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Lin Shujuan has a Masters degree in Agricultural Development Economics and she recently completed her PhD dissertation, 'Application of cost-benefit analysis to China: a case study of the Xiamen Special Economic Zone' at the National Centre for Development Studies, Research School of Pacific Studies, Australian National University. Lin Shujuan completed her undergraduate studies at Xiamen University.

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Key to symbols used in tables

- n.a Not applicable
- .. Not available
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Abstract

The shadow prices of unskilled and skilled labour are discussed and estimated for the Xiamen special economic zone in China for the period 1986-1989. Unskilled labour is assumed to be drawn from rural areas. The estimated shadow cost of unskilled labour includes the agricultural output forgone, the effect of excess migration from rural areas to urban areas when urban jobs become available and the net social cost of increased consumption by workers at new jobs with higher wages. The estimated shadow cost of skilled labour includes output forgone at the worker's previous job and the net social cost of increased consumption. The estimates for 1986-89 show that unskilled labour is over-priced and skilled labour is under-priced in the Xiamen special economic zone, resulting in capital-intensive production rather labour-intensive production more in line with China's comparative advantage.

Estimation of the shadow price of labour for China*

The consideration of labour market distortions is an important aspact of project evaluation in developing countries. In China the evaluation of special economic zone projects must take into account the negative consequences or social cost factors of transfering workers to a new project. The shadow price of labour (S_L) refers to the economic consequences of transferring labour to a new project and its estimation includes the following three social cost factors:

- direct opportunity cost: the output foregone elsewhere in the economy as a result of employing a worker on a given project;
- indirect opportunity cost: the cost of increased consumption as the result of a worker being employed on a project;
- the disutility of increased effort called for in the new job (Squire and Van der Tak 1975:83).

However, a number of arguments suggest that a social valuation is not equal to the private valuation of the disutility of effort (up to a certain normal range of hours worked per worker). Moreover, data are not available for estimation of the disutility of increased effort called for in the new job. Hence, in the next section, the formulae of the shadow price of labour derived for China, the social cost of the private disutility of effort is put at zero.

A different set of shadow wage rates may be required for different types of labour. This paper focuses on two major groups of labour, skilled and unskilled. Unskilled labour is commonly believed to be in surplus supply in China, while skilled labour is believed to be relatively scarce. It would be impossible to estimate a shadow price of either skilled or unskilled labour which would be valid for the whole of China because of geographical differences, market segmentation and restricted geographic mobility of workers. The estimation of the shadow price of skilled and unskilled labour discussed in this paper is only applicable to the Xiamen special economic zone project.

*This research was carried out as part of my doctoral dissertation presented at the National Centre for Development Studies at the Research School of Pacific Studies at the Australian National University. I am grateful for the assistance of my supervisor Professor Peter Warr, and advisers Dr Francis Perkins and Professor Helen Hughes.

The main components of the estimation of shadow wage rates

Output forgone

Consider a project in which one more worker is drawn into the project from another occupation. Output forgone elsewhere in the economy is the first component of the shadow wage rate. Let m be the marginal product in market prices of the worker drawn by the new project. If the labour market from which the worker is drawn is competitive, the prevailing market wage rate can be a good indicator for the value of m.

However, migration theory (Todaro 1969; Harris and Todaro 1970) suggests that an urban project will have an excess-migration effect. That is, the creation of a job in the urban industrial sector will induce more than one worker to migrate. Therefore, the forgone output will be greater than one worker's marginal product. Let L be the total urban labour force and E the total urban employment; L / E workers will migrate to restore an equilibrium ratio of unemployed to urban labour force, given the rural-urban wage differential. Hence, the direct output forgone for the Chinese economy is:

$$D = m\,(L/E) \tag{1}$$

where

D = direct output forgone;

m = forgone marginal product at domestic prices;

L = total urban labour force;

E = total urban employment.

Net social cost of increased consumption

The second element of the shadow wage rate is the net social cost of increased consumption. Employment on a project frequently involves a change in income. In most cases, the project provides higher wages especially when workers are drawn from rural areas. Depending on whether the worker consumes all the income or saves part, the changes in consumption and saving could either be a net cost or a benefit to the Chinese economy.

Let w be the project wage rate which is believed to be higher than the marginal product of labour in his or her previous employment. Suppose the worker's marginal propensity to save (S_w) is lower than the average marginal propensity to save (S_a). Hence, to hire a worker in the project, there is a loss in saving to the Chinese economy measured at border prices:

$$L_{sav} = (S_a - S_w)(w - m) \tag{2}$$

where

L_{sav} = loss in saving to the Chinese economy;
S_a = average marginal propensity to save;
S_w = worker's marginal propensity to save;
w = project wage rate;
m = forgone marginal output at domestic prices.

However, this loss in savings is consumed by the worker so that there is a corresponding benefit in increased consumption. To take into consideration the premium that the government places on saving and investment over consumption, that is, a dollar of saving and investment is considered to be more valuable than a dollar of current consumption, the net social loss in savings, the corresponding social benefit in increased consumption after taking into consideration income distribution effects, should be further adjusted by the shadow price of saving (v) to cope with sub-optimum saving arguments. That is:

$$B_{sav} = (S_a - S_w)(w - m) d / v \tag{3}$$

where

B_{sav} = social benefit in lost savings;
d = distribution weight;
v = conversion factor for saving.

Hence, the net social cost in savings is equal to equation 2 minus equation 3. That is:

$$C_{sav} = (S_a - S_w)(w - m)(1 - d / v) \tag{4}$$

where

C_{sav} = net social cost in savings.

Moreover, we assumed that workers consume the rest of their income, $(1 - S_w)(w - m)$. With respect to this consumption there is a net social benefit in line with equity considerations. That is:

$$B_{con} = (1 - S_w)(w - m)(d - 1) / v \quad (5)$$

where

B_{con} = net social benefit in increased consumption.

The net social cost of increased consumption is the difference between equations 4 and 5. That is:

$$N_{con} = (S_a - S_w)(w - m)(1 - d / v)$$

$$- (1 - S_w)(w - m)(d - 1) / v \quad (6)$$

where

N_{con} = net social cost of increased consumption at border prices.

The social benefit resulting from increased income will be higher if the project worker's marginal propensity to save is higher than the average level. The social benefit resulting from increased consumption will be higher if the project worker's consumption level is below the average consumption level. The complete formula for the shadow price of unskilled labour is thus given by equation 7.

$$S_L = m\left(\frac{L}{E}\right) + (S_a - S_w)(w - m)(1 - d/v)$$

$$- (1 - S_w)(w - m)(d - 1) / v \quad (7)$$

where,

S_L = shadow price of unskilled labour;

m = forgone marginal product of labour;

L = total urban labour force;

E = total urban employment;

S_a = average propensity to save;

S_w= worker's marginal propensity to save;

w = market wage rate;

d = income distribution weight;

v = conversion factor for saving.

The first component in the right hand of equation 7 is the direct opportunity cost which is the output forgone elsewhere in the economy as a result of employing a worker on the project. The indirect social costs are included in the second and third components, the net social loss due to a reduction in savings and the net social benefit generated from increases in consumption.

Estimation of the shadow price of unskilled labour in the Xiamen special economic zone project

(i) The direct opportunity cost of unskilled labour in the Xiamen zone

The most important element in the estimation of the shadow price of labour for the Xiamen zone is m, the marginal product of labour. It is commonly believed that the Chinese agricultural sector is characterized by a large amount of disguised surplus labour. The marginal product of labour in the agricultural sector, although not necessarily zero, is significantly below the wage rate in the urban industrial sector.

In this study, it is assumed that at the margin any further increase in the employment of unskilled labour in the Xiamen zone will be drawn from the agricultural sector. The output forgone in agriculture is taken to be the marginal product of unskilled labour. Because of data difficulties, the real average income in agriculture will be used as a proxy for the marginal product of unskilled labour. This is also the method used by the World Bank in a project appraisal report (World Bank 1988) to derive shadow prices for unskilled labour in China. However, the marginal products are probably lower than the real average income in agriculture, so they could be taken as an upper limit of the marginal productivity of unskilled labour in the Xiamen rural areas.

Table 1
The real average rural household income in Xiamen 1986-88
(yuan per year)

	1986	1987	1988
Total income per head	757	851	1001
Total expenditures	712	748	915
Rate of saving	0.06	0.12	0.08

Note: Real average rural household income and expenditure per person in the agricultural sector is based on a survey of 140 rural households in the Xiamen rural area. This survey is carried out by the Xiamen Statistical Bureau every year.
Source: Xiamen Statistical Bureau, *Xiamen Statistical Yearbook* 1980-89, Xiamen.

The direct opportunity cost of output forgone in the Xiamen zone is calculated as follows: first, the marginal output forgone of unskilled labour for the Xiamen zone, m, is estimated, by taking the average income from agriculture and adjusting it for the inflation rate (Table 1). Second, the excess migration effect on the total urban labour force and total urban employment is estimated (Table 2).

In Table 2 the way that excess migration effects the total labour force and urban employment for the Xiamen zone has been calculated. Given the excess migration effects of 1.18, 1.15 and 1.13 for 1986, 1987 and 1988 respectively, the direct opportunity cost of unskilled labour in border prices for 1986 to 1988 is shown in Table 3.

Table 2
The total urban labour force and urban employment in the Xiamen, 1986-88

Year	Total labour force[a] (1)	Student numbers[b] (2)	Urban employment (3)	L / E (4)= (1-2)/(3)
1986	362,957	65,666	251,227	1.18
1987	370,342	66,898	264,542	1.15
1988	376,682	66,684	274,218	1.13

[a] Population of working age 15-64.
[b] Including middle school, high school, college and university students.
Source: Xiamen Statistical Bureau, *Xiamen Statistical Yearbook* 1980-89, Xiamen.

Table 3
The direct opportunity cost of output forgone by the unskilled labour in the Xiamen, 1986-88 (yuan per year)

Year	Parameters	Direct opportunity cost (border price)
1986	m (L / N)	892
1987	m (L / N)	979
1988	m (L / N)	1,131

Note: Direct opportunity costs during 1986-88 are calculated from Tables 1 and 2.

(ii) The net social cost of the increased consumption in the Xiamen zone

Table 4 shows the data for urban cash wages. Comparing Table 1 and Table 4, it is evident that the average wage of rural workers is substantially lower than that of urban industrial workers in the Xiamen zone. When comparing rural and urban earnings differences in the cost of living must be taken into account. In the following estimation of the shadow price of labour, the data refer to the yearly real average wage per worker (1) for collectively owned enterprises, (2) for state-owned enterprises and (3) for foreign joint ventures.

Table 4
Real average income of industrial workers in the Xiamen zone 1986-1988 (yuan per year)

Class	1986	1987	1988
Collectively owned enterprises	1,192	1,379	1,524
State owned enterprises	1,519	1,596	1,862
Foreign joint ventures	1,916	1,942	2,488

Source: Xiamen Statistical Bureau, *The Xiamen Statistical Yearbook* 1980-89, Xiamen.

To calculate the indirect cost of labour resulting from transferring a worker to the urban industrial sector, the pure income distribution parameter d in equation 9 needs to be estimated. The value of d is designed to allow for the different values assigned to additional consumption at different existing levels of consumption. If the Chinese government does not wish to use project selection to improve income distribution, the value of d should be set equal to unity. However, this is not likely to be the case in China. The value of d is assumed to be greater or less than unity depending on whether project generated income accrues to those enjoying a level of consumption below or above the average of consumption.

Squire and Van der Tak (1975:63) suggested the use of a social welfare function to derive the value of d. The utility function specified in Squire and Van der Tak is:

$$U_c = c^{-n} \tag{8}$$

where

U_c = marginal utility at consumption level c;
c = consumption level c;
n = the elasticity of the marginal utility of consumption.

Hence, the income distribution weight is:

$$d = \frac{U_c}{U_{c^*}} = (c^* / c)^n \tag{9}$$

where

d = income distribution weight;
c^* = average level of consumption;
c = consumption level corresponding to any individual or group;
n = elasticity of marginal utility of consumption (income).

Given data on the distribution of consumption (income) among employees, a set of consumption distribution weights can be estimated by assuming different values for the parameter of the utility function n.

Table 5
Values of the general distribution weight (d) for the Xiamen zone

Group	C^* / C	n = 0.5	n = 1.0	n = 1.5
Unskilled	1.29	1.14	1.29	1.57
Skilled	0.70	0.84	0.70	0.59
Distribution weighted (d)		1.1	1.2	1.3

Note: Values of C* / C are based on 1988 fieldwork survey in Xiamen.

To obtain the true value of income distribution weights, all income classes have to be examined. However, it is difficult to trace the effects of the project on consumption in this way. In Table 5, a general distribution weight d is derived based on the weighted average of two groups of employees, that is skilled and unskilled labour in the Xiamen zone.

According to the fieldwork survey 60 per cent of the workers had no previous employment experience in Xiamen's Huli export processing zone in 1987. It is obvious that creation of the Xiamen zone increased employment opportunities. The general distribution weight is estimated to be 1.3 for the Xiamen zone project.

Table 6 shows the indirect opportunity cost in border prices for unskilled labour in the Xiamen zone from 1986 to 1988 based on equation 6. The negative value of the indirect opportunity cost means that a net social benefit is generated from increased consumption when one more worker is employed.

Table 6
The indirect opportunity cost of unskilled labour in the Xiamen zone, 1986-88 (yuan per year)

	1986	1987	1988
Collectively-owned enterprises	-8.1	-10.8	-10.6
State-owned enterprises	-40.6	-39.9	-47.3
Foreign joint ventures	-117.5	-110.5	-155.7

Note: Parameters involved in calculation of the indirect opportunity cost of unskilled labour are in equation 6. Where d = 1.3; and v = 3.2; saving rates are 11%, 15% and 25% in the collective enterprises, state-owned enterprises and the foreign joint ventures respectively.
Sources: Fieldwork survey 1988, Xiamen; Xiamen Statistical Bureau, *Xiamen Statistical Yearbook* 1980-89, Xiamen.

Summarizing the components in equation 7, the shadow price of unskilled labour for the Xiamen zone is shown in Table 7.

Table 7
Shadow price for unskilled labour in the Xiamen zone, 1986-88 (yuan per year)

	1986	1987	1988
Collectively-owned enterprises	884	881	881
State-owned enterprises	938	939	932
Foreign joint ventures	1,014	1,021	975

Table 8
Conversion factors for unskilled labour in the Xiamen zone 1986-88

Sectors	1986	1987	1988	Average
Collectively owned	0.74	0.64	0.58	0.65
State-owned	0.62	0.59	0.50	0.57
Foreign joint ventures	0.53	0.53	0.39	0.48
Average	0.63	0.59	0.49	0.57

Note: Conversion factors are calculated from the ratio of the shadow price and the wage rate for unskilled workers.

To facilitate project appraisal conversion factors for unskilled labour in the Xiamen zone were derived in Table 8. They range from a low of 0.48 for foreign joint ventures, 0.57 for state-owned enterprises to a high of 0.65 in the collectively owned industrial enterprises. The figure 0.57 for state-owned industrial enterprises is the average of the total.

Estimation of the shadow price of skilled labour in the Xiamen zone

In contrast to the large pool of unskilled labour, skilled labour is relatively scarce. Since working experience and periods worked are important factors in distinguishing skilled and unskilled labour, the wage scale rather than educational background was chosen as the criterion of skill.

Labour and wage rates in the Xiamen zone

According to the Department of Labour in Xiamen, the average price of a worker to a foreign investor and to joint ventures is about 150 yuan per month. Of this 50 per cent is paid to workers in the form of a basic monthly wage, 20 per cent is used as a productivity incentive in the form of additional wage payments and 25 per cent is turned over to the zone Administration Bureau which administers a welfare fund. The remaining 5 per cent is allocated to medical and recreational funds in the factories.

In practice wages, bonuses and fringe benefits paid in the zone vary considerably. As can be seen from Figure 1, the basic wage rate (excluding bonuses) varies from a low of 80 yuan to 360 yuan a month depending on the level of skill and the type of enterprise. Wages in foreign enterprises and joint ventures tend to be 20 to 40 per cent higher than in state-owned enterprises.

Estimation of the shadow price of skilled labour in the Xiamen zone

Like the shadow price of unskilled labour, the direct opportunity cost of skilled labour is the output forgone elsewhere in the economy as the result of the worker being employed on a project. However, skilled labour is in short supply and it is very unlikely that skilled workers would be unemployed if the zone did not exist. The marginal productivity of agriculture is not relevant for the output forgone elsewhere in the economy when skilled workers are employed in a new project.

When a skilled worker is employed in the zone, he or she may have been drawn from 3 areas within the zone:

- state-owned enterprises;
- collectively owned enterprises; or
- foreign joint ventures.

Hence, the worker's direct opportunity cost is the output forgone in the previous occupation. The principles for estimation of indirect social cost in increased consumption and the social benefit in increased saving are the same as those discussed in relation to unskilled labour. Hence, the shadow price of skilled labour is:

$$S_{skL} = m + (S_a - S_j)(w_j - w_i)(1 - d / v) - (1 - S_j)(w_j - w_i)(d - 1) / v \qquad (10)$$

where

S_{skL} = shadow price of skilled labour;
m = marginal product of worker's previous occupation;
S_a = average propensity to save in the society;
S_j = worker's marginal propensity to save;
w_j = project wage rate;
w_i = worker's previous wage rate;
d = income distribution weight;
v = conversion factor for saving.

In this section, the shadow price of skilled labour for the Xiamen zone is derived from the weighted average marginal productivities of labour employed in the three different types of industrial firms.

Figure 1 shows the basic wage rate which was earned in the Huli export processing zone in 1988. In the grade 1 to grade 7 skilled labour categories, wage rates ranged from 180 yuan per month to 360 yuan per month. In estimating shadow prices for skilled workers, a mean value of 270 yuan per month was used as the mean market wage rate for skilled workers in the foreign joint ventures.

The process of estimation of the shadow price of skilled labour for the Xiamen zone involves the following steps.

(i) The marginal productivity of skilled workers is calculated for firms with the three different types of ownership in Table 9.

Table 9

The marginal productivity of labour in Xiamen zone enterprises, by industrial ownership 1985-88(1980 = 100, yuan per year)[a]

Year	Collectively owned industry	State-owned industry	Foreign joint ventures
1985	13,300	20,200	27,200
1986	12,100	19,100	29,900
1987	12,000	19,400	35,300
1988	14,000	16,000	36,000

[a] Market prices; elasticity of labour = 0.32 is the elasticity of labour in total industrial output for the independent accounting units within state-owned industry which was estimated in Lin 1991, Chapter 4.
Sources: Xiamen Statistical Bureau, the *Xiamen Statistical Yearbook* 1980-89, Xiamen.

(ii) Wage scales for skilled workers are identified from Figure 1. The mean value of 270 yuan per month further adjusted by 20 per cent of bonus and subsidies (3888 yuan per year) is used as the average market wage rate for skilled workers in the foreign joint ventures in the Xiamen zone. Table 10 shows the skilled worker's wage rate in firms according to type of ownership.

Table 10
The wage rates of skilled workers in the Xiamen zone, 1985-88 (yuan per year)

	Collectively owned enterprises	State-owned enterprises	Foreign joint ventures
1985	1687	1984	2834
1986	1875	2205	3149
1987	2083	2450	3499
1988	2314	2722	3888

Sources: Fieldwork survey 1988, Xiamen, the Xiamen Labour Service Company, 1988.

(iii) The indirect opportunity costs of skilled workers are calculated in Table 11. The negative value of indirect social costs in Table 11 means that there is a net social benefit in increased consumption and savings when a skilled worker is drawn away from other industrial enterprises into the foreign joint ventures. The rates of consumption and savings for the skilled workers involved in calculations of indirect opportunity costs are based on the data obtained during author's fieldwork survey in Xiamen in 1987 and 1988.

Table 11
The indirect opportunity cost of skilled workers in the Xiamen zone, 1985-88
(yuan per year)

	Collectively owned enterprises	State-owned enterprises	Foreign joint ventures
1985	-23.3	-7.2	--
1986	-25.9	-8.0	--
1987	-28.7	-8.9	--
1988	-32.0	-9.9	--

Note: Rate of saving is 11 per cent, 15 per cent and 25 per cent for collectively owned enterprises, state-owned enterprises and foreign joint ventures respectively.

p(iv) The shadow price for skilled workers in the Xiamen zone is calculated from the sum of direct and indirect opportunity costs of the skilled worker in Table 12.

Table 12
The shadow price of skilled workers in the Xiamen zone, 1985-88
(yuan per year)

	Collectively owned enterprises	State-owned enterprises	Foreign joint ventures
1985	13,277	20,193	27,200
1986	12,074	19,092	29,900
1987	11,971	19,391	35,300
1988	13,968	15,990	36,000

Note: Calculated from Table 9 and Table 11.

(v) Conversion factors for skilled workers in the Xiamen zone in Table 13 are derived from the ratio between the shadow price of skilled workers and their wage rates.

Table 13
Conversion factors for skilled labour in the Xiamen zone 1985-88 (1980=100)

Year	Collectively industry	State owned industry	Foreign joint ventures
1985	3.4	5.2	7.0
1986	3.1	4.9	7.7
1987	3.1	5.0	9.1
1988	3.6	4.1	9.3
Average	3.3	4.8	8.3
Weights	0.09	0.78	0.03
Conversion factor for skilled worker	4.3		

Note: Wage rate of skilled labour is 3,888 yuan per year.

From the 1988 fieldwork survey, 78 per cent of the skilled labour in the Huli export processing zone was drawn from state-owned enterprises; 9 per cent was drawn from collectively owned enterprises; 2 per cent was drawn from other foreign joint ventures in the special economic zone; 1 per cent were foreign employees and 10 per cent were from other sources which included university graduates. Taking a weighted average of this distribution, the general conversion factor for skilled labour in the Xiamen zone was estimated to be 4.3.

Summary and conclusions

The shadow price of unskilled workers (equation 7) and skilled workers (equation 10) derived in this paper has several advantages compared with the traditional formula.

First, it includes the excess migration effect in the unskilled labour equation which is a common phenomenon in developing countries.

Second, the sub-optimum saving argument and the income distribution effects are both incorporated in the equations. The equations reflect the growth and equity objectives of the government.

Third, equations 7 and 10 distinguish between the change of private saving and consumption, so that the effect of government valuations of consumption versus investment have been taken into account.

The project specific conversion factors are preferred to nation wide conversion factors due to labour market segmentation in China. The conversion factors for unskilled labour and skilled workers for the Xiamen zone are estimated to be 0.57 and 4.3 respectively. These results show that the opportunity costs of employing one unskilled labourer in the Xiamen zone is only about half of the market price, while the opportunity costs for the skilled labour is about 4 times of the market price. Hence, unskilled labour is over-priced while skilled workers are under-priced in the Xiamen zone.

The policy implications of this study are clear. Given China's factor endowment, it needs to encourage the use of labour-intensive techniques. However, over-pricing of unskilled labour tends to favour the use of capital-intensive technology and leads to high costs to the Chinese economy. In the establishment of special economic zones, over-pricing of unskilled labour discourages the inflow of foreign investment and retards the exploitation of China's comparative advantage.

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