

# Changes to the Quarterly Economic Survey of Manufacturing<sup>(1)</sup>

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## 1. Summary

The previous QMS series was based on a statistical sample that was first surveyed in the December 1992 quarter. The last quarter of the old QMS was June 2001. The QMS was a panel survey. Businesses had one chance of selection at their birth, and those that were introduced then remained in the sample until either they ceased operation in the manufacturing industry, or the panel was reselected.

Over time, sample designs become less effective in representing the current population as a whole. While the original samples are maintained to include a representative selection of new businesses, periodically panel samples need to be refreshed to reflect changes in the composition of the population.

The QMS has been redesigned to provide better and more up-to-date coverage of the Manufacturing population. The new QMS design will allow changes in the composition of the population over time to be better represented in the survey.

Changes to the QMS (which will be discussed in more detail in Section 5 below) include:

- a redesign of the survey questionnaire
- the inclusion of royalty and patent fees within the definition of operating income and expenditure
- the introduction of an ANZSIC definition of Manufacturing as the basis for the sample design
- the use of administrative (tax) data for small to medium-sized businesses in place of direct surveying
- the adoption of periodic re-selection of the survey sample population
- the use of bi-variate stratification in the sample design
- improvements in non-response imputation methodologies.

These changes ensure that future estimates produced from the QMS will accurately reflect activity in the manufacturing sector of the New Zealand economy.

During the June 2001 quarter, the QMS was calculated on both the old and new bases. The primary purpose of this 'dual run' was to compare the surveys run under the previous and redesigned methods, so that the two series could be linked at a single point in time. This facilitated the production of an analytical back series for the redefined output industries. Another important function of the dual run was to measure level shifts in the results coming from the two different designs so that the results could be verified and explained.

The dual run exercise highlighted the importance of undertaking regular reselection of panel surveys in order to maintain their representativeness of the contemporary population.

## **2. Introduction**

The Quarterly Economic Survey of Manufacturing (QMS) has been redesigned. The previous design operated from December 1992 to June 2001. Sample surveys require periodic redesign to ensure that the sample adequately represents the contemporary composition of the population.

The redesign of the QMS incorporates a number of methodological enhancements aimed at improving the reliability and quality of the results of the survey, while reducing the overall respondent load.

The existing QMS time series terminated at the June 2001 quarter. To assist users in moving to the redesigned survey, Statistics New Zealand (SNZ) has produced an unofficial, analytical series from the June 2001 quarter back to the December 1992 quarter. To provide the information necessary to produce this analytical series a dual run of the June 2001 quarter was conducted, whereby the survey was run on both the old and the redesigned designs. The back-casting method incorporates a number of features:

- A graduated shift accounting for the level differences identified between the old and new level estimates for June 2001. This assumes that the differences between the new and old series observed at the June 2001 quarter have occurred gradually over the life of the previous survey. These differences have been smoothed back by a method that has ensured that where possible the direction of quarterly changes of the historical series has been maintained.
- A level shift to account for the inclusion of units which, under the previous New Zealand Standard Industrial Classification (NZSIC), were not classified to Manufacturing, but which are included in Manufacturing under the Australia New Zealand Standard Industrial Classification (ANZSIC).
- A level shift in both the Sales and Purchases variables to account for the inclusion of royalties and patent fees.

The back-cast series are provided in an Excel spreadsheet attached to this article.

As a result of the analysis undertaken during the introduction of the new design, a number of errors were identified in the existing time series. In some instances it has been necessary to revise the previously published QMS series to incorporate this new information.

### 3. Dual run and linking

For the June 2001 quarter, the QMS was run on both the old and new basis, to provide an overlap quarter to allow for linking the old and new survey estimates.

There are a number of factors which have contributed to the difference in level estimates between the old and new surveys for the June 2001 quarter. These include:

- population differences (ie change to an ANZSIC design)
- conceptual differences in the variables collected (eg royalty and patent fees)
- the previous sample becoming less effective in representing the current manufacturing population
- sample error
- non-sample error.

Of the above reasons, differences due to population and conceptual changes have been directly measured and allowed for in the back-casting of the new survey results.

Non-sampling errors in the survey data may result from errors in the sample frame, respondent error, mistakes made during processing survey results and non-response imputation. Statistics New Zealand adopts procedures to detect and minimise these types of errors but they may still occur and, when not detected, they are not quantifiable.

Sampling error is a measure of the variability that occurs by chance because a sample, rather than an entire population, is surveyed.

The old QMS sample was designed to give statistics at the following levels of accuracy (at the 95 percent confidence interval limit):

- 4 percent for total manufacturing sales.
- 1.5 percent for inter-quarterly percentage change in total manufacturing sales.
- 4 percent for total manufacturing stocks.
- 10 percent for 2-digit NZSIC sales.
- 10 percent for 2-digit NZSIC stocks of materials.

The new QMS sample was designed to give statistics at the following levels of accuracy (at the 95 percent confidence interval limit):

- 5% for value added, sales and salaries and wages at the total manufacturing level.
- 10% for value added, sales and salaries and wages at the published industry level.

when the value added design variable is calculated as follows:

- Value Added = Sales - Purchases + Stock change.

#### 4. The back-cast series

The following graphs provide a comparison of the back-cast series from the new survey along with data derived from the old survey.

The series labelled "Original" reflect the estimates which came from the old QMS design. In many instances the new published industries are more detailed than those that were originally published. In these cases, the old survey data has been re-compiled on the new industry basis.

The series labelled "Adjusted" reflect the estimates from the old QMS design adjusted for differences which are the result of a change in the population definitions, arising from the move from NZSIC to ANZSIC, and conceptual changes. These changes have been factored back over the life of the back series using the June 2001 quarter proportions.

The series labelled "Linked" represent the final analytical back series for the new QMS. The difference between the "Adjusted" and "Linked" series at the June 2001 quarter represents both the aging of the sample, which has occurred over the life of the old survey, and possible sample and non-sample error. This difference has been smoothed back over the historical back series. The smoothing methodology employed preserves, when possible, the inter-period direction of the movement in the "Adjusted" series.

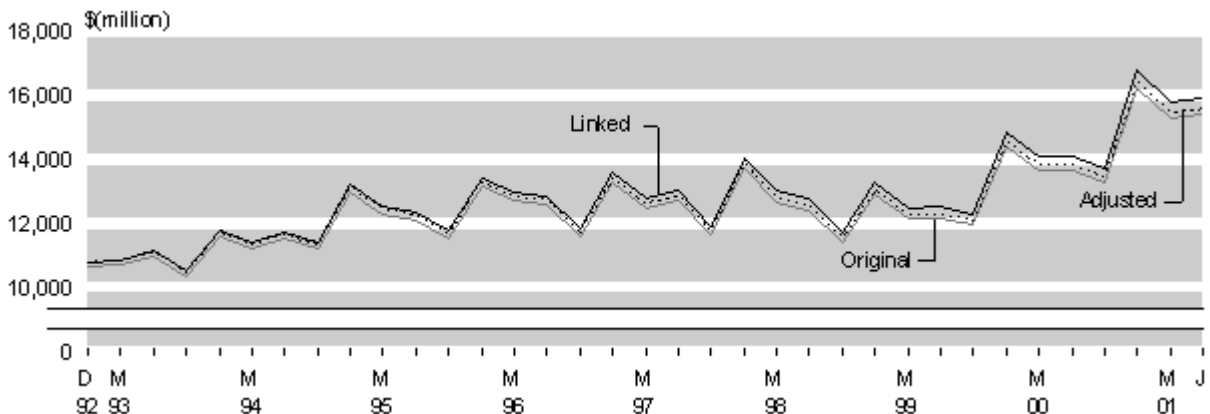
Link factors were calculated explicitly for each of the six variables for which an analytical back series was produced. The link factors are calculated as the ratio of the new survey estimate to the "Adjusted" estimate for the old series. A link factor of greater than one represents an estimated under-coverage in the old survey estimate.

The link factors for the Operating Income variable at the June 2001 quarter are summarised in the table below.

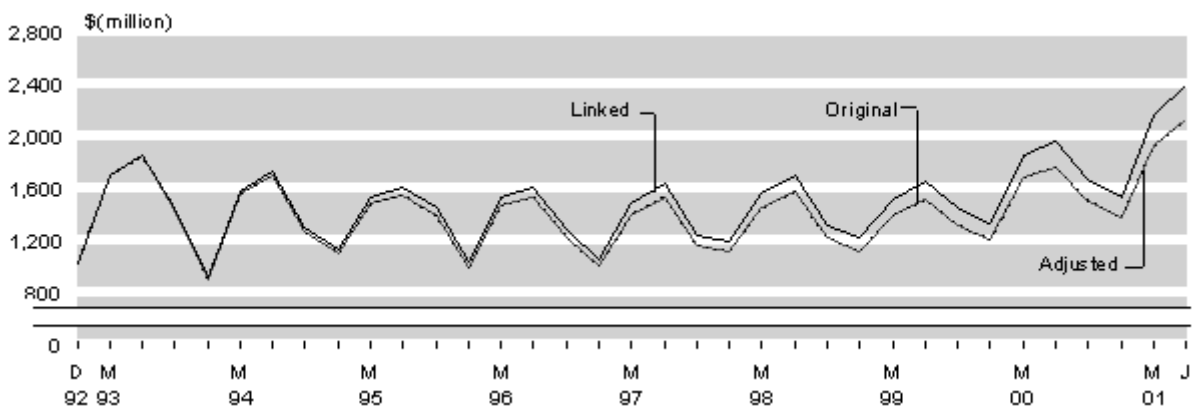
<b>Link Factors for Operating Income - June 2001 Quarter</b>	
<b>Industry</b>	<b>Link factor</b>
Meat and Dairy Product Manufacturing	1.13
Other Food Manufacturing	1.02
Beverage, Malt and Tobacco Manufacturing	1.12
Textile and Apparel Manufacturing	1.02
Wood Product Manufacturing	1.01
Paper and Paper Product Manufacturing	0.97
Printing, Publishing and Recorded Media	1.05

Petroleum and Industrial Chemical Manufacturing	0.86
Rubber, Plastic and Other Chemical Product Manufacturing	0.97
Non-metallic Mineral Product Manufacturing	1.08
Basic Metal Manufacturing	1.00
Structural, Sheet and Fabricated Metal Product Manufacturing	0.80
Transport Equipment Manufacturing	0.65
Machinery and Equipment Manufacturing	0.97
Furniture and Other Manufacturing	1.04
<b>All Manufacturing</b>	<b>1.02</b>

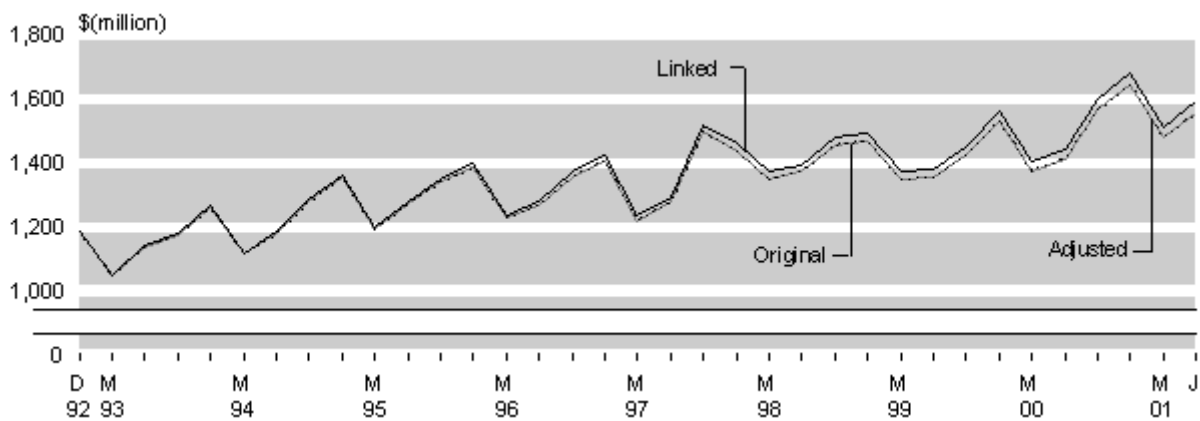
### All Manufacturing Sales



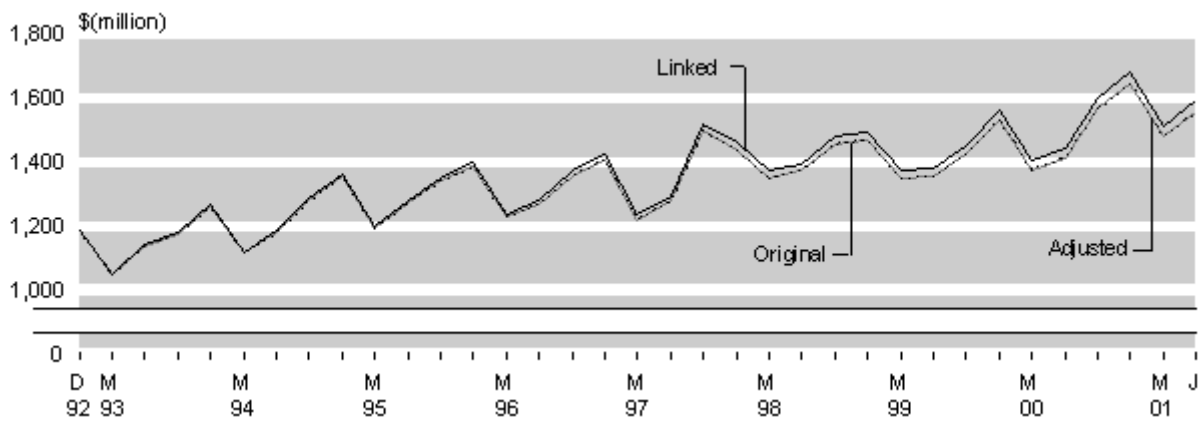
### Meat and Dairy Product Manufacturing Sales



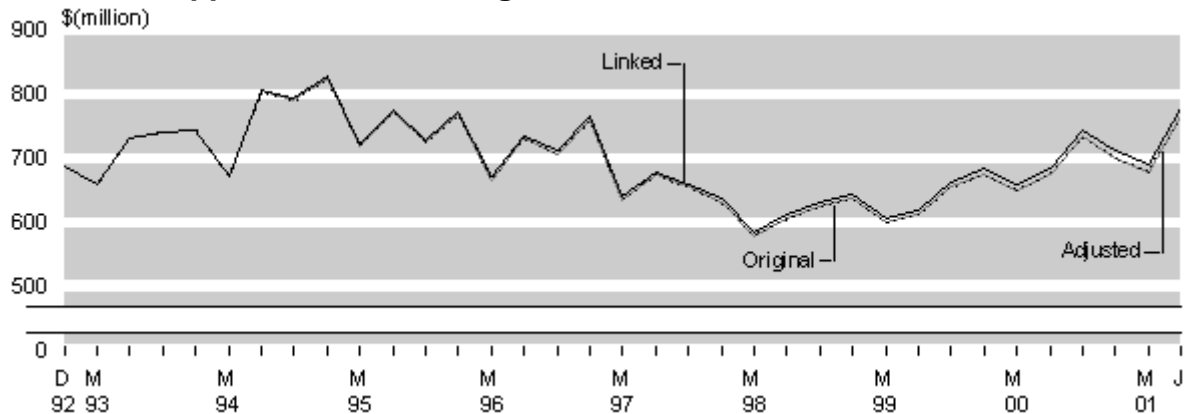
### Other Food Manufacturing Sales



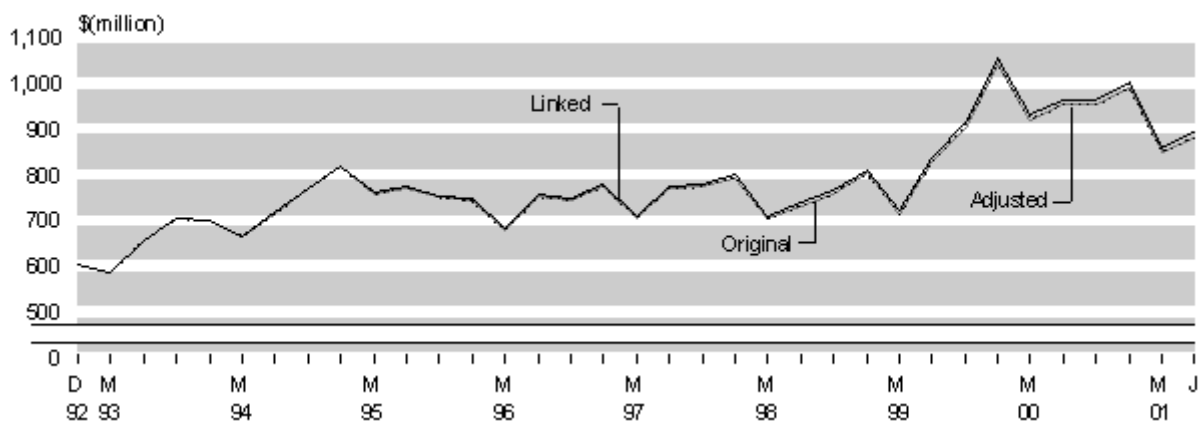
### Beverage, Malt and Tobacco Manufacturing Sales



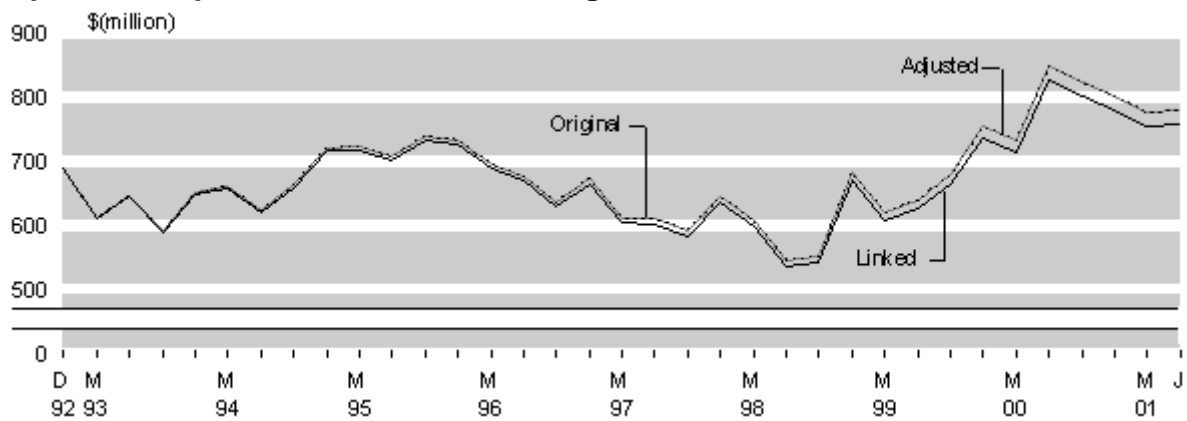
### Textile and Apparel Manufacturing Sales



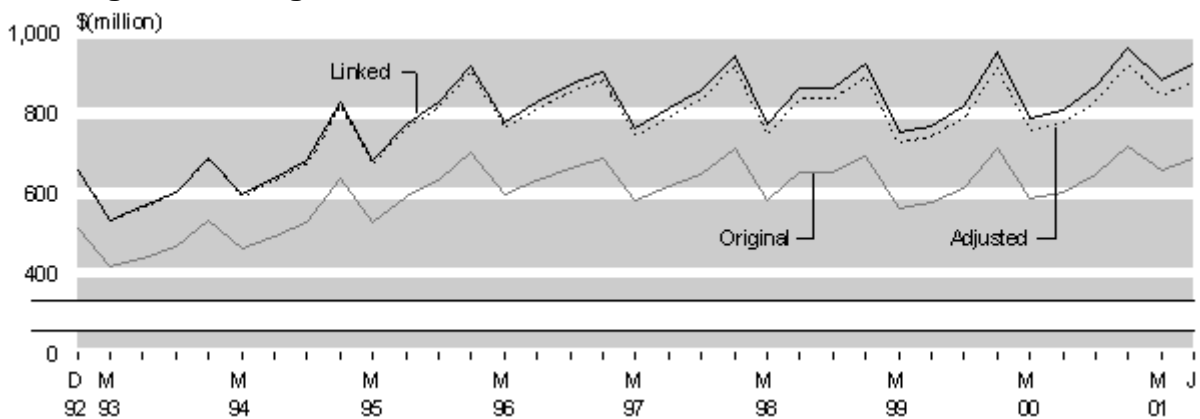
### Wood Product Manufacturing Sales



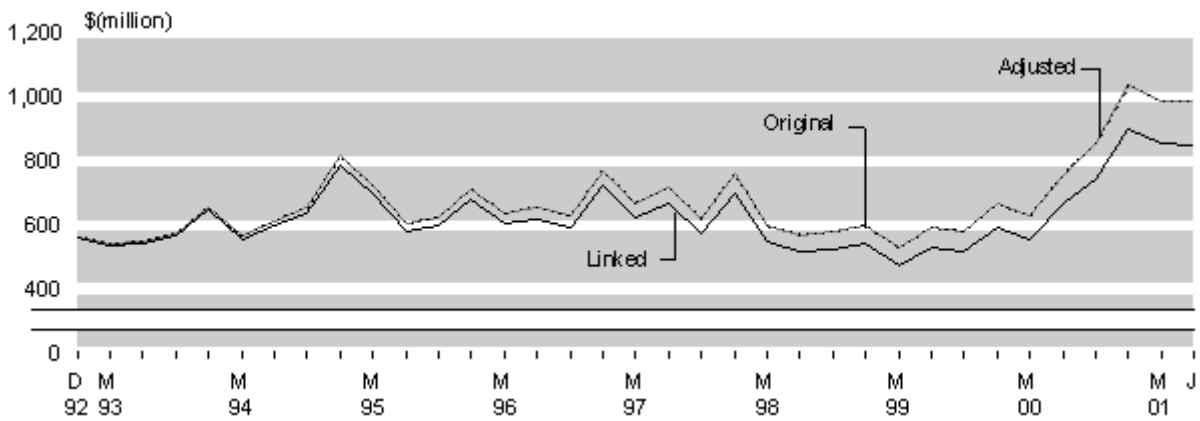
### Paper and Paper Product Manufacturing Sales



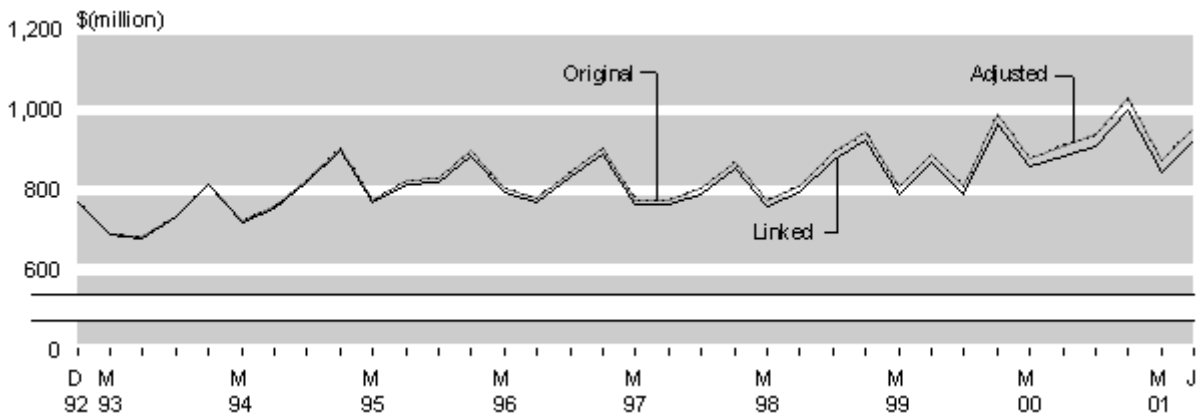
### Printing, Publishing and Recorded Media Sales



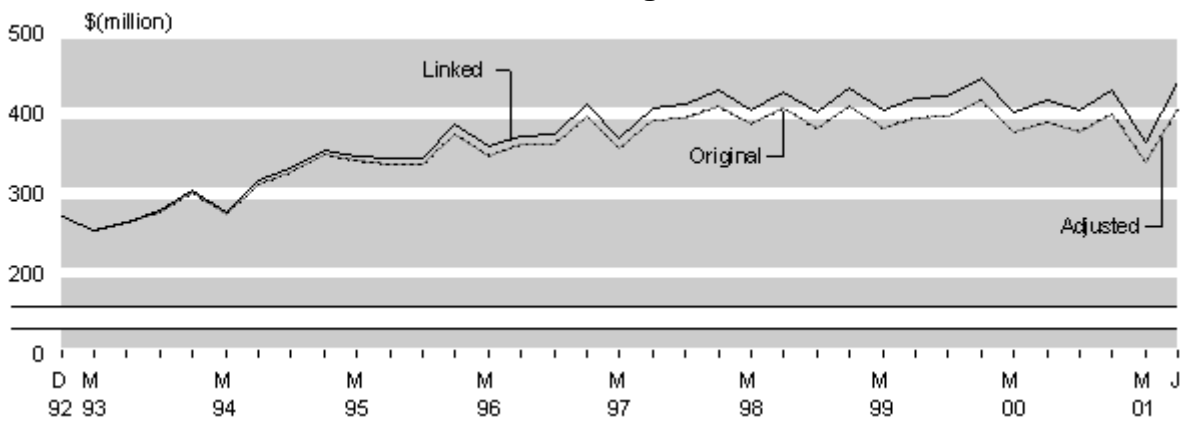
### Petroleum and Industrial Chemical Manufacturing Sales



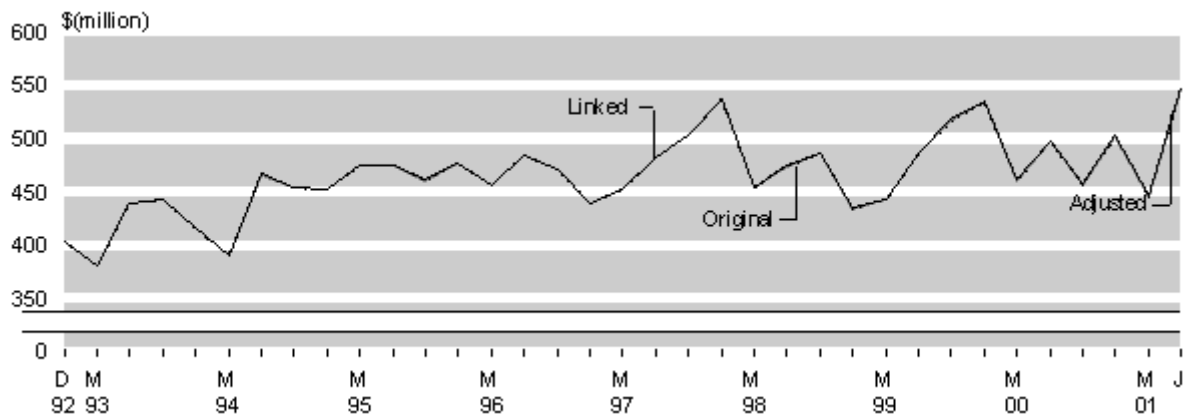
### Rubber, Plastic and Other Chemical Product Manufacturing Sales



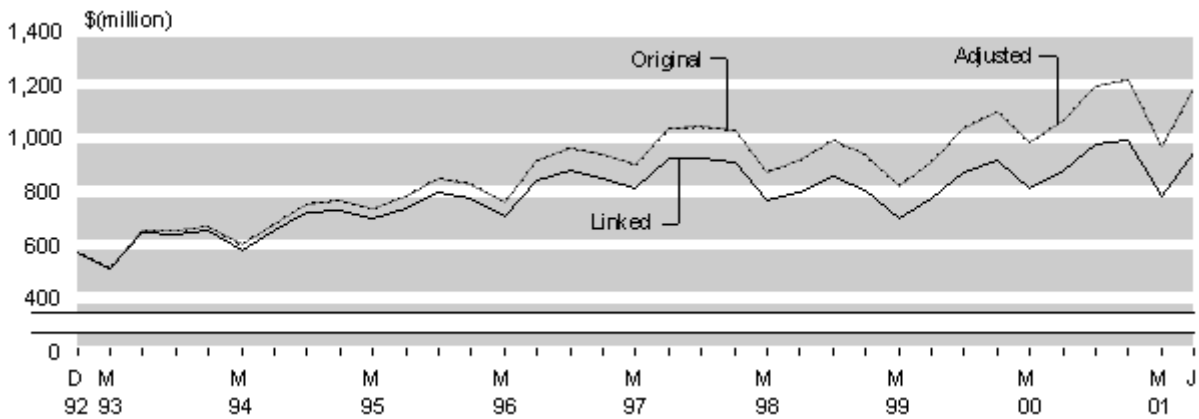
### Non-metallic Mineral Product Manufacturing Sales



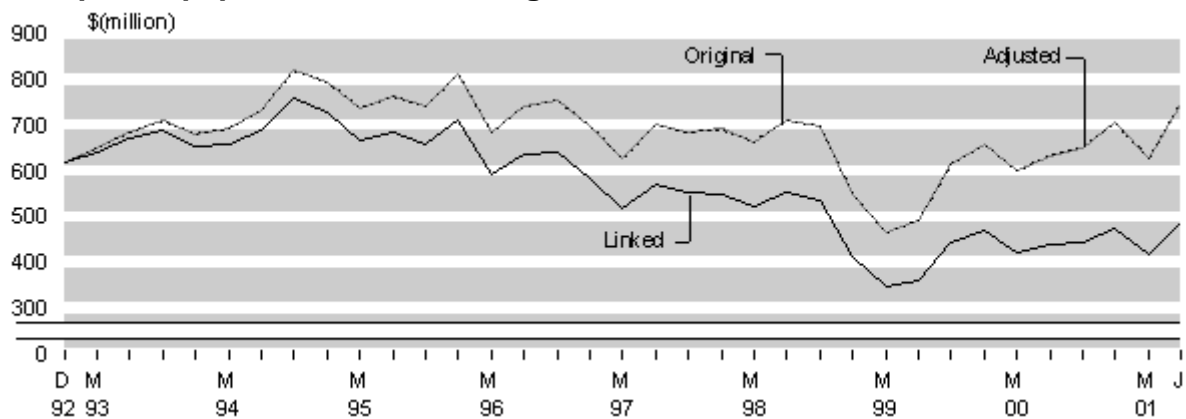
### Basic Metal Manufacturing Sales



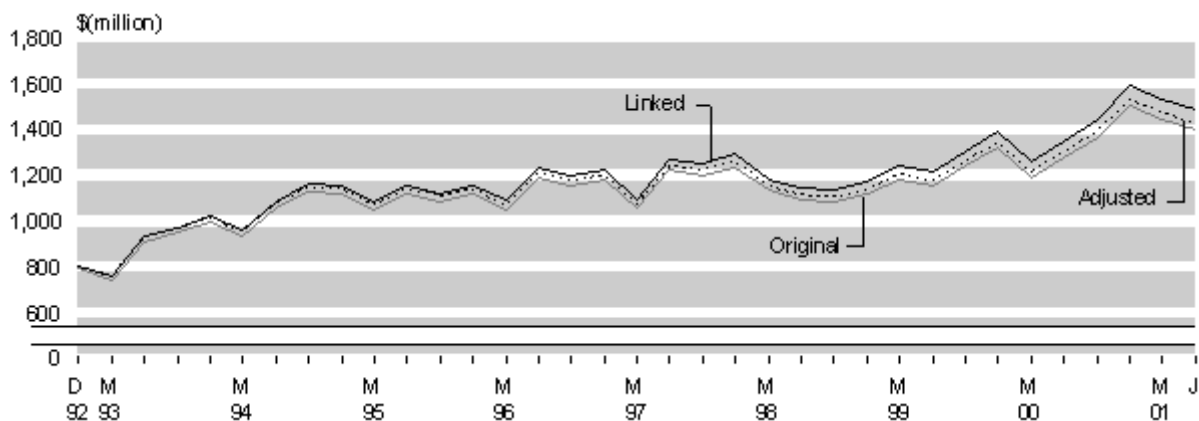
### Structural, Sheet and Fabricated Metal Product Manufacturing Sales



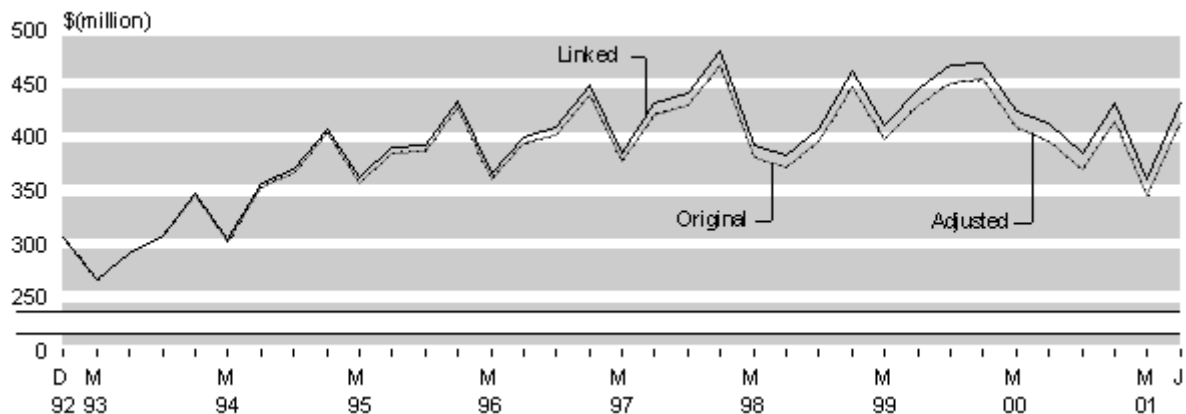
### Transport Equipment Manufacturing Sales



### Machinery and Equipment Manufacturing Sales



### Furniture and Other Manufacturing Sales



## 5. Details of changes

There were a number of distinct changes made to the QMS during the redesign process. These are detailed as follows:

### 5.1 Questionnaire redesign

Following consultation with key users of the QMS, and extensive pilot testing of the questionnaire with respondents, both the content and the format of the questionnaire have been revised.

The content of the questionnaire was reviewed with a focus on meeting the core data requirements of users, while being mindful of the burden that such collection places on respondents. The number of variables collected on the questionnaire has, as a consequence, been significantly reduced. The following items have been removed from the questionnaire from the June 2001 quarter:

- Hours worked by paid employees
- Interest received
- Dividends received
- All other income
- Salaries and wages to working proprietors

- Interest paid
- All other expenditure.

During consultation with users, it was determined that the existing Additions to Fixed Assets question was of limited use without a corresponding Disposals question also being asked. Users (both internal and external) identified Net Additions to Fixed Assets as being the information which was of most use to them. As a consequence, the following question has been added to the questionnaire from the June 2001 quarter:

- Disposals of fixed assets.

As well as the content of the questionnaire, the format of the questionnaire has also been updated. The reduction in the number of questions has allowed for variable inclusions/exclusions to be more clearly specified. The questionnaire has also been designed to allow for scanning to be used as a data capture mechanism in the future.

## **5.2 Royalties and patent fees**

In the previous QMS design, royalties and patent fees were excluded from the conceptual definition of both Operating Sales and Operating Expenditure.

The New Zealand System of National Accounts treatment of royalties and patent fees was updated in 2000 to include these fees within the definition of operating sales and expenditure. In order to maintain consistency with the NZSNA treatment of these items, the Operating Sales and Operating Expenditure questions were revised.

During the operation of the June 2001 quarter survey, respondents provided details of the amount of royalty and patent fees included in their responses. This information has been used to calculate link factors for the June 2001 quarter, which have also been incorporated into the back-cast series.

Within the Beverage, Malt and Tobacco Manufacturing Industry, the link factor is less than one. During the process of collecting the royalty and patent fee information from respondents for the June 2001 quarter, it was discovered that in some instances respondents had been reporting Operating Income inclusive of excise duties. This had been a long-standing practice. The previously published series have not been revised, as the inter-period movements were not significantly affected by this practice.

To ensure consistency with the future redesigned series, the effect of the past excise duties inclusion has been taken into account in the calculation of the back-cast series.

## **5.3 Change to an ANZSIC design**

The previous QMS had been designed to provide estimates for NZSIC industries. From March 1996 onwards, the QMS has been published on an ANZSIC basis, although the underlying population definition and weighting reflected the original NZSIC design. This

resulted in a known undercoverage within the QMS due to differences between NZSIC and ANZSIC populations. The 2001 redesign has addressed these issues by basing the design on ANZSIC.

The main industry affected by these population adjustments was the Printing, Publishing and Recorded Media industry, which saw the level of sales recorded rise by \$195 million for the June 2001 quarter as a result of the population amendment. Activities which have been brought into the scope of this industry under the ANZSIC design include:

- Book and Other Publishing
- Newspaper Printing or Publishing
- Other Periodical Publishing
- Paper Stationery Manufacturing

The only other industry affected by the population expansion was Machinery and Equipment Manufacturing, which rose by \$28 million. Activities which have been brought into the scope of this industry under the ANZSIC design include:

- Lifting and Material Handling Equipment Manufacturing
- Medical and Surgical Equipment Manufacturing

These population extensions have been incorporated into the back-cast series.

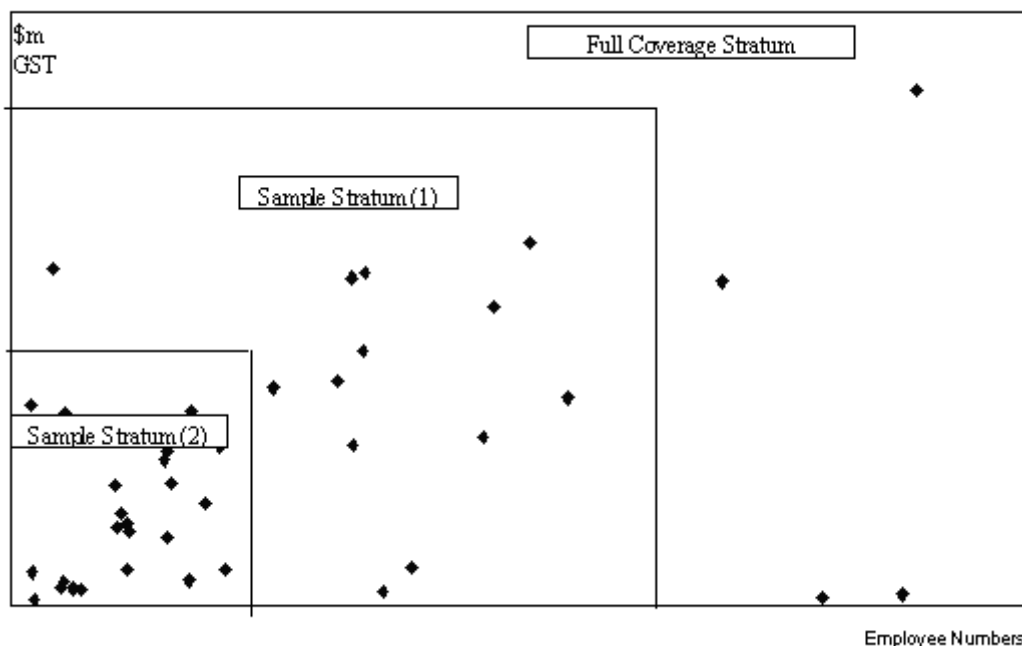
#### **5.4 Bi-variate stratification**

The previous QMS design used Full-Time Equivalent Employees (FTEs) as the sole stratification variable in specifying the sample strata boundaries.

The 2001 QMS redesign has made use of both FTE and annualised GST data in specifying the sample strata boundaries. Bi-variate stratification has been used in the Annual Enterprise Survey in recent years, and has enabled sample design and selection to be more efficient.

During the 2001 QMS redesign this stratification method, together with the use of tax data as a survey substitute for smaller businesses, has allowed Statistics New Zealand to lower the postal sample size by approximately 25 percent, from 1800 to 1400 units, while maintaining the desired levels of accuracy.

A diagrammatic representation of bi-variate stratification appears in the diagram below.



### 5.5 The use of administrative data

One of the challenges facing Statistics New Zealand is the desire to reduce compliance costs, particularly for small and medium-sized businesses. With this in mind, the redesign of the QMS undertook a thorough investigation into the potential use of existing administrative data sources in place of collecting data by direct survey.

As a result of this research, the 2001 QMS redesign has resulted in a survey design which makes extensive use of taxation data sourced from Inland Revenue. It should be noted that while Statistics New Zealand has been given access to taxation data for statistical purposes, there is no reciprocal flow of respondent information from Statistics New Zealand to Inland Revenue.

The first use of administrative data has been in the bi-variate stratification as previously mentioned. Data from GST and EMS has also been used in place of directly surveying for small businesses in the manufacturing population. Using this approach, the GST (sales and purchases) and EMS (gross salaries) data is used to model the variables which would otherwise have to have been collected by a postal questionnaire. This is the first such use of administrative data in a sub-annual economic survey within Statistics New Zealand.

For each of the units which fall within the 'Tax Stratum', their GST and EMS data is used to provide the variables that are contained in the postal questionnaire. For each variable a different approach is used, as summarised in the following table.

<b>Method of Modelling variables for 'Tax Stratum'</b>	
<b>Variable</b>	<b>Modelling Method</b>
Sales	GST sales used
Purchases	GST purchases
Salaries and Wages	EMS salaries and wages used
Closing Stocks - Raw Materials	Ratio of Raw Materials Stocks to GST purchases from surveyed units within the same detailed industry is applied to GST purchases.
Closing Stocks - Finished Goods & Work in Progress	Ratio of Finished Goods Stocks to GST purchases from surveyed units within the same detailed industry is applied to GST purchases.
Additions to Fixed Assets	Ratio of Additions to Fixed Assets to GST purchases from surveyed units within the same detailed industry is applied to GST purchases.
Disposals of Fixed Assets	Ratio of Disposals of Fixed Assets to GST purchases from surveyed units within the same detailed industry is applied to GST purchases.

Within each of the 15 publication industries, the contribution of the tax stratum to the industry total varies. The tax stratum aimed to be no more than 15 percent of sales for each industry. This, however, does vary depending upon such things as the size of the industry participants, as well as their distribution and concentration within the various strata defined for that industry.

The contribution of administrative data to the QMS sales results for the June 2001 quarter is provided in the following table.

<b>Contribution of Tax Strata to Industry Sales - June 2001 Quarter</b>	
<b>Industry</b>	<b>% Contribution</b>
Meat and Dairy Product Manufacturing	3.7 %
Other Food Manufacturing	6.0 %
Beverage, Malt and Tobacco Manufacturing	6.5 %
Textile and Apparel Manufacturing	13.2 %
Wood Product Manufacturing	10.8 %
Paper and Paper Product Manufacturing	1.0 %
Printing, Publishing and Recorded Media	10.2 %
Petroleum and Industrial Chemical Manufacturing	5.6 %
Rubber, Plastic and Other Chemical Product Manufacturing	8.8 %

Non-metallic Mineral Product Manufacturing	10.0 %
Basic Metal Manufacturing	7.7 %
Structural, Sheet and Fabricated Metal Product Manufacturing	14.4 %
Transport Equipment Manufacturing	12.4 %
Machinery and Equipment Manufacturing	12.6 %
Furniture and Other Manufacturing	27.1 %
<b>All Manufacturing</b>	<b>8.2 %</b>

It is interesting to note that while the overall contribution of the tax stratum contributes only 8 percent to total manufacturing sales, it accounts for approximately 81 percent of the units in the manufacturing population, as shown in the table below.

<b>Units in the Manufacturing Population - June 2001 Quarter</b>	
<b>Treatment in QMS</b>	<b>% of Total Population</b>
Sampled (i.e. received a questionnaire)	6.9 %
Non-sample	12.2 %
Tax	80.9 %
	<b>100.0 %</b>

## **5.6 Periodic reselection**

Statistics New Zealand conducts panel surveys to provide the best estimates of movements between periods. This is because panel surveys ensure that, when possible, the same businesses are reporting from period to period.

One of the acknowledged drawbacks of a panel sample survey is that over time, the initial selection of units will become less representative of the contemporary population. This means that the results from the survey can become similarly less representative.

A comprehensive study was undertaken by Statistics New Zealand to assess a range of options to overcome this issue and improve the ongoing quality of the survey estimates from the QMS. The investigation resulted in the recommendation that as part of the 2001 QMS redesign, a periodic reselection policy be adopted. The investigation and its recommendation were peer reviewed and approved by the methodology unit of the Australian Bureau Of Statistics.

Under periodic reselection, the underlying strata boundary definitions remain unchanged, while the units in the population of interest are reassigned within these strata based on their current values for the stratification variables. The weights applied to sampled units are then re-calculated.

A benefit of reselection is that units that are growing (or shrinking) can be promoted or demoted between the appropriate strata and move in or out of postout as required. This ensures representative coverage of units that grow faster than average, especially for births, and is expected to reduce potential bias.

Another conclusion from the study was that reselection should be done every quarter, rather than less frequently (such as annually) to reduce the level of discontinuities that occur when different units are selected or not selected.

### 5.7 Imputation and estimation methodology changes

The 2001 QMS redesign has also taken the opportunity to introduce an enhancement to the range of non-response imputation methods.

Previously, the QMS used either historical or mean imputation in the event of non-response. It is now possible to make use of the tax data for non-response imputation, using regression techniques. In many instances, this has been found to produce superior imputation results to the traditional historical and mean methods.

The following table provides an indication of the degree and nature of the imputation which took place for the June 2001 quarter.

<b>All Manufacturing Operating Income - June 2001 Quarter</b>		
	<b>(\$ million)</b>	<b>% of Total</b>
<i>Medium to large businesses</i>		
Actual responses	13,563	84.6
Regression imputation	812	5.1
Historical imputation	221	1.5
Mean imputation	184	0.6
<i>Small Businesses</i>		
Administrative data	1,312	8.2
	<b>16,093</b>	<b>100.0 %</b>

### 6.0 Series available on request

The analytical back series for the new survey and the revised survey results for the previous QMS design are available either as downloadable files on the Statistics New Zealand website, or can be supplied in hard copy on request.

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