Australian fisheries economic indicators report 2017
Financial and economic performance of the Eastern Tuna and Billfish Fishery
David Mobsby and Andrea Bath

Research by the Australian Bureau of Agricultural and Resource Economics and Sciences
May 2018
Contents

Summary 1
Key results 1

1 Introduction 4

2 Background 6
Description of the fishery 6
Key economic trends 7
Current management arrangements 9

3 Financial and economic performance 10
Financial performance 10
Economic performance 13

4 Other key performance indicators 16
Productivity 16
Terms of trade 17
Management costs 18
Quota latency 19

5 Performance against management objectives 21
Appendix A: Survey definitions 23
Financial performance 23
Net economic returns 24
Survey-based estimation of net economic returns 25
Net economic returns and economic performance 26
Appendix B: Survey methods 27
Appendix C: Non-survey based estimation of net economic returns 30
Appendix D: Productivity and terms of trade methodology 32
Productivity measurement 32
Terms of trade measurement 32
Data 32

References 35

Tables

Table 1 Key financial performance results, Eastern Tuna and Billfish Fishery, 2013–14 to 2014–15 2
Table 2 Key economic performance results, Eastern Tuna and Billfish Fishery 2
Boxes

Box 1 Economic indicators in fisheries management 5
Box E1 Fisher index 33
Summary


The ETBF is a multispecies fishery that operates in waters from Cape York to the Victoria–South Australia border, encompassing waters around Tasmania and the high seas of the Pacific Ocean. All target species caught in the fishery are internationally shared; Australia's domestic management arrangements are consistent with its commitments to the Western and Central Pacific Fisheries Commission (WCPFC). The majority of the catch is taken along the Queensland and New South Wales coasts. The key landing ports for the fishery are Cairns, Coffs Harbour, Mooloolaba and Ulladulla. The fishery predominately uses pelagic longline to target tuna species (mainly albacore, yellowfin tuna and bigeye tuna), swordfish and striped marlin. In the 2016–17 financial year the ETBF generated an estimated gross value of production of $35.8 million. Net economic returns (NER) is the key performance indicator in this report and is measured at the fishery level. It measures the economic return achieved by the fishery considering all resources used in fishing activities, including family labour and use of the fishing operator’s boat capital, and the cost of managing the fishery. Under the Fisheries Management Act 1991, the Australian Fisheries Management Authority (AFMA) is required to maximise NER—within the context of biological sustainability—to the Australian community through managing Commonwealth fisheries (AFMA 2017). Interpretation of NER trends and the other economic indicators presented in this report can assist in assessing AFMA’s performance against this aim.

The economic performance of the ETBF has improved substantially since the early 2000s. From 2003–04 NER steadily increased to become slightly positive in 2010–11, the first time since 2000–01. This positive change was driven primarily by improved productivity of the fleet and reduced operating costs. This may have been assisted by the exit of less-efficient vessels from the fishery following implementation of the Securing our Fishing Future structural adjustment package between 2005 and 2006. A change in catch composition toward higher unit value species also improved returns. NER remained positive from 2011–12 to 2012–13 but became slightly negative in 2013–14, reflecting a decline in productivity. In 2014–15 NER returned to a positive trend; positive returns are also estimated for 2015–16 and 2016–17.

Key results

The survey population—defined as vessels that recorded more than 1 tonne of catch—was 39 vessels in both 2013–14 and 2014–15. From this population, 6 vessels were surveyed in 2013–14 and 2014–15, representing 15 per cent of the population in each year.

Financial performance

- Profitability for the average ETBF operator was positive in 2013–14 and 2014–15. Profit at full equity, a profit indicator that assumes all assets are fully owned by operators, increased for the average boat in the fishery from $63,074 in 2013–14 to $250,973 in 2014–15 (Table 1).
• The rate of return to full equity increased for the average boat in the fishery from 4 per cent in 2013–14 and to 11 per cent in 2014–15.
• The rise in profit at full equity was largely a result of total cash receipts increasing proportionately higher than total cash costs.
• Crew costs accounted for the largest share of cash costs in 2013–14 and, despite increasing, did not change significantly as a proportion of total cash costs in 2014–15.
• Fuel costs were another large contributor to cash costs. Fuel costs decreased by 17 per cent in 2014–15, which could reflect lower fuel prices and reduced number of fishing days.

Table 1 Key financial performance results, Eastern Tuna and Billfish Fishery, 2013–14 to 2014–15

<table>
<thead>
<tr>
<th>Category</th>
<th>Unit</th>
<th>2013–14</th>
<th>2014–15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cash receipts</td>
<td>$</td>
<td>1,094,661</td>
<td>1,373,853</td>
</tr>
<tr>
<td>Total cash costs</td>
<td>$</td>
<td>1,023,952</td>
<td>1,101,871</td>
</tr>
<tr>
<td>Boat cash income</td>
<td>$</td>
<td>70,708</td>
<td>271,982</td>
</tr>
<tr>
<td>– less depreciation</td>
<td>$</td>
<td>61,748</td>
<td>58,876</td>
</tr>
<tr>
<td>Boat business profit</td>
<td>$</td>
<td>8,960</td>
<td>213,105</td>
</tr>
<tr>
<td>– plus interest, leasing, rent</td>
<td>$</td>
<td>54,144</td>
<td>37,868</td>
</tr>
<tr>
<td>Profit full equity</td>
<td>$</td>
<td>63,074</td>
<td>250,973</td>
</tr>
<tr>
<td>Rate of return to full equity</td>
<td>%</td>
<td>3.5</td>
<td>11.2</td>
</tr>
</tbody>
</table>

**Economic performance**

• NER for the fishery increased from –$0.6 million in 2013–14 to $6.5 million in 2014–15 (Table 2).
• Higher NER in 2014–15 was mainly a result of fishing income increasing proportionately higher than fishing costs. Operating costs in 2014–15 were moderated by lower fuel costs.
• Preliminary NER in 2015–16 is estimated to have risen to $15.7 million. This was estimated to be have been driven by increased catch, higher prices of key species and a significant fall in fuel price. Preliminary NER for 2016–17 is estimated to have fallen to $7.3 million, reflecting a fall in fishing income.

Table 2 Key economic performance results, Eastern Tuna and Billfish Fishery

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishing income</td>
<td>$m</td>
<td>40.6</td>
<td>50.7</td>
<td>73.2</td>
<td>53.4</td>
</tr>
<tr>
<td>Operating costs</td>
<td>$m</td>
<td>37.1</td>
<td>41.1</td>
<td>54.0</td>
<td>42.2</td>
</tr>
<tr>
<td>Fishery cash profit</td>
<td>$m</td>
<td>3.5</td>
<td>9.7</td>
<td>19.2</td>
<td>11.2</td>
</tr>
<tr>
<td>– less owner and family labour, opportunity cost of capital and depreciation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– plus interest, leasing and management fees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net return (excluding management costs)</td>
<td>$m</td>
<td>0.9</td>
<td>8.0</td>
<td>17.4</td>
<td>8.9</td>
</tr>
<tr>
<td>Net return (including management costs)</td>
<td>$m</td>
<td>–0.6</td>
<td>6.5</td>
<td>15.7</td>
<td>7.3</td>
</tr>
</tbody>
</table>

* Preliminary estimate. Note: management costs include all costs involved with managing the fishery, not just those recovered from industry.
Other indicators

Total factor productivity (TFP) analysis shows a rising trend of productivity in the ETBF, which increased by an annual average of 4 per cent between 2002–03 and 2014–15.

The terms of trade index, an indicator measuring the level of fishery output prices compared with input costs faced by fishers, generally declined between 2002–03 and 2012–13. Terms of trade improved in the ETBF from 2013–14 to 2014–15, reflecting a combination of higher fish prices and a fall in fuel prices in 2014–15. This had a strengthening effect on NER for the fishery.

Total management costs in the fishery have generally been decreasing since 2004–05. Management costs per vessel remained high from 2006–07 to 2007–08 when implementation of the Securing our Fishing Future structural adjustment package caused a restructure of the fishery. This is because similar management costs were shared among fewer vessels. Management cost per vessel has steadily declined since 2007–08. Management cost as a percentage of GVP declined from a high of 11 per cent in 2005–06 to 3 per cent in 2015–16.

Management through total allowable commercial catch (TACC) limits and individual transferable quotas (ITQs) commenced in 2011. The level of latency in the ETBF, measured by the proportion of TACC not caught in the fishery, has varied across the key species since 2011. In the 2015 fishing season, very low latency levels were recorded for yellowfin tuna and striped marlin. In contrast, latency for albacore, a relatively low unit value species, remained high in the 2015 season—nearly two-thirds of the TACC remained uncaught that season. In the 2016 season latency increased significantly for yellowfin tuna but declined for albacore, bigeye tuna and swordfish.

Issues for management

- From March 2011 output controls were introduced for five key target species in the form of TACCs and allocated as ITQs to fishers that were operating in the fishery. This has provided fishers greater flexibility to fish with a more efficient combination of inputs. The transferability of fishing rights has also allowed quota to be allocated to more efficient operators. However, the success of output controls depends on setting levels of TACCs that meet the management objective. In the context of internationally shared stocks, setting TACCs at levels that maximise NER is complicated by uncertainty around the catch of other jurisdictions. Although NER in the ETBF is estimated to have been positive between 2014–15 and 2016–17, managers may need to consider adjustments to TACC settings if future economic performance of the fishery significantly deteriorates.
1 Introduction

ABARES has undertaken regular surveys of key Commonwealth fisheries since the early 1990s. The resulting data are used to assess the financial performance of operators in the fishery and the economic performance of the fishery as a whole. These performance measures act as important indicators for fishery managers (Box 1). In this report, survey-based results are presented for 2013–14 and 2014–15 and preliminary non–survey based results are presented for 2015–16 and 2016–17. To provide a more comprehensive assessment of fishery-level performance, ABARES expanded the former Australian Fisheries Surveys report series in 2013 to include a range of economic indicators that draw on data collected from the surveys. In this report a distinction is made between the two primary indicators—financial performance and economic performance.

Financial performance estimates are calculated for the average boat in a fishery and include all cash receipts and cash costs that have been earned and incurred within the survey period. These estimates reflect the average boat’s profit and loss statement for all business activities, including cases where boats have operated in several fisheries. Financial performance estimates indicate how well the surveyed fishery is tracking compared with other industries and what rate of return is being earned on private capital invested in the fishery.

The key indicator of economic performance presented is net economic returns (NER), which is reported at the fishery level. The NER estimates differ from financial performance estimates because they relate only to the surveyed fishery; results exclude revenues and costs attributable to operating in other fisheries and include other economic costs such as the opportunity cost of capital and the opportunity cost of labour. NER provides a useful benchmark for the community to assess the economic returns that flow from the management of Commonwealth fisheries, and accounts for all management costs incurred to enable Commonwealth fisheries to operate. For definitions of these costs see Appendix A.

Vessel-level financial performance information provides a context for determining trends in the surveyed fishery. For example, positive financial profits at the boat level may reveal how operators continue to operate in a fishery that has experienced negative economic returns. These estimates are relevant to all industry operators, enabling them to compare their individual performance with that of the average boat.

The estimate of NER indicates the economic return to society associated with harvesting the fishery resource. According to the Fisheries Management Act 1991, the Australian Fisheries Management Authority (AFMA) is required to pursue the maximisation of net economic returns to the Australian community through managing Commonwealth fisheries (AFMA 2017). Estimates of NER do not reveal how a fishery has performed relative to maximum potential NER (maximum economic yield) in a given period. However, interpretation of NER trends together with other economic indicators can assist in assessing AFMA’s performance against this objective. Other indicators include productivity indexes, terms of trade analysis, entitlement values, management costs and latency. For example, a period of rising NER that is strongly linked to productivity growth implies that maximum economic yield is being approached. These other indicators are also assessed in this report.

The average vessel may achieve positive financial profits at the boat level while the fishery as a whole may have a negative economic returns. This could occur if costs such as non-recovered management costs, opportunity costs of capital or imputed cost of owner and family labour are sufficiently large. Another reason could be if vessels operate in another fishery during the survey.
period. This activity will be reflected in the financial results for the average vessel, but not the economic return to the surveyed fishery.

Box 1 Economic indicators in fisheries management

In September 2007 the Australian Government released the Commonwealth Fisheries Harvest Strategy Policy to provide guidelines for sustainable and profitable management of Commonwealth fisheries. The policy aims to maintain key commercial stocks at ecologically sustainable levels and maximise economic returns to the Australian community by targeting maximum economic yield (MEY) (DAFF 2007). To assess the performance of Commonwealth fisheries against their MEY targets, fishery policymakers frequently rely on economic indicators that provide them with information to inform management decisions and monitor performance.

Informing management decisions against the economic objective

This type of economic indicator is forward-looking and can advise fishery managers on policy settings necessary to achieve MEY. Bioeconomic models provide indicators for this purpose; models have been developed for the Northern Prawn Fishery (Kompas & Che 2003), the Great Australian Bight Trawl Fishery (Kompas et al. 2012) and the Southern and Eastern Scalefish and Shark Fishery (Kompas & Che 2008). Management strategy evaluation based approaches that include an economic component can also serve this purpose.

Monitoring management performance against the economic objective

This type of economic indicator is retrospective and assesses previous economic performance. It can provide insight into the impact of previous management decisions on economic performance. Most indicators examined in this report fall under this category. This includes the survey-based estimation of NER, productivity indexes, entitlement values, management costs, latency and terms of trade analysis.

Total factor productivity analysis is an economic tool used to assess how well fishers use inputs to produce outputs and how their ability to convert inputs into outputs over time has changed with changes in the fishery’s operating environment. Productivity indexes can inform fishery managers about the effect of management arrangements on average productivity levels in the fishery.

Analysis of fishers’ terms of trade provides an indication of drivers behind changes in profitability or NER. It uses an index approach to examine changes in the price of inputs and outputs for a fishery over time and reveals information about the productivity improvements required to offset long-term declines in the terms of trade.

In contrast, entitlement values (or quota values) signal the expected value of future profits to be obtained from the fishery. When compared over time, entitlement values can serve as a general indicator for how well the resources in a fishery have been sustained or managed. If entitlement values are increasing over time, this suggests resources are being managed effectively because operating in the fishery is deemed to have become more profitable.

Measures of management costs, in absolute terms and as a proportion of gross value of fishery production (GVP) and per active boat, also provide information about the cost-effectiveness of fishery management—another key objective referred to in the Fisheries Management Act 1991.

Latency, or the proportion of uncaught quota, can indicate limited economic incentives for fishers to participate in the fishery. A fishery where operators are not utilising their right to fish is unlikely to be near its MEY target.
2 Background

Description of the fishery

The Eastern Tuna and Billfish Fishery (ETBF) is located along the east and south coast of Australia, stretching from the tip of Cape York to the Victoria–South Australia border. It includes the waters around Lord Howe Island, Norfolk Island and the high seas of the Pacific Ocean (Map 1). This multispecies fishery uses predominately pelagic longline to target three species of tuna (albacore, bigeye tuna and yellowfin tuna), along with swordfish and striped marlin. Minor line method is also used but accounts for only a small portion of the fishery’s catch, effort and gross value of production (GVP). The fishery’s key ports are Cairns, Coffs Harbour, Mooloolaba and Ulladulla.

The fishery operates year-round targeting internationally shared stocks. Commonwealth management of the ETBF takes into account Australia’s obligations to the Western and Central Pacific Fisheries Commission, the regional fisheries management organisation responsible for managing highly migratory internationally shared stocks of tuna and tuna-like species in the Western and Central Pacific Ocean. Australia’s share of catch of targeted species in the Western and Central Pacific Fisheries Commission Convention area is very small for tuna species.

Map 1 Relative fishing intensity, Eastern Tuna and Billfish Fishery, 2016
**Key economic trends**

Catch in the ETBF was variable between 2002–03 and 2016–17, peaking in 2002–03, 2006–07 and 2015–16 (Figure 1). Landed catch fell from 7,695 tonnes in 2006–07 to 4,374 tonnes in 2012–13. During this period the number of active vessels and fishing effort fell significantly, suggesting unfavourable economic conditions in the fishery. Declining prices and rising input costs during this period may have reduced fishing effort and catch. Between 2012–13 and 2014–15 landed catch increased by 17 per cent to 5,109 tonnes. This reflected increased fishing effort, which may have been supported by improving terms of trade (the ratio of output prices to input prices). In 2015–16 catch in the ETBF was the highest since 2006–07, largely because of an increase in yellowfin tuna catch. The subsequent decline in total catch in 2016–17 was largely the result of a halving of yellowfin tuna catch.

**Figure 1 Landed catch of key species, Eastern Tuna and Billfish Fishery, 2002–03 to 2016–17**

GVP in the ETBF declined in real terms (2016–17 dollars) from $95.9 million in 2002–03 to $26.8 million in 2012–13, reflecting lower landed catch and falling average prices (Figure 2). GVP increased between 2012–13 and 2015–16 to reach an 11-year high in real terms (2016–17 dollars) of $49.6 million in 2015–16. The increase in GVP between 2012–13 and 2015–16 was the result of higher landed catch and rising prices of key targeted species (particularly yellowfin tuna) (Figure 3). The decline in GVP in 2016–17 was largely the result of lower yellowfin tuna catch.
NER in the ETBF was negative between 2002–03 and 2009–10 but has improved since 2003–04 (Figure 4). In 2010–11 the fishery achieved the first positive NER since 2000–01. The most recent survey results show that NER declined to be around −$0.6 million in 2013–14 but increased in 2014–15 to $6.5 million, representing the highest level of NER since 1998–99. Non-survey based preliminary estimates show a further increase in NER in 2015–16 followed by a decline in 2016–17.
Figure 4 Net economic returns, Eastern Tuna and Billfish Fishery, 2002–03 to 2016–17

p Preliminary estimate.
Note: Time series of financial and economic performance (NER) tables are available on the ABARES website.

Current management arrangements

In March 2011 the fishery moved to a system of total allowable commercial catch (TACC) for key target species—individual transferable quotas (ITQs) entitle holders to a share of the TACC (Figure 5). Quota species are albacore, bigeye tuna, yellowfin tuna, swordfish and striped marlin. Previously, the fishery was managed through transitional arrangements whereby a total allowable effort limit with transferable effort rights was in place. The system of TACC with ITQs manages catch in the fishery while allowing operators to choose a more efficient combination of inputs to operate their business in the most cost-effective way. This allows operators greater flexibility in adapting their business to improve profitability.

Figure 5 Key management changes, 2000–01 to 2016–17
3 Financial and economic performance

The survey population for a given year is defined as vessels that recorded more than one tonne of catch in the ETBF. The survey sample comprised 6 vessels, representing around 15 per cent of the population in 2013–14 and 2014–15. Because of the small sample size, figures should be treated with caution. Relative standard errors are included in Table 3 and Table 4. Details of the survey method can be found in Appendix B.

Financial performance

Between 2013–14 and 2014–15 financial performance of the average vessel in the ETBF improved. Total average cash receipts increased by 26 per cent to $1.4 million per vessel, more than offsetting an 8 per cent increase in total average cash costs to $1.1 million per vessel. This resulted in a substantially larger average boat cash income in 2014–15 compared with 2013–14.

Crew costs accounted for the largest share of cash costs at 26 per cent of total cash costs in 2013–14 and 27 per cent in 2014–15. Fuel costs were another large contributor to cash costs, making up 19 per cent of total cash costs in 2013–14 and 15 per cent in 2014–15. Fuel costs decreased by 17 per cent in 2014–15, reflecting a combination of lower fuel prices and a reduction in the number of days fished that year.

Profit at full equity for the average ETBF boat has been positive since 2010–11 but declined between 2011–12 and 2013–14, when total cash costs rose faster than total cash receipts (Figure 6). In contrast, average profit at full equity increased nearly fourfold in 2014–15 to $250,973 per boat because total cash receipts increased at a higher rate than total cash costs.

Rates of return to full equity (assuming total capital value of boat and owned quota is owned by the fishing business) fell to 3.5 per cent in 2013–14 before increasing to 11.2 per cent in 2014–15. Rates of return to full equity increased proportionally less than profit at full equity, reflecting an estimated increase in licence and quota value in 2014–15. The estimated increase in licence and quota value could be related to higher profits estimated for the fishery that year.
Table 3 Financial performance of boats operating, Eastern Tuna and Billfish Fishery

<table>
<thead>
<tr>
<th>Category</th>
<th>Unit</th>
<th>2013–14</th>
<th>2014–15</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fishing receipts</td>
<td>$</td>
<td>1,040,974</td>
<td>1,300,843</td>
</tr>
<tr>
<td>Non-fishing receipts a</td>
<td>$</td>
<td>53,687</td>
<td>73,010</td>
</tr>
<tr>
<td>Total cash receipts</td>
<td>$</td>
<td>1,094,661</td>
<td>1,373,853</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td>$</td>
<td>18,303</td>
<td>27,518</td>
</tr>
<tr>
<td>Crew costs</td>
<td>$</td>
<td>263,968</td>
<td>302,948</td>
</tr>
<tr>
<td>Freight and marketing expenses</td>
<td>$</td>
<td>157,817</td>
<td>188,344</td>
</tr>
<tr>
<td>Fuel</td>
<td>$</td>
<td>195,383</td>
<td>161,721</td>
</tr>
<tr>
<td>Insurance</td>
<td>$</td>
<td>35,531</td>
<td>41,619</td>
</tr>
<tr>
<td>Interest paid</td>
<td>$</td>
<td>12,420</td>
<td>12,390</td>
</tr>
<tr>
<td>Licence fees and levies</td>
<td>$</td>
<td>49,806</td>
<td>63,159</td>
</tr>
<tr>
<td>Packaging</td>
<td>$</td>
<td>42,586</td>
<td>27,645</td>
</tr>
<tr>
<td>Repairs and maintenance</td>
<td>$</td>
<td>106,541</td>
<td>116,748</td>
</tr>
<tr>
<td>Other costs b</td>
<td>$</td>
<td>141,597</td>
<td>159,778</td>
</tr>
<tr>
<td>Total cash costs</td>
<td>$</td>
<td>1,023,952</td>
<td>1,101,871</td>
</tr>
<tr>
<td><strong>Boat cash income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- less depreciation c</td>
<td>$</td>
<td>61,748</td>
<td>58,876</td>
</tr>
<tr>
<td><strong>Boat business profit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- plus interest leasing rent</td>
<td>$</td>
<td>54,114</td>
<td>37,868</td>
</tr>
<tr>
<td><strong>Profit at full equity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Capital (excluding quota and licences)</strong></td>
<td>$</td>
<td>679,636</td>
<td>749,592</td>
</tr>
<tr>
<td><strong>Capital (including quota and licences)</strong></td>
<td>$</td>
<td>1,798,756</td>
<td>2,242,491</td>
</tr>
<tr>
<td><strong>Rate of return to boat capital d</strong></td>
<td>%</td>
<td>9.3</td>
<td>na</td>
</tr>
<tr>
<td>Rate of return to full equity e</td>
<td>%</td>
<td>3.5</td>
<td>na</td>
</tr>
<tr>
<td>Population</td>
<td>no.</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>Sample</td>
<td>no.</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

a Including rebates, charter hire, quota leasing revenue and other non-fishing receipts. b Including quota lease payments. c Depreciation adjusted for profit or loss on capital items sold. d Excluding value of quota and licences. e Including value of quota and licences. na Not applicable.

Note: Figures in parentheses are relative standard errors (RSEs). An RSE will be higher for estimates closer to zero. A guide to interpreting RSEs is included in Appendix B.
Figure 6 Trends in key financial performance variables, Eastern Tuna and Billfish Fishery, 2001–02 to 2014–15

Note: Error bands are equal to two standard errors, approximating the 95 per cent confidence interval. Error bands are typically large for small sample sizes and wider for estimates closer to zero.
Economic performance

NER in the ETBF was negative between 2002–03 and 2009–10 but generally improved from 2003–04 (Figure 7). In 2010–11 the fishery achieved positive NER, driven primarily by reduced operating costs. The Securing our Fishing Future structural adjustment package (between 2005 and 2006) saw the likely exit of less-efficient vessels from the fishery. The number of vessels was already declining from a peak of 146 vessels in 1998–99; by 2007–08 only 58 vessels remained and in 2016–17 a total of 40 vessels were active.

For the latest survey years (2013–14 and 2014–15) NER in the fishery is estimated to have increased from –$0.6 million in 2013–14 to $6.5 million in 2014–15. The decline in NER during 2013–14 occurred despite improved terms of trade and appears to have been associated with a decline in total factor productivity in that season. The increase in NER in 2014–15 was driven by fishing income increasing at a greater rate than fishing costs and was supported by an improvement in the fisher’s terms of trade and an increase in productivity in that year.

Preliminary non–survey based estimates of NER for 2015–16 show an increase to $15.7 million. Higher NER for 2015–16 was supported by an increase in estimated income, driven largely by a 34 per cent increase in yellowfin tuna catch in that year. The estimated beach price of yellowfin tuna also increased by 10 per cent, supported by the Australian dollar’s 11 per cent devaluation against the Japanese yen (almost 90 per cent of Australia’s tuna production is exported to Japan). During 2015–16 the average off-road diesel price fell to a 13-year low in real terms. The combination of higher beach prices and lower fuel price are likely key drivers for NER increasing significantly in 2015–16. Preliminary non–survey based estimates for 2016–17 indicate that NER declined by 53 per cent to $7.3 million. Despite the estimated decline in 2016–17, NER in the ETBF that year is estimated to be well above the five-year average to 2014–15 (the latest survey year).

The decline in NER in 2016–17 was the result of fishing income falling more than fishing costs. The estimated reduction of GVP in the fishery in 2016–17 was largely the result of lower yellowfin tuna catch. Higher average beach prices for targeted species and only a moderate increase in fuel price (well below the five-year average to 2015–16) suggests an incentive to maintain catch at 2015–16 levels. Factors unrelated to effort may have played a role in the reduced catch in 2016–17.
### Table 4 Fishery cash profit and net economic returns, Eastern Tuna and Billfish Fishery

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td>RSE</td>
<td>Value</td>
<td>RSE</td>
</tr>
<tr>
<td><strong>Receipts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fishing income</td>
<td>40.6</td>
<td>(18)</td>
<td>50.7</td>
<td>(11)</td>
</tr>
<tr>
<td><strong>Cash costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating costs</td>
<td>37.1</td>
<td>(14)</td>
<td>41.1</td>
<td>(11)</td>
</tr>
<tr>
<td>Fishery cash profit</td>
<td>3.5</td>
<td>(77)</td>
<td>9.7</td>
<td>(32)</td>
</tr>
<tr>
<td>– less owner and family labour</td>
<td>2.8</td>
<td>(38)</td>
<td>1.9</td>
<td>(56)</td>
</tr>
<tr>
<td>– less opportunity cost of capital</td>
<td>1.2</td>
<td>(23)</td>
<td>1.3</td>
<td>(24)</td>
</tr>
<tr>
<td>– less depreciation</td>
<td>2.4</td>
<td>(26)</td>
<td>2.3</td>
<td>(23)</td>
</tr>
<tr>
<td>plus interest, leasing and management fees</td>
<td>3.9</td>
<td>(30)</td>
<td>3.9</td>
<td>(27)</td>
</tr>
<tr>
<td>Net return (excluding management costs)</td>
<td>0.9</td>
<td>(424)</td>
<td>8.0</td>
<td>(32)</td>
</tr>
<tr>
<td>Management costs</td>
<td>1.5</td>
<td>na</td>
<td>1.5</td>
<td>na</td>
</tr>
<tr>
<td>Net return (including management costs)</td>
<td>–0.6</td>
<td>na</td>
<td>6.5</td>
<td>na</td>
</tr>
</tbody>
</table>

**p** Preliminary estimate (for estimation method, see Appendix C). **na** Not applicable.

Notes: Figures in parentheses are relative standard errors (RSEs). RSEs are not applicable for 2015–16 and 2016–17 results because of the non-survey estimation method used (Appendix C). Management costs include all costs involved with managing the fishery, not just those recovered from industry.
Figure 7 Trends in economic returns, Eastern Tuna and Billfish Fishery, 2001–02 to 2016–17

- Fishing income
- Operating costs
- Fishery cash profit
- Net return (excluding management costs)
- Management costs
- Net return (including management costs)

P Preliminary estimate.

Note: Error bands are equal to two standard errors, approximating the 95 per cent confidence interval. Standard errors are not calculated for returns or management costs, nor for forecasted values that use non-survey methods. Error bands are typically large for small sample sizes and wider for estimates closer to zero.
4 Other key performance indicators

Other economic indicators can help in assessing the economic performance of a fishery and in understanding the trends. Indicators discussed in this report include trends in economic productivity, terms of trade and management costs.

**Productivity**

Total factor productivity (TFP) analysis shows trends in fishers’ economic productivity. TFP analysis is used to examine the ability of fishers to convert inputs into outputs over time. Results from the TFP analysis can assist in evaluating changes in net economic return (NER) over time and provide an understanding of the factors in a fishers’ operating environment affecting productivity. Such factors may include changes in management settings that regulate fishers’ technology choices, changing market conditions and changes in the mix of outputs produced. Market conditions include variations in input costs, import competition and changes in the value of the Australian dollar.

Changes to a fishers’ operating environment can provide fishers an incentive to pursue vessel-level productivity improvements. For example, to keep the business financially viable in response to adverse market conditions, such as increasing input costs or competition, fishers invest in productivity enhancing improvements. Adverse market conditions can also help drive autonomous structural adjustment in the industry. This can include fishing rights moving to the most profitable fishers and the least efficient or least profitable vessels exiting the industry, resulting in a more productive fleet.

TFP analysis was undertaken for the ETBF from 2002–03 to 2014–15 (methods for calculating the indexes are shown in Appendix D). The productivity index followed an upward trend and increased by an annual average rate of 4 per cent (Figure 8). A possible driver of improvement in productivity in the fishery from 2002–03 to 2014–15 was the reduction in fleet size and the exit of less efficient vessels. Because fewer and more productive vessels are left in the fishery, the ability to convert inputs to outputs is likely to have improved, increasing the productivity index.
The terms of trade index looks at the change in prices paid for inputs relative to prices achieved for outputs and can indicate whether improvements in NER are driven by favourable terms of trade conditions. Higher wages, fuel and repair prices resulted in the input cost index increasing from 2010–11 to 2013–14. The input cost index declined in 2014–15 reflecting a significant reduction in fuel prices. The output price index includes the price of species caught by vessels in the fishery. Over the period 2002–03 to 2012–13 the output price index declined by 43 per cent. Higher fish prices resulted in the output price index rising by 25 per cent in 2013–14 before declining in 2014–15.

As a result of increasing costs and lower output prices, the terms of trade index declined by 53 per cent over 2002–03 to 2012–13, indicating that fishers would have experienced challenging operating conditions (Figure 9). This has had a moderating effect on the level of NER earned from the fishery and increased the emphasis on achieving productivity improvements from the fleet. The terms of trade index improved in 2013–14 (reflecting an increase in fish prices) and in 2014–15 (reflecting a significant fall in the input cost index).
Management costs

Management costs are incurred to ensure the fishery continues operating, making them costs associated with harvesting fish in the fishery. Total management costs generally declined for the 10 years to 2014–15, from a peak of $4.1 million in 2006–07 to $1.6 million in 2014–15 (in 2016–17 dollars) (Figure 10). Between 2005–06 and 2014–15 total management costs declined more quickly than gross value of production of the fishery. This led to a fall in management costs as a share of gross value of production, from 11 per cent in 2005–06 to 4 per cent in 2014–15.

Management cost per active vessel in the ETBF increased from 2005–06 to 2007–08, peaking at $67,176 (in 2016–17 dollars) (Figure 11). Higher management cost per vessel in 2007–08 is likely to be an outcome of vessels exiting the industry, leaving a constant amount of management costs to be shared among a fewer number of vessels. Management cost per vessel has trended down since 2007–08 to around $40,000 (in 2016–17 dollars) in 2014–15. The steady decline in total management costs between 2005–06 and 2014–15 likely reflects both reductions in the size of the fishery and changes in management arrangements for the fishery over that period.
Quota latency

In the 2015 season (March 2015 to February 2016) the level of latency in the ETBF, measured by the proportion of TACC not caught in the fishery for all species, fell below 30 per cent for the first time since the inception of TACC in 2011. However, quota latency increased to 31 per cent in the 2016 season, largely reflecting lower catch of yellowfin tuna.

Latency has varied across the key species since 2011 (Figure 12). Latency for yellowfin tuna and striped marlin both fell to 1 per cent of TACC in the 2015 season, down from 23 per cent for yellowfin tuna and 22 per cent for striped marlin in the 2014 season. Latency for yellowfin tuna increased significantly in 2016, while swordfish quota latency reduced by around 2 percentage points. Latency for bigeye tuna declined significantly in the 2015 season—landed catch increased by 28 percentage points to 74 per cent of the 2015 TACC. Latency for swordfish TACC averaged 16 per cent for the 2014 and 2015 seasons compared with an average of 24 per cent for 2011 to 2013. Albacore TACC has the highest degree of latency in the ETBF; an average of around 68 per cent of the TACC was not caught between 2011 and 2015. However, latency decreased to 63 per cent for the 2015 season and to 56 per cent for the 2016 season.

Low latency levels can indicate increased incentives to operate in the fishery or to target particular species. This can be a result of favourable market conditions relative to input costs. Virtually no latency for yellowfin tuna and striped marlin in the 2015 season suggests that financial returns for targeting these species were favourable that season.

Relatively high latency levels (for example, for albacore) can indicate limited incentive for fishers to operate in the fishery or target particular species. This can be a result of poor market conditions relative to input costs, low fish stocks levels, other unfavourable fishing conditions such as bad weather, or more profitable options for fishers in other fisheries. Albacore is a relatively low unit value catch compared with other species targeted in the fishery and the fleet is likely to actively target the higher unit value species of the fishery over albacore. However, yellowfin tuna latency increased in the 2016 season despite the average price for yellowfin tuna increasing in the 2015–16 and 2016–17 financial years and fuel prices remaining relatively low.
Figure 12 Catch and TACC for quota species, Eastern Tuna and Billfish Fishery, 2007 to 2016
5 Performance against management objectives

Harvesting internationally shared stocks complicates selection of economic-based targets and assessment of economic status against maximum economic yield. Management actions domestically may not affect stock-wide biomass, especially where Australian catch is a relatively small proportion of total catch in the fishery. Commonwealth management of the ETBF takes into account Australia’s obligations to the Western and Central Pacific Fisheries Commission (WCPFC), the regional fisheries management organisation responsible for managing highly migratory fish stocks in the Western and Central Pacific Ocean.

Objectives of the ETBF management plan include maximising NER to the Australian community while being consistent with the principles of ecologically sustainable development, and managing the fishery efficiently and cost-effectively for the Commonwealth.

The Commonwealth Fisheries Harvest Strategy Policy (DAFF 2007) is not prescribed for fisheries managed under international agreements. A harvest strategy framework for the ETBF has been developed in line with the Commonwealth Fisheries Harvest Strategy (AFMA 2011). The harvest strategy framework has been used to set the TACC for swordfish and striped marlin since 2011. Target reference catch rates used in the ETBF harvest strategy for swordfish and striped marlin align with default reference points of 48 per cent of unfished biomass for the target and 20 per cent of unfished biomass for the limit. TACCs for tuna species are based on historical catch levels in the fishery (Larcombe & Bath 2015).

The potential lack of association between domestic management actions and changes in stock biomass for the tuna species in the ETBF means that stock-wide biomass at maximum economic yield (B_{MMEY}) may not be relevant (Larcombe, Patterson & Savage 2017). This makes it difficult to draw conclusions about the possible causes of latency in the fishery and how it is affecting overall economic performance. In lieu of meaningful B_{MMEY} targets for highly migratory and internationally managed fisheries, maintaining high levels of productivity in the fishery is consistent with minimising inputs (costs) relative to output (revenue) and thus a movement towards maximising economic returns.

TACC allocated as ITQs provides fishers greater flexibility to fish with a more efficient combination of inputs. The transferability of fishing rights allows quota to be allocated to more efficient operators. However, the success of output controls depends on setting levels of TACCs that meet the management objective. If TACCs are set too high so that they do not constrain a species’ catch, the incentive for quota trade and the associated positive impacts for fishery-level efficiency are reduced (Elliston & Cao 2004).

The relatively large and positive NER of $6.5 million in 2014–15 is likely to have been assisted by an increase in the terms of trade, which is outside the control of fishery management. Among the indicators analysed is the productivity index, which trended upwards for the fishery between 2001–02 and 2014–15. This improvement in productivity is consistent with the upward trend in NER since 2003–04. It is unclear whether the harvest strategy targets or the introduction of output controls in March 2011 are responsible for this improvement because NER was increasing before their implementation and multiple factors influence the fishery’s economic performance.
TFP in the ETBF has on average been higher in the four years following introduction of output controls (March 2011) compared with the preceding four years. However, because of the multitude of factors which can influence TFP and the variability in the series, it is difficult to determine the extent that the introduction of output controls have had on TFP.

Total management costs in the fishery have been decreasing since 2004–05. Management costs per vessel remained high from 2006–07 to 2007–08, with a similar level of management shared among fewer vessels. Management cost per vessel has generally been declining in the fishery since 2007–08, but increased by 19 per cent in 2015–16. Management cost as a percentage of GVP has declined from a high of 11 per cent in 2005–06 to an estimated 4 per cent in 2016–17.
Appendix A: Survey definitions

This appendix provides definitions of key financial performance variables, net economic returns (NER) and the ABARES method of calculating NER. Use of NER as an indicator of economic performance is briefly discussed.

Financial performance

ABARES used these definitions of key variables in the analysis of vessel-level financial performance.

**Total cash receipts** represent returns from sale of fish, from non-fishing activities (including charter operations) and from other sources (insurance claims and compensation, quota and/or endorsements leased out, government assistance and any other revenue) in the financial year.

For most operators, this information is readily available from their own records. However, different operators record their fishing income in different ways. Where fish are sold through a cooperative, some operators may only record payments received from the cooperative. These payments may be net of commissions, freight and other purchases made through the cooperative.

In other cases, the cooperative or agency pays the crew directly for the catch; the owner's financial records might include only the revenues received after the crew's share is deducted.

For these reasons, operators are asked to provide a breakdown of the total catch of their boat and an estimate of the total value of that catch. For consistency, marketing charges may need to be added back into fishing receipts for some boats to give a gross value. Where this is necessary, these selling costs are also added into the cost estimates to offset the new revenue figure. Receipts also include amounts received in the survey year for fish sold in previous years.

**Total cash costs** include payments made for both permanent and casual hired labour and payments for materials and services (including payments on capital items subject to leasing, rent, interest, licence fees and repairs and maintenance). Capital and household expenditures are excluded.

**Labour costs** are often the highest cash cost in the fishing operation. Labour costs include wages and an estimated value for owner/partner, family and unpaid labour. Labour costs cover the cost of labour involved in boat-related aspects of the fishing business, such as crew or onshore administration costs, but do not cover the cost of onshore labour to process fisheries products.

On many boats, the costs of labour are reflected in wages paid by boat owners and/or in the share of the catch they earn. However, in some cases, such as where owner–skippers are involved or where family members work in the fishing operation, payments made can be low or even nil. This will not always reflect the market value of the labour provided. To allow for this possible underestimation, all owner/partner and family labour costs are based on estimates collected at the interview of what it would cost to employ someone else to do the work.

**Boat cash income** is the difference between total cash receipts and total cash costs.

**Depreciation** costs are estimated using the diminishing value method based on the current replacement cost and age of each item. The rates applied are the standard rates allowed by the
Commissioner of Taxation. For items purchased or sold during the survey year, depreciation is assessed as if the transaction had taken place at the midpoint of the year. This method of calculating depreciation is also used in other ABARES industry surveys.

**Boat business profit** is boat cash income less depreciation and accounting for any profit or loss on the sale of capital.

**Profit at full equity** is boat profit plus rent, interest and lease payments.

**Capital** is the value placed on the assets employed by the owning business of the surveyed boat. It includes the value of the boat, hull, engine and other onboard equipment (including gear). Estimates are also reported for the value of quotas and endorsements held by the surveyed boat. Estimates of the value of capital are based on the market value of capital and are usually obtained at interview. However, in some cases quota and endorsement values are obtained from industry sources.

**Depreciated replacement value** is the depreciated capital value based on the current age and replacement values of the boat and gear. The value of quota and endorsements held is not included in the estimate.

**Rate of return to boat capital** is calculated as if the proprietors owned all fishing assets. This enables financial performance of sample boats to be compared regardless of proprietors’ equity in the business. Rate of return to boat capital is calculated by expressing profit at full equity as a percentage of total capital (excluding quota and licence value).

**Rate of return to full equity** is calculated by expressing profit at full equity as a percentage of total capital (including quota and licence value). This measures the rate of return for capital owned by fishers only. Quota can be owned by entities not directly operating in the fishery, then leased to vessel operators. For this reason, the rate of return to full equity measure could be underestimated as it does not account for capital leased-in by fishers.

**Net economic returns**

Net economic returns are the long-run profits from a fishery after all costs have been met, including fuel, crew costs, repairs, the opportunity cost of family and owner labour, fishery management costs, depreciation and the opportunity cost of capital.

More specifically, a fishery’s net economic returns for a given period can be defined as:

\[
NER = R - CC - OWNFL + ILR - OppK - DEP + recMC - totM
\]

Where:

- **NER** = net economic returns
- **R** = total cash receipts attributable to the fishery, excluding leasing income
- **CC** = total cash costs attributable to the fishery, including recovered management costs
- **OWNFL** = imputed cost of owner and family labour
- **ILR** = interest and quota/permit leasing costs
- **OppK** = opportunity cost of capital
- **DEP** = depreciation
Recovered management costs are those management costs paid by industry through management fees and are included in total cash costs (CC). These costs are removed (as indicated by ‘+ recMC’) to prevent double counting because those costs are a component of total management costs. Similarly, interest and quota/permit leasing costs are removed (indicated by ‘+ ILR’) because these costs at the fishery level represent revenues that have been redistributed to external investors in the fishery.

**Survey-based estimation of net economic returns**

**Fish sale receipts**

Fish sale receipts are usually taken from fishers’ financial accounts. Where a fisher operates in more than one fishery, they are asked to indicate the proportion of total fish sales attributable to the fishery being surveyed. Any freight or marketing costs must also be deducted. This provides an estimate of net fishing receipts that incorporates only the ‘beach price’ received for the catch; that is, the price received for fish at its first landing point.

Income received from leasing out quota and licences is not included as income in calculating net economic returns. This item represents a redistribution of profits among investors in the fishery. Also, the amount a fisher earns from leasing out quota and licences relates to the amount of profits the fishery generates. Therefore, including leasing revenue would result in double counting.

**Operating costs**

Operating costs include day-to-day operational expenses incurred to harvest fish in the fishery. Cash costs (CC) are a component of operating costs that includes those cost items that are easily identified in fishers’ accounts, such as fuel, repairs and gear replacement.

Labour costs are often specified in fishers’ accounts as wages. However, in calculating net returns, an estimate of the opportunity cost of labour is needed. The opportunity cost of labour is the wage that could have been earned performing a similar role elsewhere. Where a market wage is paid, it is assumed to represent the opportunity cost of labour and is included in the cash costs component of operating costs. The opportunity cost of owner and family labour is not easily identifiable in fishers’ accounts. Often owners and their families are involved in operating a boat, either as skippers and crew or onshore as accountants and shore managers. Some will be paid market value for their labour but some will not be paid at all and others paid very high amounts, often as ‘director fees’ or ‘manager fees’. In these cases, ABARES survey officers ask survey respondents to estimate the market value of owner and family labour; that is, the amount that would need to be paid to employ a non-family member to fulfil the same position. This amount is entered as a component of operating costs (OWNFL).

Quota and licence leasing costs and interest expenses are included in cash costs. However, these costs must be removed from calculation of net returns for the same reason they are excluded from income (see ‘Fish sale receipts’ section).

**Capital costs**

To calculate capital costs, an estimate of the value of capital is needed. ABARES survey officers ask fishers to provide information for all capital items associated with the fishing business (including hull, engine, onboard equipment, vehicles and sheds). Information collected for each item includes the year the capital item was manufactured and an estimate of what it would cost...
to replace that item with a new equivalent item. By accounting for previous depreciation and inflation, these data are used to estimate the total value of capital invested in the fishery for the survey year.

Capital costs include the opportunity cost of capital (OppK) and depreciation (DEP). The opportunity cost of capital is the return that could have been earned if capital was invested elsewhere, rather than in the fishery. This cost is not identifiable in fishers’ accounts. A real interest rate that represents the long-term average rate of return that could be earned on an investment elsewhere is applied to the value of capital in the fishery. For fisheries surveys, ABARES uses a rate of 7 per cent per year. Although generally fishing entitlements have some value and holding them imposes opportunity cost on the fisher, entitlements are not included in opportunity cost of capital. This is because the value of fishing entitlements is determined by the profit that they are capable of making, which is what is trying to be measured in NER. In addition entitlements are tied intrinsically to the fishery and so have no alternative use outside the fishery unlike boat capital.

Depreciation expense is the cost of capital becoming less valuable over time as a result of wear and tear and obsolescence. Depreciation expense is not consistently identifiable in fishers’ accounts, so ABARES calculates annual depreciation of boats based on the capital inventory list collected during the surveys and predetermined depreciation rates for each capital item type.

**Management costs**

Management costs are incurred to ensure the fishery continues operating; they are costs associated with harvesting fish in the fishery. Management costs comprise two components—recovered management costs and non-recovered management costs. Recovered management costs (recMC) are those recovered from fishers that appear in the accounts of fishers as payments of management fees or levies. Non-recovered management costs are not charged to fishers but instead are covered by the managing body or government. Calculation of net economic returns requires deduction of total management costs, which is the sum of these two components.

Total cash costs (CC) includes an estimate of recovered management costs based on management levy expenses contained in fishers’ accounts. This estimate of recovered management costs is based only on a sample of the fishery, so it may not be consistent with the actual value of management costs recovered from the entire fishery. AFMA is able to provide an estimate of total management costs for each fishery—that is, the sum of both recovered and non-recovered management costs. For these reasons, recovered management costs from fishers’ accounts are ignored (as indicated by +recMC in the net returns equation). Total management costs (totM) supplied by AFMA are then used to estimate net economic returns.

**Net economic returns and economic performance**

Fishery managers, policymakers and decision-makers require information on fisheries’ performance for achieving the objective of maximising net economic returns from use of fish stocks—an objective commonly referred to as MEY. If a fishery is operating at MEY, effort, catch and stocks are at levels where the difference between discounted revenues and costs, and therefore profits, are maximised. The term ‘discounted’ means that the difference in the value of a dollar earned today relative to a dollar in the future is accounted for. Although estimates of NER do not reveal how a fishery is performing relative to its maximum potential, positive trends in NER, together with other indicators, suggest that the MEY objective is closer to being met.
Appendix B: Survey methods

Collecting economic survey data
ABARES has undertaken economic surveys of selected Commonwealth fisheries since the early 1980s and on a regular basis for particular fisheries since 1992. Under the current program ABARES surveys major Commonwealth fisheries every two years or more frequently where the fishery is undergoing major changes and monitoring is particularly important. It aims to develop a consistent time series of economic information for each fishery. Such information, in conjunction with scientific assessments of each fishery, is vital for assessing fisheries’ economic performance.

Survey information is made publicly available so the performance of fisheries and the effect of management policies can be assessed independently.

Sample design
ABARES surveys are designed and samples selected on the basis of information provided by AFMA. This information includes data on the volume of catch, fishing effort and boat characteristics.

Because surveying all boats in a fishery is not possible, a representative sample of boats is selected. Where possible, boats are classified into subgroups based on the fishing method used (longline, purse seine and trawl) or on the size of operations (small, medium and large producers). A minimum number of representative boats from each subgroup are targeted for the survey.

In practice, this sample is seldom fully realised. Non-response is relatively high across fishery surveys, reflecting the difficulty in contacting some operators and a reluctance of others to participate. This may bias the results—for example, if profitability of respondents and non-respondents differs significantly. Sample design and weighting systems have been developed to reduce the non-response effect but care should be taken when interpreting survey information.

Between February and August every two years, an ABARES officer visits the owner of each boat selected in the sample. The officer interviews the boat owner to obtain physical and financial details of the fishing business for the survey years. When necessary, the skipper of the boat is also interviewed. ABARES subsequently obtains further information from accountants, selling agents and marketing organisations on the signed authority of survey respondents.

ABARES reconciles the information obtained from various sources to produce the most accurate description possible of the financial characteristics of each sample boat in the survey.

Sample weighting
Estimates of financial and economic performance presented in this report were calculated based on weighted survey data of sampled vessels. ABARES calculates a weight for each sampled vessel based on how representative that vessel is in the population. This report uses a regression model of GVP on catch for each vessel in the fleet population to estimate sample weights. The individual estimated weights for sampled vessels in the fleet population are then standardised such that two conditions are met, the sum of sample weights equal the population, and the weighted sum of the sample catch approximate total catch of the fleet.
That is, 
\[ \Sigma w_i = P \text{ and } \Sigma w_i x_i = X \]
where:
\( w_i \) is the weight for the \( i \)th vessel 
\( P \) is the number of vessels in the fleet population 
\( x_i \) is the catch for the \( i \)th vessel 
\( X \) is the total catch for the fleet population.

Sample weights are estimated based on a regression model of GVP on catch for each vessel in the fleet population. The individual estimated weights for sampled vessels in the fleet population are then standardised such that the two conditions in the former method are still met—the sum of sample weights equal the population and the weighted sum of the sample catch approximate total catch of the fleet.

**Reliability of estimates**
ABARES generally surveys a relatively small number of boats out of the total number in a particular fishery. Estimates derived from these boats are likely to be different from those that would have been obtained if information had been collected from a census of all boats. The number of boats in the sample, the variability of boats in the population and, most importantly, the design of the survey and the estimation procedures used influence how closely the survey results represent the population.

Measures of sampling variation have been calculated to give a guide to the reliability of survey estimates. These measures, expressed as percentages of the survey estimates and termed relative standard errors, are given next to each estimate in parentheses. In general, the smaller the relative standard error, the more reliable the estimate.

**Use of relative standard errors**
Relative standard errors can be used to calculate confidence intervals for the survey estimate. First, the standard error is calculated by multiplying the relative standard error by the survey estimate and dividing by 100. For example, if average total cash receipts are estimated to be $100,000 with a relative standard error of 6 per cent, the standard error for this estimate is $6,000.

The chance that the census value (the value that would have been obtained if all boats in the target population had been surveyed) is within one standard error of the survey estimate is roughly two in three. The chance that the census value is within two standard errors of the survey estimates is roughly 19 in 20. Therefore, in this example, the chance that the census value is between $94,000 and $106,000 is two in three and the chance that the census value is between $88,000 and $112,000 is 19 in 20.

**Comparing estimates**
When comparing estimates across groups or years, it is important to recognise that the differences are also subject to sampling error. A conservative estimate of the standard error of the difference can be constructed by adding the squares of the estimated standard errors of the component estimates and then taking the square root of the result.
For example, suppose the estimates of total cash receipts were $100,000 for one year and $125,000 for the previous year—a difference of $25,000—and the relative standard error is given as 6 per cent for each estimate. The standard error of the difference can be estimated as:

\[ \sqrt{(0.06 \times 100,000)^2 + (0.06 \times 125,000)^2} = \$9,605 \]

The relative standard error of the difference is:

\[ \frac{\$9,605}{\$25,000} \times 100 = 38\% \]

The population of a fishery may change from one year to the next. If these population changes are substantial, differences in estimates may be caused more by the changes in population than by changes in the variables themselves.

**Non-sampling errors**

The values obtained in a survey may be affected by errors other than those directly related to the sampling procedure. For example, obtaining information from certain respondents may not be possible, respondents may provide inaccurate information or respondents may differ from non-respondents for a particular variable being surveyed.

ABARES survey staff are generally experienced and undergo rigorous pre-survey training, aimed at minimising non-sampling errors. However, when drawing inferences from estimates derived from sample surveys, users should be aware that both sampling and non-sampling errors occur.
Appendix C: Non–survey based estimation of net economic returns

ABARES has developed a non-survey based method of estimating net economic returns for financial years where survey data are not yet available. It allows more timely estimation and reporting of net economic return estimates to better inform industry and government decision-making. This method is intended to complement data collection and publication of results normally undertaken through the fisheries surveys.

Method

The method used to calculate non–survey based estimates of net economic returns for a non-survey year (a year for which no survey data are available) uses regression estimates for key components of net economic returns. Regression approaches use the most relevant variables for each fishery, given unique fishing methods and other characteristics. In all cases, each component is estimated based on an assumed sample of the population and a set of corresponding assumed weights. This assumed sample represents those boats that are expected to be sampled in the next survey. Key variables correlating with cash receipts and operating costs were used in the estimates. Results (see Table D1 and Table D2 for full regression results) show that the same variables were used to estimate both cash receipts and operating costs.

Reliability of estimates

Estimates from the regression analysis are subject to uncertainties. First, relationships estimated between surveyed values of receipts and costs and other more readily available data rely on the historical sample of boats surveyed. Boats that are consistently not included in a sample may be under-represented in the estimates.

Whether historical relationships will hold in the most recent year is uncertain. Operating conditions in the fishery may change, resulting in changes in receipts and costs not foreseeable using this method.

Estimates should be used as an indication of the likely direction and magnitude of changes in net economic returns. For each receipt and cost category, the coefficient of determination (R²) gives an indication of the extent to which the explanatory variables can explain variation in the dependent variable. Lower coefficients of determination suggest a greater level of uncertainty surrounding the estimates.

Cash receipts

Cash receipts is the primary component of net economic return calculations because all other costs are deducted from cash receipts. Cash receipts represents income from fishing operations in the surveyed fishery. For non-survey years, real GVP is a good indicator for cash receipts as it is closely related to fishing income. Real GVP was estimated using average price data and catch data (Table D1).
Operating costs

Key drivers of operating costs in any fishery are fuel and labour. Therefore, accurately calculating operating costs for a non-survey year requires selecting variables that influence these two components. For labour, share payment systems imply a close relationship between fishery GVP and labour costs. Preliminary estimates of operating cost were based on real GVP and fuel price (Table D2).

Interest, leasing and management fees

Interest and leasing fees represent a redistribution of profits to investors in the fishery. As such, they are not costs at the fishery level. They are estimated based on historical ratios and values. Management fees for the purpose of the estimation are taken from AFMA (recovered and non-recovered) and include all costs for managing the fishery, not just those recovered from industry. Management fees are also estimated based on historical ratios and values.

Opportunity cost of capital and depreciation

Capital values, the opportunity cost of capital and depreciation expenses were estimated based on an implied capital rate of 7 per cent and assuming a depreciation rate equal to that in the most recent survey year and a capital upgrade rate (an assumed capital investment amount).

Management costs

Total management costs (recovered and non-recovered) for 2015–16 and 2016–17 were based on AFMA’s budgeted estimates.
Appendix D: Productivity and terms of trade methodology

Productivity measurement

Productivity is defined as the quantity of output produced with a given quantity of inputs. For example, a partial measure of productivity for a fishing vessel would be kilos of a particular species of fish produced per hook used. A more complete measure of productivity would be the total catch per unit of all inputs used. This approach is preferred as a measure of productivity and is usually referred to as total factor productivity.

Various methods have been developed to quantitatively assess total factor productivity trends for industries and individual enterprises within industries (see Coelli et al. 2005 for discussion). A frequent approach to measuring productivity trends uses index number theory. In this report a Fisher quantity index is used to measure total factor productivity trends for key Commonwealth fisheries (Box 1). Fishery-level input, output and total factor productivity indexes were estimated for each of the Commonwealth fisheries analysed and for each year where data were available. The Fisher quantity index is well-suited to handling the range of inputs and outputs recorded in ABARES fisheries economic survey data. For example, ABARES fisheries economic survey data contain many zero entries, which are well handled by the Fisher quantity index approach.

As with other index number approaches that measure productivity, the Fisher quantity index enables measurement of productivity trends with multiple inputs and outputs. The prices paid for inputs and received for outputs are used as weights to derive aggregations of outputs and inputs, which are expressed in index form. Output and input indexes are estimated using both Laspeyres and Paasche index approaches. A geometric mean of these indexes is derived to determine the Fisher output and input indexes. Total factor productivity is measured as the ratio of the Fisher output and Fisher input indexes.

Terms of trade measurement

ABARES constructs a terms of trade analysis using the same process as is used for TFP, except constructing Fisher price indexes rather than Fisher quantity indexes. The price index accounts for the prices of labour and fuel—the major cost components—and the costs of repairing and maintaining capital.

Data

Data used for this total factor productivity analysis are sourced from the ABARES Australian fisheries surveys dataset. The surveys dataset comprises physical and financial survey data for a sample of vessels operating in key Commonwealth fisheries. The inputs incorporated in the input indexes for each fishery are labour, fuel, repairs and capital. The output indexes for each fishery are described in the results section for each individual fishery. Population estimates are derived using sample vessel data from this database and are calculated for each of the fisheries analysed in this report. A weight is calculated for each boat in the sample, to represent its importance in the total unobserved population. The weight is generally based on the vessel’s catch representation. Weighted vessel-level information is used to derive fishery level input and output indexes.
Box E1 Fisher index

Using price and quantity data for a set of outputs (and separately for inputs), the Laspeyres quantity index \( Q_{0t}^L \) can be defined as:

\[
Q_{0t}^L = \frac{\sum_{i=1}^{N} P_{i0} q_{it}}{\sum_{i=1}^{N} P_{i0} q_{i0}} = \frac{\sum_{i=1}^{N} W_{i0} \left( q_{it}/q_{i0} \right)}{W_{i0}}
\]

where

\[
W_{i0} = \frac{P_{i0} q_{i0}}{\sum_{i=1}^{N} P_{i0} q_{i0}}
\]

is the share of \( i \)th item in the total value of outputs or inputs in the base period (denoted by 0). The Laspeyres index compares a total quantity in time period \( t \) to a base period.

The Paasche index \( Q_{0t}^P \) is defined as:

\[
Q_{0t}^P = \frac{\sum_{i=1}^{N} P_{it} q_{it}}{\sum_{i=1}^{N} P_{i0} q_{i0}} = \left( \frac{\sum_{i=1}^{N} W_{i0} \left( q_{it}/q_{i0} \right)}{W_{i0}} \right)^{-1}
\]

where

\[
W_{it} = \frac{P_{it} q_{it}}{\sum_{i=1}^{N} P_{it} q_{it}}
\]

is the share of \( i \)th item in the total value of outputs or inputs in the current period (denoted by \( t \)). Like the Laspeyres index, the Paasche index compares a total quantity in time \( t \) to a base period \( 0 \).

The Fisher index \( Q_{0t}^F \) is the geometric mean of Laspeyres and Paasche indexes, defined as:

\[
Q_{0t}^F = \sqrt{Q_{0t}^L Q_{0t}^P}
\]

The TFP index can be calculated as the ratio of the Fisher output \( Q_{0t}^{Fo} \) and input \( Q_{0t}^{Fi} \) indexes:

\[
\text{TFP}_{0t} = \frac{Q_{0t}^{Fo}}{Q_{0t}^{Fi}}
\]

The terms of trade index is constructed by the same means as above, except with every instance of \( Q \) replaced by \( P \) and every instance of \( P \) replaced by \( Q \).

**Inputs and outputs**

Total inputs consist of items that can be split into four major groups:

**Capital**—account for all capital items associated with the fishing business. These include the boat, hull, engine, onboard equipment, vehicles and sheds. The estimate of capital is based on the depreciated replacement value. For the total factor productivity and terms of trade analysis the quantity of capital inputs are the number of days fished, while price is user cost of using boat capital.

**Repairs and maintenance**—account for costs associated with the repairing and maintaining boat capital during the financial year. The value of repairs and maintenance is obtained through fishery surveys. A producer price index for shipbuilding and repair Services is used to estimate the price of repairs and maintenance.

**Fuel costs**—include the costs of all fuel, oil and grease. The quantity variable used for all fuel is the average of fuel use deflated by the fuel price paid.
**Labour**—includes the number of crew employed in boat-related aspects of the fishing business, such as crew or onshore administration costs, but does not cover the cost of onshore labour involved in processing fisheries products. It covers owner/partner, family and unpaid labour. For the total factor productivity and terms of trade analysis the quantity of labour input is the number of days fished multiplied by the average number of crew, while price is the opportunity cost of labour measured by average daily wage.

Total outputs are the species caught by vessels in each fishery. In the ETBF, these species are primarily swordfish, yellowfin tuna, striped marlin, bigeye tuna and albacore. The price variable is the price received for the species caught and the quantity variable is the kilograms of each species caught by individual vessels.
References

AFMA 2011, ETBF Harvest Strategy Simplified (pdf 283 kb), Australian Fisheries Management Authority, Canberra.

—— 2017, Objectives, functions and powers, Australian Fisheries Management Authority, Canberra.


DAFF 2007, Commonwealth Fisheries Harvest Strategy: policy and guidelines (pdf 527kb), Department of Agriculture, Fisheries and Forestry, Canberra.


—— 2008, Maximum economic yield in the Southern and Eastern Scalefish and Shark Fishery, ABARE report to the Fisheries Resources Research Fund, Canberra.

Kompas, T, Che, N, Chu, L & Klaer, N 2012, Transition to MEY goals for the Great Australian Bight Trawl Fishery, FRDC project no. 2009/068, Australian Fisheries Management Authority, Canberra.
