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DISCUSSION PAPER 14.18

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ABSTRACT

The retreat from public ownership of service firms and industries has left behind numerous private monopolies and oligopolies supervised by regulatory agencies. Services industries in government and private ownership generate two-thirds of Australia's value added, while the newly privatised ones, utilities, telecommunications, finance and transport, supply a fifth. This study offers an economy-wide approach that represents monopoly and oligopoly behaviour explicitly. It examines the implications of oligopoly rents for factor markets and the real exchange rate, the extent of sectoral interactions and the potential economy wide gains from tighter price cap regulation. The results confirm that the level of non-linear interaction between oligopoly sectors justifies an economy-wide approach. Moreover, pricing surveillance and price cap regulation are shown to play very significant roles in sustaining economic efficiency, helping avoid costs from oligopoly distortions that, in the absence of regulation, could amount to a third of Australia's GDP.

1. Introduction

As an advanced economy it is well understood that services make up four fifths of Australia's economic activity. Microeconomic reforms of the 1980s and 1990s saw the at least partial privatisation of key service industries, including utilities, telecommunication services, transport, education, health and finance that contribute almost half of this service activity.[1] This left numerous private oligopolies subject to price, quantity or rate of return regulation. Surprisingly, given the wide spectrum of jurisdictions, agencies, firms and activities under regulation, outcomes have been shown to be consistent across the nation (Breunig et al. 2006, Menezes 2009, Breunig and Menezes 2012). Considering their overall economic significance, it stands to reason that the analysis of regulatory regimes should account for the interactions between them as a consequence of their implications in markets for primary factors and intermediate products.

While the effects of each regulatory regime on factor and input prices, rates of return and the real exchange rate might be minor, their collective effects are probably considerable, with some partially offsetting and others reinforcing. This suggests that the analysis of the economic implications of regulatory regimes is best achieved by modelling the whole Australian economy in a way that allows explicitly for the monopoly and oligopoly behaviour that necessitates regulation in the first place. Such a model is offered in this paper. It is designed to help clarify the implications of changes in the regulation of oligopoly pricing for the structure and performance of Australia's service industries while at the same time examining inter-sectoral effects and associated changes in the performance of labour markets and the economy as a whole.

More particularly, the retreat from the government's direct provision of infrastructure services has left private firms and publicly-owned corporatised entities (government bodies subject to corporations' law) in industries that are now littered with oligopoly structures and component monopolies. These firms and entities are therefore supervised by regulatory agencies. They include: transport, electricity, water supply, gas distribution, telecommunications, finance and insurance, education and health.[2] While regulatory policies cover both product pricing and quality, we focus entirely on price regulation, including price surveillance as well as price

[1] These are shares of total value added (GDP at factor cost). See ABS (2012): Table 15.1.
[2] The health sector is not addressed independently in this study, primarily because its activity is difficult to distinguish in the available economy-wide database we use but also because it is rife with information asymmetries that make its regulation more complex than the sectors considered.

caps, and hence the control of economic costs associated with distortions due to imperfect competition.

Existing studies tend either to focus on the direct and indirect links between privatisation, regulatory reforms and national productivity[3], or to follow a long tradition in regulatory economics of applying industry-specific (partial equilibrium) comparative statics.[4] In recent years economy-wide implications have been examined using models underpinned by perfectly competitive behaviour, with oligopoly rents implied by the choice of parameters, closure or productivity shocks.[5] Industry-specific fix-ups in such models still require the assumption of perfect competition in all other industries to generate the economy-wide effects. While this approach has been very useful during the microeconomic reform transition, it tends to ignore the fact that most other economic activity is also imperfectly competitive and subject to regulation, and that regulatory changes to one industry are unlikely to occur without implications for the regulation of others or for the performance of the whole economy.[6]

Central to this paper is the mathematical model of the Australian economy it introduces and the economy wide database that serves it. This model represents monopoly and oligopoly pricing behaviour and the regulatory environments facing major firms. Its behavioural structure is based on early work by Harris (1984), Horridge (1987), Gunasekera and Tyers (1990), Rees (2004) and Tyers (2005), the latter three of which emphasised homogeneous product oligopolies with firms interacting on production in an "almost small" home economy. Subsequent extensions included differentiated product oligopolies interacting on prices. The focus in these prior applications has been trade reform and manufacturing oligopolies, wherein considerable attention has been given to the "pro-competitive" effects of trade liberalisation (Hertel 1994; Ianchovichina et al. 2000; Tyers 2005).

The model is constructed in the spirit of the elemental theory presented by Blanchard and Giavazzi (2003) and, as in their analysis, its numerical application emphasises the scale of

[3] See, for example, Productivity Commission (1999, 2009, 2010, 2013), for the accumulation of industry-specific studies and as examples of industry partial equilibrium analysis.
[4] Classic partial equilibrium studies include those by Averch and Johnson (1962), Wellisz (1963) and Courville (1974). More recent examples that embody complex industrial organisation and synthetic market behaviour include those by the Productivity Commission (2003), Madden et al. (2002), Haney and Pollitt (2011), Kao et al. (2012) and Dutra et al. (2013).
[5] These include the global model by Dee (2003), which is innovative in that it recognises the importance of domestic location for overseas-based service firms. Frequently applied is the highly detailed MONASH model of the Australian economy (Dixon and Rimmer 2002). Ours is not an attempt to compete with either of these approaches. Rather, we seek to construct a more direct means to evaluate regulatory policies by embedding more realistic monopoly and oligopoly behaviour in the economy-wide context.
[6] This is notwithstanding the fact that regulation can be applied differently across different jurisdictions in Australia and across different industries. See, for example, NECG (2003).

oligopoly rents, their distribution, and the effects on these of regulatory policies. Their regulatory instrument was the control of entry, whereas in this case the regulatory instruments extend to pricing surveillance and price caps. In addition, the Australian tax system is represented, since taxes and transfers offer an alternative approach to the achievement of regulatory objectives. Further, the model includes generic foreign ownership, thereby allowing for proper representation of net factor income flows and their effects on the real exchange rate, the composition of the current account and GNP.

Using this machinery, this paper begins with an assessment of the scale of costs the Australian economy would bear were its oligopolistic service industries to be allowed to cartelise. This hypothetical experiment is used to illustrate the extent of economy wide interactions associated with oligopoly behaviour and the scale of potential errors from adding up industry-specific results. It then assesses the potential for further gains from tighter capping of prices, once again giving emphasis to economy wide interactions. Indeed, these interactions are shown to have very significant effects on the measured benefits from regulation, confirming that economy-wide analysis is an appropriate approach to regulatory policies, even when the focus is a single sector. In the case of key network service industries, however, this is shown to be of particular importance because of the dependence of the remainder of the economy on intermediate inputs supplied by these industries and therefore on their efficiency.

Economy wide effects of the elimination of oligopoly rents tend to be large by comparison with welfare changes due to simple tariff or tax reforms, even without accounting for gains in firm-specific technical efficiency often anticipated with privatisation and more competitive pricing. Thus, gains in output and income accrue in the first instance from more competitive pricing, which tightens the bond between prices and unit costs and therefore captures some allocative efficiency. In the presence of elastic export demand in the long run, this raises volumes and attracts foreign capital and domestic investment. Depending on entry conditions, this yields a further gain in efficiency, via increased production runs in the presence of fixed costs. Arguably, efficiencies of this type underlie the productivity gains observed during Australia's "golden era" of the 1990s (Parham 2013). Indeed, the allocative and scale efficiency gains might be helpful in resolving the debate over the veracity of the "golden era" story (Quiggin 2001, 2006).

2. Regulation and Australia's Services

Australia's service industries have experienced rapid growth over the last fifty years. Their regulation is seen as redress for market failures that include lack of information, monopoly power, externalities or social objectives (income distribution or service quality).[7] Many service industries require networks with hubs that constitute substantial recurrent fixed cost and the control of which creates barriers to entry, conferring monopoly power.[8] The economic rationale for service regulation is therefore strong.

Stigler (1971) argued that the analysis of regulation should concentrate on three important questions: who will receive the benefits and who will bear the burden of regulation, the form and nature of the regulatory intervention and the effect of regulation on resource allocation. There are very substantial subsequent literatures on the generic benefits from regulation and, more particularly, the specific regulations imposed on Australia's services.[9] Devices range between price controls, ownership restrictions, limits on foreign direct investment and capacity constraints. Federal responsibility for competition regulation and monitoring rests with the Australian Competition and Consumer Commission (ACCC), which administers the Trade Practices Act 1974 ("TPA") and the Prices Surveillance Act 1983 ("PSA"). The TPA promotes competition and fair trading while also providing consumer protection. The PSA circumscribes the ACCC's monitoring of prices, costs and profits.[10]

The reach of regulatory policies in Australia has risen since these Acts were written, due to the extensive privatisations associated with the "microeconomic reform" era and the pace of technological change. The latter, particularly in telecommunications, electricity and gas, has made it possible to "unbundle" industry segments, leaving some as natural monopolies or oligopolies but with others organised around supervised new markets that foster competitive behaviour (such electricity production and the retailing of gas, electricity and telephone services). The introduction of price caps as "incentive regulation" was aimed at the monopoly and oligopoly elements, where competitive pricing could not be otherwise induced. These consequences of privatisation did, however, distort behaviour as investment sought to escape the price caps.[11] In telecommunications, air transport and the production and

[7] See Findlay (2000: 10).
[8] *Ibid*. An example of anti-competitive behaviour attributed to monopoly power over a network is Telstra's pricing for its broadband service. See ACCC (2003).
[9] See Trade Practices Act 1974 (Cth), reviewed in Productivity Commission (2003).
[10] See ACCC (2003).
[11] I am grateful to Flavio Menezes for this point. For related discussion, see Breunig et al. (2006).

distribution of natural gas and electricity these changes have been stark.[12] Inevitable distortions notwithstanding, reforms have been shown to contribute to improvements in both economic and government performance, according to the OECD (1997) to the tune of five percent of GDP.

In the late 1970s there was significant anti-regulatory sentiment in developed countries. The practice of rate-of-return regulation was found to be incompatible with increased competition. Littlechild (1983) changed this negative perception of regulation with his report on the British telecommunications industry in which he suggested price caps as a regulatory policy tool. This signalled a movement towards a more incentive-based and less heavy handed approach to regulation. The result has been very widespread application of price-caps in services, which are characterised by product-specific price ceilings, basket ceilings that offer firms greater flexibility, and periodic adjustments of ceilings to ensure that consumers share in the gains from technical change and market formation.[13]

Theoretical and applied studies have tended to be stylised and sector-specific but they have demonstrated that price-caps, even as second best measures, can protect consumers against monopoly power, promote competition, improve productive efficiency and innovation and reduce the administrative burden of regulation.[14] Empirical follow-up by Xavier (1995) assessed price-cap schemes in the UK, the USA and Australia. His Australian focus was on the (then) Telecom basket price cap between 1989 and 1992. He showed that the scheme reduced the average price of Telecom's domestic services in real terms by 13 percent. International call prices fell in real terms by 25 percent in this period, however, suggesting that the scheme fell short of delivering a fair share of technological gains to the Australian consumer. Nonetheless, he took a sceptical view of some price-cap mechanisms, preferring the fostering of competitive forces where this is possible.

Turning to economy-wide approaches with explicit representation of imperfect competition, Blanchard and Giavazzi (2003) offer an elemental general equilibrium model to investigate the combined effects of product market and labour market regulation. Their closed economy model incorporated non-collusive oligopoly behaviour in the goods market with rents being partially distributed via bargaining in the single factor (labour) market. In this context, one

[12] See Doove et al. (2001: 43).
[13] See Vogelsang and Acton (1989).
[14] Key early works in this area include: Cabral and Riordan (1989), Bradley and Price (1988), and Brennan (1989). More recent works include: Newbery (2004a and b), Camacho, F.T. and F.M. Menezes (2013) and Dutra et al. (2013).

route to more competitive behaviour is to find some mechanism to raise the elasticity of substitution between oligopolistically produced varieties. In the short-run they find that the increased competition is beneficial because it forces firms to lower their mark-up, leading in turn to reduced capital returns but a higher real wage. In the long run, however, there is exit by firms and reduced product variety. In this case no pure profits are left to erode and invariant recurrent fixed costs prevent declines in the mark-up, so there are no long run benefits. If, instead, the government attacks barriers to entry (recurrent fixed costs), the effects are unambiguously welfare improving in the short and long runs. There is an increase in the number of firms, a higher elasticity of demand, a lower mark-up and thus lower unemployment and a higher real wage. While it is not made clear how a government might alter the elasticity of substitution or entry costs, this research signals an improvement over prior studies of regulation through its characterisation of market structure in an economy-wide context and it is in this spirit that the research presented in this paper has been undertaken.

The precise extent of imperfect competition in Australia's service industries is difficult to quantify. The following are short qualitative summaries for the key sectors in which privatisation and regulation have brought most change.

Telecommunications

The ACCC's analysis indicates that this sector is slowly becoming more competitive, with most improvement at the retail level, as opposed to infrastructure provision. In line with global changes in telecommunications technology, there have also been considerable improvements in productivity, as indicated by Madden et al. (2002).[15] Subsequently, Telstra continued to be the dominant firm, with about two thirds of the sector's listed market capitalisation and between a third and three quarters of the markets for the different telecommunications products (Telstra 2003). While these shares have eroded with further entries since then, the facts suggest a high level of network concentration, but in areas such as mobile and long distance telephony and data transfer, competition is intense. Telstra's exploitable market power remains in fixed telephony and network access, though the onset of the National Broadband Network and competing partial networks constructed by recent entrants, has since modified this pattern, the net effects on structure from which remain

[15] The controversial link between the market power of firms and investments in R&D, along with associated productivity performance, is not the focus of this paper. Our approach offers a capacity to investigate this issue, however, and so it will be the subject of further research.

obscure (Ergas 2008, NBN Co 2010) except that network telecommunications services will remain a regulated oligopoly.

Electricity

Generator numbers have remained small and these firms have been found to increase prices substantially above competitive levels for sustained periods. Indeed, Short et al. (2001) indicate that the electricity market is subject to significant departures from competitive outcomes. High Lerner indices (price-marginal cost margins) suggest the collection of substantial rents. Yet, given this industry's high fixed costs, a better measure might have been the mark-up over average cost. New market mechanisms as well as regulatory reform have been introduced in this sector more recently. Linked to the ACCC, the Australian Energy Regulator was established in 2010 to govern network pricing and to monitor wholesale and retail pricing. While this has led to more competitive pricing behaviour (as per Haney and Pollit, 2011), imperfections remain (Nepal et al. 2014).

Gas

While official barriers to the free flow of natural gas across state borders have been removed, the market remains highly concentrated on the supply side and it carries many legacy agreements that limit competition. The resulting lack of liquidity in Australian gas markets has impeded the development of transparent spot markets.[16] There are three suppliers in the eastern Australian gas markets that account for more than 95 percent of the supply gas. The two incumbents BHP Billiton and ExxonMobil account for 38 percent and 41 percent respectively. As to infrastructure, the largest pipeline owner in Australia is Australian Pipeline Trust (APT) which owns a third of the total transmission pipeline system.[17] Australia's second largest pipeline owner is Epic Energy, with about half the capacity of APT. In 1997 the Australian Government introduced a Gas Code – The National Third Party Access Code for Natural Gas Pipelines – which is administered by the ACCC and the National Competition Council (NCC).[18] The Code ensures that gas can be transmitted through the pipeline network on 'reasonable' terms and conditions, though in practice these have attracted controversy.

[16] See Short, C. et al. (2003).
[17] See Australia Daily (2004).
[18] See Moran (2002).

Air Transport

The Australian airline domestic market has long had a duopoly structure, changes of players in the 1990s notwithstanding. Because of volatility associated with these changes, the market share of the only remaining incumbent, Qantas, has been measured at and above 70 percent.[19] Nonetheless it remains in the interest of both the major carriers to maintain an industry structure which allows both to generate sustainable profitability without encouraging further entry. Again, the ACCC monitors prices and frequent flyer schemes for anti-competitive elements. As to aviation infrastructure, prior to 2002, airports in Australia were subject to price-cap regulation. However, the Productivity Commission concluded that while the major metropolitan airports have substantial market power, it is not in their interests to abuse this power in such a way that would confer large costs onto the economy.[20] Hence, the government has largely deregulated airports, replacing price caps with price monitoring.[21] Debate continues, however, as new air service entrants seek access to airport services.

This very brief review makes it clear that the regulation of oligopoly service industries in Australia is made more complex by the trend toward the subdivision of each industry into more and less competitive components. In this paper, however, the purpose is to take a broad brush to the estimation of economy wide effects of service oligopoly behaviour. Accordingly attention is focussed on just 10 sectors, necessarily averaging out sectoral detail. In interpreting the research that follows it should be borne in mind that the task of sectoral regulators is not only made difficult by the non-transparency of the costs we model but also because product lines and the degree of differentiation between firms are not stable through time in the way they are modelled here.

3. Economic Structure and Performance

The privatised services, electricity, water, gas, telecommunications, finance and transport, supply at least a fifth of the economy's GDP, yet as Table 1 shows, their participation in international trade is tiny compared with agriculture, manufacturing and mining.[22] Moreover,

[19] See Freed (2004).
[20] See Productivity Commission (2002).
[21] Rather than collude to raise carrier costs, owners of privatised airports have sought and found profitability through the development of airport property by exploiting relatively relaxed federal regulations governing the use of airport land.
[22] These numbers are drawn from the database to be employed in later sections. The completeness and balance of this database necessitates that it is somewhat dated, though these shares have remained quite stable since. The

the privatised services are shown in Table 2 to be more intensive in skill and physical capital than are the tradable sectors so that their comparative performance has particular implications for the skilled wage premium and total capital use.

As in most open economies, overall economic performance is very sensitive to the relativities between home production costs and export prices, and hence to the country's real exchange rate. A standard definition has the real exchange rate as the common currency ratio of the home and foreign GDP price levels:

$$(1) \qquad e_R = \frac{P_Y}{\left(\frac{P_Y^*}{E}\right)} = E\frac{P_Y}{P_Y^*} \ ,$$

where both the real and nominal exchange rates, e_R and E, are expressed according to the financial convention, so that an appreciation is a rise in value. For a commodity exporter like Australia, external conditions that determine the terms of trade and financial market behaviour have important implications for the real exchange rate.

Less well recognised, however, is the fact that the real exchange rate is particularly sensitive to the government's fiscal position and, more particularly, to performance of, and expenditure on, non-traded services industries in general. This is because government expenditure is intensive in non-traded services and services carry such a large weight in the home price index, and hence in the numerator of the real exchange rate expression.[23] Improvements in services productivity, as Parham (2013) suggests took place in Australia during the "golden age" of the 1990s, therefore have major overall economic effects by reducing domestic costs relative to prices abroad and hence by stimulating exports and investment. This can also be seen from the simple Salter diagram graphics in Figure 1.[24] Employing the abstraction that goods and services are either tradable or not, the effect of improved productivity in non-traded services is to shift the production possibility frontier to the right, reducing the price of non-traded services relative to tradables, whose price is fixed abroad, and hence depreciating the real exchange rate.

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main changes since have been a rise in the overall share of services from three quarters to about four fifths of the economy though the shares of the privatised services have changed little. On the tradables side, contractions in the shares of agriculture and manufacturing have occurred to accommodate an expansion in the contribution of mining.

[23] The influence of government expenditure has been referred to as the "Froot-Rogoff" effect, following Froot and Rogoff (1995) and, more recently, Galstyan and Lane (2009). Of course, in the short run fiscal expansions can also appreciate real exchange rates by raising home bond yields and drawing foreign investment, thus switching demand into the home economy (Mundell 1963 and Fleming 1962).

[24] The diagram is widely used but stems from the classical article, Salter (1959).

A way of thinking about the behaviour reflected in Figure 1 that embodies the oligopoly behaviour central to this study is to consider privatisation and regulatory reform as reducing oligopoly rents and therefore raising intermediate and final demand for services. There is therefore an allocative efficiency gain as prices approach unit costs, along with reduction in those costs due to the capture of scale economies. The initial excess profits had been achieved by supplying less service output. The policy change therefore facilitates the rightward shift in the production possibility frontier shown in the figure without any requirement for associated technical change.

4. An Oligopoly Model of the Australian Economy

The model is structured in the spirit of Blanchard and Giavazzi (2003) in that it emphasises oligopoly rents and the effects on these of industry policies. While their treatment of regulation is restricted to entry restrictions, here the regulatory armoury extends to privatisation, pricing surveillance and price-cap regulations. Like that of Balistreri and Markusen (2009), the model separates subnational product differentiation from that between home and foreign products and, with generally higher elasticities of substitution between home products than internationally, it yields important relationships between industry policy, the terms of trade and the real exchange rate. The links between foreign ownership, trade policy, domestic market structure and "x-efficiency" (Markusen 2004, Markusen and Stahler 2011) are not directly explored in this model though efficiency gains from increased lengths of run in the presence of fixed costs are an important behavioural element. Foreign capital can flow into the economy in the long run but there is no endogenous distinction between FDI as greenfield investment or acquisition.

Critically for the results obtained, the oligopoly behaviour is embedded within a multi-sector general equilibrium structure which offers a complete representation of inter-industry flows. Most oligopolistic sectors (energy, metals, chemicals and network services) have tended to be comparatively little exported and primarily used as domestic intermediate inputs. This means that, while distortionary pricing by oligopolies has modest direct effects (on final product mark-ups) it has very substantial indirect effects (via mark-ups on intermediates) that build on one another economy wide. A key consequence of this is that, when initial mark-ups are large, more competitive pricing yields effects on overall economic activity that are very much

greater than the gains in allocative efficiency from simple changes in taxes or tariffs (Tyers 2005).

These large effects stem from allocative efficiency gains derived from the closer association of costs and prices. In long run mode, this raises the rate of return on physical capital relative to an exogenous external lending rate and, since export demand is comparatively elastic, the resulting declines in costs raise the (variable) capital stock and this facilitates expanded export and output volumes. If free entry is permitted in long run mode, the stock of fixed capital (the recurrent fixed cost burden at the industry level) also expands. Depending on the extent of new entries, the expanded output levels then yield a further set of efficiency gains, which come from longer production runs in the presence of recurrent fixed costs. These effects can be particularly large in capital intensive heavy manufacturing and network services to which the regulatory policies are primarily directed.

4.1 Model structure

The scope of the model is detailed in Table 2. Firms in all industries are oligopolistic in their product pricing behaviour with the degree of price-setting collusion between them represented by conjectural variations parameters that are set to account for the degree of regulatory surveillance. Each firm bears fixed capital and labour costs, enabling the representation of unrealised economies of scale. In making this representation, it is recognised that the agricultural and light manufacturing sectors generate low pure profits and tend to have low fixed costs. Their more competitive behaviour is achieved in the model via parameterisation (larger firm numbers and lower fixed costs per firm), rather than distinct behavioural assumptions.

Home products in each industry are differentiated by variety via CES nests and output is Cobb-Douglas in variable factors and intermediate inputs. While firms are oligopolists in their product markets they have no oligopsony power as purchasers of primary factors or intermediate inputs.[25] A complete system of inter-industry flows is included so as to represent the dependence of tradable industries on inputs from abroad and from the heavy manufacturing and services sectors.

[25] Imports in each industrial category are seen as homogeneous, differentiated from home products as a group, so that import varietal diversity never changes. Oligopoly firms are assumed homogeneous so there can be movement on the "extensive margin" with entry and exit but there is no productivity differentiation of the type that is evident in the models of non-homogeneous export industries by Melitz (2003) and Balistreri et al. (2007).

The economy modelled is "almost small", implying that it has no power to influence border prices of its imports but its exports are differentiated from competing products abroad and hence face finite-elastic demand.[26] Apart from Australia's comparatively small economic size, the main reason that the "almost small" assumption is so common in national modelling is that countries specialise in their exports far more than they do in their imports. Australia exports mainly resource-based products, in accord with its comparative advantage, but it imports almost everything. It is therefore much less likely to have market power on the import side.

The consumer price index is constructed as a composite Cobb-Douglas-CES index of post-consumption-tax home product and post-tariff import prices, derived from the aggregate household's expenditure function. This formulation of the CPI aids in the analysis of welfare impacts. Because collective utility is also defined as a Cobb-Douglas combination of the volumes of consumption by generic product, proportional changes in overall economic welfare correspond with those in CPI-deflated GNP.[27] Government expenditure creates demands for goods and services via nested constant elasticity of substitution (CES) preferences and government revenue stems from a tax system that includes both direct (income) taxes levied separately on labour and capital income and indirect taxes including those on consumption, imports and exports. Income taxes are approximated by flat rates deduced as the quotient of revenue and the tax base in each case.

4.2 Oligopoly in supply

Firms in each industry supply differentiated products. They carry product-variety-specific fixed costs and interact on prices. Cobb-Douglas production drives variable costs so that average variable costs are constant if factor and intermediate product prices do not change but average total cost declines with output. Firms charge a mark-up over average variable cost

[26] The effective numeraire is the import product bundle. Consumer and GDP price indices are constructed for real aggregations, following the practice in national modelling since Dixon et al. (1982) and Harris (1984).

[27] When the utility function is Cobb-Douglas in consumption volumes, the expenditure function is Cobb-Douglas in prices. If the consumer price level, P^C, is defined as a Cobb-Douglas index of prices, the equivalent variation in income can be expressed in terms of the proportional change in this index. Thus, following any shock, the income equivalent of the resulting changes to income and prices is:

$$\Delta W = Y_1 - Y_0 + EV\left(P_0^C, P_1^C, Y_1\right) = Y_1 - Y_0 - Y_1 \frac{\Delta P^C}{P_1^C} \ ,$$

which can be expressed in proportional change form as:

$$\frac{\Delta W}{W} = \frac{Y_1\left(1 - \frac{\Delta P^C}{P_1^C}\right) - Y_0}{Y_0} \cong \frac{\Delta Y}{Y_0} - \frac{\Delta P^C}{P_1^C} \ .$$

This is, approximately, the proportional change in real GNP.

which they choose strategically. Their capacity to push their price beyond their average variable costs without being undercut by existing competitors then determines the level of any pure profits and, in the long run, the potential for entry by new firms. Excessive entry is possible in the sense of Mankiw and Whinston (1986) when shocks favour profitability but pure profits are constrained by free entry. Production runs contract and average fixed costs rise. The analysis presented here, however, emphasise cases in which the number of firms remain exogenous.

Each firm in industry *i* is regarded as producing a unique variety of its product and it faces a downward-sloping demand curve with elasticity ε_i (< 0). The optimal mark-up is then:

$$(2) \qquad m_i = \frac{p_i}{v_i} = \frac{1}{1+\frac{1}{\varepsilon_i}} \qquad \forall i \ ,$$

where p_i is the firm's product price, v_i is its average variable cost and ε_i is the elasticity of demand it faces. Firms choose their optimal price by taking account of the price-setting behaviour of other firms. A conjectural variations parameter in industry *i* is then defined as the influence of any individual firm *k*, on the price of firm *j*: $\mu_i = \partial p_{ij} / \partial p_{ik}$.

These parameters are exogenous, reflecting industry-specific free-rider behaviour and the power of price surveillance by regulatory agencies. The Nash equilibrium case is a non-collusive differentiated Bertrand oligopoly in which each firm chooses its price, taking the prices of all other firms as given. In this case the conjectural variations parameter μ is zero. When firms behave as a perfect cartel, it has the value unity. This parameter enters the analysis through the varietal demand elasticity.

Critical to the implications of imperfect competition in the model is that the product of each industry has exposure to four different sources of demand. The elasticity of demand faced by firms in industry *i*, ε_i, is therefore dependent on the elasticities of demand in these five markets, as well as the shares of the home product in each. They are final demand (*F*), intermediate demand (*I*), export demand (*X*) and government demand (*G*). For industry *i*, the elasticity that applies to (2), above, is a composite of the elasticities of all five sources of demand.

$$(3) \qquad \varepsilon_i = s_i^F \varepsilon_i^F + s_i^I \varepsilon_i^I + s_i^X \varepsilon_i^X + s_i^G \varepsilon_,^G \qquad \forall i$$

where s_i^j denotes the volume share of the home product in market *i* for each source of demand *j*. These share parameters are fully endogenous in the model and the elasticities depend on component elasticities of substitution and the conjectural variations parameters μ_i.[28] Thus, the strategic behaviour of firms, and hence the economic cost of oligopolies, is affected by collusive behaviour on the one hand and the composition of the demands faced by firms on the other, both of which act through the average elasticity of varietal demand. The collusive behaviour enters through conjectural variations parameters, μ_i , and composition through the demand shares s_i^j . Of course, the capacity firms have to reduce their prices also depends on the fixed cost burden carried by each industry and hence on firm numbers.

To study the effects of price-cap regulation a Ramsey mark-up, m_i^R is formulated as:

$$(4) \quad m_i^R = \frac{afc_i + v_i}{v_i} \ ,$$

where afc_i is average fixed cost and v_i is average variable cost in industry *i*. Compromise mark-ups can be simulated by altering the parameter φ_i in an equation for the "chosen" mark-up: $m_i^C = (\varphi_i - 1) m_i^R + (2 - \varphi_i) m_i \quad \forall i$. Thus, when $\varphi_i = 1$, $m_i^C = m_i$, thus maximising oligopoly profits, and when $\varphi_i = 2$, $m_i^C = m_i^R$, eliminating pure economic profits altogether.

4.3 The database and it's the calibration of pure profits and oligopoly parameters

The model database has two components. The first represents broad economic structure and flows of payments between households at home and abroad, firms and government. It combines detailed bilateral trade, transport and protection data characterizing economic linkages, together with national accounts, government accounts, balance of payments data and input-output tables which enable the quantification of inter-sectoral flows within regions. It is constructed from the GTAP global database.[29] The flows represented in the database do not reveal details of industrial structure, however. In particular, to model oligopolistic behaviour, additional information is required on firm numbers, pure profits, fixed costs and minimum efficient scale for each industry.

[28] The relationships are complex and are spelled out in the appendix.
[29] Documentation on the GTAP 5 Data Package (Dimaranan and McDougall 2002) may be viewed at: <http://www.gtap.agecon.purdue.edu/databases/v5/v5_doco.asp>.

With the support of the few industry studies already mentioned and the Morningstar Financial Analysis Database,[30] these variables are calibrated in the following manner. First, pure profits are required as a share of total revenue in each industry. This is needed to finalise the flow database by splitting capital payments between market and over-market returns. It is also a starting point for calibrating industry competitive structure. For this data on the profitability of listed firms is used to separate the components of capital income payments that represent the market returns that are paid to creditors from over-market returns paid to residual owners.[31] Details as to the approach are offered in the supporting appendix.

Second, rough estimates of strategically interacting firm numbers in each industry and their corresponding conjectural variations parameters are required. It is not sufficient simply to record the number of establishments in each industry, however. Unless industries are subdivided finely, considerable diversity of firm size and product is embodied in each. Indeed, within a particular industry classification, many firms supply intermediate inputs to other firms in the same classification. Prices of the products that emerge from a particular industry are very likely determined by a small proportion of the firms within it. Again, the Morningstar database is the source of measures of industry concentration. From these is assigned the crude index of firm numbers indicated in Table 4 and the corresponding conjectural variations parameters shown in the same table. Again, additional detail as to our approach is provided in the accompanying appendix.

Third, to complete the formulation of industry demand elasticities, elasticities of substitution between home product varieties and between generic home and foreign products are required for each sector. These are drawn from the estimation literature.[32] Initial industry demand elasticities are then calculated for each source of demand (final, intermediate, government and export), via the equations in the appendices, and the results are also listed in Table 4. Importantly for the interpretation of later results, Table 4 also makes clear that the four sources of demand facing firms in each industry are not equally elastic. Export and final

[30] The database is formally the *Aspect Financial Analysis Database.* It is supplied by Aspect-Huntley, and the copyright is held by Huntleys' Investment Information Pty Ltd (HII) (a wholly owned subsidiary of Morningstar, Inc).

[31] After tax profits rates are compared with the prime borrowing rate in the period 1997-2007 to obtain measures of pure profits. Firm statistics were drawn from http://www.aspectfinancial.com.au/af/finhome?xtm-licensee=finanalysis.for and the data on industrial borrowing rates was from www.rba.gov.au.

[32] Summaries of this literature are offered by Dimaranan and McDougall (2002) and at http://www.gtap.purdue.edu/databases/..

demand are the most elastic and intermediate demand the least.[33] It is further evident that, where exports dominate demand firms face larger elasticities and charge smaller mark-ups.

To continue the calibration, initial shares of the demand facing each industry are then drawn from the database to enable the calculation of weighted average demand elasticities for each industry. Mark-up ratios are then deduced from these via (2), thus fixing average variable cost in each industry. The initial equilibrium industry shares, average elasticities and mark-up ratios for each sector are given in Table 5. Note that the elasticities appear large in magnitude at first glance. This is because they do not represent the slopes of industry demand curves for generic goods. Rather, they are the elasticities faced by suppliers of individual varieties and are made larger by inter-varietal substitution.

This completes the demand side calibration. The corresponding calibration of the supply side commences with the use of the mark-up ratios to deduce the initial level of average variable cost in each sector. Then, the proportion pure profits make up of total turnover is deducted from the mark-up to arrive at fixed cost shares of total turnover.[34] Total recurrent fixed cost in each sector then follows. The results of this calibration are summarised in the first three columns of Table 6. It is now possible to obtain a sense of the scale of production.[35] Under our assumption of Cobb-Douglas technology in variable factor use, combined with recurrent fixed costs, if industries could expand indefinitely without changing unit factor rewards (the partial equilibrium assumption that is relaxed here), average fixed cost would approach average variable cost asymptotically from above. Following Harris and Cox (1983), an arbitrary minimum efficient scale (MES) product volume is chosen at the point where average fixed cost would decline to a twentieth of average variable cost. The implied scale parameters are displayed in the final column of Table 6. They confirm expectations that fixed costs are most prominent in electricity, gas, water, telecommunications and transport services, due to fixed physical infrastructure and network maintenance costs. The results also suggest, plausibly, that the sectors closest to their minimum efficient scale are agriculture, mining, finance and "other services".

[33] Export demand is found to be more elastic because of the larger number of substitutable product varieties available abroad while intermediate demand is relatively inelastic because of firms' reluctance to alter arrangements for intermediate input supply which may depend on location or "just in time" relationships.
[34] Fixed costs take the form of both physical and human capital costs using the rule of thumb (based on estimates by Harris and Cox, 1983) that physical capital has a fixed cost share of 5/6.
[35] The actual calibration process is more complex than this because the elasticities of intermediate demand depend on intermediate cost shares, which depend on the variable cost share. It is therefore necessary to calibrate iteratively for consistency of elasticities and shares.

5. Sectoral Interactions with Oligopoly

To explore the interdependence of the privatised service sectors and the potential impacts of their non-competitive behaviour on the economy as a whole a first set of experiments addresses the effects of the unfettered exploitation of market power in all sectors. In particular, on the presumption that oligopoly firms fail to collude and form cartels (or consolidate into monopolies) mainly because of government price surveillance and (the threat of) anti-trust actions, it is imagined what the Australian economy would have looked like had these government activities never occurred.[36] A long run closure is selected in which physical capital is internationally and intersectorally mobile and labour markets clear at flexible wages. To explore oligopoly effects, however, the number of firms in each sector is held constant and pure profits or losses are endogenous. The entire economy is first allowed to cartelise, by raising all conjectural variations parameters to unity.[37] Then, individual sectors are cartelised one by one in a bid to identify non-linearities that might imply the necessity of economy-wide analysis. The results are summarised in Table 7.[38]

Clearly the economy would have been substantially smaller if all sectors had been cartelised. Real GDP would have been smaller by a third and real wages smaller by more than half. In general, cartel rents imply higher home product prices and hence an appreciated real exchange rate and reduced trade with the rest of the world. The agricultural and mining sectors are exceptions in that, there, cartelisation reduces home production with less impact on product prices due to foreign competition. Mobile factors are shed by the tradable sectors, however, reducing their rewards and this tends to reduce services costs and hence to offset slightly the appreciation of the real exchange rate. Manufacturing is special because, as Table 8 shows, it uses and supplies mainly intermediate inputs. Since elasticities of substitution between intermediate inputs are low, home cartelisation sees service industry costs rise due to limited substitution to competing imports. If the cartelisation had only occurred in the recently

[36] This experiment is unrealistic even as a hypothetical, since it ignores the roles of contestability and the free rider problem in the maintenance of cartels.

[37] The number of firms is held constant in this closure but it is, in any case, immaterial so far as pricing is concerned when industries are cartelised. Consolidation to a monopoly would reduce fixed costs and thereby increase monopoly profits, however, a development not explored here.

[38] It stretches credibility to imagine that sectors with large numbers of small firms, such as agriculture, could overcome free rider and communication costs in this way. Taking agriculture as an example, however, the Australian sector is rife with organised "boards" designed to extract rents for farmers (Sieper, 1982). Even the "other services" sector is full of state and local government regulations directed at reducing competition, such as zoning rules for such specialist retail outlets as pharmacies and news agents. All this said, our purpose here is not to suggest that full cartelisation is possible or likely but merely to use this caricature of oligopolistic behaviour to explore economy-wide effects.

privatised services, electricity, water, gas, telecommunications, finance, transport and "other services", GDP would have been smaller by just over a tenth and real wages by almost a third.

The central block in the table indicates how cartelisation by each individual sector affects overall economic performance. It is clear that sectors like manufacturing and "other services", which have large initial shares of GDP, also have the largest impacts on the economy following cartelisation.[39] Cartelisation creates rents that accrue to capital owners. Yet it reduces output and therefore variable factor and input demand. Unit factor rewards to mobile factors therefore fall in all cases.[40] The only cartelisation that reduces the average gross rate of return on capital is that of the manufacturing sector. This is, again, because manufactured inputs are extensively used in other sectors, as indicated in Table 8, the performance of which are retarded by high manufactured product prices.

The bottom rows of Table 7 allow an assessment of the model's linearity in proportional changes following cartelisation shocks. Where collective cartelisation yields results different from the sum of the proportional changes due to sectoral cartelisation, the case for economy-wide analysis is made clearer. While this non-linearity is evident when the cartelising sectors include the tradable ones and the government-intensive "other services", it is not strong when only the privatised service sectors are included. Opposing sectoral interactions might be expected to cancel when cartelisation occurs in all sectors and so it follows that the gross effects are smaller in this case than when sectoral cartelisations are summed. When the traded sectors are included, however, the elastic supply of competing products from abroad appears to further damp the collective, relative to the sectoral, impacts of cartelisation. Even though non-linearity is not always strong, the case for economy-wide analysis is further supported by the substantial impacts on GDP and real wages of the individual sectoral cartelisations shown in the table.

The extent to which sectors interact is further clarified by Table 9, which shows the effects of cartelisation by the column sectors on gross rates of return in row sectors. The first row reproduces the sixth column of Table 7. The first column gives the effects on all sectors of cartelisation throughout the economy. From this it is evident that interaction between sectors causes gross returns in some to fall in spite of cartelisation. Manufacturing is one of these, for

[39] The water sector also has a comparatively large impact. This is because the firms involved are few and mainly state-owned and because they do not presently exploit their market power. With this, admittedly simplistic, representation of the water sector, the water price would increase by 600 per cent if they did.

[40] The possibility that rents might be shared with sectoral workforces is real in Australia, though it is not modelled here. See Dowrick (1993) and Mumford and Dowrick (1994).

the reasons indicated above. Electricity, water, finance and transport all yield net rises in rates of return in spite of higher input costs due to corresponding changes in other sectors. The second column shows that the effects of market power in the privatised services is large at the national level and as it affects returns in the tradable sectors. The non-diagonal elements indicate the extent of sectoral interaction. This is largest for manufacturing, for reasons discussed above, but it is also significant for network services that supply important intermediate inputs to other sectors, like electricity, telecommunications, finance and transport.

It might therefore be expected that sector specific, partial equilibrium approaches to the effects of oligopoly regulation are in error, first, because of the usual omission of economy-wide effects on factor prices and the real exchange rate. More importantly for the larger services industries and those that extract large oligopoly rents, because common changes in regulatory policy have large *collective* effects on factor prices, the real exchange rate and the costs of intermediate inputs used in each regulated industry, changes in regulatory policies or standards require economy-wide analysis.

Importantly, these experiments show that the price caps that control over-market profitability in telecommunications and finance cause measurable changes in factor rewards and the real exchange rate. Table 7 confirms that, relative to a baseline with full exploitation of their oligopoly power, the minimisation and redistribution of oligopoly rents in these industries collectively raises real wages by 14 per cent and depreciates the real exchange rate by six per cent. Thus, price caps in these industries are would appear to have significant effects on the performance of other sectors and the economy as a whole.

6. Sectoral Interactions from Perfect Price Cap Regulation

Here the initial equilibrium, with the pure profits generated in all sectors as indicated in Table 6, is subjected to tighter price cap regulation, whereby product prices are forced to equal average costs. The calibrated initial equilibrium, by comparison, reflects less perfect regulation. Indeed, regulation was probably influential at the time, particularly since realised pure profit shares appear modest or negative in the data, in all sectors except for telecommunications and finance. In the experiment, tight price caps are first imposed, via equation (4), simultaneously on all sectors. Because six of the 10 sectors do not earn pure profits this implies that mark-ups are regulated to decrease in only four and to increase in the

remaining six – an unrealistic prospect included only for completeness. The next experiment imposes tight price caps only on the four industries earning pure profits (agriculture and food, mining and energy, telecommunications and finance). Then tight price caps are imposed on the profitable privatised services only. This is followed by price caps on each of the profitable sectors individually. The effects on overall economic performance are given in Table 10.

The very first row of the table shows the effects of average cost pricing in all industries and, since six initially earn less than market rates of return, the results are net increases in mark-ups and prices, and declines in real wages. The more realistic imposition of tight price caps on the four profitable sectors, however, shows that considerable additional economic activity might be obtained in this way. GDP and real wages are boosted, at the expense of gross returns on assets. Interestingly, although the two profitable service industries are not significantly larger contributors to GDP than either agriculture and food on the one hand or mining and metals on the other, their price caps are the more significant because their initial profitability is higher (Table 6).

The results for individual industries bear this out. Indeed, it is the financial sector where reduced pure profits and hence lower product prices would have the most national impact. As in the cartelisation experiments of the previous section there is again a contrast between the real exchange rate effects of price caps in the tradable and the services sectors. In the tradable sectors reduced home product prices cause increased demand and expanded output and hence increased wages and resource rents. The services sectors face higher wage costs and hence raise their prices. But they also redirect their demand to meeting the intermediate requirements of the expanded tradable sectors and so the elasticities they face fall and their mark-ups rise. This further contributes to higher service prices and hence to net increases in the real exchange rate. The price caps on previously profitable services, on the other hand, merely reduce non-traded prices and the results are straight-forward Balassa-Samuelson real depreciations.

As in the case of cartelisation, the non-linearity of economy-wide responses to sectoral price caps is tested in the last two rows of the table. By contrast with the case of cartelisation, price caps on the four profitable sectors exhibit negligible non-linearity in proportional changes. These do not include shocks to the large and idiosyncratic manufacturing and “other services” sectors, and the magnitudes of the shocks are smaller than those due to cartelisation. So it would seem that the non-linearities are associated with the scale of shocks to prices and the

particular behaviour of manufacturing and "other services". This offers weak support for economy-wide treatment of the comparatively small oligopoly distortions not removed by existing policy. The direct inter-sectoral effects summarised in Table 11 offer further weak support in the sense that price caps in the services sectors have measurable economy-wide effects and that, especially in the case of finance, interactions are strong with the tradable goods sectors.

Important general equilibrium results do emerge from this analysis of residual distortions, however. Because the level of these residual distortions is comparatively large in telecommunications and finance, and because these industries are widely used throughout the economy as intermediate inputs, their residual oligopoly rents cause measurable changes in factor rewards and the real exchange rate. Indeed, the collective minimisation and redistribution of those residual rents would raise real wages by up to two per cent and depreciate the real exchange rate by between 0.2 and 0.8 per cent. Thus, the results suggest, yet more effective regulation of just these two industries would improve both aggregate performance and the distribution of economic gains.

7. Conclusions

An economy-wide model with oligopoly behaviour facilitates the analysis of inter-sectoral and economy-wide effects of oligopoly rents and their control via price-cap regulation, suggesting that these are potentially very large. The reasons for their size are threefold. First, the long run analysis allows the physical capital stock to expand perfectly elastically at an exogenous, internationally demanded rate of return; second, this expansion is facilitated by very elastic long run external demand for exported home products and this means only modest reductions in production cost make substantial capital expansion worthwhile; and third, the reductions in production cost from the simulated industrial reforms are better than modest and these are due both to more competitive pricing (allocative efficiency) and greater industrial scale in the presence of fixed costs.

Taking the extreme of cartelisation in each sector as a benchmark, the complete exploitation of market power in all sectors is shown to leave the economy smaller by a third. Even if the cartelisation had taken place only in the newly privatised services the model suggests that Australia's GDP would have been smaller by almost a quarter. More particularly, sectoral interactions due to the exploitation of oligopoly power are shown to be large enough to justify

an economy-wide approach. Indeed, sector specific, partial equilibrium approaches to the effects of oligopoly regulation are shown to be in error for two reasons. First, the usual omission of economy-wide effects on factor prices and the real exchange rate are clear, especially for the larger services industries and those that extract large oligopoly rents. More importantly, however, since regulation is so widespread and its effects consistent across regulated service industries, large collective effects are found on factor prices, the real exchange rate and the costs of intermediate inputs used in each regulated industry.

These large effects are not only observed for oligopoly behaviour in the major sectors of the economy but also in the recently privatised services, supplying as they do about a fifth of GDP. In particular, the price caps that control over-market profitability in telecommunications and finance cause measurable changes in factor rewards and the real exchange rate. Relative to a baseline with full exploitation of their oligopoly power, the minimisation and redistribution of oligopoly rents in these industries collectively raises real wages by 14 per cent and depreciates the real exchange rate by six per cent. Thus, price caps in these industries are shown to have significant effects on the performance of other sectors and the economy as a whole.

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Figure 1: Services Productivity and the Real Exchange Rate

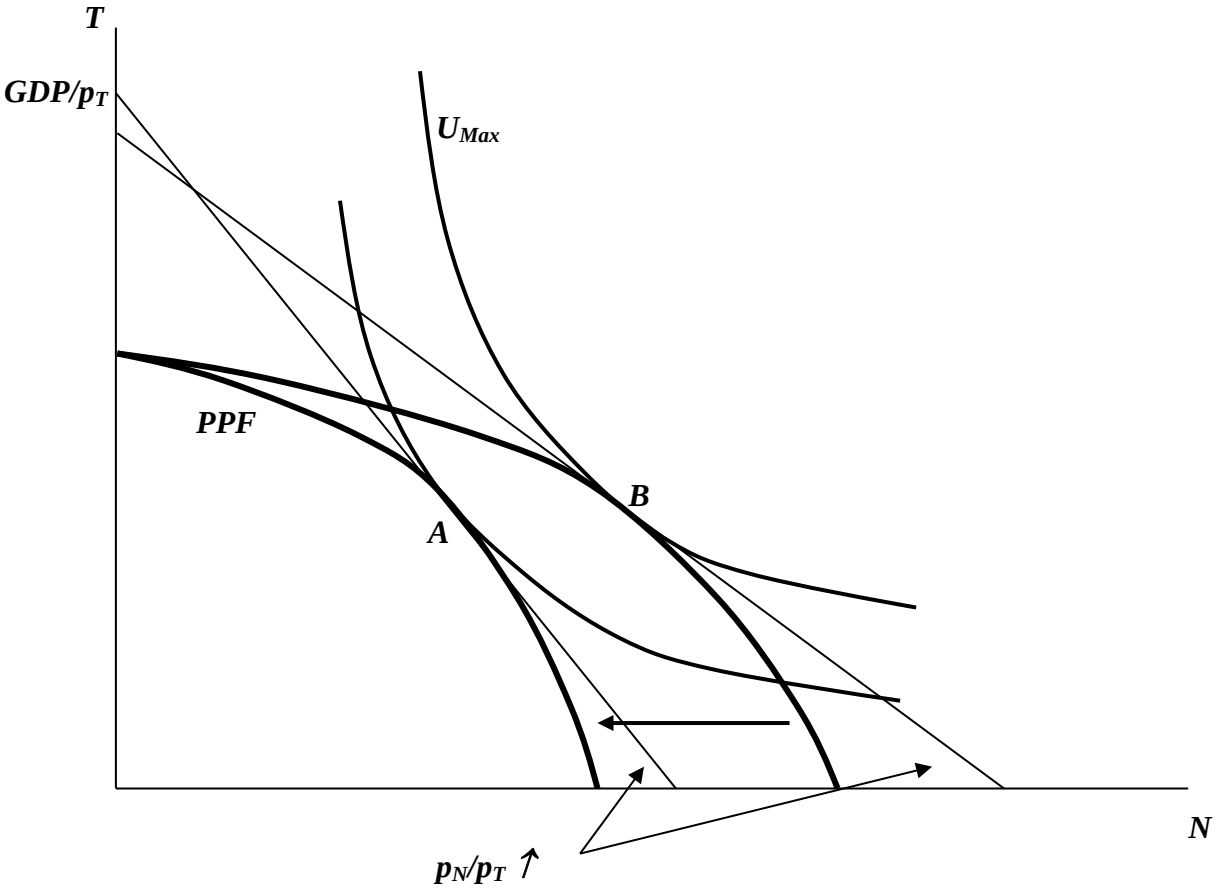

Table 1: Economic Significance of Privatised Services in the Model Database

	Value added share of GDP	Share of total exports	Export share of output
Agriculture	6.8	21.7	22.2
Manufacturing	14.0	40.5	19.4
Mining	5.5	20.3	43.8
Electricity	**1.9**	**0.0**	**0.2**
Water	**1.2**	**0.1**	**0.8**
Gas Distribution	**0.2**	**0.1**	**5.5**
Telecommunications	**3.1**	**1.5**	**6.5**
Finance	**7.4**	**2.2**	**4.2**
Transport	**5.2**	**2.0**	**3.8**
Other Services	54.7	11.6	2.3

Source: Model database (social accounting matrix), derived from Dimaranan and McDougall (2002).

Table 2: Factor Intensities by Industry[a]

	Natural resources	Skilled labour	Unskilled labour	Physical capital
Agriculture	12	7	46	34
Manufacturing	0	17	40	42
Mining	29	5	17	50
Electricity	0	8	14	78
Water	0	12	21	68
Gas Distribution	0	8	15	77
Telecommunications	0	22	23	55
Finance	0	23	25	52
Transport	0	12	33	55
Other Services	0	28	30	42

a These are factor shares of total value added in each industry, calculated from the database. Shares sum to 100 per cent horizontally.
Source: Model database (social accounting matrix), derived from Dimaranan and McDougall (2002).

Table 3: Model structure

Regions	Australia Rest of world
Primary factors	Natural resources (mineral, energy deposits) Land Skilled (professional) labour Unskilled (production) labour Physical capital
Sectors	Agriculture Manufacturing Mining, petroleum and minerals Electricity Water Gas manufacture and distribution Telecommunications Finance and insurance Transport Other services

Source: Aggregates of the 57 sector GTAP Version 5 database from Dimaranan and McDougall (2002).

Table 4: Conjectural Variations and Initial Elasticity Values

	Index of firm numbers[a]	Conjectural variations parameter	Demand elasticities			
			Final	Government	Intermediate	Export
Agriculture	50	0.1	-13.8	-13.8	-7.0	-14.3
Manufacturing	20	0.2	-12.7	-12.6	-5.7	-13.6
Mining	10	0.3	-11.2	-11.2	-6.4	-12.7
Electricity	6	0.4	-9.0	-9.2	-4.0	-10.5
Water	6	0.3	-9.9	-9.9	-4.3	-11.2
Gas Distribution	2	0.5	-5.3	-5.6	-3.1	-8.2
Telecommunications	4	0.6	-6.6	-6.6	-2.7	-8.7
Finance	10	0.5	-8.7	-8.7	-4.7	-10.0
Transport	10	0.5	-8.7	-8.7	-3.4	-10.0
Other Services	100	0.2	-12.7	-12.7	-4.2	-13.1

a This index represents the "effective" number of strategically interacting firms in each sector.
Sources: Effective firm numbers and conjectural variations parameters are crude estimates, based on industry concentration, from the Morningstar Financial Analysis Database of listed Australian firms. Elasticities are calculated via the equations in the appendices, where elasticities of substitution are sourced from surveys cited by Harris and Cox (1984) and Dimaranan and McDougall (2002).

Table 5: Initial Demand Shares, Average Elasticities and Mark-ups[a]

	Final demand share	Government demand share	Intermediate demand share	Export demand share	Average demand elasticity	Industry mark-ups[b]
Agriculture	43	0	34	22	-11.6	1.09
Manufacturing	17	0	64	19	-8.4	1.14
Mining	3	1	52	44	-9.4	1.12
Electricity	25	0	75	0	-5.2	1.24
Water	6	3	91	0	-4.9	1.26
Gas Distribution	12	0	83	4	-3.7	1.37
Telecommunications	28	0	65	6	-4.2	1.31
Finance	30	0	66	4	-6.1	1.20
Transport	21	25	50	4	-6.1	1.20
Other Services	45	22	31	2	-10.0	1.11

a All these variables are endogenous in the model. Initial (base) values are provided here.
b Industry mark-ups are the ratio of producer prices and average variable costs.
Source: Model database (social accounting matrix), derived from Dimaranan and McDougall (2002).

Table 6: Pure Profits, Fixed and Variable Cost Shares and Industry Scale[a]

Per cent of industry turnover	Pure profit	Fixed cost	Variable cost	Scale[b]
Agriculture	0.4	8.3	91.4	55
Manufacturing	-0.2	12.2	88.0	36
Mining	1.0	9.6	89.4	46
Electricity	-2.9	22.0	80.9	18
Water	-2.9	23.5	79.4	17
Gas distribution	-2.9	30.2	72.7	12
Telecommunications	4.8	19.1	76.1	20
Finance	9.1	7.2	83.6	58
Transport	-1.0	17.4	83.6	24
Other Services	-0.9	10.8	90.0	42

a The final three columns of the table are calibrated. First, elasticities are estimated, from which mark-up ratios are calculated. The pure profit shares are then used to deduce the fixed cost residual. The first three columns are shares of industry turnover.
b Scale is defined as the ratio (in %) of the gross quantity produced and minimum efficient scale, which in turn, is the level of output where unit fixed cost is 5% of unit variable cost.
Source: Pure profit proportions are from the Morningstar Financial Analysis Database of listed Australian firms.

Table 7: Effects of Cartelisation, Whole Economy and Individual Sectors[a]

Cartelisation of:	Real GNP	Real GDP	Real skilled wage	Real production wage	Real resource rent	Average gross rate of return[b]	Real exchange rate[c]
Whole economy	-22.9	-32.7	-54.7	-56.6	-48.4	46.1	24.8
Privatised services[d]	-12.0	-23.9	-28.7	-29.8	-25.2	9.8	19.2
Agriculture	-1.3	-0.3	-0.5	-3.1	-4.0	2.5	-0.9
Manufacturing	-10.5	-17.2	-18.9	-22.8	-10.6	-5.0	1.4
Mining & energy	-0.5	-1.3	-1.0	-1.1	-15.6	0.6	-0.2
Electricity	-2.6	-4.5	-4.7	-5.4	-6.6	0.7	1.9
Water	-3.2	-10.2	-10.7	-11.0	-10.7	0.4	9.1
Gas	-0.2	-0.3	-0.3	-0.4	-0.3	0.0	0.1
Telecommunications	-2.7	-4.9	-6.5	-6.0	-4.4	1.7	3.3
Finance	-2.4	-4.0	-6.7	-5.8	-3.8	3.6	3.0
Transport	-2.3	-4.2	-5.5	-7.2	-3.8	3.7	2.0
Other services	-13.3	-16.0	-39.5	-35.8	-29.1	42.0	21.8
Sum whole econ	-39.0	-62.9	-94.3	-98.5	-89.0	50.2	41.4
Sum privatised srv	-13.4	-28.1	-34.3	-35.7	-29.7	10.1	19.4

a The shock here is to raise the conjectural variations parameter from its baseline value to unity, for the whole economy, for the privatised service sectors only and, finally, for each sector in turn. The sums in the bottom rows simply add the sectoral effects to test the non-linearity of the response.
b The gross rate of return includes depreciation. It sums pure profits with (international) market capital returns and divides the total by the market value of the domestic capital stock, which is a volume measure times the current price of capital goods (an index of manufacturing and service prices). The changes shown are not percentage point or basis point changes. They are proportional changes in the rates of return, so that a rise in a rate from 5%/year to 6%/year constitutes a 20% change as displayed.
c The real exchange rate is the home GDP price divided by the foreign GDP price, where both are measured relative to unchanging import prices. In these experiments it is therefore the equivalent of the change in the home GDP price.
d "Privatised services" are electricity, water, gas, telecommunications, finance and transport.
Source: Simulations of the model described in the text, with fixed firm numbers but otherwise long run closures: full employment and flexible wages, mobile capital at a fixed exogenous rate of return.

Table 8: Intermediate Cost Shares of Total Turnover

	All inputs	Manufactured
Agriculture	65.9	13.6
Manufacturing	66.6	38.4
Mining	42.0	12.9
Electricity	49.5	4.3
Water	25.7	10.7
Gas Distribution	41.4	1.2
Telecommunications	34.9	10.9
Finance	31.2	1.3
Transport	51.9	18.2
Other Services	45.7	13.2

Source: Model database (social accounting matrix), derived from Dimaranan and McDougall (2002).

Table 9: Effects on Gross Rates of Return of Cartelisation in Each Sector[a]

% change	Whole economy	Privatised services[b]	Agriculture	Manufacturing	Mining energy	Electricity	Water	Gas	Telecoms	Finance	Transport	Other services
Average	**46.1**	**9.8**	**2.5**	**-5.0**	**0.6**	**0.7**	**0.4**	**0.0**	**1.7**	**3.6**	**3.7**	**42.0**
Agriculture	28.1	-6.4	**48.0**	-2.9	2.8	-0.6	-2.4	-0.1	-0.3	-0.3	-3.0	-9.0
Manufacturing	-11.6	-12.6	2.3	**16.6**	-0.7	-5.3	-2.7	-0.4	-1.3	-0.1	-3.5	-18.9
Mining & energy	-3.2	-4.5	3.5	-8.9	**17.0**	-3.2	-1.0	-0.1	-0.4	0.0	0.1	-9.6
Electricity	18.0	85.0	0.7	-21.2	-1.0	**99.5**	-2.3	-0.2	-0.8	-0.2	-1.0	-12.1
Water	74.3	230.4	-0.3	-6.9	-0.3	-1.0	**252.7**	-0.1	-0.5	-0.3	-0.6	-18.6
Gas	-25.3	14.8	0.1	-25.9	-0.7	-17.1	-2.1	**55.0**	-1.0	-0.1	-1.5	-12.6
Telecoms	19.4	76.6	-0.1	-10.7	-0.5	-1.4	-1.7	-0.1	**94.8**	-1.1	-1.9	-17.8
Finance	35.0	62.5	-0.2	-4.9	-0.2	-0.6	-0.9	0.0	-0.5	**69.0**	-0.6	-8.7
Transport	29.6	80.6	-1.9	-13.3	-0.2	-1.9	-1.8	-0.2	-1.4	-0.3	**96.8**	-11.5
Other services	78.2	-3.8	-0.1	-7.2	-0.3	-0.9	-1.2	-0.1	-0.6	-0.4	-0.8	**104.5**

a Here the conjectural variations parameter is shocked to a level of 1.0, indicating cartelisation, first in all sectors, then in only the "privatised services" and, finally, in each sector individually. The gross rate of return includes depreciation. It sums pure profits with (international) market capital returns and divides the total by the market value of the domestic capital stock, which is a volume measure times the current price of capital goods (an index of manufacturing and service prices). The changes shown are not percentage point or basis point changes. They are proportional changes in the rates of return, so that a rise in a rate from 5%/year to 6%/year constitutes a 20% change as displayed.

b "Privatised services" are electricity, water, gas, telecommunications, finance and transport.

Source: Simulations of the model described in the text.

Table 10: Effects of Price Caps, Whole Economy and Individual Sectors, %[a]

Price caps in:	Real GNP	Real GDP	Real skilled wage	Real production wage	Real resource rent	Average gross rate of return[c]	Real exchange rate[d]
Whole economy[b]	-0.34	-0.25	-0.09	-0.84	1.26	-0.27	-0.18
Profitable sectors	1.14	1.78	3.74	3.18	4.30	-2.91	-0.86
Prof priv services[e]	1.02	1.58	3.57	2.86	1.03	-2.62	-0.99
Agriculture	0.04	-0.02	0.00	0.17	0.26	-0.19	0.10
Mining & energy	0.09	0.23	0.17	0.20	3.40	-0.18	0.07
Telecommunications	0.26	0.39	0.75	0.62	0.26	-0.46	-0.22
Finance	0.75	1.17	2.78	2.20	0.76	-2.15	-0.76
Sum prof sectors	1.14	1.76	3.70	3.19	4.67	-2.98	-0.81
Sum prof priv srv	1.01	1.56	3.53	2.83	1.01	-2.61	-0.98

a The shock here is to impose regulated price caps ($P=AC$), for the whole economy, for the sectors with pure profits, for the privatised services among them and, finally, for each of the profitable sectors in turn. The sums in the bottom rows simply add the sectoral effects to test the non-linearity of the response.

b The first row differs in that $P=AC$ is enforced in all sectors, even those previously making pure losses – mark-ups in these sectors are therefore raised.

c The gross rate of return includes depreciation. It sums pure profits with (international) market capital returns and divides the total by the market value of the domestic capital stock, which is a volume measure times the current price of capital goods (an index of manufacturing and service prices). The changes shown are not percentage point or basis point changes. They are proportional changes in the rates of return, so that a rise in a rate from 5%/year to 6%/year constitutes a 20% change as displayed.

d The real exchange rate is the home GDP price divided by the foreign GDP price, where both are measured relative to unchanging import prices.

e "Privatised services" are electricity, water, gas, telecommunications, finance and transport. Profitable amongst these are telecommunications and finance.

Source: Simulations of the model described in the text, with fixed firm numbers but otherwise long run closures: full employment and flexible wages, mobile capital at a fixed exogenous rate of return.

Table 11: Effects on Gross Rates of Return of Price Caps in Each Sector[a]

% change	Whole economy[b]	All profitable sectors	All profitable privatised services[c]	Agriculture	Mining & energy	Telecoms	Finance
Average	**-0.27**	**-2.91**	**-2.62**	**-0.19**	**-0.18**	**-0.46**	**-2.15**
Agriculture	-2.97	-2.97	-0.35	**-2.96**	-0.55	-0.08	-0.27
Manufacturing	1.58	-0.43	-0.42	-0.16	0.10	0.04	-0.47
Mining & energy	-3.47	-3.46	-0.19	-0.25	**-3.45**	-0.01	-0.18
Electricity	7.31	0.06	-0.09	-0.05	0.19	0.05	-0.14
Water	5.69	0.08	0.02	0.02	0.05	0.02	0.00
Gas	6.26	-0.07	-0.17	-0.01	0.11	0.07	-0.25
Telecoms	-13.07	-13.05	-13.05	0.00	0.10	**-13.06**	0.40
Finance	-24.94	-24.94	-24.94	0.01	0.04	0.04	**-24.94**
Transport	3.71	0.15	0.02	0.12	0.04	0.14	-0.13
Other services	3.74	0.16	0.11	0.00	0.06	0.05	0.06

a The shock here is to impose regulated price caps ($P=AC$), for the whole economy, for the sectors with pure profits, for the privatised services among them and, finally, for each of the profitable sectors in turn. The sums in the bottom rows simply add the sectoral effects to test the non-linearity of the response. The gross rate of return includes depreciation. It sums pure profits with (international) market capital returns and divides the total by the market value of the domestic capital stock, which is a volume measure, times the current price of capital goods (an index of manufacturing and service prices). The changes shown are not percentage point or basis point changes. They are proportional changes in the rates of return, so that a rise in a rate from 5%/year to 6%/year constitutes a 20% change as displayed.

b Here $P=AC$ is enforced in all sectors, even those previously making pure losses – mark-ups in loss-making sectors are therefore raised.

c "Privatised services" are electricity, water, gas, telecommunications, finance and transport. Profitable amongst these are telecommunications and finance.

Source: Simulations of the model described in the text, with fixed firm numbers but otherwise long run closures: full employment and flexible wages, mobile capital at a fixed exogenous rate of return.

Optional Appendix to:

Looking Inward for Transformative Growth

A.1: The Model in Detail

This appendix complements the presentation of the model offered in the main text and so the analytics offered there are not repeated. It emphasises the representation of demand and production technology in the model and it details the tax system that is built into it. Although the model simulates only the real economy, an exchange rate is defined in the equations as a solution device. In one available closure its value adjusts to satisfy a balance of payments condition, thereby bringing about changes in domestic relative to international prices. Most often, however, an alternative closure is adopted in which the balance of payments condition is eliminated from the model and the artificial exchange rate fixed, so that all the adjustments to shocks are made by the home prices relative to those of imported products, which constitute the numeraire. The balance of payments condition is still met because it is implied by the household's and the government's budget constraints.

Mark-ups:

Oligopolistic firms operate in differentiated product markets and so each chooses its price, and hence mark-up, to take advantage of its monopoly over the supply of its own product variety. Thus, within each industry, each firm faces an elasticity of demand that depends on the number of other firms and the degree of pricing collusion between firms. Symmetry within each sector implies a common optimal unregulated mark-up for each firm, as in equation (2) of the main text.

Demand elasticities

These depend on the structure of the model, to be detailed below. They are essential to the capture of oligopoly behaviour since they determine the size of mark-up ratios, via equations (2) and (3) in the main text. For final demand the elasticity expression is:

$$\text{(A1.1)}\quad \varepsilon_i^F = -\eta_i^F + \frac{1}{n_i}\left\{\left(\sigma_i^F - 1\right)\delta_i^F\left(\frac{\hat{P}_{iH}}{\hat{P}_i^F}\right)^{(1-\sigma_i^F)} + \left(\eta_i^F - \sigma_i^F\right)\left(1+\left(n_i - 1\right)\mu_i\right)\right\},$$

where η_i^F is the elasticity of substitution of final demand across home varieties in sector *i*, δ_i^F is the home share in final demand for product *i*, σ_i^F is the elasticity of substitution of final demand for good *i* between domestic and foreign countries, n_i is the number of domestic firms in industry *i*, $\hat{P}_{iH}$ is the CES composite price of all home varieties of product *i*, and $\hat{P}_i^F$ is the CES composite of home and foreign final product prices in the domestic market, weighted by domestic consumption shares. Equation (A1.1) is derived in A.2, below.

The behaviour of government consumption and the expenditure of the capital goods sector on home and foreign products are similar, except that the government pays no import duties or consumption tax and the capital goods sector pays no import duties. Their composite prices are therefore formulated differently. Their structure is nonetheless the same:

$$\text{(A1.2)}\quad \varepsilon_i^{\,G} = -\eta_i^G + \frac{1}{n_i}\left\{\left(\sigma_i^G - 1\right)\delta_i^G\left(\frac{\hat{P}_{iH}}{\hat{P}_i^G}\right)^{(1-\sigma_i^G)} + \left(\eta_i^G - \sigma_i^G\right)\left(1+\left(n_i-1\right)\mu_i\right)\right\},$$

$$\text{(A1.3)}\quad \varepsilon_i^{\,V} = -\eta_i^V + \frac{1}{n_i}\left\{\left(\sigma_i^V - 1\right)\delta_i^V\left(\frac{\hat{P}_{iH}}{\hat{P}_i^V}\right)^{(1-\sigma_i^V)} + \left(\eta_i^V - \sigma_i^V\right)\left(1+\left(n_i-1\right)\mu_i\right)\right\}.$$

For the intermediate demand elasticity a similar expression is obtained:

$$\text{(A1.4)}\quad \varepsilon_i^{\,I} = \sum_{j=1}^{N} s_{ij}^{\,I}\left[-\eta_i^I + \frac{1}{n_i}(\gamma_{ij} + \sigma_i^I - 1)\phi_{ij}\left(\frac{\hat{P}_{iH}}{\hat{P}_i^I}\right)^{1-\sigma_i^I} + \left(\eta_i^I - \sigma_i^I\right)\left(1+\left(n_i-1\right)\mu_i\right)\right],$$

where $s_{ij}^{\,I}$ is the share of industry *j* in the total intermediate demand for input *i* and $\hat{P}_i^I$ is the CES composite of home and foreign intermediate product prices in the domestic market, weighted by domestic intermediate consumption shares.

For exports it is assumed that home firms face such competition in foreign markets that non-collusive pricing behaviour is necessitated. The foreign demand elasticity takes the same form as (A1.1), except that the foreign conjectural variation parameter, μ_i^X, is zero:

$$\text{(A1.5)}\quad \varepsilon_i^{\,X} = -\eta_i^X + \frac{1}{n_i}\left\{\left(\sigma_i^X - 1\right)\theta_i\left(\frac{\hat{P}_i^e}{\hat{P}_i^X}\right)^{(1-\sigma_i^X)} + \left(\eta_i^X - \sigma_i^X\right)\left(1+\left(n_i-1\right)\mu_i^X\right)\right\}$$

$$= -\eta_i^X + \frac{1}{n_i}\left\{\left(\sigma_i^X - 1\right)\theta_i\left(\frac{\hat{P}_i^e}{\hat{P}_i^X}\right)^{(1-\sigma_i^X)} + \left(\eta_i^X - \sigma_i^X\right)\right\},$$

where $\hat{P}_i^e$ is the CES composite foreign currency price of all exported varieties of product *I* and $\hat{P}_i^X$ is the CES composite of exported and competing foreign final product prices in the foreign market, weighted by foreign consumption shares. Foreigners differentiate home exports from corresponding foreign products with elasticity of substitution σ_i^X and home varieties from one another with elasticity of substitution η_i^X.

Domestic prices of imported goods:

These are:

$$\text{(A1.6)}\quad p_i^{\,*} = \frac{p_i^w(1+\tau_i^M)(1+\tau_i^C)}{e}$$

where p_i^w is the exogenous foreign currency price of goods produced in the rest of the world, τ_i^M is the ad valorem tariff rate and τ_i^C is the consumption tax rate on final demand for the products of industry *i*.

Domestic prices of home products:

As in equation (2) of the main text, these are marked up over average variable cost. To obtain average variable cost, note that production is Cobb-Douglas in variable factors and inputs, with output elasticities α_i for capital, β_{ki} for factors k and γ_{ji} for inputs *j* and that the subaggregation of imported and domestic inputs is CES. Unit variable costs are therefore calculated as:

$$\text{(A1.7)}\quad v_i = b_i r^{\alpha_i} \prod_{k=1}^{K} w_k^{\beta_{ki}} \prod_{j=1}^{N} \left[\hat{P}_{ji}^{\ I} \right]^{\gamma_{ji}} \qquad \forall i \ .$$

where the scale coefficient b_i is calibrated from the SAM, as are all the exponents in the equation, and $\hat{P}_{ji}^{\ I}$ is a CES composite of home and imported input prices weighted by the domestic and imported shares specific to consuming industry *i*:

$$\text{(A1.8)}\quad \hat{P}_{ji}^{\ I} = \left[\phi_{ji} \left(p_j \right)^{(1-\sigma_j^I)} + (1-\phi_{ji}) \left(p_j^* \right)^{(1-\sigma_j^I)} \right]^{\frac{1}{1-\sigma_j^I}} \ ,$$

where ϕ_{ji} is the domestic share of inputs from industry *j* in use by industry *i*. Then, domestic producer prices are simply higher by the mark-up, m_i: $p_i = m_i v_i$, $\forall i$.

Unit factor and input demands:

A full set of inter-industry flows is characterised in the model. The volumes of each intermediate demand are derived by solving the firm's cost minimisation problem with Cobb-Douglas production in variable factors and inputs. It is assumed that firms have no monopsony power in either factor or input markets. Therefore, the unit factor demands for capital and other factors are:

$$\text{(A1.9)}\quad u_i^K = \frac{\alpha_i v_i}{r} \qquad \forall i, \quad \text{and} \quad u_{ki}^L = \frac{\beta_{ki} v_i}{w_k} \qquad \forall k, i \ ,$$

where *k* denotes non-capital factors which are natural resources and skilled and unskilled labour.

The corresponding unit input demands are Leontief input-output coefficients, except that their values depend on product and input prices. For home-produced and imported inputs from industry *i* used in the product of industry *j*, respectively they are:

$$\text{(A1.10)}\qquad A_{ij} = \gamma_{ij} \frac{\phi_{ij} v_j}{\hat{P}_{ij}^{\ I}} \left(\frac{p_i}{\hat{P}_{ij}^{\ I}} \right)^{-\sigma_i^I} \ , \quad A_{ij}^{\ *} = \gamma_{ij} \frac{(1-\phi_{ij}) v_j}{\hat{P}_{ij}^{\ I}} \left(\frac{p_i^*}{\hat{P}_{ij}^{\ I}} \right)^{-\sigma_i^I} \qquad \forall i, j \ .$$

Prices of home product exports in foreign markets:

These are in foreign currency so they depend on the home producer price, the exchange rate, the export subsidy rate s_i^X and the foreign import tariff rate, τ_i^{*M}:

$$p_i^e = \frac{p_i\, e(1+\tau_i^{*M})}{(1+s_i^X)} \qquad \forall i \ . \tag{A1.11}$$

Export demand:

Foreigners differentiate home exports from corresponding foreign products with elasticity of substitution σ_i^X (>0) and home varieties from one another with elasticity of substitution η_i^X. This gives the following expression for foreign demand for variety *j* of home product *i*:

$$X_{ij} = \frac{\theta_i}{n_i}\left(\frac{E_i}{\hat{P}_i^X}\right)\left(\frac{p_i^{e0}}{\hat{P}_i^{X0}}\right)^{\Delta\sigma_i^X}\left(\frac{p_i^e}{\hat{P}_i^X}\right)^{-\left(\sigma_i^X+\Delta\sigma_i^X\right)}\left(\frac{p_{iHj}}{\hat{P}_i^e}\right)^{-\eta_i^X} , \tag{A1.12}$$

where θ_i is the calibrated reference share of the home export in total consumption, E_i is a calibrated constant representing foreign expenditure on exports from industry *i*, and $\hat{P}_i^X$ is a CES composite of the home export price, p_i^e, and the foreign product price, p_i^w, in the foreign market, weighted by foreign consumption shares. $\Delta\sigma_i^X$ is a shock that can be applied under short run conditions to reduce trade elasticities without affecting the database calibration. It requires the inclusion in the equation of the initial values for the home export price, p_i^{e0}, and the composite price of products abroad, $\hat{P}_i^{X0}$, so that the constant term is re-calibrated by the shock.

Final demand:

Home consumers differentiate home products from corresponding foreign products with elasticity of substitution σ_i^F (>0) and home varieties from one another with elasticity of substitution η_i^F. They have Cobb-Douglas utility in broad product groups, with the result that expenditure shares are constant across these groups. Final demand for variety *j* of home product group *i* is therefore:

$$D_{iHj} = \frac{\delta_i^F a_i^F}{n_i}\left(\frac{Y-T_Y}{\hat{P}_i^F}\right)\left(\frac{\hat{P}_{iH}}{\hat{P}_i^F}\right)^{-\sigma_i^F}\left(\frac{p_{iHj}}{\hat{P}_{iH}}\right)^{-\eta_i^F} . \tag{A1.13}$$

where a_i^F is the calibrated reference expenditure share of product group *i*, δ_i^F is the corresponding share of home goods in final demand for product *i*, *Y* is GNP, T_Y is total direct (income) tax, and the composite price is:

$$\hat{P}_i^F = \left[\delta_i^F (p_{iH})^{(1-\sigma_i^F)} + \left(1-\delta_i^F\right)(p_i^*)^{(1-\sigma_i^F)}\right]^{\frac{1}{1-\sigma_i^F}} , \tag{A1.14}$$

where the home share is δ_i^F. The expression for imports is correspondingly given by:

(A1.15) $$M_i^F = (1-\delta_i^F)a_i^F \left(\frac{Y-T_Y}{\hat{P}_i^F}\right)\left(\frac{p_i^*}{\hat{P}_i^F}\right)^{-\sigma_i^F}$$

Government demand:

The formulation adopted is similar to that for final demand by households. Total government expenditure, *G*, is endogenous in the simulations presented in the main text, where it is assumed that the government maintains a fixed fiscal deficit. This can be generalised in other applications to allow for fiscal policy shocks with exogenous government spending.

Tax revenue, and therefore the fiscal surplus or deficit, is endogenous, determined by the level of economic activity. Government expenditure is turned into demand for home produced products and imports, respectively, is given by:

(A1.16) $$G_{iHj} = \frac{\delta_i^G a_i^G}{n_i}\left(\frac{G}{\hat{P}_i^G}\right)\left(\frac{\hat{P}_{iH}}{\hat{P}_i^G}\right)^{-\sigma_i^G}\left(\frac{p_{iHj}}{\hat{P}_{iH}}\right)^{-\eta_i^G},$$

$$G_i^* = \left(1-\delta_i^G\right)a_i^G\left(\frac{G}{\hat{P}_i^G}\right)\left(\frac{p_i^*}{\hat{P}_i^G}\right)^{-\sigma_i^G},$$

where the composite price of government purchases is:

(A1.17) $$\hat{P}_i^G = \left[\delta_i^G\left(p_i\right)^{(1-\sigma_i^G)} + (1-\delta_i^G)\left(p_i^*\right)^{(1-\sigma_i^G)}\right]^{\frac{1}{1-\sigma_i^G}}$$

Demand for inputs:

This is derived from the input-output coefficients and gross industry output, *Q*, to be specified below. Demands for home-produced and imported varieties of the intermediate good *i* are:

(A1.18) $$I_i = \sum_{j=1}^{N} A_{ij} Q_j, \quad I_i^* = \sum_{j=1}^{N} A_{ij}^* Q_j \qquad \forall i$$

Tax revenue:

The government raises tax revenue from both direct and indirect taxation, the rates applied to each being exogenous and constant but the revenues earned then depend on levels of economic activity. The revenue raised from each source is expressed below.

Direct income tax revenue

(A1.19) $$T_Y = \sum_{i=1}^{N} \tau_{K_i}\left(rK_i + \pi_i\right) + \tau_U w_U L_U + \tau_S w_S L_S,$$

where K_i denotes total capital stock in industry *i*, π_i denotes total pure profit in industry *i* and the subscripts "*U*" and "*S*" denote unskilled and skilled labour (production workers and the combination of professionals and para-professionals as per the ILO classification of

occupations). Note that the tax rate on capital income is not generic. This enables the capture of tax policies that discriminate between sectors.

Consumption tax revenue

$$T_C = \sum_{i=1}^{N} \tau_i^C \, p_i D_i + \sum_{i=1}^{N} \tau_i^C \, p_i^* M_i \qquad \text{(A1.20)}$$

Import tariff revenue

$$T_M = \sum_{i=1}^{N} \tau_i^M (M_i + I_i^*) \frac{p_i^w}{e} \qquad \text{(A1.21)}$$

Export tax revenue

$$T_X = \sum_{i=1}^{N} (-s_i^X) \, p_i X_i \ , \qquad \text{(A1.22)}$$

where s_i^X denotes the net power of the export subsidy rate.

Total tax revenue is then simply a sum of the individual components above.

Pure or economic profits or losses:

These are calculated as revenue derived from mark-ups over unit variable costs, less total fixed costs. For sector *i*:

$$\pi_i = (p_i - v_i) Q_i - n_i (r \, f_i^K + w_S \, f_i^L) \qquad \forall i \ , \qquad \text{(A1.23)}$$

where n_i is the number of firms, f_i^K is the fixed capital requirement per firm and f_i^L is the fixed skilled labour requirement per firm in sector *i*. Net profit in industry *i* is therefore:

$$\pi_i^N = \left[(p_i - v_i) Q_i - n_i (r \, f_i^K + w_S \, f_i^L) \right] \left(1 - \tau_i^K \right) \qquad \forall i \qquad \text{(A1.24)}$$

National income (GNP):

This is the sum of payments to domestically owned factors of production with the home share of any net profits or losses made, the net income from indirect taxation and the net inflow from abroad, *B*, which represents the net income component of the current account and unrequited transfers.

$$Y = rK_D + \sum_{k=1}^{K} w_k L_k + \left(\frac{K_D}{K_T} \right) \sum_{i=1}^{N} \pi_i + \left(T - T_Y \right) + \frac{B}{e} + \left(1 - \frac{K_D}{K_T} \right) \tau_K^* \left(r \left(K_T - K_D \right) + \sum_{i=1}^{N} \pi_i \right) , \qquad \text{(A1.25)}$$

where T_Y is revenue from direct (income) tax. GDP, on the other hand, is a measure of the income from production in the domestic economy, so it excludes factor payments and other flows to and from abroad:

(A1.26) $$GDP = rK_T + \sum_{k=1}^{K} w_k L_k + \sum_{i=1}^{N} \pi_i + \left(T - T_Y\right)$$

Total factor demands:

The model has two capital market closures. In one (the "long run closure") physical capital is perfectly mobile abroad at the exogenous world interest rate *r*. In the other (the "short run closure"), physical capital stocks are fixed in each industry and industry rates of return are endogenous. Either way, physical capital is fully employed, with total demand having variable and fixed components:

(A1.27) $$K_T = \sum_{i=1}^{N} \left(u_i^K Q_i + n_i^D f_i^K\right),$$

where f_i^K is the total fixed cost outlaid by industry *i*. Similarly, the demand for skilled labour also includes a variable and fixed component. It is:

(A1.28) $$L_S = \sum_{i=1}^{N} \left(u_{Si}^L Q_i + n_i^D f_i^L\right)$$

Finally, demand for all other variable factors (unskilled labour and mineral-energy resources) is:

(A1.29) $$L_j = \sum_{i=1}^{N} \left(u_{ji}^L Q_i\right) \qquad j = 2,...,F$$

In the short run closure, employment of unskilled labour is endogenous, while either the real consumption or production wage is exogenous, so that unskilled labour can be unemployed.

A.2: Final Demand Elasticity with Price Interaction

Here the final demand elasticity is derived to illustrate the method by which all the elasticity expressions of Appendix I (A1.1 – A1.4) are arrived at. From (A1.13) the demand equation for domestic variety *j* of commodity *i* is:

(A2.1) $$d_{iHj} = \frac{\delta_i^F a_i^F}{n_i} \left(\frac{Y - T_Y}{\hat{P}_i^F}\right) \left(\frac{\hat{P}_{iH}}{\hat{P}_i^F}\right)^{-\sigma_i^F} \left(\frac{p_{iHj}}{\hat{P}_{iH}}\right)^{-\eta_i^F},$$

where the composite prices are the average price of generic product *i* available on the home market from both home production and imports:

(A2.2) $$\hat{P}_i^F = \left[\delta_i^F (p_{iH})^{(1-\sigma_i^F)} + \left(1 - \delta_i^F\right)(p_i^*)^{(1-\sigma_i^F)}\right]^{\frac{1}{1-\sigma_i^F}},$$

and the average price of home varieties of product *i*:[41]

[41] In equilibrium, because firms have identical technologies, these prices are equal, though this is not perceived by firms in setting their prices.

(A2.3) $\hat{P}_{iH} = \left[\frac{1}{n_i} \sum_{j=1}^{n_i} (p_{iHj})^{(1-\eta_i^F)} \right]^{\frac{1}{1-\eta_i^F}}$.

Substitute (A2.2) and (A2.3) into (A2.1) and the full demand equation can be re-written as:

$$d_{iHj} = \frac{\delta_i^F a_i^F}{n_i} \left(\frac{Y - T_Y}{\hat{P}_i^F} \right) \left(\frac{\hat{P}_{iH}}{\hat{P}_i^F} \right)^{-\sigma_i^F} \left(\frac{p_{iHj}}{\hat{P}_{iH}} \right)^{-\eta_i^F}$$

$$= \frac{\delta_i^F a_i^F}{n_i} (Y - T_Y) \left(\hat{P}_i^F \right)^{\sigma_i^F - 1} \left(\hat{P}_{iH} \right)^{(\eta_i^F - \sigma_i^F)} \left(p_{iHj} \right)^{-\eta_i^F}$$

$$= \frac{\delta_i^F a_i^F}{n_i} (Y - T_Y) \left[\delta_i^F (p_{iH})^{(1-\sigma_i^F)} + \left(1 - \delta_i^F\right) (p_i^*)^{(1-\sigma_i^F)} \right]^{-1} \left[\sum_{j=1}^{n_i} \frac{1}{n_i} (p_{iHj})^{(1-\eta_i^F)} \right]^{\frac{\eta_i^F - \sigma_i^F}{1-\eta_i^F}} \left(p_{iHj} \right)^{-\eta_i^F}$$

Differentiating with respect to p_{iHj} gives:

$$\frac{\partial d_{iHj}}{\partial p_{iHj}} = \frac{\delta_i^F a_i^F}{n_i} (Y - T_Y) \left\{ (-1) \left[\delta_i^F (p_{iH})^{(1-\sigma_i^F)} + \left(1 - \delta_i^F\right) (p_i^*)^{(1-\sigma_i^F)} \right]^{-2} \cdot \left(1 - \sigma_i^F\right) \delta_i^F (p_{iH})^{-\sigma_i^F} \cdot \left(\frac{1}{1-\eta_i^F} \right) \left[\sum_{j=1}^{n_i} \frac{1}{n_i} \left(p_{iHj} \right)^{1-\eta_i^F} \right]^{\frac{\eta_i^F}{1-\eta_i^F}} \left(1 - \eta_i^F\right) \frac{1}{n_i} \left(p_{iHj} \right)^{-\eta_i^F} \right\} \left(\hat{P}_{iH} \right)^{(\eta_i^F - \sigma_i^F)} \left(P_{iHj} \right)^{-\eta_i^F}$$

$$+ \frac{\delta_i^F a_i^F}{n_i} (Y - T_Y) \left\{ \left(\frac{\eta_i^F - \sigma_i^F}{1-\eta_i^F} \right) \left[\sum_{j=1}^{n_i} \frac{1}{n_i} \left(p_{iHj} \right)^{(1-\eta_i^F)} \right]^{\frac{\eta_i^F - \sigma_i^F}{1-\eta_i^F} - 1} \cdot \frac{\left(1 - \eta_i^F\right)}{n_i} \left[(p_{iH1})^{-\eta_i^F} \left(\frac{\partial p_{iH1}}{\partial p_{iHj}} \right) + (p_{iH2})^{-\eta_i^F} \left(\frac{\partial p_{iH2}}{\partial p_{iHj}} \right) + \cdots + \left(p_{iHj} \right)^{-\eta_i^F} \left(\frac{\partial p_{iHj}}{\partial p_{iHj}} \right) \right] \right\} \left(\hat{P}_i^F \right)^{\left(\sigma_i^F - 1\right)} \left(p_{iHj} \right)^{-\eta_i^F}$$

$$+ \frac{\delta_i^F a_i^F}{n_i} (Y - T_Y) \left\{ \left(-\eta_i^F \right) \left(p_{iHj} \right)^{\left(-\eta_i^F - 1\right)} \right\} \left(\hat{P}_i^F \right)^{\left(\sigma_i^F - 1\right)} \left(\hat{P}_{iH} \right)^{\eta_i^F - \sigma_i^F}$$

Noting that: $\frac{\partial p_{iHj}}{\partial p_{iHh}} = \begin{cases} \mu_i & j \neq h \\ 1 & j = h \end{cases}$,

and noting further that $p_{iHj} = p_{iHh} \quad \forall\, j \neq h$, because firms within an industry behave symmetrically, the expression can be written as:

$$\frac{\partial d_{iHj}}{\partial p_{iHj}} = \frac{\delta_i^F a_i^F}{n_i} (Y - T_Y) \left(\sigma_i^F - 1 \right) \left(\hat{P}_i^F \right)^{2(\sigma_i^F - 1)} \delta_i^F \cdot \frac{1}{n_i} \left(\hat{P}_{iH} \right)^{2(\eta_i^F - \sigma_i^F)} \left(p_{iHj} \right)^{-2\eta_i^F}$$

$$+ \frac{\delta_i^F a_i^F}{n_i} (Y - T_Y) \left(\eta_i^F - \sigma_i^F \right) \left(\hat{P}_{iH} \right)^{\left(2\eta_i^F - \sigma_i^F - 1\right)} \frac{1}{n_i} \left(p_{iHj} \right)^{-2\eta_i^F} \left(1 + \left(n_i - 1\right) \mu_i\right) \left(\hat{P}_i^F \right)^{\left(\sigma_i^F - 1\right)}$$

$$+ \frac{\delta_i^F a_i^F}{n_i} (Y - T_Y) \left(-\eta_i^F \right) \left(p_{iHj} \right)^{\left(-\eta_i^F - 1\right)} \left(\hat{P}_i^F \right)^{\left(\sigma_i^F - 1\right)} \left(\hat{P}_{iH} \right)^{\eta_i^F - \sigma_i^F}$$

This further simplifies to:

(A2.4) $$\frac{\partial d_{iHj}}{\partial p_{iHj}} = \frac{\delta_i^F a_i^F}{n_i} (Y - T_Y) \left(\hat{P}_i^F \right)^{\left(\sigma_i^F - 1\right)} \left(\hat{P}_{iH} \right)^{\eta_i^F - \sigma_i^F} \left(p_{iHj} \right)^{-\eta_i^F} \left\{ \begin{array}{l} \left(\sigma_i^F - 1 \right) \left(\hat{P}_i^F \right)^{\left(\sigma_i^F - 1\right)} \delta_i^F \cdot \frac{1}{n_i} \left(\hat{P}_{iH} \right)^{\left(\eta_i^F - \sigma_i^F\right)} \left(p_{iHj} \right)^{-\eta_i^F} + \\ \left(\eta_i^F - \sigma_i^F \right) \left(\hat{P}_{iH} \right)^{\left(\eta_i^F - 1\right)} \frac{1}{n_i} \left(p_{iHj} \right)^{-\eta_i^F} \left(1 + \left(n_i - 1\right) \mu_i\right) + \left(-\eta_i^F \right) \left(p_{iHj} \right)^{-1} \end{array} \right\}$$

So that the elasticity of final demand is:

$$\frac{\partial d_{iHj}}{\partial p_{iHj}} \cdot \frac{p_{iHj}}{d_{iHj}}$$

$$= \frac{\delta_i^F a_i^F}{n_i}(Y - T_Y)\left(\widehat{P_i^F}\right)^{(\sigma_i^F - 1)}\left(\hat{P}_{iH}\right)^{\eta_i^F - \sigma_i^F}\left(p_{iHj}\right)^{-\eta_i^F}$$

$$\cdot\left\{(\sigma_i^F - 1)\left(\widehat{P_i^F}\right)^{(\sigma_i^F - 1)}\delta_i^F \cdot \frac{1}{n_i}\left(\hat{P}_{iH}\right)^{(\eta_i^F - \sigma_i^F)}\left(p_{iHj}\right)^{-\eta_i^F} + (\eta_i^F - \sigma_i^F)\left(\hat{P}_{iH}\right)^{(\eta_i^F - 1)}\frac{1}{n_i}\left(p_{iHj}\right)^{-\eta_i^F}\left(1 + (n_i - 1)\mu_i\right) + (-\eta_i^F)\left(p_{iHj}\right)^{-1}\right\}$$

$$\cdot \frac{p_{iHj}}{\frac{\delta_i^F a_i^F}{n_i}(Y - T_Y)\left(\widehat{P_i^F}\right)^{(\sigma_i^F - 1)}\left(\hat{P}_{iH}\right)^{\eta_i^F - \sigma_i^F}\left(p_{iHj}\right)^{-\eta_i^F}}$$

On the symmetry assumption this simplifies to:

(A2.5) $$\boxed{\varepsilon_i^F = -\eta_i^F + \frac{1}{n_i}\left(\frac{p_{iHj}}{\hat{P}_{iH}}\right)^{1-\eta_i^F}\left\{(\sigma_i^F - 1)\delta_i^F\left(\frac{\hat{P}_{iH}}{\hat{P}_i^F}\right)^{(1-\sigma_i^F)} + (\eta_i^F - \sigma_i^F)\left(1 + (n_i - 1)\mu_i\right)\right\}}$$

A.3: Calibrating Oligopoly Parameters

No complete set of data on the structure and conduct of Australia's agricultural, manufacturing and mining sectors is publicly available. Some relevant data is available piecemeal, for individual sectors or industries, though this is occasionally at too fine a level of aggregation for an illustrative economy-wide study such as this. It has therefore been necessary to extrapolate patterns to some sectors and to make crude assumptions about others. To clarify our assumptions, this appendix offers an expansion of the summary given in Section 4 of the text.

First, estimates of pure (over-market) profits are required as shares of revenue in each industry. This is needed to finalise the flow database but also to calibrate industry competitive structure. For these we have resorted to data on the profitability of listed public firms from the Morningstar Aspect-Huntley Financial Analysis Database.[42] Accounting profit rates net of depreciation are compared with the prime borrowing rate available to corporate borrowers in the period 1997-2007 to obtain measures of pure profits. The data on industrial borrowing rates used in this comparison is from the RBA (www.rba.gov.au). The resulting paths of pure profits as a proportion of turnover are shown in Table A3.1.

This set of approximations is obviously precarious. It considers only listed firms, thus ignoring most of the farming community in agriculture and the small and family businesses in

[42] The database is formally the *Aspect Financial Analysis Database.* It is supplied by Aspect-Huntley, and the copyright is held by Huntleys' Investment Information Pty Ltd (HII) (a wholly owned subsidiary of Morningstar, Inc): http://www.aspectfinancial.com.au/af/finhome?xtm-licensee=finanalysis.for.

the services sectors, not to mention large private firms in all sectors and government-owned service firms. Moreover, the concordance with our sectoral breakdown is necessarily very crude, since beyond their ten sector classification, Morningstar's data gives only the names of listed firms and not their activity. Nonetheless, it offers the only clear indication of firm numbers, sizes and performance across the whole economy.

The results tend to show a declining trend in pure profit rates between 1997 and 2007. This might not reflect a trend in pure profitability, however, but merely short term and possibly unsustainable rise in listed asset values and an associated decline in P/E ratios. For this reason, and because we wish that the numbers used should be of sustained relevance, we have taken period averages and applied them to our model database to determine the initial level of over-market profits in each sector.

For estimates of "strategically interacting" firm numbers in each industry and their corresponding conjectural variations parameters, we examined industry structure in each sector, focussing on the numbers of firms with more than a tenth of market revenue. The results of this analysis are displayed in Table A3.2. In the end the values for the "effective" number of firms and the conjectural variations parameter in each sector are judgemental, taking into account the numbers of missing private firms and farms and the extent of regulatory surveillance limiting the full exploitation of oligopoly power.

Table A3.1: Estimated Pure Profits as % of Total Turnover[a]

%	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Adjusted period average[b]
Agriculture	0.4	0.4	0.7	0.4	0.2	0.6	1.0	0.9	-0.3	0.3	-0.5	0.4
Manufacturing	0.1	1.0	0.4	-1.0	-2.1	-0.9	1.9	1.2	1.3	-3.8	-0.7	-0.2
Mining & energy	-1.1	-0.1	-1.3	2.9	1.7	0.4	-0.2	1.4	2.8	5.3	-0.6	1.0
Electricity	-28.9	-13.1	4.4	-3.9	1.7	1.2	-0.2	-6.9	-7.5	-5.4	-9.6	-2.9
Water	-28.9	-13.1	4.4	-3.9	1.7	1.2	-0.2	-6.9	-7.5	-5.4	-9.6	-2.9
Gas	-28.9	-13.1	4.4	-3.9	1.7	1.2	-0.2	-6.9	-7.5	-5.4	-9.6	-2.9
Telecoms	11.3	7.0	-4.7	-2.8	6.8	6.9	8.7	4.3	6.0	7.7	1.5	4.8
Finance	18.3	7.3	66.6	-4.8	3.5	9.0	10.4	4.2	4.4	-10.8	0.1	9.1
Transport	-1.0	-2.9	-3.3	-4.3	-2.8	-0.7	5.2	3.3	-0.7	-4.7	0.9	-1.0
Other services	-1.9	-2.6	-2.8	-4.6	-3.4	-1.3	3.5	1.4	-2.0	-5.4	-1.4	-1.9

a These are pure profit rates derived by subtracting from the net (of depreciation) rate of return on equity the prime lending rate (the one year official borrowing rate plus 2%) They are then crudely concorded from the Morningstar classification (consumer staples, industrials, information technology, energy, materials, utilities, .telecommunication services, financials, consumer discretionary and health care) to that in the table.

b Some outlying peaks (including for financials in 1999) and troughs (including for information technology in 2000) are excluded.

Source: http://www.aspectfinancial.com.au/af/finhome?xtm-licensee=finanalysis.for.

Table A3.2: Estimated Market Structure[a]

	No listed firms	Listed firms >10%	Share of firms >10%	Effective no of firms[b]	Conjectural variations[c]
Agriculture	72	2	70	50	0.1
Manufacturing	300	3	34	20	0.2
Mining & energy	378	2	43	10	0.3
Electricity	19	3	64	6	0.4
Water	6	5	90	6	0.2
Gas	2	1	100	2	0.5
Telecoms	28	4	97	4	0.6
Finance	54	4	64	10	0.5
Transport	40	3	48	10	0.5
Other services	264	1	45	100	0.2

a These are crudely concorded from the Morningstar classification (consumer staples, industrials, information technology, energy, materials, utilities, .telecommunication services, financials, consumer discretionary and health care) to that in the table.

b These results are judgemental, based on the data in the first three columns. Firm numbers exceeding 100 have negligible effect on pricing. It is borne in mind that large numbers of farms and private firms are omitted from the data.

c the conjectural variations parameter ranges between zero (non-collusive oligopoly) and unity (cartel). The numbers chosen reflect industry concentration and the extent of existing regulatory surveillance.

Source: http://www.aspectfinancial.com.au/af/finhome?xtm-licensee=finanalysis.for.

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