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Australia's new Free Trade Agreements with Japan and South Korea: Potential Impacts on the Resources and Agricultural Sectors and their Environmental Implications

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Abstract

This paper examines both economic and environmental impacts of the two new free trade agreements (FTAs) that Australia has recently negotiated with Japan and South Korea using the GTAP-E general equilibrium model. We analyse two trade policy scenarios: first a 'Free trade scenario' where bilateral tariffs are eliminated between Australia and Japan, and Australia and South Korea; second a 'Green trade scenario' where the 'Free trade scenario' is complemented by an environmental policy using an emissions trading scheme (ETS). The results indicate that two trade agreements enhance Australia's trade at a modest expense on the environment. The paper illustrates that an ETS between Australia, Japan and Korea is an expensive policy to mitigate emissions arising from FTAs.

Key words: Free Trade Agreement; Australia; GTAP-E model; Emissions; Emissions Trading Scheme.

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INTRODUCTION

Australia has a relatively small open economy that has heavily based its economic growth on increasing exports, mostly natural resources and agricultural commodities, and foreign capital. During the last decade the mining boom and China's rapid economic growth rendered unprecedented economic boost to Australia's economic prosperity and high living standards. At the same time Australia pursued trade policies integrating multilateral, regional and bilateral approaches to gain market access opportunities for its exporters. Successive governments have favoured trade policies that are open to negotiating regional or bilateral trade agreements that deliver substantial benefits to Australia. Consequently Australia has implemented WTO-consistent Free Trade Agreements (FTAs) with many important trading partners: New Zealand, the USA, Singapore, Thailand, Chile, ASEAN-New Zealand, and Malaysia. FTAs, which improve market access and strengthen trade flows, are an important vehicle to improve bilateral trade relationships and enhance domestic welfare (Dixon and Rimmer, 2010, p.143). These bilateral and regional trade agreements deliver substantial benefits when the parties are prepared to move faster and undertake more profound liberalisation than what is currently achievable by the WTO multilateral trading system (Lloyd and Maclaren, 2004; Lloyd, 2010).

The current Abbott government has secured two more new free trade agreements with Australia's second and fourth largest trading partners - Japan and South Korea. Australia and these two countries are natural trading partners with complementary trade in the Asia-Pacific region. Both Japan and South Korea are significant destinations for Australia's resources exports such as coal, iron ores, and copper ores in addition to a range of agricultural goods. In return, Australia receives a significant proportion of its manufactured imports from both countries. Given the obvious trade complementarities, trade economists and policy makers envisage significant gains to Australia from these FTAs.

While economic returns from such trade treaties could be quantified to justify their efficacy and viability, there are perhaps important environmental considerations that need to be addressed. One such issue is the contribution towards the greenhouse gas emissions from increased trade in emissions intensive goods due to these preferential trade agreements. Despite the apparent relationship between trade liberalisation and environmental degradation, there has been limited analysis to address environmental impact of FTAs generally at global level and particularly in Australia. Cebon (2003) has examined the ways by which environment can be affected by policies that increase exports in agricultural commodities. He asserts that a bulk of Australia's environmental problems such as salinity, water overuse, land clearing and biodiversity loss, water and soil pollution, and greenhouse gas emissions are due to the overexploitation of land and the extreme agricultural practices. Extra pressure placed on demand for energy sources to meet export targets also contributes to Australia's energy related emissions. Cebon (2003) criticises the apparent lack of environmental considerations in economic modelling carried out by different commissioned agencies prior to implementing previous FTAs such as the Australia-US agreement.

In this paper we examine both economic and environmental impacts of the two new FTAs of Australia using the multi-sector, multi-country computable general

equilibrium (CGE) modelling approach. In particular we use the GTAP-E (Global Trade Analysis Project-Environmental) model which has a detailed specification of energy substitution possibilities and explicit carbon emissions accounting in addition to detailed trade flows. The analysis reported in the paper is based on GTAP-E version 8.1 database. We consider two trade policy scenarios: the first is the 'free trade scenario' where bilateral tariffs are eliminated between Australia and Japan and Australia and South Korea; the second is the 'green trade scenario' where the free trade scenario is in place, but complements it by adding an environmental policy through an emissions trading scheme (ETS) between Australia, Japan and South Korea to reduce the environmental impact. The results indicate that two trade agreements enhance Australia's trade at a modest expense on the environment. The paper illustrates that FTAs complemented by an ETS could mitigate emissions arising from increased economic activity due to increased trade. However it is achieved with a substantial economic cost to all parties.

The paper is organised as follows: Section 2 gives and overview of Australia's approach to preferential trade agreements. In Sections 3, bilateral trade between Australia and Japan, and South Korea are analysed in the context of Australia's world trade. The section also emphasises trade in emissions intensive goods with the two trading partners. In section 4, we outline the GTAP-E model used in the analysis. Policy designs for simulations are in Section 5. Section 6 presents the results of two policy simulations. Finally, Section 7 concludes the paper.

THE AUSTRALIAN TRADE POLICY ON FTAs

During the last two decades or so there has been a world-wide proliferation of Regional Trading Arrangements (RTAs) which has resulted in numerous trade agreements. It is estimated that more than half of the world trade now takes place within RTAs. Australia's commitments to a liberalised trade policy were closely aligned with non-discriminatory global trading system promoted by the WTO. Similar to its Asia-Pacific neighbours, Australia also undertook its own unilateral reforms after the 1980s and supported the creation of Asia-Pacific Economic Cooperation (APEC) and its initiatives. However, the slow progress in the multilateral system especially after the WTO meetings in Seattle and Doha, the lack of consensus amongst APEC members, and the rapid progress of RTAs in Asia prompted Australia to move in the direction of bilateralism as it did in the recent past.

Australia's involvement in bilateral trade agreements goes back to 1983 when Australia New Zealand Closer Economic Relations Agreement (CERA) was negotiated. The CERA has become one of the most successful FTAs and it has contributed to a phenomenal growth in trade between the two countries since its inception. The agreement is also regarded as perhaps the only preferential trade treaty which included entire trade in goods and service except a very narrow negative list (Armstrong, 2012). Consequently Australia has become New Zealand's number one trading partner while New Zealand is now Australia's sixth important trading partner.

After a period of strong support for the multilateralism, Australia's trade policy took a significant turn towards FTAs. This resulted in a series of preferential trade

agreements between Australia and its some of the important trading partners. Australia successfully negotiated an FTA, long after the CERA with New Zealand, with Singapore in 2003 (Sen, 2004). It came into effect in the second half of that year. Australia also signed an FTA with Thailand which became operational in January 2005 (CIE, 2004; Siriwardana, 2006).

Australia's commitments to bilateralism became rather prominent with the negotiation of the Australia-United States FTA which came into effect in 2005. At the time of signing the agreement, the US was Australia's second largest trading partner. Under the FTA, 86 percent of the bilateral trade was supposed to be import tax-free and it was envisaged that every bilaterally traded commodity would achieve tax-free status except sugar and dairy products by 2022 (Siriwardana, 2007). While Australia gained access to the wider US agricultural market under the FTA, the most significant breakthrough was the market for the Australian lamb, reducing the market share enjoyed by New Zealand (Armstrong, 2012). The most recent FTAs that Australia has implemented are with Chile (2009), with ASEAN and New Zealand (2010), and with Malaysia (2012). The seven agreements thus far under operation account for 26 percent of Australia's total trade (DFAT, 2014).

Table 1: Australia's top 10 Two-way Trading Partners (A$ million), 2013

	Goods		Services		Total	Share (%)
	Exports	Imports	Exports	Imports		
China	94,709	47,250	6,881	2,079	150,919	23.3
Japan	47,541	18,914	1,991	2,307	70,753	10.9
United States	9,582	26,751	5,951	12,430	54,714	8.4
South Korea	19,599	10,167	1,675	646	32,087	5.0
Singapore	5,660	12,935	3,549	4,943	27,087	4.2
New Zealand	7,396	7,401	3,626	3,131	21,554	3.3
United Kingdom	3,859	6,196	3,982	5,848	19,885	3.1
Thailand	4,910	11,393	804	2,439	19,546	3.0
Malaysia	5,281	9,480	1,664	1,464	17,889	2.8
Germany	1,929	11,434	1,094	1,665	16,122	2.5
Total two-way trade (with top 10)	200,466	161,921	31,217	36,952	430,556	66.5
Total two-way trade (with all economies)	*261,993*	*241,156*	*56,546*	*88,128*	*647,823*	

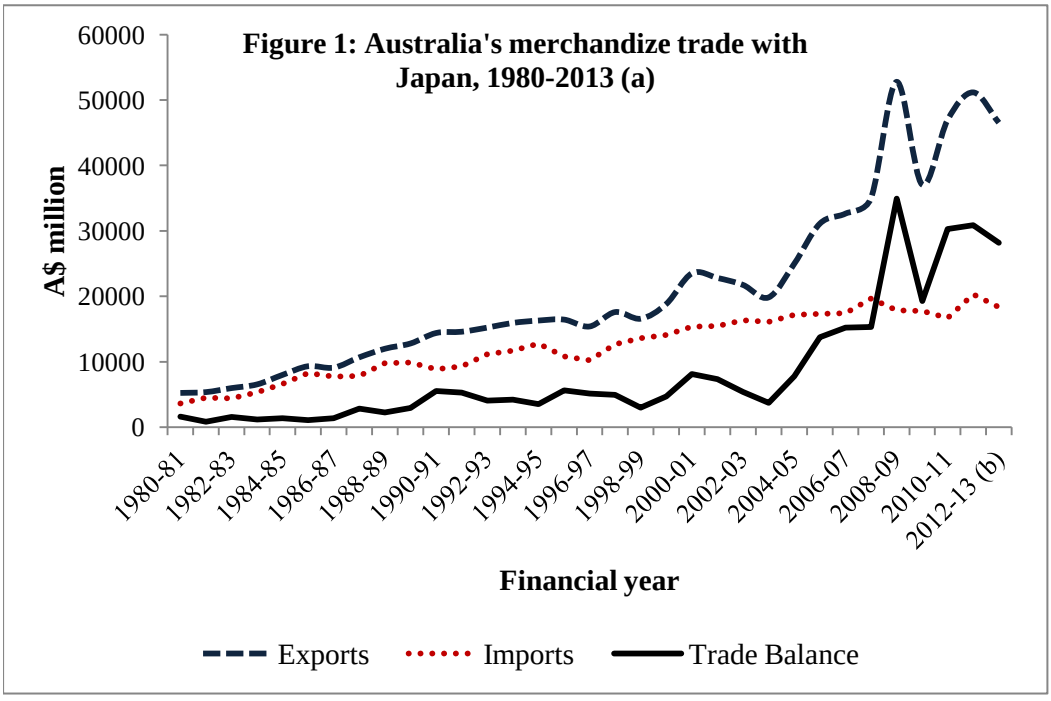
Source: Australian Government, Department of Foreign Affairs and Trade (DFAT).

Australia's recently signed two FTAs with Japan and South Korea will account for 11 and 5 per cent of Australia's total trade, respectively. Once these two agreements come into operation, Australia will have 42 percent of its total trade covered by regional trading arrangements. In addition Australia is currently pursuing seven more FTAs- three bilateral FTA negotiations with China, India and Indonesia; and four

plurilateral FTA negotiations under Trans-Pacific Partnership Agreement (TPP), the Gulf Cooperation Council (GCC), The Pacific Trade and Economic Agreement (PACER Plus), and the Regional Comprehensive Economic Partnership Agreement (RCEP). The countries included in these new FTA initiatives account for a further 29 percent of Australia's total trade (DFAT, 2014).

AUSTRALIA'S TRADE WITH THE WORLD

Australia is relatively a small player in terms of its contribution to world trade- it accounts for 1.5 per cent of world exports and 1.3 per cent of imports. Nevertheless Australia's integration to the world economy is growing and remains strong. Table 1 shows the 10 largest trading partners to Australia and China ranks number one among them. These countries account for 66.5 per cent of Australia's total trade. Japan which occupied the top position for decades has slipped to the second followed by the US. It is important to note that Asian trading partners that are within the top ten account for nearly 50 per cent of Australia's trade and three of them (Singapore, Thailand, and Malaysia) have implemented FTAs with Australia successfully over the last decade. Once two FTAs with Japan and South Korea come into effect, China remains the only largest trading partner in Asia that still has an ongoing FTA negotiation with Australia.

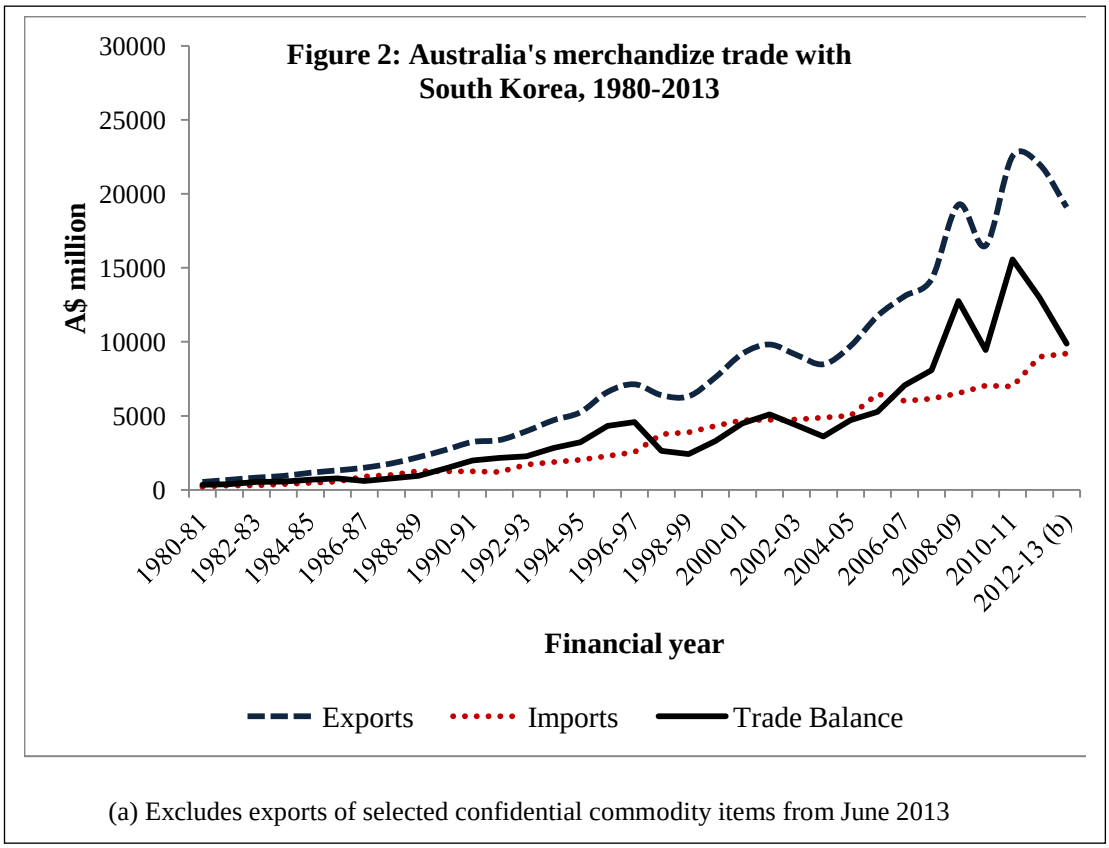


Notes: (a) Excludes exports of selected confidential commodity items from June 2013

Source: Australian Government, Department of Foreign Affairs and Trade

Figure 1 shows the bilateral trade between Australia and Japan from 1980 to 2013. Over the 33-year period, a substantial growth in trade appears to have taken place according to these trends. Exports of merchandise to Japan have increased rapidly from 2000 onwards whereas imports of merchandise from Japan have shown a gradual growth. Consequently Australia's merchandise trade balance with Japan experienced a significant surplus since 2000 and it has shown a sharp upward trend in recent years.

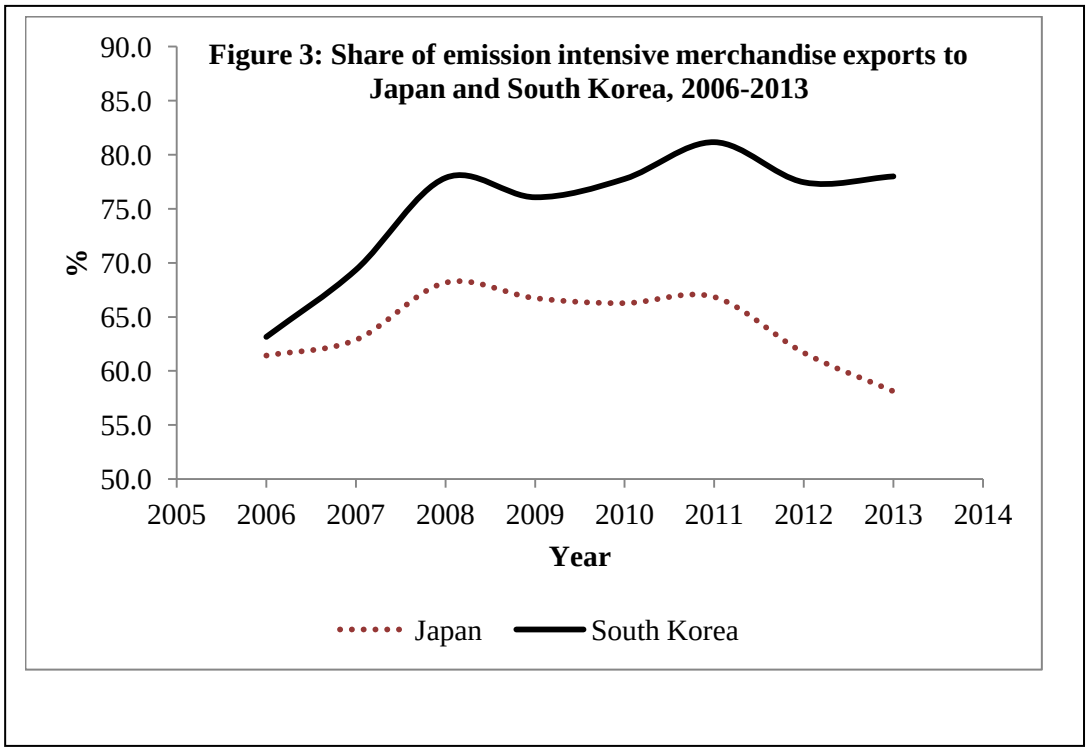
The importance of South Korea as a trading partner to Australia has also accelerated since 2000 according to Figure 2. Exports grew rapidly over the period under consideration while imports display a gradual upward trend. Australia has maintained a steady trade surplus with South Korea throughout the period (1980-2013) which shows a sudden increase since 2006. This is a clear evidence of a growing bilateral trade relationship between the two countries that gives a promising foundation for an FTA.



(a) Excludes exports of selected confidential commodity items from June 2013

Source: Australian Government, Department of Foreign Affairs and Trade

Figure 3 displays the trend in Australian exports of emissions intensive goods to Japan and South Korea. How much new emissions to be created by the two new FTAs largely depend on the composition of current exports. Figure 3 indicates that South Korea imports more emissions intensive goods from Australia than by Japan. It appears that nearly 80 per cent of exports that goes to South Korea are emissions intensive whereas to Japan it is about 65 per cent till 2011 and the share is falling.



Source: Australian Government, Department of Foreign Affairs and Trade

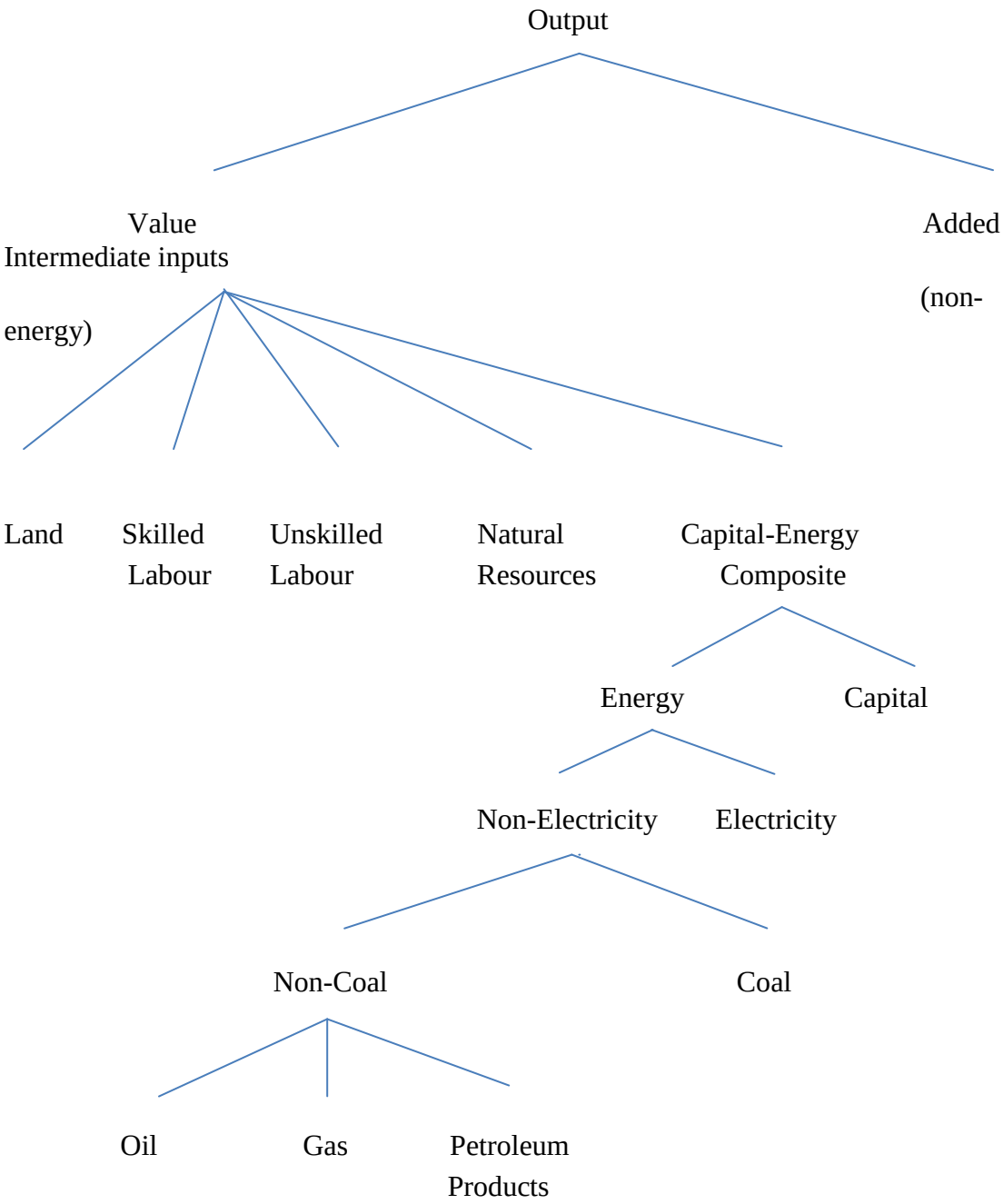
MODEL STRUCTURE AND DATA

Model

The model used in this paper is the revised version of GTAP-E model (McDougal and Golub, 2007); a slightly improved version of Burniaux and Truong (2002). This energy specific version is based on the standard GTAP model (Hertel, 1997). GTAP-E has been used in several studies of climate change policies because of its explicit treatment of substitution possibilities between energy inputs and between energy and capital in addition to its capability to incorporate CO_2 emissions (e.g. Kremers et al., 2002; Nijkamp et al., 2005; Kemfert et al., 2006; Long and Suduk, 2012).

Similar to the GTAP model, GTAP-E also uses the nested Constant Elasticities (CES) of substitution production structure. This is briefly outlined in Figure 1. In the production structure there are several sub-nests and each of them allows potential for substitution between individual or composite inputs. Each composite input is a combination of commodities (inputs) at the next lower level in the tree structure as shown in Figure 1. At the top level of the production structure, firms produce outputs by combining non-energy intermediate inputs and primary factor composite or value added. The elasticity of substitution is assumed to be equal to zero (Leontief assumption) at this level of substitution between value-added composite and non-energy intermediates. The primary factor composite is a combination of skilled labour, unskilled labour, land, natural resources, and capita-energy composite with a CES substitution between them.

Figure 4: Structure of Production in GTAP-E



Unlike in the standard GTAP specification, the production (input) structure further branches out within the capital-energy composite giving three inter-fuel substitution possibilities. They are: (i) electricity versus non-electricity composite; (ii) coal versus non-coal composite; and (iii) between oil, gas, and petroleum products. All three are modelled with CES substitution possibilities. This structure allows us to capture relative price effects when one input becomes more expensive relative to the other. For example, producers can substitute away from coal for non-coal energy (a composite of oil, gas, and petroleum products), when coal becomes more expensive

than non-coal energy. Similarly, if capital rental rises relative to the aggregate energy price, firms may substitute energy composite for capital.

Database and parameters

The database for the simulations is taken from GTAP-E version 8.1. It also contains most up to date emissions data disaggregated by fuel types. The base year for GTAP-E database is 2007 and we have adopted the parameter files that come with the model database. Given the purpose of our analysis, we have aggregated 57 sectors in the database into 20 sectors. Similarly, 134 regions are aggregated into 11 regions, with special reference to Australia's major trading partners. Table A1 in the appendix shows the sectoral and regional aggregation used in the paper.

POLICY SIMULATION SCENARIOS

Free trade scenario - FTAs

When the two FTAs with Japan and Korea are implemented, a number of changes are expected to occur in all three economies as bilateral tariffs on imports from each other are abolished. With the elimination of tariffs, prices of imports sourced from Japan and Korea are expected to fall in Australia by approximately the amount of such import duties currently in place. Similarly, Japan and Korea will experience lower prices for goods imported from Australia. These changes in prices in all three economies will result in relative price shifts that may induce resource reallocations. In the free trade (FTAs) scenario simulated with GTAP-E, Australia, Japan, and Korea are supposed to cut bilateral tariffs to zero while tariffs imposed on imports sourced from all other trading partners to Australia as well as to Japan and Korea remain unchanged. This implies preferential trading arrangements occur under FTAs and discrimination against non-FTA countries exists.

Table 2 contains the bilateral tariff rates on merchandise trade of Australia, Japan and Korea that are estimated from GTAP-E database. Australia already has below 5 per cent tariffs on most of the commodities imported from Japan and Korea except for 'Textile & leather', 'Metal products', and 'Motor vehicles & parts'. Japan and Korea also maintain fairly liberalised trade regimes with Australia except in agricultural goods according to tariff data in Table 2. In both countries 'Food', and 'Agriculture, forestry & fishing' are highly protected. Moreover Korea seems to have maintained somewhat higher tariffs than Japan on 'Mineral products', 'Metal products', 'Motor vehicles & parts', and 'Other manufacturing'.

Table 2: Barriers to Bilateral Merchandise Trade (%)

	Australian tariffs on imports from		Japanese tariffs on imports from	Korean tariffs on imports from
	Japan	Korea	Australia	Australia
Agriculture, forestry & fishing	0.4	2.1	13.9	8.3
Coal	0.0	0.0	0.0	0.0
Crude Oil	0.0	0.0	0.0	3.0
Natural gas	0.0	0.0	0.0	2.9
Other minerals	0.2	0.0	0.0	0.1
Food	1.5	2.0	34.4	39.9
Textile & leather	6.0	6.2	5.2	4.9
Wood, paper products	4.1	3.7	0.1	2.3
Oil products	0.0	0.0	0.1	3.4
Chemical, rubber, plastics	4.1	3.8	1.8	4.3
Mineral products	3.2	5.0	1.1	7.3
Ferrous metals	4.5	2.9	4.1	0.3
Metals not elsewhere counted	0.2	1.4	0.2	2.1
Metal products	5.9	5.5	0.6	6.5
Motor vehicles & parts	12.5	14.4	0.1	7.0
Electronic equipment	1.5	1.4	0.0	2.1
Other manufacturing	3.1	4.2	0.5	5.8
Electricity	0.0	0.0	0.0	0.0
Transport services	0.0	0.0	0.0	0.0
Other services	0.0	0.0	0.0	0.0

Source: GTAP-E data base.

In order to analyse the impact of tariff free merchandise trade under FTAs, tariff rates in Table 2 are reduced to zero in the simulations of GTAP-E. The model also allows different closures about factor markets and the macroeconomic environment. The tariff simulations are conducted within the long-run framework of GTAP-E. Rates of returns are equalised across regions, while capital mobility taking place. Investment occurs in each region during the tariff removal with the effect that regional investment matches with changes in global savings. The aggregate employment is fixed and the real wage adjusts in response to tariff cuts.

Green trade scenario- FTAs + Emissions Trading Scheme (ETS)

When there are no explicit policy measures to safeguard the environment from negative externalities such as greenhouse gases arising from preferential trade treaties, economic returns alone do not provide the true impact of such trade agreements. The externality, i.e. greenhouse gas emissions, is a social cost that needs to be taken into consideration in examining the true effects of FTAs. Hence it is necessary to consider an environmental policy along with trade policy that may mitigate emissions arising from the expansion of economic activity by the trade policy. The GTAP-E model has the capacity to handle such environmental policies using a carbon tax or an emissions trading scheme (ETS). Hence we define our 'green trade scenario' where the free trade scenario in place, but complements it by adding an environmental policy through an ETS between Australia, Japan, and Korea. In setting the emissions targets for three countries, we use Cancun agreement of emissions reductions for Australia and Japan, and the South Korean government policy announcements for South Korea to reduce emissions along with GTAP-E

emissions data (2007). The emissions constrains imposed on the model simulations are shown in Table 3.

Table 3: Reductions in CO_2 Emissions from 2007 Levels

Region	Cancun CO_2 Targets for 2020 relative to 2000	Required Change in CO_2 from 2007 levels[2]
AUS	-5%	-14.5%
USA	-16%	-13.6%
EU15	-12%	-7.9%
EU12	-12%	-11.8%
JPN	-33%	-30.6%
RoA1	-10%	-9.7%
South Korea[1]	-30%	-30.0%

Notes: 1. South Korea does not belong to Annex 1. Hence the target is based on the South Korean government policy. 2. Author's own estimates based on GTAP-E emissions data.

RESULTS AND DISCUSSION

As outlined in the previous section, two trade policy scenarios were simulated using the GTAP-E model and its database. On the basis of the results, this section assesses the potential outcomes of Australia's two new FTAs with Japan and Korea in terms of their economic and the environmental impacts. When bilateral tariffs are eliminated relative prices change and in response trade flows between countries change which impact upon resource allocations in the economy. It is expected that different sectors in the economy adjust their outputs according to relative price shifts which may spurt changes in greenhouse gas emissions levels. Reported in this section are the important environmental and macroeconomic effects, welfare outcomes, and industry output effects.

Impact under 'Free trade scenario'

We can first consider the macroeconomic projections reported in Table 4. According to projections shown in column 2, all three countries experience an increase in real GDP; Australia and Korea improve their real GDP in similar magnitudes whereas relatively larger Japanese economy grows by a modest margin (0.09 per cent). A reduction in import prices due to tariff elimination induces demand for imports in all three countries; however, Australia records the highest growth in imports. The cheaper imports serve to lower the prices of intermediate inputs causing higher profits to producers. This in turn stimulates the economy which results in a real growth in GDP.

Table 4: Macroeconomic Impacts of FTAs and ETS (percentage change)

		Free Trade Scenario (FTAs Only)	Green Trade Scenario (FTAs + ETS)
Real GDP	AUS	0.24	-3.69
	JPN	0.09	-2.43
	KOR	0.25	-3.52
Real Exports	AUS	2.65	-1.00
	JPN	0.65	-0.02
	KOR	0.72	-0.01
Real Imports	AUS	3.75	-1.04
	JPN	0.79	0.05
	KOR	0.71	0.04
Consumer Price Index (CPI)			
	AUS	1.02	1.68
	JPN	-0.00	1.32
	KOR	-0.21	1.40
Terms of Trade (TOT)			
	AUS	1.19	1.88
	JPN	0.05	1.19
	KOR	-0.07	1.16

Free access to Japanese and Korean markets, especially for agricultural goods and food, gives Australia's exports a considerable boost (3.75 per cent). The reduction in costs arising from the tariff elimination for imports sourced from Australia to Japan and Korea are quite significant and its impact is reflected in the decline of CPI in both countries. This in turn stimulates their exports overall; Japan's exports grow by 0.79 per cent and Korea's by 0.71 per cent. However in the case of Australia, the story is different. Australia is already a low-tariff economy and hence tariff cuts don't bring CPI down. Instead it shows a 1 per cent rise in the CPI, which is counter-intuitive in the face of tariff elimination. The increase in price level in Australia is explained by the rising real wages and rent on land (see Table 5). Australia also reports a significant gain in the terms of trade which in turn has strengthened its import capacity under two FTAs.

Table 5 includes a number of measures to gauge the welfare impact of the two trade agreements. The most important measures are the equivalent variation (EV) and the real household consumption. Australia is reported to have the highest welfare gain in terms of both; EV is projected to be US$ 3652 accompanied by 0.42 per cent growth in real household consumption. These measures show equally good outcomes in welfare for Japan and Korea relative to the size of these two economies (see column 2 in Table 5). The gain in welfare for all three countries is an indication that the benefits from trade creation outweigh the cost arising from trade diversion.

Table 5: Impact on Welfare of FTAs and ETS (percentage change)

		Free Trade Scenario (FTAs Only)	Green Trade Scenario (FTAs + ETS)
Real Household Consumption			
	AUS	0.42	-2.16
	JPN	0.10	-1.16
	KOR	0.30	-1.13
Real Wage (Skilled Labour)			
	AUS	0.36	-0.56
	JPN	0.20	0.02
	KOR	0.45	0.03
Real Wage (Unskilled Labour)			
	AUS	0.60	-0.49
	JPN	0.19	0.02
	KOR	0.45	0.03
Land Rent	AUS	31.90	1.23
	JPN	-2.80	0.00
	KOR	-2.58	0.02
Welfare–Equivalent Variation (US$ million)			
	AUS	3652	-1789
	JPN	3175	737
	KOR	1580	249

The welfare outcomes of three economies can also be seen through what happens to real wages and land rent. Real wages for skilled and unskilled labour increase in all three countries as shown by the projections in column 2 of Table 5; however Japan falls behind Australia and Korea in terms of percentage growth in wages. It is worth highlighting that the unskilled labour in Australia reports the highest wage growth among the three countries. This is explained by the phenomenal growth projected in the agricultural and food industries in Australia when Japan and Korea give free market access to agricultural and food exports. The growth potential for the agricultural sector is further highlighted by a substantial increase in land rent (mainly agricultural land) in Australia. Contrary to what happened in Australia, the cheaper agricultural and food imports to Japan and Korea drive down the land rent in those two economies. This is a quite natural outcome when both countries allow Australian exporters to access their markets without any tariff barriers. This is in fact one of the key reasons why Japan resisted an FTA with Australia for such a long period of time with prolonged negotiations.

Table 6: Environmental Impacts of FTAs and ETS

	Free Trade Scenario (FTAs Only)	Green Trade Scenario (FTAs + ETS)
Target Emissions Cut (%)		
AUS	-	-14.50
JPN	-	-30.60
KOR	-	-30.00
Target Emissions Cut (Mt.)		
AUS	-	-55.27
JPN	-	-327.85
KOR	-	-126.87
Change in total CO_2 (Mt.)		
AUS	0.15	-151.61
JPN	1.29	-238.60
KOR	1.48	-119.76
Percentage Change in total CO_2		
AUS	0.04	-39.77
JPN	0.12	-22.27
KOR	0.35	-28.32
CO_2 Permit Price (US$ per ton.)		
AUS	-	59.90
JPN	-	59.90
KOR	-	59.90
Net Seller (NS) or Net Buyer (NB) of permits (Mt.)		
AUS	-	96.36 (NS)
JPN	-	89.25 (NB)
KOR	-	7.11 (NB)

We now turn to the environmental impact of the two trade treaties under free trade scenario. As noted earlier, we assume in this simulation that there is no policy to safeguard the environment. In other words, improved economic activity with bilateral free trade may have a negative impact on the environment. GTAP-E allows us to quantify this impact via the growth in emissions of respective trading partners. Column 2 of Table 6 reports the projections of CO_2 emissions in absolute terms as well as in growth rates. The two FTAs tend to increase global emissions by nearly three million tonnes; the highest contribution comes from Korea (1.48 Mt.) followed by Japan (1.29 Mt.) and Australia (0.15 Mt.). The respective growth rates of CO_2 are relative to the 2007 emissions base in GTAP-E and both Korea and Japan show higher growth than in Australia.

Surprisingly, the increase in emissions in Australia is quite modest (0.15 Mt. or 0.04 per cent growth). There are two reasons for this low emission levels in Australia. First, the highly emissions intensive exports such as coal which account for a bulk of exports from Australia to Japan and Korea are already having free market access, i.e. import tax is zero. Hence a sudden surge of coal exports to Japan and Korea once FTAs are in operation is unlikely. Second, potentially high growth exports of agricultural and food products are low emissions intensive and may not add an undue burden on Australia's emissions.

Table 7: Output Changes under FTAs and ETS

	Australia		Japan		Korea	
	FTAs	FTAs +ETS	FTAs	FTAs +ETS	FTAs	FTAs +ETS
Agriculture, forestry & fishing	5.64	4.53	-0.59	-2.31	-0.42	-1.90
Coal	-1.74	-28.42	1.08	-36.09	0.73	-37.56
Crude Oil	0.33	-4.87	0.99	-5.55	1.04	-12.45
Natural gas	-3.81	-24.91	-0.08	-14.66	0.44	-65.67
Other minerals	-2.23	-16.48	0.13	-3.94	0.40	-6.70
Food	16.37	14.30	-1.09	-3.06	-1.68	-4.11
Textile & leather	-3.34	-3.19	0.08	-2.06	0.94	-7.95
Wood, paper products	-0.54	-3.22	-0.01	-3.54	0.31	-5.16
Oil products	0.34	-15.48	0.13	-9.18	0.34	-7.66
Chemical, rubber, plastics	-1.95	-5.59	0.06	-5.22	0.43	-6.32
Mineral products	-0.31	-5.12	0.09	-4.76	0.36	-7.20
Ferrous metals	-3.95	-9.70	0.41	-6.19	0.54	-8.86
Metals not elsewhere counted	-4.92	-42.39	0.09	-4.41	0.55	-2.67
Metal products	-1.14	-4.46	0.11	-3.46	0.40	-5.34
Motor vehicles & parts	-6.66	-7.58	0.97	-2.57	0.92	-4.75
Electronic equipment	-3.63	-4.00	-0.13	-3.96	0.23	-3.54
Other manufacturing	-1.41	-4.02	0.01	-3.53	0.35	-4.23
Electricity	-0.55	-32.33	0.16	-11.94	0.47	-18.32
Transport services	0.07	-4.79	0.05	-3.01	0.16	-4.73
Other services	0.15	-2.70	0.08	-2.41	0.21	-3.31

The sectoral output changes arising from bilateral free trade between Australia and Japan, and Australia and Korea are reported in Table 7. For Australia, a phenomenal growth in 'Food', and 'Agriculture, forestry & fishing' sectors are projected. These sectors receive duty free access into Japanese and Korean markets with the elimination of existing high tariffs. Moderate output gains to 'Crude oil' and 'Oil products' sectors are also attributable to the zero import duties they enjoy under free trade. Except in the two services, the reaming sectors in Australia appear to have lost outputs; the highest loss in output is projected to be in 'Motor vehicles & parts' sector. While the intensified import competition, particularly in manufactured goods, in the domestic market is responsible for the decline in many sectors, competition for resources from agricultural, food and resource sectors possibly plays a part in this structural adjustments within the Australian economy.

In contrast, 'Food' and 'Agriculture, forestry & fishing' are the significant losers in Japan and Korea. As protection against imports from Australia for these goods now abolished, producers in these sectors face a severe import competition domestically. It is also clear that FTA with Australia brings a mild negative impact on the Japanese 'Natural gas' sector. Almost all other sectors in Japan appear to be winners from the free trade deal even though the gains for some sectors are quite small. Overall, Korea emerges as a significant winner from bilateral free trade since all sectors but agricultural and food sectors are reported to be experiencing positive output gains.

Impact under 'Green trade scenario'

The free trade scenario examined in the previous section reveals that two trade agreements, when fully implemented, may have a negative impact on the environment as the model projections show an increase in emissions in all three countries (see Table 6). Japan and Korea contribute more to this trade induced emissions as they are fossil fuel dependent for energy and Australia is a major supplier of coal and other resources to both of them. It is therefore appropriate to consider policies to safeguard the environment when FTAs are fully implemented.

The current debate on emissions reduction policies in Japan and Korea has promoted an emissions trading domestically as well as internationally. Sooner or later, Australia may be inclined to follow suit. In view of this, we introduced an ETS between Australia, Japan and South Korea to complement the free trade policy. Table 3 displays the emissions reduction targets (cap) imposed on the basis of 2007 emissions levels of all Annex 1 countries (see column 3). Korea does not belong to Annex 1 group and its target of emissions cut was chosen according to its proposed government policy.

Macroeconomic projections of the 'Green trade scenario' are reported in column 3 of Table 4. It is apparent from the results that the ETS has a significant negative impact on real GDP in all three countries. The scheme is inflationary as indicated by the CPI projections and there is a loss of competitiveness which reduces Australia's exports and imports by one percent. In Japan and Korea, exports are also likely to be reduced; however imports appear to be experiencing a rather modest increase with the environmental policy in place. The reduced exports result in an improvement in the terms of trade for all.

Column 3 of Table 5 shows the welfare related projections. For Australia, projections for both EV and real household consumption reveal a larger negative impact on welfare. Japan and Korea experience lower EV levels along with reduced real household consumption compared to the free trade scenario. While the real wages for skilled and unskilled labour, and rent on land in Australia are severely affected by the emissions reduction through an ETS, Japan and Korea experience hardly any change in these factor prices. This outcome can be explained by looking at the reduction in exports in all three countries. Australian exports that gained momentum under free trade, mainly in agricultural and food products, are retarded to a greater extent with the introduction of an ETS with its two of the main trading partners who now find importing from Australia is rather expensive. All in all, the alternative welfare projections reported in Table 5 indicate that Australia is more negatively affected by the ETS than Japan and Korea.

Table 6 summarises (column 3) the environmental implications of the joint impact of the ETS and FTAs. To meet the targeted emissions cuts (emissions cap), the three countries are expected to engage in emissions trading according to their relative strength in demand for and supply of permits. Naturally, potential to supply permits to the market depends on the ability of a given country to reduce their own emissions below the cap. As can be seen from the table, the ETS is highly effective but expensive to all the participants. Australia exceeds the targeted cut (55.27 Mt.) by 96.36 Mt., becoming a net seller of permits. On the other hand, Japan and Korea

turned out to be net buyers of permits as they are unable to reduce emissions by the targeted 327.85 Mt. and 126.87 Mt, respectively. This means Japan ends up buying 89.25 Mt. worth permits and Korea 7.11 Mt. worth permits from Australian suppliers. By looking at the permit equilibrium price (US$59.90 per tonne), we can shed some light on the likelihood of cost effectiveness of an ETS. At the first glance, it appears that permit price is rather high and all three countries need to bear the underlined economic cost of the scheme. For example, trade induced GDP growth from FTA strategy is eroded with the introduction of an ETS.

Finally we compare the sectoral output projections in Table 7 with and without emissions trading. For Australia as it turns out, ETS has a severe negative impact on all the resource based sectors. Most notable are 'Coal', 'Natural gas', 'Other minerals', 'Oil products', 'Metals', and 'Electricity'. With the exception of emissions intensive 'Electricity', all these sectors are both trade exposed and bear high emissions intensity generally. Carbon permit price emerging from the ETS raises the cost of production in these sectors which affects their international competitiveness. The less emissions intensive 'Agriculture, forestry & fishing' and 'Food' sectors experience only a mild reduction in their outputs compared to the FTAs scenario. The rest of the sectors react with reduced outputs to the environmental policy in varying proportions.

Both Japan and Korea also respond to the high permit price and the entire sectors show a decline in their outputs. Apparently, this is a quite contrast to what happened under free trade. In Japan, worst affected are 'Coal', 'Natural gas', 'Oil products', 'Ferrous metals', and 'Electricity'. A further deterioration in 'Agriculture, forestry & fishing' and 'Food' sectors are also projected. Rest of the sectors declines evenly in response to the ETS proposal.

Korea's output response to the ETS is even more severe. Coal', 'Crude oil', 'Natural gas', and 'Electricity' are the hardest hit sectors in Korea. Virtually the production of every sector contracts which highlights Korea's reaction to the high permit price arising from the participation in an ETS with Australia and Japan.

CONCLUSION

This paper examines the impact of two free trade agreements that Australia has negotiated recently with Japan and South Korea but yet to be implemented. We simulate GTAP-E global general equilibrium model with two different scenarios, 'Free trade scenario' and 'Green trade scenario', to gain better understanding of to what extent bilateral tariff elimination is effective and how far the environmental impacts can be mitigated by adopting an ETS. The results indicate that all three countries will gain by removing bilateral protection on trade. The two FTAs tend to increase real GDP and welfare in Australia, Japan and South Korea at a modest cost on the environment.

For Australia, real gains are accrued through improved market access to Japan and Korea to export more of its agricultural and food products. Some of the resource based industries are also winners in Australia from the free trade deal. Moreover Australia benefits from increased manufactured goods available to domestic consumers at lower prices from both countries. However, this occurs at the expense

of domestic industries that experience contraction in the face of import competition. Even though free trade treaties can trigger displacement of manufacturing workers in sectors such as 'Motor vehicles & parts', 'Electronic equipment', and 'Textile and leather' with the competition from cheaper imports from Japan and Korea, the benefits to the Australian economy appear far greater and they may compensate sufficiently to mitigate adverse effects of such structural adjustments arising from import penetration.

Removal of bilateral tariffs is also beneficial to both Japan and Korea as demonstrated by the increased real GDP and welfare. In the absence of domestic protection, cheaper agricultural and food products from Australia make consumers better off in both markets and many industries which use raw material imported from Australia can improve their competitiveness due to reduced production cost. At the sectoral level, Korea appears to gain more than Japan as its pre-tariff structure is more unfavourable to Australian exports than what exists in Japan.

Benefits from free trade come at a slight environmental cost to all three countries. In other words, there is a tendency to experience increased global emissions when two free trade agreements are fully operational. Japan and Korea appear to be contributing more to it than Australia. As promoted by Japan and South Korea recently, an ETS was implemented in our 'Green trade scenario' as a complementary environmental policy to free trade policy. Our findings suggest that an ETS between Australia, Japan, and Korea is an expensive solution to the problem because permit price turns out to be fairly high. All three countries appear to lose the competitive advantage due to the high permit costs and hence the ETS is not an economically viable policy proposition to mitigate the increased emissions in this case.

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Appendix

Table A1: Regional and Commodity Aggregation

Aggregated Region	GTAP Region	Aggregated Commodity	GTAP Commodity
1.Australia (AUS)	Australia	1.Agriculture, forestry & fishing (AG-F-F)	Paddy rice; wheat; cereal grains nec; vegetables, fruit, nuts; oil seeds; sugar cane, sugar beet; plat-based fibers; crops nec; bovine cattle; sheep and goats, horses; animal products nec; raw milk; wool silk-warm cocoons; forestry; fishing
2.United States (USA)	United States		
3.European Union 15 (EU15)	Old EU15 members		
4.European Union 12 (EU12)	New EU12 members		
5.Japan (JPN)	Japan		
6.Rest of Annex 1 (RoA1)	Rest of Annex 1		
7.Oil Exporting (EEx)	Oil Exporting		
8.China (CHN)	China		
9.Korea (KOR)	Korea	2.Coal (COAL)	Coal
10. India (IND)	India	3.Crude oil (OIL)	Oil
11.Rest of World (ROW)	All other regions	4.Natural gas (GAS)	Gas; gas manufacture and distribution
		5.Other minerals (OMN)	Minerals nec
		6.Food (FOOD)	Bovine cattle, sheep and goat meat products; meat products; vegetable oils and fats; dairy products; processed rice; sugar; other food products nec; beverages and tobacco products
		7.Textile & leather (TEX)	Textiles; wearing apparels; leather products
		8.Wood, paper products (WPP)	Wood products; paper products, publishing
		9.Oil products (OIL-P)	Petroleum, coal products
		10.Chemical, rubber, plastic (CRP)	Chemical, rubber, plastic products
		11.Mineral products (NMM)	Mineral products nec
		12.Ferrous metals (I-S)	Ferrous metals
		13.Metals nec (NFM)	Metals nec
		14.Metal products (FMP)	Metal products
		15.Motor vehicles & parts (MVN)	Machinery and equipment nec
		16.Electronic equipment (ELE)	Electronic equipment
		17.Other manufacturing (OMF)	Manufactures nec
		18.Electricity (ELY)	Electricity
		19.Transport services (TRP)	Transport nec; water transport; air transport
		20.Other services (SER)	Water; Construction; trade; financial services nec; insurance; business nec; recreational and other services; public admin., defence, education, health; ownership of dwellings

Source: GTAP-E version 8.1 database.