The Treasury

Miscalculation of Disposable Income Release

February   2014

Release Document

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In preparing this Information Release, the Treasury has considered the public interest considerations in section 9(1) of the Official Information Act.

The Treasury
Peer Review of Treasury's Internal Review of the Taxwell Model Issues

Contents

1. Introduction & Background

1.1   The Treasury has developed the Taxwell micro-simulation model ("Taxwell") to enable highly detailed analysis of expenditures and income and to simulate the behavior of individuals over time.

1.2   In December 2013 it was identified that data on household incomes double-counted accommodation supplement for low-income individuals and families. Statistics NZ discovered the error in relation to an income distribution dataset request received from the Organisation for Economic Co-operation and Development ("OECD"). The data originated from the Household Economic Survey ("HES") (which is unaffected), was modelled through Taxwell by the Treasury, and then provided to Statistics NZ. This materially affected the data used for some measures of poverty and housing affordability for low income families.

1.3   In light of this discovery, the Treasury team undertook two inter-related reviews:

- The first review covered the background causes of the current issue and changes to data co-production processes between Statistics New Zealand and the Treasury to prevent this type of mistake from reoccurring ("Process Review")[1]

- The second review describes the checks undertaken by the Treasury review team to test the accuracy and reliability of the Taxwell datasets and associated documentation provided to Statistics NZ. It also sets out further review procedures and improvements to internal controls that are planned by the Treasury ("Dataset Review")[2].

1.4   As a result of the tests undertaken by the Treasury review team as part of the Dataset Review, further errors were identified. These errors are set out in detail in the Dataset Review report. Two of these issues identified were considered material by the Treasury review team. Materiality was based on assessing whether the margin of sampling error between the HES samples were within Treasury's expected range and relative to the variable's purpose. Appendix A of this report provides further detail of the impact of the two issues as well as the initial issue discovered in December.

1.5   Deloitte was engaged to peer review the programmes of work undertaken by the Treasury review team of the Taxwell Model. This peer review was undertaken in February 2014. The scope of our review is set out below.

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[1] Refer to the Treasury document 2819156v1 for the terms of reference for this review.
[2] Refer to the Treasury document 2809940v2 for the terms of reference for this review.

1.6   This report is written with the intention of reading alongside the final Process Review[3] and Dataset Review[4] reports.

Review Objectives and Scope

1.7   The objective of this engagement was to determine the extent to which the Treasury internal reviews were adequately completed to support the review findings reported. Our review was based on the following steps:

- Reviewed the draft reports for each of the Treasury reviews

- Developed a high level understanding of the model objectives, outputs and users, and areas of risk identified by the Treasury, through discussions with the model owners at the Treasury, a walk-through of the Model itself and enquiries into how the model interfaces with other agencies' data

- Reviewed supporting documentation supplied by the Treasury evidencing the process and procedures undertaken by Treasury for each review

- Interviewed relevant senior managers and staff involved at the Treasury who were involved in each review to understand how the review was undertaken, who was involved and the nature and extent of the review procedures, tests and analysis performed

- Compared the review procedures undertaken by the Treasury with Deloitte's internal practices when undertaking a review of this nature.

1.8   Key questions that this review sought to answer were:

- What additional procedures should the Treasury internal team perform to achieve the objectives of the reviews?

- What additional model risks could exist given the nature and extent of work undertaken to date?

1.9   The engagement did not involve the re-performance of any work completed by the Treasury review team nor did we review or validate any data, assumption or mathematical calculations contained within the Taxwell Model, nor did we assess whether the model is fit for purpose.

1.10   Our work was designed to provide a report on the specific objectives and scope of the engagement letter. It was not designed to provide assurance according to international or New Zealand auditing or assurance standards such as ISAE3000. Accordingly, no assurance opinion or conclusion has been provided.

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[3] Refer to the Treasury document 2823331v2.
[4] Refer to the Treasury document 2823936v5.

Context

1.11   The output of the Taxwell model is a dataset which contains original HES raw data and additional income variables as calculated by the Taxwell model. The process for calculating these outputs involves a number of steps. A basic understanding of the calculation processes included within the Taxwell model is helpful to understand the tests undertaken by the Treasury review team.

1.12   The following simplified diagram sets out the key processes as they relate to the HES Taxwell dataset:
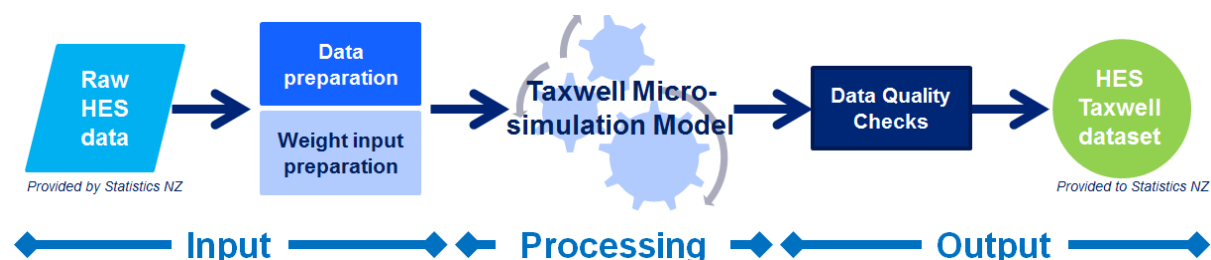
1.13   Each year Statistics NZ supplies Treasury with datasets from the HES ("HES raw data"). The Treasury then prepares the raw data for processing through Taxwell performing a series of manual and automated data preparation procedures. Examples of the data preparation procedures include forming families or households or combining original raw variables.

1.14   Concurrent to the data preparation procedures, the Treasury also prepare weight and benchmark input files which are used by the Taxwell weighting program to assign values for each HES survey record to 'scale up' the dataset into a representation of the New Zealand population.

1.15   After the data preparation is complete and weighting files are prepared, the data and input files are uploaded to Taxwell, where they are combined with other input parameters (e.g. current benefit rates). Processing in the Taxwell model occurs through the execution of procedure files. Procedure files contain the "logical coding" that initiate calculations, combine data and assign weights to create the Model outputs.

1.16   The resulting HES Taxwell dataset, which includes additional variables such as total disposable income, is assessed for quality by the Treasury to determine whether the model outputs are as expected and they fall within error tolerances. The Treasury review team also compared the additional variables against data from other agencies (such as IRD data). In parallel with the quality assessment procedures, the Treasury prepares a data dictionary which provides a description of the variables in the HES Taxwell dataset.

1.17   Once these internal quality assurance procedures are complete, Treasury supplies the HES Taxwell dataset and data dictionary back to Statistics NZ. Statistics NZ checks that the HES Taxwell dataset reconciles to the HES raw data originally sent to the Treasury. Statistics NZ then compiles a dataset containing both the Treasury HES Taxwell dataset and additional HES information, and provides this new dataset to the Ministry of Social Development ("MSD"). This dataset then becomes the basis for any analysis of disposable income.

2. Findings

2.1   Given the relatively short timeframe over which the internal review was completed and the size and complexity of the Taxwell model, the Treasury review team adopted a risk based approach in formulating the test procedures completed during both reviews.

2.2   The Treasury review team assessed which steps in the HES Taxwell dataset production process had the highest risk of an error that would have a material impact on the HES Taxwell dataset provided to Statistics NZ. Risks were determined based on the Treasury's assessment of the likely impact of a potential error, the likelihood of occurrence and the existence of internal checks and controls. Specific checks were undertaken to test for errors in the production process as a result of changes to the process year on year.

2.3   The Treasury review team has set out a list of additional test procedures and internal controls that it intends to implement to further mitigate any residual risks in the HES Taxwell dataset production process.

2.4   The testing completed as part of the two internal Treasury reviews is in addition to the usual quality assurance testing undertaken by Treasury each time the Taxwell model is run.

2.5   We have compared the approach and procedures undertaken or planned by the Treasury review team in response to the risks identified by the Treasury with the approach that we may have undertaken had we been engaged to complete this review.

2.6   As we have not re-performed any of the testing undertaken by the Treasury review team, we cannot opine on the quality or completeness of the testing undertaken or planned.

2.7   We have not identified additional test procedures that we consider should have been undertaken by the Treasury review team in addition to the actions committed to by the Treasury in its Action Plan, working within the resources and timeframes during which the Treasury reviews were completed. The testing undertaken or planned by the Treasury review team appears reasonable to address many of these risk areas.

2.8   However, we note that the following risks remain:

- There is a risk of error in the underlying calculations that have not changed during the 2006/07 to 2011/12 review period. We note that the Treasury review team has considered sources of assurance related to the implementation of Taxwell, including how the underlying calculations were tested as part of the initial development testing. However

this testing has not been updated since or as part of the test programme undertaken by the Treasury review team

- The residual risks identified in the tables in this section will remain until the additional actions identified by the Treasury review team are implemented.

2.9   The following section sets out the specific checks performed by the Treasury review team as part of its test programme in response to specific risks identified. We have also included the additional test procedures and internal controls that the Treasury intends to implement to further mitigate residual risks in the HES Taxwell dataset production process.

2.10   Separate sections are included for each of the Input, Processing and Output parts of the process.

The Treasury procedures performed over input procedures

2.11   To gain comfort that the HES raw data received from Statistics NZ did not contain material errors, the Treasury review team confirmed that Statistics NZ performs data quality checks prior to sending HES raw data to the Treasury. In addition, the Treasury review team confirmed that Statistics NZ compare the counts and sums of income variables of its HES raw data with Treasury's HES Taxwell dataset to identify any discrepancies.

2.12   The Treasury review team's approach was focussed on the impact of changes made to data preparation procedures between 2006/07-2011/12 years. Data preparation files record the steps taken to prepare the raw HES data for processing through Taxwell. The data preparation process is a combination of manual and automated procedures, which is reliant on the judgment of the analyst.

2.13   The Treasury review team compared data preparation files year on year to identify material differences in the way the data preparation procedures were performed. The Treasury review team investigated any material differences for their cause and impact.

2.14   The Treasury review team checked whether a process was in place to communicate HES raw data format changes to the Treasury and to ensure the changes have been reflected in Taxwell as necessary.

2.15   The Treasury review team determined that there were compensating checks performed as part of their review (e.g. year-on-year comparison of variable averages and Statistics NZ sum and count checks) designed to identify material errors resulting from data preparation and input errors.

2.16   The following table describes the residual risks acknowledged by the Treasury and the additional test procedures and internal control improvements which Treasury has committed to manage these risks.

Residual Risk	Treasury Action Plan
The data preparation process is a combination of undocumented manual and automatic processes, undertaken by different analysts each year. These factors increase the likelihood of inconsistencies and errors in the data preparation processes from year to year.	The Treasury will develop a new, fully documented data preparation process for preparing the 2012/13 and future datasets by late March 2014 and invite Statistics NZ to provide quality assurance review of this documentation.[5] The Treasury will use the new data preparation code and revised data from Statistics NZ to prepare revised datasets and documentation to Statistics NZ for all six historical years, incorporating the fixes described in this review by April 2014.[6]
Risk that modifications made to the HES raw data are not accurately reflected in the Taxwell model or data preparation procedures.	The Treasury will review and update its Memorandum of Understanding ("MoU") with Statistics NZ to include: • The roles and responsibilities for the two-way transfer of data between Statistics NZ and the Treasury • The timing of process • How changes are made and communicated. • Clarity on how the information will be used and by whom including third parties. This will include when stakeholders requirements on the HES Taxwell modelled dataset change.[7]

The Treasury procedures performed over processing

2.17   The Treasury review team undertook an approach that focussed on the impact of coding and parameter changes made to Taxwell between the 2006/07-2011/12 years. To gain comfort that the underlying Taxwell code was reliable, the Treasury review team checked that development testing occurred when Taxwell was originally implemented. The Treasury review team then reviewed how the HES Taxwell dataset was produced in 2006/07 and annually in each year thereafter. The Treasury review team also considered annual checks that occur during the production of the annual HES Taxwell dataset. Examples of these checks are detailed on page 3 of the Treasury's Dataset Review report.

2.18   The Treasury review team compared Taxwell procedure files and project files year on year to identify material differences. Procedure files contain the system coding that executes the actual data processing and calculations. By comparing the procedure files, this test is designed to identify the main differences in the Taxwell coding year on year. The Treasury review team investigated any material differences for their cause and impact.

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[5] Recommendation #4 as stated in the Dataset Review report.
[6] Recommendations 1, 2, and 5 as stated in the Process Review report.
[7] Recommendation for Memorandum of Understanding as stated on page 7 of the Process Review report.

2.19   Project files record the parameters specified within Taxwell for a given year. An example of a parameter utilised by Taxwell is the Accommodation Supplement classification which can be set to either '0' (exclude) or '2' (include). By comparing the project files year on year, this test is designed to identify material differences in the Taxwell parameters year on year. The Treasury review team investigated any material differences for their cause and impact.

2.20   The Treasury review team checked whether a change control process was in place to ensure modifications to Taxwell were approved, tested and communicated to all parties, as required.

2.21   Taxwell relies on the 'HesToTaxml' program that converts HES raw data into the appropriate format for Taxwell. The Treasury team also reviewed evidence that development testing was performed on the 'HesToTaxml' program to gain comfort on the file conversion process. In addition, the Treasury review team noted that problems such as changes in the number of records, checksum mismatches, and character truncations should be picked up at several stages of the Treasury quality assessment process or by Statistics NZ when they checked the HES Taxwell dataset against the HES raw data.

2.22   The following table describes the residual risks acknowledged by the Treasury and the additional test procedures and internal control improvements which Treasury has committed to manage these risks.

Residual Risk	Treasury Action Plan
That the Taxwell model may not have been fully updated for all changes in legislation between 2006/07 – 2011/12 or be updated for future legislative changes.	The Treasury will develop an annual process for checking published legislation changes that affect the modelled variables in Taxwell by June 2014.[8] The Treasury will review and update meta data provided to Statistics NZ.[9]
Additional test procedures undertaken identified short-comings in the existing analytical review tests and checks being undertaken as part of the existing process.	The Treasury will review and document an end–to-end view of the revised HES data modelling process which will include incorporating the additional QA analytical review processes undertaken as part of the current testing into the annual review process.[10]
Changes in procedure files or input parameters are not reviewed or that changes (e.g. parameter changes) made by Treasury are not communicated to Statistics NZ (or vice versa) in the absence of documented change control procedures.	The Treasury will review change control procedures to ensure that all future changes are identified, evaluated, communicated and approved at the appropriate level.[11] The Treasury will document an end–to-end view of the revised HES data modelling process. This should include formalising the handover process including sign-off at the appropriate level that all the necessary checks and balances have been done and that both parties are aware

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[8] Recommendation #7 as stated in the Dataset Review report.
[9] Process recommendation bullet points 5 in the Process Review report.
[10] Process recommendation bullet points 3 in the Process Review report.
[11] Process recommendation bullet points 1 in the Process Review report.

Residual Risk	Treasury Action Plan
	of and understand the nature of all significant changes that have been made.[12]
	The Treasury will ensure that sufficient level of documentation of the process followed is maintained.[13]
	The Treasury will work with Statistics NZ to ensure that both agencies have sufficient understanding of the process including having the overview of how variables are linked.[14]
	The Treasury and Statistics will use the 2012/13 HES data process to identify and modify the process.[15]
	The Treasury will prepare and provide to Statistics NZ documents that describe the year-on-year changes for each of the five years from (and including) 2007/08 by April 2014.[16]

The Treasury procedures performed over output procedures

2.23   The Treasury review team compared averages for all variables where a meaningful average could be calculated to previous and subsequent years. Any large variations or unexpected results such as unexpected zero figures or significant variations were investigated for their cause and impact. Additionally, the team has used analytical testing techniques including the use of "spark charts" to review the income variables. Spark charting is a method by which variables are mapped over the 6 year period and any unexplained movements or trends are investigated.

2.24   The Treasury review team compared the data dictionaries and data sent to Statistics NZ for all six years (2006/07-2011/12) to check that the variable names in the data dictionary matched the dataset sent to Statistics NZ, the cover sheet in the data dictionary was accurate, variable descriptions were accurate, variable names from Taxwell match the alias mappings given to Statistics NZ, and that the modelling methodology still matches the metadata.

2.25   The Treasury review team mapped the relationships between income variables as calculated in Taxwell and provided this mapping to Statistics NZ to check their usage of those variables. Statistics NZ sent a description to the Treasury team detailing how Statistics NZ was combining HES Taxwell variables to create the statistics requested by the OECD. The Treasury team then verified that the variables were accurately combined.

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[12] Process recommendation bullet points 3 in the Process Review report.
[13] Process recommendation bullet points 4 in the Process Review report.
[14] Process recommendation bullet points 6 in the Process Review report.
[15] Process recommendation bullet points 7 in the Process Review report.
[16] Recommendation #6 as stated in the Dataset Review report.

2.26   The Treasury review team also checked whether a process was in place between the Treasury and Statistics NZ to identify, document and monitor any issues with the HES Taxwell dataset.

2.27   The following table describes the residual risks acknowledged by the Treasury and the additional test procedures and internal control improvements which Treasury has committed to manage these risks.

Residual Risk	Treasury Action Plan
The HES Taxwell dataset production process involves interdependencies between agencies, resulting in interface risk. Interface risks could arise where: • Changes in inputs are not being adequately communicated or explained to the agency reliant on the data • Where there is a poor understanding of the overall process areas of interdependence between agencies • The absence of feedback loops to communicate the result of issues identified to the affected agency. As there is no process in place between the Treasury and Statistics NZ to identify, document and monitor any issues with the HES Taxwell dataset, there is a risk that issues with the HES Taxwell dataset go unresolved.	The Treasury will work with Statistics NZ to ensure that both agencies have a sufficient understanding of the process including having the overview of how variables are linked. This will include establishing shared issues registers and feedback loops as part of the issues resolution processes to ensure that the results of reviews undertaken by other agencies are fed back to Treasury.[17]

Management Response

2.28   Treasury is committed to implementing the recommendations that have been made in the two internal reports that have been referred to by Deloitte. Given the co-production nature of the production of the Taxwell (HES) customised dataset, we will work closely with Statistics New Zealand in the development of improved processes. An assessment of the implementation of recommendations will be made prior to the 2012/13 dataset being provided to Statistics NZ in April 2014.

2.29   A further assessment will be made by June 2014 on the implementation of any remaining recommendations, and any further processes and procedures that are needed to maintain the integrity of the Taxwell model over time.

Acknowledgment

2.30   We wish to place on record our appreciation of the assistance and cooperation received from the management and staff of the Treasury.

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[17] Process recommendation bullet point 6 in the Process Review report.

Report clearance

2.31   The contents of this report have been discussed and agreed with Angela Mellish, Manager, Economic Research & Analysis and Gary Taylor, Risk Advisor.

General Distribution Disclaimer

2.32   This report is provided solely for the exclusive use of the Treasury for the purpose of evaluating the recommendations we have made related to the internal Treasury Taxwell review. However, as the issue involves Statistics NZ a copy of the final report may be provided to Statistics NZ. Our report is not to be used for any other purpose, recited or referred to in any document, copied or made available (in whole or in part) to any other person without our prior written express consent. We accept or assume no duty, responsibility or liability to any other party in connection with the report or this engagement, including without limitation, liability for negligence in relation to the factual findings expressed or implied in this report.

Statement of Responsibility

2.33   This engagement was performed in accordance with the terms contained in our Terms of Reference, dated 5 February 2014. Where Deloitte has provided advice or recommendations to the Treasury, we are not responsible for whether, or the manner in which, suggested improvements, recommendations, or opportunities are implemented. The management of the Treasury, or their nominees, will need to consider carefully the full implications of each of these suggested improvements, recommendations, or opportunities, including any adverse effects and any financing requirements, and make such decisions, as they consider appropriate.

2.34   The engagement did not involve the re-performance of any work completed by the Treasury review team nor did we review or validate any data, assumption or mathematical calculations contained within the Taxwell Model, nor did we assess whether the model is fit for purpose.

2.35   The work performed did not constitute an assurance engagement in accordance with the New Zealand Institute of Chartered Accountants.

2.36   Our work was designed to provide a report on the specific objectives and scope of the engagement letter. It was not designed to provide assurance according to international or New Zealand auditing or assurance standards such as ISAE3000. Accordingly, no assurance opinion or conclusion has been provided.

2.37   The matters detailed in our report are only those which came to our attention during the course of performing our procedures and did not necessarily constitute a comprehensive statement of all the weaknesses or issues that exist or actions that might be taken. Accordingly, management should not rely on our report to identify all weaknesses and issues that may exist in the systems and procedures discussed. The report should be read in the context of the scope of our work.

2.38   This report should not be relied upon as a substitute for actions that the Treasury should take to assure itself that the relevant controls are operating efficiently.

2.39   This report and all deliverables have been prepared solely for the use of the Treasury, and should not be quoted in whole or in part without our prior written consent. No responsibility to any third party is accepted as the report has not been prepared, and is not intended, for any other purpose.

2.40   Suggestions for improvement should be assessed by management for their full commercial impact before they are implemented.

Appendix A: Material HES Taxwell Dataset Issues

The following table provides further details on the impact of the material HES Taxwell dataset issues.

#	Issue	Years affected	Cause	Treasury Defined Impact	Treasury Defined Resolution
1	Accommodation supplement for low-income individuals and families was double counted in the Statistics NZ HES data provided to MSD (~$1.2B).	2009/10 2010/11 2011/12	When the HES Taxwell dataset was combined with other HES variables, Accommodation Support was added to the BenAllSuppAssist variable. The data dictionary explicitly and incorrectly states Accommodation Supplement is excluded from Disposable Income calculation. A change in the Accommodation Supplement classification parameter occurred and this was not considered when the HES Taxwell dataset was combined with other HES variables by Statistics NZ.	No direct effect on Treasury calculations, as the dataset became incorrect after it left Treasury. It does affect the MSD Household Incomes report, which Treasury do quote in places, but that is one data source among many used in policy analysis and therefore policy advice is unlikely to change.	To fix the inaccuracy in the data dictionary, the Treasury has since revised the data dictionary and provided this to Statistics NZ.
2	Working for Families payments were overestimated by ($900M).	2007/08	Income variables within the HES raw data were miscoded to a more general category. The Taxwell model replaces the specific income variables with calculated equivalents, but passes through the more general variables.	While some distributional analyses for the Tax Working Group and Budget 2010 were affected, recalculations on a corrected dataset show any	To fix the miscoding of income variables, Statistics NZ, have since revised their data. To fix the data problem, the revised data from Statistics NZ has been used to prepare a new version of the 2007/08 data

#	Issue	Years affected	Cause	Treasury Defined Impact	Treasury Defined Resolution
				effects were small and unlikely to have changed policy advice.	for Statistics NZ and their clients.
3	Underestimation of Modelled Accommodation Support (~$650M).	2007/08	The data preparation process did not pick-up most rental expenditure which should have been included in the calculation of the Modelled Accommodation Support variable.	While some distributional analyses for the Tax Working Group and Budget 2010 were affected, recalculations on a corrected dataset show any effects were small and unlikely to have changed policy advice.	A revised 2007/08 dataset has been provided to Statistics NZ.

Appendix B: Glossary of Terms

Term	Description
Averages	The number that measures the central tendency of a given variable.
Benchmarks	Benchmarking is a method of using auxiliary information to adjust the sampling weights used in an estimation process, in order to yield more accurate estimates of totals.
Data dictionary	The data dictionary contains a description of variables included within the HES Taxwell dataset.
Data preparation code	The data preparation code is the code used to execute the automated tasks defined in the data preparation procedures.
Data preparation procedures	Data preparation files record the steps taken to prepare the raw HES data for processing through the Taxwell model. The data preparation process is a combination of manual and automated procedures which are reliant on the judgment of the analyst.
Development testing	Development testing is a software development process that involves a combination of prevention and detection strategies in order to reduce software development risks.
HES Taxwell dataset	The HES Taxwell dataset is the output from the HES raw data processed through the Taxwell micro-simulation model.
HesToTaxml program	The HesToTaxml program is the program that converts the original HES raw data to a readable format for the Taxwell microsimulation model. The HES raw data is provided in SAS format and the Taxwell model requires XML format.
Household Economic Survey	The Household Economic Survey (HES) collects information on household expenditure and income, as well as a wide range of demographic information on individuals and households. Purchases recorded by households include such things as fruit and vegetables, footwear and cars, as well as spending on services such as electricity, telecommunications and health. The survey also asks for detail on where households get their money from – for example, wages and salaries, self-employment, investments, or benefits.
Income variables	Income variables are the Taxwell calculated income variables that are included in the HES Taxwell dataset.
Procedure files	Procedure files contain the system coding that executes the actual data processing and calculations. One procedure file may rely on several sub-procedures. There are circa 1,000 pages of procedure files in total.
Project files	Project files record the parameters specified within Taxwell for a given year and also include information about which database and procedures to use, which inflators, the output format and where to save the output file.

Term	Description
Spark charts	Spark charting is an analytic method by which data is mapped over a period and any spikes are investigated and explained.
Taxwell Micro-simulation Model	The Taxwell micro-simulation model is a computerised analytical tool that performs highly detailed analysis of activities (e.g. expenditures and income) and is used to simulate the behavior of individuals over time.
Taxwell weighting program	The Taxwell weighting program assigns weights as an additional variable for each survey record.
Variables	A variable is any characteristics, number, or quantity that can be measured or counted. For each HES survey record there are many different variables recorded (e.g. salary).
Weights	A weight is a coefficient assigned to a variable to reflect its computational importance.

Appendix C: Interviewees

The following personnel were interviewed during the review:

Name	Position
[1]	Treasury Analyst
[1]	Treasury Analyst
Angela Mellish	Manager, Economic Research and Analysis
Gary Taylor	Risk Advisor

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