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# Service Oligopolies and Australia's Economy-Wide Performance*

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# Service Oligopolies and Australia's Economy-Wide Performance


## 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, with the results confirming the merit of an economy-wide approach. External shocks, like the present "China boom", are also simulated. Such positive shocks are shown to expand the potential for oligopoly rents and therefore to raise the bar for regulatory agencies. Moreover, less than tight price caps are shown to exacerbate entry-exit hysteresis in boom and bust cycles.


## 1. Introduction

Following microeconomic reforms of the 1980s and 1990s, excluding government agencies, corporations subject to regulation now provide almost half of Australian's employment and of its GDP.[1] The analysis of regulatory regimes must, therefore, account for economy-wide implications, such as effects on the real exchange rate and factor markets as well as on other industries through the cost of intermediate services. This is best achieved by modelling the whole Australian economy in a way that allows explicitly for the monopoly and oligopoly behaviour requiring 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.

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 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

[1] See ABS 2003: Tables 21.2 and 21.3, with public service output and employment subtracted.

[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.

quality, we focus entirely on price regulation, including price surveillance as well as price caps, and hence the control of economic costs associated with distortions due to imperfect competition.

Some existing studies suggest an indirect link between the privatisation and regulatory reforms and productivity[3], while other studies 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) and Tyers (2005), 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 oligopoly, wherein considerable attention has been given to the "pro-competitive" effects of trade liberalisation (Hertel 1994; Ianchovichina et al. 2000; Tyers 2005).

In its new guise the model is structured to focus on the more commonly regulated services industries. To this end, a more complete representation of the Australian tax system is incorporated. This is needed for two reasons. First, the response of firms to regulation

[3] See, for example, Productivity Commission (1999), Madden et al. (2002).
[4] Classic partial equilibrium studies include those by Averch and Johnson (1962), Courville (1974) and Wellisz (1963).
[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 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).

depends on the rates of tax to which they are subject, and second, 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. It then assesses the potential for further gains from tighter capping of prices, once again giving emphasis to economy wide interactions. Finally, it offers a stylised representation of the Australian economy's response to the recent "China driven" global commodity boom, which directly affects its agricultural and mining sectors but which has raised the relative prices of Australian services and so it has important implications for oligopoly rents in services and their regulation. Indeed, the results show that the maintenance of tight price caps through the boom would measurably increase the benefit from it in the short run and avoid excessive entry in the long run should the effects of the boom be transitory.

The section to follow briefly reviews developments in the structure and regulation of Australia's services sector. Section 3 reviews the behavioural structure of the model used, the detailed description of which is consigned to appendices, and the economic structure embodied in its database. The potential economic losses from oligopoly behaviour are assessed in Section 4 while the gains to be derived from tighter price capping are considered in Section 5. The response of oligopolistic services to external shocks is examined in Section 6. Conclusions are offered in Section 7.

## 2. Regulation Research 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

[7] See Findlay (2000: 10).

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[9]: 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.[10] 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.[11]

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.[12] In telecommunications, air transport and the production and distribution of natural gas and electricity these changes have been stark.[13] 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.

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[8] *Ibid*. In the Australian context a recent 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 Stigler (1971).
[10] See Trade Practices Act 1974 (Cth), reviewed in Productivity Commission (2003).
[11] See ACCC (2003).
[12] We are grateful to Flavio Menezes for this point. For related discussion, see Menezes et al. (2006).
[13] See Doove et al. (2001: 43).

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.[14]

Theoretical studies have been highly stylised and sector-specific but they demonstrate 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.[15] Empirical follow-up by Xavier (1995) assesses price-cap schemes in the UK, the USA and Australia. His Australian focus is on the (then) Telecom basket price cap between 1989 and 1992. He finds 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. He takes 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 incorporates monopolistic competition in the goods market and bargaining in the single factor (labour) market. In seeking competition, a government might try to raise the elasticity of substitution. 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. The assumption of monopolistic competition leaves no pure profits to erode and invariant recurrent fixed costs must see the mark-up return to its original value, 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

[14] See Vogelsang and Acton (1989).
[15] The key works in this area are: Cabral and Riordan (1989), Bradley and Price (1988), and Brennan (1989).

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. We offer 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).[16] Telstra continues 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 facts suggest a high level of concentration, in areas such as mobile and long distance telephony and data transfer, competition is intense. Telstra's exploitable market power is in fixed telephony and network access.[17]

*Electricity*

New market mechanisms as well as regulatory reform have been introduced in this sector. It has nonetheless been found that generators, whose numbers remain small, have often been able 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.

*Gas*

[16] 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.
[17] For this point we are grateful to Flavio Menezes.

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.[18] 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.[19] 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).[20] The Code ensures that gas can be transmitted through the pipeline network on 'reasonable' terms and conditions, though in practice these have attracted controversy.

*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.[21] 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.[22] Hence, the government has largely deregulated airports, replacing price caps with price monitoring.[23] Debate continues, however, as new air service entrants seek access to airport services.

[18] See Short, C. et al. (2003).
[19] See Australia Daily (2004).
[20] See Moran (2002).
[21] See Freed (2004).
[22] See Productivity Commission (2002).
[23] 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.

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, our purpose is to take a broad brush to the estimation of economy wide effects of service oligopoly behaviour. We therefore work at the level of 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 we model them.

## 3. An Oligopoly Model of the Australian Economy

The model is a development of that used to examine pro-competitiveness effects of trade liberalisation in manufacturing by Tyers (2004, 2005).[24] The version described here differs in five key respects. First, behavioural equations have been added to represent the effects of regulatory policy, including Ramsey price-caps; second, a government sector has been included to distinguish the government's expenditures from those of the collective household. Previously, net revenue from border taxes was transferred to the collective household in lump-sum. Like the model's single private household, the government now has Cobb-Douglas preferences over goods and a constant elasticity of substitution (CES) sub-aggregation of home goods with imports. It is not, however, treated as an optimising agent maximising a utility function like the representative household.[25] A balanced budget is assumed so that government spending changes in line with tax revenue.

Third, the border tax system in the earlier version of the model has been extended to include a more detailed representation of Australia's tax system with both direct (income) taxes levied separately on labour and capital income and indirect taxes including those on consumption, imports and exports.[26] Fourth, a new database is constructed that emphasises Australia's service industries. This database incorporates government consumption and the complete tax system.[27] Fifth and finally, stability problems encountered in the tradable goods sectors due to a uniform structure suited to the more closed services sectors necessitated a

[24] It is a distant descendent of the models of Harris (1984) and Gunasekera and Tyers (1990).
[25] One approach, not adopted in this paper, would be to incorporate the government sector so that its spending and taxation decisions are endogenous and determined by the maximisation of an assumed social welfare function. The difficulty with such an approach is that it does not capture the political economy of government policy. Thanks are due to Chris Jones for useful discussions on this topic.
[26] Income taxes are approximated by flat rates deduced as the quotient of revenue and the tax base in each case.
[27] These first four advances are due to Rees (2004).

restructuring of the model's treatment of foreign goods. These are now considered homogeneous in each broad sector but differentiated from corresponding home products, which themselves are differentiated by variety.[28]

*Model structure*

The scope of the model is defined in Table 1. It divides the Australian economy into ten sectors, of which seven offer services, and four primary factors. The ten sectors are chosen to reflect the dominance of services in domestic demand and the importance of regulation to imperfectly competitive services sectors. Firms in all ten sectors are oligopolistic in their product pricing behaviour with the degree of price-setting collusion between firms represented by conjectural variations parameters. The magnitudes of these parameters are considered to represent the flexibility allowed the firms pricing behaviour by the surveillance of regulatory agencies. Each firm bears fixed capital and skilled labour costs, enabling the representation of unrealised economies of scale. Home products in each sector are differentiated by variety[29] and output is Cobb-Douglas in variable factors and intermediate inputs. Intermediate input demands are CES subaggregates of home and imported products. Despite their oligopoly power in product markets, firms have no oligopsony power in the markets for primary factors or intermediate inputs. The sophistication with which home product markets are represented notwithstanding, the modelling of a single economy necessitates crudeness in the representation of foreign firms. Thus, imports are seen as homogeneous, differentiated from home products as a group, so that import varietal diversity never changes.[30]

In the long run, physical capital is homogeneous and fully mobile between sectors and internationally, while the domestic endowments of other factors are fixed. A short run closure is also constructed, wherein capital use in each industry is fixed and rates of return on capital can vary between sectors. In this version, the closure can be adjusted correspondingly, so that the real wage of unskilled labour is fixed and unskilled employment is endogenous. The quantity of domestically-owned capital is fixed both in the short and long runs, so that

[28] The earlier version required very large elasticities of substitution between varieties, leading to unrealistic behaviour in response to changes in border tariffs. Moreover, in a single economy model there is no satisfactory way to endogenise the number of foreign product varieties.
[29] Product differentiation is assumed to be of the Spence-Dixit-Stiglitz type. This means that each individual derives utility from consuming a number of varieties of a given product.
[30] Since all home varieties are exported there is no movement on the "extensive margin" of the type that is evident in the models of non-homogeneous export sectors by Melitz(2003) and Balistreri et al. (2007). We see this as acceptable in this study because our focus is on largely non-traded services.

changes in the total capital stock affect the foreign ownership share and hence the level of income repatriated abroad. The economic profits or losses earned by firms are dependent on the closure, under which either the number of domestic firms (varieties) can be fixed while profits are endogenous, or flexible while economic profits are fixed.

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.[31] The effective numeraire is the import product bundle, since import prices are exogenous in all experiments. Its current account deficit (of about a tenth of its initial GDP) is fixed in terms of foreign prices in all experiments.[32] For presentational purposes, prices and values can be divided through by the consumer price or the GDP price index so that the initial consumption or production bundle becomes the numeraire. The consumer price index is constructed as a composite Cobb-Douglas-CES index of home product and after-tariff import prices, derived from the single household's expenditure function and measured after consumption taxes are applied. 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 product aggregate, proportional changes in overall economic welfare correspond with those in real GNP.[33]

Firms in any sector supply differentiated products and interact on price. Cobb-Douglas production drives variable costs so that average variable costs are constant if factor and intermediate product prices do not change. Consequently, while ever factor and intermediate product prices are constant, average total cost declines with output. The magnitudes of recurrent fixed costs are calibrated from data on industry profitability, gross

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[31] This follows the practice in national modelling since the first significant economy-wide model by Dixon et al. (1982) and the first published economy-wide oligopoly model by Harris (1984).

[32] This implies that the acquisition of Australian assets by foreigners remains constant irrespective of shocks imposed on the model and their consequences.

[33] 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.

value of output and value added.[34] Firms charge a mark-up over average variable cost so that it is at least possible for them to cover their average fixed cost in a zero-pure-profit monopolistic competition equilibrium. They choose this mark-up strategically, however, so that 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 the potential for entry by new firms. As intuition would suggest, under free entry pure profits are eroded and the mark-up just covers average total costs.

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 $\varepsilon_i$ (< 0). The optimal mark-up is then:

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

where $p_i$ is the firm's product price, $v_i$ is its average variable cost and $\varepsilon_i$ 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*:

$$(2) \qquad \mu_i = \frac{\partial p_{ij}}{\partial p_{ik}} \ .$$

These parameters are considered to indicate the power of price surveillance by such institutions as the ACCC. 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 (2) is zero. When firms behave as a perfect cartel, it has the value unity. This parameter enters the analysis through the varietal demand elasticity, which is formulated in Appendix 2.

To study the effects of price-caps a regulated Ramsey mark-up, $m_i^R$ is formulated as:

$$(3) \qquad m_i^R = \frac{afc_i + v_i}{v_i} \ .$$

Firms are permitted to choose compromise mark-ups by altering the parameter $\varphi_i$ in the following:

$$(4) \qquad m_i^C = (\varphi_i - 1) m_i^R + (2 - \varphi_i) m_i \qquad \forall i \ .$$

[34] In the starting equilibrium it is assumed that each industry has pure profits equal to one percent of gross earnings. Consistent secondary data are not readily available to determine the share of pure profits in capital returns in all industries.

Thus, when $\varphi_i = 1$, $m_i^C = m_i$, and when $\varphi_i = 2$, $m_i^C = m_i^R$.

Critical to the implications of imperfect competition in the model is that the product of each industry has exposure to four different markets. It can be consumed by private households or by government, used as an intermediate input in another industry or it can be exported. The elasticity of demand faced by firms in industry *i*, $\varepsilon_i$, is therefore dependent on the elasticities of demand in each of these four markets, as well as the shares of the home product in each. More precisely, the four sources of demand for home produced products are final demand (*F*), intermediate demand (*I*), export demand (*X*) and government demand (*G*). For sector *i*, the elasticity sought is a composite of the elasticities of all four sources of demand.

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

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. Because the different sources of demand are differently elastic, with export demand most elastic and intermediate demand least, any shock that reapportions demand between them necessarily changes the competitive behaviour of the firms.[35] Almost all conceivable shocks do this to some degree.

Thus, the strategic behaviour of firms, and hence the economic cost of service oligopolies, is affected by conjectural variations parameters as they represent collusive capacity on the one hand and regulatory price surveillance on the other, and by the composition of demand as it influences the elasticities of demand faced by each firm. Of course, the capacity firms have to reduce their prices also depends on their productivity performance, which we do not examine in this paper, and on their numbers, hence the sectoral fixed cost burden.

*The database and its representation of broad economic structure*

The model database is constructed from the GTAP Version 5 global database for 1997 (Dimaranan and McDougall 2002).[36] It combines detailed bilateral trade, transport and protection data characterizing economic linkages among regions, together with individual country national accounts, government accounts, balance of payments data and input-output

[35] 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. These issues are addressed by Harris and Cox (1983).

[36] Documentation on the GTAP 5 Data Package may be viewed at: <http://www.gtap.agecon.purdue.edu/databases/v5/v5_doco.asp>.

tables which enable the quantification of inter-sectoral flows within regions. From the database key elements of our representation of the Australian economy emerge. From Table 2, it is evident that the privatised services, electricity, water, gas, telecommunications, finance and transport, supply about a fifth of the economy's GDP, yet their participation in international trade is tiny compared with agriculture, manufacturing and mining. Moreover, the privatised services are shown in Table 3 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.

The flows represented in the database do not reveal details of industrial structure. In particular, additional information is required on firm numbers, pure profits, fixed costs and minimum efficient scale for each sector. While some details are available on these variables for some industries, there is no readily available source that is consistent and comparable across sectors. With the support of the few industry studies already mentioned and the Morningstar Financial Analysis Database,[37] these variables are calibrated in the following manner. First, pure profits are required as a share of total capital income (operating surplus) in each industry. This is needed to finalise the flow database but also to calibrate industry competitive structure. For this we have resorted to data on the profitability of listed firms from the Morningstar Database.[38] Additional detail as to our approach is offered in Appendix 3.

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, we resort to the Morningstar database for measures of industry concentration. From this we assign the crude index of firm numbers indicated in Table 4 and we also posit the corresponding conjectural variations parameters shown in the same table. Again, additional detail as to our approach is provided in Appendix 3.

[37] 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).

[38] 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.

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.[39] 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. 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, fixing average variable cost in each sector, via equation (1). 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. It enables us to turn to the calibration of the supply side, where we begin by using the mark-up ratios to deduce the initial level of average variable cost in each sector. Next, we turn to pure profits. The proportion these make up of total turnover is deducted from the mark-up to arrive at fixed cost shares of total turnover.[40] 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.[41] 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) we choose an arbitrary minimum efficient scale (MES) product volume 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

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

[40] 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.

[41] 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.

network maintenance costs. The results also suggest, plausibly, that the sectors closest to their minimum efficient scale are agriculture, mining, finance and "other services".

## 4. 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 we begin by considering the effects of complete 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,[42] we imagine what the Australian economy would have looked like had these government activities never occurred. A long run closure is selected in which physical capital is internationally and intersectorally mobile and labour markets clear at flexible wages. The entire economy is first allowed to cartelise, by raising all conjectural variations parameters to unity.[43] 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 of this exercise are summarised in Table 7.[44]

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, however, reducing their rewards and this tends to reduce services costs and hence to depreciate 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 privatised services, electricity,

[42] This ignores the roles of contestability and the free rider problem in the maintenance of cartels.
[43] 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.
[44] 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.

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.[45] 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.[46] 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 from 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 the reasons indicated above. Electricity, water, finance and transport all yield net

[45] 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. The water price would increase by 600 per cent if they did!

[46] 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).

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. Scanning the other columns, 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 services like electricity, telecommunications, finance and transport.

## 5. Sectoral Interactions under Price Cap Regulation

Here the initial equilibrium, with the pure profits generated in all sectors as indicated in Table 6, is subjected to tight price cap regulation, whereby product prices are forced to equal average costs. No such regulation is represented in the calibrated initial equilibrium, even though it was probably influential in 1997. Instead, the conjectural variations parameters are set to indicate considerable constraints to collusion in the oligopolies of the time, due to regulatory policies. In our 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 considerably 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 analysis. 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.

## 6. Oligopoly and External Shocks: the China Boom

Shocks to Australia's external terms of trade, to inflows on its capital account and in its trade policy regime all have obvious effects on its relatively small agricultural and industrial sectors. They also change the real exchange rate and hence they indirectly affect the state of its largely non-traded services sector. We show in this section that these indirect effects have implications for competitive behaviour in both the tradable and services sectors of the economy. They occur through the reapportionment of demand for oligopolistically supplied goods and services toward more elastic exports or less elastic intermediate demand, via equation (5).

Both the terms of trade and the current account balance have been affected by the recent "China boom". The extraordinary nature of the associated commodity price shocks is

clear from Figure 1. Money prices of wheat and iron ore, both major Australian exports, have risen in the last year or so by several hundreds of per cent. And the shocks go beyond those two commodities. Australia's overall terms of trade rose in this period by 50 per cent, as shown in Figure 2. At the same time, foreign acquisition of Australian assets has also risen, almost doubling the current account deficit (capital account surplus) between the turn of the century and 2007.[47] To examine the effects of these shocks on privatised service performance, we subject the model to 50 per cent increases in the foreign prices of agricultural products and mining and energy products, combined with an expansion of the current account deficit by 50 per cent.

This time we use both a short run closure, in which physical capital is fixed and specific to each sector and production (unskilled) employment is flexible at a fixed real wage, and a long run closure in which capital is internationally and intersectorally mobile and employment is fixed. The number of firms in each sector is held constant in the short run, allowing pure profits to vary. Two versions of the short run experiment are carried out. In the first, no price caps are imposed and firms are permitted to choose their mark-ups.[48] In the second, two new initial equilibria are first calculated, by imposing price caps either in all profitable sectors or in the profitable privatised services only. These price caps are then retained while the economy is subjected to the China boom shocks in each case. For the long run analysis the boom shock is first imposed with fixed numbers of firms. Then a new initial equilibrium is calculated in which entry and exit are allowed and pure profits reduced to zero. To this initial equilibrium the China boom shocks are applied in such a way as to retain zero pure profits but to allow entry of new firms.

Taken collectively, in both the short and long runs, these shocks are very positive for Australia. Their principal short run effects are indicated in the first column of Table 12. Real GNP, which serves as a preparedness to pay measure given the formulation we use (as discussed in Section 3), rises significantly, capital returns increase and either real wages or employment levels rise. There are "Dutch disease" elements, however (Corden and Neary 1982). The natural resource based sectors expand at the expense of manufacturing, which suffers from higher priced factors and inputs and a real appreciation impairs its competition

[47] It must be noted that these extraordinary shocks stem not only from the surge in the growth of China and other "economies in transition". The US-initiated financial crisis that began in 2007 saw a retreat to commodities, further boosting prices and capital flight from the US.

[48] Of course, their strategic interaction is assumed to be constrained by surveillance, which prevents the enlargement of their conjectural variations parameters.

against foreign products.[49] The service sectors expand, however, sufficiently to raise overall employment in the short run and real wages in the long run. The only significant exceptions to this are electricity and gas, which are large suppliers of inputs to manufacturing. Their gross output levels are lower with the boom. In the case of the gas sector, so also is its gross rate of return on capital.

Further insight as to the role of pricing behaviour in this short run simulation is available from the first column of Table 13. Mark-ups fall in the natural resource based sectors as the share of elastic exports in the demand they face increases. For the electricity sector, the mark-up falls because manufacturing's relatively inelastic intermediate demand contracts and so the elasticity it faces rises. With the exception of electricity the privatised service sectors all experience less elastic demand as the share of intermediate use by natural resource based sectors (and by each other) expands. This is particularly true of the telecommunications sector, which raises its mark-up, reduces its output and increases its pure profits by half. The boom therefore causes these sectors to exhibit less competitive behaviour that might be expected to challenge regulatory agencies.

Returning to Table 12, the remaining four columns detail the effects of the China boom shocks on the economy if price caps are maintained tight enough to eliminate all pure profits before and after the shocks. The imposition of the caps prevents industries from raising rents associated with the boom and, as a consequence, the short run gains from the boom are larger, by amounts that depend on the number of sectors subjected to the price caps. If all four profitable sectors are so regulated, the additional gain is nearly a per cent of real GNP. The real skilled wage would rise by a further per cent and production employment would rise by more. The increase in telecommunications output due to the boom would be larger by 1.5 per cent. Indeed, output volumes would be larger for all the service sectors. If the price caps were restricted to the profitable privatised services the constraining effects are smaller and the additional boost derived from the China boom is smaller accordingly. The caps do, nonetheless, yield measurable gains in economic performance that are evident in the labour markets and in the supply of water, gas, telecommunications finance and transport services.

Two apparently anomalous results emerge from Table 13. First, the manufacturing sector, which contracts in both the short and long runs (Table 14) and whose capital suffers

[49] These changes are observed in the Australian economy. Also, the real appreciation necessitates either inflation or a nominal appreciation. Australia's central bank prefers the latter, but to bring it about some monetary tightening is required, placing low-margin mortgage holders under pressure. This link is explored empirically by Bloch et al. (2006, 2007).

declines in its gross rates of return in both, appears to transition from negative to positive pure profits as a consequence of the boom. Recall that, in the short run, sectoral capital use is fixed. The overall gross return on manufacturing capital falls due to its reduced output. But the pure profit share of these returns rises because the real appreciation caused by the boom switches manufacturing demand away from elastic exports toward inelastic intermediate markets in the domestic economy. Its overall elasticity of demand falls and its mark-up therefore rises. The second anomaly is that the boom appears to reduce pure profits in mining in the short run. In this case the explanation is the reverse of that for the manufacturing anomaly. A substantial rise in the export share of mining output increases the elasticity of demand it faces and reduces the mining mark-up. Other things equal, this reduces the pure profit margin, and this is the dominant short run force.

The long run simulations, detailed in Tables 14 and 15, yield generally the same effects, with substantial overall gains to the economy tempered by the Dutch disease contraction of manufacturing and associated contractions in utilities, particularly the gas sector. The telecommunications sector also contracts, but all the other service sectors expand strongly. The overall gains are conspicuously smaller when free entry and exit are allowed. This is because the high profitability the boom brings to most sectors does raise output in the long run but induces new entry (Table 15) to the point that output per firm actually declines.[50] This raises the overall burden of fixed costs.

Returning to the apparently anomalous behaviour of manufacturing profits, although the manufacturing mark-up remains larger in the long run due to the boom, pure profits decline substantially. This occurs because capital use is flexible at a fixed rate of return in the long run, so lower returns in manufacturing cause its capital use to decline along with its output. In the first column of Table 15, however, firm exits are not allowed so that *fixed* capital use remains constant. On reduced output, average fixed costs therefore absorb the entire mark-up, causing the decline in pure profits. In the second column, where entry and exit are free, firm numbers (and therefore fixed costs) contract by a fifth, helping maintain the zero pure profit equilibrium. In the mining sector, where pure profits decline in the short run if no price cap is applied (because the mark-up declines), in the long run variable capital use expands considerably. When entry is prohibited output also expands and the average fixed cost margin declines. Pure profits therefore increase considerably (Table 15, first column).

[50] This is clear from a comparison of the changes in gross sectoral output in Table 14 with the corresponding changes in firm numbers in Table 15.

When entry is allowed, however, output and firm numbers expand by similar proportions and so average fixed costs change little, consistent with the absence of pure profits.

*Manufacturing redress?*

The negative consequences of the China boom for manufacturing have suggested to some that its protection should be reinstated, or at least that scheduled declines should be arrested.[51] To address this, we experimented with a rise in the power of the manufacturing tariff. While differences in the short and long run responses of the whole economy occur due to the complexities of mark-up choice and fixed cost margins discussed above, the dominant outcome from more manufacturing protection is an economy-wide contraction. Surprisingly, even the manufacturing sector itself fails to benefit from the tariff increase, both in the short and long runs. The answer to this further anomaly lies in the manufacturing sector's pattern of intermediate use, which is compared with that of other sectors in Table 8.

Of all the sectors manufacturing carries the highest share of intermediate input cost in total turnover and by far the largest share of manufactured intermediates, a third of which are imported. So there are two impacts of a tariff rise across the whole manufacturing sector. First, and strongest, is the effect on intermediate input costs. Second, and weaker, is the effect of the tariff in raising the price of competing foreign manufactured products. This effect is weaker because home manufactures are differentiated from foreign ones. Consumer substitution between them is therefore constrained. The results therefore fail to offer support for a return to protection to redress inequalities from the China boom. Moreover, because a tariff rise in so important a tradable goods sector tends to turn the whole economy inward reducing elasticities of demand, mark-ups rise in all sectors except electricity, transport and "other services". And, even though gross rates of return on capital fall across the board in both the short and long runs, industry scale also falls in all sectors, confirming that such a policy would doubly impair Australia's economic efficiency.[52]

*Boom-bust hysteresis*

Like all booms, that due to the present surge in Chinese growth is likely to be transitory. Sooner or later there will be a down-cycle. Yet, because in the up-cycle the

[51] Or, at least, that scheduled declines in protection should be halted. See, for example, The Age (2008), VACC (2008).

[52] Were such a policy to be considered in response to the China boom, for the manufacturing sector to be a clear beneficiary it would need to be given relief from tariffs on its manufactured intermediate inputs. While this would direct the benefits appropriately, the economic cost of the protection would remain large and be borne in other sectors and in labour markets.

expanding tradable goods sectors bolster demand for services as intermediate inputs and this demand is less elastic than that for final consumption, the service industries tend to price less competitively. Boom conditions therefore raise the bar for regulatory institutions. As seen earlier, if tight price caps are retained, even if only in the presently profitable privatised services, the benefits to the economy from the boom are shown be measurably increased.

Moreover, the boom encourages exits from manufacturing and entries into mining, agriculture and services, and presumably, the opposite in the following down-cycle. Some empirical evidence in support of excessive entry is offered in Table 16, which shows the numbers of firms listed on the ASX by Morningstar sector. Since 2002 the greatest expansions have been in the energy, materials (mining products) and services sectors. Since exit costs are non-zero, boom-bust cycles must accompany debilitating hysteresis.[53] This suggests that, at least for the services sectors, tight price caps serve two key purposes. First, they enlarge and better distribute the gains during up-cycles and, second, they prevent excessive entry and hence down-cycle exit costs.

## 7. Conclusions

An economy-wide model with oligopoly behaviour facilitates the analysis of inter-sectoral and economy-wide effects of oligopoly rents, suggesting that these are potentially very large. 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. This is not only true for oligopoly behaviour in the major sectors of the economy but also in the recently privatised services, supplying as they do only a fifth of GDP. Moreover, the price caps that would have eliminated over-market profitability in the food, mining and metals, telecommunications and finance sectors also cause measurable changes in factor rewards and the real exchange rate. Tighter price caps are shown to have significant effects on the performance of other sectors, particularly when applied to finance.

A final set of experiments subjects the model to a stylised representation of the recent China boom. The idea is to explore implications of boom conditions for competitive

[53] This is akin to the problem explored by Caballero and Lorenzoni (2007).

behaviour in the privatised services sectors and hence their regulation. The sheer scale of the boom is made clear, along with its net positive impacts on the economy as a whole. Because one of its key consequences is an appreciation of the real exchange rate, however, there is a relative rise in services prices. The service sectors therefore expand. Yet, because the expanding tradable goods sectors bolster demand for services as intermediate inputs and this demand is less elastic than that for final consumption, the service industries tend to price less competitively. Boom conditions are therefore likely to increase stress on regulatory institutions. If tight price caps could be retained across the economy, however, even if only in the privatised services, the benefits to the economy from the boom are shown be measurably larger. Moreover, because strong "Dutch disease" consequences are unavoidable, the boom encourages exits from manufacturing and entries into mining, agriculture and services. Since booms are invariably transitory and exit costs are non-zero, boom-bust cycles inevitably accompany debilitating hysteresis. This suggests some form of assistance to manufacturing during the boom to prevent excessive exit and tight price caps in services to prevent excessive entry.

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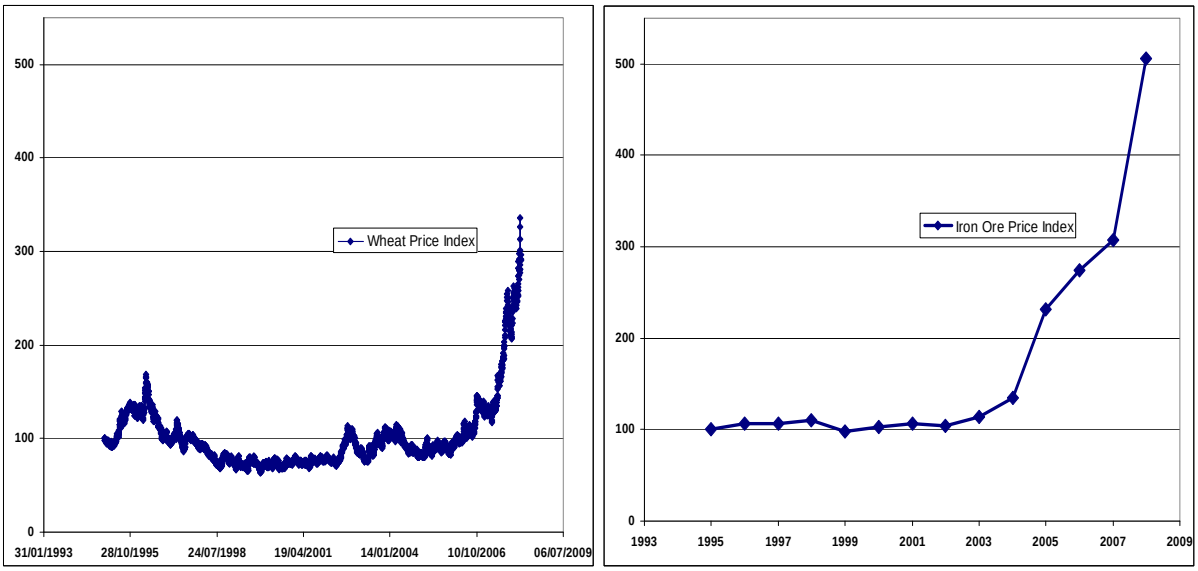
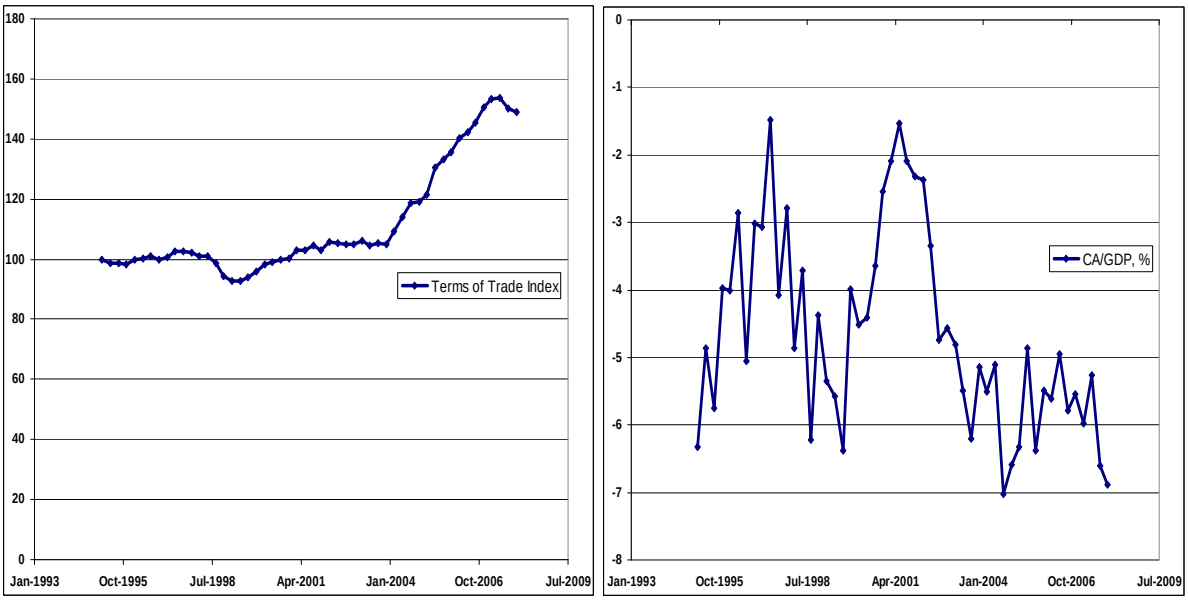
## Figure 1: Australia's "China Boom" Commodity Price Shocks




Sources: Wheat: Chicago board of trade daily wheat price in US$/bushel, from the Bloomberg Database. Iron ore: Hamersley fines, quoted in US cents/dmtu - dry iron units. If the ore shipped is 62% FE (the typical Hamersley grade) then the price per tonne of ore is the dmtu price ( for 2007 that would be US $0.82) X 62 which means US$50.84/tonne, from the IRL Database.

## Figure 2: Australia's Terms of Trade and Current Account Deficit




Sources: The terms of trade is here the quotient of the indices of export prices and import prices, where both indices are as supplied by the Australian Bureau of Statistics. The current account balance is in per cent of GDP, compiled quarterly, from the Australian Bureau of Statistics web site.

## Table 1: Model structure

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

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

## Table 2: 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 3: 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 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: Calibrated Pure Profit, Cost Shares and Industry Scale

| Per cent of industry turnover | Pure profit[a] | Fixed cost[a] | Variable cost[a] | 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.
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.

## Table 12: Short Run Economic Effects of the China Boom[a]

| % changes | No price caps | Price caps in profitable sectors[c] | | Price caps in profitable privatised services[d] | |
|---|---|---|---|---|---|
| | | | Diff due to caps | | Diff due to caps |
| Real GNP | 9.9 | 10.7 | 0.8 | 10.2 | 0.2 |
| Real GDP | 6.1 | 6.9 | 0.8 | 6.3 | 0.2 |
| Real exchange rate | 18.4 | 18.7 | 0.3 | 18.1 | -0.3 |
| Total capital use | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Real skilled wage | 1.8 | 2.8 | 1.0 | 2.0 | 0.2 |
| Real production wage | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Prodn employment | 5.2 | 6.7 | 1.5 | 5.5 | 0.3 |
| Real resource rent | 49.7 | 51.2 | 1.5 | 50.6 | 0.9 |
| Gross rate of return[b] | | | | | |
| Average, all sectors | 12.8 | 13.0 | 0.2 | 12.8 | 0.0 |
| Agriculture | 99.0 | 94.1 | -4.9 | 100.3 | 1.3 |
| Manufacturing | -22.5 | -23.2 | -0.7 | -22.2 | 0.3 |
| Mining & energy | 41.8 | 40.9 | -0.9 | 41.9 | 0.2 |
| Electricity | 3.3 | 5.1 | 1.8 | 3.6 | 0.3 |
| Water | 12.8 | 14.2 | 1.4 | 13.1 | 0.3 |
| Gas | -2.5 | -0.5 | 2.0 | -2.1 | 0.3 |
| Telecoms | 6.3 | 4.5 | -1.8 | 3.7 | -2.6 |
| Finance | 8.7 | 7.0 | -1.7 | 6.2 | -2.5 |
| Transport | 10.5 | 12.3 | 1.9 | 10.8 | 0.3 |
| Other services | 11.8 | 13.0 | 1.2 | 12.1 | 0.3 |
| Gross sectoral output | | | | | |
| Agriculture | 67.0 | 74.1 | 7.1 | 68.1 | 1.1 |
| Manufacturing | -27.0 | -25.0 | 2.0 | -26.8 | 0.2 |
| Mining & energy | 17.9 | 16.3 | -1.6 | 18.0 | 0.1 |
| Electricity | -3.8 | -3.1 | 0.7 | -3.7 | 0.1 |
| Water | 4.4 | 4.9 | 0.5 | 4.5 | 0.1 |
| Gas | -7.1 | -6.3 | 0.8 | -6.9 | 0.2 |
| Telecoms | -0.5 | 1.0 | 1.5 | 0.6 | 1.1 |
| Finance | 1.0 | 1.0 | 0.1 | 0.7 | -0.3 |
| Transport | 5.4 | 6.5 | 1.1 | 5.7 | 0.2 |
| Other services | 5.2 | 5.8 | 0.6 | 5.4 | 0.2 |

a Here the shock includes 50% rises in the international prices of agricultural and mining and energy products and an increase in capital account inflows by 50% (or about 5% of GDP). The short run closure has physical capital fixed in each sector and immobile internationally and the real wage of production labour fixed.

b The rate of return on physical capital is here gross of depreciation and inclusive of pure economic profits.

c This simulation commences with a modified initial equilibrium in which price caps are imposed on all profitable sectors, agriculture and food, mining and metals, telecommunications and finance, and pure profits are therefore driven to zero in these sectors. Price caps are assumed to be tightly applied on sectors potentially earning pure profits both before and after the China boom.

d This simulation commences with a modified initial equilibrium in which price caps are imposed only on the profitable privatised services sectors, telecommunications and finance, and pure profits in those sectors alone are therefore zero. Thus, price caps in these sectors alone are assumed to be tightly applied before and after the China boom.

Source: Simulations of the model described in the text.

## Table 13: The Role of Imperfectly Competitive Behaviour in the Short Run Response to the Boom[a]

| % changes | No price caps | Price caps in all profitable sectors[b] | | Price caps in privatised services[c] | |
|---|---|---|---|---|---|
| | | | Diff due to caps | | Diff due to caps |
| Mark-ups | | | | | |
| Agriculture | -0.21 | -0.90 | -0.69 | -0.21 | 0.00 |
| Manufacturing | 2.19 | 1.53 | -0.66 | 2.18 | -0.01 |
| Mining & energy | -1.15 | -0.56 | 0.58 | -1.15 | 0.00 |
| Electricity | -0.51 | -0.47 | 0.04 | -0.50 | 0.01 |
| Water | 0.20 | 0.21 | 0.01 | 0.20 | 0.00 |
| Gas | 1.51 | 1.56 | 0.05 | 1.48 | -0.03 |
| Telecoms | 1.52 | 0.17 | -1.35 | 0.18 | -1.35 |
| Finance | 0.32 | 0.01 | -0.32 | 0.01 | -0.31 |
| Transport | 0.67 | 0.74 | 0.07 | 0.67 | 0.00 |
| Other services | 0.03 | 0.04 | 0.01 | 0.03 | 0.00 |
| Prod prices rel to $P_{GDP}$ | | | | | |
| Agriculture | 5.6 | 4.9 | -0.8 | 5.7 | 0.1 |
| Manufacturing | -3.5 | -4.1 | -0.6 | -3.4 | 0.1 |
| Mining & energy | 13.5 | 13.6 | 0.1 | 13.7 | 0.2 |
| Electricity | 1.8 | 2.5 | 0.7 | 2.0 | 0.2 |
| Water | 0.7 | 1.2 | 0.5 | 0.8 | 0.1 |
| Gas | -1.4 | -0.7 | 0.7 | -1.2 | 0.2 |
| Telecoms | -1.9 | -2.6 | -0.8 | -2.8 | -1.0 |
| Finance | 0.3 | 0.2 | -0.1 | -0.1 | -0.5 |
| Transport | -3.5 | -3.4 | 0.2 | -3.5 | 0.1 |
| Other services | -0.8 | -0.6 | 0.2 | -0.8 | 0.0 |
| Pure profits | | | | | |
| Agriculture | 525 | .. | .. | 532 | 7 |
| Manufacturing | -293 | -100[d] | ..[d] | -297 | -4 |
| Mining & energy | -19 | .. | .. | -19 | 0 |
| Electricity | 50 | 49 | -1 | 50 | 0 |
| Water | 12 | 12 | 0 | 12 | 0 |
| Gas | -11 | -15 | -4 | -11 | 0 |
| Telecoms | 52 | .. | .. | .. | .. |
| Finance | 31 | .. | .. | .. | .. |
| Transport | -57 | -72 | -14 | -60 | -3 |
| Other services | 13 | 10 | -3 | 12 | -1 |

a Here the shock includes 50% rises in the international prices of agricultural and mining and energy products and an increase in capital account inflows by 50% (or about 5% of GDP). The short run closure has physical capital fixed in each sector and immobile internationally and the real wage of production labour fixed.

b This simulation commences with a modified initial equilibrium in which price caps are imposed on all profitable sectors, agriculture and food, mining and metals, telecommunications and finance, and pure profits are therefore driven to zero in these sectors. Price caps are assumed to be tightly applied on sectors potentially earning pure profits both before and after the China boom.

c This simulation commences with a modified initial equilibrium in which price caps are imposed only on the profitable privatised services sectors, telecommunications and finance, and pure profits in those sectors alone are therefore zero. Thus, price caps in these sectors alone are assumed to be tightly applied before and after the China boom.

d The manufacturing sector is initially unprofitable but is rendered profitable by the boom and so a price cap is also imposed on it in this simulation, forcing zero pure profits.

Source: Simulations of the model described in the text.

## Table 14: Long Run Economic Effects of a Sustained China Boom[a]

| % changes | No entry/exit[c] | Free entry/exit[d] |
|---|---|---|
| Real GNP | 10.8 | 9.5 |
| Real GDP | 9.0 | 7.8 |
| Real exchange rate | 19.5 | 19.6 |
| Total capital use | 9.5 | 12.3 |
| Real skilled wage | 2.9 | 3.2 |
| Real production wage | 8.0 | 7.9 |
| Production employment | 0.0 | 0.0 |
| Real resource rent | 76.8 | 76.6 |
| Gross rate of return[b] | | |
| Average, all sectors | 5.0 | 0.0 |
| Agriculture | 42.1 | 0.0 |
| Manufacturing | -18.0 | 0.0 |
| Mining & energy | 10.7 | 0.0 |
| Electricity | 0.1 | 0.0 |
| Water | 4.4 | 0.0 |
| Gas | -1.5 | 0.0 |
| Telecoms | 4.7 | 0.0 |
| Finance | 2.4 | 0.0 |
| Transport | 6.3 | 0.0 |
| Other services | 3.9 | 0.0 |
| Gross sectoral output | | |
| Agriculture | 81.3 | 80.0 |
| Manufacturing | -33.6 | -34.6 |
| Mining & energy | 57.2 | 57.5 |
| Electricity | 0.0 | -1.1 |
| Water | 9.7 | 8.8 |
| Gas | -8.7 | -9.7 |
| Telecoms | -1.3 | -2.3 |
| Finance | 2.2 | 1.0 |
| Transport | 6.2 | 5.1 |
| Other services | 6.5 | 5.2 |

a Here the shock includes 50% rises in the international prices of agricultural and mining and energy products and an increase in capital account inflows by 50% (or about 5% of GDP). The long run closure has physical capital mobile internationally and intersectorally and the supply of production labour fixed.
b The rate of return on physical capital is here gross of depreciation and inclusive of pure economic profits.
c The "no entry and exit" simulation begins with the original initial equilibrium, which includes firms earning pure profits in each sector.
d The "free entry and exit" simulation begins from a zero pure profit development of the initial equilibrium, generated by a long run simulation in which entry and exit are free and pure profits are shocked down to zero.
Source: Simulations of the model described in the text.

## Table 15: The Role of Imperfectly Competitive Behaviour in the Long Run Response to a Sustained China Boom[a]

| % changes | No entry/exit[b] | Free entry/exit[c] |
|---|---|---|
| Mark-ups | | |
| Agriculture | -0.22 | -0.27 |
| Manufacturing | 2.67 | 2.86 |
| Mining & energy | -1.49 | -1.63 |
| Electricity | -0.45 | -0.43 |
| Water | 0.21 | -0.19 |
| Gas | 1.63 | 2.23 |
| Telecoms | 1.75 | 1.35 |
| Finance | 0.38 | 0.31 |
| Transport | 0.77 | 0.63 |
| Other services | 0.06 | 0.05 |
| Prod prices rel to $P_{GDP}$ | | |
| Agriculture | 3.2 | 3.1 |
| Manufacturing | 0.3 | 0.5 |
| Mining & energy | 7.4 | 7.2 |
| Electricity | -0.8 | -0.8 |
| Water | -2.7 | -3.1 |
| Gas | 0.3 | 0.8 |
| Telecoms | -0.4 | -0.7 |
| Finance | 0.4 | 0.3 |
| Transport | -2.8 | -2.9 |
| Other services | -0.9 | -0.9 |
| Pure profits | | |
| Agriculture | 2532 | 0.0 |
| Manufacturing | 1151 | 0.0 |
| Mining & energy | 675 | 0.0 |
| Electricity | 22 | 0.0 |
| Water | -70 | 0.0 |
| Gas | 43 | 0.0 |
| Telecoms | 63 | 0.0 |
| Finance | 39 | 0.0 |
| Transport | -182 | 0.0 |
| Other services | -104 | 0.0 |
| Effective number of firms | | |
| Agriculture | 0.0 | 89.0 |
| Manufacturing | 0.0 | -18.4 |
| Mining & energy | 0.0 | 54.2 |
| Electricity | 0.0 | -0.7 |
| Water | 0.0 | 6.9 |
| Gas | 0.0 | -1.6 |
| Telecoms | 0.0 | 5.2 |
| Finance | 0.0 | 13.0 |
| Transport | 0.0 | 7.8 |
| Other services | 0.0 | 7.1 |

a Here the shock includes 50% rises in the international prices of agricultural and mining and energy products and an increase in capital account inflows by 50% (or about 5% of GDP). The long run closure has physical capital mobile internationally and intersectorally and the supply of production labour fixed.
b The "no entry and exit" simulation begins with the original initial equilibrium, which includes firms earning pure profits in each sector.
c The "free entry and exit" simulation begins from a zero pure profit development of the initial equilibrium, generated by a long run simulation in which entry and exit are free and pure profits are shocked down to zero.
Source: Simulations of the model described in the text.

## Table 16: Changes in the Numbers of Listed Firms in Australia 1997-2007: Sectors Ranked on Ratio of 2007 to 2002 Numbers[a]

| Morningstar sector | 1997 | 2002 | 2007 | 2007/1997 | 2007/2002 |
|---|---|---|---|---|---|
| Energy | 72 | 97 | 150 | 2.1 | 1.5 |
| Health Care | 57 | 120 | 163 | 2.9 | 1.4 |
| Materials | 252 | 319 | 414 | 1.6 | 1.3 |
| **All listed firms** | **847** | **1226** | **1428** | **1.7** | **1.2** |
| Industrials | 133 | 184 | 208 | 1.6 | 1.1 |
| Telecommunications | 18 | 32 | 36 | 2.0 | 1.1 |
| Utilities | 10 | 24 | 26 | 2.6 | 1.1 |
| Financials | 35 | 62 | 67 | 1.9 | 1.1 |
| Consumer Discretionary | 131 | 185 | 185 | 1.4 | 1.0 |
| Consumer Staples | 61 | 72 | 65 | 1.1 | 0.9 |

Source: *Aspect Financial Analysis Database*, Morningstar Inc.

## Appendix 1: The Model in Detail

We model the real economy and so incorporate no markets for money or other assets. An exchange rate is defined primarily as a solution device. Its value adjusts to satisfy a balance of payments condition, thereby bringing about changes in relative domestic prices. Most often, however, the balance of payments condition is eliminated from the model by a closure adjustment, and the artificial exchange rate fixed, so that all the adjustments to shocks are made by the home prices relative to the bundle of imported products as the numeraire. The balance of payments condition is still met because it is implied by the household's and the government's budget constraints. The artificial exchange rate serves no valuable purpose as a product of model since what matters for trade and relative service sector performance is the real exchange rate – the "common currency" (in this case "common numeraire") average price of home relative to foreign products and services.

**Demand elasticities**

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 $\eta_i^F$ is the elasticity of substitution of final demand home varieties *i*, $\delta_i^F$ is the home share in final demand for product *i*, $\sigma_i^F$ 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 prices of home varieties, 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. This expression is derived in Appendix 2.

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, $\mu_i^X$, is zero:

(A1.2) $$\varepsilon_i^X = -\eta_i^X + \frac{1}{n_i}\left\{\left(\sigma_i^X - 1\right)\theta_i\left(\frac{\hat{P}_i^e}{\hat{P}_i^X}\right)^{(1-\sigma_i^X)} + \left(\eta_i^X - \sigma_i^X\right)\left(1+\left(n_i - 1\right)\mu_i^X\right)\right\}$$

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

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 $\sigma_i^X$ and home varieties from one another with elasticity of substitution $\eta_i^X$.

For intermediate demand the expression is:

(A1.3) $$\varepsilon_i^I = \sum_{j=1}^{N} s_{ij}^I \left[-\eta_i^I + \frac{1}{n_i}(\gamma_{ij} + \sigma_i^I - 1)\phi_{ij}\left(\frac{\hat{P}_{iH}}{\hat{P}_i^I}\right)^{1-\sigma_i^I} + \left(\eta_i^I - \sigma_i^I\right)\left(1+\left(n_i - 1\right)\mu_i\right)\right]$$

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. The corresponding expression for the elasticity of government demand is:

(A1.4) $$\varepsilon_i^G = -\eta_i^G + \frac{1}{n_i}\left\{\left(\sigma_i^G - 1\right)\delta_i^G\left(\frac{\hat{P}_{iH}}{\hat{P}_i^G}\right)^{(1-\sigma_i^G)} + \left(\eta_i^G - \sigma_i^G\right)\left(1+\left(n_i - 1\right)\mu_i\right)\right\}$$

**Mark-ups:**

We assume constant marginal cost oligopolistic firms in the differentiated product markets. The assumption of symmetry within each sector implies a common optimal unregulated mark-up for each firm, as in equation (1) of the main text.

**Domestic prices of imported goods:**

These are:

(A1.5) $$p_i^* = \frac{p_i^w(1+\tau_i^M)(1+\tau_i^C)}{e}$$

where $p_i^w$ is the exogenous foreign currency price of goods produced in the rest of the world, $\tau_i^M$ is the ad valorem tariff rate and $\tau_i^C$ is the indirect consumption tax in industry *i*.

**Domestic prices of home products:**

As in equation (1) of the main text, these are marked up over average variable cost. To obtain the latter, recall that production is Cobb-Douglas in variable factors and inputs, with output elasticities $\alpha_i$ for capital, $\beta_{ki}$ for factors k and $\gamma_{ji}$ for inputs $j$ and that the subaggregation of imported and domestic inputs is CES. Unit variable costs are therefore calculated as:

$$\text{(A1.6)}\quad v_i = b_i r^{\alpha_i} \prod_{k=1}^{K} w_k^{\beta_{ki}} \prod_{j=1}^{N} \left[ \hat{P}_{ji}^{\ I} \right]^{\gamma_{ji}} \qquad \forall i$$

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 $i$:

$$\text{(A1.7)}\quad \hat{P}_{ji}^{\ I} = \left[ \phi_{ji} \left( p_j \right)^{(1-\sigma_j^I)} + (1-\phi_{ji}) \left( p_j^* \right)^{(1-\sigma_j^I)} \right]^{\frac{1}{1-\sigma_j^I}}$$

where $\phi_{ji}$ 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:**

These are derived by solving the firm's cost minimisation problem with Cobb-Douglas production in variable factors and inputs. It is assumed that firms are price takers in both factor and input markets. Therefore, the unit factor demands for capital and other factors are:

$$\text{(A1.8)}\quad u_i^K = \frac{\alpha_i v_i}{r} \qquad \forall i, \text{ and } \quad u_{ki}^L = \frac{\beta_{ki} v_i}{w_k} \qquad \forall k, i ,$$

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:

$$\text{(A1.9)}\quad A_{ij} = \gamma_{ij} \frac{\phi_{ij} v_j}{\hat{P}_{ij}^{\ I}} \left( \frac{p_i}{\hat{P}_{ij}^{\ I}} \right)^{-\sigma_i^I} , \quad A_{ij}^{\ *} = \gamma_{ij} \frac{(1-\phi_{ij}) v_j}{\hat{P}_{ij}^{\ I}} \left( \frac{p_i^*}{\hat{P}_{ij}^{\ I}} \right)^{-\sigma_i^I} \qquad \forall i, j$$

**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, $\tau_i^{*M}$ :

$$\text{(A1.10)}\qquad p_i^{\ e} = \frac{p_i \, e (1+\tau_i^{*M})}{(1+s_i^X)} \qquad \forall i$$

**Export demand:**

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

$$\text{(A1.1)}\quad X_{ij} = \frac{\theta_i}{n_i}\left(\frac{E_i}{\hat{P}_i^X}\right)\left(\frac{\hat{P}_i^e}{\hat{P}_i^X}\right)^{-\sigma_i^X}\left(\frac{p_{iHj}}{\hat{P}_i^e}\right)^{-\eta_i^X},$$

where $\theta_i$ 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.

**Final demand:**

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

$$\text{(A1.12)}\qquad D_{iHj} = \frac{\delta_i^F a_i^F}{n_i}\left(\frac{Y - T_Y}{\hat{P}_i^F}\right)\left(\frac{\hat{P}_{iH}}{\hat{P}_i^F}\right)^{-\sigma_i^F}\left(\frac{p_{iHj}}{\hat{P}_{iH}}\right)^{-\eta_i^F}$$

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

$$\text{(A1.13)}\qquad \hat{P}_i^F = \left[\delta_i^F (p_{iH})^{(1-\sigma_i^F)} + \left(1-\delta_i^F\right)(p_i^*)^{(1-\sigma_i^F)}\right]^{\frac{1}{1-\sigma_i^F}}$$

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

$$\text{(A1.14)}\qquad M_i^F = (1-\delta_i^F) a_i^F \left(\frac{Y - T_Y}{\hat{P}_i^F}\right)\left(\frac{p_i^*}{\hat{P}_i^F}\right)^{-\sigma_i^F}$$

**Government demand:**

The formulation adopted is similar to that for final demand by households. Government demand for home produced products and imports, respectively, is given by:

(A1.15) $$G_{iHj} = \frac{\delta_i^G a_i^G}{n_i}\left(\frac{G}{\hat{P}_i^G}\right)\left(\frac{\hat{P}_{iH}}{\hat{P}_i^G}\right)^{-\sigma_i^G}\left(\frac{p_{iHj}}{\hat{P}_{iH}}\right)^{-\eta_i^G}$$

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

where the composite price of government purchases is:

(A1.16) $$\hat{P}_i^G = \left[\delta_i^G\left(p_i\right)^{(1-\sigma_i^G)} + (1-\delta_i^G)\left(p_i^*\right)^{(1-\sigma_i^G)}\right]^{\frac{1}{1-\sigma_i^G}}$$

It is assumed that the government spends all it receives in tax revenues. That is, it maintains a balanced budget. The model is comparative static and it does not at present incorporate private or public savings and investment.[54]

**Demand for inputs:**

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

(A1.17) $$I_i = \sum_{j=1}^{N} A_{ij} Q_j, \qquad I_i^* = \sum_{j=1}^{N} A_{ij}^* Q_j \qquad \forall i$$

**Tax revenue:**

The government raises tax revenue from both direct and indirect taxation. The revenue raised from each source is expressed below.

***Direct income tax revenue***

(A1.18) $$T_Y = \sum_{i=1}^{N} \tau_{K_i}\left(rK_i + \pi_i\right) + \tau_U w_U L_U + \tau_S w_S L_S \ ,$$

where $K_i$ denotes total capital stock in industry *i*, $\pi_i$ denotes total pure profit in industry *i*, "*U*" denotes unskilled labour and "*S*" denotes skilled labour. 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***

(A1.19) $$T_C = \sum_{i=1}^{N} \tau_i^C p_i D_i + \sum_{i=1}^{N} \tau_i^C p_i^* M_i$$

***Import tariff revenue***

[54] The implicit assumption being that the sectoral composition of investment spending is the same as that of final demand.

(A1.20) $$T_M = \sum_{i=1}^{N} \tau_i^M (M_i + I_i^*) \frac{p_i^w}{e}$$

***Export tax revenue***

(A1.21) $$T_X = \sum_{i=1}^{N} (-s_i^X) p_i X_i \ ,$$

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.

**Economic profits or losses:**

This is revenue derived from mark-ups over unit variable costs, less total fixed costs. For sector *i* it is:

(A1.22) $$\pi_i = (p_i - v_i) Q_i - n_i (r f_i^K + w_S f_i^L) \qquad \forall i \ ,$$

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:

(A1.23) $$\pi_i^N = \left[ (p_i - v_i) Q_i - n_i (r f_i^K + w_S f_i^L) \right] \left(1 - \tau_i^K\right) \qquad \forall i$$

**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 of unrequited transfers from abroad, *B*. Since the model has no saving and investment, the capital account is formally closed. *B* could therefore be thought of as an inflow of aid, or, more precisely for Australia, as an exogenous net inflow on the capital account.

(A1.24)

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

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:

(A1.25) $$GDP = rK_T + \sum_{k=1}^{K} w_k L_k + \sum_{i=1}^{N} \pi_i + \left( T - T_Y \right)$$

**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:

$$\text{(A1.26)} \qquad K_T = \sum_{i=1}^{N} \left( u_i^K Q_i + n_i^D f_i^K \right)$$

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:

$$\text{(A1.27)} \qquad L_S = \sum_{i=1}^{N} \left( u_{Si}^L Q_i + n_i^D f_i^L \right)$$

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

$$\text{(A1.28)} \qquad L_j = \sum_{i=1}^{N} \left( u_{ji}^L Q_i \right) \qquad\qquad j = 2,...,F$$

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

## Appendix 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 1 (A1.1 – A1.4) are arrived at. From (A1.12) the demand equation for domestic variety *j* of commodity *i* is:

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

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

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

and the average price of home varieties of product *i* [55]:

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

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

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

$d_{iHj}$

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

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

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

Differentiating with respect to $p_{iHj}$ gives:

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

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

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

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

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 of the assumption that firms within an industry behave symmetrically, the expression can be written as:

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

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

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

This further simplifies to:

(A2.4)

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

So that the elasticity of final demand is:

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

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

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

On the symmetry assumption this simplifies to:

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

## Appendix 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 3 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.[56] 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 the services sectors, not to mention large private firms in all sectors and government-owned

[56] 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.

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.