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Allocating mineral valuations using unit record data

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1 Introduction

1.1 Background

Statistics New Zealand has recently published its first natural resource account for both the physical stocks and monetary asset values of minerals. For this account, a total asset value was calculated for the ‘other mining’ industry, which was then allocated to individual commodities according to each commodity’s monetary share of output.

This paper explores an alternative method of disaggregating asset values using unit record data.

1.2 Rationale

This study was undertaken to test the hypothesis that the analysis of unit record data would provide a more accurate allocation of asset values to individual resources than allocation based on monetary production data. The ‘other minerals’ industry was chosen for analysis because of the variety of commodities it encompasses, particularly gold and aggregate.

As noted, a total asset value was calculated for the ‘other mining’ industry, which was then allocated to individual commodities according to each commodity’s monetary share of output (the ‘output share’ method). The two largest commodities are aggregate and gold. Aggregate is produced in high volumes and has a low value by weight due to its relative abundance, whereas gold is produced in low volumes and has a high value by weight. Aggregate is produced for the domestic market while most gold output is exported.

A concern was that the output share allocation method may understate the value of the gold asset and overstated the value of the aggregate asset. The gold mining activity in New Zealand is dominated by just a small number of large mines and it is relatively difficult to open large new gold mines in New Zealand. Given this, it was considered plausible that the existing gold mines could be making a return on capital well above the return on capital for the rest of the industry (including aggregate mining). If this was the case, the output share allocation method would understate the asset value of gold.

Due to these concerns, Statistics New Zealand decided to explore alternative ways to allocate out these commodity asset values.

It was decided to investigate the feasibility of estimating the asset values for the ‘other minerals’ industry using unit record data, as described below. This exercise was designed as a review of commodity allocation of the minerals total asset estimate only – the total minerals estimate itself was not revised.

1.3 Scope of paper

The previously published mineral asset value series covered the years from 1994 to 2000. Unit record data was available for the ‘other mining’ industry from 1997 to 2003. This paper focuses on the overlap period, 1997- 2000, but includes analysis of unit record data up to 2003.

2 Executive summary

The current methodology used by Statistics New Zealand to calculate asset values for individual mineral commodities is consistent with international methods. It involves calculating an overall asset value for the 'other mining' industry and allocating values to individual commodities based on their contribution to overall output (in monetary terms) for the industry.

In Statistics New Zealand's recently published minerals accounts, this method led to concerns that the value of gold was being understated in the account. This study was undertaken to test an alternative method of allocating asset values to mineral commodities by using unit record data from the Annual Enterprise Survey (AES).

The results of this study support the current method's allocation of asset values and recommend that the current methodology is preferable to the proposed alternative because of:

- Volatility of AES financial data at such a low level of disaggregation
- Differences between AES financial data and National Accounts' published capital stock and consumption of fixed capital data.
- Complexity of obtaining, checking and aggregating unit record data into useable form
- Inconsistency between Australia and New Zealand Standard Industrial Classifications (ANZSIC) and actual mineral commodities.

3 Sources and methods

Calculating asset values for natural resources is seldom straightforward. The value of an asset should reflect the price that someone is willing to pay for it. However, few natural resources are traded in this way and therefore other valuation approaches need to be taken. The method used to value mineral assets by Statistics New Zealand derives a 'resource rent' for minerals based on net operating surplus for the industry, less a return to produced capital (mining equipment, structures etc.). This indirectly captures the portion of net operating surplus that is attributable exclusively to the natural resource itself. A net present value (NPV) is then calculated for minerals which sums the expected future resource rent over the expected life of the asset. Future net operating surplus is discounted at a fixed rate, expressing a time preference for returns now, rather than in the future. This method involves making a number of assumptions about discount rates and the prevailing return to produced capital for the industry, but is used internationally by a number of statistical agencies as the best alternative in the absence of market values.

The NPV method described above relies on industry financial data that is readily available from National Accounts, supplemented by monetary production data from New Zealand Crown Minerals and physical stock data from the Institute of Geological and Nuclear Sciences. The following sections describe in detail how NPVs are calculated and allocated across individual mineral commodities.

3.1 Monetary asset valuation of minerals

Statistics New Zealand currently uses a standard Net Present Value (NPV) method to calculate the monetary value of New Zealand's mineral assets as recommended by the System of Environmental and Economic Accounts (SEEA) in the absence of market values. For subsoil assets it is recommended that asset values should be estimated as the net present value of expected future resource rent.

3.2 Net present value of resource rent

The net present value method estimates natural resources asset values as the discounted sum of future resource rent generated by the utilisation of the resource.

Equation 3.1 Net Present Value Formula

$$NPV = RR\sum_{k=1}^{n}\frac{1}{(1+r)^k} = RR\frac{(1+r)^n - 1}{r(1+r)^n}$$

Where, RR = resource rent

r = discount rate,

n = lifespan

3.3 Lifespan

The expected lifespan of subsoil assets are estimated as:

$$Lifespan = \frac{\text{stocks}}{\text{extraction rate}}$$

where, stocks = proven plus probable reserves.

Some mineral stocks, such as aggregate, are known to be very large nationally but the absolute quantity is not known. However, the lifespan of the resource is definitely greater than 50 years based on normal extraction rates. Because future resource rent streams are discounted, any resource rent from 50 years in the future is discounted to almost zero, and the lifespan of the asset is effectively unlimited for Statistics New Zealand's purposes.

3.4 Resource rent

Resource rent of a natural resource is equivalent to the revenue generated from the utilisation of a natural resource over and above costs incurred in the extraction of the resource and a return to capital employed.

In New Zealand (as in most countries) the Crown as owner of mineral and mineral energy resources collects part of the revenue generated by the utilisation of these resources through royalties and levies. These royalties and levies are small but have been accounted for in the asset estimates as noted below.

3.4.1 Perpetual Inventory Method (PIM)

The perpetual inventory method (PIM) calculates the value of resource rent owing to a natural resource as the remainder of the revenue acquired by the industry utilising the resource after deducting expenses and a return to capital. In practice resource rent is calculated by deducting the return to produced assets, or fixed capital, (τ V) from the net operating surplus (NOS) of the industry.

$$RR = NOS - \tau V$$

Where RR = resource rent

τ = rate of return

V = capital stocks

NOS = net operating surplus

However, the resource rent owing to a natural resource is intended to reflect all revenue generated from the utilisation of the resource. So this method set down by the SEEA is modified to include the revenue obtained by the Crown through royalties and levies.

$$RR = NOS^* - \tau V$$

Where RR = resource rent

τ = rate of return

V = capital stocks

NOS* = net operating surplus plus specific taxes (specific taxes being royalties and levies)

The modified PIM is consistent with methodologies suggested by the Eurostat Subsoil Accounting Workgroup (Eurostat, 2003) and has been employed in the production of Statistics New Zealand's Energy and Minerals Monetary Stock Accounts (Statistics New Zealand, 2004).

3.5 Disaggregating industry total asset values

Capital stock and net operating surplus data are currently only available from the national accounts at the level of the ‘other mining’ industry.

3.5.1 Current method (output share method)

Asset values are currently allocated to individual commodities according to each commodity’s contribution to total monetary output of the industry. Monetary production data is available from New Zealand Crown Minerals and is used to disaggregate the ‘other mining’ asset value into commodity asset values.

Statistics New Zealand’s current method for disaggregating the total asset value for the ‘other mining’ industry follows recent Eurostat recommendations. Where industry data is not available at the commodity level, Eurostat recommend that each commodity’s share of total industry output may be used to split total asset value into commodity asset values. (Eurostat, 2003) This solution is generally applied to distribution of total resource rent between oil and gas, which have relatively similar production profiles.

3.5.2 Alternative method (unit record method)

The tested alternative method is to use an analysis of unit record data for the ‘other mining’ industry to calculate proportions of total mineral asset value for each industry class. Unit record data from Statistics New Zealand’s Annual Enterprise Survey (AES) was used to calculate an approximate resource rent for each industry class (gold ore mining, etc.) within the ‘other mining’ industry. Each industry class’ proportion of total resource rent was then applied to the industry totals obtained from National Accounts.

Note that the unit record data is not consistent with the industry level estimates because of National Accounts industry level adjustments. These are particularly important for the analysis in two areas:

- In the unit record analysis, Net Operating Surplus was estimated using depreciation as reported by the enterprise. (In the National Accounts, depreciation is replaced by an estimate of consumption of fixed capital of the industry)
- In the unit record analysis, Capital Stock was estimated using book value of fixed assets as reported by the enterprise. (In the National Accounts, the net capital stock of the industry was allocated from national level PIM estimates, and AES book value of fixed assets was not used).

The alternative method aims to produce new commodity proportions. However, the above factors could have a major influence on the revised commodity proportions. In principle, if the National Accounts industry level adjustments could be allocated to the appropriate enterprise, or commodity, these proportions could be improved. In practice, no changes were made for the National Accounts industry level adjustments and it is difficult to see how they can be done.

3.6 Comparing industry classes with mineral commodities

In order to compare results, we decided to compare proportions on the basis of the New Zealand Crown Minerals commodity groupings. The Crown Minerals groupings were the basis for the proportions calculated using the output share method in our previously published mineral series. The resource rent for individual commodities was modelled from the resource rent calculated for each industry class (See Table 1). This was necessary as some industry classes produce more than one mineral commodity. For example, in New Zealand silver is produced as a by-product of the ‘gold ore mining’ industry class.

It should be noted that the division of classes into corresponding mineral commodities was done only for comparative purposes. If this alternative method of disaggregating industry totals were to be adopted, disaggregation of ‘other minerals’ should be made on the basis of

Australian and New Zealand Standard Industrial Classification (ANZSIC) classes rather than individual commodities.

Table 1. Splitting Industry classes into commodities

ANZSIC industry classes [1]	Major Crown Mineral commodity groupings
Gold ore mining*	Gold
	Silver
Iron Ore mining	Ironsand
Gravel and Sand quarrying*	Aggregate
Construction Material Mining n.e.c*	Limestone
Metal ore mining n.e.c.	
Mineral sand mining	Other
* Indicates major industry classes [1] Monetary production data used to split out commodities from industry classes	

Aggregate: Aggregate and sand is used in large quantities for roading, building and a range of other construction purposes. Aggregate is produced by enterprises within the 'Gravel and Sand Quarrying and 'Construction Material Mining n.e.c' industry classifications.

Limestone: Limestone is an important raw material for agriculture and industry. It is produced in sufficient quantity to warrant analysis as a separate commodity. Enterprises producing limestone fall within the 'Construction Material Mining n.e.c' industry classification. There is no simple and reliable way to isolate units producing limestone within this classification, so monetary production data was used again to split asset values between aggregate and limestone.

Other: 'Other' includes silver, clay, dolomite and all other minerals extracted. In New Zealand, silver is produced as a by-product of gold mining. Monetary production data was used to split the 'Gold mining' ANZSIC grouping into production of gold and silver.

3.7 Data Sources

Capital Stock and Net Operating Surplus (NOS) data for Statistics New Zealand's published mineral account was provided at the 'other mining' industry level by National Accounts.

For this study, Capital Stock and NOS unit record data from Statistics New Zealand's Annual Enterprise Survey (AES) was extracted for the 'other mining' industry. This data was only available at the unit record level back to 1997, due to the implementation of a new data storage system in that year.

Royalties and levies data was provided by National Accounts. Monetary production data was obtained from New Zealand Crown Minerals, and data on mineral physical stocks was obtained from the New Zealand Institute of Geological and Nuclear Research.

4 International comparisons

A number of other countries were contacted regarding their allocation methodology for mining. The replies are summarised below. A wide variety of techniques were used but none of the countries that replied appear to have attempted the unit record approach as described in this paper.

A unit record approach may not be practical for all countries to utilise however, even if it is a superior approach. In New Zealand, the ‘other mining’ industry only consists of about 400 enterprises, and the survey is virtually full coverage. This combination makes a unit record approach relatively easy to implement in New Zealand, whereas it might not be as straightforward for other countries with larger mining industries or sampled surveys.

4.1 Australia

The Australian Bureau of Statistics (ABS) has published subsoil accounts that include asset values for a wide range of minerals (ABS, 2003). The ABS used an NPV approach similar to that used by Statistics New Zealand for calculating asset values, however the allocation of asset values to individual commodities was facilitated by the ABS’ access to mineral price and production cost data from a mining industry source. The contract for this information, however, has not been renewed for several years. The ABS are reviewing their current methodology for calculating NPV’s at the commodity level and may not be able to publish this level of detail in future.

4.2 Canada

Statistics Canada publishes Monetary Subsoil Asset Accounts (MSAA), which present annual estimates of the value of Canada’s economically recoverable reserves of subsoil assets. The Canadian MSAA presents two stock valuations based on the net price and present value methods. Only valuations based on the present value method are included on the national balance sheet (StatCan, 1997).

Statistics Canada publishes quantity data for reserves of each metal type and for conventional crude oil, bitumen and natural gas. Economic data for metals is available by mine-type, according to the North American Industry Classification System (NAICS). Statistics Canada do not attempt to allocate the value of multi-mineral mines to each of the component minerals.

4.3 Eurostat and European countries

No European countries are publishing monetary accounts for subsoil assets other than oil and gas. Norway, the United Kingdom, Austria, Denmark and France produce monetary accounts for oil and gas and calculate individual resource rent for these commodities using output share data.

Eurostat has recently given particular consideration to the division of resource rent between oil and gas. Norway and Austria make this division proportional to the shares oil and gas have in total output value of the industry. In the United Kingdom, revenue and operating costs are divided by oil and gas in the national accounts. Capital costs are divided using a weighted 10-year rolling average of development expenditure, which is available for oil and gas separately. France divides resource rent between oil and gas based on extraction company accounts. Denmark and the Netherlands do not disaggregate at all, calculating resource rent at the industry total level only. (Eurostat, 2002)

A growing number of European countries implement material flows accounts (including biomass, construction, industrial minerals and fossil fuels) to analyse the decoupling between the economy and the environment. These accounts are only expressed in physical terms.

5 Findings

5.1 Commodity proportions

Splitting the total resource rent according to the proportions derived from unit record analysis gave an unexpected result. Using this method, the resource rent attributed to the gold industry was actually less than it was under the output share method. Aggregate retained the largest share of the total resource rent and asset value. Figure 1 shows the published NPV for individual commodities based upon output share according to Eurostat recommendations.

Figure 1

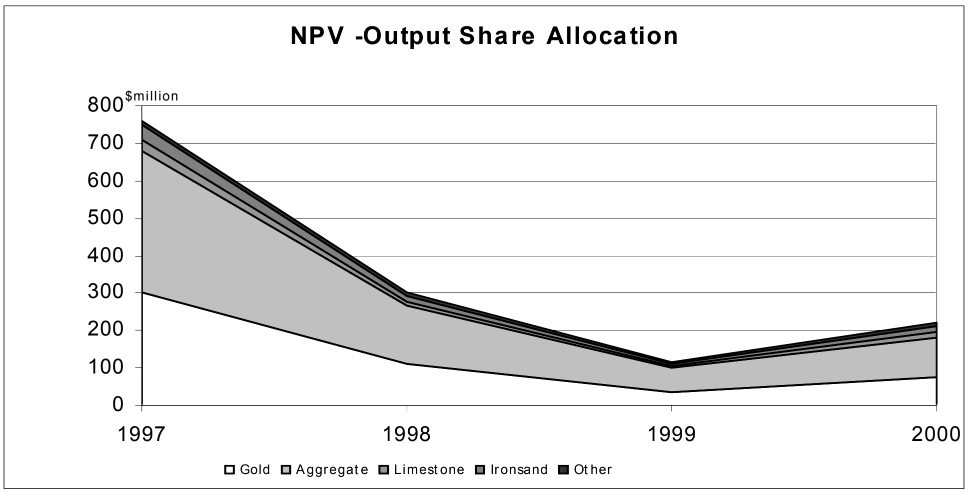
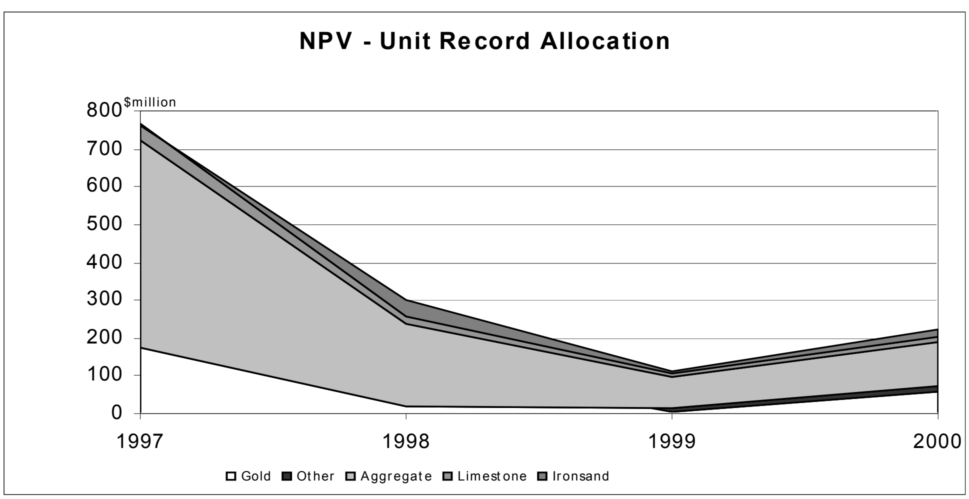


Figure 2 shows the allocation of NPVs to commodities based on the unit record method. Using this method, aggregate contributes a higher proportion of total mineral NPV relative to gold than it does using the output share method.

Figure 2



NB: The large negative values of ‘other’ in 1997 and 1998 cause the value of gold to be understated in this graph for those years. See Table 2.

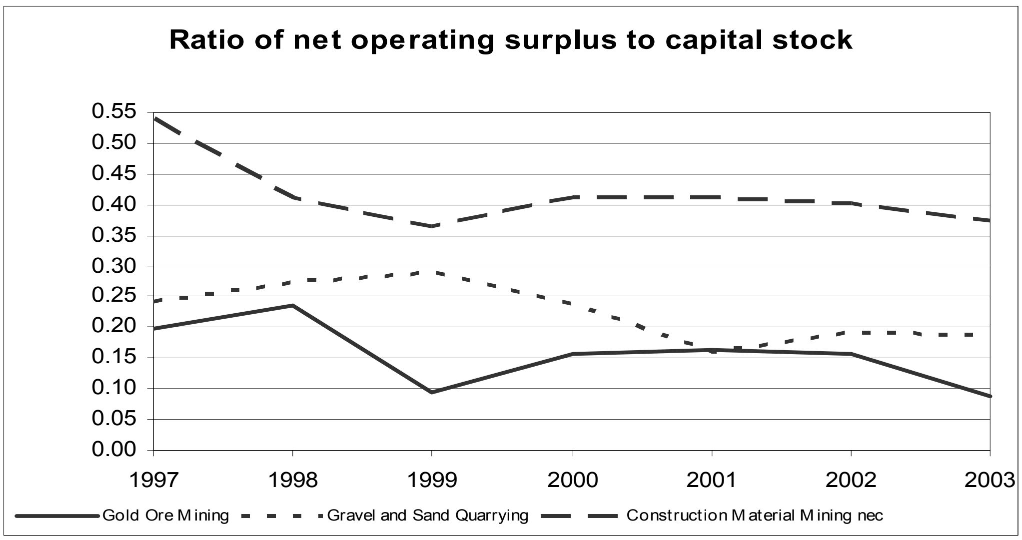
Table 2

	NPV $m									
	Gold		Ironsand		Aggregate		Limestone		Other	
Year	Unit Record	Output share	Unit Record	Output share	Unit Record	Output share	Unit Record	Output share	Unit Record	Output share
1997	316.2	301.5	-3.9	39.0	546.9	377.0	45.1	31.1	-143.0	12.7
1998	128.6	109.0	42.3	16.0	218.8	156.7	17.4	12.5	-107.7	5.2
1999	5.9	36.1	6.8	6.4	82.3	62.5	7.9	6.0	11.0	2.8
2000	56.7	76.5	17.9	13.7	113.3	105.3	17.3	16.1	17.6	11.3

5.2 Net operating surplus compared to capital stocks

Analysis of Annual Enterprise Survey (AES) data between 1997 and 2003 showed that both the ‘Construction material mining n.e.c’ and ‘Gravel and sand quarrying’ industry classes had consistently higher net operating surplus relative to their capital stock levels than the ‘gold ore mining’ class.

Figure 3



5.3 Volatility

Most industry classes within the New Zealand ‘other mining’ industry contain only a small number of enterprises, or are dominated by a few large enterprises. This results in considerable volatility in asset values from year to year. Changes from year to year in these enterprises’ reported AES data, particularly their net operating surplus, can cause significant fluctuations in the NPV of each commodity.

The allocation of commodity proportions using the unit record method proved volatile. Large fluctuations in AES net operating surplus data for a number of enterprises in the ‘metal ore n.e.c’ and ‘gold ore mining’ industry class resulted in volatile series. This was particularly pronounced in the case of ‘metal ore n.e.c’, which produced large negative NPVs for the ‘other’ mineral commodity for 1997 and 1998. (See figures 4 and 5). This result was largely attributable to one enterprise in liquidation reporting significant net operating losses in these two years. Classes containing a larger number of enterprises, such as the ‘gravel and sand quarrying’ and ‘construction material mining n.e.c’ produced a less volatile series.

Figure 4

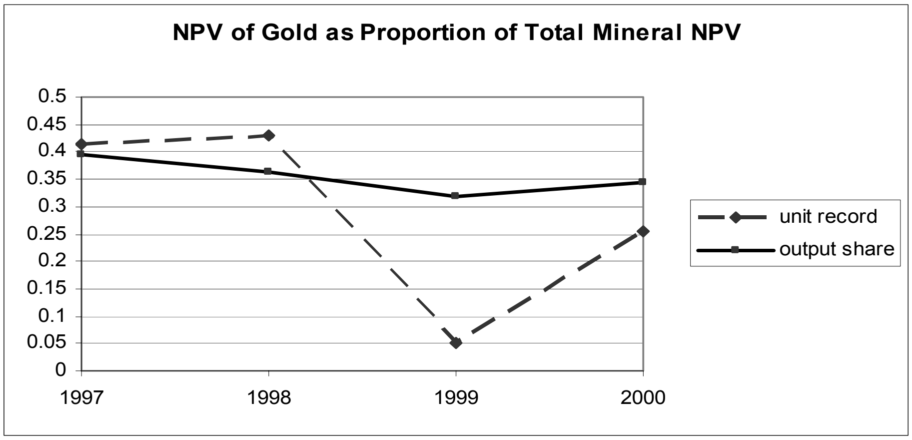
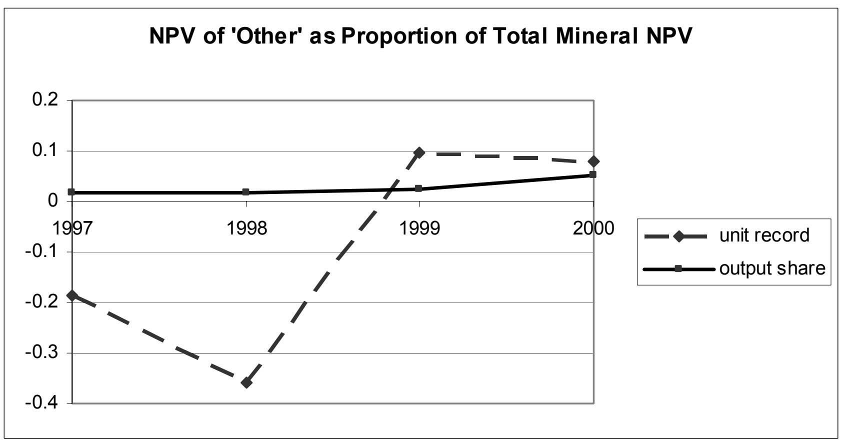


Figure 5



It is likely that this volatility between 1998 and 1999 is due largely to structural changes in the AES itself, which was redesigned in 1999 and had a new sample selected.

6 Analysis and selection of method

The results indicate that the aggregate mining activity is providing a higher return on produced capital than the gold mining activity. We analysed the unit record data to see if the underlying data appeared reasonable, or if the results were being driven by a handful of unusual results at the commodity level.

As well as theoretical and conceptual considerations, practical considerations were also important in making our final choice of method. The output share method is simple and uses readily available published data. The unit record method is more complex and requires more data manipulation and checking. Unless the unit record method produces a clearly more robust and accurate allocation, the output share method is preferred on the grounds of simplicity.

6.1 Commodity Proportions

Table 3

	NPV (proportions)									
	Gold		Ironsand		Aggregate		Limestone		Other	
Year	Unit Record	Output share	Unit Record	Output share	Unit Record	Output share	Unit Record	Output share	Unit Record	Output share
1997	41.5%	39.6%	-0.5%	5.1%	71.8%	49.5%	5.9%	4.1%	-18.8%	1.7%
1998	42.9%	36.4%	14.1%	5.4%	73.1%	52.3%	5.8%	4.2%	-36.0%	1.8%
1999	5.2%	31.7%	5.9%	5.6%	72.3%	55.0%	6.9%	5.3%	9.7%	2.5%
2000	25.4%	34.3%	8.0%	6.1%	50.9%	47.3%	7.8%	7.2%	7.9%	5.1%

The proportions generated using the unit record method showed that aggregate contributed a larger proportion of total 'other mineral' NPV compared to proportions generated using the output share method. Gold also contributed slightly higher proportions of total NPV using the unit record method in 1997 and 1998, but produced lower values for 1999 and 2000. This is shown in table 3.

The volatility in proportions generated by the unit record method was dominated mainly by large fluctuations in the 'other' and 'gold' series. 'Other' increased from a large negative NPV of -36.0 percent of total mineral NPV in 1998 to 9.7 percent in 1999. Gold fell sharply from 42.9 percent of total mineral NPV in 1998 to 5.2 percent in 1999. In both cases, these fluctuations were due largely to movements in financial data from a small number of companies. Commodities produced in industries with larger numbers of enterprises with a more even distribution of net operating surplus, such as aggregate, were more stable through time.

6.2 Aggregate

Aggregate is produced regionally in New Zealand. The price of aggregate may differ between regions, but there is little price competition between regions due to the cost of transport. Some quarries may be particularly profitable, due to being in a good location, or due to a lack of competing quarries in that region. If this is the case, we would expect to see a few highly profitable quarries pushing the overall value of aggregate up. We would also generally expect to see the same quarries making a significant contribution year in and year out.

This was borne out by the analysis, which showed a number of the most significant quarrying enterprises consistently having a high net operating surplus relative to their capital stock levels. While attempts have been made to verify the individual results of the AES data, it is often difficult to locate independent information about units in this class.

However, one of the most profitable aggregate enterprises, as shown by AES data, is located in an area that has recently undertaken New Zealand's largest roading initiative, with a budget of $93 million. This project commenced in October 1999 and finished in July 2003, coinciding well with very high net operating surplus to capital stock ratios for the largest aggregate enterprise located in this area (Strategic Roading Network).

Industry reports note that most quarries in New Zealand supply markets within a distance of 50 kilometres, and are generally concentrated around cities. The largest producers of aggregate are located in the Auckland area. Road-making accounts for over half of the final use of rocks and non-metallic minerals mined in New Zealand (NZMIA).

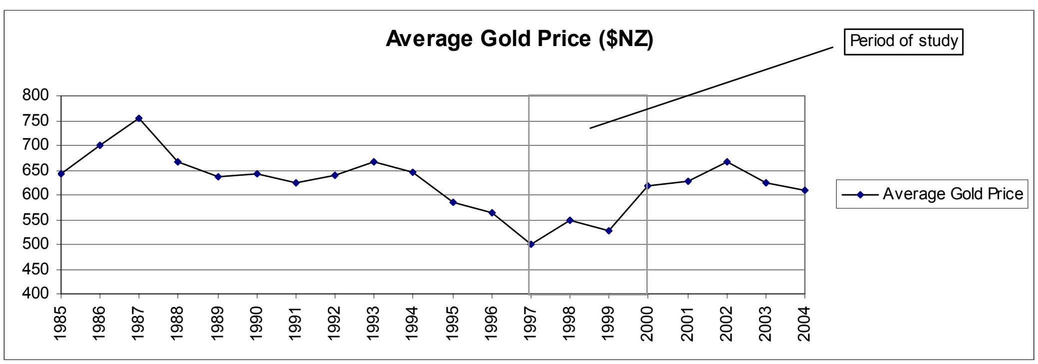
6.3 Gold

The relatively low asset value of gold is partially attributable to the depressed price of gold during the period examined. Low world gold prices may result in a period of low, or negative, operating surpluses for enterprises in the gold industry. This would have a significant impact on NPVs for gold. Figure 6 indicates that there was a slump in gold prices (in $NZ) between 1997 and 1999, with prices recovering somewhat in 2000. While company annual reports indicate that hedging provides some protection from international price fluctuations, they also point out that even the largest New Zealand gold producers are ultimately price takers. (GRD annual report, 1997)

Annual reports for the dominant enterprise in the 'gold ore mining' industry reported operating losses in 1997 and 1998, followed by profits in 1999 and 2000. In 1997, the falling US dollar price of gold, coupled with a strengthening New Zealand dollar were identified by the enterprise as having a significant negative impact on business, although internal factors also contributed.

While low prices appear to have had an impact on the New Zealand gold industry during this period, other financial and operational issues for the dominant enterprise may also have had a strong bearing on the NPV of gold from year to year.

Figure 6



Sources: Reserve Bank of New Zealand, Statistics New Zealand, www.kitco.com

Unit record data within the 'gold ore mining' industry class was much more volatile than data for the 'gravel and sand' and 'construction material mining' industry classes.

6.4 Weaknesses of unit record method

6.4.1 Limitations of Annual Enterprise Survey (AES) data

The AES has undergone significant changes through time. 1998 saw a number of changes to the survey, including the introduction of tax data to reduce respondent burden on smaller enterprises and the inclusion of a number of new industries. In 1999, the survey sample was reselected, the questionnaire was redesigned and the survey was redesigned as a two-component survey.

The evolving design of the AES survey means that long term series of AES data may be of limited use in measuring real world change. AES is designed to measure industry levels for a given year. Incremental improvements in measurement, sample design, classification and data collection may have influenced the inter-period movements, particularly over a longer time periods. Work has been done to minimise the impact of these changes and present a consistent time series in the published tables.

Furthermore, data from the AES is not analysed below the published level of detail. The industry classes used as part of this study are below the published ‘other mining’ industry level and are therefore not scrutinised closely by AES (Statistics New Zealand website).

6.4.2 Classification issues

As discussed in section 3.6, there is no direct relationship between ANZSIC industry classes and actual mineral commodities. Enterprises in the ‘gold ore mining’ class produce both gold and silver, while enterprises in classes such as ‘construction mining n.e.c’ produce a number of commodities. A possible solution to this problem is to publish results according to the lower level ANZSIC classifications, as Canada is able to do. Ideally, both reliable net operating surplus and capital stock data could be made available by National Accounts.

Enterprises must also be classified to the correct class for the unit record approach to be reliable. The class classifications of at least two enterprises were changed during the 1997-2003 period due corrections being made to their class classification. There is also ambiguity between the ‘iron ore mining’ and ‘mineral sand mining’ classes, as iron in New Zealand is produced mostly from ironsand, while silica sand is also commercially mined in the North Island.

6.4.3 Net operating surplus

Although AES data is the basis of published net operating surplus, adjustments are often made to this data by National Accounts. Large negative adjustments to raw AES net operating surplus data were made between 1997 and 2001, driven mainly by large positive adjustments made to consumption of fixed capital. The unit record estimate for consumption of fixed capital is based on depreciation from the AES and National Accounts replace this with a more realistic rate of fixed capital consumption. There is no practical way to apply these adjustments at the unit record level.

6.4.4 Capital stock

One of the major weaknesses of the unit record method is that the capital stock and consumption of fixed capital estimates produced by National Accounts are not based on AES data. The ‘other mining’ capital stock data which is currently obtained from National Accounts is sourced from their capital stock model. This model calculates estimates from a range of sources at the industry level and then allocates estimates to lower-level sub-industries. Financial data from the AES is not used as part of this process.

Therefore, estimated capital stock from unit record AES financial data is not consistent with published National Accounts capital stock data. Although these estimates should in principle be similar, results showed the estimates derived from AES data were consistently considerably lower than published National Accounts data. As National Accounts do not use

AES fixed asset data as an input to their capital stock model, it is likely that this data is not carefully analysed and may contain inconsistencies.

6.4.5 Complexity and effort

The practicalities of the two methods are an important consideration. The output share method of allocating NPV is simple to implement, relies on readily available production value data and produces a distribution of NPV among individual commodities that is not considerably different from those produced using the unit record method. Some of the differences that exist are due to factors that ideally should be adjusted for, (see section 3), and reflect weaknesses in the source data.

The unit record method requires:

- The extraction of unit record data from the AES
- The checking of this data against National Accounts' raw AES operating surplus data
- The checking individual units for inconsistent results and classification
- The aggregation of units into industry classes
- The calculation of NPVs for each mineral commodity/mine type
- Allocating proportions of total 'other mining' NPV based on these NPVs.

Repeating the exercise would require significantly less time and effort than this initial process, particularly for the first two points. However, it will remain more resource intensive and time consuming than the output share method.

7 Recommendations

As the output share method is much easier to implement than the unit record method, the unit record method needed to be clearly better than the output share method to be our preferred method.

In general, however, the unit record method led to proportions that were similar to the output share method, but were slightly against the expected result. While these movements can be rationalised, the unit record method does not produce proportions that are definitively better than the output share based proportions. The unit record based proportions depend on the reliability of unit record data for variables that are not closely scrutinised in the survey validation process. Also, several large National Accounts industry level adjustments will affect unit record based estimates but were not able to be adjusted for.

For the immediate future Statistics New Zealand will continue to use the output share approach to allocate the minerals asset estimate into commodities. This method seems to be the most practical to implement at this stage and produces results reasonably close to the unit record analysis. Statistics New Zealand will continue analyse unit record data at irregular intervals, but this will be for monitoring purposes only.

8 Acknowledgements

We are grateful to several members of other statistical agencies who provided information about how their agencies have approached this issue. These were:

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- Gerry Gravel (Statistics Canada)

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