Global Competitiveness of Thai Rice: before and after the Currency Crisis

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1. Introduction

Rice is Thailand's important crop. It is not only a domestic vital food crop, as well as a major agricultural export commodity in which Thailand is a major competitor in the world rice trade. The good quality of Thai rice and a relatively high level of comparative advantage in production cost have previously contributed to this success.

The rice economy of Thailand now appears to be in transition. The expansion of cultivated area which has been exhausted in early 1980s (Isvilanonda and Poapongsakorn [1995]). Relatively higher domestic price of other competitive crops coupled with government policy toward agricultural diversification has induced a declining share of rice production area. In Thailand, the major rice area is in rainfed. Irregular rainfall patterns causing droughts and floods often in the same season and water shortage in the dry season has kept rice yields at a low level. Furthermore, a high growth of the non-agricultural sector, in the past few decades, has stimulated farm labor out-migration which in turn created labor shortage in rural areas. As a consequence, the rise in wage rate has further inflated the cost of rice cultivation. These phenomena in the domestic economy along with the long-term declining trend in rice prices in the international market, and the increasing competition from other low-cost rice economies such as Vietnam, Myanmar, and India raise concern whether Thailand could maintain her competitive strength in the world market.

Recently, Thailand confronted with her currency crisis. A sharp devaluation of the Bahts after the crisis has moved the country's exchange rate in favor of rice

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export in spite of the higher cost of imported inputs, particularly fertilizer. But it is not evident whether the global competitiveness of Thai rice has been strengthen or not, because a skeptical prospect of Thai economy seems to have undervalued nominal exchange rate which is responsible for trade balance in the black.

This paper aims to investigate the global competitiveness of Thai rice in the world market after the crisis. For the purpose of it, we describe the past and present situation of rice sector in Thailand, and discuss the effect of currency crisis on rice sector (Section two). In section three, the estimates of DRC (domestic resource cost) in terms of real equilibrium exchange rate are used to evaluate comparative advantage and impacts of the changes in input price and technology on comparative advantage. Final section discusses the comparative advantage of rice production in Thailand and its policy implication for rice sector.

2. Situation of Rice Sector in Thailand: Past and Present

1) Rice Production, Area and Yield

The major rice production area in Thailand is under a rain-fed environment. Water resource constraint under this environment has essentially resulted in less development of farming technique. A single rice crop with local varieties is commonly found mostly in the northeastern region. generally, rice yield in rain-fed area is very low. Commercial rice production is mostly concentrated in irrigated area of central plain and lower north. Good water control induces the wide adoption of modern rice varieties (MVs) in this environment. Consequently, rice yield in irrigated area is relatively higher than that of the rain-fed environment.

During the past three decades, rice production in Thailand rose at an average rate of 2.09% per year or from 14.22 million tons during 1971-75 to 22.63 million tons during 1996-98 (Table 1). However, the production growth in the early 1970s was generated by area expansion. Rice area rose from 8.14 million ha during 1971-75 to 9.34 million ha in 1976-80 or about 2.94% per year; whereas production increased about 2.62% per year. The dry season production shared

Table 1 Average Quantity and Growth of Production, Area and Yield of Rice:1961-98

Year	Quantity			Growth		
	Wet Season Rice	Dry Season Rice	Annual Rice	Wet Season Rice	Dry Season Rice	Annual Rice
			Area			
	Average Area(1000ha)			Average Growth(%)		
1971-75	7827.32	316.54	8143.86	2.60	11.30	2.94
1976-80	8845.11	495.33	9340.44	0.84	6.39	1.23
1981-85	9216.93	653.51	9915.44	0.10	1.03	0.06
1986-90	9261.50	687.11	9948.61	-0.55	1.54	-0.42
1991-95	9004.95	736.01	9740.96	0.32	9.14	0.98
1996-98	9119.31	1005.09	10124.4			
			Production			
	Average Production(1000ton)			Average Growth(%)		
1971-75	13201.52	1019.16	14220.68			
1976-80	14314.73	1769.62	16084.35	1.69	14.73	2.62
1981-85	16535.89	2338.21	18874.10	3.10	6.42	3.47
1986-90	16586.50	2521.59	19108.09	0.06	1.57	0.25
1991-95	17438.47	2938.96	20377.43	1.03	3.31	1.33
1996-98	18339.85	4288.78	22628.63	1.29	11.48	2.76
			Yield			
	Average Yield(ton/ha)			Average Growth(%)		
1971-75	1.69	3.20	1.75			
1976-80	1.62	3.61	1.72	-0.80	2.56	-0.34
1981-85	1.79	3.57	1.91	2.10	-0.22	2.21
1986-90	1.80	3.42	1.91	0.11	-0.84	0
1991-95	1.94	2.36	2.03	1.56	-6.20	1.26
1996-98	2.01	4.27	2.24	0.90	20.23	2.59

Source:Calculated from Agricutural Statistics of Thailand, various issues.

only a relatively small amount. The production expansion tapered off in the 1980s due to a slower rate of area expansion, resulting from a scarcity of additional cultivated land. In effect, the wet season rice supply was stagnant. However, a wide diffusion of rice cropping intesity and adoption of MVs in the late 1970s substantially regenerated production growth. But then both area and production expansion declined in the second half of 1980s due largely to problems of environmental degradation and shortage of irrigation water, particularly in the dry season. Until late 1990s, output and production area increased dramatically, particularly from the second rice crop area, as a result of the Baht

devaluation stemming from the economic crisis in mid 1997. Despite this sharp rose in production and area, it is expected that the growth of rice supply will diminish and even decline in the following decades.

Rice yield in Thailand is relatively low. The lower yield of wet season crop is stemmed from a significant share of rainfed and floating rice area. During 1971-75, the annual yield performance was 1.75 ton per ha despite a higher yield in the dry season. In early 1980s increasing rice cropping intensity and the adoption of MVs significantly raised the dry season production and moderately improved the annual yield performance. In general, the average yield growth during the three decades was about 1.1% per year. In early 1990s shortage of irrigation water, particularly in the dry season, has negatively affected the growth of rice yield. Nonetheless, the average dry season yield was twice as large as that of wet season during 1996-98.

2) Labor, Machine, Fertilizer, Irrigation and R&D

During the early 1970s about 72% of the Thai labor force were engaged in agriculture. So, the expansion of land frontier for rice cultivation was not constrained by the availability of labor. But the rapid growth of the non-agricultural sector in the late of 1970s till 1990s and the widening income disparity between urban and rural areas have led to a rapid rural-urban migration of population and an absolute decline in agricultural labor force. The share of agricultural labor in total labor force declined from 72.28% during the period 1971-75 to 50.3% during the period 1991-95, and workers engaged in rice cultivation increased marginally from 10.44 million during 1971-75 to 71.83 million during 1981-85 and has started declining in absolute terms since then. The rice sub-sector's share of agricultural labor force declined from 71.15% during 1971-75 to 60.06% during 1991-92 (Table 2). The absolute decline in labor force engaged in rice cultivation started since early 1970s in the central plain because of the well-developed infrastructure and the proximity to Bangkok. The other regions also experienced the same phenomenon during early 1980s.

The farmers responded to the shortage of labor supply by adopting mechanization in farm operations (Siamwalla [1987]; Rijk [1989]). Tractor use in

land preparation started in areas with large size of farm (Wattanutchariya [1983]). Since 1969 Thailand began to produce power tillers on a large scale. During 1971-75, 8935 large tractors and 53449 power tillers were in operation. During 1996-98, the number of tractors and power tillers were nearly four times that of 1981-85 (Table 3). As a result, use of animals for land preparation has virtually ceased in most parts of the central Plain and the northern region.

Table 2 The Shares of Labor Force in Agricultural Sector and Rice Sector to Total Labor Force: 1961-97

Year	Share of Agric. Labor to Total Labor (%)	Share of Rice Labor to Total Labor (%)	Share of Rice Labor to Agric. Labor (%)
1971-75	72.28	51.19	71.15
1976-80	65.06	44.88	68.98
1981-85	61.35	40.86	66.61
1986-90	54.28	34.65	63.83
1991-95	50.30	31.40	63.56
1996-97	45.54	29.06	63.81

Source:National Statistic Office.

Table 3 Machinery and Equipment Used in Agriculture: 1971-98

Year	Large Tractor(unit)	Power Tiller(unit)
1971-75	8935	53449
1976-80	27133	190185
1981-85	34164	347143
1986-90	45967	591817
1991-95	102518	1787171
1996-98	127999	2051150

Source:Calculated from Agricultural Statistics of Thailand, various issues.

Since 1990, the custom service for combined harvester has been spreading rapidly in the central plain and lower north. In the northeastern region, the adoption of combined harvester is relatively small. However, most farmers in this region threshed their paddy by machines. Furthermore, to reduce labor use in transplanting, farmers have widely adopted the direct seeding method for crop establishment, particularly in the central plain and the lower north (Isvilanonda

[1985], [1999]).

Rice farming in Thailand uses relatively low management technique. The water resource constraint particularly in rain-fed environment prevents farmer to adopt the modern rice technologies. In the Northeast where the rice area is the largest, farmers still grow a single crop of rice with local varieties. Irrigation water constraint, low responsiveness of the local rice yield to chemical fertilizer and the relatively high fertilizer price comparing to rice prices resulted in a slow adoption of chemical fertilizer. The country's average application rate of chemical fertilizer was around 27kg/ha during 1971-75. The rate has been increased to 60 and 115kg/ha during 1981-85 and 1991-95, respectively. Between the wet and dry seasons, the average application rate of the dry season is higher than that of the wet season as a result of modern rice varieties adoption in irrigated areas (Table 4).

Table 4 Average Application Rate of Chemical Fertilizer:1971-97

Year	Wet Season Rice	Dry Season Rice	Annual Rice
1971-75	23.3	169.4	27.2
1976-80	32.8	236.1	43.6
1981-85	44.2	295.2	60.1
1986-90	66.9	297.1	83.6
1991-95	113.3	340.6	129.7
1996-97	157.6	325.6	175.5

Source:Calculated from Agricultural Statistics of Thailand, various issues.

The government made a massive investment in irrigation system. In Thailand, most large and medium scale irrigation projects were implemented by the government during 1950s and 1960s. High investment costs, long gestation period and low rates of return on investment led to a shift in investment priorities to small scale projects during 1970s. The expansion of irrigated area has taken place at a slow pace from 1.6 million ha in 1970s. The expansion of irrigated area has taken place at a slow pace from 1.6 million ha in 1091 to 3.2 million ha in 1981 and to 4.8 million ha by 1994, which increased the irrigation coverage to about 24% of the rice cropped area during early 1960s to about 30% in early 1990s.

Despite the irrigated rice that gives a yield of 4.0 ton/ha comared to 2 ton/ha for rain-fed rice, the impact of irrigation on raising country's rice yield was small due to the larger area of rain-fed environment. The dry season irrigated rice expanded from 300000 ha in 1975 to 849457 ha in 1997. However, an increasing water resource scarcity in the recent years has created conflicts in water use within the agricultural sector and between economic sectors.

The potential for further expansion of irrigation is limited because of the growing scarcity of water, rapid increase in the cost of irrigation development, and the growing concern regarding the adverse environmental effects of irrigation projects. During the 7th National Economic and Social Development Plan (1992-96), the Royal Irrigation Department intended to concentrate on improving water distribution system both for state and private irrigation projects rather than on the construction of new projects. Improving efficiency in water management and collection of water charges were also stated as a key objectives in recent years.

The public sector played a major role in research and extension activities. The agency involved in food crop research is the Department of Agriculture (DOA). In 1995, DOA had 25 research centers and 26 research stations located throughout the country. The allocation for DOA at 1988 constant price from 495.74 million Baht during 1971-75 to 1637.01 million Baht during 1991-95. Overtime, however, DOA has focused more on crop diversification and paid les attention to rice research. The share of Rice Institution budget in total DOA budget declined from 14% during 71-75 to only 10% during the 1986-90 period, resulting in a declining growth of the Rice Institution budget. During 1991-95, the share increased very little (Table 5). It is difficult to separate the research budget from the institution budget. However, around 50% was used for conducting the research. The major focus of rice research has been on increasing the yield for irrigated ecosystem, and for developing resistance against major insects and diseases. The research has had very little impact on productivity growth and improving farmer's welfare since rain-fed ecosystem constitute more than 75% of the rice area.

Table 5 Average Budgets(at 1988 price) of Department of Agriculture(DOA) and Department of Agricultural Extension(DOAE):1961-95

Year	DOA*			DOAE*	
	Average Budget (million bahts)	Average Rice Institution Budget (million bahts)	Average Annual Growth(%)	Average Budget (million bahts)	Average Annual Growth(%)
1971-75	495.74	73.53(14.83)		361.94	
1976-80	700.75	87.63(12.51)	3.83	710.67	19.27
1981-85	875.08	111.14(12.70)	5.36	1321.79	17.20
1986-90	1018.18	102.47(10.06)	-1.56	1364.42	0.65
1991-95	1637.01	197.46(12.06)	18.54	2860.37	21.93

Note:Using capital formation index to adjust for the real value.
Source:Calculated from Agricultural Statistics of Thailand, various issues.

3) Government Price Policies in Rice Sector

Being concerned with the political impact of high rice price in the domestic market, the government policies were previously designed to restrict the rice export to ensure stabilization of domestic prices. The price stabilization policies included an export tax program, rice premium, and rice reserve requirement program. The government also followed a price support program during periods of low export demand (Siamwalla [1975]; Siamwalla and Setboonsang [1989]). As a consequence of a declining trend of international rice price in the past decade, the government's export price policy has shifted towards the promotion of rice export. The "rice premium" was abolished since 1986. Furthermore, a provision of discounted credit rates or a packing credit has been available for exporters to subsidize their export cost. In 1995, the available credit was about 41% of the rice export value.

Due to its limited operation scale, the farm price support program has never been effective in shoring up the domestic price. In recent years, the government instead directed the Bank of Agricultural and Agricultural Cooperatives to provide a short-term loan to farmers during the harvesting season. The purpose of the loan is to provide farmers with incentive not to sell paddy early in the season when prices are low. Under this pledging scheme, farmers can acquire short-term loan by pledging their paddy with the Bank. The amount of loan

obtainable is about 80% of the Bank's announcing price.

The input markets in Thailand are mostly free from government intervention. Thailand is probably the only major exporter of agricultural products that imports all of its fertilizer requirement. The government has used the Marketing Organization of Farmers (MOF) and Agricultural Cooperatives (AC) to distribute fertilizer with a subsidy on transportation cost. This is financed by low cost loans provide by Farmer's Aid Fund. The most commonly used fertilizer are 16-20-0 and the ammonium sulphate. The market share of MOF and AC is around 18%. The market prices closely followed international prices and there was no import duty on chemical fertilizers.

Thailand has long been a major exporter of rice in the world market. In 1986, the share of rice export was about 4.5 million tons of white rice or about 36.4% of domestic production (in paddy equivalence). The exports have fluctuated around 4 to 6 million tons. The highest amount of rice exported was in 1998 which is 6.54 million tons. In terms of nominal value, the value of rice exported rose from 20.3 billion bahts in 1986 to 86.8 million bahts in 1998 (Table 6).

Table 6 Volume and Value of Rice Export during 1986-98

Year	Quantity (million ton)	Value (million bahts)
1986	4523.54	20314.34
1987	4443.30(-1.77)	22703.02(+11.76)
1988	5027.14(+13.13)	34676.40(+52.73)
1989	6311.41(+25.55)	45462.27(+31.04)
1990	4017.09(-36.35)	27769.53(-38.92)
1991	4332.07(+7.84)	30516.27(+9.89)
1992	5151.48(+18.91)	36213.75(+18.67)
1993	4989.22(-3.15)	32958.59(+24.09)
1994	4858.64(-2.62)	39187.30(+18.90)
1995	6197.99(+27.57)	48626.76(+24.09)
1996	5460.22(-11.90)	50734.83(+4.34)
1997	5567.52(+1.97)	65093.44(+22.06)
1998	6540.25(+17.47)	86806.21(+33.36)

Note: Figures in parentheses indicate the growth rates.
Source:Department of Business Economics, Ministry of Commerce.

4) The Effects of Currency Crisis on Rice Sector

Over the past few decades Thailand's economy has been rapidly transformed toward an increasing importance of industrial sector. This can be observed by an increasing share of industrial sector in Gross Domestic Product (GDP) from one-fifth in 1980 to nearly one-third in 1997. At the same, the share of agricultural sector gradually declined. A slow growth in agriculture and a high growth rate in non-agriculture have essentially induced an adjustment in the country's resource allocation within the agricultural sector and between agricultural and other sectors.

Until the more recent years, deficit in balance of trade followed by deficit in balance of payments in the country has been gradually accumulated and then resulted in the need of foreign exchange. The devaluation of the Baht currency in the mid of 1997 due to the country's financial and economic crisis has inevitably forced Thailand's economy to face the recession period with a sharp decline in an average GDP growth rate to -9% in 1998. A remarkable shrinkage in the growth of non-agricultural sector has seriously affected on city employment and wage rate which, in turn, reduced private spending. On the other hand, the increase in the volume of agricultural commodity export as a result of devaluation has induced a short period rise in domestic agricultural price and supply.

In Thailand, the growth performance of the rice sector is also subject to the same set of factors that affect the performance of the whole agricultural sector. The devaluation of Baht currency has directly and indirectly affected the rice sector. Importantly, the competitiveness of Thai rice in the international market has considerably improved in spite of the rise in inputs prices, particularly fertilizer and gasoline prices. This can be observed from the increase in volume of rice export which rose from 5.46 million tons in 1996 to 6.54 million tons in 1998. At the same time, the value of rice export rose from 50.73 billion Baht in 1996 to 86.81 billion Baht in 1998. Since the domestic and export markets of rice are closely linked, increase in the export price transacts into farm price. The average farm price per ton of 15% paddy in wet season (major rice) increased by 27% between 1996 and 1998 (from 4857 to 6178 Baht/ton).

Taking factor prices into consideration, the total cost of rice production increased due to higher cost of fuel, chemical inputs and machinery rental. It was reported that the total cost per ton of major rice productions increased by 10.4% between 1996 and 1998 (from 4410 to 4870 (Baht/ton)).

Nonetheless, the percentage rise in paddy price is more than double of the percentage increase in production cost, the short-run net return to farmers improves substantially. Thus, the currency devaluation generates the short-run gain to rice farmers. In the next section, we will examine the global competitiveness of Thai rice.

3. Global Competitiveness of Thai Rice in terms of Real Equilibrium Exchange Rate

1) DRC estimation and comparative advantage of Thai rice in the past

Global competitiveness in rice production is evaluated by a measure of social profitability calculated as the ratio of domestic resource cost (DRC) of foreign exchange to the shadow exchange rate (SER). DRC is a measure of the value of domestic resources needed to earn a unit of foreign exchange through exports or save a unit of foreign exchange through import substitution, reflecting the efficiency by which foreign exchange can be earned or saved by domestic production of rice. The SER, in turn, is the DRC of the marginal activity that would be chosen to balance the foreign exchange budget when all DRCs of economic activities are ranked from lowest to highest. Thus, an activity with DRC that is lower than the marginal one, or a resource cost ratio (DRC/SER) equal to less than unity reflects comparative advantage. And a decline in the resource cost ratio indicates an increase in comparative advantage.

The shadow exchange rate can be estimated the following formula.

Shadow exchange rate = Official exchange rate/Conversion factor

Here, Conversion factor = $(M+X)/M(1+Tm)+X(1-Tx)$,

M: CIF Value of Imports,

X: FOB Value of Exports,

Tm: Average tax rate on imports,

Tx: Average tax rate on exports.

The use of DRC to determine the comparative advantage in rice production in Thailand can be dated back to 1977. An outstanding research was conducted by Akrasanee and Wattananukit [1977]. There on, a series of studies has been conducted along the same line of investigation. Among these are the studies of Limskul [1979] and Komenjumrus [1996]. Before comparing the above three studies with the present study it is worthwhile to make a few notes on the similarities and differences among the four studies.

First, while the three former studies estimated DRCs of rice production in selected areas classified by first (wet season) and second (dry season) crops the present study (based on the available data) provides investigation only on the first crop. Second, there are differences in crop establishment practice. At present, broadcasting method has broadly replaced the transplanting metod in many regions, while in the studies of Akrasanee and Wattananukit [1977] and Limskul [1979], the transplanting method were still commonly found. Third, while the studies of Akrasanee and Wattananukit [1977] and that of Limskul [1979] and the present study were conducted on the provincial level, the study of Komenjumrus [1996] was conducted on the regional level.

As far as the figures of DRCs from the four studies are concerned, though the results are not perfectly comparable due to differences in various respects, such as difference in location and difference in size of location (province c.f.region). Compiling the the figures has discerned certain interesting information on the pattern of DRCs both in terms of spatial and temporal differences.

In considering the regional differences of the level of comparative advantage for each study, figures of DRCs from Akrasanee and Wattananukit [1977] indicated that during crop year 1973-74, Thailand exhibited comparative advantage in rice production for both the first and second crop in all provinces and in all techniques of production (i.e., whether using the transplanting or the broadcasting method, or using the traditional varaiety of seed or the modern high-yielding variety of seed). As shown Table 7 , the highest value of DRC was 0.46 for the second crop in Pathumtanee. When estimated with the shadow exchange rate the two values of DRCs were 0.23 and 0.37 for the two cases respectively. Since DRCs were much less than one in all cases, this indicated that

during 1973-74 Thailand had high degree of comparative advantage in rice production.

Table 7 Domestic Resource Cost of Rice Production in Selected Areas:1973-74

	DRC
Second Crop (Transplanting)	
Nontaburi	0.29
Chainat	0.32
Ayudthya	0.33
Supan Buri	0.33
Chachoengsao	0.34
Chiengmai	0.34
Nakorn Nayok	0.36
Pathumtanee	0.37
First Crop (Traditional Variety, Transplanting)	
Chainat	0.26
Sing Buri	0.25
(Modern Variety, Transplanting)	
Chainat	0.24
Sing Buri	0.23
(Traditional Variety, Broadcasting)	
Chainat	0.25
Sing Buri	0.26

Source:Compiled from Akrasanee and Wattananukit[1977].

The study of Limskul [1979] a few year later marked regional differences in the level of comparative advantage in rice production. As shown in Table 11, the figures of DRC showed comparative advantage in rice production for the second crop in Supan Buri and Nakorn Pathom, for the transplanting first crop in Rat Buri and Nakorn Nayok and for the broadcasting first crop in Nakorn Nayok and Ayudthya with the values of DRCs equal to 0.47, 0.37, 0.74, 0.63, 0.71 and 0.38 respectively. On the contrary, the figures showed comparative disadvantage in rice production for the first broadcasting crop in Rat Buri, for the first transplanting crop and the second crop in Nakorn Rajsima with the value of DRC equal to 1.38, 2.08 and 1.02 respectively (Table 8).

Table 8 Domestic Resource Cost of Rice Production in Selected Area: 1977-78

	DRC
Second Crop (Transplanting)	
Nakorn Rajsima	1.02
Supan Buri	0.47
Nakorn Patom	0.37
First Crop (Transplanting)	
Rat Buri	0.74
Nakorn Nayok	0.63
Nakorn Rajsima	2.08
(Broadcasting)	
Rat Buri	1.38
Nakorn Nayok	0.71
Ayudhya	0.38

Source: Limskul [1979].

According to the study of Komenjumrus [1996] the value of DRCs showed less disparity among locations. It was most probably that in the estimation of DRCs on a regional level the high values of DRCs in some provinces and the low value of DRCs in other provinces tended to average out. In general, as presented in Table 9 , the regional DRCs showed moderate degree of comparative advantage in rice production raging from 0.63 for the second crop in the central region to 0.94 for the first crop in the southern region. It is noted that the DRCs figures showed slight improvement on the degree of comparative advantage in all regions after the government's Structural Adjustment Scheme in the Thai agriculture.

In considering comparative advantage over time, the DRCs figures from the four studies showed certain pattern of changes in the level of comparative advantage in rice production in Thailand. During 1973-74, with all values of DRC no greater than 0.37, the production of Thai rice could be uniformly considered as comparatively advantageous with all methods of production in all provinces. However, the degree of comparative advantage has declined in some provinces (with the values of DRC ranges from 0.37 to 0.74) and turned out to be comparatively disadvantage in some provinces (with the value of DRC ranged

from 1.02 to 2.08) during 1977-78.

When determining at the regional level, during 1992-94, the values of DRC indicated moderate level of comparative advantage in rice production for Thailand, with values ranged from 0.53 to 0.92. Lastly, we also show the results of DRC estimation in the case that we use 1997/98 or 98/99 data and the same methodology as previous studies (Table10; Isvilanonda, Tinprapha, Boonmusig and Fukui [2000]). The results indicate that Thailand has recently resumed

Table 9 Domestic Resource Cost of Rice Production Classified by Region: 1992/93 and 1993/94

	DRCa	DRCb
Second Crop		
Central Region	0.63	0.53
Northern Region	0.64	0.54
Northeastern Region	0.79	0.78
First Crop		
Central Region	0.68	0.67
Northern Region	0.69	0.68
Northeastern Region	0.79	0.76
Southern Region	0.94	0.92

Note:DRCa and DRCb are domestic resource cost ratios before and after the Thai government's Structural Adjustment Scheme in the Thai agriculture.
Source: Komenjumrus[1996]

Table 10 The DRC Coefficient of Four Rice Producing Areas in Thailand in Terms of Shadow Exchange Rate

Area	DRC
Supan Buri (1997/98)	0.448
Petch Buri (1997/98)	0.428
Surin (1998/99)	0.746
Khon Khaen (1997/98)	0.900
4 provinces	0.547

Source:Estimated using data Table A1-A4 in Isvilanonda, Tinprapha, Boonmusig and Fukui[2000].

certain degree of comparative advantage in rice production with values of DRC ranged from 0.43 to 0.90. This is partly due to the devaluation of the Thai Baht. All in all, with the pattern of DRC thus far, rice production in Thailand seem to still be comparatively advantageous for years to come.

2) DRC in terms of real equilibrium exchange rate

In the previous works, DRCs were estimated by using the shadow exchange rate which would be in force if all trade distortions were removed with the trade balance remained constant.

However, in addition to implementing policies that have a direct effect such as taxation policies, a government may adopt policies that seem unconnected with the rice sector but actually influence the sector, such as macro-economic policies which was chiefly responsible for the current account imbalance that characterized the Thai balance of payments (Siamwalla and Setboonsarng [1991]) and for the inflation (Dornbush and Helmers [1989]). Throughout much of the period before currency crisis, deficit of current account is considered to have overvalued Thai Baht (Siamwalla and Setboonsarng,op.cit.) while after crisis, the current account surplus may have undervalued Baht. And the relevant price on foreign exchange market is the price of the foreign currency relative to the domestic price level. If a country is experiencing a more rapid inflation than its partner country, and the nominal exchange rate does not adjust to the price changes, it is useful to distinguish nominal exchange rate from its real counterpart. The relevant concept for "real exchange rate" is the nominal rate adjusted for differentials in inflation rates between the home country and the partner country.

To estimate the global competitiveness correctly, we need to estimate an exchange rate that would prevail in a non distorted environment (Sadoulet and de Janvry [1995]). For the purpose of estimating such a "equilibrium real exchange rate", we will use the elasticity approach (Sadoulet and de Janvry, op.cit.).

In the elasticity approach, the equilibrium real exchange rate is defined as the rate for which the market is at an acceptable level of disequilibrium D*. If the

actual balance of trade deficit D is greater than D*, the observed RER is below its equilibrium value RER*. The exports level E* and imports level M* at equilibrium exchange rate can be computed from the observed levels E and M, and export and import elasticities εx and εm, as follows.

E-E*/E =εx (RER-RER*)/RER and M-M*/M = εm (RER-RER*)/RER.

From this and D - D* = (M-M*)-(E-E*), we can derive the following equilibrium real exchange rate (RER*) as a function of the unsustainable part of the deficit D-D*, RER, M, E, εm and εx:

$$RER^* = RER\ [1+(D-D^*)/(\varepsilon xE-\varepsilon mM)].$$

A more appropriate way of DRC estimation is to make use of equilibrium real exchange rate. The DRC which is estimated by such a way will represent a more precise indicator of global competitiveness.

One difficulty with this approach is the determination of the level of the sustainable deficit D*, which is somewhat subjective. Another difficulty is the determination of import and export elasticities. In this paper, we use approximate values derived from existing literature. D* is set at 2% of GDP (Garcia and Llamas [1989]) and import elasticities εm are taken in the range-0.1to -2 while export elasticity εx = 1 is taken (Sadoulet and de Janvry [1995] and Khan and Ostry [1992]).

3) Estimation of DRC

The DRC is calculated by the following formula:

$$DRC = \sum xi^*pid/(pjb-\sum fi^*pib),$$

The numerator denotes the cost of non-tradable factors where the xi's are quantities used per ton of rice produced and pid's shadow prices. These domestic factors are primarily land, capital and labor used directly and indirectly in the production and marketing of rice.

In this study, the shadow wage is assumed to be equal to the market wage because the minimum wage law does not effectively influence the level of rural wages as employment is dominated by small-scale farming and informal non-farm work. The shadow land rent is the net revenue from growing the best alternative crop. The social cost of direct capital is estimated at its shadow price

where all input-price distortions resulting from government interventions in terms of taxation and subsidy are removed.

In the denominator, the cost of tradable or foreign sourced inputs is deducted from the border price of rice estimated as the world price. The cost of tradable inputs is calculated by multiplying their quantities, fi, with their respective border prices pib by using conversion factors based on import and export taxes.

Following this line of consideration, this paper estimates DRC of rice production after currency crisis, for four rice producing provinces, namely: Supan Buri, Petch Buri, Surin and Khon Khaen. Based on the OAE production cost data, the years are 1997/98 crop year for Supan Buri, Petch Buri and Khon Khaen and 1998/99 for Surin. As for the location, Supan Buri and Petch Buri are major rice producing areas in the central region of Thailand, while Surin and Khon Khaen are major rice producing areas in the northeastern region.

The equilibrium exchange rates are calculated through the elasticity approach as explained above and DRCs are estimated by using the exchange rates.

Table 11 shows the estimation results. The values are ranging from 0.544 to

Table 11 The DRC Coefficients of Four Producing Areas in Thailand in Terms of Equilibrium Exchange Rates

Area	DRCs Elasticities of Export εx and Import εm			
	$\varepsilon m=-0.1$ $\varepsilon x=1.0$	$\varepsilon m=-0.5$ $\varepsilon x=1.0$	$\varepsilon m=-1.0$ $\varepsilon x=1.0$	$\varepsilon m=-2.0$ $\varepsilon x=1.0$
Supan Buri(1997/98)	0.627	0.593	0.568	0.544
Petch Buri(1997/98)	0.600	0.567	0.544	0.521
Surin(1998/99)	1.115	1.022	0.961	0.902
Khon Khaen(1997/98)	1.254	1.185	1.137	1.088
4 Provinces	0.764	0.722	0.693	0.663

Source: The coefficients are estimated using DRCs calculated by data of Table A1-A4 in Isvilanonda, Tinprapha, Boonmusig and Fukui, op. cit., and equilibrium real exchange rates calculated by the data of ADB Key Indicators of Developing Asian and Pacific Countries, 1999.

0.627 for Supan Buri, from 0.521 to 0.6 for Petch Buri, from 0.902 to 1.115 for Surin and from 1.088 to 1.254 for Khon Khaen, respectively. The DRCs in terms of equilibrium exchange rates are much higher than the DRCs in terms of ordinary shadow exchange rates mentioned before. And the estimated DRCs in Central Region and Lower North Region where irrigated rice farming is predominant, are much lower than the northeastern region where rainfed rice farming is predominant. Comparing them with the figures of DRCs presented in the previous works, the results indicate that the global competitivenesses in rice production have been weakened for the four areas even after currency crisis except for the case that we use -2 of import elasticity. Particularly, the rice production in the northeast might have already lost a comparative advantage over rice in the world market.

4. Concluding Remarks: Sensitivity Analysis of DRC and Policy Implications

Despite a wide adoption of modern rice varieties and rice cropping intensity in many irrigated areas over the past few decades, rice production in Thailand seems to confront with a sluggish and declining growth. A shortage of labor supply and a continuous rise in wage rate have gradually inflated the production cost. Furthermore, water resource scarcity in many rice growing areas have resulted in a shift or rice toward other competitive crops. In the past, rice production in the cenrtal plain were relatively more comparatively advantageous than other rice production regions but its competitive strength has a diminishing trend. In addition to it, the Thai rice sector has been confronting with a declining pressure of the world price after 1998.

Meanwhile, the estimation of future rice supply and demand in Thailand suggests that even if the rice supply tends to rise at a slow growth rate, the rice demand declines at a higher growth rate, consequently, the exportable surplus of Thai rice supply in the international market inevitably increase (Isvilanonda [2001]). Unless the global competitiveness of Thai rice will be maintained or resumed, the welfare of rice farmers in Thailand who are still poor can not help being worsened under the conditions mentioned above. Therefore, the government should take some policy action for it.

Now then what government policies can be effective for improving the global competitiveness of Thai rice? Finally, we try to find an answer to this question by estimating the change of DRC as the results of price and/or yield improvement and wage increase. For that purpose, the price and/or yield and wage elasticities of DRC are calculated. The elasticity is defined as percent change in the DRC with respect to given percent changes in yield and wage, all factors held constant.

The estimated elasticities are shown in Table 12. It indicates that productivity and quality improvements are very effective for the improvement of DRCs, because they are more sensitive to changes in price and yield than in wage.

Table 12 Elasticities of DRC with respect to Price, Yield and Wage

Area	Prameter			
	Rice Price or Yield		Wage	
	Elasticities of Import and Export			
	ε m=-0.1 ε x=1	ε m=-2 ε x=1	ε m=-0.1 ε x=1	ε m=-2 ε x=1
Supan Buri	0.872	1.006	0.029	0.033
Petch Buri	0.851	0.980	0.087	0.100
Surin	0.889	1.042	0.046	0.053
Khon Khaen	0.872	1.005	0.282	0.325

Source: Calculated using the data Table A1-A4 in Isvilanonda, Tinprapha, Boonmusig and Fukui, op. cit.,.

In order to maintain or resume the global competitiveness of rice in the future, the Thai government should continue and prioritize her investment in the rice research, particularly for quality enhancement with tolerance to drought and submergence and resistance to pest while she will pay attention on the crop restructure and diversification programs for diverting areas not well suited to grow rice (Isvilanonda and Hossain [2000]).

Researches on improvement of rice variety and water management, coupled with crop protection are still very much room for improving the global

competitiveness of Thai rice in the world market.

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