasmania registers a decline in Indigenous population (the first such for a State in the modern census era). Overall, the national rate of growth is now closer to 13 per cent than 11 per cent.

REMOTENESS REGION COUNTS

Another way to consider Indigenous population change that is more reflective of settlement structure is to apply the five-category remoteness structure from the ASGC. This reveals an even wider range of results in terms of Indigenous population change (Table 3) with a very high growth rate at almost twice the national average in inner regional areas followed closely by major cities. At the other extreme, very remote areas registered a decline in population count.

Once again, when we compare these counts with post-censal estimates for the same regions (Table 4) we find notable shifts in population levels with adjusted growth in remote areas now substantially higher, with more subdued growth (though still high) in major cities and Inner Regional areas, and with the

Fig. 2. Change in Indigenous usual residence counts by Indigenous Area, 2001–06



Source: Customised data provided by the ABS.

apparent decline in very remote areas converted to a very slight gain, which is somewhat surprising given the geography of estimated Indigenous net undercount (ABS 2007b). Clearly, census counts alone are insufficient to understand how the population changed between 2001 and 2006, even at these high-level classifications. In the following section we highlight even greater uncertainty at the small area level.

POPULATION CHANGE AT THE INDIGENOUS AREA LEVEL

Changes in IA boundaries between the 2001 and 2006 AIGC present an immediate difficulty when attempting to examine change in census counts. Boundary reclassification of this sort involved a total of 162 IAs, or 29 per cent of the 2001 total. It should be noted that since we establish change from 2001 to 2006 and then use characteristics of IAs in 2001 to explain this change, in this part of the paper we deploy the 2001 version of the AIGC. In order to create a time series and minimise any error due to boundary changes, we then apply a quasi-population based concordance for the 2006 data.[2]

The resulting pattern of change in usual residence counts across the nation is shown in Fig. 2 according to four categories: areas where the count declined, areas where the count increased slightly or at a rate less than roughly the national average (up to 10%), areas where the count increased moderately above the national average (from 10% to less than 30%) and areas where the increase in the count was substantially above the national average (30% or higher).

The immediate impression that emerges is a complex spatial pattern of population change with quite varied rates often juxtaposed. While proper interpretation is hampered by the fact that a number of IAs are not visually represented in this map due to their small physical area, some broad regional consistencies are evident. Thus, in major cities most suburbs show increase with many well above 10 per cent. Relatively high rates of population growth are also evident across much of the eastern half of Australia including around Adelaide, throughout much of country Victoria, in eastern and select parts of northern New South Wales, variously in south east Queensland, in central Queensland, the Mackay/Townsville area, and much of Cape York and the Queensland Gulf country. While similar occurrences appear in the western half of the continent in parts of north east Arnhem Land, the Katherine region, the Iwupataka area west of Alice Springs, a few remote parts of the Kimberley, Pilbara, and Carnarvon, as well around Busselton, Bunbury and Coolgardie in the south of Western Australia, these are geographically more sporadic and form the exception rather than the rule. For the most part, inland areas and much of the western half of the continent from top to bottom as well as the Far West and parts of central New South Wales are more widely reflective of a decline in population counts, or at least below average growth.

Overall, more than one-quarter of 2001 IAs (28%) recorded a population decline, with an average drop of 9.3 per cent. A further 15 per cent recorded an increase in population that was below the Indigenous national average. The largest single grouping (39%) were those areas with growth that was moderately above national average (10-30% growth), and almost one-fifth (18%) experienced very high growth beyond the national average (over 30% increase). Given this diversity in outcomes, and given what we know about the volatility of census counts, the basic research and policy challenge is to determine how reliable these observed outcomes are. How can we establish some measure of the relationship between observed patterns of population change and likely contributing factors in order to then pass judgement on their utility for policy development?

MODELLING CHANGE IN IA INDIGENOUS POPULATION COUNTS

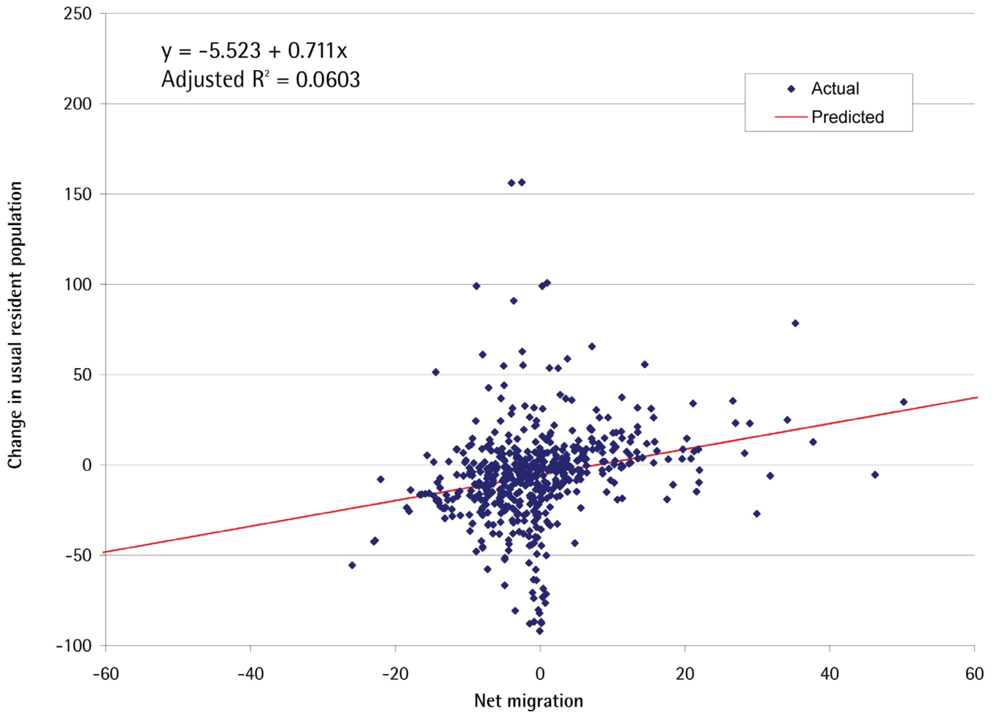
In order to establish a statistical relationship between the spatial pattern of change in Indigenous census counts and likely contributory factors, we apply a regression framework within which the linear relationship between the main variable of interest (percentage change in the Indigenous usual resident population of IAs) and an explanatory variable, or set of explanatory variables, is estimated. Recognising that there are a number of dimensions across which change in the usual resident population may vary, we estimate eight regression models each with a different set of explanatory variables (though there is some overlap). Detailed discussion of these models and their estimated results are presented in Appendix 1.

To summarise these, the regression exercise allows us to establish a few ground rules. First of all, we can say that a relationship does exist at the small area level between Indigenous population change and net migration. Second, that growth in Indigenous population is becoming more spatially widespread and is occurring increasingly away from areas with existing high concentrations of Indigenous population.[3] As a consequence, the Indigenous share of local area populations is rising more generally. Finally, something clearly went wrong with the census count of Indigenous people in Western Australia—more so than in any other jurisdiction.

THE RELATIONSHIP BETWEEN NET MIGRATION AND POPULATION CHANGE

The results summarised above highlight some of the systematic variation in the change in the Indigenous population count at the small area level. To explore the robustness of this variation we look in more detail at the results from model 1, which included net migration as the explanatory variable. The results from this model revealed a positive relationship between net migration and population change across IAs. However, the adjusted R-Squared for that model was estimated to be quite low at 0.0461, and hence a large amount

Fig. 3. Net migration by actual and predicted percentage change in population, 2001-06



Source: Customised data provided by the ABS.

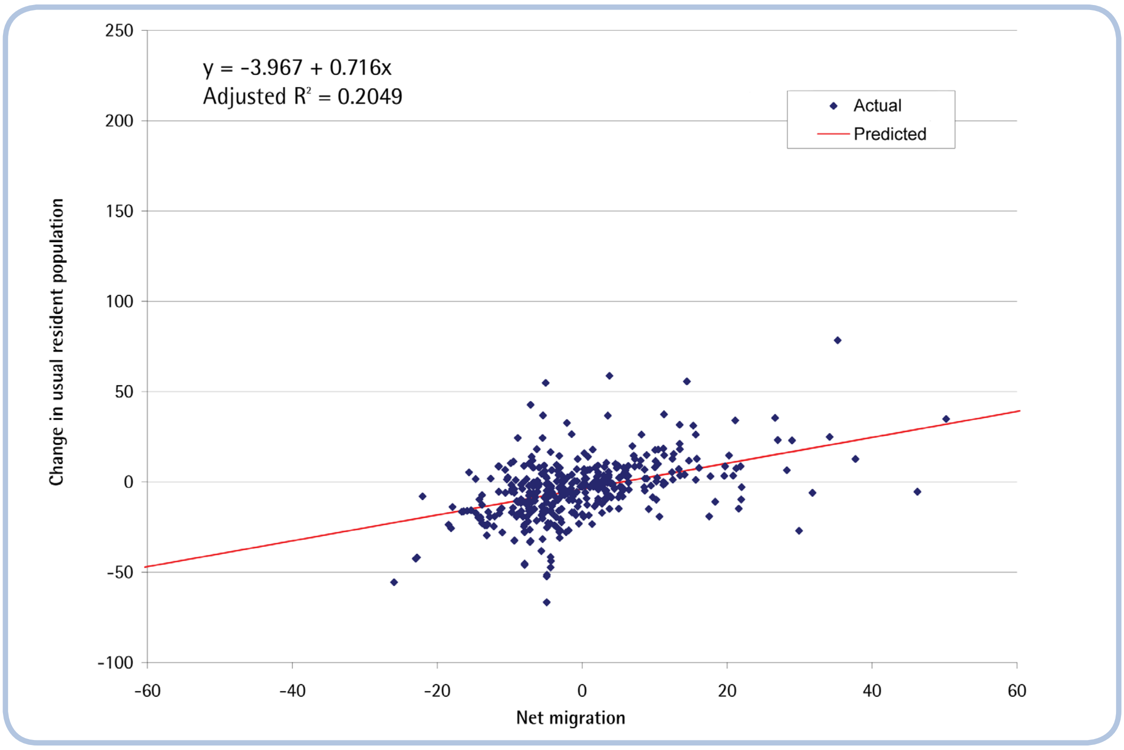
of the variation in the change in the usual resident count could not be explained by net migration. This stands in stark contrast to a similar calculation of the relationship between non-Indigenous population growth and net migration for the period 1996 and 2001 which produced an R-Squared of 0.8887, albeit using a more aggregated level of geography (Taylor 2003).

There are six reasons why the relationship between Indigenous population change and net migration at the IA level is likely to be comparatively weak:

- changes in other demographic variables such as births, deaths and overseas migration
- changes in the per cent of the population that did not report an Indigenous status
- errors caused by matching 2001 and 2006 IA boundaries
- errors caused by matching IA boundaries and the Statistical Local Area (SLA) boundaries that are used to measure migration
- uncertainty around the concept or reporting of usual residence, especially place of usual residence 5 years ago (Morphy 2007b: 42-44; Newbold 2004)
- differences in the 2001 or 2006 Census count caused by under-enumeration or increased Indigenous census capture.

At the IA level, it is not possible to estimate the number of Indigenous Australians who died between 2001 and 2006. However, it is possible to add those aged 0–4 years (intercensal births) to the 2006 figure (that is, those who would not be captured in the net migration figures) as well as a pro rata allocation to the 2001 and 2006 Censuses of those who did not state their Indigenous status. With these adjustments we find a slightly stronger relationship between population change and net migration as shown in Fig. 3.

Fig. 4. Net migration by actual and predicted percentage change in population: Areas with stable boundaries, 2001-06



Source: Customised data provided by the ABS.

The results in the top-left of Fig. 3 represent the estimated relationship between the percentage change in the population (y) and net migration (x), as well as the adjusted R-Squared. There are two things to note from these results. First, the constant term has gone from being significantly greater than zero in model 1 presented in Table A1, to significantly less than zero in Fig. 3. This is because, after controlling for births and net migration, the population in each IA will have fallen through deaths that occurred in the intervening five years. Compared to this, although the coefficient for net migration fell slightly across the two estimations, this difference was not statistically significant. The second thing to note is that the adjusted R-Squared has increased from 0.0461 to 0.0603. So, after controlling for births and the population that did not report Indigenous status we find a slightly stronger relationship between population change and net migration.

Despite this improvement in the relationship, there is still a large amount of unexplained variation. This is reflected in Fig. 3 by the fact that a number of areas still show a large increase or decline in population despite having a low net migration rate. Some of this error can be explained by changes in IA boundaries between 2001 and 2006. The effect of removing this influence is shown in Fig. 4, which excludes areas with large boundary changes from the analysis (areas where there was at least 5% of the IA in 2006 that had been in a different area in 2001).[4]

The relationship between net migration and population change in these temporally-stable areas is now clearly much stronger, as indicated by the adjusted R-Squared of 0.2049 as well as by the greater clustering of data points along the regression line representing predicted values. Even with these adjustments however, substantial variation remains unexplained, which we suspect to have been caused by either error in the population change data or error in the net migration data. Accordingly, this lack of fit between population change and demographic change provides for a measure of the robustness of each IA census count.[5]

Table 5. Coefficient estimates: Difference between predicted and actual usual resident change

	Model A	Model B	Model C
Major city	n.s.		base
Inner regional area	4.503		7.114
Outer regional area	2.831*		6.672
Remote area	n.s.		n.s.
Very remote area	-3.710		n.s.
New South Wales		4.135	n.s.
Victoria		8.263	n.s.
Queensland		n.s.	-3.878*
South Australia		n.s.	n.s.
Western Australia		-7.724	-11.578
Tasmania		n.s.	-9.952
Northern Territory		n.s.	-7.339
Australian Capital Territory		n.s.	n.s.
Adjusted R-Squared	0.0359	0.0843	0.1072

Note: n.s. denotes variables that are not significant at the 10% level of significance.

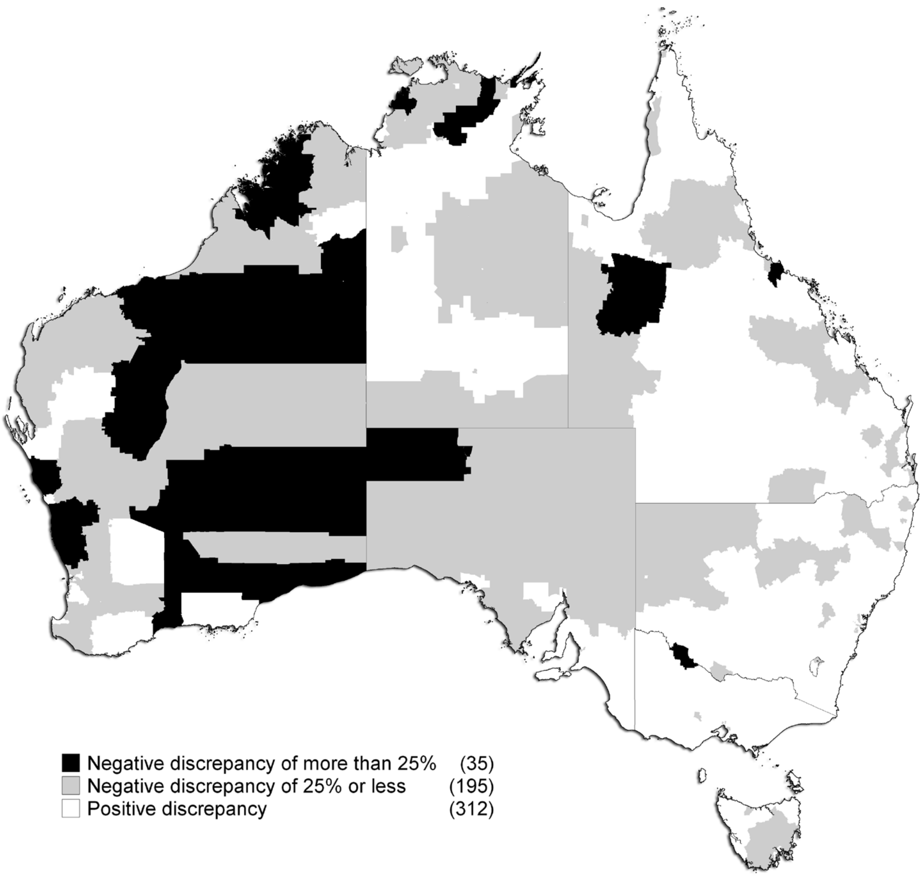
* denotes those variables that are significant at the 5% level only.

Source: Customised data provided by the ABS.

If this residual variation was randomly distributed across the IAs, we could be reasonably confident that any conclusions drawn regarding the true levels of population were sufficiently robust for our purposes. However, in order to be sure about this we require a test for systematic bias in the error. This is provided by a regression of the error term from Fig. 4 against three sets of variables: the remoteness classification of the IA (model A), the relevant jurisdiction (model B), and these two geographic classifications together (model C) as shown in Table 5.[6]

The results from model A indicate that Inner and Outer Regional areas experienced a higher count than predicted, while in very remote areas growth in the usual resident population was lower on average than expected based on the patterns of net migration. This result is also reflected in model B, with areas in New South Wales and (especially) Victoria indicating a higher than expected count and those in Western Australia experiencing a much lower count than expected. However, once we control for remoteness (model C), the results for New South Wales and Victoria are no longer significant, which would tend to suggest that the significant values in model B derived from the fact that the two States have large populations in both inner regional and outer regional areas. In contrast to this situation in the south-eastern States, the coefficient for IAs in Western Australia increases substantially between model B and model C, and two other jurisdictions (Tasmania and the Northern Territory) also record results that are significantly less than zero (Queensland was only significant at the 10% level of significance). In other words, the undercount in these areas is most likely something to do with these jurisdictions specifically, rather than reflecting simply a greater level of remoteness.

Fig. 5. Distribution of 2006 Census undercount and 'overcount' by Indigenous Area



Source: Customised data provided by the ABS.

The indications of undercount in Western Australia, the Northern Territory and Queensland are all consistent with ABS estimates based on the PES (ABS 2007b). The result for Tasmania, however, is somewhat at odds with ABS estimates in that we find evidence of substantial undercount, whereas the preliminary estimate based on the PES (ABS 2007b: 78) indicates a small undercount. This may be because the published estimate for Tasmania (and the estimate of net undercount) is grouped with estimates for Victoria and South Australia, which we have shown match up well with net migration. It may also be because of a significant 'overcount' in Tasmania in the 2001 Census. Either way, the result for Tasmania is of interest as it continues a history of uncertainty over census counts in the State that are possibly not unrelated to issues of identity (Sanders 2003). This issue aside, the results overall are significant as they broadly agree with the PES estimates using a different dataset and methodology. More importantly, they show that these results hold after controlling for the level of remoteness.

POPULATION CHANGE BY LOCATIONAL TYPE—WHAT CAN WE SAY?

The regression analysis achieves two aims. First, it confirms that for IAs in certain jurisdictions and in particular remoteness areas it is not possible to simply compare census counts in 2001 and 2006 and expect that this will provide a reliable measure of population change. By extension, this caution applies to change in census characteristics in these areas as well. While this much was already known at the State and Territory level from the PES, our analysis goes further by establishing a detailed geography of the problem. Thus, a second achievement is that of establishing a statistical relationship between change in usual residence counts and net migration, since this provides a means by which we can now classify IAs according to the probable reliability of their change in census counts. With this device we can search for regularities and reflect on what we can say with confidence about the changing structure of Indigenous population distribution.

The methodology for this classification is built on the discrepancy established between the actual change in census count observed in each IA subtracted from the expected change based on the relationship presented in Fig. 2. These discrepancies can be either negative (undercount) or positive ('overcount'). They can also vary by degree. In order to identify extreme cases we isolate results that are greater than one standard deviation from the mean (zero). Thus, IAs with a discrepancy between expected change in counts and observed outcomes of greater than 25 per cent are highlighted.[7]

Of particular note here are those IAs with negative values since these are locations where the census count in 2006 is considered to be deficient and, in effect, unreliable for policy analysis without some upward adjustment. As for IAs with positive values, these may simply reflect an improved count in 2006 compared to 2001, but in many cases it may also imply change in census coverage. Either way, the cause is of less interest than the effect, which is to enhance population increase beyond the level expected. In such areas, we have no option but to accept the 2006 count as a new true level.

Fig. 5 shows the spatial distribution of negative and positive discrepancies with extreme negative cases highlighted.[8] The resulting pattern is very striking and it is worth interpreting this map in conjunction with Fig. 1, which shows the pattern of recorded change in population counts. Thus, while Fig. 1 indicates that a decline in Indigenous population counts was widespread throughout almost the entire western half of the continent, Fig. 5 suggests that this coincided with equally widespread undercounting in 2006.

Extreme cases of estimated undercounting are heavily concentrated in Western Australia, mostly in remote parts of the State but also in some regional areas. Elsewhere, the Anangu Pitjantjatjara Lands stand out, as do Maningrida outstations, Nhulunbuy and associated outstations, and the Coomalie/Belyuen/Cox Peninsula/Cox-Finniss area west of Darwin. In Queensland, the Cloncurry and Burdekin IAs are prominent, with Swan Hill in Victoria providing the only example in the south-east.

It should be noted that some IAs that also have large negative discrepancies do not show up well in Fig. 5 because of their small physical area. These include several in Western Australia such as the remote towns of Wyndham, Halls Creek, Port Hedland, and Warmun, as well as smaller Indigenous localities including Bardi, Beagle Bay, Oombulgurri, Mulan, and Mindibungu. In Queensland it includes the Cape York communities of Wujal Wujal and New Mapoon, while Ali Curung in the Northern Territory should also be added. In addition, there are a few IAs that encompass city suburbs including two in Darwin (Darwin/Inner Suburbs and Marrara/Winnellie/Berrimah), two in Perth (Perth/Vincent and Victoria Park), and one in Cairns (Cairns – City).

As we can see, issues relating to census data quality are geographically widespread. The question therefore arises as to how this affects our capacity to reliably establish intercensal change in the distribution of Indigenous population according to the locational categories or demographic hotspots. In an attempt to answer this, we first of all have to allocate individual IAs to one of these categories. This is not as straightforward as it might seem, because IA populations may be distributed across more than one locational category. However, we can use Indigenous population counts from the ABS Urban Centres and Rural Localities (UCL) classification to determine the category of residence that applies to the majority population in each IA. In many cases, (for example in many city areas) this is not necessary, but it is deployed for determining the classification of IA populations elsewhere. This procedure is somewhat subjective, and

UCL: Urban Centres and Rural Localities

Table 6. Definitional criteria for Indigenous Area locational categories

IA locational category	Definition
City areas	IAs within urban centres of greater than 100,000 population
Large regional towns	IAs where the Indigenous population is predominantly resident in urban centres of between 10,000 and 100,000
Small regional towns and localities	IAs where the Indigenous population is predominantly resident in urban centres of between 1,000 and 10,000 or in rural localities of between 200 and 1,000 listed in the UCL classification
Regional rural areas	IAs where the Indigenous population is predominantly resident in dispersed locations in regional Australia that are not listed as rural localities in the UCL classification
Remote towns	IAs where the Indigenous population is predominantly resident in urban centres in remote Australia
Indigenous towns	IAs where the Indigenous population is predominantly resident in urban centres and localities in remote Australia that have predominantly Indigenous populations
Town camps	IAs that are made up of non-contiguous town camp localities in particular remote towns
Remote dispersed settlements	IAs where the Indigenous population is predominantly resident in the balance of small dispersed settlement in remote Australia

remains an interim strategy for building towards a more empirically-derived locational typology. This will most likely be constructed using a spatial cluster analysis of IAs in similar fashion to that conducted for the general Australian population by Stimson et al. (2001) and Baum (2006).

In the meantime, we proceed with eight locational categories that derive roughly from those highlighted as demographic hotspots by Taylor (2006).[9] These categories are defined in Table 6. It should be noted that the town camp category is included here with some reservation. Even at the IA level, the identification of town camp communities in the AIGC is problematic, with only three sets included (town camps in Alice Springs, Tennant Creek and Katherine). None of the many town camps in the Darwin region are identified, nor are any of the separate living areas in towns like Kununurra, Halls Creek, Fitzroy Crossing, Port Hedland, Kalgoorlie, and Mt. Isa. Options for establishing approximate population numbers associated with these locations are available from the ABS Community Housing and Infrastructure Needs Survey (CHINS) but this does not extend to the full range of census characteristics.

CHINS: Community Housing and Infrastructure Needs Survey

In regard to these categories, the 2006 Census suggests that the Indigenous population in remote dispersed settlements (mostly incorporating outstation populations) decreased by -4.5 per cent, while growth in remote towns was very modest (Table 7). Significantly, rates of growth in these two locational categories were well below the underlying rate of natural increase of around 2.0 per cent (ABS 2004) and more than half of the IAs (46 out of 80) experienced a population decline. Indigenous town and town camp populations increased at somewhat higher rates but they were still below the national Indigenous average. In contrast, city areas as well as towns and rural areas in regional Australia generally recorded population increases that were well above national average growth and up to three times higher than the overall rate of natural increase.

Table 7. Change in Indigenous census usual residence counts by locational category of Indigenous Areas, 2001–06

IA locational category[a]	2006 count	2001 count	Change (%)	No of IAs with population increase	No. of IAs with population decline
City areas	154,674	133,963	15.5	117	24
Large regional towns	106,762	89,615	19.1	89	5
Small regional towns and localities	76,073	67,041	13.5	91	21
Regional rural areas	10,819	9,070	19.3	19	3
Remote towns	31,920	31,538	1.2	18	18
Indigenous towns	50,655	47,135	7.5	55	24
Town camps	2,086	1,912	9.1	2	1
Remote dispersed settlements	20,423	21,386	-4.5	16	28
All Indigenous Areas	453,412	401,660	12.9	407	124

Note: a. Counts for IA locational categories exclude usual residence inadequately described, usual residence not stated and offshore IAs. As a consequence, columns do not sum. It should be noted that this was more of an issue in 2001 and hence population increases by category are likely to be overstated. In 2006 the ABS Data Processing Centre had a much improved national place name data base specifically for Indigenous communities which would have assisted in improving the allocation of usual place of residence in uncertain cases (Morphy 2007a: 105).

Source: Customised data provided by the ABS.

Table 8. Indigenous and non-Indigenous population growth and change in Indigenous share of population by locational category, 2001–06 (%)

IA locational category[a]	Intercensal growth		Indigenous share of category population	
	Indigenous	Non-Indigenous	2001	2006
City areas	15.5	4.4	1.1	1.2
Large regional towns	19.1	6.3	3.2	3.6
Small regional towns and localities	13.5	3.4	3.6	4.0
Regional rural areas	19.3	6.6	2.1	2.3
Remote towns	1.2	-5.4	14.5	15.4
Indigenous towns	7.5	-21.3	83.8	87.6
Town camps	9.1	-50.4	94.0	97.2
Remote dispersed settlements	-4.5	-1.2	32.1	31.4
All Indigenous Areas	12.9	4.5	2.3	2.4

Note: a. As for Table 7.

Source: Customised data provided by the ABS.

If we compare these rates of growth with non-Indigenous rates for the same categories (Table 8) we see that growth in the Indigenous census count was much higher in all locational categories at roughly three times the non-Indigenous rate. As a consequence, the Indigenous share of population in each category also increased, with the most notable impact observed in remote towns and town camps where non-Indigenous counts declined.

However, if we consider these outcomes in light of our predictive model of population change we find considerable reason to be cautious about some of the conclusions, at least in terms of the strength of the trends observed. Thus, if we consider the IAs classified as city suburbs in Table 9 we can see that there are 141 of these (26.6% of the total), and that their aggregate Indigenous usual resident population count in 2006 amounted to 154,674 (34.1% of the total). By identifying which of these IAs had negative and positive discrepancies as per the model in Fig. 2, we can report the proportion that had an estimated undercount (43.3% in city suburbs).

Table 9. Estimated census undercount and 'overcount' by IA locational type

IA locational category[a]	Number	% of IAs	2006 usual residence count	% of 2006 count	% of IAs with estimated undercount
City areas	141	26.6	154,674	34.1	43.3
Large regional towns	94	17.7	106,762	23.5	34.0
Small regional towns and localities	112	21.1	76,073	16.8	34.8
Regional rural areas	22	4.1	10,819	2.4	27.3
Remote towns	36	6.8	31,920	7.0	58.3
Indigenous towns	79	14.9	50,655	11.2	49.4
Town camps	3	0.6	2,086	0.5	66.7
Remote dispersed settlements	44	8.3	20,423	4.5	68.2
All Indigenous Areas	531	100.0	453,412	100.0	43.3

a. Excludes usual residence not stated.

Source: Customised data provided by the ABS.

Moving down Table 9 on this basis, it is clear that IAs classified as Indigenous towns, remote dispersed settlements, and remote towns were the most prone to undercount in 2006, with high proportions of these reporting negative discrepancies. Many of the remote or Indigenous towns implicated here were in Western Australia, and included Port Hedland, Wyndham, Halls Creek, Fitzroy Crossing, Derby, Broome, Kalgoorlie, Coolgardie, and Leonora, while elsewhere Mt. Isa, Coober Pedy and Alice Springs (excluding town camps) were also notable. A majority of IAs incorporating outstation populations (as at Maningrida for example) also recorded lower than expected 2006 counts, which makes the very low estimated resident population (ERP) adjustment noted in Table 4 all the more surprising. In contrast, IAs in regional towns and localities, as well as in rural areas in regional Australia, tended to experience an 'overcount' in 2006. Prominent examples of this were Mackay, Tamworth, Taree and Coffs Harbour, where Indigenous population growth was between one-third and two-thirds higher than expected on the basis of net migration.

ERP: estimated resident population

As for city suburbs, these fell somewhat between the two extremes identified above with almost half of IAs indicating an undercount. This appears counter-intuitive given the outcomes estimated for regional areas and the experience of higher than expected Indigenous population growth that has been noted for major urban areas for the past two decades (Taylor 2003: 27-9). Aside from the few extreme cases that have been noted, this is likely to reflect methodological difficulties that are heightened in city areas in relation to the census count and in our subsequent modelling. Firstly, the Australian Bureau of Statistics (ABS) has reported increasing difficulties in undertaking the census in areas where a large proportion of dwellings are secure apartments or units. Biddle (forthcoming-a) has shown that overall almost 10 per cent of Indigenous households occupy flats, apartments or units while in Sydney, Melbourne, Cairns, and Darwin the proportion is much higher. Second, the migration data deployed are drawn from a Statistical Local Area (SLA) matrix. As a consequence, migration is understated for contiguous IAs that fall within the same SLA. A prime example of this are the seven IAs that all fall within the same SLA in the Blacktown district of Sydney and so all display the same net migration rate.

ABS: Australian Bureau of Statistics

SLA: Statistical Local Area

It is also important to recall that the results in Table 9 are based on a simple binary of outcomes from the net migration model into either negative or positive results, with no indication of the strength of these outcomes. In fact, the overwhelming majority of negative results for IAs in city suburbs, regional towns and localities and in regional rural areas (more than three-quarters), were only barely negative (less than half a standard deviation from the mean) and therefore close enough to zero to be of no further interest. In contrast, the majority of results in Indigenous towns, remote dispersed settlements, and remote towns and were substantially negative (more than 75% were greater than half a standard deviation from the mean).

On the basis of these collective observations we are now in a position to make two general statements in regard to the spatial structure of Indigenous population change. First of all, we cannot be confident about the size and direction of intercensal change in Indigenous population counts in many Indigenous towns, remote towns and remote dispersed settlements, except to say that the majority of IAs in such locations are statistically likely to have recorded an undercount in 2006. Our modelling suggests that the modest overall population increase recorded for the categories of Indigenous towns, remote towns and remote dispersed settlements should have been higher, with up to two-thirds of IAs associated with these sorts of locations recording lower counts in 2006 than expected on the basis of net migration. As a consequence, the increase in Indigenous share of total population in these same locations is understated.

In order to make sense of intercensal population change in these sorts of locations we recommend that 2001 and 2006 population counts for the relevant IAs are adjusted pro rata using ERPs for the relevant SLAs. However, even here there are difficulties, due to the expansion of the PES to remote areas in 2006 which no doubt will have the effect of inflating 2006 estimates relative to 2001 in many areas. Once again, migration rates might be deployed to identify locations where this issue arises.

Secondly, we are confident that the population levels reported in 2006 for the vast majority of city suburbs, as well as the many towns, localities, and rural areas of regional Australia (where most of the Indigenous population resides) represent a real increase in levels. However, many of the rates of population increase implied for these locations are substantially higher than demographic processes alone can account for. Accordingly, we recommend that any attempt to measure changes in population levels for these places should be based on a reverse survival to 2001 of the relevant 2006 SLA ERPs along the lines developed by Taylor and Bell (1998) with 2001 IA populations adjusted pro rata.

KEY FINDINGS AND RELATED ISSUES

Hugo (2007: 350) emphasises the significance of spatial context in influencing demographic, social and economic processes. Simply put, where people live has important implications for outcomes and therefore needs. Because most Australian data sources for the analysis of population characteristics have tended to be structured around administrative units, the challenge for applied policy research is to manipulate existing data in such a way as to situate populations according to their appropriate milieu. As a first step towards achieving this we have established a preliminary classification of locations with a view to assessing the utility of census counts for policy analysis. From this exercise, we are able to draw several conclusions that have consequences for data users and for further analysis.

First of all, in many parts of Australia, notably in Western Australia and many remote towns, Indigenous towns, and remote dispersed settlements, it needs to be understood that undercounting of the Indigenous population in 2006 has reduced the census to the role of a large sample survey, with the key output being population rates rather than population levels. Rates established net of non-response (on the assumption that the latter are evenly distributed for each population characteristic) can then be applied to population estimates to establish 'true' levels of important measures of policy interest such as employment or unemployment.

Of course, analysis of sample surveys relies on an assumption of randomness, or at least known clustering—hence to adopt the adjustment suggested above further research is required to estimate the types of people missed in both the 2001 and 2006 Censuses with a particular focus on the Indigenous population that was not counted. This can only be done indirectly using PES data on the age and sex distribution of those not counted, and it may be that such an exercise can only be conducted by ABS officials for confidentiality reasons. In the meantime, Indigenous population counts in many remote locations cannot be accepted at face value, and adjustments to levels have to be made using official SLA population estimates when these become available.

The converse of this situation of partial counting is common in most regional towns and city suburbs. Here, rapidly expanding Indigenous populations appear to be captured incrementally by each successive census, and the trend is one of continued growth beyond expectation based on demographic components of change. Whatever the cause of this rising census capture, it is a fact that the potential pool of self-identified Indigenous population in major cities and country areas is continually expanding, not least due to increasing births of Indigenous children to non-Indigenous women. In the previous intercensal period (1996-2001) such births were estimated at 27 per cent of all Indigenous births nationally and up to 40 per cent or higher in many parts of south-eastern Australia (Kinfu & Taylor 2005). This is in line with predicted outcomes calculated by Gray (1998) and the effect is to constantly augment the base of the Indigenous age structure in areas of high inter-marriage (such as urban and regional Australia) leading to high and sustained population momentum.

Combined with the fact that Indigenous inter-regional net migration rates tend to be lower than non-Indigenous rates, certainly for long distance migration and certainly in much of inland Australia (Biddle & Taylor forthcoming), policy-makers will need to get used to (and plan for) the fact that Indigenous people will comprise a steadily rising share of local town and country populations across almost all of regional Australia in the years ahead. Such a scenario has been sketched out before in respect of the Murray-Darling Basin (Taylor & Biddle 2004) but the message here is that the phenomenon is now widespread across the agricultural zone and is structural in its formation. Aside from higher Indigenous natural increase, a key underlying dynamic is differential net migration, with Indigenous net gain often contrasting with non-Indigenous net loss, especially among youth (Biddle & Taylor forthcoming; Argent & Walmsley 2008).

Particular locations that stand out as sustaining high Indigenous growth while the population overall is in decline or growing very slowly due to such processes include the towns of Taree, Armidale, Lithgow, Griffith, Dubbo, Wagga Wagga, Broken Hill, Renmark, Shepparton, Melton, Hervey Bay, Maryborough (Qld), Albany, and Geraldton. Of the remote towns, Kalgoorlie, Alice Springs and Katherine stand out—although we estimate Indigenous counts in most remote towns were deficient in 2006 and so this list should in all probability be extended. While this outcome of relatively high Indigenous population growth also applies to city areas, this is spatially more concentrated in particular neighbourhoods—an issue will be explored in detail in a future paper focused on urban segregation (Biddle forthcoming-b).

On reflection, the geography of the 2006 Census Indigenous count and its broad regional polarity of undercount and 'overcount' areas is highly instructive from a policy perspective. It points to a need to reassess the nature of population bases used as input in determining the quantum of fiscal resourcing for Indigenous policies and programs. This reassessment should consider implications for the both the historic adequacy of population-based funding and programs and for future demand for these.

First, there is the issue of historic adequacy. While the extension of the PES sample to include remote Indigenous communities for the first time in 2006 has finally uncovered the 'true' extent of undercounting, the revelation of very high rates in Western Australia, the Northern Territory, and to a lesser extent in Queensland leaves a substantial question lingering in relation to historic levels of funding for remote Indigenous communities and the means by which these have been established to date. Simply put, if we now know that thousands of Indigenous people are not enumerated, and that they are unlikely to have been adequately accounted for in previous post-censal estimates, then can we conclude that fiscal settings based on such estimates have been commensurately undervalued over the past 35 years?

If we can, then does this imply that services and programs provided to remote communities on the basis of official population estimates have been chronically inadequate? Is this one of the reasons we encounter chronic infrastructure backlogs in many remote communities (Ah Kit 2004) as well as a manifest mismatch between settlement size and basic service provision as noted, for example, by Taylor and Stanley (2005) in their comparison of services and infrastructure at Wadeye and Longreach? More broadly, at the jurisdictional level, what does this imply for the strength of disability weightings due to remote Indigenous population shares that have historically been applied by the Commonwealth Grants Commission in estimating fiscal redistributions?

While our findings relate to the adequacy of change in recent census counts, they nonetheless show that this is understated in particular types of locations. This reinforces the view that through time the operation of Federal-State financial arrangements has long been possessed of a structural bias against remote regions and Aboriginal communities (Dillon & Westbury 2007: 185-89). The sheer scale of what is now revealed about Indigenous undercount could trigger an argument regarding a possible case for some form of restitution via future Grants Commission adjustments. However, even if such a case were to be accepted, under current arrangements the Grants Commission does not take into account capital shortfalls, and there are no guarantees in any case that such adjustment monies would be expended in remote locations (Dillon & Westbury 2007: 186).

As for the issue of future demand, it is now almost predictable that Indigenous populations counted in many regional towns and major city locations will tend to be higher than expected at future census rounds. This is the sense of 'overcount' that we have attributed to rising census capture of a self-identified population. Previous research has shown that despite the contribution of non-demographic factors to the large increase in Indigenous census counts over the past 35 years, this has not been reflected in a commensurate compositional shift in the population, with many social indicators remaining relatively stable (Altman, Biddle & Hunter forthcoming; Hunter 2004). To the extent that this lack of relationship might continue, it seems reasonable to expect that future levels of census-identified needs will be inflated accordingly leading to a constant sense of catch-up. What our modelling reveals is the structural geography of this potential problem with an indication that many regional towns in particular are likely to face escalating needs. One way to anticipate this situation, rather than react to it after the event, might be through the judicious development of customised projections.

On a final note, while adjustments to census counts via the PES and other means can restore population estimates to more reasonable levels, there remain the problems of high standard errors around estimates and limited information on the characteristics of persons missed. To this extent the PES provides only a partial solution to census analytical difficulties. This is especially the case in remote areas where there is an urgent need for an improvement in the census counts themselves. Available research would suggest that this requires changed field procedures and more extensive and ongoing community engagement (Morphy 2007a).

APPENDIX 1

This Appendix provides a detailed discussion of a series of regressions with population change as the dependent variable. The first three regression models (models 1, 2 and 3) have a single explanatory variable only. These are, in order: net migration (the main driver of Indigenous population change); change in the non-Indigenous population; and the percentage of the population that reported Indigenous status in 2001.

The next model (model 4) aggregates IAs according to their 2001 remoteness classification as per Tables 3 and 4.[10] A separate coefficient is estimated for each of these categories (apart from that of major cities) which is used as the base case against which the other categories are compared. Since there may also be diversity within each of these categories, the next two models include two separate sets of continuous variables: the population density of the area (model 5), and the percentage of the population that reported Indigenous status in 2001 (model 6). The first of these variables gives an indication of the degree of urbanisation across the area, a characteristic that is related to, but separate from, remoteness. The second variable gives an indication of whether the count of Indigenous population is becoming more or less concentrated in areas that historically had relatively high proportions of large Indigenous population. The association between these variables and the main variable of interest is allowed to vary across remoteness categories.

A further spatial dimension is provided by State and Territory jurisdictions. This is represented in model 7, with New South Wales being the area against which population change in other States and Territories is compared. Finally, model 8 includes all the variables from model 4 to 7 to establish whether the results still hold after controlling for all other factors. The final estimate includes weights for the size of the Indigenous usual resident population in the area in 2001.

The results from the regression analysis are presented in Table A1 with the size and the direction of the association with each of the explanatory variables indicated by the respective coefficients. If we start with the results for model 1, these show a strong positive association between the estimated net migration rate for an IA between 2001 and 2006 and change in the Indigenous usual resident population over the same time period. In effect, an increase in the net migration rate of one per cent is associated with an increase of 0.767 per cent in the usual resident population. This confirms that, for the Indigenous population, internal migration is one of the main drivers of local area population change. However, while the size of the coefficient is reasonably large, the strength of the association (as measured by the adjusted R-Squared) is not. We exploit this relationship in developing our analysis in the main body of the paper.

Moving on to model 2, this reveals a small negative association between local change in the non-Indigenous usual resident population and local change in the Indigenous usual resident population suggesting that different dynamics operate for the two populations. One such influence might be the proportion of local population reporting Indigenous status (model 3). This shows that areas with a high percentage of the population reporting Indigenous status in 2001 had on average lower growth than those areas with relatively small Indigenous population shares. In other words, areas that were predominantly non-Indigenous in 2001 witnessed the highest growth in the Indigenous population in the subsequent intercensal period. This is consistent with the observed higher growth in the more populous States and in major cities and regional areas shown in Tables 1 and 3. It also points to a continuing trend in many of these areas towards higher local Indigenous shares of population as first noted by Taylor (2006).

Turning to model 4, this shows that, compared to major cities, inner regional areas had higher than average growth rates, albeit at the 10 per cent level of significance only. Compared to this, very remote areas had lower growth rates. However, when we control for population density across IAs (model 5) the association with inner regional areas is no longer significant and the size of the association with very remote areas decreases substantially. Furthermore, from model 6, when the Indigenous proportion of the population is controlled for, none of the remoteness variables are significant. This shows that there is more diversity within remoteness areas than there are differences between them which reflects some of the complexity shown in Fig. 2. Looking at the individual variables, areas with relatively high densities in major cities (typically inner city areas), inner regional areas and those in remote Australia all had lower rates of growth. In model 6, all of the remoteness categories had lower growth rates if they had a high percentage of the population who were Indigenous in 2001.

Model 7 reveals two jurisdictions with substantially lower growth rates than New South Wales, namely Western Australia and the Northern Territory. Given that the variable for the Northern Territory was not significant in model 8, it would seem that the association revealed by model 7 arises because IAs in the Northern Territory were generally in remote areas where Indigenous population shares are high. For Western Australia, on the other hand, a negative coefficient appears in model 8 as well, indicating that something unique occurred in that State leading to a growth rate that was relatively much lower than expected even after controlling for all of the above characteristics.

Table A1. Coefficient estimates: Regional change in Indigenous usual resident population

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 8 (weighted)
Net migration (2001 – 2006)	0.767								
Non-Indigenous population change		-0.012							
Per cent Indigenous in 2001			-0.312						
Inner regional area				7.212*	n.s.	n.s.		n.s.	8.360*
Outer regional area				n.s.	n.s.	n.s.		n.s.	n.s.
Remote area				n.s.	n.s.	n.s.		n.s.	n.s.
Very remote area				-12.547	-19.410	n.s.		n.s.	n.s.
Population density (major city area)					-0.004*			-0.005	-0.005
Population density (inner regional area)					-0.043			-0.046	-0.041
Population density (outer regional area)					n.s.			-0.010*	-0.012
Population density (remote area)					-0.050*			n.s.	n.s.
Population density (very remote area)					n.s.			n.s.	n.s.
Per cent Indigenous in 2001 (major city area)						-2.889		-3.187	-2.238
Per cent Indigenous in 2001 (inner regional area)						-1.332		-1.351	-1.637
Per cent Indigenous in 2001 (outer regional area)						-0.430		-0.405*	-0.219*
Per cent Indigenous in 2001 (remote area)						-0.517		-0.542	-0.311
Per cent Indigenous in 2001 (very remote area)						-0.335		-0.409	-0.259
Victoria							n.s.	n.s.	n.s.
Queensland							n.s.	n.s.	n.s.
South Australia							n.s.	-9.879*	n.s.
Western Australia							-21.603	-20.270	-12.801
Tasmania							n.s.	-17.816	-14.572
Northern Territory							-12.231	n.s.	n.s.
Australian Capital Territory							n.s.	n.s.	n.s.
Constant	12.234	12.395	19.338	13.337	20.169	19.075	19.143	33.880	27.664
Adjusted R-Squared	0.0461	0.0105	0.1043	0.0502	0.0766	0.1275	0.0500	0.1904	0.1846

Note: n.s. – not significant at the 10 per cent level.
* – significant at the 10 per cent level but not at the 5 per cent level.

Source: Customised data provided by the ABS.

NOTES

1. By this term we mean intercensal changes in Indigenous population counts that are higher (often much higher) than can be accounted for by demographic data alone. This is a different concept to that of 'gross overcount' as used by the ABS in determining the net result of the Post Enumeration Survey (ABS 2006). Our use of the term is subsequently developed in the paper to represent positive variance from a model of population change based on net migration rates.

2. As the 2001 and 2006 Census' are based on different Census Collection Districts (CDs), it is not possible for the ABS to construct official population based concordances. However after finding a number of anomalous results using the area based concordances supplied by the ABS, we constructed our own concordances that more explicitly take into account the uneven nature of boundary changes. Specifically, we used an area based concordance for 2006 Census CDs to 2001 IAs. We then used the usual resident total population for the Census CDs in 2006, weighted them by the ratio of the 2006 Census CD in the 2001 IA and summed them up to 2006 IAs. This gave an estimate of the ratio of the population in each of the 2006 IAs that would have been classified into each of the 2001 IAs using that classification scheme. On a practical note, while not perfect these concordances are a substantial improvement over the area concordances available from the ABS and it is recommended that they be used for any analysis of change through time in outcomes at the IA level. At the time of writing we are exploring licensing arrangements with the ABS to make Concordances that link 2001 to 2006 IAs and vice-versa available through the CAEPR website.

3. This is a national-level observation only. As will be revealed in a subsequent paper, residential segregation within major cities is actually increasing.

4. This adjustment leaves 400 IAs.

5. In future work we intend to remove as much of the error around the migration variable through more sophisticated modelling techniques. However, such techniques require a more detailed analysis of the factors associated with net migration, which will be the subject of future work in this project.

6. Since, by definition, the dependent variable has a mean of zero, models A and B do not contain a constant. However, to ensure that model C is able to be estimated, major cities are also set as the base case.

7. At the time of writing we are exploring licensing arrangements with the ABS to make the results for all IAs available through the CAEPR website.

8. It should be noted that for Fig. 5 and for the remainder of the discussion, we revert to the 2006 IA classification. This is done for presentational purposes and to maximise policy relevance as most funding decisions and analysis will be based on the latest geography.

9. In allocating IAs to one of these categories (Indigenous towns) we apply a somewhat subjective criteria based on the fact of a majority Indigenous population together with predominantly Indigenous governance arrangements.

10. The remoteness classification used is constructed from the 2001 SLA classifications which were converted to IA classifications using an area-based concordance.

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