



# On the Volatility of Resource Rent Tax Revenue

---

ALEX ROBSON

A MINERALS COUNCIL OF AUSTRALIA **BACKGROUND PAPER**  
JUNE 2012

**Dr Alex Robson** is a Senior Lecturer in Economics at Griffith University, Brisbane. He has written extensively on public policy in Australia. Alex has published in academic journals such as *Economic Theory*, *Pacific Economic Review*, *Australian Competition and Consumer Law Journal*, *Economic Analysis and Policy* and *Agenda*. He is the author of *Law and Markets*, recently published by Palgrave Macmillan. Alex's opinion pieces on economics have been published in *The Australian*, *The Sydney Morning Herald*, *The Courier Mail*, *The Australian Financial Review*, *The Canberra Times* and the *Wall Street Journal Asia*.

The Minerals Council of Australia represents Australia's exploration, mining and minerals processing industry, nationally and internationally, in its contribution to sustainable economic and social development.

The views expressed in this publication are those of the author. This publication is part of the overall program of the MCA, as endorsed by its Board of Directors, but does not necessarily reflect the views of individual members of the Board.

**MINERALS COUNCIL OF AUSTRALIA**

Level 3, 44 Sydney Ave, Forrest ACT 2603  
(PO Box 4497, Kingston ACT Australia 2604)  
P. + 61 2 6233 0600 | F. + 61 2 6233 0699  
W. [www.minerals.org.au](http://www.minerals.org.au) | E. [info@minerals.org.au](mailto:info@minerals.org.au)

# On the Volatility of Resource Rent Tax Revenue

---

ALEX ROBSON\*

A MINERALS COUNCIL OF AUSTRALIA  
**BACKGROUND PAPER**

\* Department of Accounting, Finance and Economics, Griffith University



## Summary

The Australian Government has indicated that it expects revenue from the new Minerals Resource Rent Tax (MRRT) to be volatile. The Petroleum Resource Rent Tax (PRRT) is similar to the MRRT in many important respects; in particular, both taxes are targeted at similar bases (i.e. economic rents). A natural starting point for predicting the likely characteristics of aggregate MRRT revenue is to therefore examine revenue from the PRRT.

This paper shows that the PRRT has been a highly volatile source of revenue. In principle, PRRT revenue volatility may not be a significant problem for budgetary policy and planning if the revenue is negatively correlated with other tax revenues, or if volatile movements can be accurately forecast and incorporated into other revenue and spending decisions.

Unfortunately, PRRT revenue possesses none of these characteristics.

The paper examines the PRRT revenue forecasting record of Australian governments since 1997-98. The results show that forecasts of PRRT revenue have generally been very inaccurate, with forecast errors routinely exceeding 40 per cent of actual PRRT revenue, and sometimes exceeding 100 per cent of actual revenue.

Even if PRRT revenue is difficult to predict, this may not be a significant problem if the forecast errors are uncorrelated (or, even better, negatively correlated) with other revenue forecast errors, so that forecasting mistakes “cancel out” one another. The analysis in this paper shows, however, that this is unfortunately not the case: forecast errors for PRRT revenue are highly positively correlated with overall tax revenue forecasting errors. In other words, the PRRT does not provide much of a revenue forecasting “hedge”. ■



## 1. Introduction

The Australian Government has recently indicated that it expects revenue from the new Minerals Resource Rent Tax (MRRT) to be volatile. For example, in his second reading speech on the MRRT Bill in November 2011, the Assistant Treasurer stated that:

*“We will see volatility in MRRT revenue, particularly as prices and investment plans change, but that is good for the nation and for the industry.”<sup>1</sup>*

Research by the Australian Parliamentary Library has noted that:

*“The revenue derived from the MRRT will be heavily dependent upon (Australian dollar) commodity prices. In particular, movements in exchange rates and world prices for iron ore and coal will be fundamental in determining the revenue raised by the MRRT. The revenue flows will be highly procyclical. That is, MRRT revenues will vary significantly with nominal GDP growth. In addition, the design features of the tax in terms of how mining profits and losses are defined and deductibility of certain types of expenditures mean that there will be significant lags in MRRT collections in the event of significant rises or falls in commodity prices. This is similar to the way in which company tax revenues fluctuate with nominal GDP growth. In short, significant volatility will be a feature of the tax.”<sup>2</sup>*

The MRRT and Australia’s Petroleum Resource Rent Tax (PRRT) share a number of similar features; in particular, both taxes are intended to tax pure economic profits or rents. Whilst there are some important differences between the two tax bases<sup>3</sup>, a natural starting point for predicting some of the likely characteristics of aggregate MRRT revenue is to examine the PRRT.

The PRRT was introduced in the *Petroleum Resource Rent Tax Assessment Act 1987*, with

the tax applying to all oil and gas projects seawards of the outer limits of the territorial sea, with the exception of North West Shelf projects (which are subject to excise).<sup>4</sup> This paper examines the volatility of tax revenue that has been collected from the PRRT since its introduction in the late 1980s and is structured as follows. Section 2 computes some estimates of PRRT revenue volatility, and shows that the PRRT has been a highly unstable source of revenue. The analysis also shows that changes in PRRT revenue are highly positively correlated with revenues from the rest of Australia’s tax base, meaning that PRRT revenues have a high degree of systematic risk.

In principle, this revenue volatility may not be a significant problem for budgetary policy and planning if the volatile movements can be accurately predicted and incorporated into other revenue and spending decisions. Section 3 therefore examines the PRRT revenue forecasting record of successive Australian governments since 1997-98. The results show that Budget forecasts of PRRT revenue have generally been very inaccurate, with forecast errors routinely exceeding 40 per cent of actual PRRT revenue, and sometimes exceeding 100 per cent of actual revenue.

Even if PRRT revenue forecast errors are large, the effects may be mitigated if these errors are uncorrelated (or, even better, negatively correlated) with other tax revenue forecasting errors, so that the forecasting mistakes tend to “cancel out” one another. Section 3 also shows, however, that this is unfortunately not the case: forecast errors for PRRT revenue are highly positively correlated with overall tax revenue forecasting errors. In other words, the PRRT does not provide much of a forecasting “hedge”. Section 4 of the paper concludes by discussing some of the implications of the paper’s main results for fiscal policy.

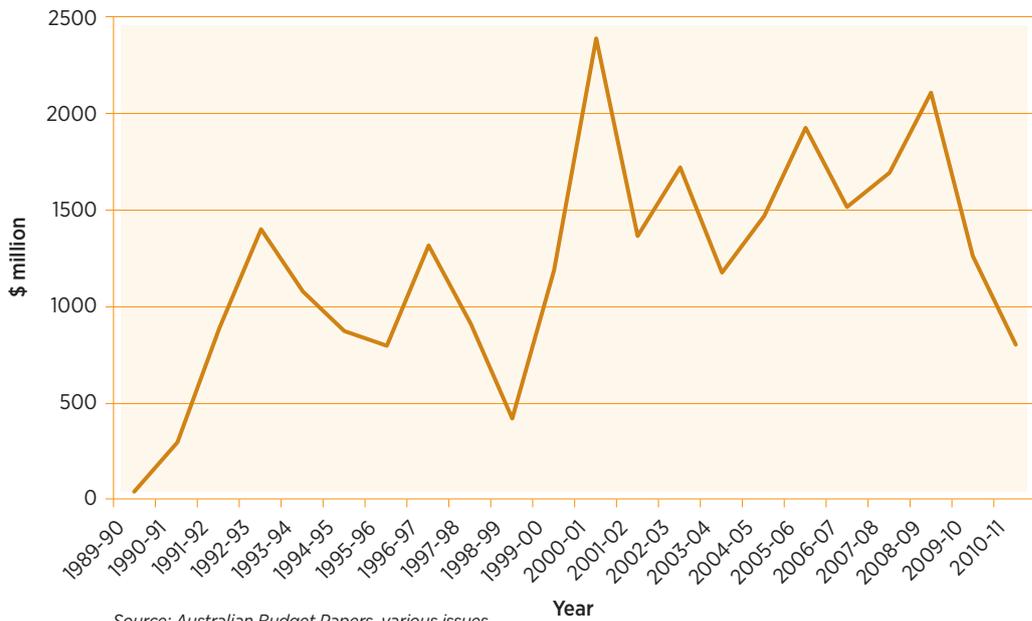
## 2. How Volatile is PRRT Revenue?

The PRRT is a cash flow tax which is levied at a constant percentage of 40 per cent on annual positive net cash flows,<sup>5</sup> with deductions allowed for certain costs, and with negative cash flows able to be carried forward at an uplift rate. Since 1989-90, governments have collected \$26.5 billion (in nominal terms) in revenue from the PRRT. Annual revenue

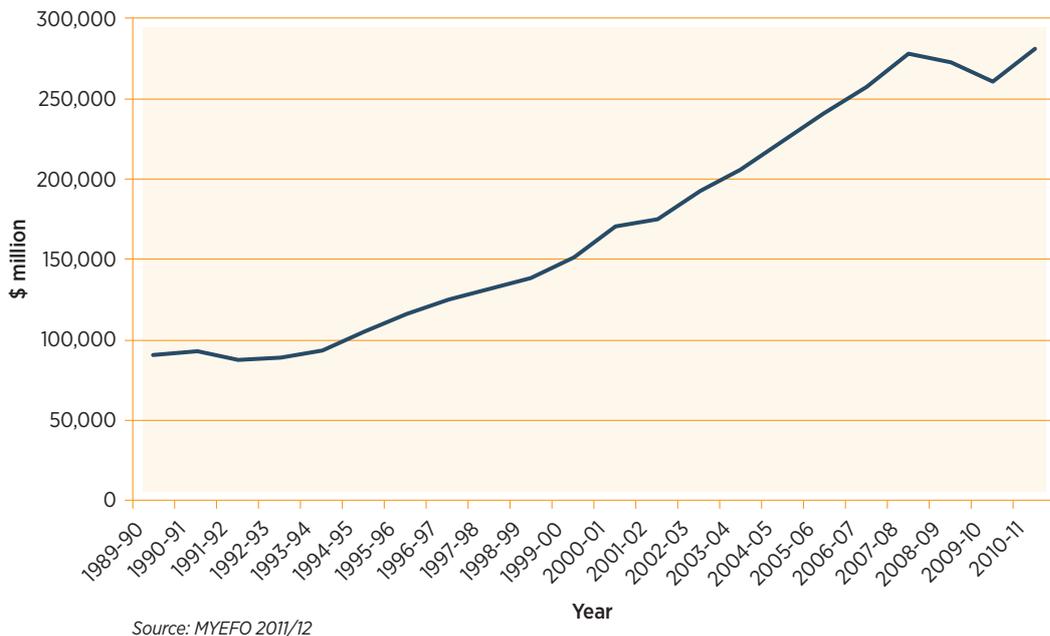
collections since 1989-90 are shown in Figure 1.<sup>6</sup> In nominal terms, PRRT revenue reached a peak in 2000-01 of \$2.38 billion, but has fallen away relatively sharply in recent years.

Compared with aggregate tax revenue (see Figure 2), the PRRT has tended to produce a highly volatile revenue stream. This volatility is investigated in more detail below.

**Figure 1. Nominal PRRT Revenue, 1989-90 to 2010-11**



**Figure 2. Nominal Aggregate Tax Revenue, 1989-90 to 2010-11**



## 2.1. PRRT Revenue Volatility

A standard measure of the volatility of a time series is its variance, which is a measure of the spread of the data around its mean. However, if there is a time trend in the data, the variance can be an inappropriate and misleading measure of volatility. A more meaningful way of measuring volatility is to remove whatever trend there is in the series and examine the volatility of the percentage deviations around the trend.

If this method is used, the measure of volatility obviously depends on the method used to estimate the trend. To estimate and compare the volatility of PRRT revenues and non-PRRT revenues, we apply four different detrending methods:

- Annual percentage changes (stochastic trend);
- Deviations from a linear trend;
- Deviations from an exponential (constant growth rate) trend;
- Deviations from a smoothed trend using the Hodrick-Prescott filter<sup>7</sup>

The estimates of revenue volatility are shown in Table 1, and demonstrate that PRRT revenue is far more unstable than other sources of tax revenue taken as a whole. The measures of volatility for PRRT revenue are in some instances three orders of magnitude larger than volatility of aggregate revenue.

There are two likely reasons for this result:

- First, as we show below, the PRRT is levied on a relatively volatile tax base.
- Second, even if the individual tax revenue elements in the rest of Australia's tax base are volatile on their own, to the extent that they are negatively correlated with each other, this leads to smoother revenue overall. In other words, even though individual elements in the tax base may be volatile on their own, large up and down movements may offset each other, and in the aggregate a relatively smooth revenue series is produced. This raises the question of whether revenues from the PRRT offset other tax revenues – this is investigated below.

As mentioned above, the PRRT is levied on a relatively volatile tax base. More specifically, as a result of the broad design features outlined earlier, aggregate PRRT revenue will depend on a number of key parameters:

- the tax rate;
- the determinants of the tax base (i.e. world prices and the exchange rate, production volumes, and costs); and
- policy changes to the structure, mechanics, administration and enforcement of the PRRT.<sup>8</sup>

Table 1. **Statistical Measures of Volatility of PRRT and Other Tax Revenue, 1989-90 to 2010-11**

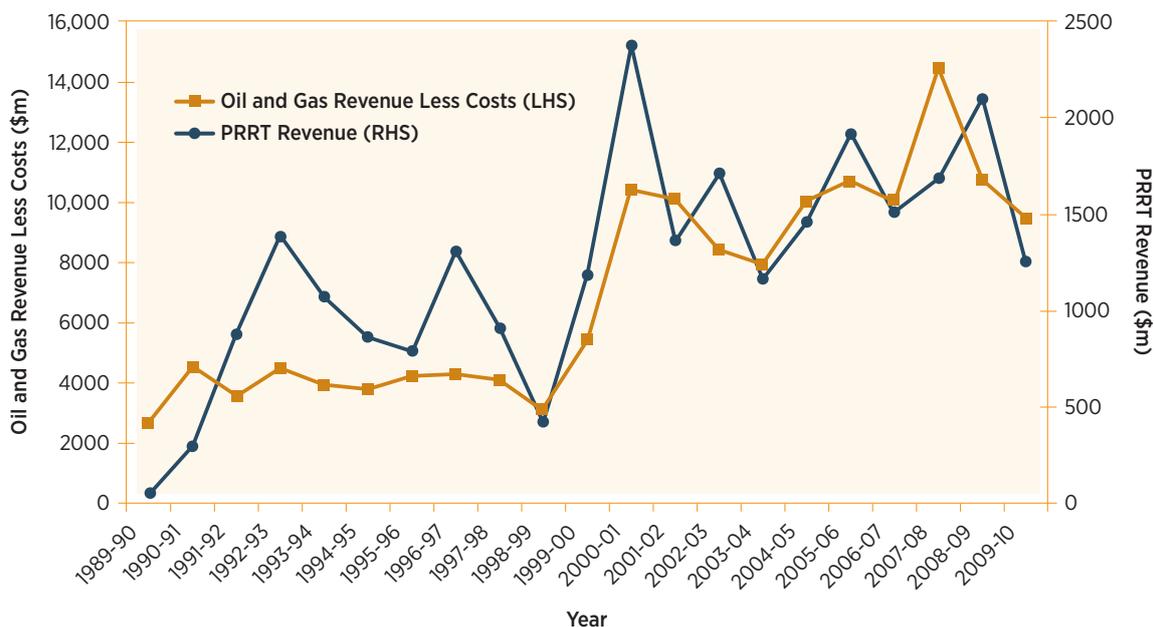
	PRRT Revenue	Other Tax Revenue
<b>Variance of Annual Percentage Changes</b>	2.063	0.003
<b>Variance of Percentage Deviations from Linear Trend</b>	0.171	0.021
<b>Variance of Percentage Deviations from Exponential Trend</b>	0.327	0.005
<b>Variance of Percentage Deviations from HP-filtered Trend (<math>\lambda=100</math>)</b>	0.156	0.004

Note: "Other Tax Revenue" is total tax revenue less PRRT revenue

For the PRRT, Figure 3 shows that at the aggregate level there is a close relationship between aggregate tax revenues and the difference between industry oil and gas revenues and total costs, which is a proxy for the PRRT tax base. Due to the volatility that is inherent in prices, exchange rates, volumes and costs in global oil and gas markets, these individual determinants of PRRT revenue also tend to be volatile.

Appendix 1 illustrates these propositions more formally, and demonstrates that for a pure profits tax [i.e. which receives negative revenues when firms incur losses; this would have been the case under the Government's original Resource Super Profits Tax (RSPT) proposal], the variance of tax revenue depends on the square of the tax rate, the variance of sales revenue, the variance of allowable costs, and the covariance between costs and sales revenue.

**Figure 3. Nominal PRRT Revenue and Oil and Gas Sales Revenue less Costs, 1989-90 to 2009-10**



Source: Commonwealth Budget Papers; APPEA; author's calculations

## 2.2. Quantifying the Economic Cost of Revenue Volatility: The PRRT Revenue's Systematic Risk

The previous section showed that PRRT revenues have been highly volatile. How should this instability be quantified in economic terms?

A key principle in economics is that a more volatile stream of revenues will be less valuable than a more stable cash flow having the same expected present value. In other words, volatility usually has a cost. Appendix 2 demonstrates that this principle also holds for governments which are at the tax design stage, even if they are risk neutral and are willing to fix tax rates forever and allow highly volatile revenue streams shift their budgets into large deficits and surpluses.

In addition, in a post Global Financial Crisis world, governments are likely to have become more risk averse and so prefer more stable revenue streams because of the additional costs associated with ever greater budget deficits and public debt accumulation.

These arguments only apply to overall revenues. For governments which have multiple sources of tax revenue, the instability of revenues from a single individual tax (such as the PRRT or MRRT) may not be a problem if they use a range of taxes and diversify their revenue risk, in much the same way that an investor would seek to invest in a range of assets to diversify risk.

In such circumstances, even if the PRRT and other resource rent taxes were volatile, as long as they provided a revenue stream that was countercyclical, they could serve as a “hedge” for governments during economic downturns. If this were the case, these tax revenues would be extremely valuable relative to other tax revenues despite their volatility.

Unfortunately, as discussed above, revenue from the MRRT is expected to be procyclical, rather than countercyclical. Ergas, Harrison and Pincus (2010) make the important point that because revenue streams from resource rent taxes are risky and are likely to be procyclical, this makes them less valuable to governments than other, less volatile revenue sources which provide the same level of revenue on average.<sup>9</sup>

In other words, the present value of the revenues from resource rent taxes such as the MRRT and PRRT should be discounted at a relatively high discount rate (i.e. higher than the government bond rate). Since the discount rate should include a risk premium that reflects the volatility of the revenue stream, applying this high discount rate will reduce the revenue stream’s present value. This risk premium needs to be taken into account in assessing the desirability of resource rent taxes.

A general principle in financial economics and risk management is that it is not the overall volatility of a series of cash flows that matters, but the extent to which the cash flows add to (or reduce) the volatility of a well-diversified portfolio. In other words, investors should only be compensated for the *systematic* risk in a series of cash flows; non-systematic risk can be diversified away.

For governments, it is only the *systematic* risk of PRRT revenue – that part which is positively correlated with other tax revenue – which is relevant for calculating the risk premium for the PRRT revenue. PRRT revenues have tended to be procyclical over the last 15 years. Table 2 uses each of the four measures of changes in revenue that were used in Table 1 to examine the correlation between PRRT revenue and other revenues since 1997-98. The second column computes the “revenue beta” of PRRT revenue – the estimated slope coefficient in a regression of PRRT revenue on other tax revenue. All of the estimates in Table 2 suggest the same conclusion: not only is PRRT revenue highly volatile; but changes in PRRT revenue tend to be positively related to changes in revenue from the rest of Australia’s tax base. This means that from the government’s point of view, PRRT revenue is likely to be worth far less than its expected value.

**Table 2. Correlation Between PRRT and Other Tax Revenue, 1997-98 to 2010-11**

	<b>Correlation Coefficient Between Changes in PRRT Revenue and Changes Other Tax Revenue</b>	<b>PRRT “Revenue Beta”</b>
<b>Annual Percentage Changes</b>	0.46	6.51
<b>Deviations from Linear Trend</b>	0.38	4.53
<b>Deviations from Exponential Trend</b>	0.49	3.93
<b>Deviations from HP-filtered Trend (<math>\lambda=100</math>)</b>	0.47	6.89

### 3. The Predictability of PRRT Revenue

As a result of the PRRT's design features (discussed above), revenue from this tax not only tends to be volatile – it also tends to be difficult to predict accurately at the aggregate level. This has been recognised as a problem by Government agencies for some time. For example, a recent Australian National Audit Office (ANAO) report noted that:

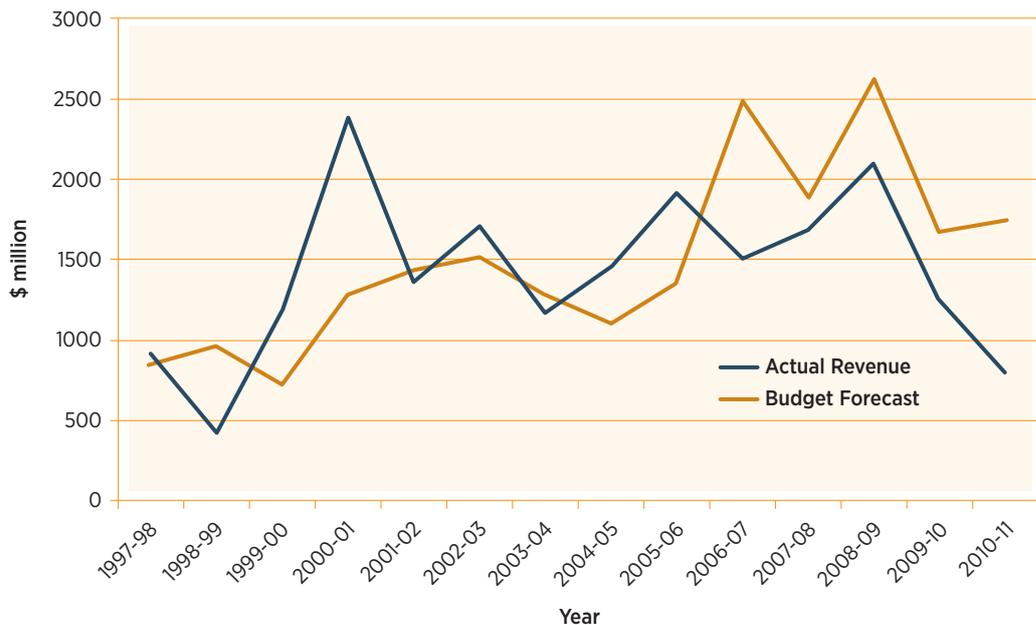
*“Largely reflecting the volatility of oil prices, exchange rates and resource costs, actual PRRT revenue varied from official forecasts by over 30 per cent in three of the five years from 2003–04 to 2007–08, and the average error in forecasts over this period was 27 per cent.”<sup>10</sup>*

This section extends this ANAO analysis and examines the PRRT revenue forecasting record of governments since 1997–98. For each year, we compare Budget forecasts of PRRT revenues (which are made roughly a year in advance) with actual revenues from that year. The data in nominal dollar terms is shown in Figure 4.

The data shows that during the recent mining boom, governments have tended to overestimate PRRT revenue by relatively large dollar amounts.

Figure 5 plots the difference between forecast PRRT revenue and actual PRRT revenue in dollar terms – the data is the difference between the two series in Figure 4. The underlying data is reproduced in Table 3.

Figure 4. PRRT Revenue - Actual Versus Budget Forecasts, 1997-98 to 2010-11



Source: Budget Papers, various years

Figure 5. PRRT Revenue Forecast Errors (Forecast minus Actual), \$million, 1997-98 to 2010-11



Source: Budget Papers, various years; author's calculations

Table 3. PRRT Revenue – Budget Forecast, Actual and Difference, 1997-98 to 2010-11

Year	Budget Forecast (\$m)	Actual (\$m)	Difference (\$m)
1997-98	850	907	-57
1998-99	960	419	541
1999-00	720	1184	-464
2000-01	1280	2379	-1099
2001-02	1430	1361	69
2002-03	1520	1712	-192
2003-04	1280	1168	112
2004-05	1100	1459	-359
2005-06	1350	1917	-567
2006-07	2490	1510	980
2007-08	1890	1686	204
2008-09	2630	2099	531
2009-10	1680	1251	429
2010-11	1740	806	934

Source: Budget Papers, various years

A better way to illustrate the size of the forecasting errors is to apply the ANAO’s method and scale the errors by actual revenues. That is, we apply a standard measure of forecasting accuracy – the percentage error, which is the size of the forecast error divided by actual outcomes.

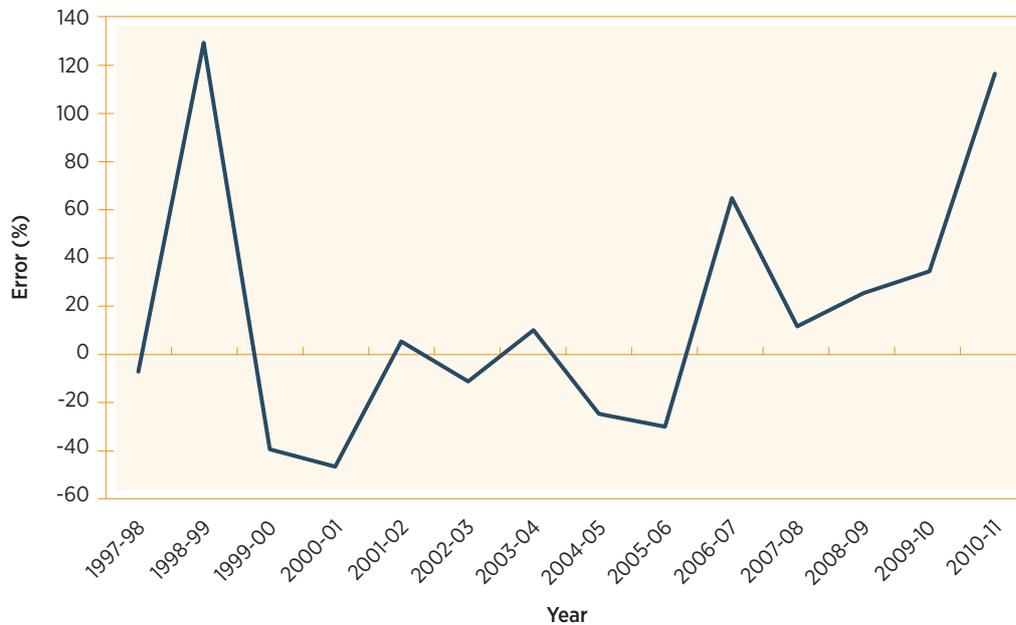
Figure 6 plots this measure for PRRT revenue forecasts. The results show that forecast errors of plus or minus 40 per cent of actual revenue have been relatively common since 1997-98, with errors of more than 100 per cent of actual revenue not uncommon.

Even though PRRT revenue forecast errors

are large, the effects may be mitigated if these errors are uncorrelated (or, even better, negatively correlated) with other tax revenue forecasting errors, so that the forecasting mistakes tend to “cancel out” one another. Figure 7 below shows, however, that this is unfortunately not the case: forecast errors for PRRT revenue are positively correlated with overall tax revenue forecasting errors. In other words, PRRT forecasting errors do not provide much of a forecasting “hedge”.

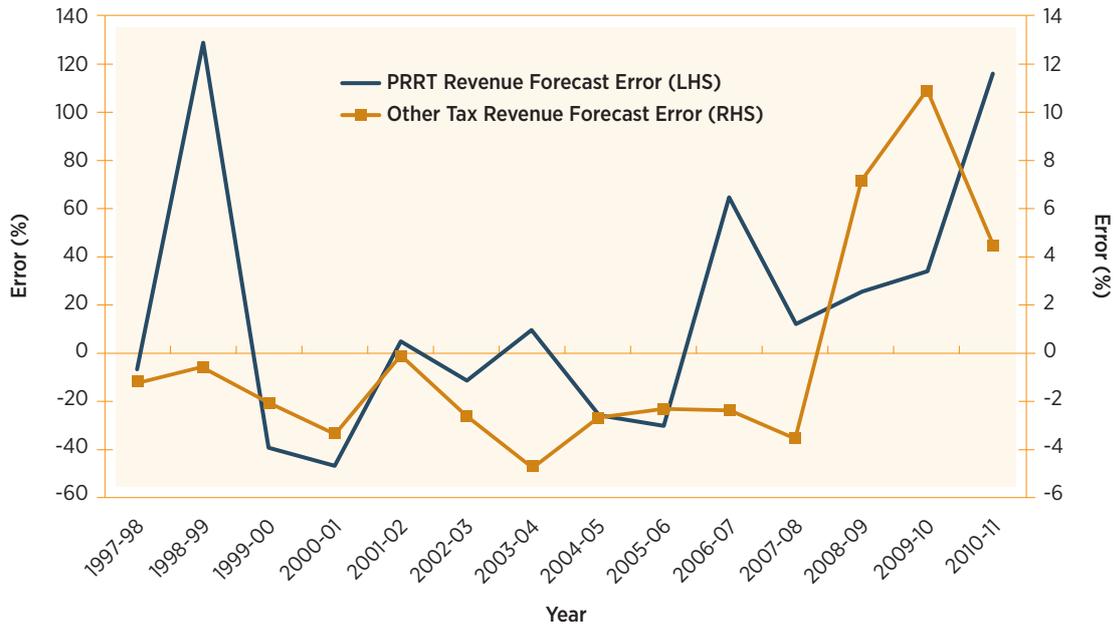
Figure 7 also illustrates the sheer size of the percentage errors in the PRRT forecasts: they are an order of magnitude larger than the forecast errors for all other tax revenue.

**Figure 6. PRRT Revenue Percentage Forecast Errors, 1997-98 to 2010-11**



Source: Budget Papers, various years; author’s calculations

Figure 7. PRRT and Total Tax Revenue Percentage Forecast Errors, 1997-98 to 2010-11



Source: Budget Papers, various years; author's calculations

#### 4. Conclusion

Because of the similarities between the two taxes, a natural starting point for examining the likely characteristics of the volatility of aggregate MRRT revenue and the consequences of this volatility is to examine revenue from the PRRT.

The analysis in this paper has shown that PRRT revenue is highly volatile and difficult to predict. The volatility and unpredictability are due to uncertainty regarding resource prices, exchange rates, aggregate production volumes, and aggregate allowable costs under the PRRT regime. PRRT revenue has tended to vary positively with other revenues, and forecast errors have also tended to be positively correlated with overall tax revenue

forecasting errors. These two sets of facts mean that not only is the PRRT a highly unstable source of revenue – it adds to the volatility of aggregate tax revenues, and also magnifies the difficulties associated with inaccurate Budget revenue forecasts at the aggregate level.

The PRRT and the MRRT share a number of similar broad design features. Like the MRRT, the PRRT is targeted at resource rents. And, as with the MRRT, under the PRRT negative cash flows are carried forward with interest (the uplift rate). It is therefore not unreasonable to expect that revenues from the MRRT will share at least some of the characteristics of PRRT revenue that have been identified in this paper. ■



# Appendices

## Appendix 1.

### The Volatility of Revenue from Profits-Based Taxes

This appendix examines the volatility of revenue from profits-based taxes. Let assessable profits be equal to

$$\Pi = PQ - C(Q)$$

where P is the resource price in Australian dollar terms (which in turn is affected by changes in the nominal exchange rate), Q is the aggregate volume of production, and C(Q) is allowable costs. Tax revenue is the tax rate multiplied by assessable profits:

$$R = t\Pi = t[PQ - c(Q)]$$

The variance of tax revenue is then equal to:

$$\sigma_R^2 = t^2[\sigma_{PQ}^2 + \sigma_{C(Q)}^2 - 2\sigma_{PQ,C(Q)}]$$

By the delta method<sup>11</sup>, the variance of total costs is approximately equal to:

$$\sigma_{C(Q)} \approx [C'(\mu_Q)]^2 \sigma_Q^2$$

and so the volatility of tax revenues is approximately equal to:

$$\sigma_R^2 \approx t^2 \{ \sigma_{PQ}^2 + [C'(\mu_Q)]^2 \sigma_Q^2 - 2\sigma_{PQ,C(Q)} \}$$

The variance of tax revenue is equal to the square of the tax rate, multiplied by the sum of three components reflecting the volatility of revenue, costs, and the covariance between revenue and costs. If market revenue and costs are positively correlated, then this will lower the overall volatility of tax revenues. However, if they are negatively correlated, then volatility will be higher. If the market is characterised by demand shocks, then revenue and costs will tend to move together. However, if the market is hit by supply-side shocks, then revenue and costs could be negatively correlated, increasing the volatility of tax revenues.

Assuming constant marginal costs, an alternative decomposition is to compute the variance of the logarithm of tax revenues. This is:

$$\begin{aligned} \sigma_r^2 &= Var \{ \log [t(P - C)Q] \} = Var \{ \log [(p - c)q] \} \\ &= \sigma_{p-c}^2 + \sigma_q^2 + 2\sigma_{(p-c),q} \end{aligned}$$

where lowercase letters represent natural logarithms. ■

## Appendix 2.

### Why should Governments Prefer Less Uncertain Streams of Tax Revenue?

Barro (1979) shows that governments which run an optimal debt policy should, having chosen tax rates which will balance their budgets in present value terms, be indifferent between revenue streams that are certain, on the one hand, or highly volatile on the other. The intuition behind his result is that if unlimited borrowing and lending is possible, then the optimal fiscal strategy is to fix the tax rate so that it is sufficiently high to satisfy the government's intertemporal budget constraint, and then allow the budget to move into deficit and surplus over time. Since deadweight losses are a convex function of tax rates, fixing the tax rate in this way (rather than shifting it around) will minimise the present value of the deadweight loss.

However, matters are quite different at the tax design stage, where the government is operating under incomplete information and the present value of future revenue is unknown. This Appendix shows that governments which lack complete information and seek to maximise the expected efficiency of the tax system should prefer less volatile or uncertain revenue streams to those that are more volatile.

To understand this result, consider the following simple model. Suppose that a government is at the stage where it is considering its choice of taxes in order to fund a given path of future spending. The government does not have to balance its budget in every period, but it must balance its budget in net present value terms. Let the present value of future spending be  $\tilde{G}$ .

Future tax revenue can come from two sources: a resource rent tax (which, for convenience, we assume to be non-distortionary), and a distortionary, specific tax on purchases of another good, which is levied at a rate of  $t$ .

At the tax design stage, the present value of the revenue from the resource rent tax is unknown. The government is operating under incomplete information and views the revenue as a random variable  $\tilde{X}$ , with mean  $\mu$  and variance  $\sigma^2$ .

Once the revenue from the resource rent tax is known, the efficient policy is, in accordance with Barro (1979) to choose a fixed distortionary tax rate  $t$  at every point in the future. The key constraint here is that the government operates under incomplete information, and this distortionary tax rate cannot be chosen today, but must be chosen after the revenue from the resource rent tax is known.

What is the expected deadweight loss of such a tax system? The government's intertemporal budget constraint is:

$$\tilde{G} \equiv \sum_{t=1}^{\infty} \frac{G_t}{(1+r)^t} = \sum_{t=1}^{\infty} \frac{X_t}{(1+r)^t} + \frac{tQ}{r} \equiv \tilde{X} + \frac{tQ}{r}$$

where  $\tilde{G}$  is the present value of government spending (and required revenue),  $\tilde{X}$  is the present value of revenue from the resource rent tax,  $t$  is the distortionary specific tax rate in the other market, and  $Q$  is the quantity in this market. Assume that the market is perfectly competitive.

To illustrate the main proposition, let us assume that marginal cost in this market is constant and equal to  $c$ , and that the demand curve is linear, with an intercept of  $a$ . Then quantity demanded in the presence of the tax is  $Q=a-c-t$ , and so we must have:

$$\tilde{G} - \tilde{X} = \frac{t(a-c-t)}{r}$$

Manipulating this expression yields:

$$t^2 + (c-a)t + r(\tilde{G} - \tilde{X}) = 0$$

and solving for  $t$  yields:

$$t = \frac{a-c - \sqrt{(a-c)^2 - 4r(\tilde{G} - \tilde{X})}}{2}$$

The required distortional tax rate is increasing in  $\tilde{G}$  and decreasing in  $\tilde{X}$ . The deadweight loss of the distortional tax is simply equal to  $1/2 t^2$ , and so:

$$DWL(\tilde{X}) = \frac{1}{2} \left( \frac{a-c - \sqrt{(a-c)^2 - 4r(\tilde{G} - \tilde{X})}}{2} \right)^2$$

It is straightforward to show that this welfare loss is a decreasing, convex function of  $\tilde{X}$ . Hence, as a result of Jensen's inequality, we get the following proposition:

**Proposition:** A mean preserving spread of  $\tilde{X}$  (i.e greater uncertainty around the present value of revenue from the resource rent tax, but with the same expected present value) results in a higher expected deadweight loss. In other words, a government seeking to minimise the expected deadweight loss of the tax system should prefer less volatile or uncertain resource rent tax revenues to those that are more volatile or uncertain.

The intuition for this result within Barro's framework is that at the tax design stage, the government is effectively in a world with a single period: it knows that although it does not have to balance its budget at all points in the future, it must do so in present value terms. But the government is uncertain about the size of the present value of revenue from the resource rent tax. There is a possibility that the present value of the revenue could be low, in which case the distortional tax will need to be high, and the deadweight loss will therefore also be high. In expected terms, the deadweight loss of the tax system will be lower if there is less uncertainty surrounding the present value of the resource tax revenue. ■

## References

Barro, R. (1979) "On the Determination of the Public Debt," *Journal of Political Economy*, 87(5): 940-971.

## Endnotes

- <sup>1</sup> See <http://ministers.treasury.gov.au/DisplayDocs.aspx?doc=speeches/2011/036.htm&pageID=005&min=brsa&Year=&DocType=>
- <sup>2</sup> [http://www.aph.gov.au/About\\_Parliament/Parliamentary\\_Departments/Parliamentary\\_Library/pubs/BN/2011-2012/MRRT#\\_Toc309898050](http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/BN/2011-2012/MRRT#_Toc309898050)
- <sup>3</sup> There are at least two potentially important differences, relating to (a) short term price volatility and (b) the treatment of State-based royalties. Historically, iron ore and coal prices have tended to be negotiated on a relatively infrequent basis (for example, annual or quarterly). However, recently there has been a trend towards shorter term (i.e. spot market) pricing arrangements, particularly for iron ore. In any case, annual or quarterly pricing tends to be closely linked to developments in the spot market. Under the MRRT (but not the PRRT), State-based resource royalties (which are typically levied on an *ad-valorem* basis and are a relatively volatile source of revenue for the States) are effectively subtracted from the MRRT tax base. This will likely add to the volatility of MRRT revenue.
- <sup>4</sup> See <http://www.appea.com.au/policy/tax-a-commercial/petroleum-resource-rent-tax.html>. The PRRT did not initially apply to Bass Strait projects, but these were brought into the PRRT regime in 1990-91. The Government has recently extended the PRRT to cover both onshore and offshore oil and gas projects.
- <sup>5</sup> See the AFTS Review, Volume 1, page 221.
- <sup>6</sup> PRRT revenue is reported in both accrual and cash terms in the Budget papers. This paper uses the cash revenue figures.
- <sup>7</sup> Hodrick, R. and Prescott, E. "Postwar US Business Cycles: An Empirical Investigation" *Journal of Money, Credit and Banking*, 29: 1 (February 1997), 1-16 argue that economic variables can be represented by the sum of a long run or trend component that varies smoothly (but not exponentially), and a cyclical component which measures deviations around this smooth, varying long run trend. Their detrending method – known as the Hodrick-Prescott (HP) filter – is ubiquitous in modern macroeconomics. The smoothed trend was computed in Excel using Kurt Annen's add-in program. This program can be downloaded at [http://www.web-reg.de/hp\\_addin.html](http://www.web-reg.de/hp_addin.html). As is standard in the literature for annual data, we use a value of 100 for the smoothing parameter ( $\lambda$ ) in the HP filter.
- <sup>8</sup> There have been some significant changes to the PRRT since it was first implemented. A history of these changes can be found at <http://www.ret.gov.au/resources/enhancing/taxation/prrt/Pages/TheHistoryofPetroleumResourceRentTax%28PRRT%29.aspx>.
- <sup>9</sup> Ergas, H., Harrison, M. & Pincus, J. (2010) "Some Economics of Mining Taxation," *Economic Papers of the Economic Society of Australia*, 29 (4), 369-389.
- <sup>10</sup> See page 16 of ANAO Audit Report No.33 2008-09 *Administration of the Petroleum Resource Rent Tax*. [http://www.anao.gov.au/-/media/Uploads/Documents/2008%2009\\_audit\\_report\\_33.pdf](http://www.anao.gov.au/-/media/Uploads/Documents/2008%2009_audit_report_33.pdf)
- <sup>11</sup> The delta method states that if  $X$  is a random variable with mean  $\mu$  and variance  $\sigma^2$ , and  $f$  is a continuously differentiable function of  $X$  with first derivative  $f'()$ , then the variance of  $f(X)$  can be approximated by  $[f'(\mu)]^2\sigma^2$







**MINERALS COUNCIL OF AUSTRALIA**

Level 3, 44 Sydney Ave, Forrest ACT 2603

PO Box 4497, Kingston ACT Australia 2604

P. + 61 2 6233 0600 | F. + 61 2 6233 0699

w. [www.minerals.org.au](http://www.minerals.org.au) | E. [info@minerals.org.au](mailto:info@minerals.org.au)