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Improving infrastructure

A cost-benefit analysis of the economic performance of the Huli industrial zone

Lin Shujuan

Research School of Pacific Studies

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This paper was presented in Xiamen in September 1991, at a seminar held to conclude a collaborative project of the Institute of Economics of the Chinese Academy of the Social Sciences, the Xiamen Economic Information Centre and the National Centre for Development Studies of the Australian National University.

Research staff worked in association with staff from the School of African and Asian Studies, Sussex University and the Economics Division of the Research School of Pacific Studies at the Australian National University. Chinese research scholars at the National Centre for Development Studies contributed.

Xiamen Economic Information Centre was responsible for arranging data collection in China. The National Centre for Development Studies arranged data collection in Australia in association with the International Economic Data Bank.

With some financial assistance from the United Nations Development Program and the Australian International Development Assistance Bureau, a series of field trips and workshops were held in Australia, China, Hong Kong, Indonesia, Malaysia, Singapore and Thailand, as part of the project. Activities in China were hosted by the Xiamen Economics Information Centre.

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.

This series is intended to provide prompt preliminary distribution of new work on China's reforms and economic growth. All papers issued in this series have been formally refereed. The views expressed in this Working Paper are those of the author and should not be attributed to the Economics Division.

Key to symbols used in tables

n.a	Not applicable
..	Not available
-	Zero
.	Insignificant

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5. 改善基礎設施建設 - 湖里工業區的成本效益分析

Lin Shujuan (林淑娟)

中國於1980年建立了四個經濟特區，主要目的是吸引外資來擴大出口生產和引進國外的先進生產技術．同時採用特區這種形式來確保區內試驗推行的特殊政策不對整個中國經濟造成不利的影響．經濟特區對國內外投資者實行特殊的補償政策，降低了區內的保護主義水平．

經濟特區在基礎設施方面投入了大量資金．鑑于東亞發展中國家的經驗，政府在經濟特區內提供許多基礎設施，不僅修建了公路，維修場所和公共服務設施，進而以資本集約型的投資方式改善了港口設備能力，興建了一批標準廠房和豪華的外國投資者住宅區．在投資決策之前，政府部門並沒有對這些公共投資項目進行財政分析和經濟成本效益分析．本文運用經濟成本效益分析方法，對廈門的湖里工業區的投資效益進行了初步的探討．

對公共投資項目進行成本效益分析首先必須計算資金和勞動力的影子價格．計算結果表明，資金的影子價格比市場價格高，而非熟練工人的影子價格則比市場價格低．資金的影子價格，或影子利率是官方利率的四倍．作者還考察了湖里工業區的經營情況．由于湖里工業區是一個進行中的投資項目，該文的重點放在討論如何運用成本效益分析方法改善湖里工業區的經濟效益，進而爲建立新的特區或出口加工區提供借鑑．

案例研究表明，從現階段的成本效益構成看，建立湖里工業區的成本高昂．以25年的投資項目生命周期計算，湖里工業區的投資收益率僅達4%．適當的調整投資結構，顯然是可以提高收益率．例如降低基礎設施的資本集約程度，減少生產過程中資本集約物品的投入，減少外資在當地資金市場的借貸，以及取消對公共設施服務的補貼等．提高勞動生產率，降低勞動成本也是提高政府部門投資和私人投資收益率的途徑之一．

Abstract

China established four special economic zones in 1980 to stimulate exports, to assist the transfer of modern technology to China, to attract foreign investment for these purposes, and in general to enable economic experimentation to take place without detrimental effects to the Chinese economy. Protection levels were lowered and special subsidies provided to foreign and domestic investors.

The special economic zones absorbed considerable public funds. Following the lead of other East Asian countries, China provided a considerable infrastructure in the zones, in fact going further than most export processing zones in Asia. Thus not only were roads, serviced sites and public utilities provided, but harbours were upgraded with capital-intensive technology and factories and living quarters for foreign investors were built. Financial and economic cost-benefit analysis that analyses the returns on such investment has not, however, been widely applied. This paper applies such analysis to the Huli industrial estate of the Xiamen special economic zone.

The cost-benefit methodology required the calculation of the shadow prices of capital and wages. These indicated that the shadow price of capital is considerably higher, and the shadow price of unskilled labour considerably lower, than the prices facing public and private decision makers. The shadow price of capital is about 4 times the official interest rate. Detailed insights into the operation of firms in the Huli estate were also obtained. As the public and private investment already made is a sunk cost, the focus of the study is on how the cost-benefit analysis can be used to improve policies affecting the operation of firms in special economic zones and investment in future special or export processing zones.

The case study suggests that, as currently structured, the Huli estate is costly. Assuming a project horizon of 25 years the rate of return to the investment in the estate is around 4 per cent. Adjustments that would increase the returns to investment seem to be advisable. These should include the reduction of capital intensity in the infrastructure, less capital-intensive inputs into production, reduction of borrowing in China by foreign firms and the elimination of subsidies to public utilities. Raising labour productivity and thus reducing labour costs would also improve the rate of return on public and private investment.

Improving infrastructure:

a cost-benefit analysis of the economic performance of the Huli industrial zone*

China initiated a program of economic reform in 1978. The establishment of four special economic zones in Guandong and Fujian provinces in 1980 is at the forefront of the policies effecting an opening to the outside world. To discuss success or failure of China's special economic zones, it is necessary to consider the economic objectives the government has set for them. The emergence of the special economic zones, their objectives and roles, must also be seen in the context of economic development strategy and performance.

The concept of an export processing zone is an extension, and development, of free ports which have a long history. The existence of free ports can be traced back to Roman times. They were normally located in a defined geographical area on the world's major trade routes. The main activities of free ports were trans-shipment and intermediate services of cargo breaking, storage and the re-export of goods. By not being subject to customs duties, they abolished impediments to the international movement of goods, services, capital and people.

Industrial estates, originating in depressed industrial areas in the United Kingdom in the 1930s, also contributed to the concept of export processing zones. Infrastructural facilities and public utilities were provided to attract entrepreneurs to revive depressed industrial areas. More recently, developing countries built on the industrial estate concept to give priority to developing public utilities and other infrastructural facilities in selected areas. This was done to facilitate the development of manufacturing industries and to overcome infrastructural bottlenecks in the process of industrialization. The areas so designated have been called industrial estates or parks.

*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. I would also like to thank Dr Philippa Dee for her help in preparing this paper.

Since the 1960s free ports and industrial estates have been brought together as export processing zones which seek to combine inputs into manufacturing at international prices with an internationally priced infrastructure. A suitable location, with access to international trade routes, is important. Administration has to be simple and efficient. If these essential conditions exist, no further regulations or incentives are necessary.

The first export processing zone was developed in 1956 in Ireland at the Shannon International Airport (Hughes 1988:167). It provided an impetus for developing countries to follow. By 1988 about 100 export processing zones operated in Asian countries (Osborne 1986) and about 600 in other developing countries (Hughes 1988).

The four special economic zones in China differ from export processing zones in other East Asian countries in several important aspects (Chu and Wong 1985, Wall 1991). China remains a socialist country, so the market nature of the special economic zones contrasts to the rest of its economy. Thus special economic zones serve as a laboratory for private enterprise and market development strategy, and as a show-place for advanced technology and management methods. They are separated from the rest of the economy by policies. Shenzhen is also separated physically. The special economic zones are much larger in land area and have larger resident populations than most industrial estate or export processing types of zones in other East Asian countries. They are comprehensive development units, unlike the small East Asian export processing zones which only possess a narrow range of manufacturing activities. Foreign investment is encouraged not only in the manufacturing sector, but also in the other economic sectors such as agriculture, construction, tourism, real estate development, commerce and other service activities.

Economic factors were not the only considerations in the creation of China's special economic zones. The creation of the Shenzhen and the Xiamen zones were of unique significance to national unification with Hong Kong and Taiwan, respectively. The market economy features of the zones were to show to the outside world that China intended to participate in the world economy and that private enterprise means of production were to be tolerated in China. The proposal for 'one nation, two systems' was projected as a possible path of national unification on the basis of foreign investment in the special economic zones, and elsewhere in China.

The nature of the special economic zones made it inevitable that some of the objectives set by the Chinese government could not be achieved. In China, special economic zones are expected to: attract foreign investment; increase exports and hence foreign exchange earnings; increase employment opportunities; transfer advanced technology and management skills; and provide backward linkage effects with other domestic sectors. In fact, the only real economic logic justifying the establishment of the special economic zones is to offset some of the domestic policies which impede foreign direct investment, hamper export development and prevent China from turning its comparative advantage into a competitive advantage. The special economic zones cannot create comparative advantage. They can only help to remove obstacles to its exploitation (Wall 1988).

The special economic zones absorbed considerable public funds. Following the lead of other East Asian countries, China provided a considerable infrastructure in the zones, in fact going considerably further than most export processing zones. Thus not only were roads, serviced sites and public utilities provided, but harbours were upgraded with capital-intensive technology, factories were built and living quarters were provided for foreign investors. The standard financial and economic cost benefit analyses that indicate the returns on such investment have not, however, yet been widely applied. This paper applies such analysis to the Huli industrial estate of the Xiamen special economic zone.

The main objectives are to discuss estimates of shadow prices for capital, unskilled and skilled labour, and for some of the important traded and nontraded commodities that can facilitate evaluations of public investment in China;, to present a cost-benefit analysis of the Huli zone in Xiamen; and finally to recommend improvements in the current design of the Huli zone.

Shadow prices and cost-benefit analysis

The rapid growth of the public sector in all modern societies, has meant that large sums of public money are collected from the population directly or indirectly by central governments and local authorities to be committed to public investment projects. It is essential to ensure that such investments have high and positive returns, when compared to alternative uses of such resources. In other words, scarce resources should be used to maximize

social welfare. Cost-benefit analysis allows investment projects to be evaluated and ranked according to their likely socioeconomic returns. It can also be used to enhance the returns to projects by indicating how to improve their design.

With cost-benefit analysis, a project is considered worthwhile if the money value of the benefits to gainers is greater than the money value of costs to the losers. The first practical widespread application of cost-benefit analysis was to evaluate public investments in water resources in the United States in the 1950s (United States Inter-Agency Committee on Water Resources 1958). In the 1950s and 1960s many practical applications were reported. These were primarily concerned with public investment decisions in industrial market-oriented countries. Since then, however, cost-benefit analysis has also played an increasingly important role in government decisions in developing countries (Little and Mirrlees 1969, Harberger 1972).

In developing countries, with their greatly distorted price systems, private profitability often bears little or no relation to real social costs and benefits. Particularly in a country such as China, official prices of a product may bear no relation to the true cost of the inputs used to produce it. Even market prices, where available, may be distorted when some inputs are obtained at official prices rather than at prices that reflect true scarcity. Techniques have therefore been developed to estimate shadow or accounting prices, for the calculation of the economic and social profitability of projects.

The shadow prices used in this study were derived using the technique outlined by Little and Mirrlees (1974) and Squire and Van der Tak (1975). The distinctive feature of the Little and Mirrlees (1974) approach is the attempt to relate public production to international trade. They divide commodities into traded and nontraded categories and argue that the shadow price of traded commodities, whether they are actually traded or not, is their international (border) price or the prices at which they could have been acquired from overseas. The shadow price of nontraded commodities is their foreign exchange equivalent. Squire and Van der Tak (1975) refined the Little and Mirrlees approach.

In the Little and Mirrlees, Squire and Van der Tak approach, traded goods are valued in border prices expressed in foreign currency, while nontraded goods' values are calculated as the border prices of their traded

good equivalents. Nontraded goods can be converted to their traded goods equivalents by looking at their input structure. For example, transportation, a nontraded good, is produced using transport vehicles, a traded good, along with labour. Transport services may also require financial service inputs, but this nontraded input can be further broken down into its traded good and primary factor components. Input-output information is used to break down nontraded goods in this way. The amount by which the domestic price of a traded or nontraded commodity must be scaled up or down to achieve the border price equivalent is called a conversion factor.

Conversion factors can also be calculated for primary factors of production – labour and capital. These conversion factors show the amount by which the market prices of capital and labour need to be rescaled to properly measure the opportunity cost of using these resources in the particular project under consideration rather than elsewhere. This can be measured by the output that would be forgone elsewhere in the economy. The conversion factors for capital and labour are therefore based on estimates of the marginal productivity of these factors in other uses.

Cost-benefit analysis of a project begins by taking normal financial data for the project, then rescaling all the cost items using the appropriate conversion factor to derive an evaluation of the project measured in opportunity cost terms. Care must also be taken to ensure that revenue items are expressed in the same units of measurement as the rescaled cost items. This calculation of social net benefit therefore differs from the calculation of private profitability in the way inputs and outputs are valued. Another difference is in the nature of the costs and benefits that are included in the evaluation. A project may be privately profitable only because it transfers income from elsewhere in the economy. From a social perspective, however, this is a transfer rather than a net gain and is typically excluded from cost-benefit calculations.

A cost-benefit analysis of the Huli zone

Within the special economic zones, which are a small part of the Chinese economy, protection levels are lowered and special subsidies are provided to foreign and domestic investors. Standard neo-classical theory suggests that a lowering of protection throughout the economy should lead to increased levels of trade and specialization, which in turn will result in

higher social welfare. However, the establishment of a special economic zone which lowers protection in a segmented sub-region of the economy may reduce welfare through a diversion of trade and misallocation of investment. Net benefits from reduced protection in such zones must be balanced against the economic cost of the subsidies provided. In addition, there are welfare effects of an indeterminate nature due to the redistribution of tax revenue. Only empirical case studies can provide estimates of the net social benefits and costs of establishing special economic zones.

The Xiamen zone initially consisted of the 2.5 square kilometre Huli industrial estate which was constructed in 1981. In 1985 the State Council passed a decree to extend the zone to the whole of Xiamen Island. This extended zone included much existing infrastructure and many enterprises established in Xiamen prior to 1985. Prior to 1981 Huli was an undeveloped area. The transportation system, factory buildings, residential housing and other public facilities which now exist in Huli were all constructed for the purposes of the export processing zone.

The Huli zone was designed to provide both a physical and a policy enclave in which neutral or export-promotion policies could be pursued without reforming China's trade regime. In order to achieve these goals, the government invested heavily in infrastructure and other public utilities. In return for this infrastructure investment, it was expected that the Chinese economy would benefit from the export-oriented foreign direct investment in manufacturing attracted to the zone. There are four kinds of firms operating in the zone: wholly foreign owned, joint venture, cooperative enterprises and inland associated enterprises. Results of a fieldwork survey in Xiamen in 1988 showed that of the total investment in the Huli zone, 28 per cent is due to foreign firms and foreign partners in the joint ventures and cooperative enterprises and 26 per cent of the total employment is in foreign firms and foreign partnerships.

The method used to estimate the net benefits to China from foreign firms operating in the Huli zone follows Warr (1990) in his study of export processing zones in the East and Southeast Asian countries. The estimation of the net benefits from local firms operating in the zone uses standard cost-benefit analysis for project assessment. The net benefits of the zone to the Chinese economy can be determined by an amalgamation of the cost-benefit analysis of foreign firms and domestic firms in the Huli zone.

Figure 1 shows what transactions of foreign firms and domestic firms are relevant when assessing the net benefits of the zone.

Figure 1
The relevance of cost-benefit analysis to economic transactions of firms in the Huli zone

Transaction with:	Foreign firms: foreign investment model	Domestic firms: domestic investment model
Rest of the world	◇	◇◇
Local economy	◇◇	◇◇

◇ irrelevant; ◇◇ relevant.

Figure 2
Benefits and costs of the Huli zone

	Benefits	Costs
Unskilled workers	*	*
Skilled workers	*	*
Taxes and profits	*	*
Interest and principal repayments		
- foreign borrowing		*
- domestic borrowing	*	*
Electricity	*	*
Water	*	*
Raw materials	*	*
Capital goods	*	*
Foreign exchange earnings from local sales	*	*
Port facilities	*	*
Buildings	*	*
Buildings	*	*
Zone administration		*
Externalities		
Technology transfer	*	
Managerial skills transfer	*	
Pollution		*

Following Corden (1974, 1985) and Warr (1990), the net benefits of foreign investment in the Huli zone can be assessed using the enclave model, called the foreign investment model. All economic activities of foreign firms in the Huli zone can be classified into two categories: first, the economic activities that occur between foreign firms (including foreign

partners in joint ventures and cooperative enterprises) and the rest of the world; and second, the economic activities that occur between the foreign firms and China's local economy. Only the second type of economic activity is relevant for the evaluation of the welfare impact on the Chinese economy that results from the development of the zone. The potential benefits and costs from foreign investment in the Huli zone were evaluated (Figure 2).

Figure 2 summarizes the potential benefits and costs from foreign investment in the Huli zone. The positive externalities of technology transfer and managerial skill transfer and the negative externality, such as pollution, cannot be quantified but certainly have an impact on the value of the project.

Employment and shadow wage rate

The income generated by employment in the Huli project is considered by the Chinese government to constitute a large share of the benefits of setting up the Huli zone. In other words, the wages received by the workers, especially by the unskilled workers, are considered to exceed the social opportunity cost of their employment in the zone. This opportunity cost includes the output forgone from that proportion of this workforce that would otherwise have been employed elsewhere in China. Moreover, workers in the zone are known to be paid consistently higher wages than similar workers employed outside the zone, so the difference may represent a source of net gain to the Chinese economy.

However, only that part of employment which was created by foreign firms and the foreign partners in joint ventures and cooperative enterprises generates benefits to the Chinese economy. Employment created in local firms, which is in excess of the opportunity cost of the labour is simply a transfer payment from Chinese entrepreneurs to workers. The net gain to the Chinese economy from employment in the Huli zone is calculated from the total wage bill for unskilled and skilled workers in foreign firms minus the estimated social opportunity cost of employing these workers.

It might appear that there are two separate benefits to the Chinese economy from foreign firms converting foreign exchange to pay their wage bills. First, there is the difference between the actual exchange rate paid by foreign firms and the shadow exchange rate and second, there is the difference between market prices and the true economic value of the

labour. However, the Little and Mirrlees (1974), Squire and Van der Tak (1975) conversion factor approach combines these two effects when shadow pricing labour and other goods and factors. Hence the net benefits to the Chinese economy from foreign firms converting foreign exchange to pay their wage bills is included in the above calculation.

Taxes and profits

In terms of an economic efficiency analysis taxes paid by foreign firms represent a source of benefit to the Chinese economy. The bulk of these taxes would not have been received if the Huli zone did not exist, with the exception of the taxes paid by those foreign firms which would have come to China even if the zone did not exist. However, it is very difficult to judge the numbers of such firms among the total foreign firms in Huli. Taxes paid by local entrepreneurs are merely transfer payments from the Chinese entrepreneurs in the zone to the Chinese financial authorities.

A situation where no company income tax is paid is the norm in many export processing zones in East Asian countries (Warr 1990). In that case, profits and losses of the foreign investors in the zone would be irrelevant. However, firms in China's special economic zones are subject to company income tax. Foreign firms may nevertheless use transfer pricing techniques to reduce the tax revenue benefits of the Huli zone.

For example, in vertically integrated firms the flow of goods and services between the zone and the rest of the world occur within the firm. To maximize total profits and minimize global tax burdens, the firm may engage in transfer pricing to relocate their profits internationally. Whether firms' profits are realized in China or not, affects the magnitude of the total tax revenue of the Chinese government. Despite the importance of this issue, data are not available to undertake this analysis. The value of taxes actually received by the Chinese economy will be counted as a net benefit to China. The administrative costs of collecting this tax revenue could not be quantified, but would reduce the net benefit of the tax revenue to China.

Domestic borrowing

One of the methods used to attract foreign investors has been to allow them access to local capital markets. In the Philippines access was even combined with government guarantees for the repayment of foreign loans. This was one of the main causes of the large negative contribution made by the Bataan export processing zone to economic welfare in the Philippines

(Warr 1985a). China, despite its acute shortage of capital, also allows foreign firms to borrow in the local capital market.

If the local capital market were a competitive market open to international transactions, access to it by foreign investors would have little socio-economic effect. However, the Chinese financial system is 'repressed'; interest rates are deliberately kept low. The marginal social productivity of capital in China exceeds commercial interest rates. This implies that the value of output forgone elsewhere in the Chinese economy as a result of foreign borrowing is likely to exceed the compensation received from foreign firms in the form of interest payments. Hence, borrowing by foreign firms in the zone is costly to the Chinese economy.

Total domestic borrowing of the Huli firms reached 39 million yuan in 1988. However, only the borrowing by foreign firms and foreign partners in joint ventures and cooperative enterprises is a net loss to the Chinese economy. Borrowing by domestic firms at subsidized interest rates represents a transfer payment from local lenders to local entrepreneurs. The net welfare loss to the Chinese economy from domestic borrowing by foreign firms in the Huli zone is calculated as the difference between total foreign firms' domestic loan interest and principal repayments and the social opportunity cost of this domestic borrowing.

Public utilities

If the prices of utilities and other services purchased by foreign firms are set below their marginal production costs, this is clearly an economic cost to the Chinese economy.

In any particular year the total loss to the Chinese economy will be equal to the difference between total electricity and water consumption of the foreign firms and foreign partners in joint ventures and co-operative enterprises and the social marginal cost of generating the electricity and water they consume. Any subsidization of utilities used by local firms represents transfer payments from Chinese utility authorities to local entrepreneurs and is not a net loss to China.

Domestic raw material and capital goods inputs

The development of backward linkages with the local economy through the purchase of raw materials and other production inputs by the firms in Huli is another benefit expected by the Chinese government from the operation

of the zone. The encouragement to use domestic raw materials and intermediate inputs in the zone implies that the prices paid by the foreign firms for these materials are believed (by the Chinese government) to exceed the social opportunity cost of producing them. However, only the purchase of raw materials and capital goods by the foreign firms and foreign partners in joint ventures and cooperative enterprises may generate net benefits for China. Purchases by local firms which exceed the opportunity cost simply represent transfers between local entrepreneurs.

Local sales

All of the above estimates of benefits to the Chinese economy from foreign firms operating in an export processing zone assume that the firms convert foreign exchange to pay for their local costs. If in fact they pay these costs out of the proceeds of local sales, this may reduce the net benefits to China from the zone. This is because the gains from forcing firms to convert foreign exchange at an overvalued exchange rate may be lost.

At present, firms in the Huli zone are officially permitted to sell up to 40 per cent of their products on the domestic market (Chen Deqiu 1989). However, these domestic sales are considered to be imports into China. They are subject to import tariffs which are collected by the Chinese government. Hence there may be no negative welfare effects on the Chinese economy from this source.

However, when protection takes the form of quantitative restrictions, allowing firms to sell locally is equivalent to having an increase in quotas of the same amount. If the foreign firms can then sell locally at a price that includes the tariff equivalent of the quota, this will represent a loss to the Chinese economy of some, if not all, of the benefits from the foreign exchange premium.

Appendix A discusses the issue of local sales in more detail, while also illustrating the steps required to ensure that all costs and benefits are measured in a common unit of account. Appendix Table B1 shows, that local sales are an important issue. Indeed, the earnings from local sales of the foreign firms and foreign partners in joint ventures and cooperative enterprises (162 million yuan) are greater than the total local currency that firms needed for their production (115 million yuan) during 1984-87. The foreign exchange earnings that were expected from the Huli zone have not occurred.

Public expenditures and administrative costs

Public expenditures required to set up the Huli zone are clearly an economic cost to China. However, using the actual expenditures in the zone would overstate the net expenditure if some of these or similar expenditures would have been required even in the absence of the zone. Local roads are an example. In the Huli zone, however, the major infrastructure expenditures have been specific to the zone. The differences between total expenditures and expenditures essential only for the zone therefore seem likely to be small.

The main components of the administrative costs of the Huli zone are the social opportunity costs of the wages of government employees and forgone rent of the administration buildings. The total wage bill of zone administrative employees adjusted by the conversion factor for skilled labour is taken as the social opportunity cost of their employment by the government.

Externalities

Ideally positive and negative externalities should be included in an economic analysis of the zone. However, externalities such as the transfer of technology and managerial skills are very difficult to quantify. Therefore, given data difficulties, the effects of these externalities must be omitted from this study. Since there are both positive and negative externalities it is possible that they may largely off-set each other. However, it seems likely that the positive externalities may exceed the negative ones in the long term, and this must be considered when the final net economic benefits of the zone are estimated.

Net benefit from foreign investment in the Huli zone

It is now possible to present an algebraic expression for the net economic benefit to China from the foreign firms operating in the Huli zone. In a given year, t, the net benefit of the Huli zone can be given by;

$$NB_{Ft} = (L_F^{u}W_u - L_F^{u}W_u^{*}) + (L_F^{s}W_s - L_F^{s}W_s^{*}) + (T_F)$$
$$+ (R_F^{i} - D_F^{b}S_k) + (U_F^{e}P_e - U_F^{e}P_e^{*})$$
$$+ (U_F^{w}P_w - U_F^{w}P_w^{*}) + (M_F^{r}P_r - M_F^{r}P_r^{*})$$
$$+ (M_F^{k}P_k - M_F^{k}P_k^{*}) + (R_F^{b} + R_F^{p}) - K_FS_k - A_FF_c^{s} \qquad (1)$$

where

NB_{Ft} = net benefit to China in year t from foreign investment in the Huli zone;

L_F^u = total employment of unskilled labour by foreign firms in year t;

W_u = wage paid to unskilled labour by foreign firms in year t;

L_F^s = total employment of skilled labour by foreign firms in year t;

W_s = wage paid to skilled labour by foreign firms in year t;

M_F^r = domestic raw material used by foreign firms in year t;

M_F^k = domestic capital goods used by foreign firms in year t;

P_r = price of raw materials;

P_k = price of capital goods inputs;

U_F^e = electricity used by foreign firms in year t;

U_F^w = water used by foreign firms in year t;

P_e = price of electricity;

P_w = price of water;

R_F^b = rent for factory buildings paid by foreign firms in year t;

R_F^p = factory buildings purchased by foreign firms in year t;

R_F^i = total interest and principal repayments by foreign firms in year t;

T_F = total taxes paid by foreign firms in year t;

W_u^* = shadow price for unskilled labour;

W_s^* = shadow price for skilled labour;

P_r^* = shadow price for raw materials;

P_k^* = shadow price for capital goods;

P_e^* = shadow price for electricity;

P_w^* = shadow price for water;

D_F^b = domestic borrowing in year t;

K_F = construction cost of the Huli zone for foreign firms in year t;

S_k = conversion factor for capital;

A_F = administrative costs of the Huli zone for foreign firms in year t;

F_c^s = conversion factor for skilled worker.

Rearranging, this is equivalent to:

$$NB_{Ft} = (L_F{}^{u}W_u + L_F{}^{s}W_s + T_F + R_F{}^{i} + U_F{}^{e}P_e + U_F{}^{w}P_w + M_F{}^{r}P_r + M_F{}^{k}P_k + R_F{}^{b} + R_F{}^{p}) - (L_F{}^{u}W_u{}^{*} + L_F{}^{s}W_s{}^{*} + U_F{}^{e}P_e{}^{*} + U_F{}^{w}P_w{}^{*} + M_F{}^{r}P_r{}^{*} + M_F{}^{k}P_k{}^{*} + D_F{}^{b}S_k) - K_F S_k - A_F F_c{}^{s} \quad (2)$$

The first bracketed term in equation 2 represents the payments made by foreign firms and foreign partners in joint ventures and cooperative enterprises in the zone to employ labour; purchase raw materials, capital goods, electricity and water; rent factories; make interest and principal repayments of domestic loans; and pay various official taxes.

The second bracketed term represents the social opportunity cost of providing labour, raw materials and capital goods inputs, and utilities for foreign firms in the zone. The third and fourth terms denote the costs of construction and administration of the Huli zone for foreign firms.

Net benefits from local firms: the domestic investment model

Besides the net benefits generated from the foreign firms, China also benefits from the operations of locally owned firms in the Huli zone. Unlike the foreign firms, all the economic transactions of the domestic firms operating in the zone are relevant in a cost-benefit analysis of the zone. However, the cost and benefit components of domestic investment are very different from the foreign investment model.

It is important to point out that a large part of benefits and costs generated from domestic investment are simply transfer payments among local entrepreneurs, local workers and various local authorities. For example, tax paid by the domestic firms in the zone is a transfer payment from local entrepreneurs to the local financial authority. Similarly, government subsidies for the use of utilities in the Huli zone are transfer payments from government to local entrepreneurs, and the difference between the market wage rate of unskilled labour and the opportunity cost of this labour is a transfer payment from local entrepreneurs to local workers. None of these are considered as costs or benefits for China as a whole.

Total benefits from domestic investment are simply the total economic value of the output of the domestic partners in joint ventures and cooperative enterprises in the zone. On the other hand, the total costs to China from the operation of local firms are the opportunity cost of productive inputs and the costs of construction and administration of the Huli zone for domestic investment. Thus, the net benefits from domestic investment in the Huli zone are:

$$NB_{Dt} = Q_D^* - (L_D{}^u W_u{}^* + L_D{}^s W_s{}^* + U_D{}^e P_e{}^* + U_D{}^w P_w{}^* + M_D{}^r P_r{}^* + M_D{}^k P_k{}^*) - K_D S_k - A_D F_c{}^s \quad (3)$$

where

NB_{Dt} = net benefit to China in year t from domestic investment in the Huli zone;

Q_D^* = opportunity cost of output of local firms in the zone measured in border prices in year t;

$L_D{}^u W_u{}^*$ = opportunity cost of unskilled labour of local firms measured in border prices in year t;

$L_D{}^s W_s{}^*$ = opportunity cost of skilled labour of local firms measured in border prices in year t;

$U_D{}^e P_e{}^*$ = opportunity cost of electricity of local firms measured in border prices in year t;

$U_D{}^w P_w{}^*$ = opportunity cost of water of local firms measured in border prices in year t;

$M_D{}^r P_r{}^*$ = opportunity cost of raw materials inputs of local firms measured in border prices in year t;

$M_D{}^k P_k{}^*$ = opportunity cost of capital goods inputs of local firms measured in border prices in year t;

$K_D S_k$ = opportunity cost of government investment in construction for the local firms measured in border prices in year t;

$A_D F_c{}^s$ = opportunity cost of administration of local firms measured in border prices in year t.

Net benefit to China from establishing the Huli zone

The net benefit to China from establishing the Huli zone is the sum of net benefits from foreign investment and domestic investment. The present value of the net benefits to China from the zone is then calculated by

discounting these net benefits over the life of the zone. A social discount rate of 9 per cent was deemed to be appropriate (Lin 1991:96).

Simplifying assumptions and data

The data relating to the Huli zone were collected during fieldwork in Xiamen in 1988. Appendix Tables B1 and B2 summarize the financial data for foreign firms and local firms in the Huli zone during 1981-88. Some simplifying assumptions are made to undertake the evaluation of the Huli zone. Some of these are later relaxed in the sensitivity analysis. It is assumed that construction costs ceased in 1989 and that 10 per cent of the total construction costs of 1989 will continue as on-going maintenance costs in later years. Administrative costs and the firms' operational costs are assumed to remain at their 1987 level.

The share of construction costs and benefits of the Xiamen port project that accrue to the Huli zone are estimated from economic analysis of the Xiamen port project (World Bank 1988). The results are shown in Appendix Table B3. Huli's contribution to total port construction costs, 6.75 per cent, is derived from the ratio of total imports and exports of Huli zone to those of the Xiamen special economic zone from 1984-87. The share of airport construction costs and benefits which could be attributed to the Huli zone are omitted because of data difficulties. But this omission will bias downwards the infrastructure costs of the zone.

Total foreign borrowing from domestic banks of 6.87 million yuan up to 1988 is assumed to be equally distributed over the years 1984-88. Interest and principal repayments are calculated on a 10 year term at an interest rate of 6 per cent per year.[1]

The project life that is assumed will alter the estimated rate of return to the project. A project life of 25 years is used in the 'base case' by assuming that assets in the zone such as factory buildings and infrastructure will cease operation at the end of 2005. However, a project life of 30 to 50 years is chosen for sensitivity analysis.

The conversion factors of skilled and unskilled labour, capital, electricity, water and the so-called standard conversion factor, are those calculated in Lin (1991). They are summarized in Table 1. The shadow

[1] According to the Planning Department of the People's Bank (1985), 'Report on the adjustment of interest on deposits and loans of the People's Bank, December 1982', the interest rate on loans to foreign joint ventures are the same as the interest rates for domestic industrial enterprises.

price estimates indicate that in China, capital is too cheap while unskilled labour is too dear. The shadow price of capital is about four times the official interest rate, that is, the shadow interest rate is well over 20 per cent. This suggests that official interest rates are too low. Rather than subsidize its use, China should raise the price of capital to make it more expensive to the user. The estimates also show that unskilled labour is overpriced and skilled workers are underpriced in Xiamen. Overpricing of unskilled labour discourages the inflow of foreign investment and retards the exploitation of China's comparative advantage.

Table 1
Shadow prices applied in the case study

	Shadow prices
Standard conversion factor	0.69
Raw materials	0.70
Capital goods inputs	0.59
Electricity	1.44
Water	1.36
Unskilled labour	0.83
Skilled labour	3.70
Capital investment	4.00
Official exchange rate	4.7[a]
Secondary exchange rate	5.8[a]
Social discount rate	9.00
Conversion factor for commodity i for foreign firms[b]	0.79

[a] data for 1990.
[b] Calculated from Table B1 using equation A16.
Source: Lin Shujuan, Application of Cost-benefit Analysis in China: A Case Study of the Xiamen Special Economic Zone, Ph.D. thesis, Australian National University, Canberra.

Results of the cost-benefit analysis

Appendix Table B4 provides the aggregate economic analysis of the Huli project. The negative net present value (-295.47 million yuan) at a 9 per cent social discount rate and a low economic rate of return of 3.77 per cent indicate that the Huli project is not economic. Even with a 50 year operating horizon, the net present value is still negative (-190.16 million yuan) and the economic rate of return (6.73 per cent) is still lower than the 9 per cent social discount rate.

However, the economic performance of the domestic investment is better than the performance of the foreign investment. Appendix Tables B5 and B6 analyse foreign firms and domestic firms in the Huli zone. The economic rate of return of the foreign firms as summarized in Table 2 is lower than that of the domestic firms. The poor performance of foreign firms in the zone is primarily caused by the high opportunity costs of labour, particularly scarce skilled labour, and by opportunity costs of the intermediate inputs, local capital, and factory buildings used by the foreign firms that are greater than the market prices paid by those firms.

Table 2
Composition of net present value of costs and benefits of the Huli zone: base case (1980=100, million yuan)

	Total	Foreign investment	Domestic investment
PV benefits	945.39	196.45	748.94
PV costs	-1240.86	-358.58	-882.28
NPV	-295.47	-162.13	-133.34
ERR (%)			
25 years	3.77	-	5.78
30 years	5.11	-	6.92
40 years	6.28	1.17	7.89
50 years	6.73	2.06	8.24

Notes: Present value (PV); Net present value (NPV); Economic rate of return (ERR).
Sources: See Appendix Tables B4, B5 and B6.

Sensitivity analysis

Appendix Table B7 summarizes the sensitivity analysis of economic rates of return and net present values of the Huli zone under various assumptions in six case scenarios.

Case 1 In the base case it was assumed that foreign firms financed the purchase of local inputs from a combination of exports and local sales, but that the local sales were only partly tariff inclusive, reflecting the actual situation in the Huli zone. In Case 1, it is assumed that foreign firms operating in the zone receive full tariff inclusive prices for all their local sales. In this case the economic rate of return of the Huli zone drops to only

3.27 per cent in the 25 years of project life time and has a negative net present value of 315.08 million yuan at border prices.

Case 2 Here the net economic benefits from the zone are calculated on the basis of a 20 per cent increase in local raw materials and capital goods inputs usage by the foreign firms in the zone. This raises the economic rate of return to 4.1 per cent.

Case 3 Since capital is very costly to the Chinese economy, allowing export processing zone firms to borrow from local markets generates substantial social costs for China. In Case 3, the net benefits from the Huli zone are calculated as if foreign firms are prohibited from borrowing in the domestic market and receive no subsidies from utilities. The economic rate of return would rise to 4.43 per cent in this case. However, the economic rate of return of the Huli zone is still significantly lower than the social discount rate of 9 per cent. Even after 50 years of operation without domestic borrowing and without government subsidies for utilities, the net present value of the zone is still high, -147.12 million yuan at border prices, and the economic rate of return is only 7.22 per cent.

Case 4 If the foreign firms operating in the Huli zone are assumed to receive tariff exclusive prices for all their local sales, the economic rates of return rise to 4.78 per cent, if the zone is assumed to operate for 25 years. However, the economic rate of the zone is still well below the 9 per cent social discount rate in China even after 50 years of operation. Hence, none of these scenarios significantly improves the economic performance of the Huli zone.

Case 5 A better design for the Huli zone under the present trade and economic regime would undoubtedly be less capital intensive. If total government construction costs could be reduced by 10 per cent, the economic efficiency of the Huli project would be slightly better than the previous cases, with the economic rate of return rising to 4.89 per cent over a 25 year project.

Case 6 However, if the total costs of the zone could be reduced 20 per cent, while the total benefits are kept at the same level, the Huli project would still not be economically viable. Only after 30 years of operation would the Huli project have 9.05 per cent economic rate of return which is close to the social discount rate in China.

Case 7 To improve the economic viability of the Huli project, the government would need to reduce total construction cost by 20 per cent and at the same time, prohibit domestic borrowing and utilities subsidies. The Huli project would then be economically viable after 25 years of operation with an economic rate of return of 8.74 rising to 9.64 over 30 years.

The case studies show that the Huli zone project is not viable economically unless the positive externalities, such as technology and managerial skill transfer, have significant effects on the Chinese economy. To raise the welfare effects of the Huli zone, the design of the zone should be improved. The sensitivity analysis confirms that the Huli zone should reduce capital intensive inputs, markedly reduce domestic borrowing and eliminate government subsidies for the usage of public utilities. This would lead to an appreciably higher economic rate of return to the Chinese economy.

Appendix 1

Common units used in measuring cost and benefit components

To calculate the net benefits received by China from the foreign firms operating in the Huli zone, all components of costs and benefits must be measured in a common unit. In this study, border prices converted to local currency at the official exchange rate are employed as the numeraire. The conversion factors in the second bracket of equation 2 in the text are used to convert the domestic prices of unskilled labour, skilled labour, local raw materials and capital goods inputs, utilities, construction and administrative costs into social opportunity costs in terms of border prices expressed in local currency. We must ensure that components in the first bracket of equation 2 in the text are also measured in border prices converted to local currency at the official exchange rate. A simplified example is used to show how this requirement can be met.

For simplicity, assume that foreign firms need 1,000 yuan to meet their domestic wage bill. There are two sources of funds that foreign firms can use to pay this bill. One is from export earnings and the other is from local sales. If export earnings are used, they may be converted at either the official or the secondary market exchange rate. If local sales are used, they may occur at tariff inclusive or tariff exclusive prices.

Payment of local costs from foreign firms' export earnings converted at the official exchange rate

Suppose the local wage bill is paid out of earnings from exports. If foreign firms are required to use the official exchange rate to convert their export earnings to local currency in order to pay a wage bill of 1,000 yuan, this local expense of (1,000 yuan) can be directly included in the calculation of net benefits in equation 2 in the text. For example if the official exchange rate (US$1 = 4.7 yuan) is applied, the foreign firm will need to convert export earnings of US$213 to pay their local wage bill. That is,

$$1000 \text{ yuan} / OER = US\$213 \qquad (A1)$$

where

OER = official exchange rate = 4.7 yuan

In this case, the actual exchange rate applicable to foreign firms is the official exchange rate. What foreign firms actually pay in dollars for their wage bill is already correctly measured in border prices expressed in local currency. The value of local costs paid by foreign firms' export earnings converted at the official exchange rate is:

VBP = 1,000 yuan * (OER / OER) (A2)

where

VBP = value of local costs paid by foreign firms' export earnings converted at the official exchange rate, measured in terms of our numeraire.

Payment of local costs from foreign firms' export earnings converted at the secondary exchange rate

If the actual exchange rate which foreign firms are allowed access to, in order to convert their export earnings to local currency, is the secondary exchange rate (SeER), the foreign firms will only need to convert US$ 172 to pay their wage bill (where the secondary exchange rate is US$1 = 5.8 yuan). That is,

1000 yuan / SeER = US$172 (A3)

In this case, the local wage bill of 1,000 yuan is only worth 810 yuan measured in border prices and expressed in local currency (that is US$172 * OER = 810 yuan). In this situation, the wage bill multiplied by the ratio of the official exchange rate to the secondary exchange rate should be included in equation 2 in the text to estimate the net benefits of foreign firms' operations to the Chinese economy.

V_{BP} = 1,000 yuan (OER/SeER) = 810 yuan (A4)

where

VBP = value of local costs paid by foreign firms' export earnings converted at the secondary exchange rate, measured in terms of our numeraire.

Payment of local costs from local sales at a tariff inclusive price

For this discussion, we should assume that the difference between the domestic price of commodity i and its border price is the tariff. If tariffs at

rate t are the only protection measure that China employs on imports of commodity i, the domestic price of commodity i is:

$$DP_i = BP_i (AER)(1+t) \quad (A5)$$

where BP_i is the border price of commodity i in foreign currency and AER is the actual exchange rate used in paying for the import. The domestic price needs to be measured in terms of our numeraire BP_i^*, which is the border price of commodity i in domestic currency: suppose foreign firms make 1,000 yuan from local sales at this tariff inclusive price.

$$BP_i^* = BP_i (OER) \quad (A6)$$

Therefore, the appropriate conversion factor to use is

$$CF_i = BP_i^* / DP_i = OER / (AER)(1+t) \quad (A7)$$

If foreign firms make 1,000 yuan from local sales of product i, and use this revenue to pay their 1,000 yuan wage bill, the wage bill of 1,000 yuan valued at border prices is:

$$V_{BP} = 1{,}000 \text{ yuan } (BP_i^* / DP_i) \quad (A8)$$
$$= 1{,}000 \text{ yuan } (CF_i)$$

where

V_{BP} = value of local costs paid by the foreign firms from local sales at a tariff inclusive price, measured in terms of our numeraire.

Payment of local costs from local sales by foreign firms at a tariff exclusive price

In this case foreign firms sell their goods in the local market at domestic prices and pay over to the government the equivalent of actual import taxes levied on the commodities. The tariff paid by the foreign firms is simply a transfer payment from the local consumer to the Chinese authority. Assume the firms use the proceeds of their local sales at this tariff exclusive price to pay their 1,000 yuan local wage bill. The value of the wage bill of 1,000 yuan to the Chinese economy measured at border prices expressed in local currency will then be only 790 yuan. That is:

$$V_{BP} = 1{,}000 (BP_i^* / DP_i) \quad (A9)$$

where in this case

$$DP_i = BP_i (AER) \quad (A10)$$

$$CF_i = BP_i^* / DP_i = OER/AER \quad (A11)$$

and

$$V_{BP} = 1{,}000 (OER/AER) \quad (A12)$$

where

V_{BP} = value of local costs paid by foreign firms from local sales earnings at a tariff inclusive price, measured in terms of our numeraire.

Excess revenue from local sales

If there is excess local sales revenue after payment of all local costs, firms must convert these funds at the secondary market exchange rate to obtain foreign exchange to pay imported raw materials and intermediate inputs. Suppose the firms receive a tariff inclusive price for these local sales. To the extent that the ratio of the price received by foreign firms from local sales to the border price of commodity i, DP_i / BP_i^* is greater than the ratio of the secondary exchange rate to the official exchange rate, SeER / OER, then China will lose foreign exchange and tax revenue from such transactions, compared to simply importing such goods at the border price. That is:

$$NC = (DP_i / BP_i^*) - (SeER / OER) \quad (A13)$$
$$= 1.27 - 1.23 = 0.04$$

where

NC = net loss to China from foreign firms' conversion of excess revenue from local sales to obtain foreign exchange to pay imports;

BP_i^*/DP_i = 0.79 = consumption goods conversion factor as estimated in Lin (1991:36);

OER/SeER = 4.7 / 5.8 = 0.81

It can be seen that this difference is likely to be small. The loss to China from this source will therefore be omitted.

The calculation of net benefits to the Chinese economy generated from the purchase of local inputs by foreign firms can now be simplified. Figure A1 summarizes the conversion factors which are applied to the local costs paid by the foreign firms to estimate their gross benefit to the Chinese economy under the various scenarios examined.

This discussion can now be illustrated by deriving the net benefit to China from employment of local unskilled workers by foreign firms, considering each of the cases summarized in Figure A1.

Figure A1
Conversion factors applied in the calculation of the gross benefit to China from foreign firms' purchase of local inputs
(measured at border prices expressed in local currency)

Foreign firm exports to pay local costs		Foreign firm uses local sales to pay local costs	
OER (i)	SeER (ii)	Tariff inclusive (iii)	Tariff exclusive (iv)
1	$\frac{OER}{SeER}$	$\frac{BP_i^*}{DP_i}$	$\frac{BP_i^*}{DP_i}$

Notation explained in the text.

Cases (i) and (ii)

In terms of the numeraire, the net benefits to the Chinese economy generated from the purchase of local inputs by foreign firms which convert foreign exchange earnings to pay these costs, are:

$$NB_E = L^u W_u (OER / AER) - W^* \qquad (A14)$$

where

NB_E = net benefit to China from local unskilled workers employed by foreign firms, with local currency earnings expressed at border price;

L^u = total unskilled workers employed by foreign firms;

W_u = wage of unskilled worker at local prices;

OER = official exchange rate

AER = actual exchange rate at which foreign firms convert foreign exchange;

W^* = opportunity costs of unskilled worker measured at border price in local currency.

Cases (iii) and (iv)

Depending on the prices actually received by foreign firms from their local sales *net* of any tariffs or other taxes paid, the net benefits to the Chinese economy generated from the employment of local unskilled workers by foreign firms which use local sales of commodity i to pay these costs are:

$$NB_E = L^u W_u \ (BP_i^* / DP_i) - W^* \qquad (A15)$$
$$= L^u W_u * CF_i - W^*$$

where

NB_E = net benefit to China from employment of local unskilled workers by foreign firms, with local currency earnings expressed at border price;

BP_i^* = border price of commodity i in domestic currency;

DP_i = domestic price of commodity i received by the foreign firms from local sales;

CF_i = conversion factor for commodity i for foreign firms.

The actual situation in the Huli zone is that some of the firms convert foreign exchange earnings at the secondary exchange rate to pay local costs. The relevant conversion factor to obtain the gross benefits to China is 0.81 (OER/SeER = 4.7 / 5.8 = 0.81).

For firms which sell locally, domestic prices invariably include a tariff and non-tariff barrier component. Usually foreign firms selling locally do not receive the tariff component; this is paid to the Chinese government. However, they will usually receive some of the non-tariff barrier component. The proportion they receive is negotiated case by case.

A weighted average conversion factor for local sales of commodities by foreign firms can be calculated by using the following equation:

$$CF_i = \frac{XS}{LC} * \frac{OER}{SeER} + \frac{LS}{LC} * \frac{BP_i^*}{DP_i} \qquad (A16)$$

where

CF_i = total weighted average conversion factor for local sales of commodity i for foreign firms;

XS = total domestic currency obtained by foreign firms from conversion of export revenue;

LC = total local costs paid by the foreign firms;

LS = total local sales by the foreign firms;

BP_i^* = border price of commodity i;

DP_i = domestic price of commodity i received by the foreign firms from their local sales.

In the case study, this weighted average conversion factor for foreign firms is employed as the base case. The effects on the gross benefit to China of applying the official exchange rate or the shadow exchange rate to foreign firms can be tested using sensitivity analysis.

Appendix Table B1
Summary financial data for foreign owned firms[a] in the Huli zone (1980 = 100, million yuan)

1988		1981	1982	1983	1984	1985	1986	1987
Revenue								
Total exports				0.38	0.16	3.69	6.46	
Local sale				2.33	31.19	39.82	53.59	
Reported profits of firms				0.02	0.26	0.14	5.70	
Costs								
Total imports				4.18	25.22	18.45	35.60	
Local purchases of								
Raw materials				0.03	19.69	8.61	15.05	
Capital goods					0.32	0.59	1.66	
Electricity		0.11	0.26	0.33	0.39	0.50	0.87	
Water	0.04	0.05	0.08	0.08	0.10	0.10	0.12	0.12
Rent					0.17	0.63	1.20	1.45
Buildings purchased				3.56	2.51	0.15	1.17	2.95
Total official taxes		0.11	0.17	4.49	13.18	13.74	13.74	
Total wage bills								
Unskilled				0.21	0.60	1.14	1.51	
Skilled				0.11	0.31	0.59	0.66	
Domestic borrowing								6.87

[a] Includes foreign partners in joint ventures and cooperative enterprises.

Source: Fieldwork survey, 1988.

Appendix Table B2

Summary of financial data for domestic firms[a] in the Huli zone (1980 = 100, million yuan)

	1981	1982	1983	1984	1985	1986	1987	1988
Revenue								
Total exports				0.92	0.38	9.55	16.61	
Local sale				6.00	80.20	102.38	137.80	
Reported profits of the firms				0.04	1.12	0.33	18.29	
Costs								
Total imports				10.84	74.02	47.36	91.50	
Local purchased								
Raw materials				0.06	50.64	22.13	38.69	
Capital goods					0.82	1.50	4.27	
Electricity		0.30	0.66	0.84	1.01	1.28	2.23	2.23
Water	0.11	0.14	0.19	0.21	0.27	0.25	0.32	0.27
Rent					0.45	1.61	3.10	3.74
Building purchased				9.15	6.44	0.37	3.02	7.59
Total official taxes		0.39	0.62	16.88	49.60	51.71	28.42	
Domestic borrowing								17.67
Total wage bills								
Unskilled				0.61	1.72	3.26	4.29	
Skilled				0.32	0.89	1.68	1.88	
Government construction costs[b]	2.44	10.62	28.99	103.61	91.39	19.43	22.55	6.51

[a]Includes domestic partners in joint ventures and cooperative enterprises;
[b]Total government construction costs of the Huli zone.

Source: Fieldwork survey, 1988.

Appendix Table B3
Costs and benefits of the Xiamen port project 1989-2011 (million yuan)

Year	Total costs			Total benefits		
	Huli	Foreign	Domestic	Huli	Foreign	Domestic
1989	3.38	0.95	2.43	--	--	--
1990	5.30	1.48	3.82	--	--	--
1991	10.02	2.81	7.21	--	--	--
1992	5.30	1.48	3.82	3.70	1.04	2.66
1993	0.91	0.25	0.66	9.34	2.62	6.72
1994	0.91	0.25	0.66	10.34	2.90	7.44
1995	2.26	0.63	1.63	11.41	3.19	8.22
1996	0.98	0.27	0.71	11.67	3.27	8.40
1997	0.98	0.27	0.71	11.94	3.34	8.60
1998	0.98	0.27	0.71	12.20	3.42	8.78
1999	0.98	0.27	0.71	12.46	3.49	8.97
2000	0.98	0.27	0.71	12.72	3.56	9.16
2001	0.98	0.27	0.71	12.72	3.56	9.16
2002	1.10	0.31	0.79	12.72	3.56	9.16
2003	1.43	0.40	1.03	12.72	3.56	9.16
2004	1.43	0.40	1.03	12.72	3.56	9.16
2005	1.43	0.40	1.03	12.72	3.56	6.16
2006	1.43	0.40	1.03	12.72	3.56	6.16
2007	1.43	0.40	1.03	12.72	3.56	6.16
2008	1.43	0.40	1.03	12.72	3.56	6.16
2009	1.43	0.40	1.03	12.72	3.56	6.16
2010	1.43	0.40	1.03	12.72	3.56	6.16
2011	1.43	0.40	1.03	12.72	3.56	6.16

Notes: Total port costs and benefits components of Huli are calculated from 6.75 per cent of the Xiamen port project.

Source: World Bank, *Xiamen Port Project*, Staff Appraisal Report, N0.7296-CHA, World Bank, Washington D.C., 1988.

Appendix Table B4
Economic analysis of the Huli zone: base case (1980=100, million yuan at border price)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	2015
Total benefits	0.03	0.21	0.40	12.43	93.26	109.32	150.88	152.64	150.47	150.47
Output (D)				5.47	63.66	88.42	121.98	121.98	121.98	121.98
Unskilled (F)				0.17	0.47	0.90	1.19	1.19	1.19	1.19
Skilled (F)				0.09	0.24	0.47	0.52	0.52	0.52	0.52
Raw materials (F)				0.02	15.56	6.80	11.89	11.89	11.89	11.89
Machinery (F)					0.25	0.47	1.31	1.31	1.31	1.31
Electricity (F)		0.09	0.21	0.26	0.31	0.40	0.69	0.69	0.69	0.69
Water (F)	0.03	0.04	0.06	0.06	0.08	0.08	0.09	0.09	0.09	0.09
Rents (F)					0.13	0.50	0.95	1.15	1.15	1.15
Building purchased (F)			2.81	1.98	0.12	0.92	2.33	--	--	
Interest and principal (F)				0.16	0.32	0.47	0.63	0.79	0.79	
Taxes (F)		0.09	0.13	3.55	10.41	10.85	10.85	10.85	10.85	10.85
Port charges (F)										
Total costs	-10.40	-45.29	-123.02	-443.49	-446.74	-124.63	-160.25	-91.40	-65.86	-67.78
Opportunity cost of										
Unskilled (T)				-0.68	-1.93	-3.65	-4.81	-4.81	-4.81	-4.81
Skilled (T)				-1.59	-4.44	-8.40	-9.40	-9.40	-9.40	-9.40
Raw materials (T)				-0.06	-49.23	-21.52	-37.62	-37.62	-37.62	37.62
Machinery (T)					-0.67	-1.23	-3.50	-3.50	-3.50	-3.50
Electricity (T)		-0.59	-1.32	-1.68	-2.02	-2.56	-4.46	-2.81	-2.81	-2.81
Water (T)	-0.20	-0.26	-0.37	-0.39	-0.50	-0.48	-0.60	-0.52	-0.52	-0.52
Domestic borrowing				-5.48	-5.48	-5.48	-5.48	-5.48		
Construction (T)	-9.76	-42.48	-115.96	-414.44	-365.56	-77.72	-90.20	-26.04	-2.60	-2.60
Administration (T)	-0.44	-1.96	-5.37	-19.17	-16.91	-3.59	-4.18	-1.22	-1.22	
Port (T)									-3.38	--
Net cash flow	-10.37	-45.08	-122.62	-431.06	-353.48	-15.31	-9.37	61.24	84.61	82.69
Project life		25 years			30 years		40 years			50 years
Discount rate		9			9		9			9
PV benefits		945.39			1014.17		1086.77			1117.35
PV costs		-1235.60			-1264.43		-1294.75			-1307.51
NPV net cash flow		-290.21			-250.25		-207.98			-190.16
IRR		3.77			5.11		6.28			6.73

Notes: Domestic investment (D); Foreign investment (F); total of Huli zone (T); Present value (PV); Net present value (NPV); Internal rate of return (IRR).

Appendix Table B5
Economic analysis of foreign investment in the Huli zone (1980=100, million yuan at border price)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	2015
Total benefits	0.03	0.21	0.40	6.96	29.60	20.90	28.90	30.66	28.49	28.49
Unskilled				0.17	0.47	0.90	1.19	1.19	1.19	1.19
Skilled				0.09	0.24	0.47	0.52	0.52	0.52	0.52
Raw materials				0.02	15.56	6.80	11.89	11.89	11.89	11.89
Machinery					0.25	0.47	1.31	1.31	1.31	1.31
Electricity		0.09	0.21	0.26	0.31	0.40	0.69	0.69	0.69	0.69
Water	0.03	0.04	0.06	0.06	0.08	0.08	0.09	0.09	0.09	0.09
Rents					0.13	0.50	0.95	1.15	1.15	1.15
Building purchased			2.81	1.98	0.12	0.92	2.33	--	--	
Interest and principal				0.16	0.32	0.47	0.63	0.79	0.79	
Taxes		0.09	0.13	3.55	10.41	10.85	10.85	10.85	10.85	10.85
Port charges										
Total costs	-2.90	-12.67	-34.45	-133.45	-128.89	-38.61	-48.53	-29.27	-17.87	-18.40
Opportunity cost of										
unskilled				-0.17	-0.50	-0.95	-1.25	-1.25	-1.25	-1.25
skilled				-0.41	-1.15	-2.18	-2.44	-2.44	-2.44	-2.44
raw materials				-0.02	-13.78	-6.03	-10.54	-10.54	-10.54	-10.54
machinery					-0.19	-0.35	-0.98	-0.98	-0.98	-0.98
electricity		-0.16	-0.37	-0.48	-0.56	-0.72	-1.25	-0.79	-0.79	-0.79
water	-0.05	-0.07	-0.11	-0.11	-0.14	-0.14	-0.16	-0.16	-0.16	-0.16
domestic borrowing				-5.48	-5.48	-5.48	-5.48	-5.48		
construction	-2.73	-11.89	-32.47	-116.04	-102.36	-21.76	-25.26	-7.29	-0.73	-0.73
administration	-0.12	-0.55	-0.15	-10.74	-4.73	-1.00	-1.17	-0.34	-0.03	-0.03
port									-0.95	--
Net cash flow	-2.87	-12.46	-34.05	-126.49	-99.29	-17.71	-19.63	1.39	10.62	10.09
Project life		25 years			30 years		40 years			50 years
Discount rate		9								
PV benefits		196.45			228.84210.21		223.80			229.46
PV costs		-358.58			-366.39		-374.61			-378.06
NPV net cash flow		-162.13			-156.18		-150.80			-148.60
IRR		0			0		1.17			2.06

Notes: Present value (PV); Net present value (NPV); Internal rate of return (IRR).

Appendix Table B6

Economic analysis of domestic investment in the Huli zone (1980=100, million yuan at border price)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	...2015
Total output				5.47	63.66	88.42	121.98	121.98	121.98	121.98
Unskilled labour				-0.51	-1.43	-2.71	-3.56	-3.56	-3.56	-3.56
Skilled labour				-1.18	-3.29	-6.22	-6.96	-6.96	-6.96	-6.96
Electricity		-0.43	-0.95	-1.21	-1.45	-1.84	-3.21	-3.21	-3.21	-3.21
Water	-0.15	-0.19	-0.26	-0.29	-0.37	-0.34	-0.44	-0.44	-0.44	-0.44
Raw materials				-0.04	-35.45	-15.49	-27.08	-27.08	-27.08	-27.08
Machinery					-0.48	-0.89	-2.52	-2.52	-2.52	-2.52
Construction	-7.03	-30.59	-83.49	-298.40	-263.20	-55.96	-64.94	-18.75	-1.88	-1.88
Administrative	-0.33	-1.41	-3.86	-13.80	-12.17	-2.59	-3.00	-0.87	-0.09	-0.09
Port charges									-2.43	-3.82
Total costs	-7.51	-32.62	-88.56	-315.43	-317.84	-86.04	-111.71	-63.39	-48.17	-49.56
Net cash flow	-7.51	-32.62	-88.56	-309.96	-254.18	2.38	10.27	58.59	73.81	72.42
Project life		25 years			30 years			40 years		50 years
Discount rate		9								
PV benefits		748.94			803.96			862.96		887.89
PV costs		-882.28			-903.37			-925.57		-934.91
NPV		-133.34			-99.41			-62.61		-47.03
IRR		5.78			6.92			7.89		8.24

Notes: Present value (PV); Net present value (NPV); Internal rate of return (IRR).

Appendix Table B7
Summary of sensitivity analysis (1980=100, million yuan at border price)

	Case (1)	Case (2)	Case (3)	Case (4)	Case (5)	Case (6)	Case (7)
PV benefits	920.52	962.40	942.34	997.61	945.39	945.39	942.34
PV costs	-1235.60	-1235.60	-1193.30	-1235.60	-1157.06	-988.48	-954.64
NPV	-315.08	-273.20	-250.96	-237.99	-211.68	-43.09	-12.30
ERR (%)							
25 years	3.27	4.10	4.43	4.78	4.89	8.10	8.74
30 years	4.66	5.41	5.71	6.02	6.12	9.05	9.64
40 years	5.90	6.55	6.81	7.08	7.17	9.79	10.33
50 years	6.38	6.98	7.22	7.47	7.55	10.03	10.54

Notes:
Case 1 = tariff inclusive prices for local sales;
Case 2 = 20% increase in local raw materials and capital goods inputs;
Case 3 = without domestic borrowing and subsidies in utilities;
Case 4 = tariff exclusive prices for local sales;
Case 5 = 10% reduction in government total construction costs;
Case 6 = 20% reduction in total costs including administrative cost;
Case 7 = 20% reduction in total costs including administrative cost and without domestic borrowing and subsidies in utilities prices;
PV = present value;
NPV = net present value;
ERR = economic rate of return.

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