CLIMATIC FLUCTUATIONS AND THE INTERNATIONAL RICE TRADE: A PRELIMINARY INVESTIGATION

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In the late nineteenth century, Manchester was the market centre of the Lancashire cotton textile industry and dominated the world of international commerce. It was also an intellectual centre and mill-race of ideas. In a paper read to the Manchester Statistical Society on April 13th, 1870, J.C. Ollerenshaw first raised the issue of the link between fluctuations in rice prices and fluctuations in purchasing power. He drew attention to the relationship between rice prices in India, and the demand there for Lancashire cotton textiles. India was a major market and he said `In proportion that grain is cheap and plentiful, or scarce and dear in India, will our trade in Lancashire be flourishing or depressed' (Ollerenshaw 1869-70 114). Little is known of Ollerenshaw, but his well-argued paper caught the eye of Liverpool born W. Stanley Jevons. Jevons had studied meteorology whilst assayer in the Sydney Mint 1854-59. He graduated from University College, London, in 1860 and in 1866 was appointed Professor of Logic and Cobden Lecturer in Political Economy in Owens College, Manchester. From 1876 to 1881 he was Professor of Political Economy in University College, London, and in 1879 published in *Nature* a famous paper on sun-spots and commercial crises. In this he specifically refers to Ollerenshaw's paper (Jevons 1979 588). There was a follow-up paper in 1882, the year of his death in a drowning accident (Jevons 1882 226-228). In the 1879 paper he refers to the recurrent economic crises which came every ten or eleven years. ``I feel sure the explanation will be found in the cessation of demand from India and China occasioned by the failure of harvests there, ultimately due to changes of solar activity'.(Jevons 1879 590). In the 1882 paper he says `The theory of the solar-commercial cycle and of the partially oriental origin of decennial crises has received such confirmation as time yet admits of.' (Jevons, 1882 228).

Such ideas have often been treated with derision, as Jevons himself was aware (Jevons 1879 588). Yet the subject of climatic fluctuations continued to attract further research, notably by Sir Gilbert Walker (Walker 1924, 1932, 1936). Walker's research led him to conclude there was what he termed a Southern Oscillation in sea-temperature and air pressure in the Pacific. A recent account of this phenomenon notes that when it occurs ` `the low-pressure zone over Indonesia and its associated warm, moist air move eastwards over the mid-Pacific….Because this warm air has moved to the east of its usual position, the cold dry air that usually descends over the Pacific, Indian and Atlantic Oceans is also moved further east than normal, and falls over Australia and Africa….This significantly alters global rainfall patterns because cold, dry air – associated with low rainfall – has replaced the warm, moisture-bearing air formerly centred over Australia/Indonesia and Africa….The increase in sea-surface temperature of the eastern Pacific heats up the air above it….which usually brings rain to Indonesia to the east and causes rain to fall over the western Andes instead.' (United Nations Environment Programme 1992 14-15). Walker did examine the relationship between sun-spots and the Southern Oscillation but found there was none (Walker, 1932 64). This whole phenomenon is now known as *El Nino*-Southern Oscillation (*EN*S0), although the link between Walker's Southern Oscillation in the Western Pacific and the intermittent heavy rainfall pattern in the Eastern Pacific and Western Andes was not recognised until Bjerknes' work in 1969 (Philander 1990 4-5).

In 1987 Quinn and Neal tracked *EN*SO occurrences over four and a half centuries. They specifically examined *El Nino* occurrences based on evidence from the west coast region of northern South America and its adjacent Pacific Ocean waters. Relative strengths of events were based on such considerations as wind and current effects on travel times of ancient sailing ships, degree of physical damage and destruction, amounts of rainfall and flooding, mass mortality of endemic marine organisms and guano birds, extent of invasion by tropical nekton, rises in sea temperatures and sea levels, affects on coastal fisheries and fish meal production, etc. Their emphasis was on strong and very strong events. For example, 1891 and 1925/26 were very strong occurrences (Quinn and Neal 1987 14,449). Table 1 lists *El Nino* occurrences 1871-1940/41.

EL NINO OCCURENCES 1871-1940/41

	Strength
1871	S+
1877-78	VS
1884	S+
1891	VS
1899-1900	S
1911-1912	S
1917	S
1925-26	VS
1932	S
1940-41	S

(Quinn and Neal 1987 14,451)

This paper however will not examine *El Nino* events in the Eastern Pacific and South America, but the related and simultaneous Southern Oscillation events in the Western Pacific and Asia in the period 1870-1940. The chosen source of information for this study are the statistics of rice movements in Asia, specifically those relating to imports of rice to rice-deficient countries of the region.

The first of these is Indonesia, known then as the Dutch East Indies or Netherlands India. In the early nineteenth century Indonesia produced more than enough rice for its own needs, and even had a surplus, which it exported. But over the course of the century it ceased to be rice-sufficient and became a rice importer, as the country turned to other commercial crops like sugar, and later rubber. In this, rice movements were obeying the rule that "Rice moves to areas where incomes are rising" (Latham 1994 23-24. Latham 1999 117-19). 1873 was the crucial turning point, a year of heavy imports. There was a temporary reversal of this pattern from 1886 to 1889, but from then on rice imports took place every year. (See Table 2). Although a very high proportion of rice consumed was still produced locally, it was also necessary to import rice, and a temporary short-fall in local production would lead to sharply increased imports. It is this rice-import sensitivity on which this paper focuses. During a Southern Oscillation event, the warm moist air which usually covers Indonesia bringing ample rains, moves eastwards across the Pacific, and is replaced by colder, dry air, causing low rainfall and even drought. Ideal rice growing conditions are replaced by adverse rice growing conditions, leading to diminished harvest out-turns. In such circumstances rice imports increased, as is shown in the rice import figures. Quinn and Neal mention 1891 and 1925/26 as being years of very strong ENSO events, and a cursory examination of the import figures for Java and

Madura, the main islands, confirm this to be the case. As has been noted, 1886 to 1889 were net export years, but 1890 saw imports of 46.06 000MT, followed by 45.52 000MTS in 1891, 79.76 000MTS in 1892, 101.72 000MTS in 1893 and 126.98 000MTS in 1894. Clearly the impact of the 1891 event was felt long after it had occurred. As for 1925/26, a time when rice import levels were in any case greater due to increased rice import dependency, rice imports rose from 242.87 000MT in 1924 to 252.80 000MT in 1925 and a peak of 312.25 000MT in 1926, before falling back to 104.37 000MT. It has been estimated that by this time about 11 per cent of rice consumed was imported (Feldwick 1926 613-14). So a cursory examination of the rice import figures supports the proposition that Southern Oscillation events were marked in Indonesia by adverse rice growing conditions, harvest shortfalls, and increased rice imports.

Quinn and Neal also mark 1877/78 as seeing a very strong event, and bearing in mind time-lags involved in each event across the Pacific, this fits with the heavy imports of 96.91 000MT of 1875 and 119.96 000MT of 1876. Other event years marked by Quinn and Neal were 1871S+, 1884 S+, 1899/1900 S, 1911/12 S, 1917 S, 1932 S, 1940/41 S. (Quinn and Neal 1987 14,451). The 1871 S+ event is marked by increased imports of 8.09 000MT in 1872 and massive imports in 1873 of 111.07 000MT, the turning points at which Java and Madura becomes permanently a rice importer. The 1884 S+ event is not marked by high imports after the event in the Eastern Pacific, but immediately prior to this event, there were high imports with 1880 at 137.12 000MT, 1881 139.64 000MT, 1882 137.22 000MT and 1883 109.13 000MT. It appears that events could have a prolonged impact, sometimes being felt in Indonesia and the Western Pacific before they were felt in the Eastern Pacific. The 1899/1900 S event is clearly marked by heavy imports in 1900 of 118.07 000MT, 1901 325.58 000MT and 1902 220.36 000MT. The 1911/12 S event in South America was also preceded by heavy imports to Java and Madura of 491.80 000MTS in 1910 and 396.19 000MTS in 1911. As for 1917 this too was preceded by rising imports in 1915 of 333.76 000MTS, 1916 390.76 000MTS, with 1917 406.49 MTS and 1918 412.52 000MTS. 1921 with 576.54 000MT and 1922 with 400.77 000MT were years of extremely heavy imports, which do not seem to be explained by the Southern Oscillation. The 1925/26 VS event has already been dealt with, but the 1932 S event was again preceded by heavy imports to Java and Madura of 1929 345.85 000MTS, 1930 248.78 000MTS and 1931 287.01 000MTS. The 1940 S shows no such increased imports prior to the event, but by this time there was disruption due to the war in Europe, which may have obscured the true situation.

Paddy production estimates for Java and Madura for 1880-1940 do exist, but `These figures are based on the figures for the area planted with rice and on estimates of rice production per bau. During this period these estimates were based increasingly on sampling, with the actual harvest yields being measured in representative trial plots. In contrast to the data on the area planted with rice, which are comparatively unreliable, these estimates (i.e of rice production per bau) may therefore be regarded as fairly reliable.' (Boomgaard and van Zanden 1990 117. Also 142. See also van der Eng, 1996 293-94). Because they do not give actual production figures they are little help in this exercise.

The figures for the Outer Islands reflect this pattern to a degree. Here less rice was grown on irrigated land, and most was directly rain fed, making it less responsive to a lack of inundation in the irrigation channels. But the figures do show steadily increasing imports over time as import dependency increases with commercial development, and some of the major Southern Oscillation shocks are clearly marked. The first of these is the period of heavy imports to Java and Madura of 1880-1883,which immediately precede the S+ event in South America of 1884. 1879 shows imports of 65.70 000MT, 1880 64.05 000Mt and 1881 58.59 000MT. The years of 1880 and 1881 show heavy imports to both sets of islands. However, the time lag to 1884 is quite substantial, and raises the question of the length of these events. The 1891 VS event is associated with heavy imports of 75.71 000MT in 1890 and 74.86 000MT in 1891. The 1899/1900 S event is marked by spectacularly increased imports in 1901 of 281.37 000MT. Similarly the 1911/1912 S event sees massive imports of 213.20 000MT in 1910 and 324.01 000MT in 1911. The 1917 S event is shown by imports of 301.92 000MT in 1916, 348.02 000 MT in 1917 itself, and 305.95 000MT in 1918. The VS event of 1925/26 seems to have caused considerable problems with huge imports of 281.37 000MT in 1925, 318.18 000MT in 1926, followed by 366.00 000MT in 1927. Imports remained high in 1928 at a peak of 401.66 000MT, and continued with 389.33 000MT in 1929 and 379.22 in 1930. They were heavy in 1931 at 321.45 000MT in 1931, immediately preceding the S event of 1932. It is if, at least as far as the Outer Islands were concerned, the 1925/26 VS event had merged with the S event of 1932. The 1940 event is less clearly marked, although 1938 saw large imports of 311.80 000MT and 1939 continued high at 244.73 000MT.

TABLE 2

RICE IMPORTS TO INDONESIA, PHILIPPINES AND JAPAN 1868-1940 (000MT)

		JAVA & MADURA	OUTER ISLANDS	PHILIPPINES	JAPAN*
1868		0.09			12.58
1869		0.92			92.24
1870		0.82			**322.62**
1871	S+	0.01			25.17
1872		**8.09**			
1873		**111.07**		7.31	1.14
1874		21.54	11.94	10.84	.70
1875		**96.91**	21.93	2.91	.61
1876		**119.96**	27.20	0.24	.01
1877	VS	49.34	28.61	23.00	.00
1878	VS	24.25	28.97	23.67	.00
1879		37.41	**65.70**	**58.81**	**7.49**
1880		**137.12**	**64.05**	13.55	**11.89**
1881		**139.64**	**58.59**	5.55	3.25
1882		**137.22**	44.11	9.41	.43
1883		**109.13**	39.89	**54.41**	.00
1884	S+	63.40	41.13	**108.43**	.35
1885		29.95	42.19	42.44	**17.75**
1886		0.94	49.88	61.79	.58
1887		0.45	44.47	79.98	4.21
1888		9.85	54.66	82.44	.73
1889		28.16	67.83	85.41	3.10
1890		**46.06**	**75.71**	71.16	**275.79**
1891	VS	**45.52**	**74.86**	**82.66**	**100.68**
1892		**79.76**	56.70	62.70	49.45
1893		**101.72**	71.14	41.00	83.94
1894		**126.98**	76.23	44.87	**198.27**
1895		75.46	71.20	11.66	**101.12**
1896		114.85	64.78		**111.72**
1897		159.89	90.15		**378.08**
1898		56.16	90.65	3.91	**701.77**
1899	S	68.46	97.26	**110.14**	99.03
1900	S	**118.07**	100.83	**145.83**	137.21
1901		**325.58**	**281.37**	**170.64**	186.71
1902		**220.36**	151.04	**290.05**	270.54
1903		66.44	132.91	**334.33**	**729.74**
1904		133.17	174.15	**265.75**	**883.90**
1905		135.83	163.95	**219.27**	**695.75**
1906		182.27	163.32	127.05	366.06
1907		121.73	150.31	119.02	406.21
1908		188.26	144.13	158.38	291.21

1909		214.88		177.21		167.12		198.76	
1910		**491.80**		**213.20**		**197.32**		137.79	
1911	S	**396.19**	(396)	**324.01**	(224)	**183.67**	(184)	257.93	(237)
1912	S	245.58	(241)	206.72	(207)	**301.05**	(301)	**335.16**	(308)
1913		258.41	(258)	248.21	(251)	86.99	(87)	**545.59**	(502)
1914		215.74	(216)	255.45	(255)	96.92	(97)	**303.39**	(279)
1915		**333.76**	(334)	249.61	(250)	**218.44**	(218)	68.64	(63)
1916		**390.76**	(391)	**301.92**	(302)	**189.83**	(190)	46.37	(43)
1917	S	**406.49**	(406)	**348.02**	(249)	**146.98**	(147)	84.65	(78)
1918		**412.52**	(344)	**305.95**	(305)	**183.73**	(184)	**697.07**	(641)
1919		141.92	(140)	135.01	(135)	50.81	(51)	**696.35**	(641)
1920		114.33	(114)	108.80	(106)	77.33	(77)	70.66	(65)
1921		**576.54**	(576)	187.78	(188)	59.52	(59)	239.30	(220)
1922		**400.77**	(401)	223.78	(225)	42.29	(42)	456.58	(420)
1923		199.90	(200)	217.72	(218)	66.44	(66)	265.43	(245)
1924		**242.87**	(243)	208.44	(208)	**151.10**	(151)	490.18	(451)
1925	VS	**252.80**	(253)	**281.37**	(281)	**109.30**	(101)	**771.08**	(709)
1926	VS	**312.25**	(312)	**318.18**	(318)	70.48	(70)	345.51	(318)
1927		104.37	(104)	**366.00**	(366)	12.16	(11)	**584.86**	(541)
1928		182.78	(183)	**401.66**	(402)	43.75	(43)	283.40	(261)
1929		**345.85**	**(346)**	**389.33**	(389)		**(105)**	184.01	(184)
1930		**248.78**	**(249)**	**379.12**	(379)		(11)	180.19	(180)
1931		**287.01**	**(287)**	**321.45**	(321)		(12)	125.83	(126)
1932	S	149.78	(150)	273.88	(274)		(13)	152.81	(153)
1933		105.92	(106)	252.18	(252)		(20)	142.54	(143)
1934		61.50	(62)	218.61	(218)		(-1)		(7)
1935		118.10	(108)	270.19	(270)		(5)		(39)
1936		8.60	(9)	224.40	(224)		(91)		(93)
1937		8.56	(9)	169.16	(168)		(72)		(55)
1938		22.51	(22)	311.80	(312)		(9)		(33)
1939		33.55	(34)	244.73	(244)		(84)		(23)
1940	S	11.90		96.80					(44)

VS, S+, S indicate strength of El Nino event in Eastern Pacific – South America.
*Foreign rice only not including rice from Korea and Formosa.

Government of the Philippine Islands (1921) 171 Table 67; (1923) 56 Table 55; (1924) 87 Table 73; (1925) 90 Table 71; (1926) 94 Table 76; (1927) 126 Table 76; (1928) 146 Table 90; (1929) 152 Table 93).
Ishibashi, (1935) 154.
Mansvelt and Creutzberg 1978 Table 6, 65-72
Wickizer and Bennett 1941 Table V 324-25. (Java and Madura). Note discrepancies in 1918 and 1935 and (Outer Islands) 1911. Table IV 322-23 (Philippines). Net figures imports-exports. Note discrepancy in 1925. This is an error that has been copied from the official statistics. 109,305 (109) is correct. Similarly 1927 where 12,164 (12) is correct. Table V 324-5 (Japan). Note difference with Ishibashi 1911-1928. Then figures agree.

But Indonesia was not the only rice-deficient island group in the Western Pacific region. The Philippines too were rice deficient. Like Indonesia, the Philippines originally produced enough rice for its own needs, and had a surplus for export. But during the late nineteenth century it also became a rice importer, as cultivators turned to crops like sugar and abaca (hemp fibre), and as the population grew. About 9 per cent of their rice needs were imported in the 1870s and over 21 per cent in the late 1880s (Legarda y Fernandex 196711. Legarda 1955 278-303. Legarda 1999 156-78). As in Java and Madura the turning point came in 1873, with imports of 7.31 000MT when both countries seem to have suffered crises (Legarda 1955 283. Legarda 1999 161). As in Indonesia this may be a lagged response to the S+ event of 1871. 1879 was a year of heavy imports of 58.81 000MT, also a late response associated with the VS event of 1877/1878. This was also a year of notably heavy imports to the Indonesian Outer Islands. In connection with the S+ event of 1884, it can be seen that 1883 was a year of heavy imports of 51.41 000MT, a year when there were also heavy imports to Java and Madura, followed by huge imports of 108.43 000MT in 1884 itself. The VS event of 1891 does not seem to be clearly marked in the import figures, although the underlying trend of imports was still strongly upwards. But after the United States took control in 1898 imports surged, with 110.14 000MT in 1899, 145.83 000MT in 1900, 170.64 000MT in 1901, 290.05 000MT in 1902, 334.33 000MT in 1903, 265.75 000MT in 1904, and 219.27 000MT in 1905. These figures reflect the S event of 1899/1900 and echo the situation in Java and Madura and the Outer Islands. Figures then fell back but surged again in 1910 with 197.32 000MT and 1911 183.67 000MT, followed by massive imports of 301.05 000MT in 1912. This reflects the S event of 1911 and 1912, which was clearly felt in both Java and Madura and the Outer Islands. The next surge in imports came in 1915 with 218.44 000MT, followed in 1916 by 189.83 000MT, 146.98 000MT in 1917 and 183.73 in 1918. These imports coincided with the S event of 1917. The Philippines, Java and Madura, and the Outer Islands all showed heavy imports at this time, which is somewhat surprising as the European countries and the United States were at war, and desperately seeking food supplies wherever they could. This did not stop the flow of rice into these distant colonies. Moving forward, 1924 with 151.10 000MT and 1925 with 109.30 000T are the next crisis years, and are associated with the VS event of 1925/26, also felt heavily in Java and Madura and the Outer Islands. 1929 is the next year of significance, with imports of 105.00 000MT, a year of heavy imports in both Java and Madura, and the Outer Islands, although not clearly linked with the VS event of 1925/26 and the S event of 1932. The 1930s were quieter years, although there were imports of 91.00 000MT in 1936 and 84.00 in 1939, just before the S event of 1940.

Besides Indonesia and the Philippines, there was one other island group in the Western Pacific that was rice-deficient. This was Japan. More northerly, and probably only on the edge of the Southern Oscillation, it is still of interest to look at the rice import pattern here. The first point to note is that the rice figures are for foreign rice, and do not include rice from Korea and Taiwan. This is therefore long-grain *indica* rice, not the round-grain *japonica* rice preferred by Japanese consumers (Latham 1998 3-4). It is surprising that Japan was importing rice of a kind not favoured by Japanese consumers, and on occasion in considerable quantities! To this day rice of this type is used for rice flour and confectionary, but the quantities involved in these imports on occasion are too large to be explained in this way! The fact that the rice was not pleasing to Japanese consumers emphasises how much these large quantities were needed! Another point to note is that before 1868 Japan was a closed economy, but that when her ports were opened rice imports flooded in. From 12.58 000MT in 1868 imports rose quickly to 92.24 000MT in 1869 and amazingly 322.62 000MT in 1870, immediately preceding the S+ event year of 1871! It seems that Japan was the first to feel the effects of this event. As has been shown, the early 1870s were crisis years in Java and Madura and in the Philippines, with 1873 being the year when both groups of islands become rice importers. There seems to be a direct connection! Through the rest of the 1870s imports were negligible, although there was a small `hiccup’ in 1879 when 7.49 000MT were imported, and 1880 when 11.89 000 came in, possibly an aftermath of the 1877/1878 VS event. 1885 saw imports of 17.75 000MT again perhaps a consequence of the 1884 S+ event. Several years of negligible imports followed, then a huge turnaround came in 1890 with 275.79 000MT coming in, followed by 100.68 000MT in 1891.This echoes the 1891 VS event, which was also felt in Java and Madura. Imports remained heavy in the 90s as in Java and Madura, with very heavy imports of 198.27 000MT in 1894, 101.12 000MT in 1895, 111.72 000MT in 1896, with huge imports of 378.08 000MT in 1897 and massive imports of 701.77 000MT in 1898, immediately preceding the S event of 1899 and 1900. It is worth noting that the continuing high imports of 1894 and 1895 could be associated with the war with China in 1895, but this would not explain the heavy imports of 1897 and 1898. Imports fell back from this high, but still remained substantial through 1899 to 1902 but then jumped to 729.74 000MT in 1903 and 883.90 000MT in 1904, continuing high at 695.75 000MT in 1905. The war with Russia of 1904/05 may explain this, but it is worth noting that these were also years of high imports to the Philippines, suggesting a common cause even though there was no ENSO event at this time. Imports fell back again the next surge coming with 335.16 MT in 1912, and 545.59 000 in 1913, with 303.39 000MT in 1914, which may be associated with the S event of 1911/1912. Lower imports then prevailed until there was a huge jump in 1918 to 697.07 and 696.35 in 1919, again possibly an aftermath of the S even of 1917. Imports then do not reach this level until the 771.08 000MT of 1925, a VS event year, as was 1926, when imports were less but still substantial at 345.51 000MT, but followed by heavy imports in 1927 of 585.86 000MT. After this foreign rice imports were at a more modest level, although the 1930s were years of markedly increased `internal' imports from Korea and Formosa (Wickizer and Bennett 1941 Table 5 324-25).

This has been a preliminary investigation into Southern Oscillation incidents in the Western Pacific, using rice import figures to rice deficient countries in the region. It does suggest that the dry cold spells associated with these events did result in decreased rice harvest out-turns, resulting in increased rice imports. However, the imprint of these incidents is not as clear as might be expected. Sometimes the impact in the Western Pacific comes before the event in the Eastern Pacific, which is quite plausible, indicating a time lag before the event makes itself felt in South America. At other times the effect of the event is simultaneous, or even ongoing after the event. Nor were these events necessari1y felt by all three island groups at the same moment, although some were clearly felt throughout the region, such as the 1891 VS event, the 1911/12 S event, and the 1925/1926 VS event. It is also clear that not all rice import surges were due to harvest deficiencies caused by *EN*SO events, as some happened at times not linked to these events. A good example are the huge rice import shipments to Japan in 1903 of 729.74

000MT, in 1904 of 883.90 000MT and in 1905 of 695.75 000MT. Here military provisioning may be the answer, although as has been noted these were also years of heavy imports to the Philippines.

So the relationship between rice movements and climatic fluctuations seems to be a topic worthy of more investigation. A further step would be to examine fluctuations in the export pattern of the major rice suppliers to the region and beyond, and relate them to the import patterns discussed here.

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