ASSESSING THE SIGNIFICANCE OF INTERNAL MIGRATION IN DROUGHT AFFECTED AREAS: A CASE STUDY OF THE MURRAY-DARLING BASIN

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ABSTRACT: The Murray-Darling Basin is the heart of Australia's agricultural industry, representing 14 per cent of all agricultural output and housing almost 40 per cent of Australia's farmers. The area is also one of the biggest consumers of Australia's scarce water resources and was subject to a severe drought over the period from 1997-2009. The drought years placed intense pressure on agricultural communities and industries within the Basin. The drought and its effects have placed additional pressures on rural communities, with population growth in some areas decreasing or non-existent. Within this setting, this article analyses migration patterns and makes a judgement on how severe internal migration issues are in the Murray-Darling Basin. Conceptualising internal migration as a movement from one local government area to another, we find that although enduring a negative net migration pattern especially among the youth, the net migration in the Murray-Darling Basin during the drought is not significantly different to other areas in Australia.

KEY WORDS: drought; internal migration; out-migration; Murray-Darling Basin

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1. INTRODUCTION

Internal migration is an important measure of the gains and losses to populations in a particular area and, together with natural population change and overseas migration, forms one of the key elements for measuring population growth or decline (Voss *et al.*, 2001). Given that Australia's internal migration rate is one of the highest in the world (Bell and Hugo, 2000), this makes the contribution of internal migration substantially more significant in the Australian context. Internal migration also serves as a key indicator of the economic sustainability of specific areas and provides a critical component of labour market flexibility and the main channel through which the population adjusts to regional labour and housing market conditions (Greenwood and Hunt, 1984; Muhidin *et al.*, 2008).

The Murray-Darling Basin (MDB) is an area where the patterns of internal migration are even more essential to assess. It is an important and diverse area of land that has been bound together through one common factor – water. This valuable natural resource, combined with the change in the area's use towards primarily being a region that produces goods for human consumption, has seen it formally demarcated through both legislation and hydrological reporting. The MDB's importance to Australia's agricultural production is self-evident, generating almost 40 per cent of the national agricultural sector's production (MDBA, 2011). Over the past decade, from 1997 to 2009, the area has endured one of the longest drought periods, with consistently below median rainfall in southeast Australia (CSIRO, 2010). This has placed pressure on people residing within the MDB, which may result in a decline in the overall population as people exit, leading to the decline of the region itself.

There has been a large volume of research dedicated to examining the dynamics of internal migration especially in rural areas (see for example Alston, 2004; Argent and Walmsley, 2008; Gabriel, 2002; Hugo, 2001). Hugo *et al.* (2013) notes most areas with negative net migration were located in regional Australia. At the same time, non-metropolitan areas still have higher in-migration than out-migration. However, this is mainly in coastal and areas adjoining capital cities. The exception to this pattern is regional young adults moving to the metropolitan areas, which is possibly explained by this demographic relocating for the purposes of education or getting their first job (Hugo *et al.*, 2013). The analysis of internal migration patterns in rural areas is important for our purposes as we are able to use it as a starting point to examine whether the growth area can sustain a larger population, as well as allowing us to examine the

survival of an area with continuous negative net migration. The analysis may be of use in determining infrastructure investment strategy, or to assess whether the distribution of resources such as water could match the population distribution (Hugo and Harris, 2011). In light of this, the lack of research examining migration patterns for the MDB, a region that has faced a decade of drought, is surprising. The main interest of this article is the severity of internal migration issues in the MDB. We will also focus on a number of key research questions, including: do migration patterns within the MDB differ from the rest of Australia? And can these differences, if they exist, be classified as severe?

The sub-section 'The Murray-Darling Basin' of this introduction briefly describes the MDB as the area of study in this article. This is followed by the sub-section 'internal migration' that describes the main indicator and the reason why the indicator is chosen. The section 'methodological approach' presents data sources, the spatial unit and the statistical measure used for assessing the internal study of the MDB. The results and discussion about the potential impact on the MDB follows the methodological approach. Finally, the article is concluded.

The Murray-Darling Basin

Covering an area of over one million square kilometres in south-eastern Australia (about the size of South Africa) and occupying around 14 per cent of the Australian land mass, the MDB is a highly important economic, social and environmental region in Australia (Rao *et al.*, 2013). Currently, around two million people reside in the Basin, with the area covering over three-quarters of Australia's most populous state – New South Wales (ABS, 2008). The Basin's economy is dominated by agriculture, and in turn, agricultural production in the region contributes significantly to Australian agricultural output. Almost 40 per cent of Australia's farmers reside in the Basin, and the Basin produces 14 per cent of total Australian agricultural production and around one-third of Australia's food supply. Within the Basin itself, Agriculture, forestry and fishing businesses total over 65 000 entities, representing close to one-third of all businesses (MDBA, 2011).

The issue of water often dominates discussions about this area, with the Millennium drought intensifying the rhetoric and political activity around water resources. The Basin includes 65 per cent of Australia's irrigated land and uses more than two-thirds of Australia's water. In 2005-06, the MDB's irrigated agriculture accounted for around 37 per cent of the

Basin's gross value of agricultural production. Therefore, the main concern adding to the issue of migration in the basin is related to the severe drought years from 2001-2010. This drought has had many consequences for the economy (Wittwer and Griffith, 2011; Kirby *et al.*, 2012) and society (Berry *et al.*, 2010) of the region, such as a reduction in production, a decrease in employment and an increase in physical and mental health issues (increased suicide rate).

The key question this article aims to address is whether or not the MDB has experienced severe internal migration, with negative net internal migration increasing during the intense drought period. To examine this issue, we must first define the MDB.

A number of delineations have been used to define the MDB - all for different yet related purposes. However, there is one commonality among the areas that lie within - water sources form part of the basin. This article applies the definition used by the Murray-Darling Basin Authority (MDBA) which is the main authority that deals with the progress and decline of this area. The area has been defined under the Water Act 2007 and is based upon the boundaries specified in 'Australia's River Basins 1997' dated 30 June 1997 (Geoscience Australia, 1997).

Internal Migration

Conceptualising and defining migration has been the source of numerous discussions throughout the discipline of demography, particularly as migration cannot be as definitively identified or measured as other concepts or events, such as births or deaths (Greenwood, 1997). Consensus has generally been achieved, with migration typically defined as the change of residence that crosses jurisdictional boundaries, measured in terms of usual residence at a prior point in time, typically one or five years earlier (Greenwood, 1997). Between the two measures (that is, one and five years), the use of five year periods is more favourable as Bell and Muhidin (2009) argue that it can "best reflect contemporary spatial patterns of redistribution, free from the influence of short term period effects which tend to distort patterns over a single year".

As outlined in the introduction, our primary focus is on a specific type of migration - internal migration, within both Australia and the MDB, and comparisons between the two. This indicator is a key indicator of the economic sustainability of areas, providing a critical component of labour market flexibility and the main channel through which the population adjusts to regional labour and housing market conditions (Obstfeld and

Peri, 1999). The Australian Bureau of Statistics defines internal migration as "the movement of people from one defined area to another within a country" (ABS, 2011). This definition implies that defining areas and the person who is deemed to be an 'internal migrant' are important considerations for this type of research. For example, in studies that seek to determine migration patterns in relation to local labour markets, areas that best delineate these markets need to be adequately determined for correct comparison. Often a specified minimum distance of travel is used to determine whether an individual or household has really migrated in or out of a uniquely identified community (Greenwood, 1997).

One important issue regarding internal migration is how the patterns differ among age groups, particularly in rural areas. In general, it is important to observe different characteristics of people that may determine not only the decision to migrate, but also the choice of destination, as individual circumstances as well as an individual's stage in their life course are often influential in such decisions (Stillwell and Dennet, 2012). In the case of the MDB, age group is arguably one of the most important characteristics since out-migration of younger people is a long standing and continuous issue in rural areas (Clawson, 1963; Gabriel, 2002; Tonts, 2005). Other age-specific migration issues around youth exodus are more dynamic. For example, Barr (2004) notes that in the 1970s and 1980s, patterns of rural youth exodus have become important as in-migration declined rapidly in 1990s, and is related to an increasing trend in older age farmers having to stay on working due to a lack of younger replacements.

2. METHODOLOGICAL APPROACH

Data Source and Spatial Unit

The data source used to assess recent internal migration in the MDB and the rest of Australia is the ABS 2011 Census of Population and Housing. The majority of internal migration statistics are reported at a five-year time-frame. The population in scope for this measurement includes persons aged 5 years or more who responded to the questions 'where does the person usually live' and 'where did the person usually live five years ago'. One difficulty in analysing migration movements is that the characteristics of the person reflect the condition on Census night; the condition after, rather than before, they moved.

For the purpose of this study, a number of spatial units were explored as potential base units for our analyses. This was particularly prudent, given the new Australian Standard Geographical Structure (ASGS) that accompanied the latest Census. The ASGS has now replaced the Australian Standard Geographic Classification (ASGC); with the Statistical Local Area (SLA) unit remaining as an interim geography to allow comparison between Censuses.

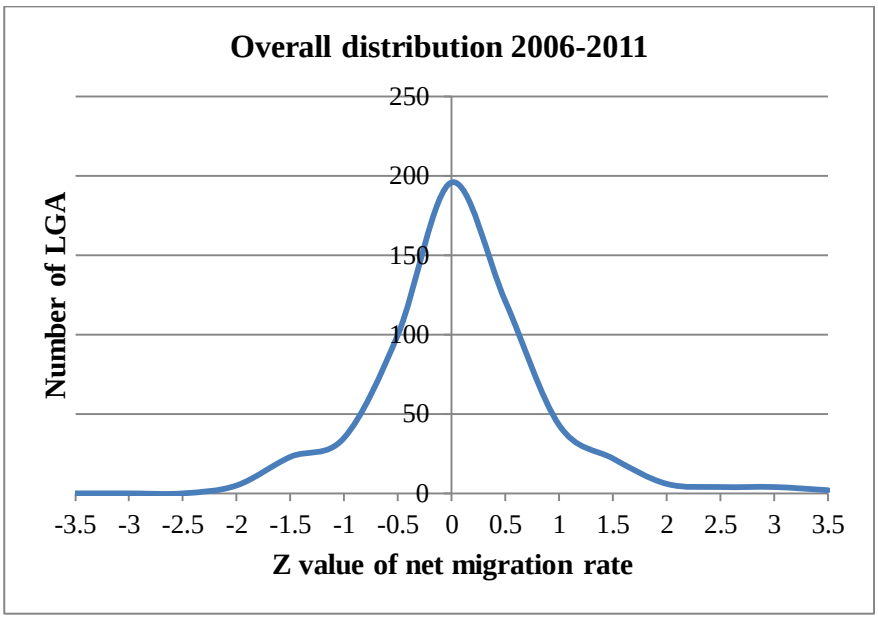
Our selected defined area is Local Government Area (LGA), with internal migration defined as movement from one LGA to another. The LGA area has been selected as the underlying base unit for a number of reasons, particularly its representation of an area denoted by administrative boundaries, and ease of identification and relating to areas being analysed. It is important to note that there are limitations in the selection of LGA as the underlying base area of analysis, as these regions are not always as homogenous as one would expect, and instead lend themselves to out-dated administrative boundaries rather than being defined by common factors such as economic, social and community activities (Hugo, 2007). To examine this migration, a matrix was constructed that cross-classified LGA of usual residence five years or one year ago.

As with any spatial unit or definition of 'area', a number of limitations exist. This includes the relatively small distance between some LGAs (or central localities within them), making the boundaries and occurrence of community exit or entry less distinct.

A number of concordances have been developed to allow for consistent measurement of spatial units and the MDB as an entity. The first relates to aligning SLAs to LGAs within the 2006 matrix constructs. A further concordance was required to delineate the MDB region as per the Water Act 2007. If the majority of the population (as defined by the location of urban localities) was within the MDB boundary, then the LGA was considered to be within the MDB.

Statistical Measure

The crucial contribution of this article is to assess the severity of the net migration outflow in the LGA of the MDB. In order to determine the severity of internal migration out-flows, we apply statistical inference based on a Z-test. This is because the distributions of net migration rate in Australia resemble the Bell shape of a normal distribution, with the mean value around zero (Figure 1).



Source: Authors' calculations from ABS (2011) Census of Population and Housing

Figure 1. Distribution of net internal migration, 2006-2011.

The test will help us infer whether the negative migration rate observed within the MDB is significantly different from zero. The test statistic is defined as

$$Z = \frac{X - \mu_0}{s}$$

where X is the net migration rate, s is the standard deviation of the net migration rates for all LGAs in Australia, and μ_0 is the average of the net migration rates for all LGAs. All these values are unweighted.

The net migration rate indicates the rate of decrease or increase of the population due to internal migration. The value of μ_0 is expected to be equal or very close to zero nationally as the movement out of one area means movement into another area, cancelling each other out.

The five and ten per cent tail of the normal distribution or significance level are often used to determine the critical value that can be used to determine if a certain rate is (statistically) significantly higher or lower relative to the average based on a normal distribution. For this analysis,

we adopt a significance level of 10 per cent. The choice of the critical value of 10 per cent in a two-tailed test means that if the net migration rate is normally distributed, there is a 95 per cent chance that values in the upper and lower tails of the distribution will differ from the average by no more than 1.28 standard deviations. Besides statistically significant values, we will also differentiate values that are within 10 per cent of the normal distribution from zero as 'around zero' while values exceeding that but less than the cut-off for significantly positive and negative, as positive and negative not significant, respectively.

This assessment produces five classifications of net migration by LGA – significantly positive, positive but not significant, around zero, negative but not significant and significantly negative. These five classifications are presented in choropleth maps containing five greyscale colours. Darker colours indicate more negative net migration and the lightest colour indicates a significantly positive net migration rate.

Another approach that we took to analyse the severity of migration issues in the MDB is by looking at two key indicators that are directly affected by migration, human capital, and employment.

3. SUMMARY STATISTICS

Here we provide an overview of persons staying in the same LGA or moving to a different LGA (internal migration), within and outside the MDB across the last decade (Table 1). The data indicates that people in the MDB are less mobile than those outside the basin. Among residents living outside the MDB, the proportion that stayed in the same LGA between 2010 and 2011, was slightly lower – 92.9 per cent for those outside the MDB, compared to 94.2 per cent for those in the MDB. Looking at five-year mobility patterns, the increase in the proportion of people remaining in the same LGA within MDB areas was 80.1 to 82.6 percent. However, this was also the case for areas outside the MDB. A slight increase in the proportion of the population staying in the same LGA when comparing figures from MDB areas in the 2011 and 2006 Censuses is also observed.

Table 1. Mobility Within and Outside the MDB (%).

				Migration	
		Place of residence	Stayed in the same LGA	Within MDB	Outside MDB
1 year mobility	2010-11	Outside MDB	92.9	0.4	6.7
		MDB	94.2	2.3	3.5
	2005-06	Outside MDB	92.6	0.4	7.0
		MDB	93.5	2.9	3.6
5 year mobility	2006-11	Outside MDB	80.1	1.2	18.6
		MDB	82.6	6.4	10.9
	2001-06	Outside MDB	78.2	1.3	20.5
		MDB	80.1	8.2	11.6

Note: The proportions were calculated as the ratio of population totals for each year/area. The denominator was the population for the 'previous year' where previous year could be 2010 or 2005 for 1 year mobility, or 2006 or 2001 for 5 year mobility. **Source:** Authors' calculations from ABS 2006 and 2011 Census of Population and Housing Table Builder.

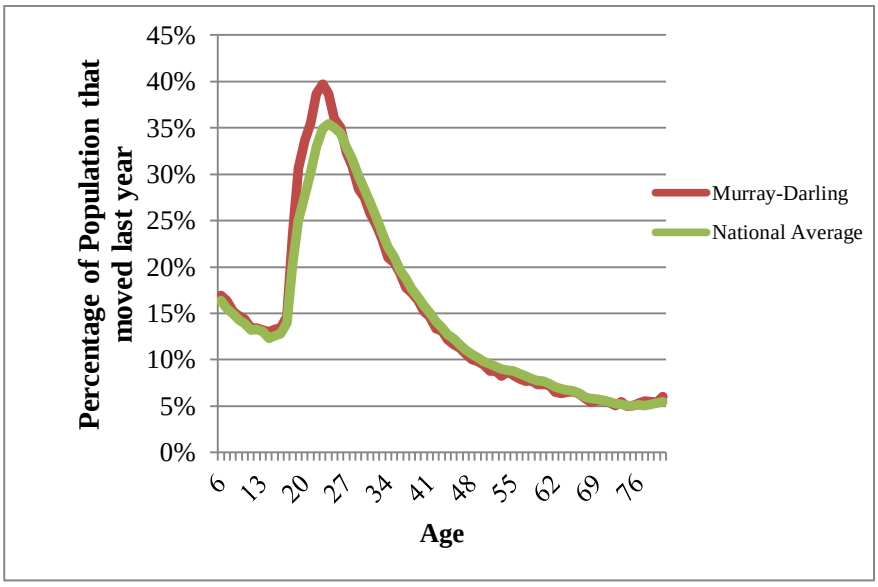
Observing where people moved either within or outside the MDB, there is an indication that more people from the MDB moved to areas outside of the MDB, rather than to another LGA within the MDB. Although this difference is not large there is an increase in this pattern when comparing both 1 and 5 year mobility patterns.

While these statistics illustrate broad patterns of mobility in and outside of the MDB over the past decade, they conceal underlying patterns for particular population groups. These patterns can differ considerably, particularly among different age groups. Argent and Walmsley (2008) point out that although the issue of young people moving (especially those aged 15-24) has become such a hot issue in rural areas, it is important to examine these trends carefully, as the movement of this age group is generally high in almost all locations in Australia. Census data offers a good opportunity to investigate recent age-specific migration patterns. By investigating people's place of residence in the previous year, a very distinct pattern emerges from the data. As seen in Figure 2, the age-specific migration rate is clearly right-skewed. Young people,

especially those aged between 20-35 years, move much more than those living beyond their 36th birthday. The migration rate after age 26 decreases steadily, to around 5 per cent at age 70. Infant and young children's mobility is comparable to age 30-40, corresponding to the age of their parents.

By comparing the MDB area with the national average, we find that young people in the MDB seem to be even more mobile. Nearly 40 per cent of individuals aged 22 in the MDB said their place of residence had changed between 2011 and 2012. This compares with the national average of 35 per cent.

It is worthwhile to point out that the actual migration rate might differ slightly from what has been shown due to the fact that the Census did not collect previous residential information for all individuals and cannot track individuals who have moved overseas.



Source: Authors' calculations from ABS 2011 Census of Population and Housing.

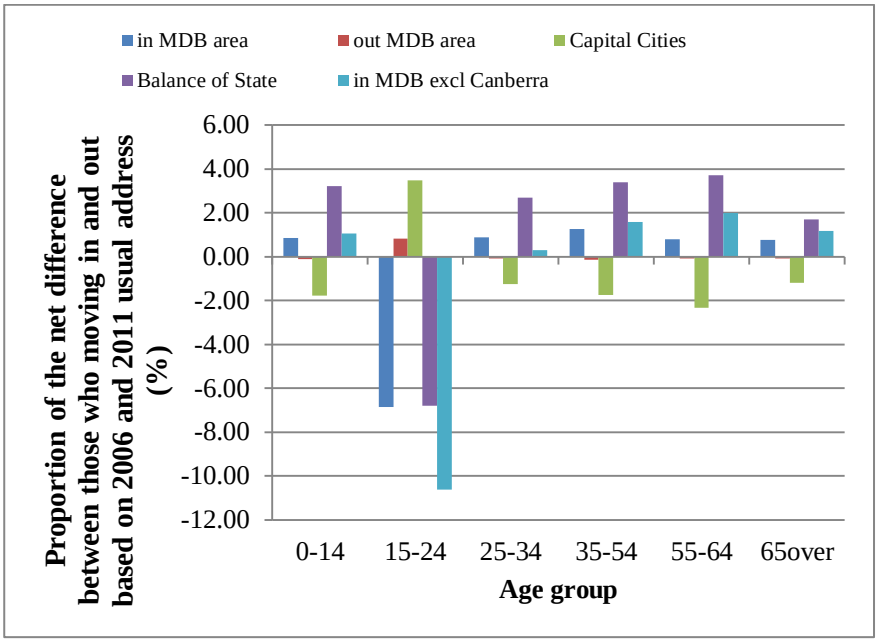
Figure 2. Age-Specific Internal Migration, MDB and National Average, 2010-11.

Young people in the MDB are not only moving more, they are also more likely to move outside the MDB. Figure 3 shows the net migration rate based on the LGA usual address of 2011 and 2006. It shows that the net migration of those aged 15-24 in the MDB, is not only negative, but

that the rate is much higher than any of the others. At almost 7 per cent, the rate of out-migration is as high as the rate of out-migration from the balance of Australian states and territories. Excluding Australia's capital (Canberra), which lies within the MDB, from the analysis, the rate is even higher - above 10 per cent.

Within the MDB, the net migration rate of other age groups is positive – a similar pattern to that in other balance of state areas. However, in general the positive rate in the MDB is much smaller than the non-capital city areas. It is important to note that balance of state areas include some outskirt areas of capital cities and regional urban centres such as Newcastle and Wollongong. Therefore, migration towards the balance of state area would naturally include some movement of families who are trying to find a bigger house or older people finding a place to retire. In general, the positive net migration is higher when Canberra is excluded except for the 25-34 year age group. This means that relatively, there is still a movement toward Canberra for this age group. On the other hand, the in-migration rate is much higher when Canberra is excluded from the 55-64 age group (those nearing retirement age), indicating that this age group may be moving out of Canberra, possibly to the surrounding MDB area.

Argent and Walmsley (2008) argue that mobility patterns, especially among younger age groups, is often over-generalised as rural-urban movement, while variations in movement patterns to surrounding areas or small rural towns can be just as important. Although the data indicates that there were growing differences between migration patterns in and out of the MDB, there is no strong basis to judge whether the migration pattern in the MDB is really that different from outside the MDB area, and hence whether it can be considered as severe.



Note: Balance of State refers to all areas throughout Australia, excluding respective state and territory capitals. **Source:** Authors' calculations from ABS 2011 Census of Population and Housing.

Figure 3. Net Internal Migration by Age Group, in MDB, Capital cities and Balance of State.

4. RESULT AND DISCUSSION

Figure 4 shows the spatial distribution of net migration over the period 2006-2011 based on the five classifications described above. It indicates that in general there is negative net-migration throughout LGAs in the MDB. This is dominated by areas in the centre of the basin, while those with high positive migration rates are located near capital cities and/or hubs for educational institutions. These include Yass and Palerang bordering Canberra, Bathurst to the west of Sydney, Alexandrina to the east of Adelaide, Mitchell and Mansfield in the north of Melbourne.

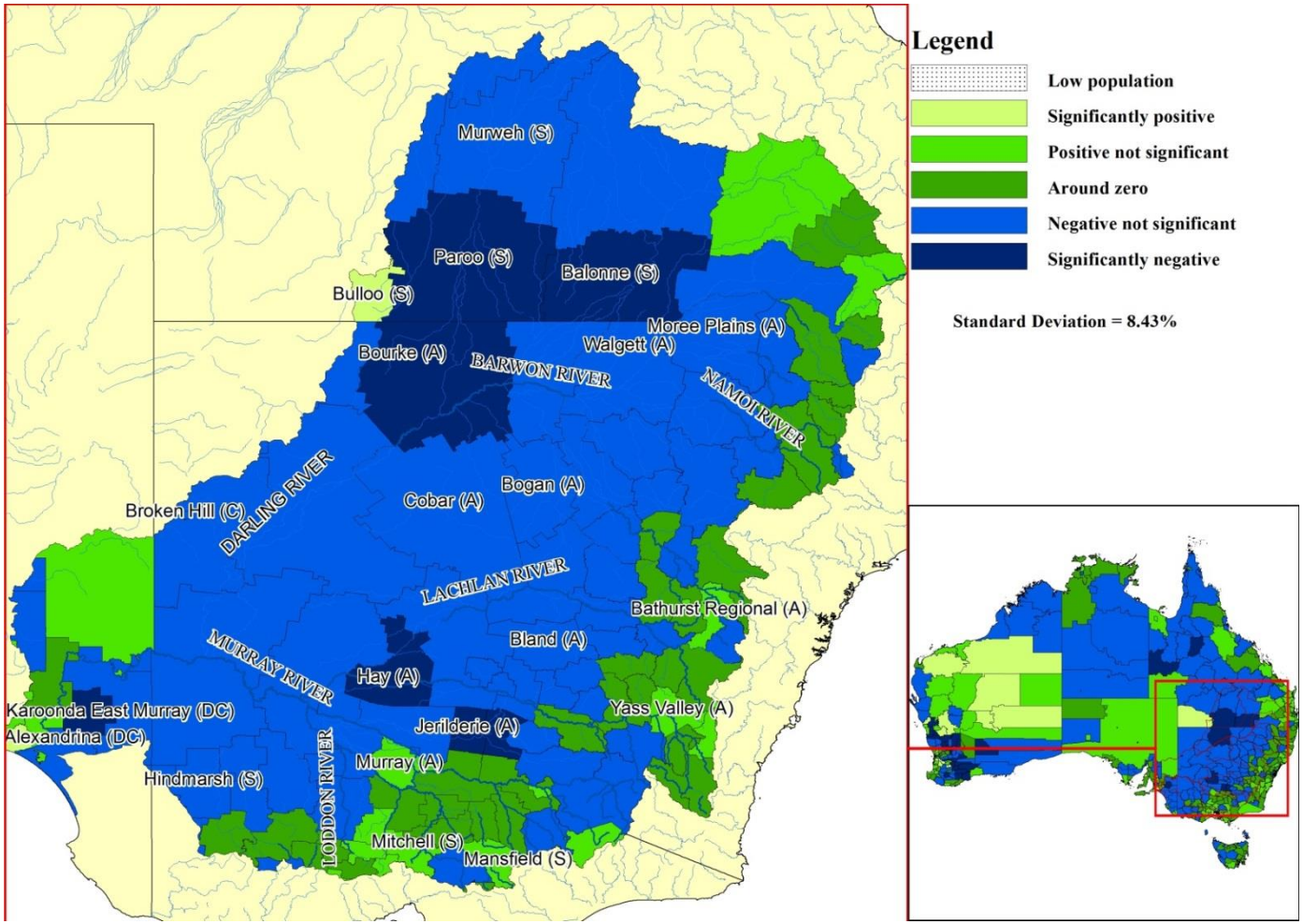
Despite the negative net migration pattern, most net migration rates in the MDB are not significantly different from the net migration pattern throughout Australia. This means that the negative pattern in the MDB is not much higher than the rate in other places in Australia. The inset map of Australia in Figure 4 indicates that the negative pattern in the MDB resonates with the common theme of migration in Australia — out-

mobility from regional areas and especially outer regional areas, and a massive influx towards mining areas in Western Australia.

There are some areas in the MDB that do have a significantly high rate of negative net migration – Balonne, Paroo, Bourke, Hay, Jerilderie and Karoonda East Murray. Among MDB areas, Hay has the most significant negative migration rate at -15.3 per cent. Hay is primarily an agricultural area, however, the proportion of people working in agriculture decreased from 31 per cent in both 2001 and 2006 to only around 22 percent in 2011.

Given the important issue of young migration, we analyse the spatial migration patterns for the younger age groups of 15-24 and 25-34. The standard deviation of the 15-24 year age group net internal migration rate is 23.3 per cent: almost triple the 8.4 per cent standard deviation of net migration for the overall population, indicating greater variability in younger populations. In addition, Figure 5 shows almost all areas within the MDB have a negative net migration rate for this age group. Although we have taken into account that the rate of movement of this younger age group is much higher than the overall population, the areas stretching from Hindmarsh to Hay and Weddin are identified as having significant negative net-migration of young people.

Compared to other areas in Australia, the negative pattern of net-migration of young people is more pronounced in the MDB. Only a small part of north Queensland and less in the Northern Territory show significant negative patterns. However, a large part of Western Australia outside Perth, in the wheatbelt region, is also showing significant negative net-migration rate. In addition, Figure 5 also shows some areas within the MDB have also become destination areas. These areas are Canberra, Wagga-Wagga, Bathurst and Armidale. One common feature among these areas is the existence of higher degree education institutions, with Charles Sturt University located in both Wagga-Wagga and Bathurst, The University of New England in Armidale, and Canberra being home to the Australian National University, University of Canberra, the Australian Catholic University and Australian Defence Force Academy.



Notes: The MDB boundary is based on the spatial definition of the MDB Authority, with LGAs on the boundary being defined to be within or outside the MDB based on the greater proportion of the population within or outside the boundary. The significance thresholds were based on a significance level of 10% of a normal distribution. **Source:** Authors' calculations from ABS 2011 Census of Population and Housing.

Figure 4. Net Internal Migration in the MDB, 2006-2011.

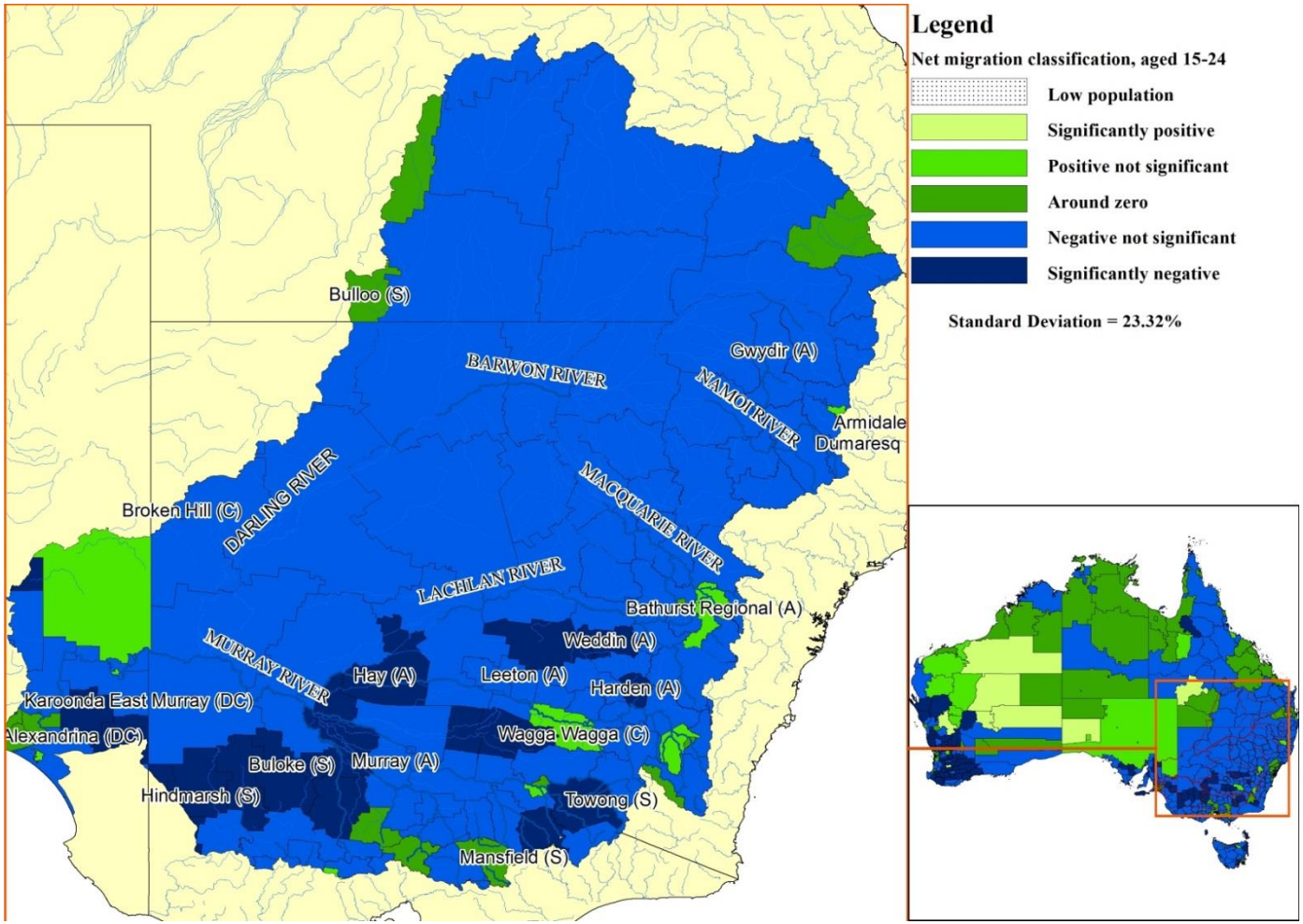


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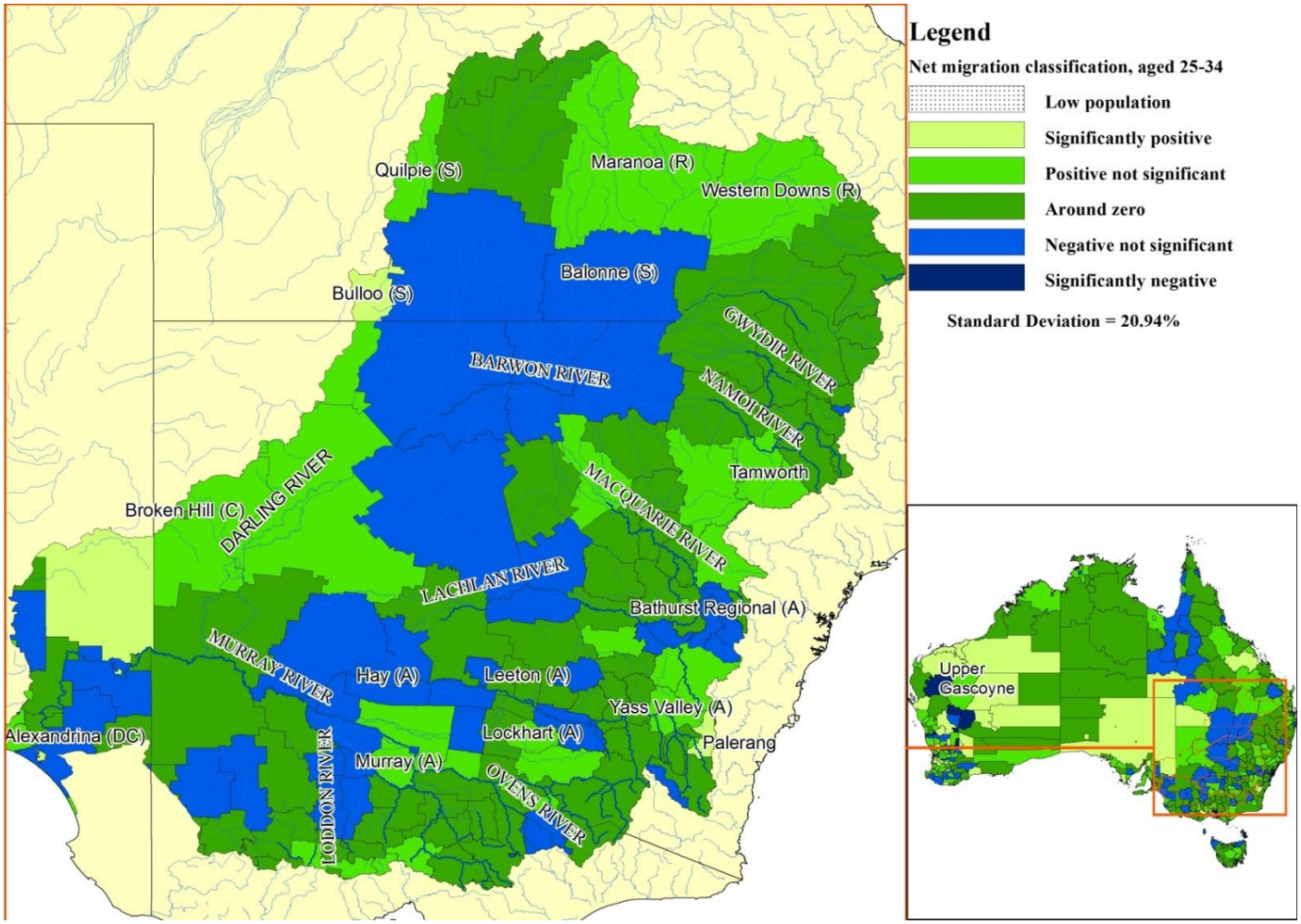
Figure 5. Net internal migration in the MDB, 15-24 year olds, 2011.

Figure 6 shows the significance of net migration patterns for 25-34 year olds. With the standard deviation of movement around 21 per cent for this group, the mobility of persons aged 25-34 years is lower than that of the 15-24 years groups, but the standard deviation still remains high when compared with all other age groups. A significantly high out-movement is detected from Armidale at the east edge of the MDB area. This indicates that possibly young people who come to Armidale to study are not staying after obtaining their degree. To a lesser extent, out-migration of this age group is also occurring in Wagga-Wagga. For Canberra and Bathurst, net movements are closer to zero.

One important feature for this age group is that there are several areas in the MDB with positive net migration. It may not be statistically significant due to the fact that the mining areas in Western Australia dominate this positive net migration, but given the high standard deviation, the number may still be important. The positive net migration detected for this age group is observed in the MDB areas of Tamworth, Central Darling, Lockhart, Murray, Orange and Weddin. This could be a sign that some students are moving back to their place of origin once graduating from university. Maranoa and Western Downs in Queensland are largely agriculture areas but contain substantial employment in retail (such as Dalby and Tara in Western Downs or Roma in Maranoa), health and community service (such as Roma in Maranoa), education (such as Tara in Western Downs and Bendemere in Maranoa) or increasing construction work (such as Chinchilla in Western Down). These areas also have large scale mining operations (coal, CSG and petroleum). In addition these conditions would be influencing positive net migration for this age group and local employment in other sectors.



Notes: The MDB boundary is based on the spatial definition of the MDB Authority, with LGAs on the boundary being defined to be within or outside the MDB based on the greater proportion of the population within or outside the boundary. **Source:** The significance thresholds were based on a significance level of 10% of a normal distribution. Authors' calculations from ABS 2011 Census of Population and Housing

Figure 6. Net Internal Migration in the MDB, 25-34 years, 2006-2011.

To summarise, the rate of negative net migration in the MDB appears to be not as significant as first thought, with many migration rates in many areas throughout the MDB largely similar to national averages. However, for some areas and age groups, significantly higher net negative migration rates prevail, especially in relation to young people aged 15-24 years. Despite this these rates are not dissimilar to those observed in other agricultural areas throughout Australia, such as the Wheatbelt in WA. Employment opportunities for this group were likely to have suffered considerably due to the impact of the Millennium drought on local industries, with younger people left no choice but to pick up and look for work elsewhere, or move to locations where they may study for a number of years. While not significant, we also observe movements towards areas within the MDB among those in their mid-twenties and beyond, inferring that circular migration may be a common characteristic among some MDB communities.

There is also evidence that the population balance of the MDB is moving towards the eastern part of the Basin. Apart from education and possibly work opportunities these changes may also be triggered by the movement of older people to areas with greater access to health and other facilities that are required in later life.

5. CONCLUSION

In this article we have sought to examine the intensity of internal migration patterns within the MDB over a period of severe drought, which has placed pressure on rural communities across Australia. The results have shown that over the last decade, people in the MDB have been less likely to move, than those living outside the Basin. However, for those that did move, they more often moved outside the Basin than within. The destination suggests that better labour force and educational opportunities are the main pull factor.

Within the MDB most areas displayed patterns of negative net migration between the 2006 and 2011 Census periods, however, these patterns were not markedly different to those for other areas throughout Australia. Differences do begin to emerge when looking at rates for specific sub-populations. Using statistical inference based on the distribution of net migration rate in Australia, we find that the negative net migration for the younger segment of the population is more pronounced in the MDB than it is in other areas of Australia, particularly in areas dominated by agriculture such as Hay and Weddin. However, these patterns are not dissimilar to other agricultural areas in Australia –

such as the Wheatbelt, West of Perth. It is important to note that internal migration flows and the standard deviation of this age group is very high overall, with the standard deviation for the internal migration rate of 15-24 year olds three times that of the general population. Population movements for young people are common, with young people more likely to move to enhance human capital through either education or work or a combination of both. However, these movements have been stronger for this group within particular areas of the MDB over the course of the drought, with local job opportunities diminishing, as local economies weaken.

This research offers a contemporary picture of the internal migration patterns of the MDB. The results indicate that although the MDB is facing a reduction in population due to internal migration, the pattern does not differ significantly from other regional areas. As such, we may argue that there is no necessity to have a specific migration policy in this drought affected area. Instead, there is a necessity to have an overarching policy that examines the overall issue of this inter-regional pattern of migration. However, many steps must be taken before we are able to have that discussion. For example, in our study we were unable to differentiate between permanent and transitory mobility. It is speculated that circular migration may be closely related to the development of infrastructure, especially transport and communication (Bell 2001). This includes road transport, as well as the development of internet connections and fly-in fly out and drive-in drive-out modes of transport. Future research may investigate this issue with the availability of longitudinal census information.

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