CHINA'S DEMAND FOR AUSTRALIAN IRON ORE

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NEDLANDS, WESTERN AUSTRALIA 6907

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Damione Wright*
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MoonJoong Tcha*

*Economic Research Centre, Department of Economics,
The University of Western Australia, Nedlands, WA 6907, Australia.

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Abstract

This paper analyses China's demand for Australian iron ore using annual time series data for the period 1973-1992. Considerations include variables affecting Australia's iron ore supply and China's demand, such as the GDP growth rate and steel production per capita in China, labor disputes in Australia, the relative price of Australian iron ore to the world average, and Chinese government policies. Results indicate China's demand for Australian iron ore as being closely related to the growth rate of the economy, steel production per capita, and Chinese government policy. It is notable that labor disputes in Australia and the relative price of iron ore between Australia and the world did not prove to be significant factors affecting Australia's iron ore exports to China.

JEL Classification: Q32; Q38; F14; N65; C51
I. Introduction

In just over two decades Australian exports of iron ore to China have rapidly increased from 86 kilotonnes in 1973, to 17160 kilotonnes in 1994. This increase has been primarily generated by the increase of steel production in China, that accelerated by the construction of infrastructure and the change in industrial structure during this time period. Although China’s own reserves of iron ore are plentiful in quantity, the quality is not sufficient for the production of high quality materials. Considering that China’s steel production will continue to rapidly increase to meet domestic demand and given the need to supplement domestic iron ore supplies, imported iron ore requirements are assured to rise.


Recent estimates (Feng, 1994) suggest iron ore consumption in China to increase five fold in the coming decade, which will provide lucrative export opportunities for Australian iron ore producers in the future. However, although China’s demand for imported iron ore has been predominantly supplied by Australia as shown in Figure 1, previous studies (for example, AME, 1993, Feng, 1994, Findlay, 1994, Labson et al., 1995, McCallum et al., 1993) addressing the future of China’s demand for Australian iron ore did not give empirical support to their arguments.

Our paper constructs a model which describes China’s demand for Australian iron ore and proceeds to empirically test it. The paper first
discusses predominant theoretical factors affecting China’s demand for Australian iron ore and then empirically investigates the relationship between these factors and Australian exports of iron ore to China.

II. Factors Affecting Demand

This section considers the characteristics of variables which are considered to affect China’s demand for Australian iron ore. They include some variables related to China, Australia’s capacity of supply and prices

1. The Structure of the Chinese Market

_Pari passu_ to economic growth in China, is its increased demand for steel. Figure 2 details GNP per capita and steel consumption in China, which clearly illustrates the graphical correlation between the demand for steel in China and economic growth. Accompanying China’s increased steel demand are iron ore imports of which Australia is a major supplier, as shown in Figure 1. Chinese demand for foreign iron ore arises due to insufficient domestic supplies of iron ore in China. Although China has an abundant reserve of iron ore, as discussed above, most of its quality is largely insufficient for the production of high quality steel, such that utilising its own reserves requires iron ore to be additionally processed, involving higher costs.

Labson et al. (1995) reveal that after processing China’s low quality ore and imposing production taxes, the unit price of China’s iron ore inflates to approximately US$35 per WMT\(^1\), compared with a world traded price of US$25 per WMT. China can reap obvious savings in the cost of steel production by importing the necessary high quality iron ore.

\(^{1}\)Wet Million Tonne.
Chinese demand for iron ore is also influenced by government policy encouraging domestic steel production. The Eighth and Ninth Five-Year Plans emphasise Chinese government’s aim to develop sectors that use steel intensively, thereby increasing demand for steel (Sugimoto, 1993 and China Business Journal, 1995). So long as the Chinese government sustains its efforts in encouraging domestic steel production, demand for iron ore will increase. To meet such demand, China is not only having to supplement its own production of iron ore with imports, but also demanding intermediate iron products, such as Direct Reduced Iron (DRI), for the production of high quality steel products. In 1990, two thirds of new production plants built were of the electric-arc type (Findlay, 1994). As, the ratio of production by electric-arc furnace to total steel production is increasing, the demand for high quality intermediate iron products such as DRI, high quality pellets, and lumps is increasing too. This transition towards high quality steels is likely to provide increased value-added opportunities for Australian producers of high quality iron ore.

While numerous applications of iron ore beyond steel production exist, most iron ore is consumed in the production of pig iron for additional processing into steel. Alternatively, as discussed above, iron ore is processed into DRI which has experienced growing demand in the world, including China. However, “analysis of world demand for iron ore....is complicated by the numerous forms in which iron ore can be bought, the broad range of both intermediate and end products of iron ore processing, the completion from other raw materials, and the effects of past steel consumption levels on current scrap supplies”(Ma, 1993). Subsequently, demand for iron ore is primarily derived from the blast furnace production of steel (Ma, 1993 and Chi, 1993) and as such, considering China’s likely need to import iron ore, this paper considers steel production as one of the most important factors affecting China’s demand for Australian iron ore.
2. The Price of Iron Ore

It is widely accepted that iron ore demand is inelastic with respect to its price (Chang, 1993, pp.218). There are several reasons for this. First, iron ore accounts for approximately 5% of steel production costs (Tex Report, 1988, pp.26), therefore the cost of steel production is likely to be unaffected by small increases in the price of iron ore. Second, there is no substitute for iron ore in the production of steel and as such steel producers face little room for adjustment to the product mix. As a result producers are unlikely to significantly alter quantities of iron ore given a change in its price. Third, steel production plants are in general highly specific and capital intensive operations. Significant economies of scale can be achieved by maximising the utilisation of the plant, therefore, normal operation aims to sustain high capital utilisation. Decreasing capital utilisation due to an increase in iron ore prices would significantly affect unit steel costs of output and is subsequently undesirable (Chang et al., 1993, pp.216). As a result, demand for iron ore may not change significantly following a price change. However, when suppliers have different prices, the relative price of iron ore between suppliers may be important in determining China's demand for Australian iron ore. Quoted as being “the most important consideration” (McCallum et al, 1993, pp.3), Australia traditionally competes well against other suppliers with respect to its competitive price of iron ore. Australia's high Ferrous content and its naturally 'dry' ore give it a competitive edge over other suppliers such as Brazil.

Another advantage of Australia is its geographical close to the Chinese market. Relative to world standards, China’s port facilities are inadequate for iron ore imports. Therefore shipments of ore to China require small capacity carriers, about 40,000-50,000 tonnes (Labson et al., 1995). Large
inefficiencies are experienced with small capacity containers, since an increased number of shipments are required. Australia enjoys significant advantages given its geographical proximity to China in accommodating China's shipping inefficiencies, which helps Australian iron ore exporters keep their price lower than other more distant suppliers.

Annual negotiations in Japan provide benchmark prices for iron ore exports to China (McCallum et al., 1993). China's prices are usually quoted at a discounted rate, recognising China's developing country status. For simplicity and as a measure-of-best-fit, iron ore prices for Australia and the world as quoted from the Tex Report (1993) will be considered for comparisons of supplier's pricing.

3. Australian Influences

In contrast to Australia's flexible shipping arrangements, its domestic industrial disputes threaten to restrict iron ore flows to China. Industrial relations in Australia have undergone a revolutionary change in attitude since the confrontationist days of the 1970s and early 1980s (Bachman et al., 1995, pp.25). It would be important that Australian industrial relations continue to improve if exploitation of China's market is to be fully realised.

III. The Model

The following model employs time series data to investigate China's demand for Australian iron ore. The model includes both quantifiable and qualitative factors, which potentially influence the growth of China's
demand for Australian iron ore (CDAI). The model's regressors are briefly discussed below.

Steel production per capita in China (SPPC) is included as a measure of steel output in the economy. Since iron ore is the most important input into the production of steel, and given the model's focus upon China's industrialization and its relationship with CDAI, the selection of this variable is intended to capture increasing steel production throughout China's economic development.

According to theories on the intensity of use of steel, SPPC increase as the economy experiences structural changes from the agricultural economy to the industrial economy, and then starts to decrease as it matures to the service sector oriented economy. Although this may occur, CDAI can continue to rise through the qualitative change in steel products given the persistent development and increased sophistication within the Chinese economy. For this reason it is important to consider GNP, as well as SPPC, as an indication of China's economic development and the induced effect upon China's demand for Australian iron ore.

The qualitative change in China's steel production such as increased sophistication will be more accurately explained by GNP per capita. Therefore, GNP per capita in China (GNPPC) is considered rather than GNP; measured in Yuan. It is hypothesised that CDAI will continue to increase with economic development in China.

To distinguish competitive advantage of Australian iron ore in China's market from its competitors, the relative price measure (RP AW) is

---

2 The dependant variable used in this paper is \( \ln CDAI_t - \ln CDAI_{t-1} \) where \( \ln \) represents logarithm and the subscript \( t \) stands for time period. Accurately speaking, this is not a logarithmic value of the growth rate of CDAI but logarithmic value of \( (1+\text{growth rate}) \). For the simplicity of notation throughout this paper, \( \ln(X_t/X_{t-1}) \) for any variable \( X \) is expressed as a logarithmic value of the growth rate of the variable \( X \).
constructed comparing the *tel quel* price of Australian iron ore to the world *tel quel* average at each period t. $RPAW_t$ is defined as

$$RPAW_t = \frac{\text{Average 'tel quel' price of Australia}_t}{\text{Average 'tel quel' price of World}_t}$$

As discussed above, figures quoted from the Tex Report (various issues) are used in constructing the relative price measure.

Industrial disputes in Australia take account of Australia's ability to supply iron ore to China as contracted, and China's preference for a stable supply of iron ore. To capture supply restrictions in Australia which may hamper CDAI, we include the number of working days lost by industrial dispute in Australia (AWDL) as a regressor in our model. It is assumed that supply restrictions from Australia are based upon the aggregate labor dispute level, not that solely for the iron ore sector. Labor disputes arising in other sectors of Australia's economy (such as transport, shipping and the service sector) can influence the country's export of iron ore. It is likely to be the reputation of the Australian labor market as a whole that will shape China's view of possible supply restrictions from Australia given a labor dispute, rather than disputes which may occur in the iron ore sector alone.

One period lagged Australian exports of iron ore to China (CDA$\text{i}_t$) is thought to be an important factor influencing CDA$\text{i}_t$, and as such, is included as an explanatory variable in the model. Proposing CDA$\text{i}_t$ to be an important factor influencing CDA$\text{i}_t$ in essence incorporates into the model a memory for unquantifiable variables including cultural understanding, environmental conditions, the existing Australian network built in China and China's trade policy. Australian export variables lagged more than one period are not considered in this paper because both Akaike Information Criterion and Schwarz Bayseian Criterion suggest that the
model with one period lagged variable is superior to those with more lagged variables.

As discussed in the previous section, direct intervention of the Chinese government should be considered as an important determinant of China’s economic performance. Dummy variables accounting for structural changes and production displacements in China are therefore enlisted. Dummy variable D1 encompasses the period from the end of the Cultural Revolution in 1976 until the administration of Adjustment Policies in 1981. This period, a priori, is considered to contain a set of outliers which may not be consistent with the theoretical trend, given the exogenous influence of policy upon China’s economic performance. Dummy variable D1 is defined as the following:

\[ D1 = \begin{cases} 
1, & 1977 - 1981 \\
0, & \text{elsewhere} 
\end{cases} \]

Considering the strong drive of Chinese government for rapid industrialisation and the expansion of steel production, it is expected that the dummy variable which represents this period will have a positive effect on CDAI.

In addition to D1, another dummy variable (D2) was included in preliminary estimations in an attempt to capture additional political events which may have influenced economic development. Specifically, D2 targeted the effect of Tienanmen and the subsequent Austerity program introduced into China from 1989. The inclusion of this dummy variable provided no statistically significant result and is therefore deleted after preliminary estimations.
IV. Results

Stationarity tests conducted for each time series in its logarithmic value indicate that CDAI, AWDL, and RPAW are integrated to the order of $0 \ (I(0))$, while GNPPC and SPPC are $I(1)$\(^3\). With 20 observations (1973-1992) it may be premature to fully consider unit root problems. However, at the expense of losing one observation, first differencing GNPPC and SPPC provides regressors which are trend stationary (as shown in Appendix A) while maintaining economic significance and meaning. Given the theoretical consideration of CDAI, the model initially estimated is defined by:

$$
\Delta \ln CDAI_t = \beta_0 + \beta_1 T + \beta_2 D_1 + \beta_3 \ln CDAI_{t-1} + \beta_4 (\ln SPPC_t - \ln SPPC_{t-1})
$$
$$
+ \beta_5 (\ln \text{GNPPC}_{t-1} - \ln \text{GNPPC}_{t-2})
$$
$$
+ \beta_6 (\ln \text{AWDL}_t)
$$
$$
+ \beta_7 (\ln \text{RPAW}_t) + u_t
$$

where \( T = \) time trend, and
\( u = \) error term

Table 1 presents the results of estimation of this initial specification (A) by OLS. Parameter estimates for AWDL and RPAW are not statistically significant and as such, with the intention of parsimonious model estimation, nested variable deletion tests are conducted to examine the possibility of removing these variables from the given theoretical model. The results of these tests, detailed in Appendix B, indicate that AWDL and RPAW are not significant regressors in the estimation of CDAI and their deletion does not generate the model specification problem\(^4\). The model is then re-estimated without regressors AWDL and RPAW.

\(^{3}\) More detailed discussion on the stationarity of variables is given in Appendix A

\(^{4}\) We are reserved in concluding that labour disputes in Australia do not give any significant effect on CDAI, because AWDL is just one measure of labour disputes and some other measure may perform better. Perry (1978) and Tcha (1994) show that selected measures of labor disputes are closely related to some economic variables.
Estimates of the nested model, detailed in Table 2, suggest the possibility of serially correlated errors. This is implied given the value of the Durbin-Watson statistic, falling within the inconclusive zone\(^5\). An autoregressive (AR) method is adopted to correct for a possible serial correlation problem. Table 3 presents the results of AR(1) estimation. Note only first order serial correlation is reported, since the LM test indicated only first order serial correlation is significant, and estimations considering higher order correlation provided no statistically significant result as far as serial correlation was concerned.

The results in Table 3 show all coefficient values are significant at the 1% level and have anticipated signs. The intercept and time trend are positive as expected, with the time trend indicating a growth rate of CDAI of approximately 0.13% annually.

It is found that when CDAI\(_{t-1}\) changes by 1%, (CDAI\(_t\)/CDAI\(_{t-1}\)) changes by (-0.83)%. This is seen from the coefficient of (lnCDAI\(_{t-1}\)) being -0.83. The rate of change in (CDAI\(_t\)/CDAI\(_{t-1}\)) is approximately the same as the rate of change in CDAI\(_t\) subtracted by the rate of change in CDAI\(_{t-1}\). This implies that, in order for (CDAI\(_t\)/CDAI\(_{t-1}\)) to change by (-0.83)% as CDAI\(_{t-1}\) changes by 1%, CDAI\(_t\) has to change by approximately 0.17%. Other things being equal, the past export performance yields a positive effect on the present export performance, although the effects are diminishing. This diminishing effect implies convergence of the dependent variable over time.

As anticipated, the level of economic growth measured by GDP per capita is a significant factor influencing CDAI. The estimated change in growth rate suggests that the growth rate of CDAI will increase approximately 4%.

\(^5\)Gujarati, pp 363.
given an 1% increase in the growth rate of a lagged GNP per capita. This finding is consistent with Australian exports of iron ore to China over the past 20 years.

Steel production per capita in China also appears to have a significant effect on CDAI. More specifically, an 1% increase in SPPC growth rate generates an approximate 2.87% increase in the growth rate of China’s demand for Australian iron ore. The results from GNPPC and SPPC indicate that when GNPPC or SPPC in China increases, China’s demand for Australian iron ore increases more than proportionately.

The dummy variable included in the model captures the ‘boom’ experienced in China at the end of the Cultural Revolution and the subsequent relative recessed state of development preceding the implementation of Adjustment Policies in 1981. Yet the degrees to which these positive outliers affected CDAI depends largely upon the methods of estimation considered although they do not appear to be significantly different. The coefficient of D1 is always positive ranging from 0.75 to 0.85. This finding strongly supports the view that the Chinese government’s policies directly affect China’s economic performance and iron ore imports from Australia. More specifically, government policy from 1977 to 1981 contributed to booming Chinese steel production, which in turn led to higher demand for Australia’s iron ore.

In conclusion, on the effects of political variables on CDAI, it appears that Tienanmen did not have any significant effect as discussed above while the Chinese government’s economic policy after the Cultural Revolution appears to have had a significant influence on China’s demand for Australian iron ore.
V. Conclusions

In spite of the limited number of observations, this study has shown how economic and political variables have affected China's demand for Australian iron ore in the recent past. Our empirical model supports the proposition that per capita steel production and GNP per capita are important factors generating China's demand for Australian iron ore. These two variables are shown to induce a more than proportional increase in China's demand for Australia's iron ore.

The relative price of Australia's iron ore was expected to be a significant determinant of CDAI. The measure we used to distinguish Australia's iron ore qualities (emphasizing price) from other iron ore suppliers, however, did not produce the required result upon which we would have expected this variable to be significant. Australian labor disputes were observed as being insignificant when the number of working days lost is used as a regressor.

Political and policy influence upon CDAI may benefit from further investigation. Our results suggest that the political environment between 1976 and 1981, which accounts for the end of the Cultural Revolution and the 'boom' period subsequent to the administration of Economic Reform policies and later Adjustment Policies, is an important consideration for the model specification.
Appendix A- Stationarity

Stationarity tests for each of the variables were conducted using the Augmented Dickey-Fuller (ADF) test. The degree of augmentation presented in column three of Table A1 has been chosen so as to produce serially uncorrelated error terms and significantly lagged difference terms, and thereby maximizing the unit root test power for each of the quantified variables. DF denotes the Dickey-Fuller test for unit root, where this test is the most powerful for the variable in observation. The results indicate CDAI, AWDL and RPAW to be I(0) while SPPC and GNPPC to be of order equal to or greater than 1. The conventional critical value for the ADF test in this case is approximately 3.6. The same ADF stationarity test was then conducted upon the log-level difference for SPPC and GNPPC to assess the order of integration of those variables. Table A2 details the results of this test, and confirms SPPC and GNPPC to be I(1), showing that differencing these variables ensures stationarity.

Table A1- ADF Test for Unit Root, level data in logarithm

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF (DF)</th>
<th>Order</th>
<th>Serial Correlation (LM)</th>
<th>Heteroscedasticity (LM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDAI</td>
<td>-5.8253</td>
<td>DF</td>
<td>2.8159[0.093]</td>
<td>0.00048[0.982]</td>
</tr>
<tr>
<td>SPPC</td>
<td>-2.9562</td>
<td>DF</td>
<td>2.6431[0.104]</td>
<td>0.01037[0.919]</td>
</tr>
<tr>
<td>GNPPC</td>
<td>-2.3509</td>
<td>DF</td>
<td>0.1537[0.695]</td>
<td>0.08834[0.766]</td>
</tr>
<tr>
<td>RPAW</td>
<td>-4.8776</td>
<td>DF</td>
<td>3.9423[0.047]</td>
<td>0.13552[0.713]</td>
</tr>
<tr>
<td>AWDL</td>
<td>-3.7065</td>
<td>DF</td>
<td>2.0209[0.155]</td>
<td>0.40272[0.526]</td>
</tr>
</tbody>
</table>

Table A2- ADF Test for Unit Root, Difference data in logarithm

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF (DF)</th>
<th>Order</th>
<th>Serial Correlation (LM)</th>
<th>Heteroscedasticity (LM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔSPPC</td>
<td>-4.1873</td>
<td>DF</td>
<td>0.0308[0.861]</td>
<td>0.07018[0.791]</td>
</tr>
<tr>
<td>ΔGNPPC</td>
<td>-4.7546</td>
<td>DF</td>
<td>0.9267[0.336]</td>
<td>0.77856[0.378]</td>
</tr>
</tbody>
</table>

Therefore, by using log-level difference for SPPC and GNPPC in this study, the problem of non-stationary regressors is resolved and economic meaning is still maintained.
### Appendix B- Variable Deletion Test

OLS variable deletion tests conducted indicate AWDL and RPAW to be insignificant to the regression. Table B1 below details the results of this test.

**Table B1- Variable Deletion Test**

Dependent variable is $DCDA_{it}$

Variables deleted from the regression are AWDL and RPAW

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-ratio[Prob.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Z_t$</td>
<td>5.2211</td>
<td>0.90569</td>
<td>5.77[0.000]</td>
</tr>
<tr>
<td>$T_t$</td>
<td>0.1412</td>
<td>0.30801</td>
<td>4.58[0.001]</td>
</tr>
<tr>
<td>$D_{lt}$</td>
<td>0.8492</td>
<td>0.23376</td>
<td>3.63[0.003]</td>
</tr>
<tr>
<td>$CDA_{lt-1}$</td>
<td>-0.9064</td>
<td>0.14459</td>
<td>-6.27[0.000]</td>
</tr>
<tr>
<td>$DSPPC_{lt}$</td>
<td>2.2247</td>
<td>0.67362</td>
<td>3.30[0.006]</td>
</tr>
<tr>
<td>$DGNPPC_{lt-1}$</td>
<td>4.4819</td>
<td>1.1328</td>
<td>3.96[0.000]</td>
</tr>
</tbody>
</table>

Joint test of zero restrictions on the coefficients of deleted variables:

Lagrange Multiplier Statistic $\text{CHSQ}(2)=1.66[0.435]$

Likelihood Ratio Statistic $\text{CHSQ}(2)=1.75[0.418]$

F-Statistic $F(2, 10)=0.51[0.616]$

All variables are in logarithms

$DCDA_{lt} = \Delta\ln CDA_{lt}$

$DSPPC_{lt} = \Delta\ln SPPC_{lt}$

$DGNPPC_{lt-1} = \Delta\ln GNPPC_{lt-1}$
Figure 1- China's Total Iron Ore Import Demand and Australia's Iron Ore Export to China (1978-1993)

Figure 2- Per Capita GNP and Aggregate Steel Consumption (1953-1992)

Source: China Statistical Yearbook (1993)
Figure 3- Steel Production by Process in Percentage Terms, 1978-1991

Source: IISI (1993)
TABLE 1- China's Demand for Australian Iron Ore (1973-1992)

**OLS**

Dependent variable is DCDAI_t

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-ratio[Prob.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z_t (constant)</td>
<td>2.435</td>
<td>4.381</td>
<td>0.56[0.591]</td>
</tr>
<tr>
<td>T_t</td>
<td>0.187</td>
<td>0.056</td>
<td>3.34[0.008]</td>
</tr>
<tr>
<td>CDAI_{t-1}</td>
<td>-1.045</td>
<td>0.214</td>
<td>-4.87[0.001]</td>
</tr>
<tr>
<td>DGNPPC_{t-1}</td>
<td>4.717</td>
<td>1.206</td>
<td>3.91[0.003]</td>
</tr>
<tr>
<td>DSPPC_t</td>
<td>2.623</td>
<td>0.809</td>
<td>3.24[0.009]</td>
</tr>
<tr>
<td>D1_t</td>
<td>0.851</td>
<td>0.245</td>
<td>3.47[0.006]</td>
</tr>
<tr>
<td>AWDL_t</td>
<td>0.340</td>
<td>0.337</td>
<td>1.01[0.337]</td>
</tr>
<tr>
<td>RP AW_t</td>
<td>1.495</td>
<td>3.408</td>
<td>0.44[0.670]</td>
</tr>
</tbody>
</table>

All variables are in logarithms.

- DCDAI_t=ΔlnCDAI_t
- DSPPC_t=ΔlnSPPC_t
- DGNPPC_{t-1}=ΔlnGNPPC_{t-1}

R^2 = 0.875
R(bar)^2 = 0.788
Akaike Information Criterion = -1.706
Schwarz Bayesian Criterion = -5.268
Standard Error of Regression = 0.229
Residual Sum of Squares = 0.524
Durbin Watson Statistic = 2.316
F-Statistic, F(7, 10) = 10.00[0.0001]
TABLE 2- China’s Demand for Australian Iron Ore (1973-1992)
OLS (after deleting AWDL and RPAW)

Dependent variable is DCDAIt

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-ratio [Prob.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Z_t$</td>
<td>5.221</td>
<td>0.906</td>
<td>5.76 [0.000]</td>
</tr>
<tr>
<td>$T_t$</td>
<td>0.141</td>
<td>0.031</td>
<td>4.58 [0.001]</td>
</tr>
<tr>
<td>CDAIt-1</td>
<td>-0.906</td>
<td>0.145</td>
<td>-6.27 [0.000]</td>
</tr>
<tr>
<td>DGNPPCt-1</td>
<td>4.482</td>
<td>1.133</td>
<td>3.96 [0.002]</td>
</tr>
<tr>
<td>DSPPCt</td>
<td>2.225</td>
<td>0.674</td>
<td>3.30 [0.006]</td>
</tr>
<tr>
<td>D1t</td>
<td>0.849</td>
<td>0.234</td>
<td>3.63 [0.003]</td>
</tr>
</tbody>
</table>

r² = 0.862
R(bar)² = 0.805
Akaike Information Criterion = -0.579
Schwarz Bayesian Criterion = -3.250
Standard Error of Regression = 0.219
Residual Sum of Squares = 0.577
Durbin Watson Statistic = 2.494
F-Statistic, F(5, 12) = 15.03 [0.000]

All variables are in logarithms.
DCDAIt = ΔlnCDAIt
DSPPCt = ΔlnSPPCt
DGNPPCt-1 = ΔlnGNPPCt-1

Dependent variable is DCDAIt
### TABLE 3- China's Demand for Australian Iron Ore (1973-1992)
#### AR(1) Maximum-likelihood Method

Dependent variable is $\text{DCDAI}_t$

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-ratio[Prob.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Z_t$</td>
<td>4.783</td>
<td>0.737</td>
<td>6.49[0.000]</td>
</tr>
<tr>
<td>$T_t$</td>
<td>0.128</td>
<td>0.024</td>
<td>5.25[0.000]</td>
</tr>
<tr>
<td>$\text{CDAI}_{t-1}$</td>
<td>-0.0831</td>
<td>0.123</td>
<td>-6.77[0.000]</td>
</tr>
<tr>
<td>$\text{DGNPPC}_{t-1}$</td>
<td>4.047</td>
<td>1.000</td>
<td>4.04[0.002]</td>
</tr>
<tr>
<td>$\text{DSPPC}_t$</td>
<td>2.870</td>
<td>0.606</td>
<td>4.74[0.000]</td>
</tr>
<tr>
<td>$\text{Dl}_t$</td>
<td>0.746</td>
<td>0.186</td>
<td>4.01[0.002]</td>
</tr>
</tbody>
</table>

$R^2$, $R(\text{bar})^2$, Akaike Information Criterion, Schwarz Bayesian Criterion, Standard Error of Regression, Residual Sum of Squares, Durbin Watson Statistic, F-Statistic, $F(6, 11)$

$R^2$ = 0.886
$R(\text{bar})^2$ = 0.825
Akaike Information Criterion = 0.207
Schwarz Bayesian Criterion = -3.096
Standard Error of Regression = 0.208
Residual Sum of Squares = 0.475
Durbin Watson Statistic = 2.027
F-Statistic, $F(6, 11)$ = 14.34[0.000]

Parameters of the Autoregressive Error Specification

$u_t = -0.51u_{t-1} + E_t$

T-ratio[Prob.] = -2.50[0.029]

All variables are in logarithms.

$\text{DCDAI}_t = \Delta \text{lnCDADAI}_t$
$\text{DSPPC}_t = \Delta \text{lnSPSPC}_t$
$\text{DGNPPC}_{t-1} = \Delta \text{lnGNPPC}_{t-1}$
References


7. IISI (International Iron and Steel Institute) (various years) Steel Statistical Yearbook, Brussels.


