Australian Bureau of Statistics

A DATA QUALITY FRAMEWORK FOR THE AUSTRALIAN GOVERNMENT'S DIRECT MEASURE OF INCOME FOR CAPACITY TO CONTRIBUTE

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CONTENTS

EXECUTIVE SUMMARY

Introduction

This report by the Australian Bureau of Statistics (ABS) provides a statistical quality framework for the Australian Government's direct measure of income (DMI) score.

The use of a DMI in capacity to contribute (CTC) scores was adopted by the Australian Government in September 2018[1], in response to recommendations from the National School Resourcing Board (NSRB)[2] and, previously, Gonski et al in 2011[3]. CTC scores inform the assessment of non-government school communities' capacity to contribute financially to their school operations. As part of implementing DMI scores, the Department of Education, Skills and Employment (the Department) engaged the ABS to:

1. evaluate the statistical fitness-for-purpose, or quality, of the DMI score, focusing on how well it calculates the median income of school communities; and
2. develop a quality assurance process to support the annual production of the DMI score.

This framework constitutes ABS' response to that engagement. It describes the DMI score and presents a summary of ABS's evaluation of it, including analysis, key findings and recommendations.

The report also describes a comprehensive quality assurance process which uses statistical quality gates[4]. This process was co-designed by the ABS and the Department and will be implemented from 2020. The co-design approach has allowed for the best practice application of statistical quality management techniques, while also meeting the practical needs of the new CTC policy settings.

As part of the adoption of the DMI in 2018, the ABS provided statistical advice in relation to its design. This report focusses on the quality of the results achieved by the DMI and the appropriateness of the available data sources. The ABS's evaluation focuses on the quality of DMI scores from a statistical viewpoint only and does not comment on school funding policy. References by the ABS to aspects of CTC policy implementation are correct at the time of writing.

Quality evaluation

The data for the DMI score is produced via a data integration process which links administrative data from the Department's Student Residential Address and Other Information Collection (Address Collection), to the Multi-Agency Data Integration Project (MADIP) data asset. ABS's evaluation of the quality of the DMI score has included:

[1] Australian Government (2018). *The National School Resourcing Board's Review of the socio-economic status score methodology, Australian Government Response*. https://docs.education.gov.au/node/51416
[2] NSRB (2018).
[3] Gonski, D. et al. (2011) *Review of Funding for Schooling – Final Report.* https://docs.education.gov.au/system/files/doc/other/review-of-funding-for-schooling-final-report-dec-2011.pdf. See: Chapter 2, Section 2.3: Socio-economic Status funding model.
[4] A quality gate is a statistical risk management tool. It acts as a checkpoint, at which a defined set of assessments are made, to determine whether to proceed to the next stage of the process. See the Glossary for more information.

- reviewing the DMI score based on the ABS Data Quality Framework;
- evaluating the end-to-end statistical production process for the DMI score, from data collection to output, including the quality assurance processes undertaken at each stage;
- developing quality metrics to analyse school community data, in particular:
    - data linkage results and income data coverage;
    - coherence between income data sources used in the direct measure;
    - the effect of unlinked records or missing data, and imputation methods;
    - the impact of school characteristics such as size, growth and income distribution; and
    - alternative measures, calculations and data sources for validation.

Based on these investigations, the ABS considers the DMI score is based on a statistically sound approach which makes use of the best available data for measuring the median income of school communities. The DMI score:

- uses the most relevant data to assess the target concept of median income for the school community population; and
- uses the most timely data, since it can be updated annually.

In most cases, median incomes produced using the DMI are expected to be fit-for-purpose estimates of true school community median incomes.

The framework aims to identify and treat cases where available data may not be sufficient to support an accurate assessment of median income for a school community. This process is described in detail in Quality Gate 3: Examine school scores.

Quality assurance process

Section 4 of this report describes a set of quality gates to support statistical quality throughout the DMI production process:

- *Quality Gate 1: Collect and prepare input data* supports data governance and the quality and the completeness of each input dataset.
- *Quality Gate 2: Standardise, link and assemble* identifies major errors in the source data that impact on linkage quality and flags unexpected linkage quality outcomes for follow-up.
- *Quality Gate 3: Examine school scores* supports the validation of DMI scores, the identification of DMI scores with potential quality issues, and decision-making by the Department about cases in which the DMI score may not be the most fit-for-purpose estimate and should not be used.
- *Quality Gate 4: Protect privacy and release* checks that all final privacy and confidentiality protections are applied in accordance with legislative requirements so that data can be released from the ABS DataLab.
- *Quality Gate 5: Review and evaluate* provides for annual review of the quality assurance processes.

SUMMARY OF RECOMMENDATIONS

Overall, the DMI is considered fit-for-purpose, however, the following recommendations may further improve quality and are proposed for consideration.

Recommendation 1: Review data linking methods to improve linkage rates.

Linkage rates underpinning the direct measure are high. While this creates a high quality result for the majority of schools, some schools have lower linkage rates. Annual improvements to data linkage capabilities, commencing in 2020, will improve overall linkage rates. In addition, investment in improving linkage methods for some sub-populations may result in further quality improvement for some school communities.

Recommendation 2: Consider further options for imputing income when ATI is not available.

In the DMI, adjusted taxable income (ATI) is the primary source of income data. In 2019 ATI was available for 77% of parents. For other parents, an alternative income estimate is sourced from information such as payment summaries or social services data. This is robust for the purpose of estimating DMI. However, given the richness of the other data available, there may be opportunities to further improve data quality using imputation, but this requires further exploration.

Recommendation 3: Investigate options to improve timeliness on a regular basis.

While the DMI score is considered a timely statistic overall, the ABS recommends that options to improve timeliness be investigated on a regular basis. These investigations should consider new opportunities to directly measure income which may arise due to changes in reporting requirements within the tax and other administrative systems.

SECTION 1 INTRODUCTION

1.1 The Data Quality Framework for the Australian Government's Direct Measure of Income for Capacity to Contribute

The *Data Quality Framework for the Australian Government's Direct Measure of Income for Capacity to Contribute* has been produced by the Australian Bureau of Statistics (ABS) at the request of the Department of Education, Skills and Employment (the Department). As part of incorporating a direct measure of income (DMI) score into its capacity to contribute (CTC) assessment, the Department engaged the ABS to:

1. evaluate the statistical fitness-for-purpose, or quality, of the DMI score, focusing on how well it calculates the median income of school communities; and
2. develop a quality assurance process to support the annual production of DMI scores.

As a summary of the ABS' response to this engagement, this framework provides:

- a description of the DMI score and its use in CTC score calculation (Section 2);
- an independent assessment of the fitness-for-purpose of the DMI score as a representation of school community median income (Section 3);
- a quality assurance process, in the form of a set of quality gates (Section 4); and
- recommendations for further analysis.

The publication of this report aims to support understanding of the DMI score and the quality assurance process, from data collection to the release of CTC scores.

The ABS' assessment focusses on the quality of the DMI score. Specifically, the ABS examined the statistical fitness-for-purpose of the DMI score, as defined, for estimating school community median incomes. The ABS has developed the quality gates as a quality assurance process designed according to statistical best practice. Certain settings within the quality assurance process are determined by the Department and informed by ABS analysis and stakeholder requirements.

1.2 What is capacity to contribute?

Capacity to contribute is a measure of the capacity of a non-government school community to contribute to the cost of schooling. Under the *Australian Education Act 2013 (Cth)*, the national school funding model uses capacity to contribute to inform Australian Government funding for non-government schools.

For analytical purposes, the ABS has used a target concept of median income and a target population of the parents and guardians in each non-government school community to evaluate the fitness-for-purpose of the DMI.

SECTION 2 METHODOLOGY

2.1 How the DMI score is calculated and used in a capacity to contribute score

The DMI score is based on the median income of the parents and guardians (hereafter referred to as 'parents') in the school community. Its calculation is described in Figure 2.1. The final output is a CTC score, which indicates a school community's capacity to contribute, relative to other schools.

Figure 2.1: The DMI is based on each school community's median income

Step 1	•For each student in a school, the income of up to two parents is combined.
Step 2	•The annual median parental income for each school community is calculated.
Step 3	•The distribution of median incomes for all school communities is standardised to create a **DMI score**. Standardisation transforms each school community median into a score with an average of 103 and a standard deviation of 13, weighted by enrolments.
Step 4	•The most recent annual **DMI scores** are averaged to create the **CTC score**. In some instances **DMI scores** may be found not to be fit-for-purpose and the Department will use an alternative approach to produce the final **CTC score**.

In step 3, the median income for each school community is standardised. Standardisation is a common statistical process which involves converting a set of numbers, which may have any average and spread, to fit a pre-determined average and spread. In the case of DMI scores, the median incomes are standardised so that the same categories can be used for funding purposes, even though incomes will change over time. The standardisation process does not change the order of school communities in the distribution. That is, a school community will have the same ranking according to its standardised score as it does based on its median income. The formula used to standardise the median incomes into DMI scores is:

$$D_i = \frac{S * (x_i - \bar{x})}{s_x} + M$$

Where:
D_i = DMI score of school i
S = target standard deviation
x_i = median income of school i
$\bar{x}$ = sample mean
s_x= sample standard deviation
M= target mean

The sample mean and sample standard deviation are calculated from all schools in the Address Collection and weighted by the number of students in each school. Further information about the methodology is available on the Department's website: www.education.gov.au.

2.2 How the DMI differs from the previous area-based measure

The use of a direct measure of income in CTC scores was adopted by the Australian Government in September 2018[5], in response to recommendations made by the National School Resourcing Board (NSRB)[6] and, previously, by Gonski et al, in 2011[7]. The previous measure used area-based data to produce a socio-economic status (SES) score. The NSRB described this measure as "no longer the most accurate measure available", noting that "while accurate in many cases, [it] materially overstates the SES of some schools and understates that of others."[8]

The SES score for the school was calculated as the average of SES scores of the areas (defined as Statistical Areas Level 1) in which the students of each school lived. The SES score for each area was a weighted average of four different socio-economic indexes: 1/3 occupation, 1/3 education, 1/6 household income and 1/6 income of families with children. These were calculated every five years using data from the Census of Population and Housing (the Census).

2.3 Direct measure: introduction to key data sources and production process

To produce the DMI score, data about the parents of each student at a school is collated in the Department's Student Residential Address and Other Information Collection (the Address Collection). It contains information collected by schools and provided to the Department.

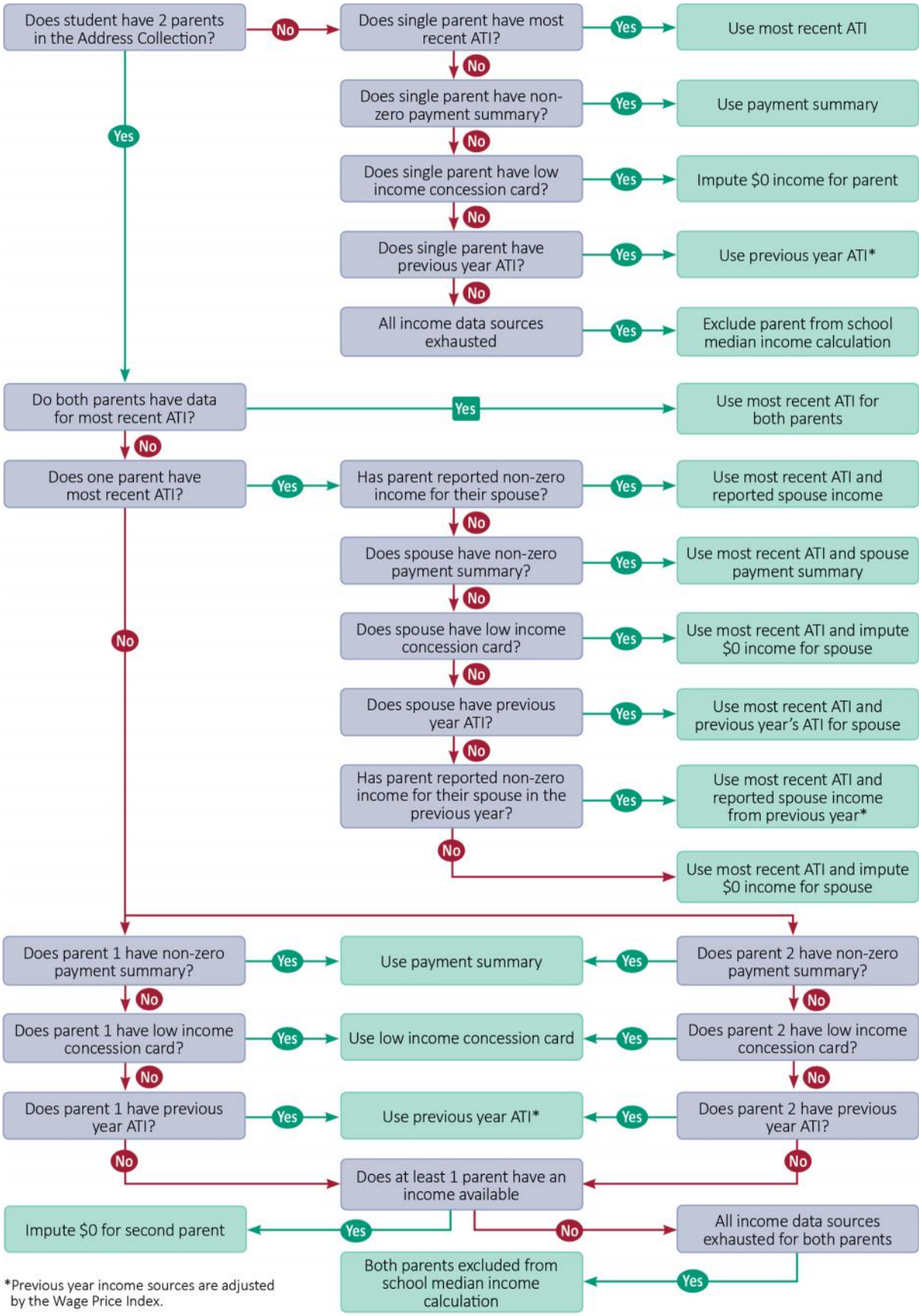
Student names are not collected. Parent data is anonymised and linked to data made available by the Multi-Agency Data Integration Project (MADIP). MADIP contains a collection of data from a broad set of government domains, including health, education, government payments, personal income tax and demographic information. MADIP enables this data to be brought together for policy, research and statistical purposes. MADIP is described further in Section 3.2 Institutional environment and privacy.

Underpinning MADIP is a 'spine', created through a three-way linkage between extracts from the Medicare Consumer Directory, the Social Security and Related Information (SSRI) dataset, and Personal Income Tax (PIT) data. Together, these datasets have very high coverage of the Australian population. The high coverage of the spine enables high quality linkage of other datasets to the spine. To be able to link, the records on the Address Collection must have a matching record on the spine (or, for 2018 and 2019 CTC, a matching record on 2016-17 PIT data. See 3.5 Accuracy for more information). To capture the highest quality and number of links, the DMI score uses a deterministic, or exact match, linkage process.

Once linked, income data available via MADIP is assigned to anonymised parent records. ATI data from PIT is used where available. If ATI is not available, income information from other sources, such as payment summary or concession card data from SSRI, is assigned according to the Department's income source assignment decision tree (see Figure 2.2).

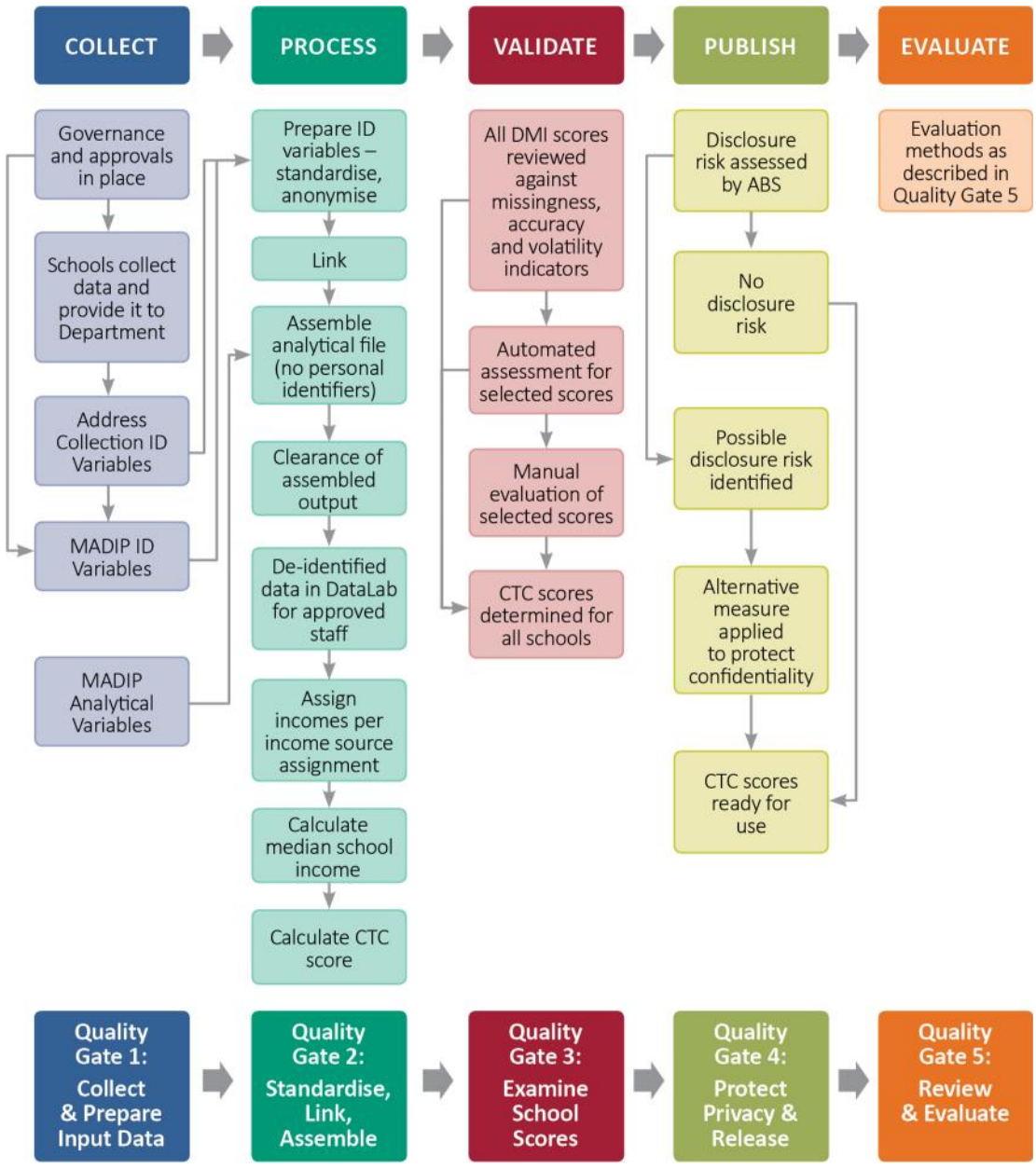
[5] Australian Government (2018).
[6] NSRB (2018).
[7] Gonski, D. et al. (2011).
[8] NSRB (2018) pp.x-xi.

Figure 2.2. Department of Education, Skills and Employment's income source assignment decision tree



After the assignment of income, DMI and CTC scores are calculated. The scores are validated and prepared for release, to ensure quality and confidentiality through the process. The final stage is to review the process, as shown in Figure 2.3.

Figure 2.3. Capacity to contribute high level process



SECTION 3 QUALITY FRAMEWORK FOR THE DIRECT MEASURE OF INCOME (DMI) SCORE

3.1 ABS Data Quality Framework

The quality of data is often described as its fitness-for-purpose. The ABS Data Quality Framework covers seven dimensions of quality: institutional environment, relevance, timeliness, accuracy, coherence, interpretability and accessibility. It is important to include all seven interrelated dimensions in a quality assessment, though the importance given to each dimension may vary. The ABS Data Quality Framework is based on the Statistics Canada Quality Assurance Framework (2002) and the European Statistics Code of Practice (2005). The ABS Data Quality Framework is considered to be an exemplar for the use-focussed analysis of data quality[9].

3.2 Institutional environment and privacy

Overview

Institutional Environment and Privacy ***- the institutional and organisational factors which may have a significant influence on the effectiveness and credibility of the agency producing the statistics***	
Summary	**Validation technique & recommended application**
i. Which organisations collect the data and what sort of organisations are they?	
All are Australian Government departments or statutory bodies. Most information is collected for administrative purposes.	Qualitative assessment of legislative, policy and data integration framework, undertaken annually. Governance checks completed prior to each cycle per Quality Gate 1A: Data use governance.
ii. What authority/ legislation/ agreement was the data collected under? Is statistical confidentiality guaranteed? If so, under what legislation?	
Australian Education Regulation 2013 (Cth); Census and Statistics Act 1905 (Cth); *Privacy Act 1988 (Cth),* and the legislation listed in Table 3.1. Statistical confidentiality is also guaranteed under the legislative arrangements.	As above.
iii. Which organisations compile the data, and what sort of organisations are they?	
Department of Education, Skills and Employment & Australian Bureau of Statistics	As above.
iv. To what extent and how quickly are any identified errors in published statistics corrected and publicised?	
The purpose of the quality assurance process is to prevent errors occurring across the end-to-end cycle. In the unlikely event that an error is identified, a quality incident response plan will be enacted immediately.	The quality assurance process describes how errors are avoided, and complements additional checks throughout the statistical process.

[9] Groves, RM & Lyberg, L (2010) Total Survey Error: Past, Present, and Future. *Public Opinion Quarterly*. 74:5, pp 849-879 (ref pp 873-874).

Definition

The institutional environment refers to organisational factors, such as governance, legislation, resourcing, purpose of the collection, quality assurance processes, and privacy which may influence the quality of statistical products. These factors can affect data collection, processing and release.

Key aspects considered

The key institutional factors that influence the production of DMI and CTC scores include the legislation governing data collection and analysis, quality assurance processes and privacy and confidentiality protections. Quality assurance processes are described in detail in Section 4.

Assessment of data sources and statistical production process

Student Residential Address and Other Information Collection (the Address Collection)
In accordance with the *Australian Education Regulation 2013 (Cth)*, the Department conducts the Address Collection with all eligible non-government schools to inform Commonwealth school education policy and non-government school funding arrangements.

The Department provides a collection notice for schools to distribute to parents, informing them about the information schools disclose to the Department, how it is used, how it is protected, and that it may be disclosed to the ABS and used in data integration projects.

The Department may carry out audits of school submissions. In an audit, contracted auditors may compare a school's *statement of addresses* with student enrolment information held by the school. These auditors will not use the information for any other purpose.

Multi-Agency Data Integration Project (MADIP)
MADIP is a partnership of Australian Government agencies to develop a secure and enduring approach for combining a broad set of person-centred data to create a comprehensive picture of Australia over time. Agencies in MADIP are authorised to collect personal information as part of their core functions and to share it with the ABS for policy analysis, research and statistical purposes.

The ABS is the Accredited Integrating Authority responsible for combining the data, providing access to authorised users for approved research projects via highly secure ABS systems and safeguarding privacy in collaboration with its partners. The ABS' application for accreditation, available at www.data.gov.au, was independently audited in 2012. This accreditation ensures that risks are assessed, managed and mitigated for all data integration projects. Approved research projects must have a strong public benefit, per the High Level Principles for Data Integration Involving Commonwealth Data for Statistical and Research Purposes. The public benefit from using integrated data to calculate the DMI is expected to result in a "more targeted, more accurate measure that will ensure funding flows to the schools that need it most".[10]

[10] Australian Government (2018).

MADIP information is protected by the *Census and Statistics Act 1905 (Cth)*, which ensures no information is released in a way that is likely to enable an individual to be identified and makes it a criminal offence to breach secrecy provisions. All ABS staff and authorised users sign legally binding undertakings of secrecy and fidelity

The use of information in MADIP must also adhere to the legislation under which each agency can collect and provide data. The relevant legislation for the CTC project is shown in Table 3.1.

Table 3.1: Data sources accessed via MADIP, owner agencies and legislation

Data source	Agency	Legislation
Data accessed for linkage purposes		
Medicare Consumer Directory	Services Australia	*Health Insurance Act 1973 (Cth)* *National Health Act 1953 (Cth)* *Australian Immunisation Register Act 2015 (Cth)*
Personal Income Tax (PIT) data	Australian Taxation Office	*Taxation Administration Act 1953 (Cth)* *Tax Law Amendment (Confidentiality of Taxpayer Information) Act 2010 (Cth)*
Social Security and Related Information	Department of Social Services	*Social Security (Administration) Act 1999 (Cth)* *A New Tax System (Family Assistance) (Administration) Act 1999 (Cth)* *Paid Parental Leave Act 2010 (Cth)* *Student Assistance Act 1973 (Cth)*
Data accessed for analytical purposes		
Personal income tax and payment summary data	Australian Taxation Office	*Taxation Administration Act 1953 (Cth)* *Tax Law Amendment (Confidentiality of Taxpayer Information) Act 2010 (Cth)*
Social Security and Related Information	Department of Social Services	*Social Security (Administration) Act 1999 (Cth)* *A New Tax System (Family Assistance) (Administration) Act 1999 (Cth)* *Paid Parental Leave Act 2010 (Cth)* *Student Assistance Act 1973 (Cth)*
Census of Population and Housing	ABS	*Census and Statistics Act 1905 (Cth)*

For more information, see the MADIP Data and Legislation page on the ABS website.

Privacy

Australian Government agencies must comply with the *Privacy Act 1988 (Cth)* and apply the Australian Privacy Principles when dealing with personal information. The ABS Privacy Policies and the Department's privacy policy (available at www.education.gov.au) describe how these organisations handle personal information. The Census Privacy Policy describes specific protections in place for Census data.

The ABS cannot, and will not share or provide identifiable personal information to any government department or organisation. Aside from the legislative protections, key measures to safeguard information include strong encryption of data, restricted access on a need-to-know basis, monitoring of all staff, and regular audits.

A privacy impact assessment is a systematic assessment that identifies the impact a project may have on the privacy of individuals and sets out recommendations for managing, minimising or eliminating that impact. A privacy impact assessment of the 2018 Address Collection was undertaken by the Department in 2018 and is on the Department's website. An independent privacy impact assessment of MADIP is available on the ABS website.

For the DMI, privacy is also protected using the separation principle and the five safes framework.

The separation principle means identifiable personal information, such as name and address, must be stored separately from other (analytical) information. Access to data is restricted so that no person can ever see identifiable and analytical information together at any stage.

The five safes framework is a disclosure risk management framework. Five key areas of risk - people, projects, settings, data and outputs - are assessed and controls are placed to mitigate the risk of disclosure.

To mitigate disclosure risk associated with publishing CTC scores, additional protections are applied for very small schools. For example, in 2019, 8 schools had fewer than 10 students. Schools such as these are assessed by ABS staff for disclosure risk. If disclosure is a risk, the DMI score is not be released and the Department will use an alternative CTC score.

Data Quality Assurance

In addition to understanding the statistical fitness-for-purpose of the DMI score (Section 3) and the quality gates established throughout the statistical process (Section 4), it is also important to state how any statistical errors will be managed. In the unlikely event an error in a DMI or CTC score is identified, a quality incident response plan will be activated immediately. Appendix 1 provides an overview of quality incident response planning. These plans set out how to monitor statistical quality, identify and assess a quality incident, and implement an appropriate response. Finally, an evaluation process ensures lessons learned about quality management can be incorporated into future cycles.

Summary of assessment

The overall assessment of this quality dimension finds that the DMI:

- is conducted for a transparent purpose;
- is underpinned by a legislative framework;
- is subject to satisfactory quality assurance processes throughout, with a demonstrated commitment to continuous improvement of data quality (see Section 4); and
- applies a strong commitment to privacy and confidentiality, including acknowledging where this may have an impact on the statistics that can be disseminated.

3.3 Relevance

Overview

Relevance ***- how well the statistical product meets the needs of users in terms of the concepts measured and the populations represented***	
Summary	**Validation technique & recommended application**
i. What key data items are available?	
The key data item produced is a DMI score, based on the median income of a school community relative to other school communities in the non-government sector.	The validation of the DMI score, in terms of its fitness-for-purpose in defining the median income of a school community, is described in Quality Gate 3: Examine school scores. This involves quantitative assessment of various metrics and qualitative assessment in select cases.
ii. About what was the data collected?	
The target concept for the DMI score is the median income of a school community. Where ATI is used in the DMI, it is closely aligned with the target concept. Alternative data sources used in cases where ATI is unavailable are discussed further in relation to accuracy and coherence.	Qualitative assessment of data sources to identify definitional changes, scope (population) changes and emerging data sources for investigation. Quantitative assessments of the relevance and coherence of alternative data sources is included in 3.6 Coherence.
iii. About whom was the data collected?	
The target population is the non-government school community, the parents / guardians of students enrolled at a school. The scope and coverage of the data sources used – the Address Collection and MADIP - are well aligned with the target population.	Quantitative assessments of actual vs expected population counts for each input data source are conducted annually as described in Quality Gate 1B: Address Collection and 1C: Complete and correct datasets.
iv. What levels of disaggregation are data available for?	
Data are available by school community, as long as there is not a risk of personal identification or disclosure.	Techniques for ensuring safe disclosure are described in Quality Gate 4: Protect privacy and release.
v. What was the original purpose for collecting the data?	
The data used in the direct measure are administrative data, collected for the purposes of administering government programs and services according to legislative and policy frameworks and implementing Australian taxation law.	Qualitative assessment of legislative, policy and data integration framework annually to identify any changes to data availability or definitions, as above.
vi. What does the data not represent or cover?	
Income data from PIT does not cover all people, such as late lodgers of tax returns and people whose taxable earnings are below the tax-free threshold. Alternative data sources are used to estimate income in these cases. The ability to link the Address Collection to MADIP affects the coverage of the target population.	Quantitative assessment of missingness, accuracy and volatility indicators, conducted annually as described in Quality Gate 3: Examine school scores.

Therefore, population coverage measures, considered alongside other quality metrics such as accuracy measures, are key indicators for validation purposes.	
vii. Have standard classifications been used? If not, why not?	
Adjusted taxable income is used where available.	Qualitative assessment of data sources to identify definitional changes.

Definition

Relevance explains how well a statistical product meets users' needs in terms of the concepts measured and the populations represented.

Key aspects considered

For the DMI, the two key questions are:

- How well does the data measure the target concept of median income?
- How well does the data represent the target population of the school community?

Assessment of target concept: median income of a school community

PIT data is the timeliest and most detailed source of income information available, and is the main source used in the DMI score. Adjusted taxable income (ATI) is the definition used, and represents taxable income adjusted for common deductions (see the Glossary for a detailed definition of ATI). Using ATI to define income is consistent with other Australian Government policy applications, such as eligibility for certain government benefits.

ATI data was available for 77% of parents in the 2019 Address Collection. ATI data is not expected to be available for all parents, as some parents may not be required to lodge a tax return, and some may not lodge their tax return on time. If ATI is unavailable, income information from an alternative data source may be used. The impact of using alternative income sources is assessed in Section 3.6 Coherence.

Assessment of target population: the school community

The DMI score is highly relevant to the target population, because the Address Collection includes information about parents and guardians of students in all eligible non-government schools. In 2019, the Address Collection contained records for over 2,600 non-government schools, approximately 1.3 million students and approximately 2.5 million parents[11].

Schools with alternative funding arrangements (such as non-government special schools, special assistance schools, sole provider schools, and majority Aboriginal and Torres Strait Islander schools) and students to whom the CTC assessment does not apply (such as overseas and distance education students) are excluded from the analysis.

[11] The parent-record count does not refer to unique parents. Parents with multiple children at non-government schools are counted multiple times in this figure.

The relevance of the DMI score is dependent on the quality of the Address Collection. The Department requests that records are provided for all (up to two) persons responsible for students at a school, including parents who reside in a separate household. Previously collected information about schools is used to check for anomalies in the data. Schools with a high proportion of students for whom only one parent is recorded in the Address Collection are contacted to confirm that this is correct. In 2019 93% of students had two parents recorded on the Address Collection and for most schools (75%), less than 10% of families had one parent in the Address Collection. To maintain the quality of parent coverage in the Address Collection, the proportion of students for whom only one parent is recorded in the Address Collection is assessed by the Department in quality measures 1.8 and 1.9 in Quality Gate 1.

The proportion of single parent families with children in non-government schools can also be analysed using Census data. According to the Census, single parent families made up 16% of families with children in non-government schools in 2016. ABS notes that the data available to define a family in the two data sources is different, so while Census and Address Collection figures will not be directly comparable, Census provides useful information about broad trends in family composition over time.

For their income to be included in the DMI score, parents in the Address Collection must have a matching record in the MADIP spine (or, for 2018 and 2019, the 2016-17 PIT data). The MADIP spine is comprised of data from the Medicare Consumer Directory, the Social Security and Related Information dataset, and the PIT data. For the 2020 DMI, the MADIP spine will include:

- all people with a Medicare program entitlement between 2006 to 2019;
- all people who received at least one Australian Government social security benefit from 2006 to 2019; and
- all people active in the Australian tax system between 2006 and 2019.

Population groups that may not be present in MADIP include some people who have recently migrated to Australia and people not registered with Medicare, social security or the tax system. Overall, this results in a very high coverage of the target population.

Summary of assessment

ATI data is the main source of income data used in the DMI. It is closely aligned with the target concept of median income and is the most relevant source of data currently available. Alternative data sources used when ATI is unavailable are discussed further in relation to accuracy and coherence. The scope and coverage of the data sources used are also well aligned with the target population.

3.4 Timeliness

Overview

Timeliness ***- the delay between the reference period and the date at which the data become available; and the delay between the advertised date and the date at which the data become available***	
Summary	**Validation technique & recommended application**
i. How often are the data collected?	
CTC scores are produced and published annually.	Qualitative assessment of source data availability, undertaken annually.
ii. When did the data become available?	
The Address Collection is undertaken annually. The MADIP spine is refreshed on a regular basis. Income data from ATO is updated annually. See Table 3.2 for more information.	Qualitative assessment of source data availability, undertaken annually.
iii. What is the reference period for the data?	
2020 DMI scores use data with the following reference periods: - 2020 Address Collection; - 2019 MADIP spine; and - 2017-18 income tax and payment summary data.	The DMI score is considered a timely statistic overall, as it uses the timeliest data available. ABS recommends options to improve timeliness be investigated regularly, including any new opportunities to directly measure income due to changes in reporting requirements within the tax and other administrative systems.
iv. Are there likely to be updates or revisions to the data after its release?	
No.	n/a
v. Are there other less frequent data sources that contain more detailed data that can be used in other reporting years when available?	
CTC scores are produced annually. With respect to the timeliness of income data, there are currently no known data sources that are timelier that would provide the same detail or coverage.	See recommendation above.

Definition

Timeliness describes how often a data source is available and the time taken for data and analysis to become available. Delays between the reference period (the time period described by the data) and the availability of data and analysis can reduce its usefulness.

Key aspects considered

For the timeliness of the DMI score, we consider the frequency with which the measure can be produced, and the delay between the reference period of source data and the availability of the DMI. The trade-off between timeliness and other quality dimensions is also considered.

Assessment

Table 3.2 summarises the timeliness of the data sources used in DMI scores.

Table 3.2: Timeliness of data sources used in the DMI (from 2020 onwards).

Data source	Frequency	Reference period	Availability
Address Collection	Annual	From 2019, data collected in term 1 each year	Early extract available mid-May
Linkage data used in MADIP	Annual	Year preceding Address Collection	April (or earlier) each year
Analytical tax information (income tax and payment summary data)	Annual	From end of each financial year to 16 months later	16 months after end of financial year
SSRI analytical information	Annual	Year preceding Address Collection	April (or earlier) each year
Census	5 yearly	August 2016 and then every five years	Approximately 18 months after collection

The Address Collection is made available in a timely manner. In states which have mid-year school intakes, these students are included in the following year's collection.

Each year, the ATO provides ABS with income tax return data processed up to 31 October, 16 months after the end of the financial year. Returns lodged after 31 October are not included and these are estimated to represent up to 6% of tax returns each year. The ABS and the Department investigated the use of a 12-month extract of tax data instead of the 16-month extract. However, the analysis showed that 5% fewer people linked to an income, and the later lodgers tended to have higher incomes. It was decided that for CTC, the more complete coverage of the 16-month extract was preferable to the 12-month extract, which, whilst more timely, had reduced coverage and potential to introduce bias.

Census data is not used in DMI scores, however it is used for validation purposes. As the time since the Census reference period increases, the difference between observations based on Census data and observations based on more recent data sources, such as PIT data, is likely to increase. Thus, the number of schools being flagged for follow up based on comparison with Census data is also likely to increase, and this should be considered in validation processes, particularly at Quality Gate 3.

To reduce fluctuations in funding associated with an annual score, a three year rolling average will be used. CTC scores which inform funding in 2021 will be based on an average of 2020, 2019 and 2018 DMI scores. The exception is 2020, in which a two-year rolling average will be used as only two years of data are available.

Summary of assessment

DMI scores are produced annually, and based on the most timely income data currently available for the target population. Although some of the data reflects a period of time up to two years prior, this improves on the previous Census area-based measure (SES Score) which could only be updated every 5 years, and also had a time lag to allow for post-collection processing. The use of a three year average also introduces a trade-off with respect to timeliness, as the use of data from three previous years in the CTC score reduces timeliness, but increases the stability of funding from year-to-year.

Opportunities for future improvement

While the DMI score is considered, overall, a timely measure, the ABS recommends that options to improve timeliness are investigated regularly. These investigations should identify any changes in the tax and other administrative systems that may introduce new opportunities to measure income.

3.5 Accuracy

Overview

Accuracy *- the degree to which the data correctly describe the phenomenon they were designed to measure*	
Summary	**Validation technique & recommended application**
i. How is the data collected?	
The data are collected as part of administrative processes. The two key data sources – the Department's Address Collection and MADIP – are brought together using data integration in the secure ABS environment.	Quantitative assessments of actual vs expected population counts for each input data source are conducted annually as described in Quality Gate 1B: Address Collection and 1C: Complete and correct datasets.
ii. As an administrative data collection, are any parts of the population unaccounted for in the data collected?	
The Address Collection and MADIP have very high coverage of the target population. Parents who do not link to MADIP and parents for whom no income information is available, may be missing from the DMI. In 2019, 6% of parents were excluded from the DMI due to a lack of income information.	Qualitative assessment of the scope of source data collections. Quantitative assessment of expected vs actual records in each data collection, per Quality Gate 1.
iii. How is the quality of linkage assessed?	
Address Collection records that link to MADIP are given a linkage quality score. Only high quality (quality 1 and 2) links are used in the DMI. Overall, the quality of linkage can be assessed using a combination of link rate and quality.	Quantitative assessment of Address Collection – MADIP linkage rates and linkage quality rates. See Quality Gate 2 for further detail.
iv. How is the accuracy of income data estimation assessed?	
The proportion of parents with income data from ATI and alternative sources is quantified. In 2019, ATI was available for 77% of parents, alternative information was available for 13% of parents, 4% had income imputed as zero and 6% were excluded due to a lack of information.	Quantitative assessment as described in Quality Gate 3: Examine school scores. For ATI coverage, see quality measures 3.1 – 3.5 in Quality Gate 3A.
v. What quality measures are used to assess DMI score accuracy?	
As part of the evaluation of DMI scores, quality metrics have been developed to assess missingness, income accuracy, and volatility over time. Missingness is assessed using linkage rates and an uncertainty measure analogous to a sampling error. Income accuracy is assessed using the proportion of records with complete, partial or no ATI. Volatility over time compares scores with the previous year to identify unusual movements which could indicate an error. DMI scores are also validated against other indicators that enable analysis against assumptions about the target population.	See Quality Gate 3: Examine school scores for further information.
vi. What impact does a low linkage rate have on the quality of the DMI score?	
ABS analysis shows that a low linkage rate may not necessarily be an indicator of a poor quality score. A	See Quality Gate 3: Examine school scores for further information.

median income produced using a sample of parents from the school community may be a robust estimate of the true median income if the parents included in the estimate are a representative sample of the whole school community population. Therefore, it is important to consider the appropriateness of this assumption when assessing DMI accuracy.	In particular, the uncertainty measure (Quality measure 3.2) combines coverage and variation in the income distribution of the school community to provide an indicator of uncertainty in the median associated with missingness. The lower bound score (Quality measure 3.7) provides a way to quantify the sensitivity of the median income to the assumption that excluded parents have the same income profile as those included in the median.
vii. Has the data been adjusted in any way? If so, how much was adjusted and on what data items?	
Various adjustments are made in the production of DMI and CTC scores. For example: - historical income data is indexed using the Wage Price Index; - median incomes are converted into an annual DMI score using standardisation; and - the final CTC score is the average of each school's score for the past three years.	Quantitative assessment of the accuracy of the final DMI score is undertaken according to Quality Gate 3: Examine school scores. This includes measures to assess missingness, accuracy and volatility.
viii. What steps have been taken to minimise processing errors?	
These are described in Section 4: Quality gates.	The quality assurance process will be reviewed annually, in accordance with Quality Gate 5: Review and evaluate.

Definition

Accuracy is the degree to which data correctly describe what is intended to be measured. For the DMI score, accuracy refers to how well each school's median income reflects the true median income of the school community.

Key aspects considered

To assess accuracy for DMI scores, the ABS considered:

- The fitness-for-purpose of the data, including the coverage of the analytical population and the coherence of alternative income data used when ATI is missing or non-existent. This is also discussed in Section 3.6: Coherence.
- The rates and quality of linkage between the Address Collection and MADIP and PIT.
- Income data availability, including ATI and alternative data, and the assumptions inherent in the use of alternative data sources.
- The effect of school community characteristics, such as size and income distribution, on the sensitivity of the median income to data coverage issues.
- The development of new quality metrics to help detect potential inaccuracies.

Assessment

Linking the Address Collection to MADIP

Several quality assurance processes are carried out to prepare the Address Collection and MADIP datasets for linking. These include:

- Linkage variables, including anonymised parent name and geocoded address, are standardised and formatted consistently on each dataset.
- If multiple values are reported for a variable (such as two addresses), all are used to maximise the likelihood of a link.
- Name information is repaired, standardised and anonymised. This involves converting common misspellings or variations to their 'origin name' (e.g. Libby to Elizabeth).
- Addresses are coded to the most precise geographic code.

Deterministic (exact match) linkage is used to capture the highest quality and number of links. This method matches records on each dataset that have the same combination of linking variables. The search criteria are gradually broadened to identify more matches and the final parameters are chosen to maximise both linkage rate and quality. For the DMI, link quality is defined as:

- Quality 1 links predominantly match on anonymised parent name and ARID or Mesh Block.
- Quality 2 links match on anonymised parent name and a higher level of geography (i.e. SA1).
- Quality 3 links are made at a broader level of geography. As this introduces uncertainty in the accuracy of the link, quality 3 links are not used in the DMI.

When this analysis was done, 2016-17 PIT data was not available via the MADIP data asset. Therefore, two different types of linkage were performed – one linked the Address Collection to MADIP, and another linked it to PIT data directly[12]. As Table 3.3 shows, linking via MADIP achieved higher linkage rates than linking directly to the tax data. Linkage rates are also higher when the reference periods of the datasets being linked are more closely aligned.

Table 3.3: Linkage of Address Collection records to MADIP spine and PIT, by link quality

Address Collection data is linked…	… to MADIP 2016 (including PIT 2015-16)	… to PIT 2016-17
2018 Address Collection	Quality 1 = 80.7%	Quality 1 = 78.5%
	Quality 1 & 2 = 85.7%	**Quality 1 & 2 = 81.2%**
	Quality 1 & 2 & 3 = 91.4%	Quality 1 & 2 & 3 = 87.4%
2019 Address Collection	Quality 1 = **77.4%**	Quality 1 = 76.5%
	Quality 1 & 2 = 83.2%	**Quality 1 & 2 = 79.7%**
	Quality 1 & 2 & 3 = 90.2%	Quality 1 & 2 & 3 = 87.7%

[12] The direct linking of 2019 Address Collection data to PIT was done to enable the most recent PIT data (2016-17) to be used in the 2019 DMI. It will not be required in future CTC cycles due to improvements in the timeliness of updating PIT data in MADIP. Though the 2018 Address Collection was also linked directly to PIT, the results of this linking were not used in the DMI (rather, the analytical dataset produced via linking to MADIP was used).

Linking the Address Collection to the MADIP spine, rather than directly to income data, supports improved accuracy in several ways. As the MADIP spine is a combination of the Medicare Consumer Directory, SSRI and PIT data, it includes people who are active in the labour force and / or earning a taxable income, and people active in the social security system. As well as its population coverage, another benefit of linking using the range of data sources available via MADIP is that, as people interact with different administrative services at different times, their details may be up-to-date in one dataset but not another. Therefore, linking the Address Collection to the MADIP spine is more likely to find links for more records, and allow information from multiple data sources to provide relevant insights for people with a range of socio-economic circumstances.

Linking rates between the Address Collection and MADIP are not expected to be 100%, as a match may not be possible for the following reasons:

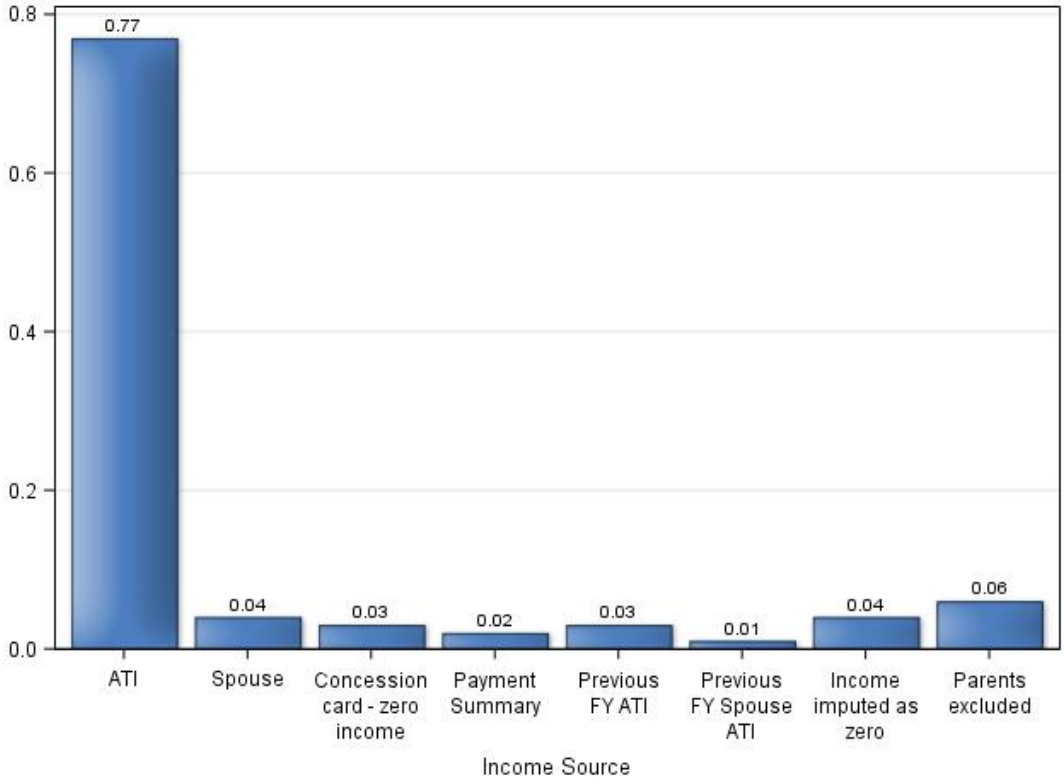
- A small number of people may not have a Medicare program entitlement recorded in MADIP. This could happen if a person has not enrolled in Medicare (e.g. a recent migrant).
- A person may not link to SSRI data because they do not receive any social security payments.
- People who are out of the labour force or who earn under the tax-free threshold may not appear in income data sourced from PIT.
- There may be differences in how a name is recorded on two different datasets which are not resolved by standardisation.
- A person may have moved and may have a different address on each dataset.
- In the case of non-unique matches, where two people with the same name live in the same geographic area, ABS attempts to find the true match using information available such as age. However in some cases it may not be possible to identify the true link.

Availability of ATI and alternative income information

ATI is the primary source of income data in the DMI as it the most relevant and timely source. However, since ATI is not expected to be available for many zero and low income earners, it is necessary to seek alternative income information for these people. In 2019, alternative data was available for approximately 70% of parents who were missing a 2016-17 ATI.

In 2019, ATI was available for 77% of parents (see Graph 3.4). Spouse-reported income (4%), low income concession card (3%), previous year's ATI (3%), payment summary data (2%) and the previous year spouse reported income (1%) were used. In total, an income data source was available for 90% of parents.

Graph 3.4: Proportion of parents with each income data source used in 2019 DMI



As noted above, the use of alternative income sources can increase accuracy, compared with having no income information, by allowing the median income estimate to incorporate parents across a range of income and labour force participation categories. For example, where a low income earner has not needed to submit a tax return, the use of concession card information (to assign zero income for that parent) is likely to improve the accuracy of the median income, by allowing the low-income earning parent to be included in the median. Imputing zero income in such cases may not be perfectly accurate, as such people's income could actually be non-zero yet still low. However, this is unlikely to affect the robustness of the median income, for which it is preferable to have parents represented approximately where they should be ranked (particularly where they are far away from the median), than to exclude them completely. Further consideration of the use of alternative income data is made in Section 3.6: Coherence.

Assumption of zero income, where no other information is available

Where a student has two parents recorded on the Address Collection, and income is available for only one of the parents, that parent's income is used in the DMI, and the income for the second parent is assumed to be zero (after all alternative income sources are exhausted). In DMI scores for 2019, zero income was assigned to the second parent for 4% of income assignment.

In cases where this assumption holds, this approach can be expected to improve the accuracy of the median income estimate (compared with excluding both parents if one has no income information). For example, where one parent works in paid employment and the other parent undertakes caring responsibilities and has no income, this approach will lead to an accurate assessment of parental income. However, this assumption may not always hold and in such cases may introduce some

inaccuracy. The accuracy of these assumptions are reviewed in the quality gates, which include tests for missingness and accuracy.

Exclusion from DMI, where no other information is available

Where income data is missing for a student who has only one parent in the Address Collection or for both of a student's parents where two are recorded, those parents are excluded from the DMI score. In 2019, this resulted in the exclusion of 6% of parents.

The impact on accuracy of excluding some parents depends on whether the excluded parents have a similar or different income profile to parents included in the measure. If the incomes of parents who are excluded are similar in distribution to those of the parents included, then the median income may be accurate, even if a relatively large number of parents' incomes are missing. However, if the incomes of the parents who are excluded are systematically different to those of the parents included, then the median is less likely to be accurate. As the measure being estimated is a median, the effect is likely to be stronger for small school communities and those with an atypical income distribution.

Comparing the DMI with Census income data

Comparing the DMI with scores created in different ways can provide an indication of the robustness of the assumptions described above. For example, comparing the DMI with an indicator created using person-level Census income data, for parents who link to MADIP, provides some insight into the assumptions associated with the use of alternate data sources for those parents who do not have an ATI. One benefit of using Census data for validation purposes is that missingness of incomes in Census data is not expected to be biased, that is, coverage is expected to be similar for lower incomes and higher incomes. When comparing the 2019 DMI with a Census income measure, 43% of schools received the same score using person-level Census data, and 83% of scores were within 2 points. Schools in the lowest funding category were most likely to stay in the same category. This result is important because these schools also tend to have a relatively high proportion of parental income imputed as zero.

Summary of assessment

For the DMI, the coverage of the population in the MADIP spine, overall linking rates, quality of linking and proportion of records with income data are positive indicators of accuracy. Overall, the use of alternative income data should improve the accuracy of the median income, because as a measure, the median is more sensitive to missing sub-populations (such as low income earners) than to minor inaccuracies that may be introduced by the use of alternative data that is not perfectly coherent with ATI. Further information about the assessment of accuracy, including validation indicators and assessments, is provided in Quality Gate 3: Examine school scores.

Opportunities for future improvement

Further options for imputing income when ATI is not available could be considered. Alternate data sets, such as payment summary and SSRI, are a rich source of information about the incomes of parents where an ATI is missing, and can reduce bias associated with the fact that that low income-earning parents are more likely to be missing an ATI than higher earning parents. The simplest way to use these data sources is to substitute the income directly from an alternative data source.

However, modelling a parent's income using the full range of data available may further improve accuracy and coherence.

3.6 Coherence

Overview

Coherence ***- the internal consistency of a statistical collection, product or release, as well as its comparability with other sources of information, within a broad analytical framework and over time***	
Summary	**Validation technique & recommended application**
i. How consistent is the data over time? What are the differences and what is their impact?	
Since the most of the data used are administrative, they are subject to change should the administrative framework on which they are based change. For example, income information availability in PIT can change when the tax-free threshold changes.	Qualitative assessment, as above, of data sources over time. Quantitative assessment of actual vs expected counts, per Quality Gate 1B: Address Collection and 1C: Complete and correct datasets.
ii. To what extent are the different income data sources used in the DMI consistent with each other?	
There are conceptual and population coverage differences between the income data sources used in the DMI. - ATI is the main source of income information. It is sourced from income tax data and provides adjusted taxable income for earners in the tax system in the relevant year. - Alternative sources are used where ATI is unavailable. - Non-zero spouse reported income is highly correlated with self-reported income and is a coherent substitute. - Payment summary data is available for employees. It only includes wage and salary income, which is one component of ATI. - Previous year ATI uses the same target concept and population, but a different reference period, so it is indexed by the Wage Price Index. - Low income concession card data includes people who earn low or no income and is used to estimate zero income for this sub-population, which may otherwise be under-represented in the DMI.	Quantitative assessment of scores produced using ATI and alternative data sources, where data exists (see Graphs 3.5-3.7). Quantitative assessment of income of specific sub-populations, where data exists, such as Census income data for low income concession card holders (see Graph 3.8) Qualitative assessment of assumptions about income for populations not represented in the data. ABS recommends further exploring if coherence can be improved by imputing for missing ATI using modelling, rather than using direct substitution.
iii. Have any real world events impacted on the data since the previous release? How have these impacts on the data been managed?	
Real world events such as economic shocks may impact on the collection of administrative data in future. This should be monitored on a case by case basis.	Qualitative assessment of data sources, including data provider quality statements, each year. Stakeholder engagement with data providers, for example, as part of conducting the Address Collection and the MADIP data refresh.
iv. What other data sources is this data comparable with? What other data sources in society report similar information? How do these data sources compare?	
The target concept and population of the DMI are not available from existing public data sources. However,	Qualitative assessment of other sources of income data.

median income ranges and trends associated with DMI scores can be compared with broader population data, using data sources such as the Census, SIH, HILDA and Estimates of Personal Income for Small Areas.	Quantitative assessment for validation purposes, as outlined in this section and Quality Gate 3: Examine school scores.

Definition

Coherence refers to the internal consistency of a statistical collection, its comparability with similar data sources, and consistency over time. Coherence is affected by the instructions and explanatory material provided to people completing a data collection, the use of standard definitions and changes to data collections or administrative processes over time.

Key aspects considered

For the DMI score, coherence is assessed by considering:

- quality assurance processes, such as the provision of explanatory materials in source data;
- the extent to which the data sources change over time;
- the extent to which the data used describe different periods of time; and
- differences among the definitions used in the source datasets, such as the difference between the definitions of ATI and alternative income data.

Assessment

Quality assurance processes, such as the provision of explanatory material, quality checks and error correction processes, undertaken as part of collecting the Address Collection and administrative data used in the direct measure, are positive indicators of internal coherence.

The difference in reference periods is one factor affecting comparability of the data used. For example, the 2020 Address Collection will be linked to a MADIP spine population with a June 2019 reference period, with associated analytical PIT data for 2017-18, SSRI data from 2018 and may be confronted with Census data from 2016.

Consistency over time is important because the coverage of administrative data collections can vary due to legislative changes. For example, PIT data coverage depends on the tax free threshold, and SSRI coverage depends on eligibility for social security payments. ABS recommends that this is monitored and included as a consideration in Quality Gate 5: Review and evaluate.

Coherence of income data sources used in DMI scores

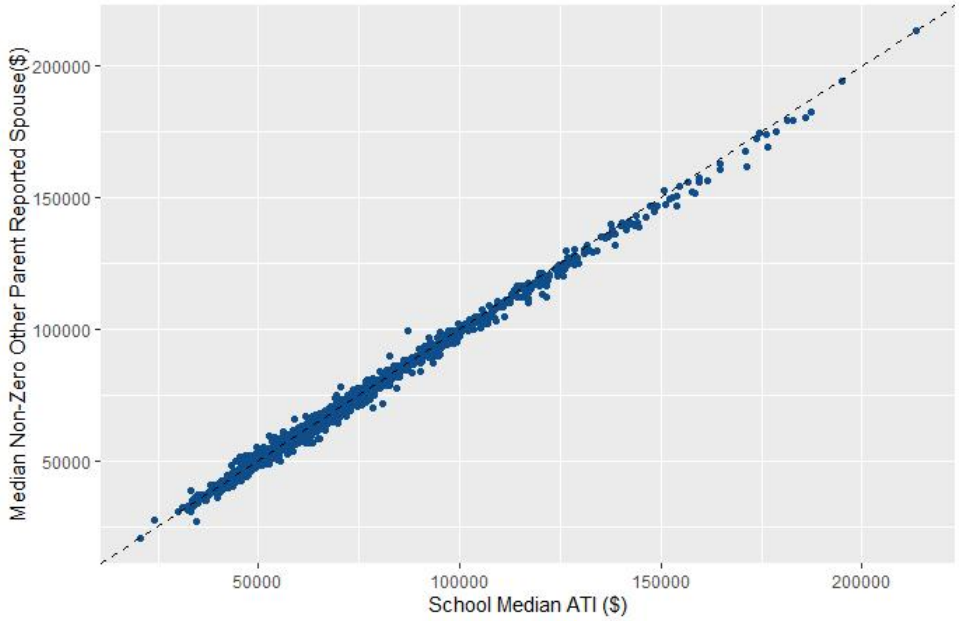
The accuracy of DMI scores is affected by differences in the definitions of income in the alternative data sources, which are assigned in order of coherence (see Figure 2.1).

Spouse reported income

When completing a tax return, respondents must provide information about their spouse's income. This information can be used in the DMI as a substitute for self-reported income for people whose ATI is unavailable. Analysis shows that while spouse reported income is generally highly correlated with self-reported ATI for parents who have both, it tends to be inaccurate for very low amounts,

such as zero. Thus, spouse reported income is only used in the DMI when it is not zero. Graph 3.5 shows there is high agreement between the median incomes produced using non-zero spouse-reported income and ATI, for parents with both.

Graph 3.5: 2019 median school community income using non-zero spouse reported income against ATI for parents with both, for schools with >250 parents.

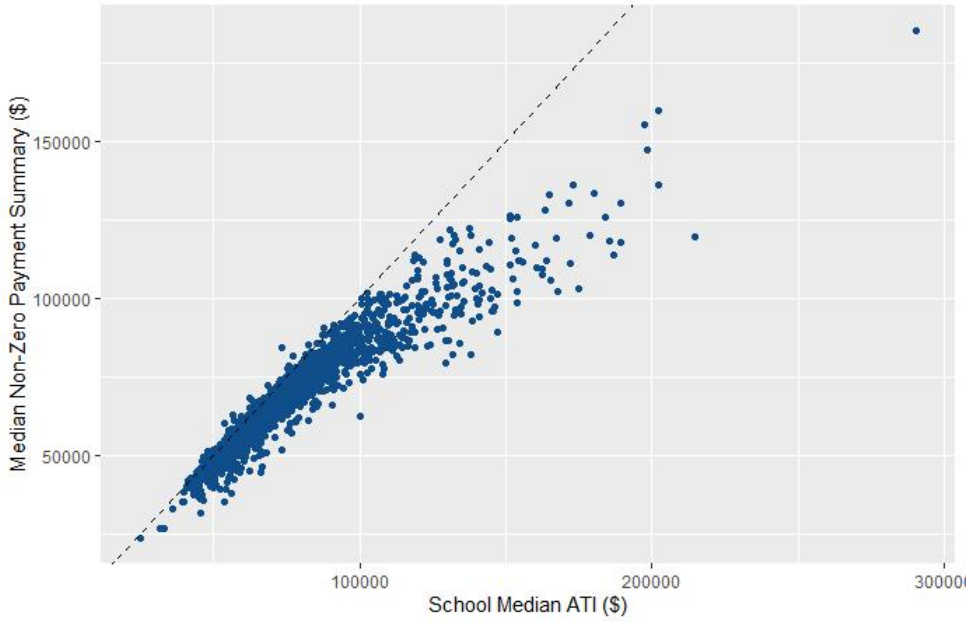


Despite the high level of agreement, spouse reported income is less accurate for lower income brackets. Parents with spouse reported income and without an ATI are more likely to be in the lower income brackets than those with both a spouse reported income and an ATI. Whilst spouse reported income is only used for 4% of parents in the DMI, one factor that should be investigated further is that in some cases spouse reported income may not refer to the same person listed as the second parent on the Address Collection.

Payment summary data

Payment summary data provides the total wage or salary earnings paid by an employer to an employee during the year. Unlike ATI, it does not capture income from other sources or tax deductions. Payment summary data tends to underestimate ATI more often than overestimate it. Median school community incomes based on payment summary data tend to be lower than those based on ATI, and the absolute difference increases with higher median incomes (Graph 3.6), though as a proportion of income it is greater for low income earners. Although only 2% of parents were assigned an income using payment summary data in 2019, it is recommended that DMI scores where the use of payment summary data is high be reviewed.

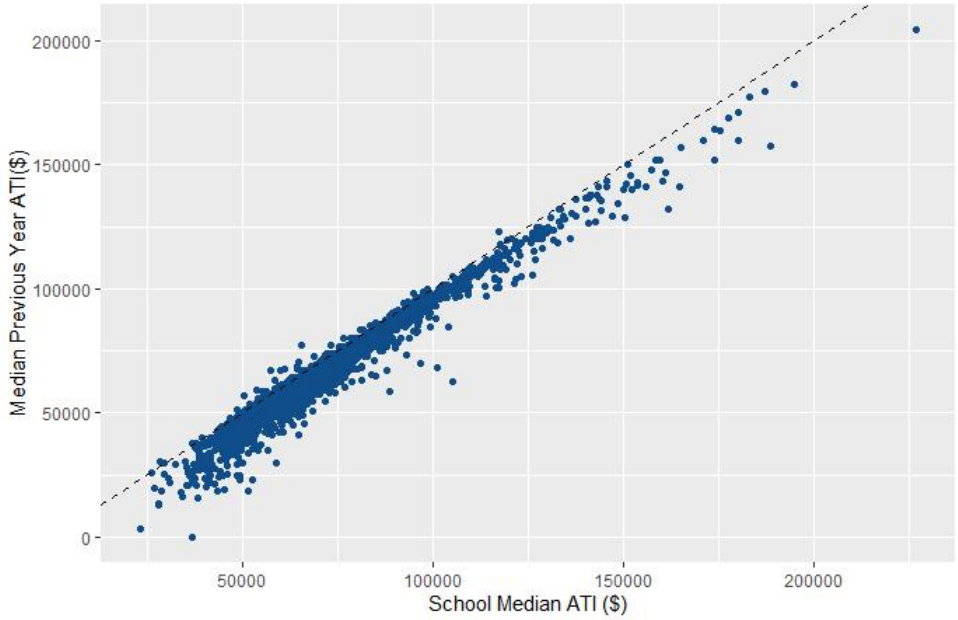
Graph 3.6: 2019 school community median payment summary income versus median ATI for parents with both income data sources, schools with > 250 parents.



Previous year ATI

Previous year ATI uses the same income definition as ATI, but is less timely. Graph 3.7 shows school community median incomes produced using data from parents with both current and previous year ATI. Previous year ATI is reasonably accurate, though it tends to be a slight underestimate. It should be noted that parents who have a previous year ATI but not a current year ATI are likely to be different from those who have both. This may be because these parents' incomes have reduced and they are no longer required to submit a tax return.

Graph 3.7: 2019 school community median income based on previous year ATI against current year ATI, for schools with >100 parents.

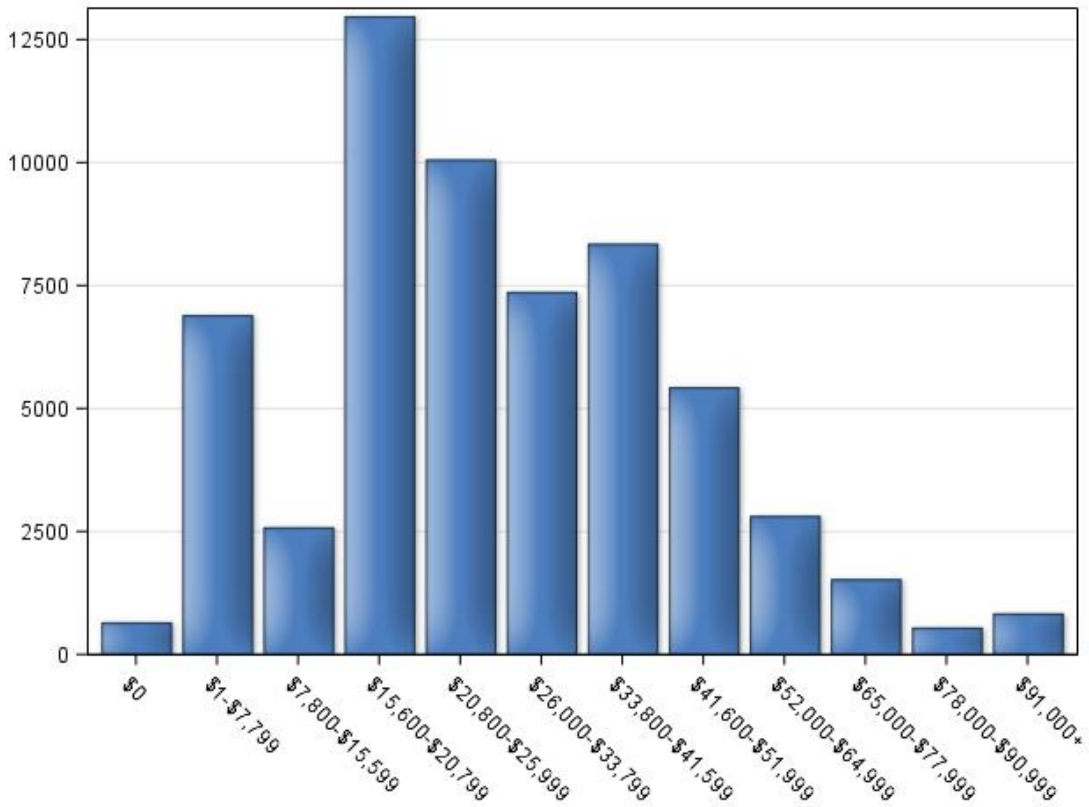


Social Security and Related Information (SSRI)
SSRI data provides information about the characteristics and circumstances of people who have interacted with the social security system. For the DMI score, the SSRI data improves the coverage of income information for non-government school communities, and reduces the risk of potential bias if these parents were excluded from the school community's data due to being inactive in the tax data system.

Given eligibility requirements, low income concession card holders are expected to be low income earners. Analysis of the Census income of parents who do not have an ATI, spouse-reported ATI or payment summary income, but do have a low income card, shows that most (55%) have incomes below $26,000 and 90% have incomes below $52,000 (Graph 3.8).

Inferring a parent's income based on possession of a low income card may not be completely accurate. However, because the target concept is the school community median, in certain circumstances (such as where the parental income is far away from the median) an inexact estimate of parent income may be sufficient.

Graph 3.8: 2016 Census annual income for low income concession card holder parents without ATI, spouse-reported income, or payment summary income data.



Coherence with other sources of income information

Comparison with other data sources, known as confrontation or validation, is an important aspect of the CTC data quality framework. Quality Gate 3: Examine school scores, describes checks to help

validate DMI scores. Confrontation must take into account the coherence between data used for validation and those used in the DMI.

Census of Population and Housing

Census data is available every 5 years and has a very high level coverage of the Australian population, providing a valuable source of demographic and income information. The Census collects the number of people in a household, including children, and the type of school they attend.

The Census collects total income, which tends to be higher than ATI. Income in the Census is collected in ranges, which increase in size as income rises, up to $156,000+. Census is therefore a less precise measure of income, especially for higher income earners. Also, income reporting for the Census may not be as accurate as in PIT data. Though an exact match between Census and PIT income is not expected, significant differences can be used as a flag for further investigation.

Census data can be used for validation via MADIP, as de-identified person-level data (which cannot be released) can be used to create alternative median incomes for school communities. Publicly available Census data can also be used to compare income trends for small areas such as SA2s.

Survey of Income and Housing

The ABS Survey of Income and Housing (SIH) is conducted every two years. It collects information on income sources, amounts received and household characteristics, for persons aged 15 years and over resident in private dwellings across Australia. SIH includes all income earners; people receiving pensions, or low incomes, or receiving tax exempt superannuation income, who may not be required to lodge tax returns. As a sample-based survey, income estimates for small geographic areas are not available, however SIH can provide a national and state / territory perspective of income over time.

Estimates of Personal Income for small areas

Estimates of Personal Income for Small Areas uses income tax data to provide a comprehensive range of income indicators for small geographic areas. This can be used to identify general income trends and changes. As individuals who do not submit a tax return are not represented in these statistics, this data may provide an incomplete picture of low income earners, such as people who earned below the tax-free threshold and recipients of government benefits.

Household, Income and Labour Dynamics in Australia (HILDA)

The Household, Income and Labour Dynamics in Australia (HILDA) survey is a longitudinal study of more than 17,000 Australian respondents and collects information on economic and personal well-being, labour market dynamics and family life. HILDA reports several measures of household income. 'Regular private income' combines salary and wages, business income, investment income, private pensions, and regular private transfers. Household disposable income is derived from total income, which includes personal income and government benefits, less calculated income tax. Like SIH, income data from HILDA provides a sound base for analysing income data for larger geographic areas, due to its detailed input taxation and government benefits data.

Summary of assessment

The use of a range of data sources in the DMI introduces complexity and this is reflected in the analysis of coherence above. While each data source has a high degree of internal coherence, there is potential for issues of coherence to be introduced with the use of multiple alternative income data sources. Ongoing monitoring of the extent to which alternative income data are used is important for assessing coherence of the direct measure over time.

Opportunities for future improvement

Further investigation is recommended into whether coherence can be improved by exploring options for imputation using modelling, as described in the previous section.

3.7 Interpretability

Overview

Interpretability ***- the availability of information to help provide insight into the data, such as information about the variables used, the availability of metadata, and measures of accuracy.***
Summary
i. Is there a particular context that this data needs to be considered within?
The data should be considered in the context of the quality framework presented in this report and the supporting documentation published by the Department of Education, Skills and Employment.
ii. What other information is available to help users better understand this data source?
Information on school funding policy is available from the Department of Education, Skills and Employment. Information on input data is available from the data providers, at the websites listed below. Further information about the analytical environment is available on the ABS website, as below.
iii. Are there any ambiguous or technical terms that may need further explanation?
See Appendix 2: Glossary for further information.

The validation technique for this dimension is qualitative assessment of supporting material provided with the data release.

Definition

Interpretability reflects how important it is for statistical information to be understood and used appropriately.

Key aspects considered

Interpretability is supported by the availability of information to help provide insight into the data. This includes information about the datasets, variables and methodologies used, including definitions and explanatory material.

Assessment

This report assists with interpreting the DMI and CTC scores, data sources, processes and methods. Further information is available about the source data and analytical environment. For example:

- Information on school funding arrangements is published, including a number of fact sheets available at Quality Schools Fact Sheets. This information is regularly updated.
- Information on funding calculations including on the assessment of capacity to contribute for each school is made available to Approved Authorities through a secure portal called Schools HUB.
- MADIP-based links and analytical data underpin the DMI. Information on the data that is used and associated metadata are available in ABS's reference material for MADIP.
- ATI and payment summary data are described in the ATO's Tax Stats reference material.
- More information about SSRI can be found in A guide to Australian government payments and at www.dss.gov.au.

3.8 Accessibility

Overview

Accessibility ***- the ease of access to data by users, including the ease with which information can be obtained, and the suitability of the medium through which information can be accessed.***
Summary
i. Can data that has not been published be requested?
This depends on what kind of data is requested. The ABS cannot release personal data or data likely to result in the identification of an individual under any circumstances, under the *Census and Statistics Act 1905 (Cth).*
ii. What are the contact details for requesting more information?
All inquiries about the direct measure should be directed to the Department of Education, Skills and Employment in the first instance.
iii. In which formats is the data available for people to use? Where and how do you access them?
All information will be published according to the Whole of Australian Government web accessibility guidelines. Information will be published on the Department's website: www.education.gov.au.
iv. Are there any privacy or confidentiality issues that prevent the data from being released publicly?
Yes, data which present a disclosure risk will not be released under any circumstances.

The validation technique for this dimension is qualitative assessment of materials published and disclosure assessment per Quality Gate 4: Protect privacy and release. This quality gate is undertaken by ABS.

Definition

Accessibility refers to the ease of access to data by users, including the ease with which information can be obtained and the suitability of the medium through which information can be accessed.

Key aspects to consider

For the DMI, the focus of accessibility is on what data will (and will not) be published and made available to schools and school communities, how data and information will be published, and what additional information schools and interested stakeholders are able to request.

Assessment

CTC scores and supporting information, including DMI scores, will be provided by the Department to Approved Authorities each year. Approved Authorities for schools will also be provided with access to a funding estimator that they can use to estimate the funding impact of the use of the score.

All information will be published according to the Whole of Australian Government web accessibility guidelines.

Schools which seek additional information to understand their score should contact the Department in the first instance. Any requests by schools for further information, however, need to be carefully assessed. Any data released will be reviewed to ensure that individuals and households cannot be directly or indirectly identified. This may prevent some data from being released, especially for small schools or schools with low coverage of income information. The ABS will work with the Department to determine how accessibility to information can best be supported, including considering options such as modelling or perturbation[13], while ensuring confidentiality is maintained and subject to the *Census and Statistics Act 1905 (Cth)*.

Further information about processes to ensure privacy and confidentiality through the publication process for CTC scores is provided in Quality Gate 4: Protect privacy and release.

[13] Perturbation involves a small random adjustment of the statistics and is considered the most satisfactory technique for avoiding the release of identifiable statistics while maximising the range of information that can be released. These adjustments have a negligible impact on the underlying pattern of the statistics.

SECTION 4 QUALITY GATES

4.1 Introduction to quality gates

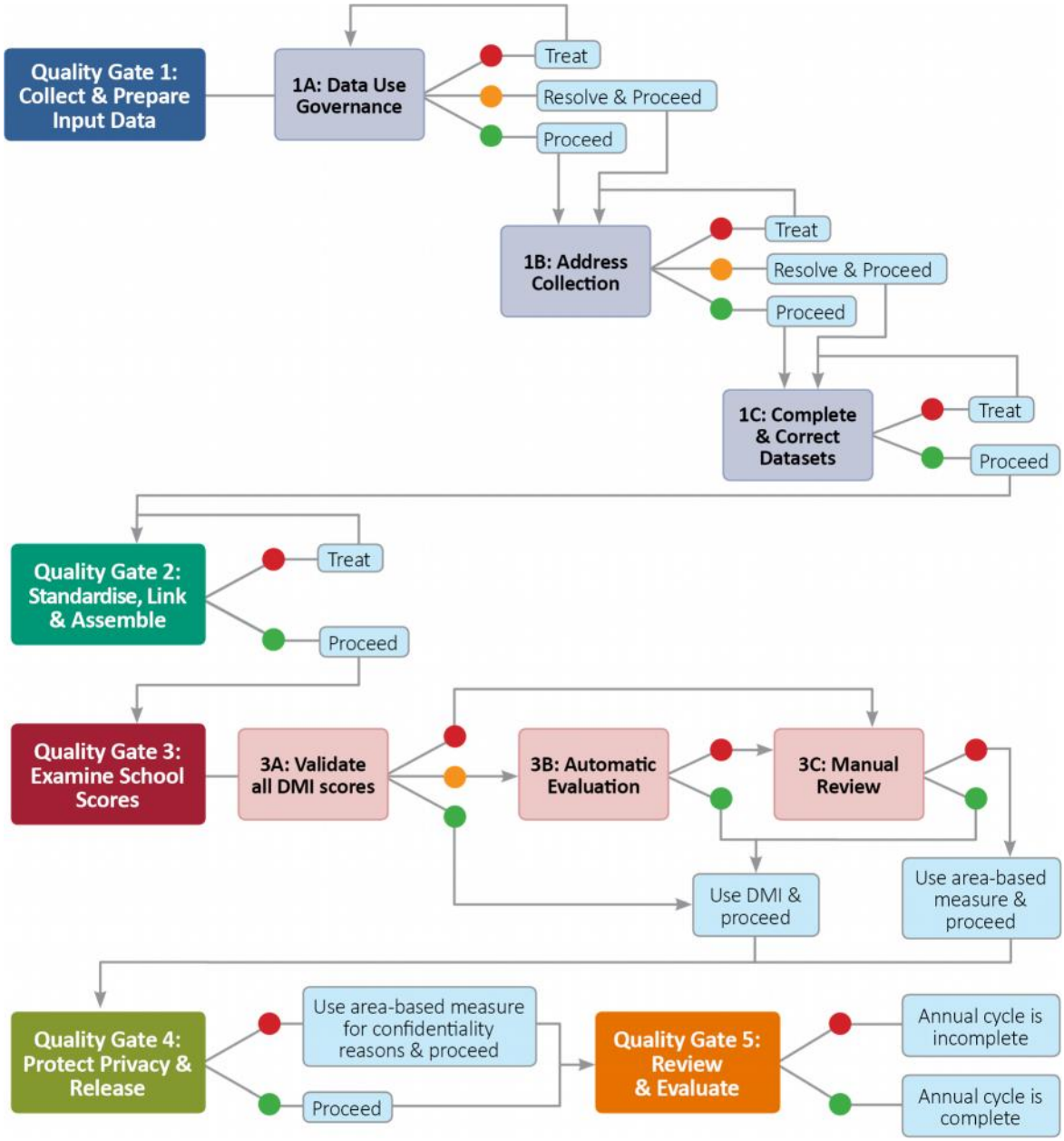
Quality gates are check points placed throughout the statistical production process to support the identification and treatment of statistical quality risks. Figure 4.1 describes the components of a quality gate.

Figure 4.1: Components of a quality gate

Quality gates represent major decision points where critical measures are assessed and actions taken according to an agreed strategy. Five quality gates are placed in the DMI production process. The quality gates consist of a set of quality checks, called quality measures, which have been co-designed by the Department and the ABS. Actions are taken depending on the pre-defined tolerance levels associated with each quality measure. The quality assurance process is reviewed annually.

Figure 4.2 provides an overview of the quality gates for the direct measure.

Figure 4.2: Quality gates overview



The five quality gates are described below. The quality gates contain suggested tolerance threshold values that can be used to determine which scores are flagged for review. It should be noted that in keeping with best practice outline in Figure 4.1 these values will be set by the Department to support policy and stakeholder requirements. It is not possible to determine exact threshold values solely based on statistical methods. The tolerances support a robust quality assurance process in the context of practical constraints, by providing an indication of the quality of the score for all schools, and enabling the Department to review and check schools that are flagged. The ABS recommends that tolerance values are evaluated and adjusted if necessary depending on the number and characteristics of schools that are flagged.

4.2 Quality Gate 1: Collect and prepare input data

Quality Gate 1 sets out actions to assure the quality of input data sources. It consists of three parts:

1A: Quality measure 1.1 confirms that data governance requirements are met.

1B: Quality measures 1.2 to 1.10 assure the quality of the Address Collection.

1C: Quality measures 1.11 to 1.12 assure that the input datasets are correct and complete.

This is critical to downstream quality outcomes. The gate detects input data problems so they can be rectified in a timely manner. It also detects issues that may erode the accuracy of the Address Collection over time by flagging unusual patterns for investigation in future cycles.

Table 4.1: Quality Gate 1

Quality measure 1.1: All governance requirements for data use, including data custodian approvals, are in place to acquire and use data for the purpose of calculating the DMI score. Undertaken by ABS and DESE.		
	Tolerance	**Action**
	Full compliance	Proceed.
	Delayed compliance	Escalate delays with relevant custodians. If possible, proceed with fully approved project components while waiting for outstanding components.
	Incomplete compliance	Evaluate and escalate. If necessary, redesign or replace project components to meet requirements. Do not proceed with project until compliance is achieved or on track (as per amber status).
Quality measure 1.2: Schools and school communities in scope of the Address Collection have been informed of the data collection and associated requirements. Undertaken by DESE.		
	Tolerance	**Action**
	Engagement with all schools	Proceed.
	Minor delays (resolvable within 2 weeks)	Delay Address Collection operations. If delay only applies to some schools proceed where possible.
	Major delay (more than 2 weeks) or other barrier to engagement	Escalate. Do not proceed with Address Collection until appropriate communication with schools and school communities is complete. Advice schools if the delay will impact on timely receipt of funding.
Quality measure 1.3: Preparation. Confirm with each school that their systems and records are up to date. Undertaken by DESE.		
	Tolerance	**Action**
	School on track to deliver accurately	Proceed.
	School experiencing problems	Work with school to resolve within 2 weeks. Escalation and delays may result.
Quality measure 1.4: Preparation. DESE systems are in place to receive and process school data; and tested with dummy data. Undertaken by DESE.		
	Tolerance	**Action**
	New system successfully processes and delivers dummy data.	Proceed.
	Minor system errors or barriers identified.	Resolve. Document any changes that may impact on how data is processed. Include documented issues in relevant downstream checks.
	Major system errors or barriers identified.	Invest in rectification. Advise all stakeholders. Work with schools and ABS to address any upstream or downstream impacts.

Quality measure 1.5: Preparation. Manual checks of Address Collection request. Check that the correct template is provided to schools. Check that template and any supporting documentation addresses all issues raised in previous cycle's evaluation report. Undertaken by DESE.

	Tolerance	Action
	All checks are passed	(In conjunction with 1.6) release Address Collection template to schools.
	Errors or concerns identified	Resolve errors and release template to schools (in conjunction with 1.6). Retest systems with new template (quality measure 1.4) if corrections have introduced changes.

Quality measure 1.6: Preparation. Manual checks of explanatory material (i.e. metadata, explanation of changes) provided with Address Collection request. Check that explanatory material addresses all issues raised in previous cycle's evaluation report; incorporates any Address Collection template changes; and can be understood by anyone completing the Address Collection for the first time. Undertaken by DESE.

	Tolerance	Action
	All checks are passed	(In conjunction with 1.5) release explanatory material to schools.
	Errors or concerns identified	Resolve errors and release explanatory material to schools (in conjunction with 1.5).

Quality measure 1.7: Data receipt. Check student counts for each school are correct. Undertaken by DESE.

	Tolerance	Action
	Exact match with expected counts	Proceed.
	Any anomalies	Seek clarification and possible resupply from school. If data is resupplied re-do Address Collection data receipt quality measures (commencing at 1.7)

Quality measure 1.8: Data receipt. Check single parent rates for each school are consistent over time, where the single parent rate is calculated at the student level. Undertaken by DESE.

	Tolerance	Action
	School single parent rate +/- <3 percentage points of previous year's rate	Proceed.
	School single parent rate +/- 3-10 percentage points of previous year's rate	Proceed and flag school for review in subsequent year to assess if an unusual pattern is developing that requires follow-up with the school. If pattern appears unusual based on four years of data, take the action described for the +/- >10 percentage points scenario (below).
	School single parent rate +/- >10 percentage points of previous year's rate	Follow up with school to determine if the changing rate of single parents seems to reflect the school community. If not, work with school to rectify data. If data is resupplied re-do Address Collection data receipt quality measures (commencing at 1.7). Proceed when complete.

Quality measure 1.9: Data receipt. Compare single parent rates for each school with aggregate results for all schools and in the wider community, where the single parent rate is calculated at the family level. Undertaken by DESE.

	Tolerance	Action
	School single parent rate < 12%	Proceed.
	School single parent rate between 12% and 16%	Flag school for review in subsequent year to assess if an unusual pattern is developing that requires follow-up with the school. Then proceed. In future years, if pattern appears unusual based on four years of data, take the action described for the >16% scenario (below).
	School single parent rate >16%	Follow up with school to determine if there is an error or if the data seems to reflect the circumstances of the school community. Work with school to rectify if necessary. If data is resupplied re-do all Address Collection data receipt quality measures (commencing at 1.7). Flag school for follow-up in subsequent year (as described above). Then proceed.

Quality measure 1.10: Data receipt. Check Address Collection files from schools for missing linkage variables. Undertaken by DESE.

	Tolerance	Action
	Missingness rate for each linkage variable <2% at the school level	Rate is similar to previous aggregate Address Collection rate. Proceed.
	Missingness rate for each linkage variable ≥2% at the school level	Missingness rate is high. Follow up with school. If data is resupplied re-do all Address Collection data receipt quality measures (commencing at 1.7). If missingness rate is still high, the impacts will be reviewed at Quality Gate 3. Then proceed.

Quality measure 1.11: On receipt of Address Collection file, ABS staff compare number of schools and enrolment totals at each school with previous year's data with DESE assistance to confirm that Address Collection file is complete and correct. Undertaken by ABS.

	Tolerance	Action
	Exact match with DESE current year data. Comparison with previous year is broadly consistent (under 3% difference across total number of enrolments in each state / territory).	Proceed.
	Any differences in current year data, or any >3% difference in total enrolments against previous year in each state/territory	Check for analytical errors and work with DESE to seek re-supply if necessary. If data is resupplied re-do all Address Collection data receipt quality measures (commencing at 1.7). Then proceed.

Quality measure 1.12: ABS staff confront and validate MADIP spine and analytical datasets. This includes:

- the distribution of records in the MADIP spine and analytical datasets in each state/territory compared with expected population ratios and numbers;
- the number of records with ATI in the MADIP analytical dataset compared with number of earners in published ATO data; and
- median and mean income for Australia and state and territories in MADIP analytical dataset compared with published ATO statistics

This checks the files are complete. Undertaken by ABS.

	Tolerance	Action
	Expected results	Proceed.
	Anomalies found	Check for analytical errors and seek re-supply if necessary. If data is resupplied re-do this data receipt check. Then proceed.

4.3 Quality Gate 2: Standardise, link and assemble

Quality Gate 2: Standardise, link and assemble is placed after linkage is complete. It must be done by ABS linkers, assemblers and analysts in the ABS secure environment.

Table 4.4: Quality Gate 2 – Standardise, link and assemble

Quality measure 2.1: Check for schools with low Address Collection to person spine linkage rates. This is done to identify formatting errors that typically prevent all or almost all records in a file from linking. Undertaken by ABS.		
	Tolerance	**Action**
	School linkage rate is ≥ 50%	School's Address Collection file is not likely to have significant formatting or linking errors. Quality issues may still be present in schools with lower linkage rates. These will be detected and actioned in quality gate 3. Proceed.
	School linkage rate is < 50%	School's Address Collection file may have formatting errors. Check for formatting errors or other systematic data issues. If an error in the file is identified, ABS to work with DESE to identify best path of action. If DESE correct the error or seek resupply from school, re-do all Address Collection data receipt checks commencing with quality measure 1.7. If no errors are identified, then proceed. Quality issues may still be present in schools with low linkage rates. These will be detected and actioned in quality gate 3.
Quality measure 2.2: Qualitative check: Final analytical files are complete and correct. Undertaken by ABS.		
	Tolerance	**Action**
	Number of records in final dataset meets expectations (e.g. number of parent records) and analytical variables only include those approved in governance documentation. Unlinked parent records are retained on the file.	No concerns identified and all standard checks are complete. Proceed.
	Anomalies are identified.	Undertake initial investigations and rectify immediately if possible. In the unlikely event that a complex problem is present, notify analysts that delays are expected. Escalate and quarantine resources until resolved. Then proceed.

4.4 Quality Gate 3: Examine school scores

This quality gate is placed after DMI scores are created. It checks the fitness-for-purpose of the final analytical file and the resulting medians and scores. This quality gate consists of three parts:

3A: Coverage, accuracy and volatility analysis of all scores refers some school scores for secondary assessment and some for manual review.

3B: Secondary quality assessment is undertaken, resulting in a final list of school scores for manual review.

3C: Manual review is undertaken of selected school scores, and a decision is made as to whether the direct measure or the alternative measure is a more fit-for-purpose indicator of school median income.

Setting and interpreting tolerance levels

As noted in the Introduction, the tolerances in this quality gate have been set by the Department, informed by advice and analytical tools provided by the ABS. The tolerances are set in order to identify those schools for which the DMI score may not be a fit-for-purpose estimate of school median income. This decision is made by the Department, taking into account all available information about a particular school. This is required because it is not possible to determine exact threshold values solely based on statistical methods. These tolerance values give no guarantee that a score that is not flagged will be of high quality, or that a score that is flagged is of low quality. The ABS recommends tolerance values be evaluated and adjusted if necessary depending on the number and type of schools that are flagged.

Quality Gate 3A: Missingness, accuracy and volatility analysis

In this stage, all DMI scores are assessed according to six quality measures as described in table 4.5.

Table 4.5: Quality Gate 3A – Missingness, accuracy and volatility analysis

Quality measure 3.1: Missingness and linkage check. Identify schools with low rates of income coverage, using the number of students with income data as a proportion of all students in the school.	
Tolerance	**Action**
School student income coverage is ≥ 95%	Do not flag for quality evaluation. Proceed.
School student income coverage is ≥ 60% and < 95%	Flag for secondary assessment of missingness at Gate 3B, quality measure 3.7. Then proceed.
School student income coverage is < 60%	Flag for manual review at Gate 3C. Then proceed.
Quality measure 3.2: Missingness check. Assessment of uncertainty in the median income due to missingness, converted into 95% confidence interval on the DMI score. According to this measure, 'uncertainty' measure is higher when there is greater variation in the school community income distribution and the number of members of a school community missing from the median. This measure is described further in the Glossary.	
Tolerance	**Action**
Relative difference between DMI and confidence interval is ≤ 2 funding points	Do not flag for quality evaluation. Proceed.
Relative difference between DMI and confidence interval is > 2 and ≤ 4 funding points	Flag for secondary assessment of missingness at Gate 3B, quality measure 3.7. Then proceed.
Relative difference between DMI and confidence interval is > 4 funding points	Flag for manual review at Gate 3C. Then proceed.

Quality measure 3.3: Accuracy check. Identify schools with a high proportion of students for whom no parental ATI data is available. This is expressed as the number of students with no ATI data, as a proportion of students for whom income data is available. This measure is intended to be an indicator of the accuracy of income data.

	Tolerance	Action
	% of students with no ATI data is ≤16%	Do not flag for quality evaluation. Proceed.
	% of students with no ATI data is >16% and ≤34%	Flag for secondary assessment of accuracy at Gate 3B, quality measures 3.8 and 3.9. Then proceed.
	% of students with no ATI data is >34%	Flag for manual review at Gate 3C. Then proceed.

Quality measure 3.4: Accuracy check. Identify schools with a high proportion of students with partial (i.e. one of two parents) parental ATI data, expressed as a proportion of students for whom income data is available. This measure is intended to be an indicator of the accuracy of income data.

	Tolerance	Action
	% of students with partial ATI data is ≤31%	Do not flag for quality evaluation. Proceed.
	% of students with partial ATI data is >31% and ≤50%	Flag for secondary assessment of accuracy at Gate 3B, quality measures 3.8 and 3.9. Then proceed.
	% of students with partial ATI data is >50%	Flag for manual review at Gate 3C. Then proceed.

Quality measure 3.5: Accuracy check. Identify schools with a high proportion of students for whom full parental ATI data is available expressed as a proportion of students for whom income data is available. This measure is intended to be an indicator of the accuracy of income data.

	Tolerance	Action
	% of students with full parental ATI data is ≥55%	Do not flag for quality evaluation. Proceed.
	% of students with full parental ATI data is ≥27% and <55%	Flag for secondary assessment of accuracy at Gate 3B, quality measures 3.8 and 3.9. Then proceed.
	% of students with full parental ATI data is <27%	Flag for manual review at Gate 3C. Then proceed.

Quality measure 3.6: Volatility check. Measure of volatility in school scores, based on change from previous year.

	Tolerance	Action
	Change from previous year ≤ 6 funding points	Do not flag for quality evaluation. Proceed.
	Change from previous year > 6 funding points	Flag for manual review at Gate 3C. Then proceed.

Quality Gate 3B: Secondary quality assessment

In this assessment, certain DMI scores which have been flagged are compared with validation indicators. The validation indicators assist with understanding the sensitivity of the DMI to different assumptions and present information about the school community using different data sources.

Table 4.6: Quality Gate 3B – Secondary assessment of selected school scores

Quality measure 3.7: Secondary missingness assessment. Relative difference between DMI and lower bound sensitivity measure. The lower bound sensitivity measure reflects a hypothetical scenario where parents who are excluded due to missingness are assumed to have systematically lower incomes than those included. The lower bound difference is an indicator of the sensitivity of the median income to assumptions about the incomes of parents who are missing from the DMI.		
	Tolerance	**Action**
	Relative difference between DMI and lower bound sensitivity measure is ≤ 2 funding points.	Do not flag for manual review. Proceed to quality gate 4.
	Relative difference between DMI and lower bound sensitivity measure is > 2 funding points.	Flag for manual review at Gate 3C. Then proceed.
Quality measure 3.8: Secondary accuracy assessment. Relative difference between DMI and an area-based score. This indicator uses Census data to provide an alternative score, using the income status of parents of students at non-government schools in the area in which students live as a substitute for direct income data.		
	Tolerance	**Action**
	Relative difference between DMI and area-based score is ≤ 2 funding points.	Do not flag for manual review. Proceed.
	Relative difference between DMI and area-based score is > 2 funding points.	Flag for manual review at Gate 3C. Then proceed.
Quality measure 3.9: Secondary accuracy assessment. Relative difference between DMI and Census person-level score. This measure provides an alternative score against which to compare the DMI, using income data from the Census.		
	Tolerance	**Action**
	Relative difference between DMI and person-level Census score is ≤ 2 funding points.	Do not flag for manual review. Proceed.
	Relative difference between DMI and person-level Census score is > 2 funding points.	Flag for manual review at Gate 3C. Then proceed.

Quality Gate 3C: Manual review of selected DMI scores

In the third stage, the schools flagged for manual review are subject to an assessment of interrelated quality aspects. This is a data-driven statistical assessment using indicators designed by the ABS, as well as further information obtained by the Department. The results of the assessment inform a qualitative evaluation of whether the DMI is considered to be fit-for-purpose. If the DMI is not considered fit-for-purpose, a refined area-based measure will be used in the CTC score.

Table 4.7: Quality Gate 3C – Evaluation of selected DMI scores

Quality measure 3.10: Undertake a quantitative and qualitative (intelligence based) evaluation to examine a set of quality metrics, such as: school community characteristics, income distribution, change over time, difference between DMI and validation indicators and evaluate the fitness-for-purpose of the DMI score.		
	Tolerance	**Action**
	Quantitative and qualitative assessment indicates that a school's DMI score **is** fit-for-purpose	Assign CTC score based on DMI score.
	Quantitative and qualitative assessment indicates that a school's DMI score **is not** fit-for-purpose	Assign CTC score based on a refined area-based measure.

A list of indicators which may be used in the evaluation is provided in Appendix 3.

4.5 Quality Gate 4: Protect privacy and release

The fourth quality gate – Protect privacy and release - checks that all final privacy and confidentiality protections are applied.

Table 4.8: Quality Gate 4 – Protect privacy and release

Quality measure 4.1: Check that all data to be released from the ABS DataLab (or published) protects the privacy and confidentiality of individuals. Undertaken by ABS.

	Tolerance	Action
	At least 10 students at school	Score may be released.
	< 10 students at school	Data is assessed by ABS staff for confidentiality risk. If risk to confidentiality is considered possible, score and funding allocation based on DMI score cannot be released. An area-based measure must be used.

4.6 Quality Gate 5: Review and evaluate

It is important that the quality assurance process is reviewed on an ongoing basis. Annual process evaluations should be undertaken to respond to:

- lessons learned and recommendations from any quality reviews or quality incident response plans;
- changes in data quality and availability;
- changes in legislative and administrative arrangements that affect data availability; and
- new risks that arise.

Tables 4.9: Quality Gate 5 – Review and Evaluate

Quality measure 5.1: Review and document issues and problems arising during DMI score production process and identify options for ongoing improvement. Place additional controls into the process or review thresholds as required. Undertaken by DESE.

	Tolerance	Action
	Complete	Complete annual cycle.
	Incomplete	Annual cycle is not complete, do not commence next cycle.

APPENDICES

Appendix 1: Quality incident response plans

A quality incident response plan is a remediation control that should be initiated if a high impact risk is realised during the DMI production process, or if an anomaly becomes evident once scores are published. The aim of a quality incident response plan is to resolve the incident as quickly as possible, minimising its impact and focussing on recovery.

The prevention and detection of anticipated quality incidents is managed via other risk management controls such as quality gates. Quality incidents that arise despite these controls are managed by contingency plans that are responsive to the particular circumstance. This summary provides a practical overview of quality incident response planning and some of the tools that will be employed in the case that a high impact issue arises.

Step 1. Initiating a quality incident response

Quality incidents may be identified by anyone involved in the production process or by an interested stakeholder. If the known or possible impact is high, it will require an immediate, authoritative and dedicated response.

This requires an appropriate team to be established. The team should be led by an independent facilitator who is responsible for driving the process and making sure it is thoroughly documented; and should include all relevant technical experts and decision makers. Depending on the nature of the incident, it may be necessary to identify whether or not key people are cleared to review information held in the ABS DataLab.

Step 2. The first meeting

The first meeting is important in making sure the incident is well understood, that insights are shared, and that the right people are involved. This involves sharing the objective evidence of the incident and any important context. In the case of a post-publication incident, or an incident that occurs late in the process, it may be necessary to restrict the meeting invitations to individuals cleared to review information held in the ABS DataLab. This will allow for free discussion of quality gate reports and quality indicators (see Appendix 3) that have not been cleared for release.

Response planning to minimise impacts and to recover from the incident should commence at this meeting. The response plan should include communication considerations for all stakeholder groups.

Step 3. Take action

Following on from the meeting, all relevant parties should be aware of possible sources of the quality incident, and be working towards finding solutions. Actions should be communicated and followed up by the facilitator. Once decision makers have identified the appropriate treatments, remediation work can commence.

Any changes that are implemented must be tested and appropriately communicated. It is important to document all changes that are implemented. If changes need to be made to future production processes or to quality gates, these should be included in recommendations and documented in associated standard operating procedures.

Step 4. Evaluation

Evaluating the success of the response is important for informing future responses. Lessons learnt during the incident response and recovery process need to be documented and communicated to others. Quality Gate 5: Review and evaluate plays an important role in the evaluation process.

Appendix 2: Glossary

ABS analyst, assembler, librarian and linker

Analyst, assembler, librarian and linker are the roles required to perform data integration in the ABS.

- Librarian: prepares information for linkage
- Linker: links information together
- Assembler: creates files for analysis
- Analyst: analyses linked information

Address Register Identifier (ARID)

A unique identifier representing an individual, physical Australian address.

Adjusted taxable income (ATI)

For the 2016-17 tax year, the Australian Taxation Office defined a person's adjusted taxable income (ATI) as the sum of the following amounts:

- taxable income
- adjusted fringe benefits (total reportable fringe benefits amounts multiplied by 0.51)
- reportable employer superannuation contributions
- deductible personal superannuation contributions
- certain tax-free government pensions or benefits received by the person
- target foreign income (income and certain other amounts from sources outside Australia not included in your taxable income or received as a fringe benefit)
- net financial investment loss (the amount by which the person's deductions attributable to financial investments exceeded their total financial investment income)
- net rental property loss (the amount by which the person's deductions attributable to rental property exceeded their rental property income)
- less any child support payments the person provided to another person.

Approved Authority

An Approved Authority for a school is the legal entity the Australian Government holds responsible for the administration of the school, in accordance with the *Australian Education Act 2013* and the *Australian Education Regulation 2013*.

Capacity to contribute

A measure of the capacity of a non-government school community to financially contribute to the cost of schooling. Capacity to contribute is used as an assessment of a non-government school's need for public funding.

Data integration

Data integration means bringing information together. It is an efficient and effective way of creating new insights by reusing existing data to address questions about Australian society. When an issue is identified that no single set of data can resolve, data can be brought together in a safe, privacy preserving and controlled way, to enable analysis of the issue.

Direct measure of income (DMI)

A methodology used to calculate capacity to contribute based on the median income of parents or guardians of students at a non-government school.

Lower bound sensitivity measure

By excluding some parents for whom there is no income information available, the DMI assumes that the missing parents' income distribution is similar to that of the parents included in the measure. In reality, this assumption may not hold – parents who do not link to any available income data may be more likely to have lower incomes. The lower bound sensitivity measure shows what a school community's median income might be if parents missing from the DMI score had systematically lower incomes than other parents, by assigning:

- zero income to any parent who linked to MADIP but did not have income data; and
- the first quartile parental income from the school community's DMI calculation to all remaining parents without an income.

The lower bound sensitivity measure can be considered a reasonable lower bound estimate of a school community's median income. A large difference between the lower bound and the DMI indicates that the DMI score is sensitive to the assumptions made about the incomes of missing parents.

Mesh block and other statistical geography information

Mesh Blocks are the small geographical units that form the basis for the larger regions of the ASGS. For more information on Mesh blocks and other geographic information see Australian Statistical Geography Standard (ASGS).

Payment summary (as defined on the ATO website)

An advice supplied at the end of the financial year by an employer showing earnings during the year, also known as an income statement.

Person-level Census income measure

A measure based on school community median income calculated using 2016 Census income data, linked to the Address Collection via MADIP and intended for use as a validation indicator. Since income data in the Census is collected in ranges, this measure assigns each parent the mid-point of their respective income bracket from the Census.

The person-level Census income measure is calculated as below:

- Parents who link to MADIP and have a 2016 Census income are assigned the mid-point of the personal income bracket.
- For each student with two parents, both parents' incomes are summed together, otherwise the parents are excluded from the measure. This approach differs from the DMI in that there is no assumption of zero income for a second parent where the other parent has an income amount. It reflects the assumption that missingness in Census data is not related to income (that is, it is not considered more likely that income data for a lower income parent would be missing).

- Where a student has only one parent, that parent's income is used, otherwise the parent is excluded from the measure.
- The school community median is calculated, the medians are ranked and converted into a score in the same way as the DMI score.

Quality gate

Quality gates are a statistical risk mitigation strategy designed to improve the early detection of errors or flaws in any part of the statistical process cycle, be it collecting, processing, analysing or disseminating statistics. They act as a checkpoint at which an assessment of the quality of the process is made either qualitatively or quantitatively, to determine whether to proceed to the next stage of the process. This is done using the six components of a quality gate, which act as acceptance criteria. For more information, see: Quality Gates – a brief summary.

Area-based Census income measure

A measure based on school community median income calculated using the median income of the area (SA2) in which each parent lives. The income assigned to each parent is based on the median equivalised household income of parents in the area who have children attending schools of the same type (i.e. primary or secondary, Catholic or Independent). This measure is intended for use as a validation indicator and may be used at quality gate 3.

School community

The parents and guardians of the students at a school.

Separation principle

When undertaking data integration activities, the ABS applies the Separation Principle to store identifiable personal information (such as name and address) separately from other information, and access to data is restricted according to functional separation roles and what is necessary for their function or role. A person working on a project can only hold one role at a time. This means that identifiable and analytical information cannot be accessed at the same time and no person can see identifiable and analytical information together at any point in the process.

Total income

Also referred to as gross income, total income is the sum of income received from all sources before any deductions such as income tax, the Medicare Levy or salary sacrificed amounts are taken out.

Uncertainty in the median income due to missing data

In the DMI, each school community's median income is estimated from the available data. However, as data may not be available for every parent in a school community, there is a degree of uncertainty associated with the median income. This uncertainty measure treats the parents for whom income data is available like a representative sample being used to estimate the true median income of the whole school community population. Therefore, it can be considered analogous to a sample error. This measure assumes the income profile of the parents who are missing from the estimate is the same as the parents who are represented. In reality, this assumption may not hold, so this measure can be considered the minimum expected uncertainty in the median income due to missing data. The level of uncertainty is higher when there are more parents for whom income data is missing, so this measure helps identify schools with potential coverage issues. The measure is also higher when

the school community's income distribution is more widely spread, so this measure also helps identify schools with less homogenous income distributions.

Appendix 3: Data quality indicators

This table provides a list of indicators which may be used by the Department to assure the quality of DMI scores, including as part of the manual review process in Quality Gate 3C.

Indicator	Purpose
1. School size - number of students - number of parents - very small school flag Data source: Address Collection	Assists to understand the characteristics of the school community, and may support the evaluation of quality indicators. For example, school size is inversely proportional to uncertainty in the median (see below), holding other factors constant. The very small school flag is set for schools whose data cannot be released from the secure ABS environment due to confidentiality protections.
2. School growth rate - change in number of students over time, expressed as a percentage of students - high growth flag may be set Data source: Address Collection	Assists to understand the characteristics of the school community, and may support the evaluation of quality indicators. For example, knowing a school is high growth may help to explain a large movement in median income from year to year.
3. School single parent rates - calculate by student and / or by family - compare against other school communities, the wider community (using Census data) and historical patterns Data source: Address Collection, Census	Supports the analysis of completeness of school community data.
4. Proportion of Aboriginal or Torres Strait Islander students Data source: School Census	Assists to understand the characteristics of the school community, and may support the evaluation of quality indicators.
5. Proportion of students at the low SEA Quartiles Data source: School Census	Assists to understand the characteristics of the school community, and may support the evaluation of quality indicators.
6. Remoteness indicator of school Data source: School Census	Assists to understand the characteristics of the school community, and may support the evaluation of quality indicators.
7. Non-government school type - Primary, Secondary or combined Data source: School Census	Assists to understand the characteristics of the school, and may support the evaluation of quality indicators.
8. Parent level link rate to MADIP - the proportion of parents who link to MADIP, by link quality level Data source: CTC linkage report	Assists to understand the proportion of parents included in the DMI. Assists to understand the quality of linking.
9. Proportion of students in a school with complete parental income Data source: CTC analytical dataset	Supports analysis of accuracy, by providing information about income coverage.
10. Proportion of parents with income from alternative sources (i.e. non-ATI income). This includes the proportion with payment summary income and estimated zero income. Data source: CTC analytical dataset	Supports analysis of accuracy and coherence, by providing information about income coverage and income source.

11. Proportion of parents with missing income data (excluded from the measure) Data source: CTC analytical dataset	Supports the analysis of coverage / missingness, and, along with the shape of the income distribution, helps to interpret the uncertainty in the median income due to missingness.
12. Uncertainty in the median income due to missingness Data source: CTC analytical dataset	This measure is analogous to a sampling error. It assumes parents included in the measure are a representative sample of the entire school community population, and produces a measure of uncertainty which reflects both the 'sample' size and the statistical variation or spread of the distribution of incomes. Supports analysis of impact of coverage / missingness and variation in parental income distribution.
13. School community income distributions Data source: CTC analytical dataset	These are represented as graphs and support the understanding of the spread of parental incomes within a school community. Along with the proportion of parents represented in the DMI calculation, the shape of the income distribution is one component used to interpret the uncertainty in the median income due to missing data.
14. Kurtosis and Skewness of income distribution for the school Data source: CTC analytical dataset	Supports identification of schools with asymmetrical income distributions. The skewness of the income distribution supports an understanding of the sensitivity of the median income to missing data.
15. Difference between DMI and lower bound median income Data source: CTC analytical dataset	This indicator quantifies how different the school community median income would be if parents who were excluded due to missingness had systematically lower incomes than those included. A greater difference indicates that the median income used in the DMI is sensitive to the assumptions made about the incomes of parents who are missing.
16. Difference between DMI and upper bound median income Data source: CTC analytical dataset	This indicator quantifies how different the school median income would be if parents who were excluded due to missingness had systematically higher incomes than those included. A greater difference indicates that the median income used in the DMI is sensitive to the assumptions made about the incomes of parents who are missing.
17. Difference between DMI and a person-level Census income measure Data source: CTC analytical dataset	This indicator provides a different income measure, using person-level Census data. It should be noted that this approach assigns income to members of a school community using Census income data which has a different income definition, may reflect a different reference period, and is collected in ranges which are less precise for higher incomes. Thus, it should be interpreted as an indicative measure of possible differences between parents with an ATI and those without.
18. Compare median school community incomes with: - Median income for Australia and state and territories using all available data sources - Where possible, refine indicators for persons / households with school aged children / dependents in non-government schools Data source: CTC analytical dataset, datasets for confrontation including	These indicators provide a set of benchmarks with which to compare movements in school community median incomes.

Census, SIH, HILDA, Estimates of Persona Income for Small Areas, etc.	
19. Compare median income and DMI score with previous years	Supports analysis of change in school community income over time, provides an indication of volatility. It may be useful to interpret this indicator alongside other indicators of change in the school community, such as school growth rate, per item 2 above.
20. Difference between DMI and previous year's SES score	During the transition period to the DMI, it may be useful to be aware of the differences between the DMI and the previous SES score. Comparisons to the SES score are not recommended after the transition period ends.

Appendix 4: References

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Appendix 5: Acronyms

ABS	Australian Bureau of Statistics
ARID	Address Register ID
ATI	Adjusted taxable income
ATO	Australian Taxation Office
CTC	Capacity to Contribute
DESE	Department of Education, Skills and Employment
DMI	Direct Measure of Income
HILDA	Household, Income and Labour Dynamics in Australia
MADIP	Multi-Agency Data Integration Project
NSRB	National School Resourcing Board
PIT	Personal Income Tax
SA1	Statistical Area Level 1
SA2	Statistical Area Level 2
SEA	Socio-Educational Advantage
SES	Socio-Economic Status
SIH	Survey of Income and Housing
SSRI	Social Security and Related Information