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Economy-wide impact of a decline in live-sheep exports:
a CGE analysis¹

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ABSTRACT

Sheep industry is one of the important agricultural industries in Australia. More than 50 percent of the sheep sold in Australia are exported live and of the total live sheep exports, 70 to 80 percent is exported to the Middle-East countries. In August 2003, Saudi Arabia's rejection of the MV Cormo Express led to a widespread concern among the members of the industry as well as among the citizens at large. Many started to question about the need for live-sheep trade. This paper examines the effects of reductions in live-sheep exports on the Western Australian economy in a general equilibrium framework.

Key words: Live-sheep exports, CGE model.

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1. INTRODUCTION

Sheep industry is one of the important agricultural industries in Australia. More than 50 percent of the sheep sold in Australia are exported live and of the total live sheep exports, 70 to 80 percent is exported to the Middle-East countries (LiveCrop 2004). Among these countries, Saudi Arabia alone imported more than 50 percent in 2001 and 2002. Western Australia's share in the national live-sheep exports is more than 75 percent.

However, in August 2003, Saudi Arabia's rejection of the MV Cormo Express with a load of 56,000 sheep aboard, delays in unloading the vessel to a willing recipient and subsequent announcement of the Australian government of indefinite cessation of the live sheep trade to Saudi Arabia led to a widespread concern among the members of the industry as well as among the citizens at large. Many started questioning about the need for such live trade in sheep. Animal welfare group expressed great concern about the wellbeing of live sheep on board for such a long period ban (see for example, Norris and Norman (2003), [Animals Australia](#) and <http://www.animal-lib.org.au/lists/sheep/exsheep.shtml>). Both Federal and State Governments had setup enquiry commissions to investigate the Cormo incident and to recommend remedial actions so that such an event dose not happen again (Keniry report, 2003). These reports identified several factors which are of social, legal, environmental and political in nature and provided recommendations about how to overcome them.

Those who oppose the live exports, argue that the current live sheep export to the Middle East is inhumane and economically questionable. Some view that if animals are to be used for meat, then from both the issue of animal welfare and maximising financial returns to economies, animals should be killed as close as possible to the place of production (Heilbron, 2000). It is also viewed that there is a potential for chilled meat exports to substitute for live exports and Australia is well placed to capitalise on the growing market for chilled meat across the Middle East and South East Asia (Nicholson, 2002 and RSPCA 2004).

In this debate the obvious question is to what extent the live-sheep exports can be restricted? How the live-sheep industry, the agriculture sector and the economy as a whole will be effected if a total export ban is imposed? To what extent it would be necessary to

expand the meat processing industry to absorb the current level of sheep production? No systematic study is done so far to have answers to these questions².

This paper presents effects of a total ban on live-sheep exports on the Western Australian economy in a general equilibrium framework. It also presents some indications on the extent at which the increase in export demand for the meat product or the capital expansion for the meat processing industry would be necessary by maintain the present level of sheep production.

2. THE MODEL AND DATABASE

The economy-wide model for Western Australia, called WAM in short, captures the specific structure of the State economy with a particular focus on the agriculture sector. It accounts for interdependencies among agricultural and other WA industries. WAM models individual commodities (including sheep meat, wool, cereals, pulses & oil seeds, beef, pigs, poultry, horticulture and dairy) produced in the WA economy by explicitly specifying their production processes, input and output demands and trade. The model incorporates constraints applying to the State economy, as well as for specific sectors. Examples include limits on the supply of factors of production and given world prices. WAM includes input demands and commodity supplies by industries; commodity demands by households and governments; and the external sectors comprising imports into and exports from WA (see Islam and Johnson 2003 for further details).

The WAM database is made up of various shares and elasticities. To calculate the shares, the model uses the most recent input-output table for WA that refers to the year 1994-95, developed at the UWA Economic Research Centre³. This table represents the present-day State economy. The input-output table has 108 industries and as many commodities. Also, based on the rationale in Dixon *et al.* (1982, p.176), the model considers one fictitious local industry called “Complementary (non-competing) imports”⁴. Hence, the original input-output table has been modified to represent 109 industries and 109 commodities.

² Piesse (2004), and Islam and Piesse (2004) only investigated the effect of a decline in the demand for and tariff restrictions on the live-sheep exports on the Western Australian Economy.

³ The original input-output table by Islam and Johnson (1997) has been updated in 2002 at the ERC.

⁴ The industry is modelled to produce a negligible quantity.

To examine the effect of a ban in live-sheep exports we used the export demand equation

$$p_i^{e*} = \alpha_i^{e*} + \left(\frac{1}{\eta_i^{e*}} \right) x_i^e$$

The equation describes the world price of exports of good i . where, p_i^{e*} is the percentage change in the world price of exports of good i ; α_i^{e*} is the autonomous trend in foreign currency price of exportable good i and treated as endogenous only for the live-sheep export demand in this study (in other words, α_i^{e*} is the endogenous percentage shift in the foreign demand curve for the live-sheep exports); and η_i^{e*} is the foreign price elasticity of demand for the i th export commodity and this is a parameter value. Given the value of export demand elasticity η_i^{e*} , the export quantity x_i^{e*} of good i (the live-sheep exports in this study) is treated as exogenous to simulate the impact of total export ban of sheep exports. To determine the extent of changes needed to the meat processing industry by maintaining the present level of sheep production, the model was also simulated separately for the following two scenarios: (1) the sheep production, y_j and x_i^{e*} (sheep exports) as exogenous and α_i^{e*} (for meat and meat products exports) as endogenous; and (2) the sheep production, y_j and x_i^{e*} (sheep exports) as exogenous and k_j (capital stock for meat and meat products) as endogenous.

By applying the stylized Johanson method the WAM model was simulated using GEMPACK –7.0, a computer software package (Harrison and Pearson, 2000).

3. THE RESULTS

Effects on agricultural and processed meat commodities

Table 1 shows the price and production effects of five major agricultural commodities and the Meat and meat products. Column 1 reveals that except for the Beef-cattle, a total ban on live-sheep export will have negative price effects on all the major agricultural commodities. It also has a negative impact on the Meat price. However, in column 2 and 3

where respectively the export demand and capital stocks were allowed to change simultaneously by fixing the sheep production, the prices of most commodities increase. The Grains price however decreases in both the simulations but the decrease in Meat price occurred in column 3 where the meat processing industry's capital stock was allowed to change.

TABLE 1
IMPACT ON PRICE AND PRODUCTION OF MAJOR RAW AND
PROCESSED AGRICULTURAL COMMODITIES
(Percent change)

Affected Commodities	Simulations ²		
	1	2	3
<i>Price effect</i>			
Primary commodities			
Sheep meat (live)	-0.186	0.060	0.054
Wool	-0.183	0.065	0.052
Grains	-0.209	-0.020	-0.016
Pulses & oilseeds	-0.154	0.127	0.114
Beef cattle (live)	0.003	1.684	1.683
Processed commodities			
Meat & meat products	-0.002	20.268	-1.122
<i>Production effect</i>			
Primary commodities			
Sheep meat (live)	-47.162	0.000	0.000
Wool	0.989	-0.725	-0.631
Grains	6.208	0.630	0.554
Pulses & oilseeds	5.215	-4.852	-4.267
Beef cattle (live)	0.008	0.243	0.259
Processed commodities			
Meat & meat products	0.171	103.920	103.897

Notes:

1. The percentage changes are relative to 1994/95 (the base year) levels.
2. **Simulation 1** is 100 percent ban of sheep exports and other thing remaining the same. **Simulation 2** is 100 percent ban of sheep exports and the autonomous trend of meat exports as endogenous and the production of sheep as fixed. **Simulation 3** is 100 percent ban of sheep exports and the capital stock of meat exports as endogenous and the production of sheep as fixed.

On the production effects, about 50 percent of the sheep production declines but the production of all other commodities including processed meat, increase under the scenario of a total export ban. The resulting directions on production changes are however the same in simulations 2 and 3. Other than the Wool and Pulses and Oilseeds the production for all other commodities increases. However, a significant level of increase in production takes place for the Meat industry.

The above effects on prices and productions could be explained by examining the capital share and input coefficient of the Sheep and Meat industries database in the model (see Appendix 1). With the reduction of sheep exports, the sheep price falls and as a result sheep production falls. When sheep production falls, capital used for sheep production is substituted for Wool, Grains and Pulses and oilseeds production. As the production of these commodities increase their prices fall.

The exception is the Beef-cattle industry (column 1). By examining the input coefficients we could find that the Beef-cattle industry' share is about 30 percent of the total input used in the meat and meat production industry. As sheep export declines, Meat production increases and given the size of the input share more beef-cattle is also used by the Meat and meat product industry giving rise to its price and production. Similar explanation also holds for the other two simulations in columns 2 and 3 of Table 1.

The effects on the changes in exports of major agricultural and meat products are presented in Table 2. The major change occurs in Beef-cattle and Meat and meat product industries. The reason for such a large negative change in Beef-cattle is because of the size of its input coefficients for the Meat industry. As more sheep are processed for meat proportionately more Beef-cattle is used in the meat processing industry (see column 2 and 3) and therefore less Beef-cattle is available for exports. A decline of more than 100 percent means an import of Beef cattle is involved in the expansion of meat production.

Macroeconomic effects

The effects on important macroeconomic variables are presented in Table 3. As the agricultural industries in the model are linked with other sectors of the economy, the initial impact of the ban on Sheep exports is likely to reduce the sheep production and thereby decrease the demand for inputs by this industry which, in turn, forces other related industries

to scale down their output and employment. Table 3 reveals that all the macroeconomic variables: GSP, CPI, employment, imports and exports have declined (column 1).

TABLE 2
IMPACT ON EXPORT QUANTITY OF MAJOR PRIMARY AND PROCESSED
AGRICULTURAL COMMODITIES
(Percent change)

Commodities	Simulations ¹		
	1	2	3
Primary commodities			
Sheep meat (live)	-100.000	-100.000	-100.000
Wool	0.914	-0.325	-0.260
Grains	7.090	0.666	0.547
Pulses & oilseeds	6.946	-5.717	-5.150
Beef cattle (live)	-0.785	-505.117	-504.909
Processed commodities			
Meat & meat products	0.436	235.743	224.439

¹ See notes of Table 1.

TABLE 3
MACRO ECONOMIC IMPACT OF LIVE SHEEP
EXPORT BAN IN WA
(Percent change¹)

Macro-economic variables	Simulations ³		
	1	2	3
GSP ² at market price	-0.0756	1.0005	0.9856
Total consumption (real)	-0.0756	1.0005	0.9856
Consumer Price Index (CPI)	-0.0577	1.2805	0.8600
Aggregate employment	-0.0987	2.3480	1.8586
Total imports	-0.0774	1.5523	1.3469
Total exports	-0.0415	2.5349	1.9693

¹ See notes of Table 1.

Overall, the GSP declined by 0.08 percent (see column 1). This, in 2002/03 dollar terms, means that WA's GSP will be lower by more than \$55 million⁵. Lower GSP means lower income and lower overall consumption, which results in reduced demand for consumer goods and intermediate inputs. In turn this means less imports. As indicated in Table 3, both the aggregate imports and exports have declined by 0.08 and 0.04 percent respectively.

In contrast, the GSP value significantly increases if the Meat processing industry's export demand or capital stock increases significantly (see columns 2 and 3 of Table 3). Again, this, in 2002/03 dollar terms, WA's GSP will increase by more than \$7 billion in both the scenarios. The results also indicate that the aggregate employment also increases significantly under simulation 2 and 3.

Effects on WA economic structure

Table 4 shows the effects on broad sectoral outputs in WA. Except for the Mining and agricultural processing sectors, all the broad industry sectors decline when only total export ban is simulated (column 1). However for simulations 2 and 3 the result becomes almost the opposite (see columns 2 and 3 of Table 4). The reason can be explained in terms of the 'Gregory effect' (Gregory, 1976) i.e. when the highly export-oriented agricultural sector shrinks (expands) and its export is significantly reduced (increased), the exchange rate in real terms depreciates (appreciates) and thus boosts (contracts) exports of other export-oriented sectors of the economy, such as Mining.

Among the positively affected sectors however, the agricultural processing sector became the most affected one. This is extremely high in particular for the export demand increase and the capital expansion scenarios of the Meat and meat product industries (see column 2 and 3 of Table 4).

⁵ Estimated based on WA's GSP value of \$74.7 billion in 2002/03.

TABLE 4
EFFECTS ON BROAD SECTORAL OUTPUT
(Percent change¹)

Sector	Simulations ³		
(1)	1	2	3
Agriculture	-1.533	1.684	1.7125
Forestry, logging & Fishing	-0.013	0.000	-0.0481
Mining	0.004	-0.101	-0.0843
Agriculture processing	0.148	28.883	29.3579
Other manufacturing	-0.018	0.195	0.2381
Trade and transport	-0.079	0.483	0.4937
Construction	-0.066	1.388	1.4206
Services	-0.055	0.853	0.8557
Public Admin. & Defence	-0.073	1.206	1.1977
Total	-0.017	0.345	0.3514

¹ See notes of Table 1.

4. CONCLUDING COMMENTS

For decades Australian live animal export industry has been experiencing precariousness both in external and domestic fronts. The situation has worsen with the recent rejection of the Cormo Express by Saudi Arabia and the industry has come under close scrutiny. Individuals and organisations who are against live animal exports became more vocal in campaigning in favour of a total export ban. Many are arguing for expanding the domestic meat processing industry instead. Their point is that there is a potential for chilled meat exports to substitute for live exports.

This study made an attempt to examine the economy wide effects of a total export ban of sheep exports and to determine the extent at which the export demand and capital expansion of the meat processing industry would require if present level of sheep production

is to be maintained. A general equilibrium model for the Western Australian economy called WAM, is applied for the study.

The results of the model indicate that the individual agricultural industries as well as the overall economy of the State declines from the live-sheep export ban. Although the meat processing sector gains, but such gain is much smaller than the loss occurs in other sectors of the economy. In 2002/03 dollar term, the overall economy declines by more than \$50 million.

On the other hand, with the maintenance of current level of sheep production and an increase in export demand or the capital expansion of the meat processing industry the State economy gains by more than \$7 billion. In reality however, whether such an extent of capital expansion and demand enhancement for the processed meat is feasible or not needs to be investigated.

Presently to a certain extent the policies of the state, federal and foreign governments distort markets in favour of the live trade (Nicholson 2002, Ministerial Taskforce Report 2003). Governments of importing nations offer subsidies for live exports and often place tariffs on processed meat in order to protect domestic processing (Piesse 2004). At the national level, domestic policies provide greater support to live exporters than to meat processors. This study provides an indication that processed meat production and exports appears to be highly beneficial for the economy as a whole as well as for the related agricultural industries.

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Appendix I

TABLE A1
INPUT COEFFICIENTS FOR THE SHEEP AND
MEAT PROCESSING INDUSTRY
(percentage)

Supply Industry	Sheep (live)	Meat and meat products
Sheep (live)	0.00	13.85
Wool	0.00	0.00
Cereals	3.42	0.00
Pulses & oilseeds	1.17	0.00
Beef cattle	0.00	27.95
Pigs	0.00	5.34
Poultry	0.00	8.63
Other goods and services	30.43	23.21
Total intermediate uses	35.07	78.98
Compensation of employees	5.81	12.98
Gross operating surplus	46.06	3.84
Taxes	1.33	2.44
Imports	11.78	1.75
Total	100.00	100.00

TABLE A2
CAPITAL STOCK SHARE AND ADJUSTMENTS
(percentage)

Affected Industries	Capital Share	Simulations		
		1	2	3
Sheep (live)	9.30	-4.36	0.00	0.00
Wool	23.60	0.24	-0.16	-0.14
Cereals	62.00	3.86	0.40	0.35
Pulses and oilseeds	5.10	0.27	-0.25	-0.22
Total	100.00	0.00	0.00	0.00