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An index number decomposition of profit change in two Australian fishing sectors

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Index number profit decomposition (INPD)

Decomposes change in vessel level profit into relative contributions of key drivers of profit using index numbers

Key drivers of a fishery profitability

- prices received for outputs
- prices paid for inputs
- vessel level productivity
- fish stock levels

Each index shows the contribution of a variable to a firm's profit relative to the contribution of that variable to some other reference firm's profit

The approach

Profit, price and quantity indexes

A profit index between two firms where *a* is the reference firm

$$\theta^{a,b} \equiv \pi^{b} / \pi^{a}$$

$P^{a,b}$ shows the relative prices of all netputs between firms

$Q^{a,b}$ shows the relative quantities of all netputs between firms

$$\theta^{a,b} \equiv P^{a,b} \cdot Q^{a,b}$$

An “implicit quantity index” can be derived indirectly

$$Q^{a,b} \equiv \theta^{a,b} / P^{a,b}$$

The approach

Productivity index

$$R^{a,b} \equiv Q^{a,b} / K^{a,b}$$

The decomposition

Given that $Q^{a,b} \equiv \theta^{a,b} / P^{a,b}$ and $R^{a,b} \equiv Q^{a,b} / K^{a,b}$ then:

$$R^{a,b} = (\theta^{a,b} / P^{a,b}) / K^{a,b}$$

Rearranging gives the overall profit decomposition:

$$\theta^{a,b} = P^{a,b} . R^{a,b} . K^{a,b}$$

The approach

Including stocks

Redefine the overall profit decomposition as

$$\theta^{a,b} .(S_a / S_b) = P^{a,b}.\ K^{a,b}.\ R^{a,b}.(S_a / S_b)$$

$$\theta s^{a,b} = P^{a,b} .\ K^{a,b}.\ Rs^{a,b}$$

Stock abundance aggregation required in a multispecies fishery to get *S*

The approach

Deriving the aggregated price index

Törnqvist index

$$lnP^{a,b} \equiv \sum_{n=1}^{N} \frac{1}{2}(s_n^b + s_n^a) ln(p_n^b / p_n^a)$$

where $s_n = (p_n y_n) / (\sum p_n y_n)$

$P^{a,b}$ can be decomposed into individual netput price indexes

$$\theta_S^{a,b} = PO^{a,b} . PF^{a,b} . PL^{a,b} . R_S^{a,b} . K^{a,b}$$

The two fishery sectors

Commonwealth trawl sector (CTS)

- Otter trawl sector
- Danish seine sector

Gillnet hook and trap sector (GHTS)

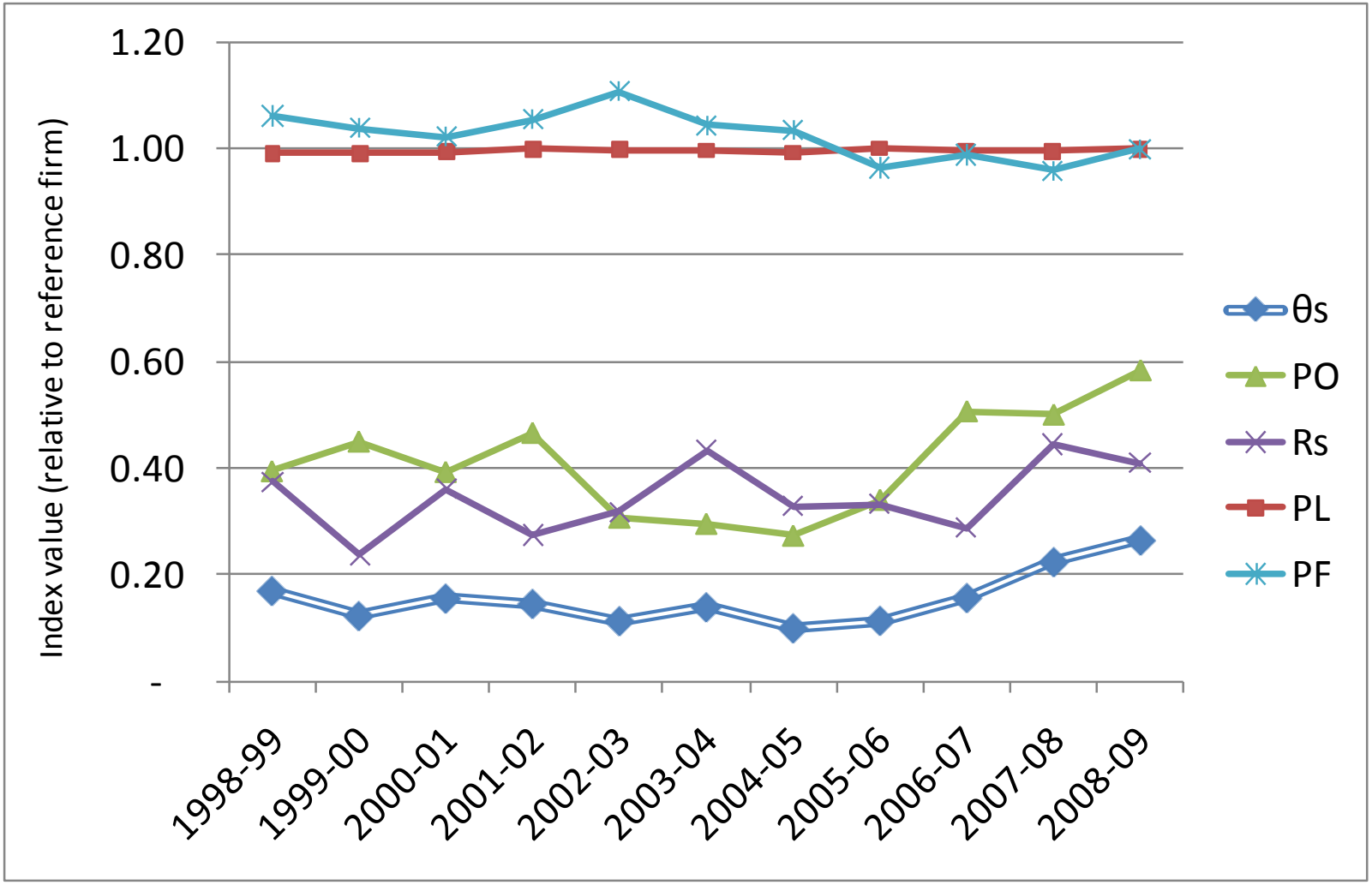
- Gillnet sector

Results: Commonwealth trawl sector

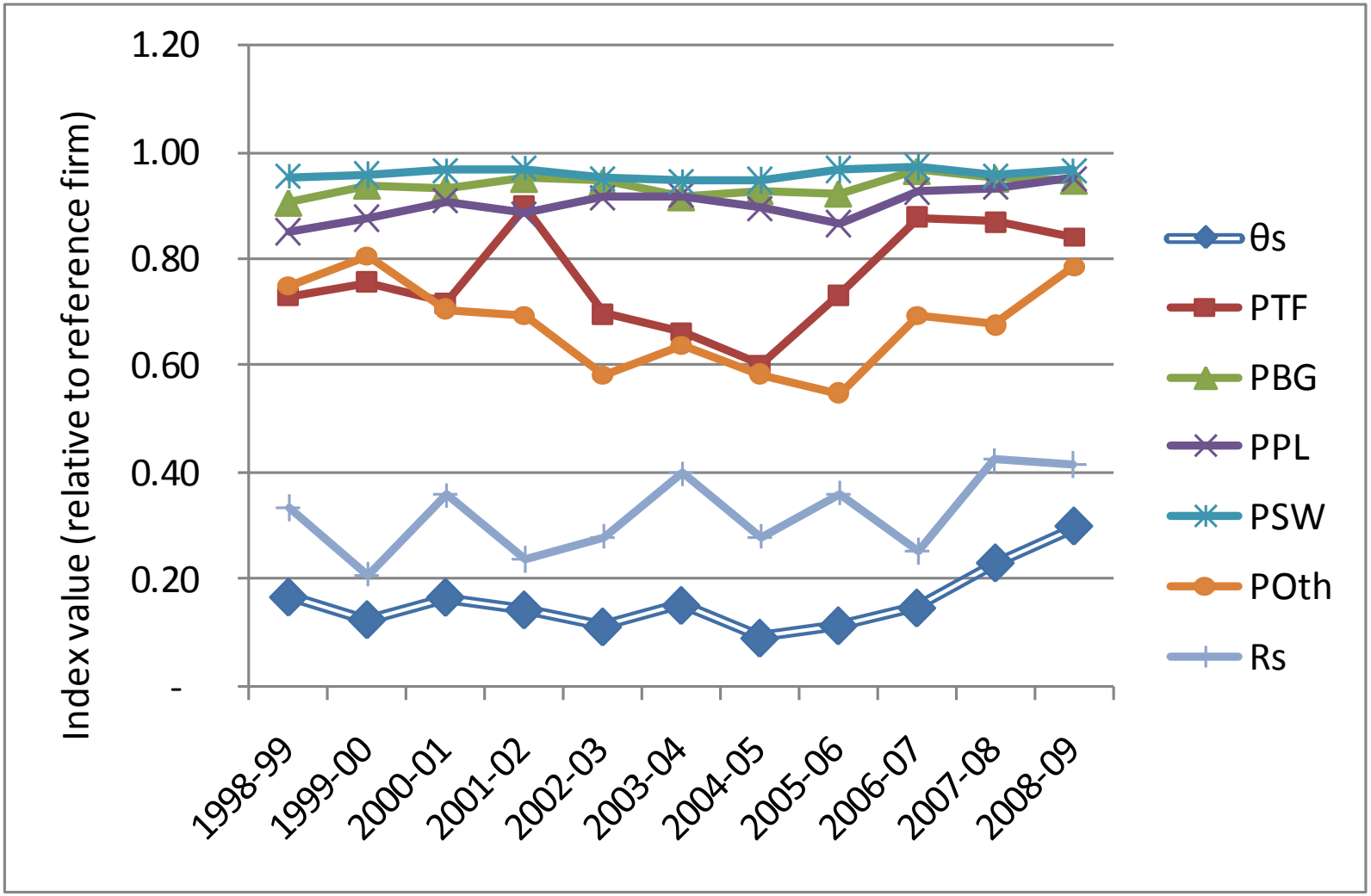
Financial year	No.	θs	θ	P	PO	PL	PF	K	S	Rs
1998-99	30	0.17	0.20	0.42	0.39	0.99	1.06	1.09	1.17	0.37
1999-00	31	0.12	0.20	0.46	0.45	0.99	1.04	1.12	1.64	0.24
2000-01	27	0.16	0.17	0.40	0.39	0.99	1.02	1.08	1.07	0.36
2001-02	31	0.15	0.18	0.49	0.47	1.00	1.06	1.08	1.24	0.27
2002-03	19	0.11	0.10	0.34	0.31	1.00	1.11	1.04	0.93	0.32
2003-04	20	0.14	0.12	0.31	0.30	1.00	1.04	1.04	0.87	0.43
2004-05	22	0.10	0.10	0.28	0.27	0.99	1.03	1.07	0.98	0.33
2005-06	18	0.11	0.12	0.33	0.34	1.00	0.96	1.04	1.03	0.33
2006-07	15	0.16	0.20	0.50	0.51	1.00	0.99	1.08	1.26	0.29
2007-08	13	0.22	0.22	0.48	0.50	1.00	0.96	1.05	1.00	0.44
2008-09	13	0.26	0.26	0.58	0.58	1.00	1.00	1.11	1.00	0.41

If index greater (less) than one, it expands (contracts) the profit ratio

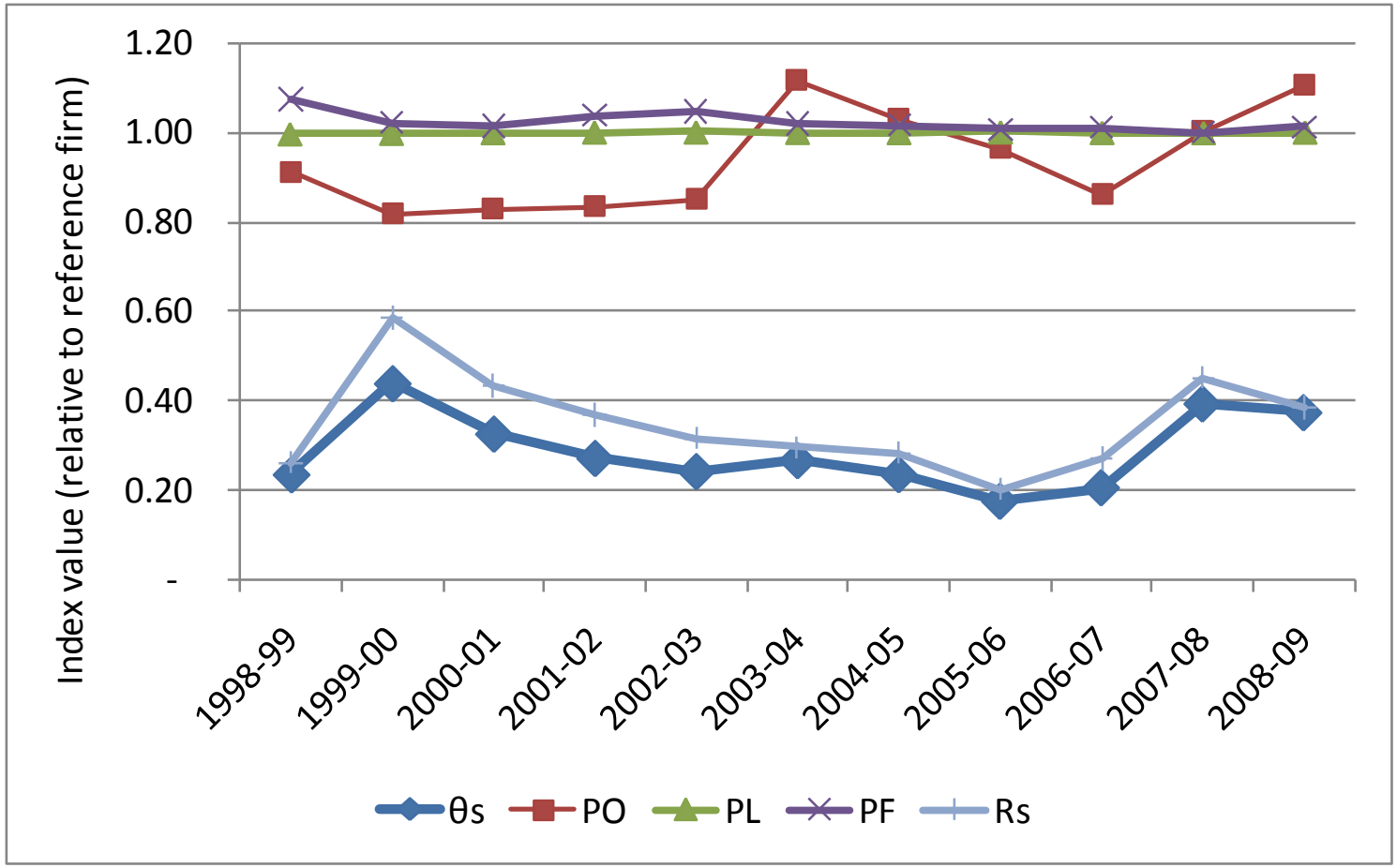
Results: Commonwealth trawl sector (CTS)



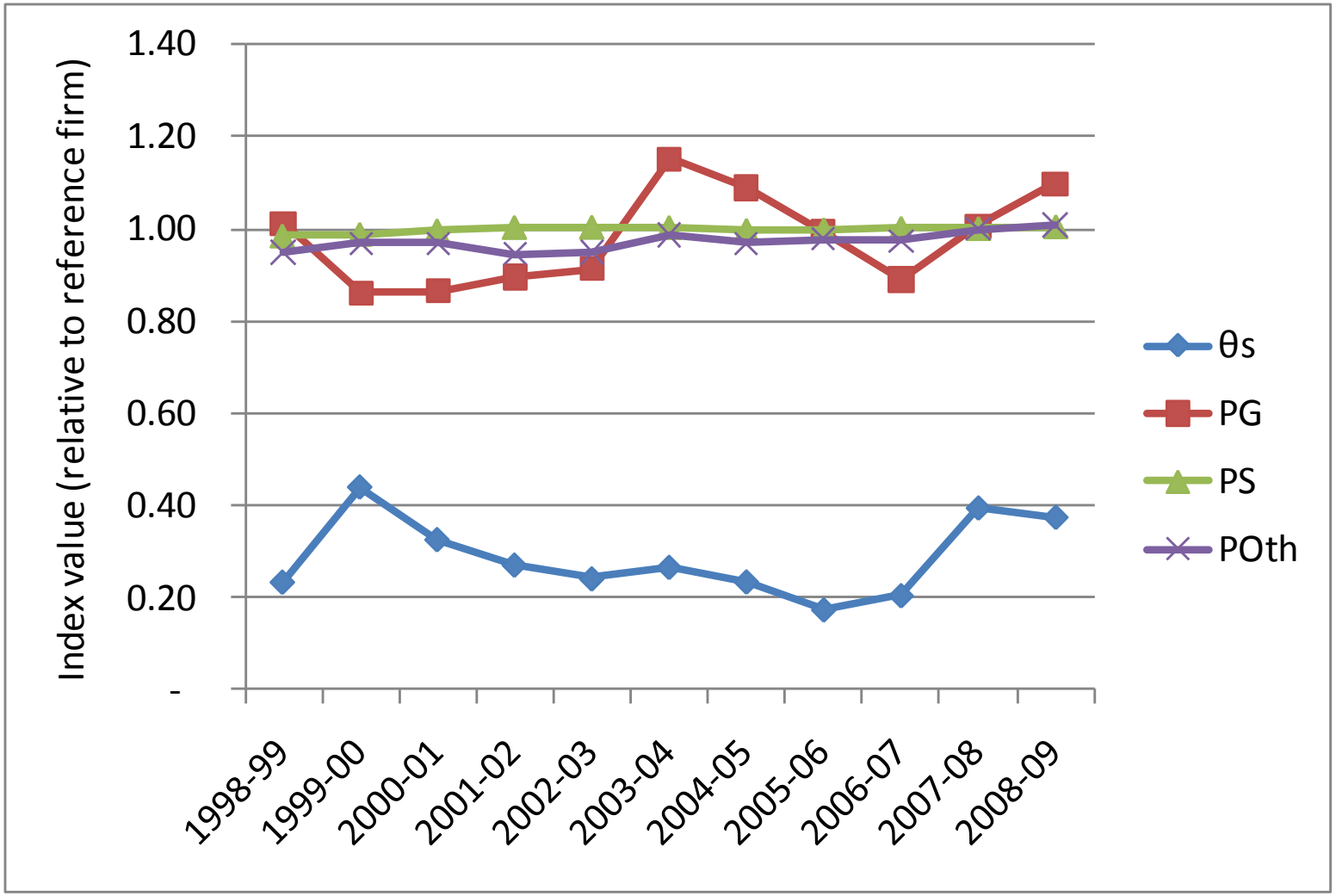
Results: otter trawl sector of CTS



Results: gillnet sector of GHTS



Results: gillnet sector of GHTS



Issues and future work

- Choice of reference firm
- Measuring capital
- Using average prices in the multiple output approach
- Exclusion of other key inputs and costs
- Relevance of stock biomass estimates to vessel performance
- Complexity of approach and interpretation of results

Conclusions

- The two sectors appear to have moved towards rather than away from MEY
- The buyback had an immediate positive effect on stock adjusted productivity
- Fewer vessels competing for the fishery resource
- INPD can assist with the assessment of previous fishery management decisions with regards to MEY
  - Can separate the impacts of external factors versus factors that management can influence

Thank you

Science and economics for decision-makers