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Mining booms and government budgets*

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The different time paths of effects of a mining boom driven by an increase in demand or by an outward shift of supply on the revenues and expenditures of the Australian Commonwealth and State Governments are described using a partial equilibrium model. Theoretical arguments to replace the present system of royalties with one of the different forms of economic rent tax and to increase the average revenue collected are presented. Some of the practical challenges to achieve more efficient special taxation of mineral and energy resources are reviewed. In the Australian context, it is argued that the case for placing the windfall revenue gains of a mining boom into a sovereign wealth fund rather than the normal budget processes is not compelling.

Key words: mineral taxation, mining boom, sovereign wealth fund.

1. Introduction

Windfall benefits from mining and energy commodity booms are partly shared as increases in government revenues, but they also require increases in government outlays. In Australia, both the Commonwealth and the State (and Territory) Government budgets are affected. Mining booms[1] can be driven by a demand shift, such as the contemporary rapid economic growth of China, India and other developing countries, a supply shift reflecting successful exploration and R&D lowering costs, or a combination. The response of product prices, quantities and incomes and then the effects on budget revenue and expenditure differ with the different source of mining boom. It is important also to trace the time path of effects of a mining boom on government budgets given the often long lead times between investments in exploration and in mine and infrastructure development before production increases. Using Australia as a case study, this article describes the time path links from demand side and supply side driven mining booms to Commonwealth and State Government revenues and outlays. It then evaluates some policy options affecting the form of and magnitudes of the special taxation of mining, and it reviews options for governments to manage the revenue windfall from a mining boom.

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[1] Throughout the article, the mining industry is taken to include energy and minerals.

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Mining booms identified as significant jumps in investment and output with flow-on effects to the rest of the economy have been important features of the Australian economy since European settlement. Battellino (2010, p. 63) identifies and describes five major booms: 'the 1850s gold rush; the late 19th century mineral boom; the 1960s/early 1970s mineral and energy boom; the late 1970s/early 1980s energy boom; and the current episode.' Knowledge of new resources was paramount in the first three booms and important in the last two. Global demand increases have been important drivers of the last three major booms. Each boom lasted < 15 years because of one or more of resource depletion, a global economy downturn, or as supply increased to match and even over-shoot the demand increase. Each boom was associated with a positive stimulus to the economy through more productive investment and employment and an increase in migration and international investment. In addition to overseas sourced extra capital and labour inputs, each boom involved a transfer of some resources from other industries and regions of the economy to the booming mining sector. The combination of the aggregate factor augmentation effects, the Australian internal factor reallocation effects, and the stimulus to the aggregate size of the economy has important effects on the time paths of government budget revenues and expenditures.

The mining sector is a capital intensive and relatively small sector of the modern Australian economy. In 2011, the sector contributed 13 per cent of GDP, about 1.7 per cent of employment but close to 5 per cent of wage income, and 25 per cent of non-dwelling investment (Connolly and Orsmond 2011; Figure 3, using ABS data). Mining investment booms provide significant direct flow-on demand increases for the building and manufacturing sectors. Up to 80 per cent of the shares of the large mining companies are estimated to be owned by non-residents (Connolly and Orsmond 2011). The magnitude of the current mining boom with large demand increases, for example growth in the world consumption of iron ore and coal of 50 and 80 per cent since 2003, respectively, and large increases in Australian supply, including the LNG projects and likely coal seam gas projects, will have large effects on the economy, including government taxation receipts and infrastructure expenditures (Connolly and Orsmond 2011; and Stevens 2011).

The rest of the article is organised as follows. Section 2 provides a base case. With this base case, Sections 3 and 4 evaluate the effects of a mining boom driven by a demand shift and a supply shift, respectively, on the time paths of investment, production, quantities and prices, and then their first round effects on government revenues, outlays and fiscal outcomes. Section 5 reviews the different options for special taxation of the mining industry, including their pros and cons. Arguments pro and con using a sovereign wealth fund or a stabilisation fund relative to the normal budget processes to manage some of the government revenue windfall from a mining boom are assessed in Section 6. A final section provides some conclusions.

2. Base case

A partial equilibrium model of the mining sector is used to describe the base case before a mining boom.[2] The model describes sector outcomes for price, quantity and different categories of income and expenditure. Commonwealth and State Government revenue gains via general taxation of income, expenditure and assets and via special taxes on miming are then described. Government outlays, mostly by the states on the provision of transport infrastructure for mining products and on education, health and other human capital investments for mining communities, complete the base case budget picture.

Figure 1 provides a market model for the Australian mining industry. Demand, D, represents excess demand by the rest of the world plus Australian domestic demand. The general case of a downward sloping curve rather than a perfectly elastic demand is shown. This reflects a combination of the importance of Australian supply in world supply for some minerals, real product heterogeneity in terms of product characteristics and transport access and the real and perceived benefits to buyers and suppliers of market diversification. Many computable general equilibrium models, including GTAP (Hertel 1997) and MONASH (Dixon and Rimmer 2002), normally specify a export mineral demand elasticity of between −4 and −8.

Mining involves the stages of exploration, development, production and mine closure. It requires the geographically fixed in supply natural resource deposit input together with the relatively mobile (across Australia and the globe) inputs of capital, labour, management and materials. The supply curve, S, shows the opportunity cost of reallocating the mobile inputs from the rest of the economy to the mining industry. It has an upward slope to reflect that some mines, and stages of mines, have different costs of mobile inputs per unit output. Favourable or well endowed mines have large, relatively rich and easy to access minerals, the mines are close to transport with excess capacity, and there are few costs in terms of loss of environment amenity and heritage value alternative uses. They are relatively low-cost mines. Other mines are less favourably endowed and face higher opportunity costs. Daley and Edis (2010), and references therein, provide data showing that for many mineral and energy products, per unit cash costs for the low-cost quintile of mines are a half or less of the per unit costs for the high-cost quintile. Market equilibrium has price P and quantity Q.

Mining sector income has two key components. The mobile labour, management and capital inputs receive at least the opportunity cost returns

[2] With the advantage of simplicity, and still with the capacity to reveal the main implications for budget outcomes, the partial equilibrium framework disguises the details of important second round effects, such as changes to the exchange rate, the inflation rate and aggregate real disposable income, which require a computable general equilibrium model. Connolly and Orsmond (2011) and references therein provide an excellent survey and contemporary data of the general equilibrium and broader economy effects.

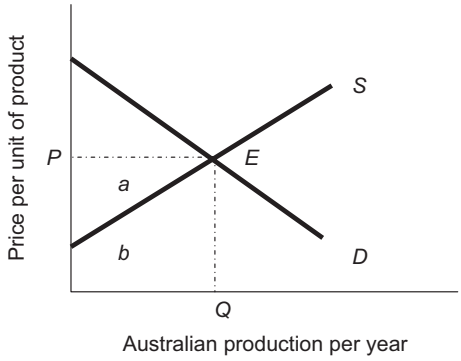

Figure 1 Basic model of mining industry.

available from employment in other sectors of the economy (or globe). This is area *b* in Figure 1. The fixed supply natural resource deposits earn a scarcity rent, area a, which is a residual of gross returns less the market price or opportunity costs of the mobile inputs. Well endowed mines with low costs earn relatively large rents, while marginal mines with costs close to the market price earn a zero rent.

Australian governments collect taxation revenue via several tax bases, and with different rates, from the mining sector. For the Commonwealth, the largest sources of taxation revenue on the mining industry are income taxation and special taxes on off shore oil and gas, namely the petroleum resource rent tax (PRRT) and some royalties; exports are exempt from the GST, mining is largely exempt from the excise on petroleum products via the off-road exemption, and no tariffs or customs duties are levied on imported equipment. For the State Governments, the main sources of revenue from the mining industry are royalties, mostly ad valorem, and to a lesser extent payroll taxation; stamp duty on insurance and registration fees for on-road motor vehicles are relatively small contributors. The process of horizontal fiscal equalisation (HFE) used by the Commonwealth to redistribute GST revenue to the different states, on advice of the Commonwealth Grants Commission, effectively spreads the bigger royalty receipts of the resource intensive states around to the other states.[3]

Labour income generates income tax revenue for the Commonwealth and payroll tax revenue for the states. The net effect of a mining boom on these taxation receipts depends on the reallocation of employees from other parts of the economy to higher remuneration packages in mining, supported by a progressive personal income tax rate schedule, and any net increase in national employment associated with some residents moving from unemployment or not in the labour force into employment and with migration.

[3] HFE also provides some compensation for extra expenditures by the state to provide transport and other infrastructure for mining.

Commonwealth income taxation also collects revenue from both the returns on investments in mining buildings, machinery and R&D, and on the economic rent earned on the favoured natural resource deposits. In the first instance, a 30 per cent corporate tax rate is collected on a close to a comprehensive nominal income tax base as a withholding tax on equity capital. The principal tax expenditure departure from a comprehensive tax base is the immediate write-off of exploration and R&D expenditure. In the case of resident individual investors, the progressive personal tax rate applies to dividend income, with a credit for corporate tax paid on franked dividends, and a 50 per cent rate discount applies to realised capital gains (for shares held for 12 months or more). For superannuation funds, the tax rate on dividend and interest income is a flat 15 per cent, but with a credit offset for corporate tax paid, and a flat rate of 10 per cent applies to capital gains. For non-resident equity investors: fully franked dividends are exempt from further Australian taxation; unfranked dividends are subject to a 0–15 per cent dividend withholding tax depending on the international tax treaty with the non-resident country; and capital gains on share sales are exempt from Australian tax. In the case of debt investments in the mining industry, the debt interest is a deductible expense for measuring corporate income tax, residents pay personal income tax at the personal rate, superannuation funds 15 per cent, and non-residents pay a withholding tax of 0–10 per cent depending on the tax treaty. These are gross transfers to the Commonwealth.

The net capital income tax on investment in mining includes the following: the 30 per cent corporate income tax on the economic rent income; corporate and non-resident withholding taxes collected on additional international capital inflow to Australia; and corporate and personal income taxes on the incremental higher returns received on funds reallocated from other sectors in the economy to mining.

In practice, the 30 per cent corporate tax is the most important income tax revenue flow from the mining sector to the Commonwealth Government. Using data for 2008–2009, the ATO (2011) report that mining companies paid $13.4 billion in corporate income tax, or 24 per cent of total corporate income tax. With higher commodity prices and increased production since then, both the aggregate sum and relative share of Commonwealth revenue will have increased.

The Commonwealth and State Governments impose a variety of special charges on the mining industry in addition to the general taxes levied on all businesses. A general motivation for the special charges is a way of collecting a return on public owned natural resources, which are leased or rented to the private sector to generate value added products. They collect some of the economic rent, area a, of Figure 1.The measured special taxable sum, and especially the tax rate, varies between different governments and for different minerals. The Treasury (2008) and Hogan and McCallum (2010) provide details. A resource rent tax base is applied by the Commonwealth to off-shore oil and gas, except for the North West shelf where an excise levy is applied,

and to uranium in the Northern Territory (NT). For on-shore minerals owned by the state, State Governments generally apply an ad valorem royalty. Royalty rates vary from zero for gold in Victoria, around 2.5–5 per cent for most iron ore and base metals, higher rates for bauxite, and for coal up to 10 per cent for Queensland (QLD) coal with a price above $100 a tonne. In all cases, these special charges are a deduction against measured corporate taxable income, so that the effective corporate tax rate on economic rent is $t_c\ (1 - t_s)$, where t_c is the corporate tax rate and t_s is the special tax rate per dollar of economic rent. In 2006–2007, special taxes on mining collected $7.1 billion, with a half from oil and gas to the Commonwealth and the rest to the states (Hogan and McCallum 2010).

As a guide to the net contribution of the mining industry to government revenue, suppose the sum of corporate income tax paid by mining and the special mining taxes provides a crude measure of additional taxation revenue generated by mining collected on economic rents to society owned natural resources, additional capital investment and employment enticed into Australia, and on higher returns on capital and labour reallocated from other Australian industries. For 2008–2009, this measure of net mining sector revenue to government was about $20 billion, or 6 per cent of aggregate taxation revenue collected from all sources. The special mining industry revenue collected is strongly related to commodity prices. For example, the almost doubling of the RBA index of non-rural commodity prices from 2006–2007 to 2011 will more than double the special mineral tax revenue collected. Although the revenue sums are important, they do not dominate Australian budgets to the same extent as some other resource intensive economies, such as Norway and Middle East oil producer countries.

State Governments are responsible for the funding and management of transport infrastructure in rail, roads and ports for a significant proportion of mining projects; with off-shore and Pilbara projects the main exceptions. In principle, but not often in practice, these infrastructure investments should pass a formal, transparent and public evaluation. Also, over the life of the project, the fees charged for services provided for mines should more than cover all costs, including a risk-adjusted opportunity return on the funds invested. In practice, some mining projects fail and some complementary transport infrastructure projects also may incur a loss, but others make more than expected returns. A challenge from the perspective of the practical operation of state budgets is the time path of upfront investment outlays against concerns of budget deficits, and then a delayed stream of revenue receipts for the infrastructure services provided over the extended life of the mining project.

Relocation of workers and their families from other parts of the economy to remote mining regions, plus migration, add to state costs of providing education, health and other human and social capital services. Cost disadvantages arise from the remote location, costs of small economies of scale, and for some mining communities a shorter time frame than for similar investments in larger urban areas with more diverse industry mixes.

Other government outlays directed at the mining industry are relatively insensitive to the stage of a mining boom and slump. These include Commonwealth outlays on the collection and analysis of information, for example Geoscience Australia and ABARES, and state outlays on managing exploration and mining titles and on establishing, monitoring and enforcing health, safety and other regulations.

3. Demand expansion

This section considers the effects of a mining boom driven by an increase in demand, such as the effect of rapid growth in the demand for coal, iron ore and other basic manufacturing inputs by China, India and other developing countries from about 2005 to the present (described in Stevens 2011; Connolly and Orsmond 2011, and elsewhere). Effects on market outcomes, and then on government taxation receipts and expenditure, are considered for three time periods of adjustment, the very short run with minimal supply response, the investment boom stage to increase supply, and the longer run when the investment turns into a production response.

The effects on mining market outcomes of a demand expansion are shown in Figure 2, which augments the base case of Figure 1. The demand expansion is reflected as an outward shift of demand to D'. In the very short run against a very inelastic short run supply function (assumed to have a zero elasticity for simplicity), the demand response primarily is reflected as a price rise to P' and a relatively small quantity increase.

Higher returns and the expectation of a sustained increase in demand induce an investment boom to develop new mines and to expand the capacity of current mines and associated infrastructure along the long-run supply curve. But, it may be some years before production increases, at least 3 years (Topp *et al*. 2008).

At the long-run equilibrium, price falls to P'', but is $> P$ (unless supply is perfectly elastic) and quantity increases to Q''. The apportioning of the

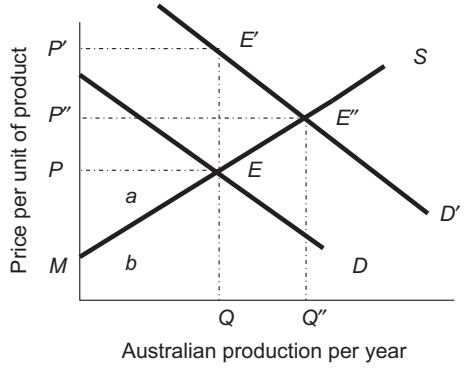

Figure 2 Increased demand.

demand increase to higher prices and higher production depends on the relative elasticities of demand and supply.

Consider next the flow-on effects of the demand expansion to Commonwealth and State Government receipts and outlays for the three time periods. In the very short run, the higher price, P to P', raises the economic rent by $PP'E'E$ with no other significant changes. State Government ad valorem royalty income rises proportionately with the price increase. Commonwealth corporate income tax on the resource rent rises more than proportionately with the rent increase. But, in the short run, only a small proportion of the higher corporate income is distributed to shareholders and higher personal income tax on dividends.

In the investment expansion phase, there are effects on government receipts and outlays in addition to the above very short run effects. Where the investment phase draws additional labour into the workforce from the unemployed, not in the workforce and from immigration, the investment involves additional foreign savings to finance the investment, and some labour and capital are reallocated from other sectors of the economy to earn higher returns in mining investment, the aggregate income tax base and taxation revenue increase. Complementary public infrastructure investments require additional expenditure from governments and mostly State Governments.

Long-run effects of a demand increase driven mining boom on government budgets are clear when compared with the base case, but when compared with the very short run and investment boom stages the direction of effects depends. For the states, ad valorem royalty income continues to rise with increased production so long as the demand curve is elastic. Available evidence and modelling supports an elastic demand. Following the additional investment outlays during the investment boom, State Governments receive revenues from the sale of extra services provided by their infrastructure investments, but not directly from the extra funds invested in human capital. Compared with the base case, the increase in aggregate employment and capital of an expanded mining industry, and the increase in returns for inputs reallocated from other sectors of the economy to the mining sector, increase the Commonwealth income tax base and the state payroll tax base.

Whether the taxation revenue collected on incomes received from additional employment and investment in the mining industry and from higher returns on reallocated inputs to mining, in the long-run mining production stage is greater than, less than or about the same as during the investment boom stage is an empirical issue. At an aggregate level and as planned, the discounted value of the investment returns exceed the costs, but the investment returns are spread over a much longer production stage. Income tax revenue collected from income generated during the investment and expanded production stages depends on the relative factor intensities of investment versus production, and on the relative tax rates on labour and

capital income, the share of structures and equipment sourced domestically, and the share of funds sourced domestically and from non-residents.

The comparative magnitude of the economic rent gained between the short run and the long run, $MP'E'E$ and $MP''E''$ of Figure 2, depends on the elasticities of supply and demand, and on the increase in production relative to base production.[4] The more elastic is demand relative to supply, the less the fall in price P' to P'' and the less the loss of economic rent on existing production in the long run; with no loss when demand is perfectly elastic. The greater the increase in production relative to current production, the more likely is economic rent to increase in the long run. For example, if the elasticities of demand and supply are of the same magnitude, the production increase needs to be at least double initial production. The change in corporate income tax and royalty revenue moves with the change in economic rent.

4. Supply shift

Consider next a mining boom driven by a supply curve shift. The shift could be the result of successful exploration, such as the early Australian gold discoveries or the new off-shore gas fields of recent times, or new technology which substantially lowers production costs, such as drilling technology for ever deeper off-shore oil and gas and coal seam gas technology in Eastern Australia. The mining boom initially has an investment phase, much as discussed in the previous section for a demand increase, and then the longer run production expansion stage.

Some of the details of the effects of the longer run supply shift depend on the nature of the supply curve shift.[5] It could be represented as a parallel supply curve shift, implying discovery of mines and new technology with very low through to high costs, or a convergent supply curve shift with most of the discovery for relatively low cost mines. The more likely scenario, but not always the case, can be represented as a divergent supply curve shift with discoveries more towards relatively higher cost mines when compared with existing mines of the base case.

Figure 3, which builds on the base case model of Figure 1, shows the divergent supply curve shift from S to S'. The long-run mining boom equilibrium involves an increase in output to Q' and a fall in price to P'. By contrast, the demand driven boom increases both price and quantity.

[4] Formally, using the notation of Figure 2, economic rent falls by $(P' - P'')\,Q$ and rises by $0.5\,(P'' - P)\,\Delta Q$. The price change $(P' - P'')$ relative to $(P'' - P)$ is larger the more elastic is demand relative to supply, with equal changes for equal relative elasticities. For equal relative elasticities, the relative price changes cancel, and ΔQ has to double Q for the long-run economic rent to rise in the long run. ΔQ is larger the more elastic demand and supply.

[5] There is an extensive related literature on estimation of the benefits of agricultural R&D, and the distribution of the benefits between consumers and producers, which highlights the importance of the nature of the supply curve shift. For a comprehensive synthesis and set of references see Alston *et al*. (1995).

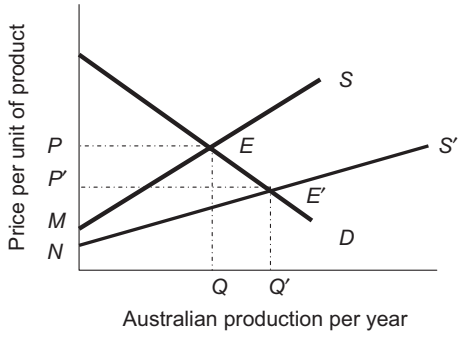

Figure 3 Increase in supply.

Where the demand for Australian mining is elastic, the increased production stage of the supply boom will increase mining revenue. Also, the aggregate income earned by mobile labour, management and capital inputs attracted to the mining boom plus economic rent on the natural resource input will increase. The flow-on effects of the income changes to government revenues requires a more disaggregated assessment. State royalty revenue will rise. Also, state receipts from the sale of transport infrastructure services on earlier investment will increase. Economic rent, and the associated resource rent tax and corporate income tax collected on it, will rise if the supply curve shift is a parallel or convergent type. In the case of a divergent supply curve shift shown in Figure 3, economic rent could fall, i.e. $P'E'N <$ PEM. A fall in economic rent is more likely the more divergent the supply curve shift and the lower the demand elasticity, both of which contribute to a larger price fall. Because the effective tax rate varies by category of income, including a relatively higher rate on economic rent, it is possible that Commonwealth taxation revenue would fall, but the required circumstances are unlikely.

5. Special taxes on mining

In addition to income, expenditure, asset and transfer taxes levied on all businesses, including mining, special and additional taxes are levied on the mining industry. The additional taxes are charged partly as a fee or return on community owned natural resources. Also, if well designed to share the economic rent, they are a relatively efficient tax compared with income taxes levied on more mobile factor inputs. There is an extensive literature on the relative merits of different forms of special taxation of natural resources in fixed geographic supply.[6] In Australia, the states primarily impose ad valorem royalties, the Commonwealth imposes a resource rent tax on off-shore

[6] There is an extensive general literature on the special taxation of mining, including Daniel *et al*. (2010) and references therein. Discussion about specific reform options for Australia which have arisen from the Henry Review (Henry *et al*. 2010) include Garnaut (2010), Hogan and McCallum (2010), Smith (2010), Freebairn and Quiggin (2010) and Ergas *et al*. (2010).

oil and gas, and it proposes to add a resource rent tax to iron ore and coal.[7] This section considers efficiency effects of the different options for special taxation of mining, and to a lesser extent their redistribution effects. Relative pros and cons of the different options are considered initially from an ideal perspective and then with reference to some practical challenges to their implementation.

The royalty system used by the states and by the Commonwealth on the North West Shelf imposes an additional cost per unit of production. In the context of Figure 1, the royalty involves a parallel upward shift of the supply curve. The higher supply curve results in a reduction of production with an efficiency loss, and the loss increases with the elasticity of supply at around the market price. The Henry Review (Henry *et al*. 2010, p. 13) estimated that royalties are the most distorting of all Australian taxes with a marginal cost of 70 cents per dollar of revenue collected. In terms of distribution of the tax burden, the royalty system is inequitable within the industry in that the share of the economic rent collected is relatively small for the low-cost mines and close to 100 per cent for the marginal mines.

A number of special taxes aimed at collecting a share of the economic rent without distorting production decisions have been proposed. In the context of Figure 1, an economic rent tax takes a proportionate share of area a. In principle it is a non-distorting tax, and it collects relatively more from the more favourably endowed mines. Several options have been proposed to measure the economic rent earned on fixed in geographic supply natural resources, or the difference between sales revenue and the market price paid for, or opportunity cost of, mobile inputs.

The expenditure tax, which also has been labelled a Brown tax and the Meade Committee's R-base tax, in principle is the ideal non-distorting tax on rent. If the before tax discounted present value of receipts minus outlays on all inputs purchased by the firm is positive and the project proceeds (or negative and the project does not proceed), so will the after expenditure tax share to the project be positive and the project proceed (negative and not proceed). In effect, and different to the corporate income tax, a normal rate of return on funds invested is exempt from the expenditure tax. Up- and down-side risks of mine investments are treated symmetrically. Effectively, government becomes a shareholder equal to the expenditure tax rate. Better natural resource endowed mines pay more tax per unit output than less endowed mines, and the economic rent tax collected moves up and down with the commodity cycle.

Despite these efficiency and intramine equity properties, governments have not used the expenditure tax model for mining, or elsewhere. A principal concern to government is paying miners upfront during the exploration and

[7] In each case, the special tax is treated as a deductible expense when calculating corporate income tax so that the effective special tax rate is less than the statutory rate. For a special tax rate of t_s, the effective special tax rate is $t_s\,(1 - t_c)$, where t_c is the corporate tax rate.

development phases when cash flow is negative.[8] Other concerns about the practicality and errors of measurement, state's ability to operate an expenditure tax and challenges in the transition from current arrangements will be discussed further on. A number of variants of the expenditure tax model, which reduce or completely avoid government writing cheques to miners, have been proposed.

The Allowance for Corporate Capital (ACC) model proposed by the Henry Review (Henry *et al*. 2010, chapter C1), and which was the basis of the ill-fated Rudd government proposed Resource Super Profit Tax of 2010, in principle would have the same efficiency properties as the expenditure tax. Here, depreciation on capital investments rather than expenditure is deductible, and there is a deduction at the long term bond rate on the net capital stock (equity as well as debt financed). A negative cash flow is carried forward, and it is uplifted by the long-term bond rate. Government has to make a payment only in the event that the project at the end of its life has an accumulated net loss. In effect, the miner becomes a compulsory supplier of government bonds during the earlier periods of negative losses.

Critics of the ACC model argue that if the government promise to refund its share of an eventual loss is to be credible, government with a guaranteed capacity to borrow at the long term bond rate should pay upfront as with the expenditure tax. Further, given doubts about the credibility of future government payouts, the uplift factor must be higher than the long term bond rate by a risk premium.

The resource rent tax model is illustrated by the PRRT and the proposed MRRT. It uses the cash flow as a tax base, but with the differences that any negative cash flow is carried forward at a risk adjusted rate and government does not pay in the event of a negative cash flow. At no stage does the resource rent tax model involve government writing cheques to miners. However, the resource rent tax introduces an additional risk for the miner of a non-compensated loss at the time of mine closure. This asymmetric treatment of wins and losses involves a higher effective tax rate than the statutory tax rate, and it has an efficiency cost. Importantly, because the risk adjusted rate applied to losses carried forward varies from mine to mine, and it is not known by government, the rate chosen is arbitrary.[9] Efficiency losses then arise because the resource rent tax biases the choice of investments away from high risk towards low risk projects.

[8] Illustrative simulations for a expenditure or Brown tax with a 40 per cent rate by Hogan and McCallum (2010) show that government pay outs would have been made in the 2 years 1981–1983 and the 3 years 1996–1999, even though over the economic cycle aggregate Brown tax payments would have exceeded the current special taxes.

[9] To illustrate, the PRRT uses the long-term bond rate plus a 15 per cent risk premium for exploration and a 5 per cent risk premium for development for off shore oil and gas, and the proposed MRRT for coal and iron ore mines proposes a 7 per cent risk premium. A priori, variation of the risk premium is likely to be greater for different mines within a particular mining industry than the average across industries.

Another suggested option to collect government revenue on the expected economic rent to be earned on favourably endowed mining deposits is to auction the right to mine a particular mining lease. In principle, competitive bidding for mining sites uses the information held by firms to extract most of the economic rent from the more favoured mines as an upfront fee or as an annual lease payment. The magnitude of funds required for the upfront auction bid and for outlays on exploration and development investment, combined with a limited number of firms with the required information, suggest the number of bidders will be few, and then with a question over a competitive bidding outcome. Further, there is a large sovereign risk that future governments will impose additional special taxes on those mines which turn out to be very profitable, but not to compensate those which lose. As a consequence, miners will use a very high discount rate for sovereign risk. Almost certainly the auctioning model could not be applied to existing mines, and it would be difficult to draw somewhat artificial lines between historically agreed rights to mine and major mine extensions.

An augmented corporate tax rate on 'above normal returns' is another option for special taxation of mines to capture some of the economic rent. As the corporate income tax base is used, and this includes in addition to economic rent the normal returns to investments in equipment, buildings and R&D, the higher tax rate discriminates against capital invested in mining relative to other industries. An augmented corporate income tax rate also would compound and increase corporate income tax distortions to the aggregate level of investment.

A number of critics of the economic rent model accept the theoretical logic of its efficiency effects, but then focus on problems of measurement in reality and how inevitable measurement errors result in distorted investment and production decisions with associated efficiency costs (for example, Ergas *et al.* 2010). Challenges to the measurement of the economic rent on natural resource deposits include the following: available measures also may include quasi-rents earned on the productive but limited in supply mobile management and technical expertise which lowers production costs; and, most mine operations are a component of a much longer integrated supply chain involving transport and some processing so that the measured taxable sum includes also rents and quasi-rents earned in the up stream stages. Ergas *et al.* (2010) contend that the taxation of these mis-measures of the economic rent on natural resources would distort against these other productivity enhancing investments, and in turn this would shift the supply curve higher than otherwise, with a rectangle of efficiency losses. Further, a royalty system does not have these distorting effects.

A number of counter arguments and qualifications to the legitimate concerns about measurement of the economic rent can be offered. In the same way that an expenditure tax does not distort mine investment decisions as described previously, because it has the government as a de facto shareholder sharing in the wins and losses of these other investments, nor should an

expenditure tax discriminate against other investments to reduce mine costs or downstream costs. While not quite as fixed in supply as the natural resource deposit, many of these other productivity enhancing investments have an important degree of geographic and local circumstances specificity. Estimation of the mine head price of a mineral for determining an ad valorem royalty payment faces similar problems of measurement of downstream transport and processing costs as described for an economic rent tax. In reality, the comparison of special systems of taxing mining has to be in the context of measurement errors.

Inevitably there will be formidable practical problems in moving from the current royalty based system to an economic rent base tax. Foremost, the royalties are a state tax and the proposed economic rent tax is a Commonwealth tax. As the Henry Review (Henry *et al*. 2010) noted, proposed changes in the special taxation of mining would need to be part of a much larger and challenging reform package involving Commonwealth-state financial arrangements. Failure to head this advice lies behind some of the problems with the proposed MRRT and the extension of the PRRT to on-shore oil and gas. The current MRRT proposal retains the royalty system and gives firms a credit for state royalties (Argus *et al*. 2010). As a result, the proposed extension of the PRRT to on-shore oil and gas and the MRRT to coal and iron ore is the minimum of the royalty and the resource rent tax. There will be no reduction in production distortions and efficiency costs caused by the current royalty system. There are other concerns about state autonomy to vary royalty rates, and in the event of changes, there is uncertainty about the implications for measured PRRT and MRRT.

Suppose that shifting more of the special taxation of the mining industry from royalties to an economic rent based tax in net provides gains in efficiency and in equity. A subsequent question becomes one of whether to increase the relative revenue share? In principle, with the Brown or ACC options the tax rate could be close to 100 per cent and capture all of the economic rent without distorting decisions. With a resource rent tax and its asymmetric treatment of wins and losses, a rate well below 100 per cent would involve some efficiency losses. Recognition of imperfections in measurement discussed earlier in practice indicate a rate < 100 per cent to leave some incentives to invest in cost saving at the mine and at other stages of the production chain.

The Henry Review (Henry *et al*. 2010) recommended a rate of 40 per cent, which is the current PRRT. On average, over the commodity cycle, this would have generated an increase in revenue, but for less well endowed mines and in times of commodity price slumps less revenue (Hogan and McCallum 2010). The Henry Review (Henry *et al*. 2010) argued for increasing the relative tax burden on factors in inelastic supply, and particularly on land and natural resources, as part of an aggregate revenue neutral and more efficient tax mix change package to fund reductions of tax rates on factors in elastic supply, and particularly a lower corporate tax rate affecting the global supply

of funds for investment in Australia. Such a tax mix change recognises that the economic incidence and redistribution effects of taxes on the returns to either the land or capital mostly end up on the fixed factors, and that a lower tax rate on capital will lead to increased investment in Australia, a higher capital to labour ratio flowing onto higher labour productivity and real wages and a net gain for Australia.

A potential risk of proposals to increase the tax burden on mining is the sovereign risk effects of changes in the rules of the game on investment in Australian mines in a world of mobile international capital. Because most of the capital invested in existing mines is a sunk cost, higher special taxes on these mines largely have redistributive effects and minimal resource reallocation effects. But, the changes could raise the required risk premium on new investments in mining.

Replacing the current royalty system with one of the economic rent taxes discussed would alter the variability of after special and corporate tax returns to mining investors, and the variability of government revenue, in response to commodity cycles and adverse production events. The Brown and ACC taxes would reduce the variability of miner after tax returns and shift the variability to government relative to the royalties. These taxes would leave unchanged the variability of pre- and after-tax returns because government takes an equal share of wins and losses. A resource rent tax with its asymmetric treatment of wins and losses would increase the volatility of after tax returns relative to pre-tax returns, and in most circumstances it would reduce variability relative to the current royalty system.

Arguably, the greater sensitivity of an expenditure tax or resource rent tax to mineral prices, compared with royalties, will be more robust to tax rate changes in the future than the observed one-way increases in royalty rates in times of mining booms.

6. Managing budget revenue windfalls

Rather than governments taking the revenue windfalls of a mining boom into consolidated revenue and the normal budget processes, some countries have placed the funds in a special off-budget fund with specific spending objectives and independent management structures. Options include a sovereign wealth fund and a stabilisation fund. A sovereign wealth fund has an independent authority to invest in financial assets, and in particular international assets, to maximise long-term average returns and with restrictions on the use of the returns or the capital for the current generation. The sovereign wealth funds of Norway, Chile and a number of Middle East oil producers have these characteristics. Australia's Future Fund to fund previously unfunded public servant and military personnel superannuation liabilities is another example. A stabilisation fund involves an independent authority acting as an intermediary with a medium term objective of taking the volatile flow of funds collected from the booms and busts of mining cycles to provide a smoother

pattern of funds for government uses. This section reviews the arguments made for a sovereign wealth fund, and to a lesser extent a stabilisation fund. It evaluates in the specific Australian context some of the arguments pro and con Australian Commonwealth and/or some of the State Governments establishing a sovereign wealth fund(s) for some of the government mining boom revenue windfall.

Three general sets of reasons for establishing a sovereign wealth fund rather than the normal budget processes to handle government revenue windfall gains of a mining boom have been made.[10] These are: to ensure intergenerational equity in the returns from a non-renewable resource that is state owned; to modify the magnitude of real exchange rate appreciation and to avoid potentially unnecessary or excessive economy wide structural adjustments; and to reduce the opportunities for poor decision-making by governments and in the worst case, avoid many of the so-called Dutch disease or resource curse outcomes.

An underlying argument for special treatment of the revenue windfall from a mining boom which is different from other government revenue, such as income tax and the GST, is the special intergenerational aspects of the revenue source. Mining transforms a finite supply non-renewable resource available for future generations into dollar income for today's generation. By contrast, most of the income tax and expenditure tax revenues come from renewable resources and spending. Provided that the one-off mining economic rent, area *a* of Figure 1, is invested to increase available production capacity, including in education, R&D, physical infrastructure and financial claims on future incomes of the rest of the world, a wealth transfer from future to current generations can be avoided (Hartwick 1977). In turn, these investments could be made by individuals, businesses or governments, and in the case of governments through the usual budget processes.

A second set of arguments for a sovereign wealth fund which invests some of the revenue windfall of a mining boom in international domiciled financial assets is to achieve a partial offset to the exchange rate appreciation effects of the increase in export receipts of a mining boom. This also would quarantine some of the inflationary effects of the increase in incomes and added demand for limited labour. Then, the smaller real currency appreciation modifies the adverse effects of the mining boom on the rest of the traded sector. Further, if the boom is large in terms of the economy and of limited duration because of limited reserves relative to current production, as is the case for oil for Norway and the smaller Middle East countries, some argue that the magnitudes of restructuring of the economy involved in downsizing the rest of the traded sector during the mining boom and then upsizing it after the boom would be modified.

[10] See, for example, Davis *et al*. (2001), Yi-chong and Bahgat (2010), Hart (2010), Van der Ploeg (2011) and Fry *et al*. (2011).

The third set of arguments for placing the government revenue windfall of a mining boom into a sovereign wealth fund, or a stabilisation fund, with an independent authority with a constrained and narrow terms of reference, rather than into general government recurrent revenue, is that it avoids the temptations of conflicting objectives faced by governments in their normal budget processes, including much shorter term ones of gaining popular electoral support. At worst, as illustrated by the resources curse model, a short sighted government spends the temporary revenue windfall on consumption which then has to be reversed at the end of the boom, or government has to increase other more distorting taxes, or government commits to expenditure on investments with low social returns, or even spends some of the revenue windfall on corruption which ultimately reduces productivity (Van der Ploeg 2011).

Turning to the current Australian context, one can argue against the strength of the above three sets of arguments for creating a sovereign wealth fund as a superior option to the general budget process to better manage the revenue windfall of the current mining boom. These contrary arguments apply both absolutely and in terms of important differences in the situation of Australia relative to Norway, Chile and the Middle East countries. First, the importance of, the structure of and the likely time profile of mining in Australia has different intergeneration implications. Mining in Australia is a smaller share of the economy and of government revenue than in most of the other countries with sovereign wealth funds. The Australian mining boom is broad based with a diverse portfolio of deposits of different forms of energy and minerals. For most of these energy and minerals, known reserves are in excess of 50 years at current production rates, and there are good prospects of finding further economic recoverable deposits (Geoscience Australia, 2008). The Treasury in its intergenerational report (Swan 2010) project future generations will benefit from further productivity growth with other investments which will provide much higher per capita incomes than the current generation.

Arguably, the rundown of government expenditure on both physical infrastructure and human capital in Australia over the past two decades means that there are many socially welfare improving government investments available to use the windfall revenue to raise productivity and the incomes of future generations. Alternatively, using a share of mining economic rent income with its relatively low distortion costs to reduce other more distorting taxes would provide large productivity gains (Henry *et al*. 2010). Or, government debt might be repaid. Collectively, these observations cast doubt on the necessity to explicitly set aside the government revenue windfall from a mining boom in a sovereign wealth fund to sustain the living standards of future generations, or to constrain what is a much wider range of government fiscal options to support further productivity growth.

The magnitude of effects of a sovereign wealth fund reducing the exchange rate appreciation and required industry structural adjustment from a mining

boom seems likely to be small in the Australian context. Government revenue from the industry will be only a small share of the mining boom induced increase in net exports. Given that Australia is a net capital importer (historically of from 2 to 6 per cent of GDP), it is unlikely that all funds would be invested overseas, as is illustrated by the Future Fund. The anticipated duration of a trend increase in mining's share of the economy for at least several decades, if not the rest of this century, and other structural changes in the world economy, almost certainly require substantial sustained structural change of the future Australian economy. Also, greater flexibility of the Australian economy, largely following the microeconomic reforms of the 1980s and 1990s, makes structural change a more successful and less painful process than in earlier mining booms. Inevitably, there is considerable uncertainty about the timing and magnitudes of mining cycles and of other structural changes bearing on the Australian economy. These and other changes can be foreseen no better by the managers of a sovereign wealth fund than the governments of the day.

It is contestable that an independent stabilisation authority to smooth the volatility of government revenues over mining cycles would achieve better fiscal outcomes than the normal budget process. Reality is that Australian budgets face many uncertainties besides mineral booms and busts. Examples of other volatile and uncertain forces include droughts and agriculture, business cycles and corporate income and capital gains tax revenues, and housing booms and state conveyance duties. Importantly, these other forms of variation in government revenues and outlays often are not correlated with mining booms. For example, the general economy boom of the 1990s coincided with a mining downturn, and the current mining boom occurs at a time of stagnant house prices and falling share values. Then, the case for a stabilisation fund for a mining boom is no stronger or weaker than the case for a stabilisation fund for agriculture booms, stock market booms and housing booms.

A broader strategy of medium- and long-term budget philosophy for all random, cyclical and trend disturbances to budget revenues, expenditures and deficits applying to the fiscal stance as an aggregate may be more useful than a mining stabilisation fund. The current Commonwealth budget has explicit medium term indicators of a surplus on average over the cycle and maximum taxation as a share of GDP. This represents a part of such a strategy. Adding a requirement for formal, transparent and publicly available benefit cost assessments of investment programs also would be important.

Assumptions that a stabilisation fund has access to better information and that it will be independent of government are tenuous at best. The manner in which the Rudd government spent the capital of the Education, Health and Building Australia funds over 2008–2010 illustrate the lack of independence. Consideration of government expenditures of past mining booms provides anecdotes of far sighted and wasteful expenditures. For example, on the positive side is the legacy of government investments from the gold rush booms,

and many would place on the negative side the increase in middle class welfare payments of the current boom.

A practical challenge for Australia is to determine which level of government the sovereign wealth or stabilisation fund might apply to. Under current taxation arrangements, the Commonwealth collects windfall mining boom revenues via the corporate income tax, the PPRT and the proposed MRRT. The states collect royalties, but only for WA and QLD are these significant sources of their revenues, and then HFE affects the share ultimately available to them.

7. Conclusions

Mining booms increase both government receipts and outlays. Additional revenues come primarily from the special taxation of economic rents on public owned mineral and energy resources and from income taxation of additional capital and labour drawn to the industry from overseas, some domestic labour drawn into employment, and from higher returns earned by labour and capital reallocated from other industries to mining. The time pattern and magnitude of the increased revenue varies between a mining boom driven by an increase in demand and an increase in supply, and on such factors as the elasticities of supply and demand, the shape of the supply curve shift, and the ratio of increased production to initial production. Aggregating across the Commonwealth and State Governments, in 2008–2009 the mining sector directly contributed about 6 per cent of government revenues, with the current boom to about double the contribution. During the investment expansion stage, some State Governments provide funds for investments to expand transport and other physical infrastructure which are recovered by fees over the production stage. Also, higher outlays on social infrastructure for remote mining regions are required.

At the conceptual level, there are compelling arguments to change the structure of current special taxes on mining and to increase the average revenue collected as proposed in the Henry Review (Henry *et al.* 2010). However, as illustrated by government proposed reforms, there are formidable practical challenges. Replacing current royalties with an economic rent sharing tax would reduce distortions to investment and production decisions, and it would shift the tax burden to the more favourably endowed deposits and away from the marginal deposits. A change in the tax mix involving a lower burden on capital with its relatively high factor supply elasticity and a higher burden on land and natural resources, and to a lesser extent labour, would raise national income and real take-home wages. Practical challenges to achieve these desirable changes include reworking Commonwealth-state financial relations, measurement of at-mine economic rents with integrated supply chain production systems, transition arrangements for established mines and overcoming the to-be-expected resistance of mine operators and their shareholders to higher taxation.

The applicability of arguments used in other countries, including Norway and the smaller Middle East oil producers, to quarantine the revenue windfalls of a mining boom in a sovereign wealth fund for use by future generations are questioned for Australia. Relative to these countries, in Australia mining revenues represent a smaller share of the economy and budget, and Australia has a much more diverse portfolio of different minerals and energy, and many with proven reserves exceeding 50 years at current extraction rates. There are other sources of volatility of government revenues and outlays with low correlations with mining government revenues. Future generations are expected to have higher per capita incomes than the current generation. Including mining revenues and outlays within the normal budget processes provides greater flexibility for using the mining boom revenue windfalls for a wider range of investment, tax reform and debt reduction strategies to support higher future incomes than a sovereign wealth fund.

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