Oligopolistic Manufacturing and Economic Reform in Four Archetype Western Pacific Economies: Model Construction and Analysis

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Abstract

To examine the effects of policy intervention in the presence of imperfect competition in manufacturing, general equilibrium models are constructed of four Western Pacific economies, chosen according to their level of development and the comparative sizes of their manufacturing sectors. The countries chosen are Australia, an industrialised importer of manufactures, Japan, an industrialised exporter, the Philippines, a developing importer, and the Republic of Korea, a developing exporter. In each case the manufacturing sector is characterised as comprising nine separate industries, each with identical oligopolistic firms producing homogeneous goods which are differentiated from competing imports. The economies are subjected to exogenous shocks, which include trade reforms, increased surveillance of pricing behaviour, technological change and shifts in the terms of trade. Differences in the simulated economic responses in each case are examined and discussed. This paper also offers a complete specification of the model used and a detailed description of the construction of databases for the four countries.

1. Introduction

From the mid 1980s, governments in most industrial economies cast about more zealously than before in search of sources of renewed internal growth. The impetus for this was a pervasive trend toward higher unemployment since the early 1970s. In developing countries, on the other hand, the debt crisis of the early 1980s exposed their governments to increased external pressure to improve aggregate productivity. This, combined with the demonstration effect of better growth performance in the comparatively open, comparatively undistorted Asian developing economies, led to growth-oriented reforms throughout the developing world. Common elements in the reforms in both industrial and developing economies were trade liberalisation (the removal of exchange controls and non-tariff barriers, combined with commitments to reduce tariff levels) and competition-enhancing changes to policies governing the behaviour of domestic firms. In Australia, both elements came under the general rubric "microeconomic reform".

This paper examines the effects of two such reforms in the context of the late 1980s. These are the removal of trade barriers and more competitive (non-collusive) pricing behaviour

by manufacturing firms, the latter being achieved through improvements in competition law and trade practices surveillance. To aid the comparison of their respective effects, both policy reforms are examined in the context of a general equilibrium model which incorporates oligopoly behaviour in manufacturing in the manner of Harris (1984).[1] And the generality of the results obtained is enhanced by fitting the model to four differently structured yet archetypal Western Pacific economies of the late 1980s. The countries chosen are Australia, an industrialised importer of manufactures, Japan, an industrialised exporter, the Philippines, a developing importer, and the Republic of Korea, a developing exporter.

In Section 2 a brief description of the model is provided. Section 3 then discusses the structure of the four economies and the behavioural implications of the model's characterisation of their manufacturing sectors. Section 4 presents the results from trade reform experiments and Section 5 the results from pricing behaviour reform. Conclusions are then offered in Section 6 and the paper is supplemented by two substantial appendices. The first of these details the formulation of the model while the second describes its construction, detailing the sources of data and parameter estimates in its application to all four economies.

2. The Model

In order to highlight the role of imperfect competition in the analysis of trade policy, yet keep the model manageable, its structure has been made simpler than many modern computable general equilibrium models.[2] Institutions, including government, are represented by a single consuming household with Cobb-Douglas preferences among types of goods and CES subaggregation of home goods with imports. A complete mathematical description of the model and its solution is given in Appendix 1.

Firms in all 12 sectors are oligopolistic in their product pricing behaviour, each holding calibrated conjectural variations. Each also bears fixed capital and skilled labour costs, enabling the

[1] There is, of course, a substantial literature which sees trade reform as competition-enhancing in domestic markets (Hertel 1994; Ianchovichina et al. 2000). In the approach adopted here this effect is very slight and it is useful to examine separately the effects of more substantial changes in the pricing behaviour of firms.
[2] The model is a substantially revised and extended version of that used by Gunasekera and Tyers (1990).

representation of unrealised economies of scale. But home products in each sector are homogeneous and output is Cobb-Douglas in variable factors and intermediate inputs. The latter are Cobb-Douglas aggregates of home and imported products.[3] The existence of oligopoly power in product markets notwithstanding, firms are price takers in the markets for both primary factors and intermediate inputs.

The five primary factors are capital, skilled labour, unskilled labour, arable land and mineral/energy resources. Assumptions about their mobility are summarized in Table 1. In the length of run assumed, capital is homogeneous and fully mobile internationally while the domestic endowments of the other factors are fixed. Land and mineral resources are sector-specific in all lengths of run. Domestically-owned capital is fixed in quantity, so that changes in the domestic capital stock affect the level of income repatriated abroad and hence they have implications for the balance of payments. Depending on the closure chosen, however, firms need not earn market returns on capital in this model. If, for example, the entry and exit of firms are prohibited (or even if they are costly) then pure economic profits or losses occur.

The economy modelled is "almost small" following Harris (1984). It has no power to influence the border prices of its imports but its exports are differentiated from competing products abroad and hence face finite-elastic demand. An exchange rate is defined and its value set to retain any gap in the current account of the balance of payments evident from the model database. Real depreciations calculated as needed to hold this degree of imbalance raise the relative cost of imports in the home market and lower the prices of exports relative to competing goods in foreign markets. The numeraire used is a consumer price index, the quantities in which are drawn from the reference database (social accounting matrix, or SAM). This database is presented in full in Appendix 2.

The model is solved using two "Walrasian adjustment" algorithms. If firm entry and exit are prohibited, corresponding to the "short run" closure of Harris (1984), the exchange rate and the prices of the four factors which are not internationally mobile are adjusted to remove any payments imbalance and to achieve the appropriate degree of factor market clearance. If firm entry and exit are permitted, this solution is embedded in a second iterative process which adjusts the numbers of firms in each sector until

[3] Since the elasticities of substitution between home goods and imports in final demand are generally greater than unity, this implies, reasonably, that products are less substitutable as intermediate inputs than in final demand.

incentives for entry and exit no longer exist.[4]

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3. Economic Structure and Behaviour

All four economies are characterised by social accounting matrices (SAMs) assembled from input output tables and other data for the mid-1980s and aggregated so as to include 12 sectors and the five primary factors listed in Table 1. The assembly of these datasets and the calibration of the four models from them are described in Appendix 2. A recurring difficulty with our comparison of different economies in comparative statics is that such data are not available annually. It is therefore impossible to construct the data bases for all four economies for the same year or to average out idiosyncratic business and political cycle effects. The result is four SAMs representing different years and different departures from long run economic trends. For Australia, Japan, the Philippines and Korea the years selected are 1986, 1985, 1983 and 1985, respectively. For Australia, Japan and Korea, the departures from trend are associated with the extraordinary boom period of the 1980s. For the Philippines, 1983 was a year of comparatively poor performance associated with the collapse of the Marcos regime. As a consequence, the pure profits observed, particularly in Australia and Japan, are probably higher than the manufacturing sector could expect to maintain in normal years, while net losses observed in the Philippines are also atypical. In the course of our stylised characterisation of each economy, it will occasionally be useful to bear these departures in mind.

[4] Since the applications described herein the model has been written in the Gempack software, which does not require so structured a solution algorithm. See Tyers (2004a).

The size and sectoral structure of the four economies is suggested by Table 2. There are obvious disparities in overall size, with that of Japan having more than twice the population of the next most populous country and about ten times the output of the next wealthiest country, measured at market exchange rates. Nevertheless, the desired contrast between the two developed and the two developing economies is evident. The GDP per capita of the former is more than double that of the latter, even when the International Comparison Program (ICP) measure is used. Moreover, the service sector is comparatively large in both the developed economies, while agriculture remains a substantial contributor to GDP in both the developing economies.

The manufacturing sector, to which we give emphasis in this study, contributes more than a quarter of total GDP in Japan and the developing countries. Where the roles of manufacturing are contrasted is in the balance of payments, which is depicted in Table 3. In both Australia and the Philippines, about nine per cent of GDP is spent on *net* imports of manufactures. In Japan and Korea, on the other hand, net manufacturing exports amount to eight and five per cent of GDP, respectively. It is, however, important to bear in mind the contrast in the overall sizes of the countries' respective manufacturing sectors. Even using ICP measures, that in Japan is six times larger than that in Korea and 15 times larger than those in either Australia or the Philippines. This immediately suggests the presence of more firms in each manufacturing industry, and/or the greater likelihood that potential economies of scale in each are more frequently realised in Japan than elsewhere.[5]

The components of the balance of payments listed in Table 3 clearly show the relatively substantial dependence of Japan and Korea on manufacturing export earnings. For the three countries other than Japan, there was considerable intra-industry trade in manufactures, with manufactures having a dominant share in imports. For each country the capital account is modelled as closed, with the net income component of the current account comprising repatriated capital earnings. Transfers, which also enter the current account, are derived in the construction of SAMs as a balancing item. Given the abstract representation of the economies by these SAMs this item cannot be considered an accurate

[5] Greater product diversity and differentiation are probably also associated with the larger volume of Japanese manufacturing. Moreover, it is possible that external economies exist which, because of its size, enhance the overall productivity of Japanese manufacturing. Although these effects have not been quantified here, their potential role is discussed later in the text.

estimate of actual transfers. Given the structure of the model, which has no saving or investment demand[6], these transfers might be considered as including net inflows on the capital accounts of the four economies.

Factor intensities in each sector are summarised in Table 4. Notably, in the two industrial countries manufacturing is labour intensive compared with the other sectors. In the developing countries, manufacturing tends to be more intensive in capital (at least relative to labour) than the other sectors.

In the model, each sector comprises a number of identical oligopolistic firms and each firm bears recurrent fixed costs. Were average variable costs constant, this would imply forever declining average total costs. Minimum efficient scale (MES) in this context is defined (following Harris) as the level of output at which average cost exceeds marginal cost by one per cent. The magnitude of recurrent fixed costs then depends on the MES and the slope of the average cost curve. Our estimates for these parameters are derived using the Harris approach, as explained in Appendix 2. Of course, to cover these fixed costs, firms must be able to set prices above their average variable costs. Their capacity to do this without being undercut by competitors determines the potential for either the entry of new firms (the coverage of additional fixed costs) or earning pure profits. If entry is free, pure profits attract new entrants and the mark-up over variable costs is exhausted entirely by fixed costs. This is the case of "inefficient entry" (Eastman and Stykolt 1966, Horstman and Markusen 1986). The key, therefore, to the characterisation of imperfectly competitive manufacturing firms is in their product pricing behaviour and, in particular, their capacity to maintain mark-ups over average variable costs.[7] Since both this and the extent of excessive entry depend on measures of the number of "representative" identical firms, we turn next to our estimation of firm numbers.

The number of representative identical firms:

[6] The structure might be considered as implying that savings and investment are equal and that the product composition of investment demand is the same as that of final demand. If investment were to exceed savings, creating net inflows on the capital account that contribute to the balancing item identified in this model, the same assumption is implied about the composition of investment demand at home.

[7] Throughout this research, firms are assumed to be price takers in the markets for primary factors. Labour markets, for example, are assumed perfectly competitive, variations in average wages between sectors are explained in this model as due to differences in the skill mix.

The best measure for the representative number of identical firms in each imperfectly competitive sector would require a very high level of disaggregation of the manufacturing industries in all four economies, beyond the resources available to this project. The necessity to work with only 12 industry categories stretches the assumption that firms in each are identical. Since the distribution of firm size in such broadly defined industry categories often exhibits a modest number of very large firms and a large number of small firms. We chose to interpret this pattern as representing small numbers of oligopolistic leading firms depending upon large numbers of relatively competitive suppliers of components.[8] It is then most realistic to model this as an oligopoly among the large firms, each of which incorporates its suppliers of components. In all four countries, the size distribution of manufacturing firms is available in terms of employment. The number of representative firms was then chosen as that including firms with more than 200 employees in the Philippines (WB 1987), more than 300 in Japan (Statistics Bureau 1986), and more than 500 in Australia (ABS 1989) and the Republic of Korea (UN 1987).

Unrealised scale economies:

A crude indication of the extent to which there had been inefficient entry can be obtained from the ratio of the MES and the average output of representative firms in each industry, as in Table 5. The extent to which this exceeds unity indicates the level of unrealised scale economies. For manufacturing as a whole, these appear to have been largest in the two net importers of manufactures. Indeed, the ranking on unrealised scale economies was precisely the opposite of that on the size of the manufacturing sector (Table 2). In Japan, scale economies in manufacturing seem to have been exhausted except in food processing. In pre-microeconomic-reform Australia, they remained unexploited in both light manufacturing intensive in labour, including food processing and textiles and clothing, and also in heavy manufacturing, particularly in the production of paper, transport equipment and machinery. In the developing economies, it was in the heavy industries that they remained unexploited (manufacturing, including chemicals, transport equipment and other machinery) where fixed costs were comparatively

[8] This characterisation seems particularly appropriate in the cases of Japan and Korea, where large oligopolistic firms have large numbers of smaller affiliates which supply inputs. See, for example, Fruin (1992).

high.

The shares of fixed costs in the total payments to capital and labour are listed in Table 6. These were clearly high in industries where scale economies were unexploited, signifying prior excessive entry. In spite of the ranking of the four economies mentioned earlier, and that both Australia and the Philippines had import-competing manufacturing sectors, fixed costs appear to have made up a greater proportion of the total in Australia than in the Philippines. This is because a greater proportion of manufacturing product in the Philippines was in light, labour intensive, manufacturing.

The potential unit cost reduction from production at MES in each industry can be crudely estimated by reducing average fixed cost by a proportion based on the ratios in Table 5. Such estimates are listed in Table 7. They show that the potential for cost reductions was greatest in the heavy manufacturing industries of Australia, the Philippines and Korea. Of course, these measures underestimate the potential for cost reductions of this sort because they omit the extent to which these industries supplied each other with inputs. The full potential for such cost reductions is best estimated in full general equilibrium using the model.

Pure profits:

That proportion of mark-ups over unit variable costs not absorbed by fixed costs accrues as pure profits. The implied excess rate of return on capital in each of the four economies is indicated in Table 8. These rates were extraordinarily high in Japan and, to a lesser extent, in Australia. Since they are estimated as residuals, our measurement error is substantial. Nevertheless, such high rates are not unexpected during the boom period of the mid-1980s. They were, in any case, more modest fractions of total manufacturing costs, averaging 5, 11, -8 and 4 per cent in Australia, Japan, the Philippines and Korea, respectively.

Pricing behaviour:

The luxuries of excessive entry and pure profits are afforded only by virtue of oligopoly pricing. In setting their prices, we assume firms know the level and elasticity of sectoral demand and the number of their identical competitors. They play a game in the selection of quantities. For this comparative

static analysis it is convenient to abstract from the multi-period nature of this game and to represent their capacity to collude by a fixed conjectural variations parameter, μ_i, defined as the influence any individual firm has over the entire output of industry i. Thus, the profit-maximising mark-up, derived by setting marginal revenue equal to marginal cost, $\mathbf{v}_i$ is

$$(1) \quad m_i = \frac{p_i}{v_i} = \frac{1}{1 + \frac{\mu_i}{n_i \varepsilon_i}} \qquad \forall\, i \text{, where } \mu_i = \frac{\partial Q_i}{\partial q_i} ,$$

ε_i is the price elasticity of demand for home goods in industry i (defined negative), n_i is the number of firms and Q_i and q_i are industry and firm output. Note that, for the conjectural variations parameter, the values $\mu_i = 0, 1, n_i$ imply, respectively, perfect competition, non-collusive (Cournot) oligopoly or a colluding cartel.

The product of each industry can be consumed either directly, indirectly as intermediate inputs or it can be exported. The elasticity ε_i therefore depends on the shares of the home product going to each of the three markets and the elasticities in each. As explained in Appendix 1, the elasticities of final consumption and export demand depend principally on the elasticities of substitution between home goods and their foreign substitutes. Because of the Cobb-Douglas function used for unit variable costs, however, those of intermediate demand tend to have magnitudes less than unity. Importantly, in this formulation the precise values of ε_i depend only very weakly on border distortions. When trade policy is changed, the principal mechanism by which ε_i is altered is the redistribution of demand amongst its three components. Reference values for ε_i are listed in Table 9, along with the corresponding elasticities of substitution.

Since the mark-up in each industry covers both fixed costs and pure profits, it can be estimated as the ratio of the sum of these and total product value, drawn from the SAM (Appendix 2). Indirect estimates of the ratios μ_i/n_i then follow from equation (1). We call this the index of non-competitive pricing. It ranges from zero (perfect competition, zero mark-ups) to unity, or 100 per cent (perfect cartel, monopoly mark-ups). The values thus calibrated are given in Table 9. They suggest that pricing is generally collusive but that it is very rare that firms achieve more than a quarter of the discipline of a perfect cartel.

To speculate on the effects of this collusion, however, it is useful to compare the calibrated ratios with those which would apply in a non-collusive, or Cournot, oligopoly when the ratio takes the value $1/n_i$. Its estimation depends heavily on our selection, above, of a "representative" number of firms in each industry. The results, also listed in Table 10, show the smallest gulf between calibrated values and the non-collusive case to occurred in Australia and by far the largest in Japan. It comes as no surprise that the non-collusive ratio for Japan was low. The comparatively large size of Japan's manufacturing sector is associated with a correspondingly large number of oligopolistic firms.[9] It follows, then, that policy reforms that might have reduced the capacity of firms to collude would have had their largest proportional effects on prices in Japan. This is illustrated more clearly in Table 11 which lists the optimal mark-ups to correspond with the ratios of the previous table. Non-collusive pricing would have forced the virtual disappearance of mark-ups in Japan and, to a slightly lesser extent, in Korea and the Philippines. In Australia, however, where the number of firms was smallest, non-collusive mark-ups would have been set at about a quarter of the calibrated levels.

These crude calculations underestimate the cost reductions that might have stemmed from more competitive firm behaviour in the same way that those above on unrealised scale economies do. Aside from aggregation issues, they ignore the substantial interactions among manufacturing industries via input markets. Moreover, the changes in mark-ups shown in Table 11 depend on the assumption that the number of firms would remain fixed. In reality, more competitive pricing would drive some firms out of each industry. At the extreme of non-collusive behaviour, mark-ups would be higher than those shown. The best way to improve these approximations, and to measure the consequences of policy reform more generally, is to turn to the full general equilibrium model.

4. Trade Reform

The 1980s pattern of protection in all four economies, summarised in Table 12, gave most assistance to import-competing producers. The net importers of manufactures, Australia and the Philippines, both protected their manufacturing sectors and the net manufacturing

[9] This result depends also on the subdivision of manufacturing into only nine industries each of which is here assumed to supply a single homogeneous product. Product diversity in Japan was clearly greater than this and so the non-collusive pricing ratio would be expected to have been much larger.

exporters, Japan and Korea, both protected their agricultural sectors. But the pattern was more complex than this. In Australia, substantial protection was afforded the labour-intensive end of manufacturing, while in the Philippines the capital-intensive end was most favoured. In Japan, although manufacturing protection was low overall, the food processing was highly protected. In Korea, although the other sectors appear to have received greater assistance, a substantial residue of the old import substituting regime remained through the mid-1980s, particularly in metals and labour-intensive manufactures.[10]

To examine the consequences of trade reform in the period and their sensitivity to model formulation, the following experiments are performed.

1. A reference equilibrium is calculated to reproduce the model databases on the assumption that manufacturing firms were perfectly competitive and had constant returns to scale.[11]
2. All trade distortions are removed and a new equilibrium is calculated on the assumption that firms are perfectly competitive.
3. The original model, incorporating imperfectly competitive behaviour, is then used to calculate a new "no-entry" reference equilibrium which also reproduces the observed pattern of pure profits.
4. All trade distortions are removed and a new, no-entry equilibrium is calculated.
5. Trade distortions are reinstated and a "free entry" reference equilibrium is calculated. This solution allows firms to enter and exit until pure profits are competed away.
6. Again, all trade distortions are removed, this time under "free entry" conditions.

Thus, three reference equilibria are compared with a corresponding three in which all trade distortions are removed. The resulting estimates of the impacts of trade reform on the size and structure of the four economies are summarised in Table 13. Most striking at the outset is that the estimates are robust across the three different formulations of the model. Allowance for

[10] The protection of services, which are consolidated in this study, is difficult to gauge from available publications of the period. Although it is set to zero in the industrial countries, this is unlikely to be accurate (Dee and Hanslow 2000).
[11] Pure profits in this adjusted database are absorbed into market returns on capital and the capital stock and its distribution allowed to adjust to retain the original rate of return on capital.

imperfect competition and increasing returns to scale appears to change value added effects little. Because a precise index of product prices is used as the numeraire, changes in the welfare of the single integrated household are correctly indicated by changes in real GNP. As in numerous prior studies of trade reforms, the net welfare gains in economic welfare are small but uniformly positive. This is in spite of some correspondingly small declines in GDP, driven by net reductions in the capital stock as comparatively capital intensive industries shrink following the loss of their protection.

The structural change that underlies these small changes in overall economic size is substantial, however. Manufacturing shrinks where it had been protected and expands where protection is removed elsewhere. Mining and energy are the big beneficiaries in Australia and the Philippines. Agriculture does not benefit in Australia, for two reasons. First, it had, at the outset, enjoyed some protection. A post-reform real devaluation does less than offset the loss of that protection. And second, per unit of output, the agricultural sector is more dependent than mining on chemical and fuel inputs, the real costs of which rise after the reform. In Korea and Japan, on the other hand, agriculture shrinks while manufacturing expands.[12]

This structural change is reflected in the associated changes in the unit rewards of domestic factors, given in Table 14. Capital owners are largely indifferent in all formulations by virtue of the assumed international mobility of that factor. Only in the no entry equilibria do pure profits occur but the changes in these which accompany trade reform are negligible. The corresponding changes in real unit rewards to domestic factors (those not mobile internationally) are more dramatic, however. Mineral and energy resource rents increase substantially in Australia and the Philippines while agricultural land rents decline in Japan and Korea. Real wages rise throughout. Although all closures of the model set wages to clear labour markets, these increases in real wages confirm that even constant *real* wage solutions would not yield increased unemployment.[13] Where the beneficiaries of trade reform are the comparatively

[12] The latter expansion is greatest in the case of Korea where the large services sector had been characterised as receiving a high level of protection. The services sector shrinks so as to benefit manufacturing both through the supply of cheaper service inputs and through its release of domestic factors the unit rewards to which would otherwise have shown larger increases.

[13] In the course of each solution, however, trade reform lowers the domestic price level and nominal wages most

capital intensive mining and energy sectors, the demand for labour is nevertheless boosted by increased demand for service inputs to that sector. Declines in real land rents in Australia, Japan and Korea aside, domestic factors are gainers from trade reform.[14]

The response to trade reform by the imperfectly competitive manufacturing sector is summarised in Table 15. Consider first the no entry closure and the two countries in which a previously protected manufacturing sector contracts. Trade reform reduces the relative prices of competing imported manufactures. This is partially offset by real devaluations and lower home prices due to the reduced cost of imported intermediates, which also enhance the competitiveness of exports abroad. Home products are redistributed away from final (and, to a lesser extent, intermediate) demand to meet increased export demand. This increases the elasticity of demand facing home manufacturers very slightly. Mark-ups, as given by equation (1), fall but by very little. Thus, there is no significant "pro-competitiveness" effect of trade reform in this case.[15] Pure profits change very little and the changes in the scale of production, corresponding with the associated changes in output at the industry level, are too small to significantly affect average fixed costs.

In the free entry closure, trade reform first induces pure losses in both the Australian and the Philippine manufacturing sectors. This forces three per cent of firms in Australia and five per cent of firms in the Philippines to exit. Instead of making pricing behaviour more competitive, however, it raises the index of imperfectly competitive pricing (Table 10) and increases mark-ups (though only very slightly[16]). Whether the firms which remain produce at a more efficient scale then depends on the change in industry output. If this declines by less than the reduction in the number of firms, as in Australia, then value added per firm rises. Any scale

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often fall (but, by less than the price level). Sticky *nominal* wages would therefore cause increased unemployment following trade reform. For an analysis of the effects of nominal wage rigidity following trade reform, see Rees and Tyers (2004).

[14] That these gains are most often larger than those in real GNP reflects the loss of tariff revenue, previously transferred directly to households, and its replacement by increased factor income.

[15] For a more complete discussion of pro-competitive effects, see Hertel (1994), Ianchovichina et al. (2000) and Hertel et al. (2002).

[16] The elasticity of the mark-up to the index of competitive pricing, when the elasticity of demand is about two (Table 5), is about 0.1. Thus, a five per cent reduction in the number of firms induces a 0.5 per cent increase in the mark-up.

gain is offset by more collusive pricing, however. In Japan and Korea, on the other hand, trade reform enhances the overall profitability of manufacturing, induces entry by a small number of additional firms and the sector expands enough to ensure that value added per manufacturing firm increases. The reform is unambiguously pro-competitive in these countries but, again, the changes are so slight as to have an almost negligible effect on prices.

5. Non-Collusive Pricing

Firms are here assumed to be induced to price without collusion through revisions to competition law and more active trade practices surveillance. In both the no entry and the free entry cases, the model is shocked with reductions in the index of imperfectly competitive pricing from μ_i/n_i to $1/n_i$. In general, this forces substantial reductions in mark-ups and hence in product prices in the manufacturing sector. Domestic demand shifts away from imports toward home products and export demand increases as lower export prices cause substitution abroad. The decline in import volume, and the associated rise in export volume, causes a real appreciation and hence a decline in the general price level. Output expands in all sectors, raising demand for domestic factors, real unit rewards to which rise.

The net effects on the size and structure of the economy are summarised in Table 16. The gains in aggregate welfare (as indicated by real GNP), and in output (GDP) are large by comparison with those due to trade reform. In the no entry closure all sectors tend to expand their value added. The Philippines is the single exception, for reasons to be returned to later. Agriculture is a consistent beneficiary, though the expansion in manufacturing comes at the cost of substantial pure losses, incurred by firms unable to exit. This quite large expansion is the consequence of the demand boost in response to reduced mark-ups and hence lower manufacturing product prices. The gains in GDP in this case are tempered by the transition from pure profits in manufacturing to pure losses.

Price reform yields even larger net gains in welfare and output in the free entry case. Then, the pure losses initially induced by lower manufacturing product prices cause more than half the firms to exit. As they do so, mark-ups rise again, but to values well short of their pre-

reform levels. The burden of recurrent fixed costs is substantially reduced by the decline in the number of firms so value added in manufacturing (factor cost) shrinks. But the volume of output (and hence the cost of variable factors) is universally larger. The increases in this volume are smaller than those which occur in the no entry case because mark-ups are higher and hence the expansion in aggregate demand for manufactures is smaller. Even more important than the differences in mark-ups in moderating the expansion in demand for home goods is that the reduction in the number of firms and hence in the fixed capital stock in manufacturing is so large that expansions in the other sectors are insufficient to prevent declines, of between three and nine per cent, in the overall capital stock. These changes are large in proportion to the foreign owned part of that stock and hence there is a big decline in repatriated returns on capital in the balance of payments. This magnifies the real revaluation which occurs, lowering the relative cost of imported substitutes. The free entry closure yields larger gains in welfare and GDP because the burden of fixed costs is reduced and the reform induces no pure losses.

The changes in real unit rewards to domestic factors are summarised in Table 17. Apart from the loss of pure profits by domestic capital owners in the no entry case, gains are virtually universal. They are larger in the no entry case than in the free entry case since, in the latter, oligopoly rents are larger and these accrue to capital, part of the income from which leaks abroad. The only declines are in mineral and energy rents in the Philippines (no entry case) and in the skilled wage in Korea (free entry case). The latter arises because recurrent fixed costs include skilled labour costs. When the number of firms declines, fixed costs are reduced proportionally and hence the demand for fixed skilled labour also declines. This source of demand for skilled labour is comparatively large in Korea and so the change is sufficient to reduce overall demand for skilled labour.

The extent of some of the changes in manufacturing industry structure is indicated in Table 18. In the no entry case, where the decline in home product prices is most substantial, capital is drawn into manufacturing to meet increased demand. This increase in product volume raises value added per firm but fixed capital costs are not covered at the lower prices and what were pure profits under collusive pricing become pure losses. In the free entry case, the lower

prices cause pure losses which are subsequently eliminated by the departure from the market of more than half its firms and the resulting decline in average fixed costs. Value added per firm rises very substantially.

The industry composition of changes in value added in manufacturing is detailed in Table 19. Apart from the Philippines, the industry pattern most often mirrors that for the sector overall. These are dominated by the increases in variable capital use in the no entry case, on the one hand, and the substantial decreases in fixed capital in the free entry case. The capital intensive transport equipment and machinery industries in Korea show exceptional expansion in the no entry case and exceptional contraction in the free entry case. There are other departures from the central trend that depend on differences in economic structure and are therefore of special interest for particular economies. Correspondingly, the industry pattern of non-collusive mark-ups, shown in Table 20, tends to mirror the manufacturing sector averages while exhibiting a number of interesting industry variations that differ between the economies.

In many respects the behaviour of the Philippines departs from the general pattern described here. This has most to do with assumptions made in assembling the Philippine data base. It was quickly apparent that firms in six of the manufacturing industries (garments, textiles and footwear; wood and paper; chemicals; mineral products; transport equipment; and miscellaneous manufactures) were loss-making in 1983. These industries accounted for 60 per cent of manufacturing value added in that year. Moreover, in four of these industries, prices in that year appeared not even to be covering average variable costs. This made it nonsensical to calibrate a coefficient of imperfectly competitive pricing from equation (1) for those industries.

It is, however, no impediment to the reference and counterfactual equilibria in the no entry case. Accordingly, that reference equilibrium incorporates the low prices charged in those industries. When Cournot pricing is imposed on all firms in the counterfactual equilibrium, prices in former loss-making firms rise to more than cover all average costs. Thus, in the Philippine no-entry case, the direction of average manufacturing prices is therefore the opposite of those in the other three economies.[17] In the free entry case the Philippine model behaves

[17] The reason why the minerals and energy sector contracts in the Philippines when manufacturers are forced to

much like the others. For the reference free entry equilibrium, the assumption is made that, in more normal years, firms in loss-making industries would play Cournot and price non-collusively. When non-collusive pricing is imposed on all firms, mark-ups fall on less than half the output of the sector and hence the observed benefits are muted relative to those observed in the other economies.

6. Conclusion

This comparison of the potential gains from trade reform and more competitive pricing behaviour in manufacturing suggests that the gains are larger from more competitive behaviour and, moreover, that they are more nearly Pareto improving. This is most clearly true in the long run when free entry and exit of firms is a more appropriate assumption. Then, where capital is mobile internationally, the rate of return earned by domestic capital owners is unaffected by either change of policy. Whereas trade reform redistributes rents away from factors in which protected industries are intensive, while yielding a small net gain across the whole economy, more competitive pricing behaviour reduces the price level, raises the volume of home production and of exports and enhances the purchasing power of all non-mobile factor rewards.

The analysis of similar reforms in the four "archetype" Western Pacific economies does show that the dependence of the gains from reform on economic structure is significant. The specification used causes the introduction of imperfectly competitive behaviour not to yield large differences in the effects of trade reform on overall economic activity in any of the countries. When the reforms include changes to competition policy and hence oligopoly pricing behaviour, however, this dependence is greatly strengthened. The large size of Japan's manufacturing sector in the 1980s and the substantial pure profits it then enjoyed, meant that the potential gains from competition reform would have been larger in proportion to its GNP than for the other countries. This result suggests that competition reforms in Japan in the late 1980s might not only have boosted growth at a time when the economy was slowing but also that, with

price non-collusively (Table 19) is that manufacturing industries which are intensive in the products of that sector tend to be the ones in which prices rise in this experiment. They contract and so, therefore, does the mining and energy sector. The decline in mineral rents indicated in Table 17 follows.

better-distributed rents, the collapse of the 1990s and the subsequent economic stagnation might have been mitigated or even avoided.

In measuring these effects, however, two important caveats suggest further research. First, the assumption of product homogeneity within any manufacturing industry, combined with a uniform sectoral disaggregation irrespective of economic size, overlooks the possibility that product diversity was much greater in the larger manufacturing sectors such as that of Japan. It is therefore likely that the extent of any collusion in pricing is overestimated in such cases, and so, therefore, are the potential gains from more competitive behaviour. The solution to this problem is not necessarily to jump to a differentiated products model of the Spence-Dixit-Stiglitz type (Hertel 1994). The same judgement must be made there about the degree of differentiation (or the elasticity of substitution) between varieties. A first approximation might adjust the number of representative firms according to the level of product diversity.

Second, calibrated general equilibrium models are vulnerable to the peculiarities of those years for which complete sets of data (principally input-output tables) are available. The 1983 Philippine database, for example, is extraordinary in the extent of the manufacturing losses incurred. This made it difficult to calibrate the "normal" pricing behaviour of manufacturing firms in that country. A larger investment is needed in database assembly in such cases.

Finally, manufacturing is not the only sector in which oligopoly behaviour is influential. Indeed, in many industrial countries the focus of pro-competitive reforms is the services sector. The models used here are clearly imbalanced in their consolidation of services and further work might attempt an examination of imperfectly competitive behaviour in parts of that sector.

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Table 1 Primary factors and their mobility

Factor	Mobility
Capital[a]	intersectoral, international
Skilled labour[a]	intersectoral
Unskilled labour	intersectoral
Agricultural land	sector specific
Mineral/energy resources	sector specific

[a] Firms have fixed capital and skilled labour costs but these factors are acquired at the same rates from the pool of mobile capital and skilled labour.

Table 2 Economic size and structure

	Australia	Japan	Philippines	Republic of Korea
Population, millions	17	124	61	43
GDP, US$ billions	296	2,943	44	236
GDP per capita, US$	17,000	25,400	730	5,400
ICP estimate[a]	16,100	17,000	7,200	2,300
GDP in manufacturing, US$ billions	45	829	11	66
ICP estimate[a]	41	610	35	96
The distribution of GDP, %				
Agriculture 4	3	20	13	
Mining	4	1	6	1
Services	75	68	44	57
Manufacturing	15	28	29	29
The distribution of manufacturing GDP, %				
Food, beverages and tobacco	18	11	30	12
Garments, textiles and footwear	6	4	10	12
Wood and paper products	17	4	5	4
Chemicals	7	7	9	21
Petroleum and coal products	5	4	2	2
Mineral products	24	17	9	6
Transport equiptment	8	12	4	10
Machinery	10	29	23	23
Miscellaneous manufactures	5	11	7	6

a United Nations International Comparison Progam.

Source: Population and GDP estimates are for 1990, drawn from World Bank (1992). GDP in manufacturing is for 1989, from the same source. GDP shares are from the SAMs detailed in Appendix 2.

Table 3 The balance of payments

(per cent of GDP)

	Australia	Japan	Philippines	Republic of Korea
Inflows				
Transfers[a] 15	-2	19	18	
Exports	16	17	17	37
Agriculture	2	.3	.7	.7
Minerals	4	.0	1.4	.1
Services	4	3	7	8
Manufactures	6	14	9	29
Total	31	15	36	54
Outflows				
Repatriated market returns on capital	11	3	14	9
pure profits	.8	.9	-1.4	1.4
Export subsidies	.7	.4	1.2	5
Imports	18	11	23	39
Agriculture	.3	1.1	.3	3
Minerals	.5	4	3.3	9
Services	2	2	.6	3
Manufactures	15	4	18	24
Total	31	15	36	54

a A closed capital account is imagined with these current account income transfers constructed to balance the social accounting matrices. Given the model's structure they might be considered, however, as also including net inflows on the capital account as explained in the text.

Source: The SAMs presented in Appendix 2.

Table 4 Factor proportions by industry

(Per cent expenditure on each factor group)

		Agriculture	Mining & Energy	Services	Manufacturing
Australia	Capital	25	35	36	26
	Labour[a]	36	28	64	74
	Natural resources[a]	39	37		
Japan	Capital	39	8	32	15
	Labour	24	56	68	85
	Natural resources	37	36		
Philippines	Capital	10	27	33	70
	Labour	60	34	67	30
	Natural resources	30	39		
Korea, Rep.	Capital	10	14	34	34
	Labour	42	37	66	66
	Natural resources	48	50		

a Labour is further disaggregated into skilled and unskilled labour, while natural resources is disaggregated into agricultural land and mineral/energy resources. These factor groups are consolidated in this table to clarify the overall labour and capital intensities.

Source: The SAMs presented in Appendix 2.

Table 5 Unrealised scale economies in manufacturing[a]

$$\left(\frac{q_m}{q} = \frac{n * MES}{Q} \right)$$

	Australia	Japan	Philippines	Republic of Korea
All manufacturing	3.6	1.1	6.4	2.5
Food, beverages and tobacco	3.0	2.0	1.1	3.0
Garments, textiles and footwear	1.5	1.2	1.1	1.0
Wood and paper products	5.0	1.1	2.1	3.0
Chemicals	1.7	1.0	2.2	2.5
Petroleum and coal products	1.0	1.0	1.1	2.5
Mineral products	4.0	1.0	1.0	2.5
Transport equipment	5.0	1.0	116	3.0
Machinery	3.2	1.0	3.3	4.0
Miscellaneous manufactures	5.0	1.0	2.9	3.0

a The ratio of minimum efficient scale (MES) to average firm output.

Source: Estimates of MES based on those of Gupta and Fuss (1979) and adapted for application to the four economies, combined with estimates of the numbers of oligopolistic firms, as explained in Appendix 2.

Table 6 Share of fixed capital and labour in returns to those factors in manufacturing[a], per cent

$$\left(\frac{\overline{K}}{K}, \frac{w_s \overline{L}}{w_u L_u + w_s L_s} \right)$$

	Australia	Japan	Philippines	Republic of Korea
All manufacturing	56, 10	26, 4	21, 3	46, 8
Food, beverages and tobacco	55, 9	72, 12	13, 2	63, 10
Garments, textiles and footwear	31, 4	22, 4	2, 1	20, 4
Wood and paper products	82, 14	28, 5	10, 2	71, 12
Chemicals	34, 6	20, 3	8, 1	33, 5
Petroleum and coal products	20, 3	27, 5	89, 15	33, 5
Mineral products	55, 9	27, 5	14, 2	50, 9
Transport equipment	87, 15	28, 5	87, 15	60, 10
Machinery	32, 5	15, 2	15, 2	75, 13
Miscellaneous manufactures	61, 10	17, 3	15, 2	68, 11

a Share of market returns to all capital and labour in manufacturing which is made up of returns to fixed capital and labour. The denominator excludes the substantial pure profits made during the 1980s in Australia, Japan and Korea. Note that fixed labour receives the skilled wage.

Source: Derived from the parameters discussed in Appendix 2 and equations (A2.8) and (A2.9).

Table 7 Potential reductions in average cost due to the realisation of potential scale economies

(per cent)

	Australia	Japan	Philippines	Republic of Korea
Share of fixed in total cost, all manufacturing[a]	5.8	1.8	5.5	4.2
Potential price reductions[b]				
All manufacturing	4.2	.2	3.3	3.5
Food, beverages and tobacco	3.3	1.8	1.1	.2
Garments, textiles and footwear	.6	.3	.0	.1
Wood and paper products	8.2	.2	.0	.8
Chemicals	1.2	.0	2.8	3.5
Petroleum and coal products	.0	.0	.8	.1
Mineral products	5.3	.0	3.5	.1
Transport equipment	7.5	.0	13.4	1.5
Machinery	2.5	.0	4.1	4.5
Miscellaneous manufactures	5.4	.0	3.1	3.2

a Quotient of combined fixed capital and labour costs and total cost of production (total value of output, excluding pure profits).

b The product of $(1 - q/q_m)$ and the ratio of fixed to total cost.

Source: The cost ratios are drawn directly from the SAMs presented in Appendix 2. The ratio of q and q_m is from Table 5.

Table 8 Rates of economic profit in manufacturing[a], per cent

$$\left(\frac{\pi_i}{K_i}\right)$$

	Australia	Japan	Philippines	Republic of Korea
All manufacturing	9	20	-4	5
(Per cent of GDP)	(2)	(9)	(-4)	(5)
Food, beverages and tobacco	12	33	16	7
Garments, textiles and footwear	37	8	-7	2
Wood and paper products	14	9	-12	-27
Chemicals	21	20	-8	7
Petroleum and coal products	23	30	68	5
Mineral products	4	16	-12	-11
Transport equipment	-5	16	-18	-2
Machinery	6	23	2	17
Miscellaneous manufactures	10	24	-4	27

a The ratio of pure profits to the value of the capital stock in each industry in the reference SAM. The losses in the Philippines are large enough in some sectors that firms are not fully covering variable costs. This may well be representative of the state of that economy in 1983.

Source: All are drawn from the SAMs, as explained in Appendix 2.

Table 9 Elasticities of substitution in demand and of demand for home goods[a], per cent

	Elast. of substn. σ	Price elasticities of demand, ε			
		Australia	Japan	Philippines	Republic of Korea
Agriculture	2.8	-2.7	-1.9	-1.9	-2.0
Mining	2.8	-3.3	-2.0	-2.6	-2.1
Services	1.9	-1.8	-1.8	-2.1	-1.9
All manufacturing[b]	2.9	-2.4	-2.3	-2.5	-2.6
Food, beverages and tobacco	2.2	-2.4	-2.0	-2.2	-2.0
Garments, textiles and footwear	3.0	-2.6	-2.3	-2.9	-3.1
Wood and paper products	2.3	-2.1	-1.9	-2.4	-2.2
Chemicals	1.9	-1.8	-2.0	-1.9	-2.0
Petroleum and coal products	2.8	-2.1	-2.1	-2.1	-2.2
Mineral products	2.8	-2.4	-2.2	-2.2	-2.2
Transport equipment	5.2	-3.2	-3.0	-3.5	-2.8
Machinery	2.8	-2.7	-2.6	-3.0	-3.1
Miscellaneous manufactures	2.8	-2.2	-2.0	-2.3	-3.8

a The elasticity of substitution, σ, is defined positive and, for each sector, set the same in each country. The elasticities of demand are with respect to home product prices. They are for an aggregate of direct or final demand, intermediate demand and export demand, as explained in Appendix 1. Unlike the elasticities of substitution, which are permanent parameters, these change as the mix of these three types of demand change.

b The aggregate, for all manufactures, is an average of the component industry values, using value added shares as weights.

Source: The elasticities of substitution are drawn from Stern et al. (1976) and Industry Commission (1991). The demand elasticities are calculated from them as indicated in Appendix 2.

Table 10 Index of non-competitive pricing[a], per cent

$$\left(\frac{\mu_i}{n_i}, \frac{1}{n_i}\right)$$

	Australia	Japan	Philippines	Republic of Korea
All manufacturing[b]	25, 7	28, .3	14, 2	24, 2
Food, beverages and tobacco	24, 3	27, .3	20, .6	16, 2
Garments, textiles and footwear	19, 10	12, .4	1, .6	4, .6
Wood and paper products	36, 7	15, .3	1, .9	6, 6
Chemicals	21, 25	27, .3	2, 2	21, 5
Petroleum and coal products	22, 20	35, 2	11, 20	16, 1
Mineral products	24, 3	24, .2	2, 2	1, 3
Transport equipment	22, 2	27, .2	43, 4	3, 3
Machinery	18, 5	37, .1	24, 1	48, .6
Miscellaneous manufactures	26, 20	28, .4	3, 3	53, 8

a The ratio of the conjectural variations parameter, μ, and the number of oligopolistic firms in each sector, from equation (1). The first ratio is that observed, while the second applies to non-collusive, or Cournot, pricing behaviour. The upper limit is 100 %, signifying a perfect cartel. The lower limit is 0 %, signifying perfect competition.

b The all-manufacturing estimates are averages across manufacturing industries, with value added shares as weights.

Source: The indices are calibrated using equation (1). Once estimates of the mark-up and the elasticity of demand for each home product are available, the ratios listed here follow. The mark-ups are derived from the SAM, and the elasticities of demand depend primarily on estimates of elasticities of substitution, as explained in Appendix 1. Their estimation is explained in Appendix 2.

Table 11 Oligopoly price mark-ups over marginal cost, manufacturing[a], per cent

(Cartel, Observed, Non-collusive or Cournot)

	Australia	Japan	Philippines	Republic of Korea
All manufacturing[b]	71, 12, 3.1	77, 14, .1	67, 6, .7	63, 10, .6
Food, beverages and tobacco	71, 11, 1.1	100, 16, .2	83, 10, .3	100, 9, .9
Garments, textiles and footwear	63, 8, 4.0	77, 6, .2	53, .3, .2	48, 1, .2
Wood and paper products	91, 21, 3.3	111, 9, .2	71, .4, .4	83, 3, 2.9
Chemicals	125, 13, 16	100, 16, .2	111, 1, .8	100, 12, 2.7
Petroleum and coal products	91, 12, 11	91, 20, .1	91, 6, 11	83, 8, .5
Mineral products	71, 11, 1.3	83, 12, .1	83, .9, .8	83, 1, 1.4
Transport equipment	45, 7, .6	50, 10, .1	40, 14, 1.2	56, 1, 1.0
Machinery	59, 7, 1.8	63, 17, .0	48, 8, .5	50, 19, .2
Miscellaneous manufactures	83, 13, 10	100, 16, .2	77, 1, 1.5	36, 16, 2.1

a Mark-ups over marginal cost derived using equation (1). In the three cases included, the index of non-competitive pricing (μ/n) is set at unity, to represent the perfect cartel, at its calibrated value from Table 9 to represent observed behaviour, and at 1/n to represent non-collusive Cournot behaviour.

b The all-manufacturing estimates are derived for illustration by applying equation (1) to the weighted average values of the index of non-competitive pricing and the elasticity of demand.

Source: All values are derived using equation (1) and substituting the elasticities of demand given in Table 9 and the index of non-competitive pricing, given in Table 10.

Table 12 The nominal rate of protection[a]

(per cent)

	Australia	Japan	Philippines	Republic of Korea
Agriculture	7	70	13	49
Mining	0	0	9	1
Services	0	0	10	50
Food, beverages and tobacco	8	55	35	28
Garments, textiles and footwear	33	11	42	14
Wood and paper products	13	3	18	10
Chemicals	10	6	51	6
Petroleum and coal products	0	4	27	9
Mineral products	9	3	50	16
Transport equipment	23	2	98	6
Machinery	16	4	41	7
Miscellaneous manufactures	19	5	49	16

a The proportion by which the domestic price, adjusted for infrastructural costs, exceeds that at the border. The same proportions are assumed to apply to ad valorem tariff equivalents on imports (**t**) and ad valorem export subsidy equivalents on exports (**s**).

Source: For Australia the estimates are from Industry Assistance Commission (1987), for Japan Saxonhouse and Stern (1989), for the Philippines they are from unpublished data supplied by the Philippine Tariff Commission, and for Korea they are from Kim (1988).

Table 13 Effects of trade reform on economic structure[a]

(per cent change)

		Australia	Japan	Philippines	Republic of Korea
Real GNP[b]	Perfect competition	.4	.3	.1	
	Oligopoly, no entry	.4	.6	.8	3.2
	Oligopoly, free entry	.4	.3	.6	3.1
Real GDP	Perfect competition	-1.2	-.2	-4.5	
	Oligopoly, no entry	-1.1	.0	-4.6	.5
	Oligopoly, free entry	-1.1	-.1	-5.1	.5
Value added at factor cost[c]					
Agriculture					
	Perfect competition	-.3	-5.7	4.5	
	Oligopoly, no entry	-.2	-5.4	4.4	-1.0
	Oligopoly, free entry	-.5	-5.5	4.1	-1.1
Mining/energy					
	Perfect competition	9.2	1.4	11.4	
	Oligopoly, no entry	9.2	1.4	11.5	1.1
	Oligopoly, free entry	8.7	1.7	11.7	1.3
Services					
	Perfect competition	.8	.6	5.0	
	Oligopoly, no entry	.8	.9	4.9	-1.2
	Oligopoly, free entry	.7	.7	4.7	-1.1
Manufacturing					
	Perfect competition	-3.1	1.2	-6.6	
	Oligopoly, no entry	-2.0	1.6	-4.5	3.0
	Oligopoly, free entry	-2.9	1.8	-5.2	3.1

a Three separate pairs of equilibria are compared. The first pair are constructed on the presumption that perfect competition and constant returns to scale prevail in manufacturing. The others presume oligopolistic behaviour with either no entry or exit of firms or free entry or exit.

b GNP includes "transfers" from abroad but excludes repatriated returns on capital (Table 2). GDP excludes the former and includes the latter. See equations (A1.19) and (A1.19a). Since the numeraire is a Cobb-Douglas index of composite product prices, these results are “real” in that they are relative to consumer prices.

c Value added at factor cost, as represented here, differs from sectoral GDP in that all capital used is valued at the market rate of return (pure profits are excluded) and indirect taxation (tariff revenues associated with imports of intermediates) are excluded.

Source: Simulated equilibria calculated using the model presented in Section 2 and Appendix 1.

Table 14 Effects of trade reform on real rewards of non-mobile factors[a]

(per cent change in unit reward[b])

	Australia	Japan	Philippines	Republic of Korea
Skilled labour				
Perfect competition	.7	.8	1.5	
Oligopoly, no entry	.9	1.0	1.7	.1
Oligopoly, free entry	.8	1.1	2.2	.1
Unskilled labour				
Perfect competition	.0	.7	3.6	
Oligopoly, no entry	.1	.9	3.5	.1
Oligopoly, free entry	.0	.9	3.6	.3
Agricultural land				
Perfect competition	-.0	-5.5	4.4	
Oligopoly, no entry	-.1	-5.2	4.3	-1.0
Oligopoly, free entry	-.0	-5.2	4.0	-1.0
Mineral resources				
Perfect competition	8.9	.9	11.2	
Oligopoly, no entry	9.0	1.1	11.2	2.0
Oligopoly, free entry	9.1	1.2	11.7	2.1

a Three separate pairs of equilibria are compared. The first pair are constructed on the presumption that perfect competition and constant returns to scale prevail in manufacturing. The others presume oligopolistic behaviour with either no entry or exit of firms or free entry or exit.

b Proportional changes in unit rewards on those factors which are not internationally mobile, measured relative to the price of the consumption basket in the reference equilibrium.

Source: Simulated equilibria calculated using the model presented in Section 2 and Appendix 1.

Table 15 Effects of trade reform on imperfectly competitive manufacturing[a]

(per cent change, unless otherwise indicated)

	Australia	Japan	Philippines	Republic of Korea
Manufacturing capital stock				
No entry	-2.1	-1.5	-.2	.2
Free entry	-2.2	.6	-12.3	.1
Pure profits[b]				
No entry	-8	1	-9[c]	5
Excess rate of return on manufacturing capital, no entry case, %				
Reference9.4	20.1	-4.7	5.2	
Trade reform	8.9	20.5	-5.1	5.4
Number of firms				
No entry	.0	.0	.0	.0
Free entry	-2.5	.4	-4.7	.3
Value added per firm[d]				
No entry	-2.0	1.6	-4.5	3.0
Free entry	.7	1.5	-.1	2.5

a Two separate pairs of equilibria are compared. The first pair presumes oligopolistic behaviour with no entry or exit of firms while the second allows free entry and exit.

b In the free entry case, pure profits are zero in both the reference equilibrium and the trade reform equilibrium.

c In the Philippines, economic losses are enlarged by this proportion.

d Value added at factor cost, as represented here, differs from sectoral GDP in that all capital used is valued at the market rate of return (pure profits are excluded) and indirect taxation (tariff revenues associated with imports of intermediates) are excluded.

Source: Simulated equilibria calculated using the model presented in Section 2 and Appendix 1.

Table 16 Effects of non-collusive pricing on economic structure[a]

(per cent change)

		Australia	Japan	Philippines	Republic of Korea
Real GNP[b]	No entry	1.1	1.6	.8	1.5
	Free entry	1.9	3.7	2.1	4.4
Real GDP	No entry	.7	1.6	.1	-.1
	Free entry	1.5	2.6	2.0	2.3
Value added at factor cost[c]					
Agriculture					
	No entry	5.7	15.5	5.4	7.0
	Free entry	2.6	9.4	3.9	6.9
Mining/energy					
	No entry	1.6	39.6	-5.8	13.3
	Free entry	.7	12.3	1.3	9.2
Services					
	No entry	2.3	7.0	.0	5.3
	Free entry	2.5	5.2	2.4	5.7
Manufacturing					
	No entry	14.3	35.3	-3.8	19.5
	Free entry	-5.3	-4.1	1.7	-8.4

a Two separate pairs of equilibria are compared, in each case one having calibrated pricing parameters and the other assuming non-collusive or Cournot pricing. The first pair is constructed on the presumption that there is no entry or exit of firms and the second that entry and exit are free.

b GNP includes "transfers" from abroad but excludes repatriated returns on capital (Table 2). GDP excludes the former and includes the latter. See equations (A1.19) and (A1.19a). Since the numeraire is a Cobb-Douglas index of composite product prices, these results are “real” in that they are relative to consumer prices.

c Value added at factor cost, as represented here, differs from sectoral GDP in that all capital used is valued at the market rate of return (pure profits are excluded) and indirect taxation (tariff revenues associated with imports of intermediates) are excluded.

Source: Simulated equilibria calculated using the model presented in Section 2 and Appendix 1.

Table 17 Effects of non-collusive pricing on real rewards of non-mobile factors[a]

(per cent change in unit reward[b])

	Australia	Japan	Philippines	Republic of Korea
Skilled labour				
No entry	4.1	14.3	.5	8.7
Free entry	1.4	1.6	3.9	-6.2
Unskilled labour				
No entry	5.3	15.3	1.9	10.0
Free entry	4.1	6.8	3.9	8.1
Agricultural land				
No entry	6.0	15.4	5.3	7.1
Free entry	3.3	9.2	3.9	6.6
Mineral resources				
No entry	2.0	40.0	-6.1	13.1
Free entry	1.2	12.0	1.3	9.4

a Two separate pairs of equilibria are compared, in each case one having calibrated pricing parameters and the other assuming non-collusive or Cournot pricing. The first pair is constructed on the presumption that there is no entry or exit of firms and the second that entry and exit are free.

b Proportional changes in unit rewards on those factors which are not internationally mobile, measured relative to the price of the consumption basket in the reference equilibrium.

Source: Simulated equilibria calculated using the model presented in Section 2 and Appendix 1.

Table 18 Effects of non-collusive pricing on imperfectly competitive manufacturing[a]

(per cent change, unless otherwise indicated)

	Australia	Japan	Philippines	Republic of Korea
Manufacturing capital stock				
No entry	5.7	21.7	-6.2	8.0
Free entry	-28.2	-32.7	-3.0	-33.2
Pure profits[b]				
No entry	-139	-115	15[c]	-200
(change as per cent of GDP)	(-3)	(-11)	(1)	(-9)
Excess rate of return on manufacturing capital, no entry case, %				
Reference9.4	20.1	-4.2	5.2	
Non-collusive pricing	-3.4	-2.3	-3.8	-4.8
Number of firms				
No entry	0	0	0	0
Free entry	-51	-85	-58	-67
Value added per firm[d]				
No entry	14.3	35.3	-3.8	19.6
Free entry	93	654	243	280

a Two separate pairs of equilibria are compared. In each case one has calibrated pricing parameters and the other assumes non-collusive or Cournot pricing. The first pair is constructed on the presumption that there is no entry or exit of firms and the second that entry and exit are free.

b In the free entry case, pure profits are zero in both the reference equilibrium and the trade reform equilibrium.

c The magnitude of the Philippine loss is reduced by this proportion.

d Value added at factor cost, as represented here, differs from sectoral GDP in that all capital used is valued at the market rate of return (pure profits are excluded) and indirect taxation (tariff revenues associated with imports of intermediates) are excluded.

Source: Simulated equilibria calculated using the model presented in Section 2 and Appendix 1.

Table 19 Effects of non-collusive pricing on manufacturing value added[a]

(Per cent change: no entry case, free entry case)

	Australia	Japan	Philippines	Republic of Korea
All manufacturing	14, -5	35, -4	-4, 2	20, -8
Food, beverages and tobacco	13, -13	20, -18	13, -8	10, -15
Garments, textiles and footwear	9, -1	13, -2	-2, -0	6, -1
Wood and paper products	20, -9	27, -3	-2, 2	16, -3
Chemicals	2, 4	45, -4	-2, 3	18, -9
Petroleum and coal products	5, 2	38, -15	-1, 3	8, 7
Mineral products	19, -6	45, -3	-21, 5	16, 11
Transport equipment	15, -5	32, -3	8, 158	29, -10
Machinery	11, -1	40, -2	13, 2	39, -19
Miscellaneous manufactures	9, 2	36, 1	-7, 3	30, -9

a Value added at factor cost, as represented here, differs from sectoral GDP in that all capital used is valued at the market rate of return (pure profits are excluded) and indirect taxation (tariff revenues associated with imports of intermediates) is excluded.

Source: Simulated equilibria calculated using the model presented in Section 2 and Appendix 1.

Table 20 Mark-ups in non-collusive pricing equilibria[a]

(Per cent: no entry case, free entry case)

	Australia	Japan	Philippines	Republic of Korea
All manufacturing[b]	4.1, 3.7	.13, .26	1.0, 2.0	.7, 1.6
Food, beverages and tobacco	1.1, 2.2	.14, .52	.3, .6	.9, 2.0
Garments, textiles and footwear	4.0, 2.5	.19, .51	.2, .4	.2, .3
Wood and paper products	3.3, 5.6	.18, .52	.36, 1.3	2.9, 2.3
Chemicals	15.8, 6.2	.15, .25	.82, 2.0	2.7, 4.0
Petroleum and coal products	10.7, 3.5	1.17, .98	10.8, 3.7	.5, 1.2
Mineral products	1.3, 2.9	.08, .22	.78, 2.6	1.4, 4.8
Transport equipment	.6, 2.4	.07, .23	1.2, 13.6	.12, 1.2
Machinery	1.8, 2.5	.02, .04	.47, 1.6	.18, .8
Miscellaneous manufactures	10.1, 8.1	.21, .36	1.5, 2.9	2.1, 2.9

a Per cent by which prices exceed average variable cost.

b Arithmetic average of industry mark-ups using value added shares as weights.

Source: Simulated equilibria calculated using the model presented in Section 2 and Appendix 1.

APPENDIX I

THE MODEL

This follows the general account in Section 2 of the main text. A detailed description of the model is offered, along with an outline of the steps required for its solution.[18] The approach taken is illustrated schematically in Figure A1.1. First, any counterfactual variations in exogenous parameters are made. These might include changes in trade distortions, in the external cost of capital, in technology, as reflected in the parameters of the production functions, or in industry structure, as indicated by the fixed factor requirements of firms and their conjectural variations.

Then initial values are set for the numbers of firms in each industry, reference values for which are derived principally from the social accounting matrices (SAMs) presented in Appendix 2. A "no entry" solution, in which the numbers of firms is held constant, is then derived. This solution iterates on the vector [e,**w**], comprising the exchange rate, e (expressed as foreign currency units per unit of local currency) and a vector of non-capital factor rewards, **w**. In the reference equilibrium, all elements of this vector are unity, and the search for counterfactual equilibria generally begins with these values.

Next, product prices and the quantities produced, consumed and traded are calculated, from which are derived any foreign payments imbalance or any non-capital factor market excess demands or supplies. Depending on the closure chosen, acceptably small values may be required for these disequilibria. To achieve these targets, the exchange rate and the factor rewards are adjusted and the no-entry solution recomputed. If firm entry and exit are permitted, the no-entry solution is tested for economic profits or losses in each industry. If these exceed an acceptable tolerance level, the vector of firm numbers in each sector, **n**, is adjusted and a new no-entry solution is sought. This process is repeated until convergence is achieved and no further incentive remains for firm entry or exit, usually within 15 iterations. In what follows we focus on the analytical structure of the model and its solution.

[18] Note that the model is currently operational in an extended version and its solution now uses the Gempack software. Details are offered, along with the Gempack Tablo file, by Tyers

The no-entry solution for given [e,**w**]:

The number of representative identical firms, **n** = [n_i, i=1,N sectors] is held constant. The rate of return on capital, r, is also exogenous, since capital is homogeneous and internationally mobile. The initial vector of unit rewards to domestic factors is **w** = [w_k, k=1,K non-capital factors]. The steps are as follows:

1. Demand elasticities facing domestic industries, **ε**

These must be calculated first, since oligopoly pricing behaviour depends on them. They depend on many other variables in the model, however, so it is best that their formulation be described once the core equations of the model have been presented. For now we will take these as given.

2. Mark-ups over marginal (unit variable) cost

We assume constant marginal cost oligopolistic firms in homogeneous product markets. The profit-maximising mark-up is derived by setting marginal revenue equal to unit variable (or marginal) cost, **v**. The result is

$$(A1.1) \quad m_i = \frac{p_i}{v_i} = \frac{1}{1 + \frac{\mu_i}{n_i \varepsilon_i}} \qquad \forall i \text{ , where } \mu_i = \frac{\partial Q_i}{\partial q_i}$$

and Q_i and q_i are industry and firm output in sector i, respectively. Note that $\mu_i = 0,1,n_i$ implies, respectively, perfect competition, Cournot oligopoly or a colluding cartel.

3. Domestic prices of imported goods

$$(A1.2) \quad p_i^* = \frac{P_i (1 + t_i)}{e} \qquad \forall i$$

Where P_i is the (exogenous) foreign currency price of goods produced in the rest of the world, and t_i is the equivalent ad valorem tariff rate.

(2004).

4. Domestic prices of home products

Production is Cobb-Douglas in variable factors and inputs, with output elasticities α_i for capital, β_{ki} for factors k and γ_{ji} for inputs j. The subaggregation of imported and domestic inputs is also Cobb-Douglas, thus assuming unit elasticities of substitution, with expenditure shares on home inputs τ_{ji}. First, unit variable costs are calculated as:

$$(A1.3) \quad v_i = b_i \, r^{\alpha_i} \prod_{k=1}^{K} w_k^{\beta_{ki}} \prod_{j=1}^{N} [p_j^{\tau_{ji}} \, p_j^{*(1-\tau_{ji})}]^{\gamma_{ji}} \qquad \forall \, i \ ,$$

where the scale coefficient, b_i, is calibrated from the SAM, as are all the exponents in the equation. Then, domestic prices follow as:

$$(A1.4) \quad p_i = m_i \, v_i \qquad \forall \, i \ .$$

Together, these yield:

$$(A1.5) \quad \log p_i = \log b_i + \log m_i + \alpha_i \log r + \sum_{k=1}^{K} \beta_{ki} \log w_k + \sum_{j=1}^{N} \gamma_{ji} \, \tau_{ji} \log p_j + \sum_{j=1}^{N} \gamma_{ji} \, (1 - \tau_{ji}) \, p_j^* \qquad \forall \, i$$

This is a set of N linear simultaneous equations in p_i which is readily solved by matrix inversion.

5. Unit factor and input demands

These follow from cost minimisation by firms whose production is Cobb-Douglas in variable factors and inputs. Although these firms are oligopolistic in product markets, they are price takers in both factor and input markets. The unit factor demands for capital and other factors, respectively, are:

$$(A1.6) \quad u_i^K = \frac{\alpha_i \, v_i}{r} \qquad \forall \, i$$

$$(A1.7) \quad u_{ki}^L = \frac{\beta_{ki} \, v_i}{w_k} \qquad \forall \, k, i$$

The unit input demands are just Leontief input-output coefficients, except that their values depend on product and input prices. For home-produced and imported inputs, respectively, they are:

(A1.8) $$A_{ji} = \frac{\gamma_{ji}\,\tau_{ji}\,v_i}{p_j} \qquad \forall\, i, j\ ,$$

(A1.9) $$A^*_{ji} = \frac{\gamma_{ji}\,(1-\tau_{ji})\,v_i}{p^*_j} \qquad \forall\, i, j\ .$$

6. Prices of home product exports in foreign markets:

These depend on the domestic price, p_i, the ad valorem export subsidy rate (with border price as denominator), s_i and the ad valorem equivalent import tariff rate in foreign markets, t_i^*.

(A1.10) $$p^e_i = \frac{p_i\, e\,(1+t^*_i)}{(1+s_i)} \qquad \forall\, i\ .$$

7. Exports:

Foreigners aggregate home exports and foreign products with elasticity of substitution σ_i^* (defined positive). Their demand for product group i has elasticity $-\Omega_i$ (where Ω_i is also defined positive).

(A1.11) $$X_i = \frac{E_i\,\theta_i\,[\theta_i\, p_i^{e(1-\sigma^*_i)} + (1-\theta_i)\, P_i^{(1-\sigma^*_i)}]^{\rho_i}}{(p^e_i)^{\sigma^*_i}} \qquad \forall\, i\ \text{, where} \qquad \rho_i = \left(\frac{\sigma^*_i - \Omega_i}{1-\sigma^*_i}\right).$$

When exports are small compared with foreign markets (θ_i is small), foreign demand for home product i has approximate elasticity $-\sigma_i^*$, irrespective of foreigners' elasticity of demand for that product group. E_i is also a calibrated constant.

Thus far, we have been able to solve directly for domestic and imported product prices, the volume of exports and unit factor demands. Despite the simplifying dependence of this solution on an exchange rate and factor prices which are (at this stage) exogenous, solving for the other key variables which characterize the equilibrium involves unavoidable simultaneity. The additional relationships on which the simultaneous solution is based are those which follow.

8. Final demand:

Home consumers are assumed to subaggregate home goods and imports with elasticity of substitution σ_i. They have Cobb-Douglas utility and hence expenditure shares across product groups are constant. Final demand for home goods is therefore:

$$(A1.12) \quad D_i = \frac{a_i Y \delta_i p_i^{-\sigma_i}}{\delta_i p_i^{(1-\sigma_i)} + (1-\delta_i) p_i^{*(1-\sigma_i)}} \qquad \forall i \ ,$$

where a_i is the calibrated reference expenditure share of product group i, δ_i is the corresponding share of home goods in final demand for group i and Y is aggregate income (GNP).

Similarly, final demand for imports is

$$(A1.13) \quad M_i^D = \frac{a_i Y (1-\delta_i) p_i^{*-\sigma_i}}{\delta_i p_i^{(1-\sigma_i)} + (1-\delta_i) p_i^{*(1-\sigma_i)}} \qquad \forall i \ .$$

Note that, if imports dominate final demand (δ_i approaches zero), the price elasticity of final demand for home goods is approximately $-\sigma_i$. If, on the other hand, home goods dominate the domestic market, the elasticity is approximately -1.

9. Demand for inputs:

This is derived from the input-output coefficients and gross industry output, **Q**. For home inputs of type j it is

$$(A1.14) \quad I_j = \sum_{j=1}^{N} A_{ji} Q_i \qquad \forall j \ .$$

For the corresponding imported inputs it is

$$(A1.15) \quad I_j^* = \sum_{j=1}^{N} A_{ji}^* Q_i \qquad \forall j \ .$$

10. Total imports:

This is simply the sum of final demand with intermediate demand for imported goods.

(A1.16) $M_i = M_i^D + I_i^* \qquad \forall i$.

11. Gross industry output:

In matrix form, where **Q**=[q_i], this is

(*A*1.17) $Q = \left(I - A\right)^{-1}\left[D + X\right]$,

where intermediate demand is implied through the inverse Leontief matrix.

12. Economic profits or losses:

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

(A1.18) $\pi_i = (p_i - v_i)\, Q_i - n_i\,(r\, f_i^K + w_1\, f_i^L) \qquad \forall i$,

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.

13. National income (GNP):

This is the sum of payments to domestically owned factors, the home share of any profits or losses made, net income from tariffs and export subsidies and the net inflow of unrequited transfers, including financial aid.

$$(A1.19)\quad Y = r\,K_D + \sum_{k=1}^{K} w_k L_k + \left(\frac{K_D}{K_T}\right)\sum_{i=1}^{N}\pi_i + \sum_{i=1}^{N} p_i^*\, M_i\left(\frac{t_i}{1+t_i}\right) - \sum_{i=1}^{N} p_i\, X_i\left(\frac{s_i}{1+s_i}\right) + \frac{B}{e}$$

where B is the (exogenous) net inflow of aid, borrowings and other unrequited transfers, measured in foreign currency. K_D is that part of the capital stock which is domestically owned. It is also held constant. By comparison, the measure of GDP referred to in the paper incorporates all income to capital but omits the transfer from abroad.

$$(A1.19a)\quad GDP = r\,K_T + \sum_{k=1}^{K} w_k L_k + \sum_{i=1}^{N}\pi_i + \sum_{i=1}^{N} p_i^*\, M_i\left(\frac{t_i}{1+t_i}\right) - \sum_{i=1}^{N} p_i\, X_i\left(\frac{s_i}{1+s_i}\right)$$

14. Total factor demands:

In the case of capital, which is infinitely elastic in supply at exogenous interest rate r, the capital stock, K_T, is the value of capital demanded.

$$(A1.20) \quad K_T = \sum_{i=1}^{N} (u_i^K Q_i + n_i f_i^K)$$

The demand for skilled labour is

$$(A1.21) \quad L_l = \sum_{i=1}^{N} (u_{li}^L Q_i + n_i f_i^L)$$

and that for the other factors is

$$(A1.22) \quad L_k = \sum_{i=1}^{N} u_{ki}^L Q_i \qquad k = 2, K \ .$$

15. Calculating imbalances:

Once the above equations have been used to solve recursively for $\mathbf{p}^*$, $\mathbf{p}$, $\mathbf{p}^e$, and $\mathbf{X}$, and simultaneously for $\mathbf{D}$, $\mathbf{I}$, $\mathbf{M}$, $\mathbf{Q}$, $\boldsymbol{\pi}$, $\mathbf{Y}$, K_T, and $\mathbf{L}$, any imbalances in foreign payments and domestic factor markets can be calculated.

Inflows and outflows on the balance of payments are calculated in domestic currency. Inflows combine export earnings with net transfers, B (set as exogenous in foreign currency).

$$(A1.23) \quad \text{Inflows} = \frac{B}{e} + \sum_{i=1}^{N} p_i X_i$$

Outflows are repatriated earnings on foreign owned capital, the pre-duty cost of imports and the cost of export subsidies.

$$(A1.24) \quad \text{Outflows} = r\,(K_T - K_D) + (1 - \frac{K_D}{K_T}) \sum_{i=1}^{N} \pi_i + \sum_{i=1}^{N} \frac{p_i^* M_i}{1 + t_i} + \sum_{i=1}^{N} p_i X_i \left(\frac{s_i}{1 + s_i} \right)$$

The external imbalance is then

$$(A1.25) \quad \Delta_e = \frac{\text{inflows}}{\text{outflows}} - 1 \ .$$

The corresponding factor market imbalances follow directly from equations (A1.21) and

(A1.22), above. They are

$$(A1.26) \quad \Delta_k^L = \frac{L_k}{\bar{L}_k} - 1 \qquad \forall\, k \ ,$$

where L_k is the full domestic endowment of factor k. These imbalances enter the algorithm by which the exchange rate and factor prices are adjusted in search of the no-entry general equilibrium.

16. The solution algorithm

The objective is to calculate the vector [e,**w**], which we shall call **ω**, yielding a vector of imbalances $\mathbf{\Delta}=[\Delta_e,\mathbf{\Delta}^L]$ which is suitably close to **0**. A variant of Newton's Method is used. Extensive use is made of the above no-entry solution for given **ω**. At the outset, a matrix of derivatives is calculated by imposing small shocks on **ω** and calculating the associated changes in **Δ**. This matrix, **H**, has the following elements:

$$(A1.27) \quad h_{ij} = \frac{\Delta_i^1 - \Delta_i^0}{\left(\frac{\omega_j^1 - \omega_j^0}{\omega_j^0} \right)} \qquad \forall\, i, j \ ,$$

where the superscript 0 indicates reference values and superscript 1 indicates those following s small shock to **ω**. In any iteration m,

$$(A1.28) \quad \Delta^m - \Delta^{m-1} = H \left(\frac{\omega^m - \omega^{m-1}}{\omega^m} \right)$$

But the objective is to choose the new values of **ω**, ω^m, so that $\mathbf{\Delta}^m=\mathbf{0}$. Imposing this yields

$$(A1.29) \quad \omega^m = \omega^{m-1} (1 - H^{-1} \Delta^{m-1})$$

Thus, the solution is derived by successive application of (A1.29) until **Δ** is within a suitable tolerance of **0**.

The solution with firm entry and exit

Where firm entry and exit are allowed, a common closure requires that this take place to exhaust all economic profits. The objective is then to calculate the vector **n** which yields $\boldsymbol{\pi}(\mathbf{n})=\mathbf{0}$. The imbalance used in this case is the excess rate of return on capital.

$$\text{(A1.30)} \quad \Delta_i^n = \frac{\pi_i}{K_i} \qquad \forall\, i$$

where K_i is the total demand for capital in sector i.

$$\text{(A1.31)} \quad K_i = u_i^K Q_i + n_i f_i^K \qquad \forall\, i$$

The algorithm used is very similar to that used in the no-entry solution to solve for **ω**. A matrix of derivatives is approximated by first disturbing elements of the vector **n** slightly and using the complete no-entry solution to calculate the resulting changes in **π**, and hence in $\boldsymbol{\Delta}^n$. An adjustment rule identical to equation (A1.29) is then applied at each iteration, until $\boldsymbol{\Delta}^n$ is within a suitable tolerance of **0**.

The elasticity of demand facing domestic industries

The sources of demand for home products are final demand, intermediate demand and export demand. For sector i, the elasticity sought is a composite of the elasticities of all three sources of demand.

$$\text{(A1.32)} \quad \varepsilon_i = s_i^F \varepsilon_i^F + s_i^I \varepsilon_i^I + s_i^X \varepsilon_i^X \qquad \forall\, i \ ,$$

where s here designates the volume share of the home product in each source of demand. Beginning with final demand, differentiating (A1.12) yields

$$\text{(A1.33)} \quad \varepsilon_i^F = -\sigma_i + \left(\frac{p_i D_i}{a_i Y}\right)(\sigma_i - 1) \qquad \forall\, i \ ,$$

where the share in parentheses is that of home goods in final demand for product group i. Its value in the reference SAM is δ_i.

Turning then to export demand, differentiating (A1.11) yields

$$(A1.34) \qquad \varepsilon_i^X = -\left(\frac{\theta_i \Omega_i p_i^{e(1-\sigma_i^*)} + (1-\theta_i)\sigma_i^* P_i^{(1-\sigma_i^*)}}{\theta_i p_i^{e(1-\sigma_i^*)} + (1-\theta_i) P_i^{(1-\sigma^*)}} \right) \qquad \forall i$$

Note that this is a weighted average of the elasticities $-\Omega$ and $-\sigma^*$. In the likely even that θ_i is small, the approximate value of this elasticity is $-\sigma_i^*$.

Finally, turning to intermediate demand, we follow Harris (1984) in approximating this component elasticity on the assumption that gross sectoral output, $\mathbf{Q}_j$, is unaffected by the price of any individual input, i. Analytical expressions for ε_i^I, for the case in which this assumption is relaxed, are available on request from the authors. These lengthy expressions have not been used in the current version. From (A1.14)

$$(A1.35) \qquad \frac{\partial I_i}{\partial p_i} = \sum_{j=1}^{N} Q_j \frac{\partial A_{ij}}{\partial p_i} \qquad \forall i \ .$$

Then, expanding A_{ij} using (A1.8) and (A1.3), we obtain the derivative and elasticity:

$$(A1.36) \qquad \frac{\partial I_i}{\partial p_i} = \sum_{j=1}^{N} \frac{I_{ij}}{p_i} (\gamma_{ij}\tau_{ij} - 1) \qquad \forall i \ , \quad (A1.37) \qquad \varepsilon_i^I = \sum_{j=1}^{N} s_{ij}^I (\gamma_{ij}\tau_{ij} - 1) \qquad \forall i \ ,$$

where s_{ij}^I is the share of industry j in the total intermediate demand for input i. These component elasticities are assembled using (A1.32). In the solution to the model this is done in such a way as to ensure that all the shares, s_i^F, s_i^I, s_i^X and s_{ij}^I are up-dated at each iteration.

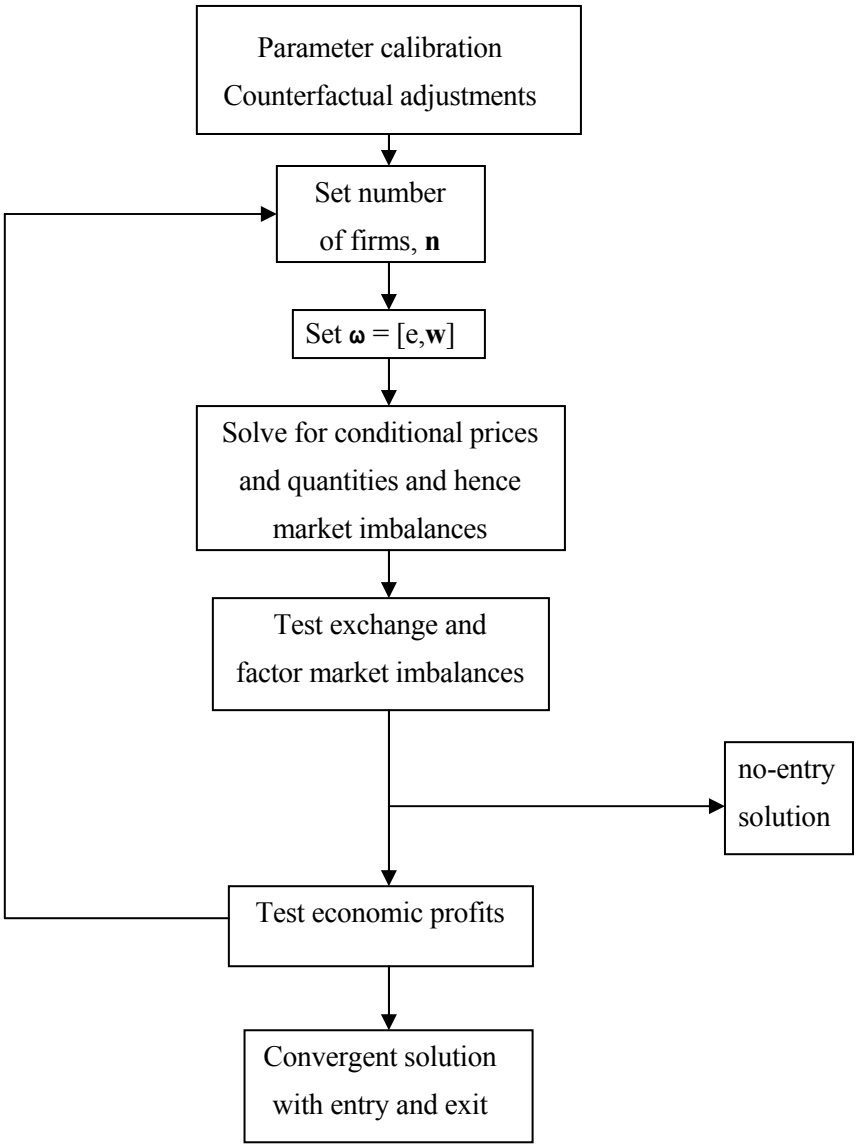

Figure A1.1: Model Solution

Appendix 2: Data Base Construction and Parameterisation of the Model

For each country, the parameter set is derived principally from a social accounting matrix (SAM). Each SAM is constructed by reconciling IO tables, aggregated to 12 sectors, with other data, including the national accounts, the balance of payments accounts and other subsidiary sources. Once each is complete and in balance, most the parameters of the corresponding model are obtained by calibration. Some, however, such as elasticities of substitution in demand, must be derived from independent empirical studies. The analytical structure of each model, detailed in Appendix 1, assumes optimising behaviour at the level of households and firms. This, and the choice of functional forms for utility and production functions, yields behavioural relationships which are readily calibrated directly from the SAMs. The elasticities in the Cobb-Douglas utility function, for example, are observed in the consumer's expenditure shares.

A summary of the data gathering is presented in Table A2.1 while the parameters and the procedures used in estimation and calibration are summarised in Table A2.2.

Construction of the Social Accounting Matrix (SAM)

The social accounting matrices of the four countries are presented in Table A2.3 to Table A2.6. The primary source for each was an IO table from the mid 1980s. That for Australia is from 1986, those for Japan and the Republic of Korea 1985, and that for the Philippines 1983. Differences in the availability of data for each country make it simplest to discuss the SAMs for each country separately.

Australia and Japan:

The IO tables for these two countries classify payments to primary inputs into salaries and wages, indirect taxes, depreciation and a residual, operating surplus. One important task is to allocate the sum of these payments among payments to the five factors defined in the model.

Labour (skilled and unskilled):

The first step is to calculate total payments to labour by deducting an estimate of imputed wages for agriculture and services from the operating surplus and adding it to the wage bill. For Australia, the estimate was taken from the Australian Industry Commission ORANI database, the information being

provided directly by that institution. The estimate for Japan, on the other hand, assumed the same ratio of imputed agricultural and service wage cost to the overall wage bill as in Australia.

Payments to labour comprises payments to skilled and unskilled labour. It is assumed that each type of labour is homogenous and that both labour markets are competitive, and hence that the wage rates in each labour market are the same in all industries. Accordingly, total payments to labour in each industry is

$$V^i = L^i_s w_s + L^i_u w_u \quad \text{(A 2.1)}$$

and total labour in each industry is

$$L^i = L^i_s + L^i_u \quad \text{(A 2.2)}$$

where Vi is the total payment to labour in industry i; L^i is total labour in industry i; L^i_s is total skilled labour in industry i; L^i_u is total unskilled labor in industry i; w_s is the average wage of skilled labour; and w_u is the average wage of unskilled labour. Employment by industry was obtained from ABS (1986) and ABS (1988) for Australia and from OECD (1990a) for Japan. For the purpose of apportioning payments to labour between skilled and unskilled, the largest and the smallest average wage among the 12 industries in the aggregated IO table were taken as the skilled and unskilled wage rates, respectively. Payments to skilled and unskilled labour were then estimated using equation (A2.1) and equation (A2.2).

Payments to capital and profits/losses:

Payments to capital for all sectors except services were calculated as the product of the interest rate and the capital stock of the sector. Estimates of Australia's capital stock in agriculture, mining and manufacturing were taken from ABS (1988b). The capital stock in manufacturing was disaggregated according to Hagan (1991). Capital stock levels for each sector in Japan were taken from the OECD International Sectoral Database, access to which was provided by the ANU International Economic Data Bank. In the services sector, the operating surplus net of imputed wages is regarded solely as the return to capital. No reliable independent estimate of either the return to service capital or the service capital stock is available.

In the benchmark equilibrium, represented in the SAM, the number of firms (and hence the fixed capital stock) is considered fixed. Firms are therefore earning pure (economic) profits or losses. These

were estimated by deducting payments to capital from the operating surplus. On the other hand, each of the three industries characterised as perfectly competitive (agriculture, mining and services) is assumed in the benchmark equilibrium to be in a position of long run competitive equilibrium. Thus, no pure profits are being earned.

Land and mineral resources:

Agriculture is specified as the only sector using land. Payments to land were obtained by deducting payments to capital from the operating surplus net of imputed wages. Likewise, mining is the only sector using mineral resources and payments to mineral resources are given by deducting payments to capital from the operating surplus.

Fixed capital and labour costs:

In each manufacturing industry in the model, capital and skilled labour are assumed to include both fixed and variable components. Payments to skilled labour derived from the input-output table and payments to capital imputed from the capital stock data only provide information on the total (fixed plus variable) primary factor costs. In order to apportion these primary factor costs between fixed and variable components, a modified version of the procedure adopted by Harris (1984) was used.

In the absence of empirical estimates of fixed costs incurred by manufacturing firms, a cost function is postulated and values of fixed capital and labour costs are derived which are consistent with this cost function. The assumed cost function, C, has the functional form,

$$(A\,2.3) \qquad C(w, r, p, q) = q\,h(w, r, p) + r\,\overline{K} + w_s\,\overline{L}$$

where q is firm-level output; $\overline{K}\,1$ is the fixed capital requirement; $\overline{L}\,2$ is the corresponding fixed labour requirement; r is the rental rate of capital; **w** is the vector of variable factor rewards, in which the reward for skilled labour, from which fixed labour is drawn, is w_s; **p** is the vector of other input prices; and h is average variable cost. The problem is to identify $r\overline{K}$ and $w_s\overline{L}$.

The average total cost (AC) curve of the firm is assumed to be monotonically decreasing and approaches average variable cost h(**w**,r,**q**) asymptotically. The minimum efficient scale (MES) of the firm is defined to be that level of output at which average cost is 1 per cent greater than average variable cost. Thus, MES is implicitly defined by the equation

$$(A\,2.4) \quad AC(q_m) = \frac{C(q_m)}{q_m} = 1.01\,h(w,r,p)\,9$$

where q_m is the MES. Given the definition of the MES, the following also holds,

$$(A\,2.5) \quad AC(0.5q_m) = (1+s)\,1.01\,h(w,r,p)$$

where *s* is the percentage by which average cost exceeds average variable cost at an output level one-half of the MES. Following Harris (1984), this represents the "slope" of the long run average cost curve.

Alternatively, average cost at one-half MES can be written as

$$(A\,2.6) \quad AC(0.5q_m) = h(w,r,p) + \frac{r\,\overline{K}}{0.5q_m} + \frac{w_s\overline{L}}{0.5q_m}\,11$$

Equating (A2.5) and (A2.6) and rearranging yields the expression

$$(A\,2.7) \quad r\,\overline{K} + w_s\,\overline{L} = (0.01+1.01s)\,h(w,r,p)\;\;0.5q_m\,12$$

which has three unknowns $r\,\overline{K}$, $w_s\,\overline{L}$ and h(**w**,r,**p**).

To obtain an expression for total fixed cost in terms of the slope, MES and total cost, substitute (A2.1) into (A2.7) and rearrange terms.

$$(A\,2.8) \quad r\,\overline{K} + w_s\,\overline{L} = \left(\frac{\frac{0.5q_m}{q}(0.01+1.01s)}{1+\frac{0.5q_m}{q}(0.01+1.01s)} \right) C\,13$$

Estimates of total cost, C, were taken from the SAM. The slope coefficients, taken from Gupta and Fuss (1979), were aggregated up to a twelve sector level by taking weighted averages using United Nations production data, expressed in value terms, as supplied by the International Economic Data Bank (IEDB). The estimation of the minimum efficient scale (MES) is discussed in the next section.

In order to allocate total fixed cost between capital and labour, it is assumed that the ratio is proportional to the ratio between total payments to capital and total payments to labour

$$(A\,2.9) \quad \frac{r\,\overline{K}}{w_s\,\overline{L}} = (1+\varepsilon)\frac{r\,K_T}{w_s L_s + w_u L_u}$$

where sectoral super and subscripts, i, are dropped for convenience. Estimates of total payments to both capital and labour were taken from the SAM. Following Harris (1984), a value of five was used for the

parameter ε. Payments to fixed capital and fixed labour, expressed as a percentage of total payments to capital and labour are presented in the main text, in Table 6. The return to mobile capital and skilled labour were estimated by deducting the value of fixed capital and labour from the total costs of capital and skilled labour, respectively.

Matrix of imports used as intermediate inputs:

An import matrix was not available for Japan. The vector of total imports from the 1985 IO table was therefore disaggregated into a matrix using the same proportions from the country's 1975 import matrix taken from the Institute of Developing Economies (1981).

Philippines:

Payments to primary factors in the 1983 IO table were classified into "salaries and wages" and operating surplus. The latter includes unrecorded labour income in family farms or firms, return to capital and possible pure profits. The first step was to allocate operating surplus into the five factors of the model.

Land and mineral resources:

Following the assumption of Evenson and Sardido (1986), the return to land in agriculture was assumed 30 per cent of total factor payments in that sector. On the other hand, mineral resource rent in the mining sector was assumed 40 per cent. This is a best guess in the absence of reliable information.

Labour (skilled and skilled):

As in the case of the Australian and Japanese SAMs, imputed income which includes the income of owner-operators and unpaid family workers was estimated for both the agriculture and services sectors only. Such income was assumed to make up 24 per cent and 59 per cent of total labour income in these sectors, respectively. These assumptions were roughly based on the percentage excess of total employment over the total number of employees recorded. Total employees are defined to include all persons who work in or away from establishments (firms), receive compensation and are under the control of the establishments. On the other hand, total employment includes total employees as defined above and working owners and unpaid family workers who work for the establishments but are not on the regular payroll (NCSO 1987). The imputed income was then added to the value of labour income in

the IO table to arrive at total labour income.

Estimation for the return to skilled and unskilled labor was the same as in Australia and Japan. Data on skilled and unskilled wage rates from UN (1989) were reconciled with the average wage rates in each industry derived using the labour income in the IO table and employment data from NSCB (1988) and NCSO (1987). To apply equations (A2.1) and (A2.2), the levels of employment were drawn from NSCB (1988) and reclassified according to the 12 sectors in the model. This required the adaptation of the distribution of employment in manufacturing industries from NCSO (1987).

Payments to capital and profits/losses:

The economic return to capital and pure (economic) profits were derived as the residual operating surplus after deducting imputed labour income, returns to land and returns to mineral resources. For the perfectly competitive industries (agriculture, mining and services), these residuals were taken to be market returns to capital only. In the benchmark equilibrium characterised by the SAM, the nine manufacturing industries are assumed to be earning pure profits or making losses.

At first, market returns to capital were separated by using Hooley's (1985) estimates of capital stock in the manufacturing sector and assuming a nominal rate of return of 22.5 per cent throughout. It was immediately apparent, however, that these estimates of the capital stock were too small. Residual pure profits emerged in all manufacturing sectors and these were of ridiculous proportions (ranging from 50 per cent of total value added in textiles, garments and footwear to 94 per cent of that in petroleum and coal products). Such results were quite implausible considering that 1983 was a year of pervasive losses in the manufacturing sector. The residuals of the operating surplus in the imperfectly competitive industries were therefore allocated between return to capital and profits/losses by using, instead, Hooley's shares of the overall capital stock across manufacturing sectors and assuming that manufacturing as a whole made less than the market return on its capital in 1983 (by about 4 per cent; see Austria 1992).

First, consider only the manufacturing sectors (i=4,12). The actual rate of return on all capital in these sectors combined is observed as r_m and the yet unknown capital stock in those sectors is K_m. The total payment to each manufacturing industry is known from the IO table as g_i and Hooley's (known) industry share of all manufacturing capital is ki. The values of π_i (i=4,12), the unknown profits/losses in each industry, and K_m are then readily obtained from following conditions.

$$(A\,2.10) \quad g_i = k_i\,(r_m\,K_m) + \pi_i\,, \qquad i = 4,12$$

$$(A\,2.11) \quad \sum_{i=4}^{12} \pi_i = (r_m - r)\,K_m$$

where r is the market rental rate of capital. Once $\boldsymbol{\pi}$ and K_m are known, the following conditions on the presumed competitive sectors, agriculture, mining and services (i=1,3), make it possible to estimate the overall capital stock and, thereby, market returns to capital in all sectors.

$$(A\,2.12) \quad \pi_i = 0\,, \quad g_i = r\,K_i\,, \qquad i = 1,3$$

$$(A\,2.13) \quad K_T = K_m + \sum_{i=1}^{3} K_i$$

Fixed capital and labour costs:

Fixed capital and labour costs were estimated by the same method as that employed in the cases of Australia and Japan. Payments to fixed capital and labour, as a percentage of total payments to those factors are presented in the main text, in Table 6.

Matrix of imports used as intermediate inputs:

An import matrix recording the use by each industry of imported inputs classified by sector of origin was not available. An import matrix was therefore constructed by distributing the vector of total imports, drawn from the IO table, across sectors using the shares of each sector in total output.

Republic of Korea:

The 1985 Korean IO table classifies payments to factor inputs into four groups, namely compensation of employees, operating surplus, capital consumption allowances and indirect taxes less subsidies. For each sector, the operating surplus, which is computed as a residual, includes returns to labour and capital and possible pure profits.

Land and mineral resources:

Payments to land in the agriculture sector were based on the factor proportions observed by Kim and Park (1979). Payments to mineral resources are derived as a residual, after those to labour and

capital have been calculated.

Labour (skilled and unskilled):

The level of employment and the average wage rate in each industry were taken from Monthly Statistics of Korea, National Statistics Office, Republic of Korea. Skilled labour is defined as university and college graduates. The average wage rates for these two categories are chosen from the work of Bai (1990). Once these rates are known, resort to equations (A2.1) and (A2.2) yields the division of payments to the two factors.

Payments to capital and profits/losses:

Payments to capital are estimated by using the capital stock in each industry, drawn from Hong (1988), and an assumed universal rate of return on capital (the interest rate on long term borrowings, set in 1985 at an average of 9.5 per cent per year) drawn from the Bank of Korea, *Monthly Bulletin*. Profits/losses in the imperfectly competitive industries were estimated by deducting from the total value added reported in the 1985 IO table payments to capital and labour and tariff revenue to the government.

Fixed capital and labour costs:

The approach taken to the estimation of fixed capital and labour costs was the same as for the other economies modelled. Payments to fixed capital and labour as a percentage of total payments to capital and labour are presented in Table 6.

Number of Firms

The choice of a measure for the number of identical firms in each imperfectly competitive sector is important in determining the response in mark-ups to changes in collusive behaviour (equation A1.1). Moreover, it is also important in estimating the extent of any unrealised scale economies, via comparisons of average firm output with the corresponding MES, estimates of which are discussed in the next section. To do both these things well would require a very high level of disaggregation of the manufacturing sectors of all four economies, beyond the resources available to this project. The necessity to work with only 12 industry categories stretched the assumption that firms in each are identical. Since the distribution of firm size in such broadly defined industry categories often includes a modest number of very large firms and a large number of small firms. We chose to interpret this pattern

as representing small numbers of oligopolistic leading firms depending upon large numbers of relatively competitive suppliers of components. It is then most realistic to model this as an oligopoly among the large firms, each of which incorporates its suppliers of components.

In applying this characterisation, the key problem is to determine the cut-off point in firm size between the large and small firms. We did this judgementally. In all four countries, the size distribution of manufacturing firms is available. We tended to choose the largest size category available for each country. For the Philippines, this includes firms with 200 or more employees (WB 1987); 300 or more employees for Japan (Statistics Bureau 1986); and 500 or more employees for Australia (ABS 1989) and the Republic of Korea (UN 1987).

Estimation of Minimum Efficient Scale (MES)

Independent estimates of minimum efficient scale are not available for manufacturing in the four countries studied. The original sources used were therefore the econometric estimates by Gupta and Fuss (1979) for various ISIC three-digit and four-digit level industries in Canada in 1968. These estimates were adapted to all four economies on the assumption that the MES in each industry is the same in physical units as that in Canada. There were considerable difficulties, however, in the adaptation between industry classifications and across time.

A first approach was to use commodity production data for Canadian manufacturing industries, given in terms of physical quantity units, to convert the Gupta and Fuss estimates into those units. For the four countries, production data in physical units was available at no higher aggregation than 6-digit ISIC, and data in value terms was disaggregated at no more than 4-digit ISIC. The idea was to calculate a weighted average of the MES figures associated with the 6-digit classifications to determine an MES in physical quantity units for each 4-digit class. Then for each 4-digit class, the MES could be calculated in value terms by dividing the MES in physical units by the physical production of the 4-digit class and multiply this ratio by the production of the 4-digit class in value terms. The MES for each sector is then a weighted average of the MES for the 4-digit classes within each sector.

The practical problem with this approach was that taking a weighted average in the first stage and then converting to value terms both require calculation of total production in physical units for a 4-

digit class. The first and fundamental problem is the lack of uniformity of units within a 4-digit class (the necessity, for example, to add metric tonnes of raw wool to metres of wool yarn). Secondly, there are a large number of 6-digit classes within each 4-digit class, ensuring an unacceptable number of approximations (since inconsistent units are required for each 4-digit total).

A second approach was to translate the Gupta and Fuss (1979) MES estimates across to the four economies in units of value. The MES figures for the industries considered by Gupta and Fuss were aggregated to the sector classification of the model, with the number of firms in each industry used as weights. For this method, the vector of MES estimates (in 1968 Canadian dollars) needed to be expressed in mid-1980s Canadian dollars, for conversion to the currencies of the four economies. For this purpose, the producer price series from OECD (1990) was used. The figures for MES were then converted at surrounding three-year average market exchange rates drawn from the IMF's *International Financial Statistics* (various issues). Purchasing power parity rates from Summers and Heston (1991) were also tried, though these appeared to enhance rather than resolve inconsistencies in the results, to which we now turn.

The important parameter in the equation for fixed cost (equation A2.8) is not the absolute value of the MES, but its value as a proportion of the output of the firm. As outlined above, however, we considered a firm to be one which is sufficiently large to alter product prices. Ideally, therefore, a firm size consistent with this definition should be used. For example, in Japan, a firm includes only those with 300 or more employees. Were data available for the output of this class of firms (by sector), then dividing by the number of firms within this class would yield a more appropriate firm size for the purpose of equation (A2.8). Such data was not available, however. Moreover, it is insufficient to simply divide the total output in each classification by the number of firms in the narrow class of interest. In most cases, small firms produce a significant proportion of the value of output so that this quotient overestimates the average product in the focus firms.

Ultimately, average firm size in the four economies was approximated by dividing output in each classification by the number of firms using a definition of firm consistent with that used by Gupta and Fuss (all firms, excluding the smallest class, generally those with less than five employees). The resulting estimates of the ratio 3 seemed overly high, so much so that payments to fixed capital from

(A2.8) occasionally appeared to exceed all payments to capital. They were nevertheless useful as indicators of relativities between the sectors. The final figures adopted, which are indicated in the main text in Table 6, preserve these observed relativities but have been adjusted to maintain realistic ratios of fixed to total capital.

Elasticities of Substitution and Export Demand Elasticities

In the absence of econometric estimates for each country on the elasticities of substitution between imports and domestic goods and between domestic exports and world exports for the industry classification of the model, these two sets of elasticities are assumed to be identical. The values used are drawn from the surveys by Industry Commission (1991) and Stern, Francis and Schumacher (1976).

Constant Terms in the Production and Cost Functions

The Cobb-Douglas production function underpinning the technology assumed in the model has the form,

$$(A2.14) \quad Q_i = A_i K_i^{\alpha_i} \prod_{k=1}^{K} L_{ki}^{\beta_{ki}} \prod_{j=1}^{N} I_{ji}^{\tau_{ji}\gamma_{ji}} \; I_{ji}^{*(1-\tau_{ji})\gamma_{ji}} \;, 4$$

where L_{ki} is the quantity of mobile factor k used in the production of i, I_{ji} is the corresponding volume of intermediate input j, and its asterisked counterpart refers to imported inputs. The constant coefficient A_i is determined by rearranging the production function in terms of A_i and calculating with all variables at their benchmark equilibrium values.

From the production function, the unit variable cost function (A1.3) is derived. The constant term in the function, b_i, has the value

$$(15) \quad b_i^{-1} = A_i \alpha_i^{\alpha_i} \prod_{k=1}^{K} \beta_{ki}^{\beta_{ki}} \prod_{j=1}^{N} [\tau_{ji}\gamma_{ji}]^{\tau_{ji}\gamma_{ji}} [(1-\tau)\gamma_{ji}]^{(1-\tau_{ji})\gamma_{ji}} \; .$$

Table A2.1 Summary of data gathering and calibration of the model

Symbol	Variable	Sources	Procedure
Q_i	Gross output	(1) IO table	Sectoral totals from (1).
p_i, p^*_i	Product prices	(1) IO table	IO table defines units so all prices are 1 in the reference short equilibrium.
w_k	Return to non-capital factor inputs		See main text of this appendix.
r	Return to capital	(1) AU: INDECS (1990) (2) JA: IMF (1987) (3) PH: WB (1987) (4) KO: Bank of Korea (1990)	Interest rate on long term borrowing was used.
K_T	Total capital stock (domestic and foreign)	(1) AU: ABS (1988); Hagan (1991) (2) JA: OECD sectoral database (3) PH: See main text of this appendix (4) KO: Hong (1988)	See main text of this appendix.
K_D	Domestically owned capital stock	(1) IO table (2) AU: Horridge (1987) (3) JA: OECD sectoral database (4) PH: Kunio (1985) (5) KO: Gunasekera and Tyers (1991)	Total capital stock from (1) broken down according to domestic share from (2) - (5).
L_k	Domestic endowment of non-capital factor inputs	(1) IO table	See main text of this appendix.
ψ	Share of domestic ownership in industry	(1) AU: Horridge (1987) (2) JA: OECD (3) PH: Kunio (1985) (4) KO: Gunasekera and Tyers (1991)	

π_i	Pure profits/losses	(1) IO table	See main text of this appendix.
f_i^L, f_i^K	Fixed labour and fixed capital requirement per firm in the imperfectly competitive industries	(1) I/O table	See main text of this appendix.
m_i	Mark-ups of the imperfectly competitive industries	(1) SAM	Each column total of the SAM corresponding to each production sector divided by the respective column total of net of fixed costs and profits.
t_i	Domestic ad valorem tariff	(1) AU: IAC (1987) (2) JA: Saxonhouse and Stern (1989) (3) PH: Philippine Tariff Commission (4) KO: Kim, K-S (1988)	
t_i^*	Foreign ad valorem tariff rate	(1) Whalley (1980) (2) Deardoff and Stern (1984) (3) IEDB, ANU	Based on (1), (2) and (3), weighted averages were calculated.
s_i	Domestic export subsidy rate	(1) AU: IAC (1987) (2) JA: Saxonhouse and Stern (1989) (3) PH: Gregorio (1979) (4) KO: Kim, K-S (1988)	
X_i	Exports	(1) IO table	
M_i	Imports	(1) IO table	
Y	Total expenditure by households and government	(1) IO table	

I_{ij}	Intermediate demand for domestically produced good of industry i used by industry j	(1) IO table	
I^*_{ij}	Intermediate demand for imported good of industry i used by industry j	(1) IO table	
n_i	Number of firms in the imperfectly competitive industries	(1) AU: ABS (1989) (2) JA: Statistics Bureau (1986) (3) PH: WB (1987) (4) KO: UN (1987)	See main text of this appendix.

Table A2.2 Summary of parameters and their estimation

Symbol	Parameter	Source	Procedure
α_i, β_{ki}, γ_{ij}	Production function parameters	(1) SAM	Parameters based on share data from Cobb-Douglas production function.
τ_{ij}	Share parameter in the composite intermediate input price index	(1) SAM	Cobb-Douglas function parameters based on share of domestic intermediate product j in total j used in the production of i.
a_i	Share parameter in the utility function	(1) SAM	Share of consumption in commodity i in total consumption expenditure.
A_i	Constant term of the production function	(1) SAM	Based on output and factor usage of sectors in the reference SAM and Cobb-Douglas production parameters. See main text of this appendix.
b_i	Constant term in the unit variable cost function	(1) SAM	Based on the constant term of the Cobb-Douglas production function. See main text of this appendix.
δ_i	Distribution parameter for domestically produced goods in domestic final demand	(1) SAM	Domestic share in total final demand for each sector.
θ_i	Distribution parameter for home country exports	(1) IO table (2) IEDB, ANU	Share of each country's exports in total world exports.
Ω_i	Price elasticity of world export demand	(1) Stern, Francis and Schumacher (1976) (2) IEDB, ANU	

σ_i	Elasticity of substitution between imports and domestically produced goods	(1) Industry Commission (1991) (2) Stern, Francis and Schumacher (1976)	See main text of this appendix.
σ_i^*	Elasticity of substitution between domestic exports and rest of the world exports	(1) Industry Commission (1991) (2) Stern, Francis and Schumacher (1976)	See main text of this appendix.

TABLE A2.3 Social Accounting Matrix, Australia, 1986 (million dollars)

		P/L	K	S/L	U/L	LAND	Nat R	Instins	1	2	3	4	5	6	7	8	9	10	11	12	ROW	TOTAL
Factors	Profits and Loss								0	0	0	1355	492	1209	764	963	855	-300	318	325		5981
	Capital								2639	4107	65879	1512	175	1153	462	543	2529	780	750	404		80933
	Skilled Labour								0	2515	53562	1286	88	1248	791	406	2872	866	1070	470		65174
	Unskilled Labour								3872	876	65468	2480	1587	2783	670	0	2739	1563	1787	872		84697
	Land								4127	0	0	0	0	0	0	0	0	0	0	0		4127
	Mineral Resources								0	4405	0	0	0	0	0	0	0	0	0	0		4405
Institutions		5981	80933	65174	84697	4127	4405	2808	60	110	1306	91	392	272	138	87	145	484	259	104	5029	256602
Production	1 Agriculture							2360	1473	37	525	7660	829	383	13	4	2	1	1	6	5324	18618
	2 Mining							840	10	1493	2387	48	5	43	118	1921	2737	11	18	91	9261	18983
	3 Services							192380	2892	3046	65642	4492	1472	3068	1863	2533	4972	1390	2051	979	10454	297234
	4 Food, beverages & tobacco							14649	803	64	1337	3310	17	61	244	13	18	10	8	274	4785	25593
	5 Garments, textiles & ftwear							4453	53	17	570	45	1845	183	22	47	118	72	37	109	1052	8623
	6 Wood and paper products							3381	86	81	7754	544	52	2496	182	84	319	116	162	78	534	15869
	7 Chemicals							1568	820	256	1655	129	67	268	1556	590	308	79	156	828	513	8793
	8 Petroleum & Coal products							2868	1013	192	3826	95	11	94	93	738	628	13	30	18	655	10274
	9 Mineral Products							1918	29	400	8718	991	18	284	271	148	7370	988	1426	100	4790	27451
	10 Transport Equipment							5581	30	20	2393	8	0	8	3	23	16	1836	13	2	773	10706
	11 Machinery							5019	73	314	3355	31	3	55	11	40	122	160	839	9	977	11008
	12 Misc. manufactures							994	41	131	1720	532	275	262	224	51	148	301	333	563	365	5940

R of world	1 Agriculture							198	46	0	139	262	4	7	2	0	0	0	0	55		
(imports)	2 Mining							38	7	44	19	0	0	10	64	755	187	0	0	6		
	3 Services							1657	53	157	2235	167	15	97	10	134	83	32	48	17		
	4 Food, beverages & tobacco							1351	8	3	96	196	0	3	21	2	1	3	0	14		
	5 Garments, textiles & footwear							1276	22	17	198	27	1105	111	2	31	69	29	16	99		
	6 Wood & paper products							717	25	16	444	40	6	1222	29	17	45	15	18	11		
	7 Chemicals							274	222	93	529	53	35	142	1037	521	203	15	46	321		
	8 Petroleum & coal products							222	80	20	517	8	1	7	29	478	65	1	2	2		
	9 Mineral products							344	5	58	1091	31	5	93	26	13	708	184	250	23		
	10 Transport equipment							3054	13	46	727	0	0	0	0	0	2	1709	3	0		
	11 Machinery							7769	83	381	4344	82	17	193	104	114	129	174	1194	9		
	12 Misc. manufactures							886	35	85	802	114	105	116	45	16	60	177	171	156		
	TOTAL	5981	80933	65174	84697	4127	4405	256605	18620	18984	29723	25589	8621	15871	8794	10272	27450	10709	11000	5940		

TABLE A2.4 Social Accounting Matrix, Japan 1985 (100 million yen)

		P/L	K	S/L	U/L	LAND	Nat R	Instins	1	2	3	4	5	6	7	8	9	10	11	12	ROW	TOTAL
Factors	Profits/Loss								0	0	0	38655	5291	9151	28141	25876	50424	28194	90598	30160		306490
	Capital								37968	1127	723764	6956	4061	6427	8558	5135	19294	10270	23341	7391		854292
	Skilled L								15182	6821	783352	30142	2701	1210	2260	9488	34871	54724	66951	48101		1055804
	Unskilled L								8841	1241	737122	26212	25964	24653	27136	0	50071	20792	84541	16051		1023834
	Land								36663	0	0	0	0	0	0	0	0	0	0	0		36663
	MinResources								0	5227	0	0	0	0	0	0	0	0	0	0		5227
Institutions		5981	306490	854292	1055804	1022624	36663	5227	9003	1140	11	2748	17880	3488	5978	1720	102	600	104	539	174	-112790
Prodn	1 Agriculture							41136	19566	56	12218	96364	1342	4865	234	0	14	3	1	1708	794	178301
	2 Mining							604	0	68	1850	0	1	246	197	13494	7525	7	58	103	155	24308
	3 Services							2307499	21545	8053	788687	51759	25145	27532	45836	13613	91360	49082	120267	40429	87362	3678169
	4 Food, b & t							255365	16621	0	48347	50550	299	162	239	0	32	0	0	1295	2915	375825
	5 Gmt, tx & ft							63848	1123	35	10962	290	42252	849	0	27	507	666	752	3052	10999	135362
	6 Wood paper							17879	1971	45	55735	6015	1292	37847	4053	0	2607	668	4024	18353	3005	153496
	7 Chemicals							21840	6945	95	41886	3564	9088	4461	71399	95	5595	4807	8412	29511	21705	229403
	8 Petr & Coal							23966	2816	177	78704	1678	1293	3141	14557	9449	17425	1463	2130	783	3701	161283
	9 Mineral							16291	444	404	130575	8677	363	4414	3521	596	214418	31996	71557	4826	49872	537954
	10 Transp Eq							89477	746	3	40135	4	0	0	1	1	6	140463	200	0	116528	387564
	11 Machinery							259746	1323	349	45008	1540	547	846	2112	1496	6954	21966	185993	2299	163878	694057
	12 Misc. mfg							48381	1585	231	81759	6244	3024	6896	3389	287	2178	18088	19970	36684	14534	243250

R o W	1 Agriculture							4124	1342	0	1207	17965	4639	8216	356	2	5	0	0	90		37676
imports	2 Mining							0	0	5	32702	0	1	77	1199	78685	14643	0	41	29		127382
	3 Services							8625	271	100	35436	882	582	408	1594	368	1258	635	1121	215		51495
	4 Food, b & t							7570	178	0	1619	9357	0	0	1604	5	1	0	0	30		20364
	5 Gmt, tx & ft							5534	101	2	793	12	3515	84	143	10	58	46	37	206		10541
	6 Wood paper							353	13	1	2632	25	15	5320	63	12	45	7	135	107		8728
	7 Chemicals							2028	766	57	5232	405	387	374	7288	316	106	4	252	32		17247
	8 Petr & Coal							3901	974	152	9206	420	210	172	3039	2198	2280	82	341	95		23070
	9 Mineral							804	127	44	2335	229	47	165	758	28	15605	555	5134	858		26689
	10 Transp Eq							3762	0	0	2257	0	0	0	0	0	0	1837	0	0		7856
	11 Machinery							13441	2	4	688	2	0	0	3	0	73	908	7384	49		22554
	12 Misc. mfg							6624	47	0	1208	0	0	0	0	0	0	195	276	620		9058
	TOTAL	30649	854292	1055804	1022624	36663	5227	3211797	178301	24308	3678169	375825	135362	153496	229403	161283	53795	387564	694057	243250		

TABLE A2.5 Social Accounting Matrix, Republic of Korea, 1985 (billion won)

		P/L	K	S/L	U/L	LAND	Nat R	Instins	1	2	3	4	5	6	7	8	9	10	11	12	ROW	TOTAL
Factors	Profits and Loss								0	0	0	657	91	-182	140	871	-502	-148	2252	192	0	3371
	Capital								945	112	14582	908	537	65	204	1760	447	904	1272	68	0	21805
	Skilled L								0	0	5304	271	161	15	156	593	258	430	546	58	0	7792
	Unskilled L								4118	306	23443	1686	1728	137	453	1302	905	615	2495	300	0	37487
	Land								4644	0	0	0	0	0	0	0	0	0	0	0	0	4644
	Mineral Res								0	410	0	0	0	0	0	0	0	0	0	0	0	410
Institutions		5981	3371	21805	7792	37487	4644	410	571	59	1	809	674	571	239	39	426	14	85	367	24	1374
Prodn	1 Agriculture							4930	1363	28	201	7488	46	10	6	3	0	0	0	5	563	14643
	2 Mining							50	12	0	256	5	3	0	4	568	320	76	13	6	38	1351
	3 Services							46101	746	252	15574	1350	1432	209	524	2244	583	927	3010	266	5637	78855
	4 Food, b & t							12250	1242	0	1614	1633	46	0	8	61	0	1	0	1	507	17363
	5 Gmnt, txtl ft							1937	35	2	191	9	4859	8	18	398	4	5	63	351	6019	13899
	6 Lumber							303	26	28	513	7	5	185	21	15	4	12	101	24	138	1382
	7 Paper							329	17	3	1089	221	114	11	1057	163	72	9	129	62	131	3407
	8 Chemicals							2705	1040	112	5358	524	1876	85	239	4231	308	610	984	231	3437	21740
	9 Non-,metals							42	5	1	1966	135	7	9	15	100	502	83	230	16	265	3376
	10 Basic metal							0	6	15	1169	9	9	4	35	50	17	3913	2447	69	1600	9343
	11 Machinery							6617	121	71	2903	141	83	32	27	207	82	124	4131	118	8138	22795
	12 Misc mfg							433	3	1	208	33	24	0	1	14	1	1	9	14	1243	1985

R o W	1 Agriculture							95	15	0	0	1130	612	470	3	162	0	0	0	3		
(imports)	2 Mining							0	0	0	233	0	0	0	4	5829	262	473	1	5		
	3 Services							381	72	0	1251	32	26	1	16	67	2	2	61	8		
	4 Food, b & t							191	2	0	13	340	303	0	0	58	0	0	0	0		
	5 Gmnt, txtl ft							42	3	0	2	0	946	1	3	81	0	0	4	66		
	6 Lumber							13	0	0	14	0	0	52	9	0	0	0	15	11		
	7 Paper							16	0	0	49	31	7	1	334	32	1	1	28	4		
	8 Chemicals							97	148	0	911	64	331	20	78	2431	35	42	267	29		
	9 Non-,metals							28	0	0	66	0	0	0	3	13	36	42	124	6		
	10 Basic metal							11	0	0	53	0	1	0	1	5	0	1061	860	8		
	11 Machinery							3565	21	9	1069	13	29	10	9	52	25	75	3382	30		
	12 Misc mfg							56	0	0	13	2	52	0	0	4	0	0	3	11		
	TOTAL	3371	21805	7792	37487	4644	410	80763	14643	1351	78855	17363	13899	1382	3407	21740	3376	9343	22795	1985		

TABLE A2.6 Social Accounting Matrix, Philippines, 1983 (million pesos)

		P/L	K	S/L	U/L	LAND	Nat R	Instins	1	2	3	4	5	6	7	8	9	10	11	12	ROW	TOTAL
Factors	Profits / Loss								0	0	0	10451	-3561	-4184	-4341	1831	-9077	-9354	1152	-1108	0	-18192
	Capital								8351	7221	61478	15112	10918	8115	12454	605	17391	11498	14742	6196	0	174083
	Skilled Labour								0	6659	83780	8232	2555	683	2543	102	1896	1687	10086	2728	0	120950
	Unskilled L								51129	2307	40476	2610	2718	1526	654	0	860	561	1905	531	0	105277
	Land								25735	0	0	0	0	0	0	0	0	0	0	0	0	25735
	Mineral Res								0	10557	0	0	0	0	0	0	0	0	0	0	0	10557
Institutions		-18192	174083	120950	105277	25735	10557	19205	19205	935	161	4780	889	958	274	728	1314	1310	584	1612	824	23269
Prodn	1 Agriculture							42108	7240	42	2601	54264	1320	5574	47	0	0	0	0	1453	3318	117966
	2 Mining							1635	10	0	1037	0	0	3	74	19340	1947	1	58	2	6197	30303
	3 Services							185542	7949	1193	48438	13684	2755	2539	2454	5559	3381	764	3277	1961	29211	308706
	4 Food, b, t							87158	7095	0	4851	22727	0	0	2708	0	0	0	0	221	12752	137514
	5 Gmnts, textiles & ftwr							16330	63	0	319	131	7257	150	5	0	8	0	12	254	6838	31367
	6 Lumber							4597	290	17	8233	211	41	2891	145	16	107	17	135	74	3946	20718
	7 Paper							8304	3852	369	2998	561	785	601	3158	426	411	67	419	1363	629	23944
	8 Chemicals							10478	2476	865	17471	3607	1027	1196	632	339	2528	60	508	307	1607	43098
	9 Non-metals							5421	146	324	11634	842	17	153	505	101	8374	501	3387	140	1725	33271
	10 Basi Metals							5590	76	2	1605	11	2	7	2	21	2	926	5	2	255	8506
	11 Machinery							29271	141	68	3319	30	16	60	211	10	53	97	4472	12	8689	46262
	12 Misc. manufactures							6585	64	118	3322	259	2319	174	551	66	163	320	686	3545	2101	20273

R o W	1 Agriculture							1542	246	1	88	1842	45	189	2	0	0	0	0	49		
(imports)	2 Mining							5242	7	0	694	0	0	2	49	12945	1303	1	39	2		
	3 Services							7418	275	41	1673	473	95	88	85	192	117	26	113	68		
	4 Food, b, t							3107	221	0	151	707	0	0	84	0	0	0	0	7		
	5 Gmnts, textiles & ftwr							3243	9	0	45	18	1016	21	1	0	1	0	2	36		
	6 Lumber							654	22	1	630	16	3	221	11	1	8	1	10	6		
	7 Paper							2843	1226	117	954	179	250	191	1005	136	131	21	133	434		
	8 Chemicals							1182	242	85	1708	353	100	117	62	33	247	6	50	30		
	9 Non-metals							1733	35	79	2822	204	4	37	123	24	2031	122	822	34		
	10 Basi Metals							2832	37	1	778	5	1	3	1	10	1	449	3	1		
	11 Machinery							20548	77	37	1797	16	9	33	12	5	29	53	2420	6		
	12 Misc.							2686	20	36	1027	80	717	54	170	20	50	99	212	1096		
	TOTAL	-18192	174083	120950	105277	25735	10557	475251	117966	30303	308706	13751	31367	20718	23944	43098	33271	8506	46262	20273		