Modelling the potential impacts of lower air transport prices in Australia

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This information paper provides two simulations to illustrate the potential benefits of effective competition policy reforms in the market for air transport services in Australia:

- S1 A shift in the domestic aviation industry supply curve that results in an initial 10 percent reduction in the domestic price of domestic aviation services; and
- S2: Matching shifts in both the domestic and imported aviation supply curves that collectively result in an initial 10 percent reduction in the domestic price of aviation services.

The scenarios modelled are those specified by the Treasury Competition Taskforce to support its preparation of the Aviation White Paper.

The simulations use the GDyn-FS dynamic multi-region, multi-sector general equilibrium model of the global economy (Gretton 2021). The model is an intertemporal variant of the GTAP comparative static modelling framework used extensively in assessing the impact of economic changes on trade, production and consumption in regional economies and across the globe.

The Australian economy would be better off with lower priced air transport services supported by improvements in the productivity of local service providers and availability of lower cost services from international providers. An initial 10 percent reduction in the price of air transport services is estimated to lead to an 0.23 percent increase in Australia's gross domestic product (GDP). Workers would be better off with consumer-price adjusted real wages increasing by around 0.3 percent and national income rising in a similar proportion. There would be some adjustment pressures in the short run, particularly: (i) in investment goods activities as rising activity levels and higher national income prompt new investment; and (ii) productive inputs move between sectors in response to changes in relative competitiveness. Slower transition of domestic service providers to international best practice or more gradual access to lower-priced international services could dilute the economic gains from productivity enhancing regulatory and competition reform in Australia. Failure to keep up with global developments could prove costly to the domestic industry but not so much for local consumers providing they can turn to international service providers. On the other hand, higher growth in

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incomes across the globe and hence purchasing power for exports of Australian air transport services could add to gains available from effective productivity-improvements in the Australian air transport service industry. There is therefore a need to avoid unduly restrictive policies that could erode: (i) the competitiveness and capability of Australian air transport service providers both domestically and internationally; and (ii) access of Australian consumers to least-cost international services.

This paper describes the modelling framework applied and, for each of the scenarios modelled, reports the projected impacts. The scenario analysis is supported by sensitivity testing using alternative scenario and modelling assumptions. The scenarios and supporting sensitivity tests, are intended to illustrate the scale of economic benefits potentially available from an effective economic reform agenda, and to support the assessment of strategies, proposals and priorities for air transport market reform.

Modelling framework

The GDyn-FS model database used has 32 individual national economies with Australia and each G20 economy shown separately, and 5 multi-country regional groups (see appendix 1). There are 57 industry groups in each region — 14 Agriculture, forestry and fishing, 4 Mining, 24 Manufacturing and 15 Service industry groups (see appendix 2). Air transport service provision is included as a separate industry. The policy scenarios, that is 'shocks', are applied to the model, with effects determined by the linkages between industries and regions, assumptions about the economic behaviour of firms and households, and national resource constraints.

The model is a recursive dynamic variant that compares the global economy with and without the changes applied, allowing for gradual adjustments across time and economies in response to a policy or other economic change. As the model is dynamic, it traces the adjustment path through time in annual steps against a model baseline.

Under this approach, it is assumed that labour would to move gradually between industries in each region (a sluggish labour market assumption) in response to changes in the relative competitiveness of industries according to a constant elasticity of transformation assumption. Aggregate regional labour endowments are assumed not to be affected by the policy changes modelled. (That is, regional labour is modelled as fixed with real wages adjusting to clear regional labour markets. Labour market participation and unemployment is therefore assumed fixed at baseline levels). Agricultural land and natural resource endowments used in the forestry and mining industries are also assumed not to be affected by the policy changes modelled (that is, assumed fixed).

Capital stocks by region and industry are assumed to adjust gradually to equilibrate regional rates of return on capital to their long-run steady-state value. Under this assumption, a reduction in costs such as from a reduction in the price of imports, productivity improvement or the availability of capital, would initially raise average industry returns to capital, ultimately leading to a higher capital stock and output, and higher real wages, income and consumption. Capital of a regional economy is reallocated gradually between regional industries according to a constant elasticity of transformation assumption based on industry-specific measures of

the rental price of capital. All industries in a region are assumed to face a common capital-goods price.

Regional industries substitute between labour and capital according to relative user costs and between value-added factors and intermediate inputs according to a constant elasticity assumption. Industries also substitute between intermediate inputs according to a constant elasticity of substitution technology.

All tax rates are held fixed (unless shocked) with tax revenue and the ratio of tax revenue to regional income adjusting.

The GDyn-FS model (Gretton 2021) used in this study includes: (i) explicit modelling of investment and capital-finance flows that exhibit long-run stability; and (ii) a relaxation of the assumption of fixed shares in the consumption-saving decisions of national households. The model variant used in these simulations is also augmented to allow for negative saving and to control for the simulation of negative flows in small value items.

The modelling adopts the standard trade and production technology parameters provided with the standard GDyn database with two modifications. First the Leontief fixed real input coefficient assumption is relaxed to allow a degree of input substitution in response to relative price changes. This more flexible case is represented by a substitution parameter of 1.2 for each production sector. The value allows for the gradual change in input shares with relative price change. Second, as noted, labour and capital services are treated as imperfectly mobile between sectors (that is, sluggish) in place of the database assumption of perfect mobility within a CET nest. Transformation elasticities values of 20 for labour and 10 for capital are adopted. The modified approach allows for sluggishness in the short run and flexibility in the longer run (Gretton 2021, p. 94). Foreign-domestic investment parameters have been set to reflect a home-country bias associated with the Feldstein-Horioka (1980) hypothesis (Gretton 2021 p.94).

The results represent the potential changes given the theory of the model, and the industry and trade structure prevailing in the annual databases of the projection period. The base year of the projection period is 2011. This database is influenced by the aftermath of the global financial crisis and the terms of trade and investment boom affecting Australia and China. The database is projected forward by year to provide a reference case for the policy simulations. The analysis is comparative dynamic with only time changing and the database adjusting through time to a long-run steady-state. Model prices are therefore in 2011 USD updated across time for changes in relative competitiveness across regions and sectors. The sensitivity of results to changes in baseline values to reflect business-as-usual projections of gross domestic product by region, population and labour divided into skilled and unskilled groups are provided (see below). The baseline and sensitivity test abstract from the influence of the COVID-19 global pandemic and its aftermath. The policy shocks are introduced in the calendar year 2020, termed ‘year 1’ with results reported to year 30, the long-run time horizon for the analysis.

The modelling provides an indication of the direction and scale of impacts of productivity improving policy changes from the time of effective implementation to the longer run, for Australia against the baseline adopted.

The scenarios

Air transport services are provided in Australia by two dominant operators (Qantas and Virgin) while access to the Australian market by international carriers is subject to government licensing. Domestic and international air traffic is predominantly through capital city terminals with the domestic movement of passengers and air cargo supported by a diverse network of regional airports. The main legislative instruments and regulatory frameworks pertinent to the conduct of the air transport industry in Australia are governed by: the Australian Civil Aviation Safety Authority, Airservices Australia, the International Civil Aviation Organisation and the Australian International Air Services Commission. Air transport service provision in Australia is also subject to regulations facilitating competition and fair trading enforced by the Australian Competition and Consumer Commission (ACCC), and the regulation of corporations, markets, financial services and consumer credit administered by the Australian Securities and Investment Commission (ASIC).

Against this background, it is assessed that there is scope for regulatory and operational change that would lead to greater competition in the provision of air traffic passenger and freight services leading to lower air transport services prices for an equivalent or improved quality of air transport service. The scenarios modelled in this note consider the potential benefits that may be leveraged to the design and application of regulatory frameworks governing the conduct of the air transport market in Australia. The scenarios considered are illustrative of the magnitude of effects for a 10 percent reduction in domestic and foreign air transport service providers operating in the Australian national market. The effects are assumed to be realized through technological and organizational change within the domestic industry or a margin on the price of exports of service providers abroad, to Australia. As noted, the scale of change modelled is illustrative. Results can be scaled up or down depending on informed assessments of changes that may reasonably be expected to be realized, relative to the reference scenario.[3] The central scenarios assume that all anticipated changes are fully and effectivity implemented in the first year. Through sensitivity tests the implications of introducing the changes over time are considered. Further sensitivity tests are provided to: (i) consider the implications of business-as-usual growth assumptions on the scale of results; (ii) the sensitivity of results to alternative assumptions concerning the responsiveness of export demand to changes in the price of Australian service provision; and (ii) the implications of local air transport services' providers falling behind advances abroad in technology and ways of working.

The application of the modelling scenarios is outlined in box 1.

[3] Although it should be noted that scaling is subject to 'linearization' error that may be material for large-changes.

Box 1: Modelling of domestic output and import supply-price reductions in air transport services provided to Australia

The modelling considers the impact of a reduction in the supply-price of locally produced and imported air transport services to Australia. It is assumed that the illustrative price reductions are achieved by domestic industry output-specific technological and organizational changes and import product-specific price changes, respectively. The percentage change in the supply price of domestically supplied air transport services, pm, is defined as $pm = ps - ao$, where ps is the change in the supply price of air transport services under prevailing technologies and ways of working and ao is a product-specific output augmenting technical and organizational change. Similarly, the percentage change in the market (that is , landed or border) price of imports, pim, is defined as $pim = pms - amsprod$ where psm is the change in the supply (that is, landed duty paid) price of air transport services and $amsprod$ is a product-specific effect of domestically accruing import augmenting technical and organizational change. In turn, the supply price of imported services is defined, in abbreviated form, as $pms = tms + pfob$ where tms are border taxes on imports accruing to the home region (Australia) and $pfob$ is the free-on-board price at the export destination. The fob price is, in turn, equal to $pm + txs$ where pm is as defined above and txs are the taxes on exports accruing to the exporting region. In the GDyn-FS database, trade and transport margins ($ptrans$) on international air transport service is assumed to be zero by convention.

The technology variables ao and $amsprod$ and the product tax terms tms and txs are considered determined outside of the model (that is, exogenous) in standard model simulations and provide possible instruments for modelling policy-induced changes in the market price of products. In this analysis, the price of domestic supplies (pm) is targeted by allowing the technology and organization of domestic service provision (ao) to vary, as indicated above. This assumes that regulatory and competition policies in Australia affect the technology and ways of working of Australian carriers in providing services in Australia and abroad. The price of imported air transport services to Australia (pim) is targeted via the export tax-inclusive free-on-board price (pms) by allowing the income of the territory of foreign service providers to vary through an export tax on air transport services to Australia (txs). This approach makes the simplifying assumptions that restrictive regulatory and competition policies in Australia provide the opportunity for price markups accruing to the home country on services provided to Australia but do not: (i) affect technology and ways of working of foreign carriers (ao in the home territory); or (ii) that the rent does not accrue to Australia (via $amsprod$).

The GDyn-FS commands implementing a 10 percent price reduction in domestic and imported air transport (atp) services in Australia (AUS), respectively, are:

```
Swap ao("atp","AUS") = pm("atp","AUS"); ! en-ex
tShock pm("atp","AUS") = -10.0 ;
Swap txs("atp"eREGEXAUS,"AUS") = pms("atp",REGEXAUS,"AUS") ; ! en-ex
tShock pms("atp",REGEXAUS,"AUS") = uniform -10.0 ;
```

Source: Based on GDyn-FS model code.

Cost and sales structure of the air transport industry in Australia

As recorded in the GDyn-FS database used in this study for the pre-COVID19 year 2019, value added of the air transport services industry is recorded as contributing 0.4 percent to Australia's Gross Domestic Product evaluated at factor costs (table 1). This proportion is consistent with estimates based on ABS Australian National Input-Output tables (0.55 percent) also for the pre-COVID financial year 2018-19 and provides a meaningful basis from which to assess the impacts of a change in price of air transport services on the Australian economy.4

In terms of the supply of air transport services in Australia, the GDyn-FS database records about on quarter sourced offshore with the remainder sourced from resident suppliers (Table 1). While of similar orders of magnitude, ABS Input-Output tables for 2018-19 record a slightly higher proportion being sourced offshore.

Table 1 Supply of air transport services in Australia (percent)

	Currency unit	Domestic production	Imports	Total
GDyn-FS 2019 database	2011 USD	74	26	100
National 2018-19 IO tables	2018-19 AUD	71	29	100

Sources: Author calculations based on Table 5 Industry by Industry flow table (direct allocation of imports) evaluated at basic prices and Table 3 Imports – Supply by Product Group and Inputs by Industry and Final Use Category evaluated at basic prices, in ABS (2021), *5209.0.55.001 Australian National Accounts: Input-Output Tables, 2018-19*; GDyn-FS model projections with flows evaluated at agents (ie before product taxes and subsidies) prices.

In terms of the distribution of domestic output, the baseline data gives greater emphasis to exports as a source of demand and less emphasis to intermediate inputs and household consumption, than ABS Input-Output data for 2018-19 (Table 2). These differences suggest that market shares in the disposition of domestic output are subject to substantial variation over time. Industry reversion towards model database shares would raise the sensitivity of prospective domestic output changes to changes in competitiveness in exporting, whereas continuation (or erosion) of Input-Output table shares would lower the sensitivity of prospective output changes to changes in competitiveness. Sensitivity tests reported below consider the sensitivity of domestic output changes to alternative modelling assumptions which may inform assessments of the implications of structural differences on results.

The disposition of imports in the modelling baseline and ABS Input-Output data closely align (Table 2). A matter for the interpretation of results would be the likelihood of the continuation of the reported distribution pattern and what would any prospective change have on results. For example, heightened relative demand for imported air services for final consumption would feed directly through to consumer prices and real wages, and vice versa for domestically provided services.

4 ABS estimates indicate that the air transport industry contributed about 0.1 percent of GDP in the COVID year of 2020-21. Because of the atypical operating environment prevailing in 2021-22, data references in this paper refer to the pre-COVID year 2018-19.

Table 2 Use of air transport services in Australia (percent**)**

			Consumption				
	Currency unit	Int. use	H'hold	Gov't	Capital	Export	Total
Domestic production							
GDyn-FS 2019 database	2011 USD	26	38	0	0	37	100
2018-19 IO tables	2018-19 AUD	34	46	0	0	19	100
Imports							
GDyn-FS 2019 database	2011 USD	25	75	0	0	0	100
2018-19 IO tables	2018-19 AUD	25	75	0	0	0	100
Total							
Gdyn-FS 2019 database	2011 USD	25	47	0	0	27	100
2018-19 IO tables	2018-19 AUD	31	55	0	0	14	100

Sources: See table 1.

Estimates of industry cost shares derived from the modelling database and Input-Output tables indicate at the broadest level that intermediate inputs make up the largest share of costs to the air transport services industry (Table 3). Within intermediate inputs, products in the group 'petroleum and coal products' (inclusive of aviation fuel) is the single most important input, but the relative importance of that input is subject to substantial variation over time. In this regard, it is likely for a fixed technology of service provision that the relative importance of this category could vary substantially with swings in the world price of aviation fuel. Such changes, if modelled, could influence the projections of down-stream industries and imports and indirectly influence changes in macro aggregates to some degree (depending on the scale of variation).

Table 3 Cost structure for air transport service provision in Australia (percent)

	2018-19 IO tables	GDyn-FS 2019 database
Intermediate inputs	68	75
Labour income	19	15
Capital income	14	10
Total	100	100

Sources: Author calculations based on Table 2 Input by Industry and Final Use Category and Australian Production and Imports by Product Group (product taxes less subsidies included in intermediate inputs) in ABS (2021), in *5209.0.55.001 Australian National Accounts: Input-Output Tables, 2018-19*; GDyn-FS model projections with flows evaluated at market (ie inclusive of product taxes and subsidies) prices.

Table 4 Main intermediate inputs to air transport service provision in Australia (percent**)**

2018-19 IO (AUD basis)		GDyn-FS 2019 database (2011 reference USD basis)	
Petroleum & coal product manufacturing	16	Petroleum and coal products	35
Transport support services and storage	12	Business services nec	13
Employment, travel agency & other admin. Services	11	Transport nec	9
Aircraft manufacturing	10	Transport equipment nec	8
Professional, scientific & tech. services	6	Trade	3
Sub-total (percent of total costs)	**54**	**Sub-total (percent of total costs)**	**69**
Proportion of total intermediate costs	80	Proportion of total intermediate costs	92

Sources: Author calculations based on Table 2 Input by Industry and Final Use Category and Australian Production and Imports by Product Group (at basic prices) in ABS (2021), in 5209.0.55.001 Australian National Accounts: Input-Output Tables, 2018-19; GDyn-FS model projections with flows evaluated at market (ie inclusive of product taxes and subsidies) prices.

Overall, the GDyn-FS database adopted provides a basis for meaningful modelling of the impact of reductions in air transport service prices. Interpretation of results should be mindful of the potential for changes in the detailed structure of the sector and the national and distributional effects that conjected changes may have. The sensitivity tests provided below may inform such interpretations.

Effects

Sectoral effects

The results suggest that a 10 percent reduction in the price of Australian domiciled air transport services through more productive use of inputs could lead to substantial changes in the level of service provision as indicated by the projections of industry output. After 30 years from the full effective implementation of reforms, the long-run policy time horizon adopted in this paper, the Australian air transport industry is projected to be about 26 percent larger than otherwise (scenario 1, Table 5). With a more competitive domestic air transport sector relative to other domestic sectors, labour and capital employed in the industry is projected to be around 12 percent higher than otherwise. With reforms not assumed to change aggregate employment, the projected increase in labour in air transport would be accommodated by workers seeking higher paid employment in the more competitive air transport sector. Higher capital would be accommodated by higher national capital accumulation and a change in the balance of accumulation in favour of air transport relative to baseline levels.

The domestic sector gain relative to the baseline, would be slightly moderated if local carriers faced increased competition from abroad as depicted in scenario 2. Under this scenario, output of the local industry is projected to rise by about 24 percent in the longer run after full effective implementation of reform with proportional changes in labour and capital employed in the industry (scenario 2, Table 5).

Table 5 Illustrative Projections of the Effect of a 10 per cent Reduction in the Price of Air Transport Services, years 5 and 30 (Percent deviation from baseline)

		Year 5		Year 30	
	Label	S1	S2	S1	S2
Supply prices					
Domestic services	pm	-9.7	-9.7	-9.8	-9.8
Imported services (cif)	pim	0.0	-9.9	0.0	-9.9
Domestically produced supplies					
Gross output	qo	26.2	24.3	25.9	23.8
Employment - process and trade	qfe(UnskLab)	12.8	11.1	12.6	10.8
Employment - professional and managerial	qfe(SkLab)	12.8	11.2	12.6	10.8
Capital services	qfe(Capital)	12.0	10.5	11.9	10.2
Absorbed in:					
Domestic sales (total)	qds	15.1	11.6	15.1	11.6
Private consumption	qpd	14.7	10.1	14.7	10.1
Export sales	qxw	44.6	44.6	44.9	45.0
Imported supplies					
Imports	qim	-5.2	11.5	-5.3	11.3
Absorbed in:					
Private consumption	qpm	-5.6	10.5	-5.7	10.4

Source: Author GDyn-FS model projections.

The central influences on these projected changes, in addition to the illustrative price shocks, are tied to the relative responsiveness of domestic demand for local and imported services and export demand for Australian air services, to the price changes modelled. These influences are considered, in turn. Focusing on just the domestic household consumption element, a first approximation of the gain (in percentage changes) can be depicted as a combination of product demand (qp) and import substitution effects ($qsub$) by $qpd = qp + qsub$. As a first approximation, the demand effect (qp) can be represented as varying with income and price according to the relation $qp = yp + \delta * pp$ where yp is an income effect and $\delta * pp$ is a price effect where δ is an arbitrary price elasticity of demand (assumed to be -1 to represent a constant share assumption) and pp is percentage change in the price of the air transport services to consumers. A first approximation of the income effect (yp) can be estimated as $yp = x * SATP/100 * \zeta$ where x represents domestic air transport industry output augmenting (total factor) technical change (proxied by the (negative) of the domestic policy induced price change), SATP represents the share of air transport in GDP (about 0.5 percent) and ζ is a shift effect to recognise a reallocation of scarce factors from the broader economy to the more competitive air transport industry (approximated as 0.5). The first approximation of the income effect yields 0.25 (that is, 10*0.5/100*0.5). With domestic production accounting for about 75 percent of supply (Table 1), a first approximation of the price effect is estimated as 7.5 (that is, $1*(0.75 * 10)$). Combining these elements give a total product demand effect (qp) of 7.75 percent (that is, 0.25+7.5). Second, residents can substitute between locally provided services and imports according to the relation $qsub = \sigma * (pp - ppd)$ where σ is the Armington

elasticity of import substitution (set at 1.9 in the GTAP parameters file), pp is the combined domestic and import price of air transports services used in private consumption of -7.5 percent (that is, 0.75*-10), and $ppd = pms$ is the policy induced price change of domestic services (-10 percent). This first approximation yields an import substitution effect of 4.75 percent (1.9*2.5). The combined effect (7.75 plus 4.75) yields a first approximation of 12 percent, compared to the model projection of around 15 percent. Similarly, private consumption demand for imports can be represented as $qm = qp + \sigma * (pp - ppm)$ where ppm is the market price of imports (assumed zero in scenario 1) to give a first approximation, after the income effect is considered of -6.5 percent (that is, 7.75+(1.9*-7.5)) compared to a model projection of -5.3 percent in scenario 1.

Turning to exports, offshore demand for Australian air transport services can be represented by offshore demand for imported air services in total and the allocation of that composite demand across offshore exporters (the suppliers) of air transport services, including Australian carriers. Focusing on the allocation of demand across suppliers in the global market, a first approximation of the demand for the export of Australian air transport services in international markets can be depicted as $qxs = \varphi * (pms - pim)$ where qxs represents regional demand for disaggregated imported commodity by source (Australia), φ is a regional generic elasticity of substitution across imports in an Armington structure (set at 3.8 in the standard GTAP parameters file), pms represents the percentage change in the price of air transport service supplied from one to another (assumed zero in scenario 1) and pim represents the percentage change in the import price of Australian air transport services abroad (-10 percent). The partial equilibrium first approximation yields a 38 percent (that is, 3.8*10) increase in international demand for Australian air transport services, an estimate broadly aligned in terms of scale with the model long-run projections of around 45 percent. This difference points to the importance of general equilibrium effects in the determination of the modelled result.

The second scenario introduces the possibility that domestic reform would make available lower priced international air services to the Australian market. The scenario assumes that the price change is specific to the Australian market and does not extend to a global reduction in air transport service prices (a theme that is considered in a sensitivity test to the central simulations reported below). As above, demand for imports can be depicted as a combination of product demand and import substitution effects defined as $qpm = qp + qsub$. In this case, with changes in domestic and foreign prices aligned by assumption, the substitution effect is assumed zero in the partial equilibrium framework. The first approximation of import demand effect (qp) can then be represented as varying with income and relative price according to the relation $qp = yp + \delta * pp$. With the change in consumer prices across domestic and imported supplies equal to 10 percent, the partial equilibrium estimate of the increase in import demand becomes 10.25 percent (that is, 0.25+10), an estimate closely aligned with the model projection of 11.3 percent.

These first approximations and broad alignment with model results highlight the importance of the scale of any reform dividend, export demand and import substitution possibilities. The comparisons also emphasise, the importance of wider factors and the progression of time included in the full model but not in the stylized partial equilibrium illustrations. The sectoral results are at the core of the national effects and the time scale of effects reported in the following sections. The sensitivity of results to alternative reform implementation assumptions,

export demand responses and modelling baselines are then reported. Also reported is a scenario in which other countries (but not Australia) lower the price of air transport services through improvements in productivity, that is, scenario 1 applied to the rest of the world.

National effects

The lower air transport prices enabled by improved industry productivity under scenario 1 is projected to increase activity in the Australian economy by 0.22 percent above baseline levels, after 30 years – which as noted is the longer-run time horizon adopted in these illustrative simulations (scenario 1, Table 6).[5] Higher activity levels and lower domestic prices is estimated to raise real national income by a similar proportion. Access to lower-priced international air transport services under scenario 2 is projected to raise real income by a further margin to 0.31 percent above baseline levels. The real wages of the labour force, assumed to be in fixed supply, is projected to rise in similar proportions to output and income in the long run. As producers respond to increase demand for capital services, installed capital stock is projected to increase above baseline levels by 0.12 and 0.14 percent in scenarios 1 and 2, respectively. Real capital rentals increase in line with the price of capital goods adjusted for inflation.

Influenced by lower air transport export prices, the terms of trade are projected to decline in the long run under scenario 1 by around 0.2 percentage (that is, equal to the decline in the export price index). This balance is projected to be reversed in scenario 2 with the availability of lower priced imported air transport services. In this case, the terms of trade are projected to improve by 0.6 percent (that is, export prices of -0.22 percent *less* import prices of -0.28 percent) The balance of trade to income is not projected to be influenced materially under either scenario.

Each category of final demand is projected to increase above baseline levels in the long-run, but at variable rates. Regarding the categories of consumption, real (price adjusted) government consumption is projected to increase in both scenarios markedly below real private consumption (0.08 percent compared to 0.22 percent in scenario 1). This difference reflects the constant private-government share assumption adopted (Gretton 2021, p. 120), the more labour-intensive nature of the government service bundle relative to the private consumption bundle of products and the increased cost of labour relative to capital inputs.

The projected long-run increase in investment broadly aligns with the increase in capital stocks, 0.08 percent above baseline levels compared to 0.12 percent in scenario 1 and 0.09 percent compared to 0.14 percent in scenario 2. Ultimately, in a new steady state growth path, it would be expected that the two estimates would fully align. The gap in the projections suggests that even after 30 years, the long-run time horizon adopted in this study, further adjustment remains. The time scale of effects is taken up in the next section and sensitivity test 1.

[5] The projected increase aligns closely with the first approximation of national income effect of 0.25 percent noted above.

Table 6 Illustrative Projections of the National Effects of a 10 per cent Reduction in the Price of Air Transport Services, years 5 and 30 (Percent deviation from baseline)

		Year 5		Year 30	
	Label	S1	S2	S1	S2
Summary indicators					
GDP (real)	qgdp	0.22	0.22	0.22	0.23
Capital stock	qk	0.08	0.09	0.12	0.14
Real income	yreal	0.23	0.31	0.22	0.31
Real wages - Trades, process workers	pfactreal(UnskLab)	0.27	0.35	0.24	0.32
Real wages - Managerial, professional	pfactreal(SkLab)	0.25	0.33	0.24	0.32
Real capital rentals	pfactreal(Capital)	0.14	0.22	0.11	0.19
Terms of trade	tot	-0.15	0.11	-0.20	0.06
Balance of Trade to Income (points)	DTBALR	0.00	0.00	0.00	0.00
Final demand quantum					
Private consumption	qpriv	0.23	0.31	0.22	0.31
Government consumption	qgov	0.07	0.09	0.08	0.10
Investment	qcgds	0.36	0.39	0.09	0.09
Exports (vol.)	qxwreg	0.48	0.55	0.69	0.78
Imports (vol.)	qiwreg	0.60	0.99	0.42	0.78
Final demand prices					
Private consumer price index	ppriv	0.09	0.00	0.02	-0.08
Government consumption price index	pgov	0.25	0.22	0.16	0.13
Capital goods price index	pcgds	0.20	0.18	0.13	0.10
Export prices	psw	-0.15	-0.17	-0.20	-0.22
Import prices	pdw	0.00	-0.28	0.00	-0.28
GDP price deflator	pgdp	0.11	0.10	0.03	0.01
Factor prices					
Unskilled labour	pm(UnskLab)	0.36	0.35	0.26	0.24
Skilled labour	pm(SkLab)	0.35	0.34	0.26	0.24
Rental price of capital	pm(Capital)	0.23	0.22	0.13	0.10

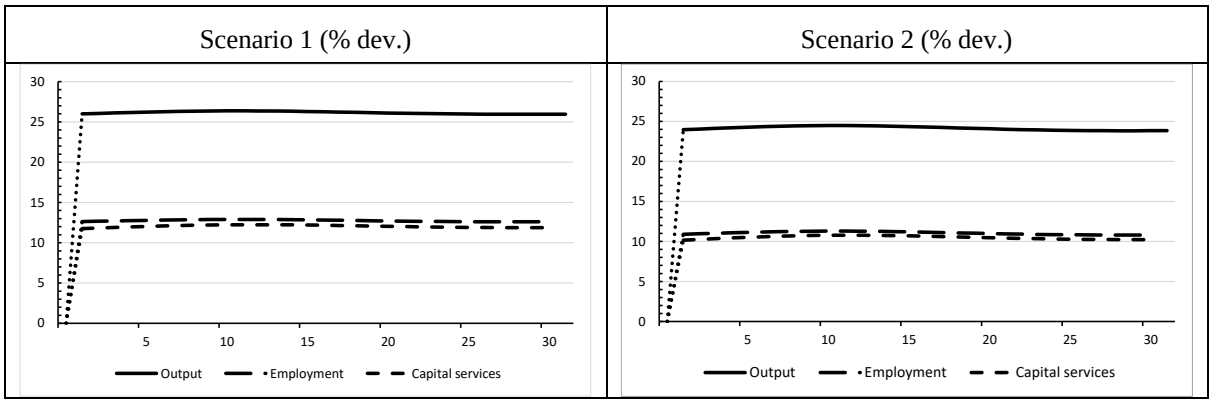
Source: Author GDyn-FS model projections.

The projected increase in export volumes above baseline levels (0.69 and 0.78 percent in scenarios 1 and 2, respectively) is attributed to the increase in the export of air transport services balanced against a decline in the export of other goods and services. The projected increase in aggregate imports in scenario 1 (0.42 percent) reflects a decline in the import of air transport services (Table 5) balanced against increases in imports across other product categories which is in response to higher domestic output and income and higher-cost local offerings (driven by higher wage and capital costs). Amongst the highest projected increases in import demand is in the product groups petroleum and coal products (inclusive of aviation fuel) and other transport services which were projected to increase by 2.3 and 1.1 percent, respectively, above baseline levels. The higher projected aggregate imports under scenario 2 is attributed to the projected increase in the import of air transport services (Table 5).

Time scale of effects

The first year in the transition period is defined for the purpose of this analysis to occur with the full effective implementation of reform. Under this definition, a 10 percent reduction in the price of Australian domiciled air transport service is projected to lead to a 26 percent rise in domestic output and a rise in industry employment and capital services of around 12 percent as resources are drawn to the now more competitive sector (Figure 1, left panel). With the increase in import competition introduced in scenario 2 and as discussed above, the domestic sector gain is projected to be moderated. Slightly fewer labour and capital services are drawn to the sector (Figure 1, right panel).

Figure 1 Illustrative Projections of Air Transport Services Sector Effects of a 10 per cent Reduction in the Price of Domestic and Foreign Air Transport Services (Years from full effective implementation**,** Deviation from baseline)

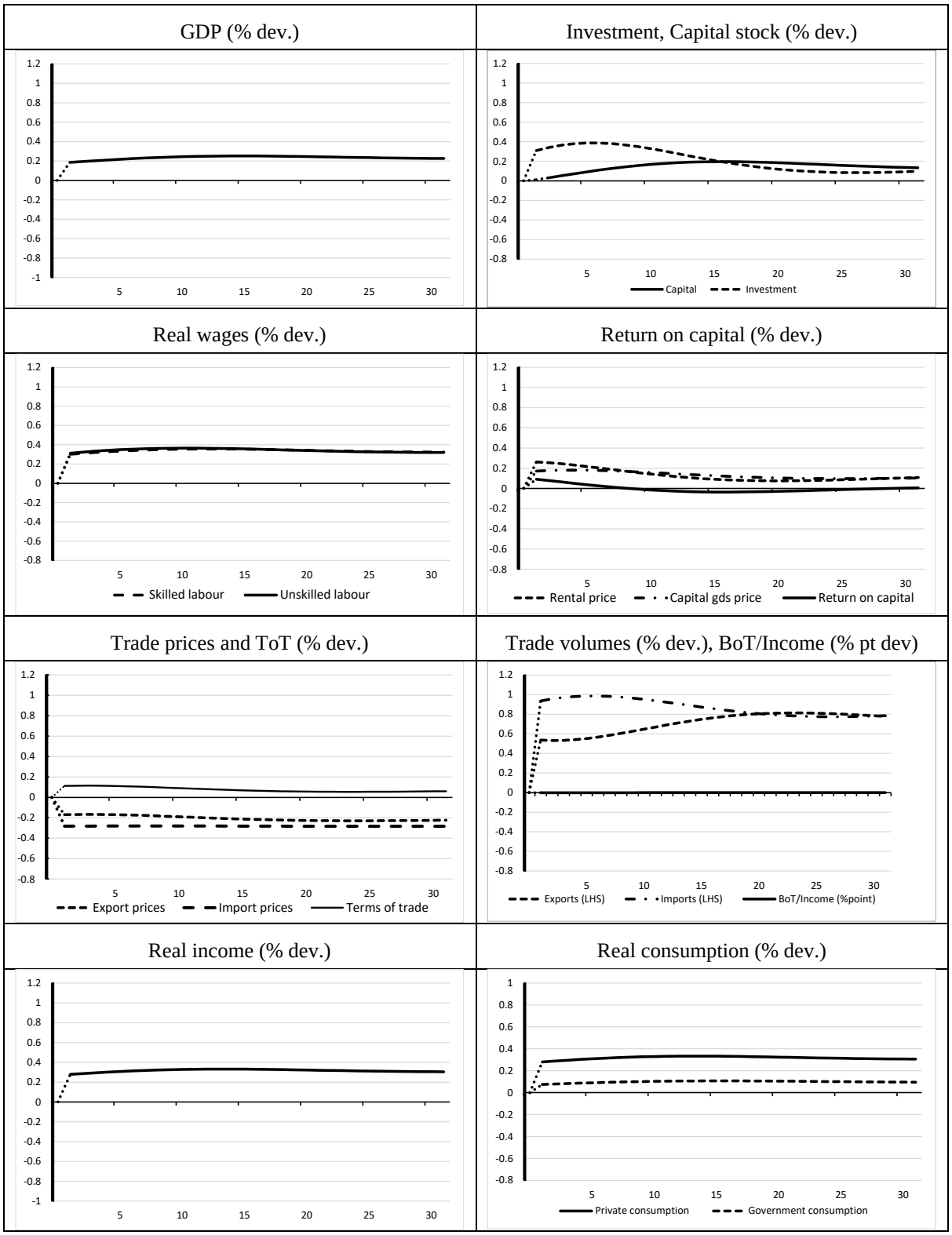


Source: Author GDyn-FS model projections.

At a national level, the projected expansion of the air transport sector and availability of lower cost air transport services, would, as discussed, increase the returns to labour and capital. With the labour supply assumed to be fixed at baseline levels, this increase would accrue to labour as higher real wages (Figure 2, second left panel). The increase in the demand for capital would initially increase the rental price and returns to capital, above base line levels increasing the incentive to invest (Figure 2, second right panel). This is projected to flow through to an increase in investment spending and a gradual increase in national capital stocks (Figure 2, top right panel). Higher investment demand would also place upward pressure on the price of capital goods. With the passage of time, the percentage change in the rental price of capital services and the capital goods price would be gradually drawn together at above-baseline levels. With the change in the rate of return defined as the difference between the change in rental price and the capital goods price, the percentage deviation of the rate of return on capital from baseline levels would approach zero (Figure 2, second right panel).

On the trade account, in the early stages of transition following the full implementation of sector reform, the influence on export and import prices is mainly via the projected decline in air transport services from baseline levels. With the passage of time, in scenarios 1 and 2, the decline in the rise of production costs (as depicted by the GDP price deflator Table 6) see a slight movement in the deviation of export prices from baseline levels towards the projected passage of import prices. With this, the terms of trade is projected to decline (Figure 2, third left panel).

Figure 2 Illustrative Projections of the National Effects of a 10 per cent Reduction in the Price of Domestic and Foreign Air Transport Services (Scenario 2)
(Years from full effective implementation**,** Deviation from baseline)



Source: Author GDyn-FS model projections.

On the volume side, the imports will be influenced by expanding investment activity, particularly in the early phases of transition, together with any increased demand for imports

of air transport services (Table 5; Figure 2, first and third right panels). As the investment phase tapers, higher projected import demand relative to the baseline is associated with continuing higher imports of air transport services and higher general activity levels. Taking into account both price and volume effects, the balance of trade as a share of income is projected to remain close to baseline levels in both scenarios (Figure 2, third right panel). With higher activity levels and lower consumer prices, real incomes and consumption are projected to exceed baseline levels (Figure 2, fourth panels). As noted, the positive effects on real private consumption are projected to be greater than the positive effects on government consumption.

Importantly, the transition paths reported relate to the period following the full effective implementation of reform. The following sensitivity tests consider a scenario involving progressive implementation of effective reform and other possible growth assumptions. They also consider the case of autonomous productivity improving reforms offshore, without a domestic response.

Sensitivity of results to alternative modelling assumptions and some implications

Four sensitivity tests were conducted. The first involved progressive effective reform and the realization of price reductions in tranches by 2 percentage points per year over five years. The second involved the recalibration of the parameter governing the regional demand for imported commodities by source. As illustrated above, this parameter is key to determining the demand for Australian exports of air transport services. The recalibration involved the adoption of an approximate constant share assumption in foreign markets. The third involved a business-as-usual baseline with values reflecting projections of gross domestic product by region, population and labour divided into skilled and unskilled groups to 2050 (Foure et.al. 2013, Chappuis and Walmsley 2011). The saving rate for China which in the 2011 reference year was nearly half of GDP and at historically high levels was projected to decline gradually to the neighbourhood of the historical average. This baseline abstracts from the influence of the COVID-19 global pandemic and its aftermath. The fourth sensitivity test involved a shift in the offshore aviation industry supply curve that results in an initial 10 percent reduction in the price of foreign carrier aviation services, but no response by local carriers.

Progressive effective implementation (sensitivity test 1) represents the case in which it takes time to implement new regulatory and corporate governance frameworks and implement the technological and organizational changes at the finance, product and labour market levels. Under the projections, the project policy effect, is augmented gradually diluting the compounding effect inherent with the progression of time as well as stretching out the time of benefits. Reflecting in particular the first of these effects, in the longer run, the economic benefits fall short of the full implementation scenario with GDP being projected to increase by 0.19 percent above baseline levels after 30 years compared to the central case of 0.23 percent (Table 7). The projected increase in exports and imports are similarly attenuated.

The standard setting governing regional demand for imported products, a proxy for the price responsiveness for source-regions exports, reflects an assumption that importing countries exhibit, within a nested Armington framework, a high degree of responsiveness to relative price changes between suppliers. The substitution parameter value of 3.8 adopted for air transport services reflects this assumption and is common across service activities in the standard GTAP

parameters set adopted in the analysis of this paper. Nevertheless, it is possible that there is a degree of interregional/inter carrier product differentiation that warrants a lower parameter setting for air transport. To examine this hypothesis, the relevant parameter value was changed from 3.8 to 1.2 (a value close but not identical to the constant share (Cobb-Douglas) assumption of 1) and the policy simulation repeated. The simulation projects export sales to increase by about 13 percent in the long run above baseline levels compared to the projected increase of about 43 percent in the central case. Output and GDP are similarly projected to be lower. A view that importers were more price responsive than implied by the standard parameter settings (not simulated) would be associated with larger increases in exports, output and GDP than in the projected central case.

The third sensitivity test scenario consider the case of a business-as-usual baseline aligned with standard economic growth assumptions. Broadly, in this baseline, non-OECD countries as a group are projected to grow faster that the OECD group as output per capita converges between regions over time and towards the global frontier. The baseline therefore projects a growing market for air transport services including in the Asia-Pacific region in which Australia is located. With a growing international market, Australian exports of air transport services are projected to increase ahead of the comparative-dynamic central case (based on the more conservative zero baseline growth assumption) by around 49 percent compared to the central case of 45 percent (Table 7). Similarly, output is projected to increase above the central case estimate, 26 percent compared to 24 percent. Stronger assumptions about international market growth would lead to a further widening of the difference. On the other hand, a more cautious view of the growth potential of international markets with increased global trade and security tensions could see a narrowing of the difference or even contraction.

The fourth and final, sensitivity test considered the possibility of advances in technology and ways of working by offshore air transport service operators with no response by domestic carriers. Such an eventually may occur if the local sector were unduly sheltered from international competition or suffered impediments to broad advancement in line with global trends. Under the scenario of a 10 percent decline in international prices achieved via productivity improvements (the mirror of scenario 1), Australian exports are projected to decline by over 20 percent while imports are project to rise by some 17 percent (Table 7). With such a substantial loss of international market share, domestic output of air transport services is projected to decline by over 10 percent. Nevertheless, with the availability of lower-cost international services, real GDP is projected to rise and real income more so because of the influence of lower-cost international travel in the private consumption bundle (the deflator adopted in real income calculations). It is important to note from this sensitivity test, that while economic gains are afforded by access to lower cost international air transport service, they do not match the gains from equivalent improvements in the productivity of domestically provided air transport services.

Table 7 Sensitivity of Illustrative Projections to Alternative Modelling Scenarios, years 5 and 30 (Percent deviation from baseline)

	Label	Year 5	Year 30
Scenario 2			
Central case (comparative dynamic)			
GDP	qgdp	0.22	0.23
Real income	yreal	0.31	0.31
Gross output	qo	24.3	23.8
Export sales	qxw	44.6	45.0
Imports	qim	11.5	11.3
Sensitivity tests			
1 Progressive effective implementation			
GDP	qgdp	0.17	0.19
Real income	yreal	0.25	0.26
Gross output	qo	19.2	18.8
Export sales	qxw	35.2	35.6
Imports	qim	10.6	10.6
2 Lower regional allocation of imports parameter (ESUBM)			
GDP	qgdp	0.18	0.19
Real income	yreal	0.26	0.26
Gross output	qo	12.0	12.0
Export sales	qxw	13.2	13.2
Imports	qim	11.2	11.2
3 CEPII business as usual baseline			
GDP	qgdp	0.24	0.25
Real income	yreal	0.32	0.32
Gross output	qo	26.3	26.1
Export sales	qxw	48.6	48.9
Imports	qim	11.8	11.6
4 Foreign carrier autonomous supply shifts, no response by local carriers			
GDP	qgdp	0.04	0.03
Real income	yreal	0.14	0.14
Gross output	qo	-10.8	-10.6
Export sales	qxw	-23.1	-23.3
Imports	qim	17.0	17.2

Source: Author GDyn-FS model projections.

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Appendix 1 Country/region mapping adopted

Regions in database	*G20*	*Code*	*Country(s) in database region*
1 Australia	G20	AUS	Australia
2 New Zealand		NZL	New Zealand
3 China	G20	CHN	China
4 Hong Kong		HKG	Hong Kong
5 Japan	G20	JPN	Japan
6 Korea	G20	KOR	Korea
7 Taiwan		TWN	Taiwan
8 Indonesia	G20	IDN	Indonesia
9 Malaysia		MYS	Malaysia
10 Philippines		PHL	Philippines
11 Singapore		SGP	Singapore
12 Thailand		THA	Thailand
13 Vietnam		VNM	Vietnam
14 India	G20	IND	India
15 Rest of Asia & Oceania		ROA	Cambodia; Iran; Kazakhstan; Kyrgyzstan; Laos; Myanmar; Pakistan; Sri Lanka; Bangladesh; Rest of East Asia; Rest of Oceania; Rest of South Asia; Rest of Southeast Asia; Rest of Western Asia
16 Canada	G20	CAN	Canada
17 United States	G20	USA	The United States
18 Mexico	G20	MEX	Mexico
19 Brazil	G20	BRA	Brazil
20 Argentina	G20	ARG	Argentina
21 Rest of America		ROM	Bolivia; Caribbean; Chile; Colombia; Costa Rica; Ecuador; Guatemala; Nicaragua; Panama; Paraguay; Peru; Uruguay; Venezuela; Rest of Central America; Rest of North America; Rest of South America

Continued next page

Attachment 1 Country/region mapping adopted (continued)

Regions in database	*G20*	*Code*	*Country(s) in database region*
22 France	G20	FRA	France
23 Germany	G20	DEU	Germany
24 Italy	G20	ITA	Italy
25 United Kingdom	G20	GBR	United Kingdom
26 Rest of European Union (28)	G20	REU	Austria; Belgium; Bulgaria; Cyprus; Czech Republic; Denmark; Estonia; Finland; Greece; Hungary; Ireland; Latvia; Lithuania; Luxembourg; Malta; Netherlands; Poland; Portugal; Romania; Slovakia; Slovenia; Spain; Sweden
27 Turkey	G20	TUR	Turkey
28 Russia	G20	RUS	Russian Federation
29 Rest of Europe		ROE	Albania; Armenia; Azerbaijan; Belarus; Croatia; Georgia; Norway; Switzerland; Ukraine; Rest of EFTA; Rest of Eastern Europe; Rest of Europe; Rest of Former Soviet Union
30 Saudi Arabia	G20	SAU	Saudi Arabia
31 South Africa	G20	ZAF	South Africa
32 Rest of World		ROW	Rest of Africa and the Middle East, and other countries not separately identified.

Source: Author's GTAP data base aggregation.

Appendix 2 Industries and industry sectoring adopted

No.	GTAP code	Modelling industries
1	pdr	Paddy rice
2	wht	Wheat
3	gro	Cereal grains nec
4	v_f	Vegetables, fruit, nuts
5	osd	Oil seeds
6	c_b	Sugar cane, sugar beet
7	pfb	Plant-based fibres
8	ocr	Crops nec
9	ctl	Cattle, sheep, goats, horses
10	oap	Animal products nec
11	rmk	Raw milk
12	wol	Wool, silk-worm cocoons
13	frs	Forestry
14	fsh	Fishing
15	coa	Coal
16	oil	Oil
17	gas	Gas
18	omn	Minerals nec
19	cmt	Meat: cattle, sheep, goats, horse
20	omt	Meat products nec
21	vol	Vegetable oils and fats
22	mil	Dairy products
23	pcr	Processed rice
24	sgr	Sugar
25	ofd	Food products nec
26	b_t	Beverages and tobacco products
27	tex	Textiles
28	wap	Wearing apparel
29	lea	Leather products
30	lum	Wood products
31	ppp	Paper products, publishing
32	p_c	Petroleum, coal products
33	crp	Chemical, rubber, plastic products
34	nmm	Mineral products nec
35	i_s	Ferrous metals
36	nfm	Metals nec
37	fmp	Metal products
38	mvh	Motor vehicles and parts
39	otn	Transport equipment nec
40	ele	Electronic equipment
41	ome	Machinery and equipment nec

Appendix 2 GTAP industries and industry sectoring adopted (continued)

No.	GTAP code	Description	No.	Description
42	omf	Manufactures nec	6	Light manufacturing
43	ely	Electricity	8	Utilities
44	gdt	Gas manufacture, distribution	8	Utilities
45	wtr	Water	8	Utilities
46	cns	Construction	11	Construction, Other services
47	trd	Trade	9	Transport and communication
48	otp	Transport nec	9	Transport and communication
49	wtp	Sea transport	9	Transport and communication
50	atp	Air transport	9	Transport and communication
51	cmn	Communication	9	Transport and communication
52	ofi	Financial services nec	10	Financial services nec
53	isr	Insurance	10	Financial services nec
54	obs	Business services nec	10	Financial services nec
55	ros	Recreation and other services	11	Construction, Other services
56	osg	Public administration, defence, education, health	11	Construction, Other services
57	dwe	Dwellings	12	Dwellings

Source: GTAP data base version 9a.