

## A SPECIFIC FACTORS APPROACH TO THE ANALYSIS OF LABOR POLICY IN SINGAPORE

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### I. INTRODUCTION

**D**URING the past decade, the Singapore government has sought to restructure its economy toward industries which are more intensive in capital, skilled labor, and technology. In 1979, for example, the National Wages Council (NWC) initiated a "wage correction policy" which began three successive years of recommended high real wage increases designed to discourage firms from continuing to rely on cheap, unskilled labor.<sup>1</sup> This policy was subsequently seen as contributing to a considerable slowdown in economic growth by the mid-1980s (see, for example, [21]). Since then, the same objectives have been pursued through the regulation of the supply of unskilled as well as various types of skilled labor in the economy. This is done through a virtual public monopoly of education and the training at all levels and through the control of foreign labor migration using a work permit system.<sup>2</sup>

Clearly, the objective of the government is to foster growth in skill-intensive industries by making factors specific to those industries less scarce. The result is an acceleration of the natural shift in the pattern of Singapore's comparative advantage, away from industries intensive in natural resources and unskilled labor, as its economy grows [12] [7]. Appropriate reasons for fostering this acceleration include the anticipation of a shift in the international terms of trade favoring skill-intensive products and services, presumably because such products and services

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<sup>1</sup> The NWC, founded in 1972, is a tripartite body with high level representation by the government, unions, and employers. It seeks to ensure orderly wage settlements and makes annual recommendations to wage increases. Prior to 1985, the same set of nominal wage guidelines were applied across-the-board to all companies in all sectors. The objective of the wage surge of 1979-81 was "... to phase out the low quality labor-intensive industries which have experienced rapid growth between 1973 and 1979 ..." [14, p. 35].

<sup>2</sup> For discussions of the details of Singapore's wage and manpower policies, see Lim and Associates [14].

are income-elastic in demand. Alternatively, technological improvements might be anticipated which will increase preparedness to pay for complementary skilled labor. These are not unreasonable expectations on the part of the government [1]. Either way, depending on the cost of the adjustments undertaken, there is the potential for net improvements in economic welfare.

In this paper Singapore's restructuring policies are analyzed in general equilibrium. The approach used is based on the idea that most labor skills are sector-specific and that skilled labor is therefore comparatively immobile between sectors. Thus, an appropriate analytical tool is the open economy model with some sector-specific factors. This model was originated by Haberler [9, Chapter 12], revived by Jones [11] and developed by Mayer [15] and Mussa [16]. The results fuelled the subsequent "booming sector" literature, which addressed the effects on a whole economy of sudden changes in endowments of specific factors [4]. Throughout that literature, however, specificity has been restricted to capital and natural resources. A recent example is by Edwards [6] in which, although sector-specific wage rigidities are examined, labor is homogeneous and intersectorally mobile.

Labor specificity was first introduced by Baldwin [2], to explain collusion by labor and capital in seeking industrial protection. Empirical evidence from the United States studies [10] [17] [20] clearly demonstrates the importance of sector specificity, even for low-skill workers. These studies showed that permanently displaced workers generally suffer a significant and sustained loss of earnings due in part to the redundancy of old industry-specific skills. Our interest is to examine the economic effects of this sector specificity in the presence of Singaporean labor policies. In particular, we examine the economic effects of increases in the endowments of labor specific to particular sectors. How will anticipated changes in technology and the international terms of trade facing Singapore interact with the shifts in labor endowments induced by manpower policy? What are the effects of a centrally determined wage surge of the type which occurred in 1979-81?

For this purpose we begin with a traditional neoclassical general equilibrium model with seven sectors and intersectorally mobile capital and labor. To serve our emphasis on skilled labor endowments and wages, we expand the number of primary factors to seven, adding five types of sector-specific labor.<sup>3</sup> In Section II, which follows, we offer a brief introductory review of the theoretical implications of skill specificity. Then Section III describes the salient features of the general equilibrium model used. Section IV examines the implications of sector-specific skilled labor when technology and the terms of trade are changing. In Section V, the economic benefits from labor force restructuring are assessed, with and without changes in technology and the terms of trade. These results are then compared, in Section VI, with the effects of wage increases similar to those which took place in 1979-81. Finally, the main conclusions are summarized in Section VII.

<sup>3</sup> An extensive survey by Decaluwe and Martens [5] suggests that these issues have not previously been investigated in a developing country context using specific-labor models.

## II. IMPLICATIONS OF LABOR SKILL SPECIFICITY

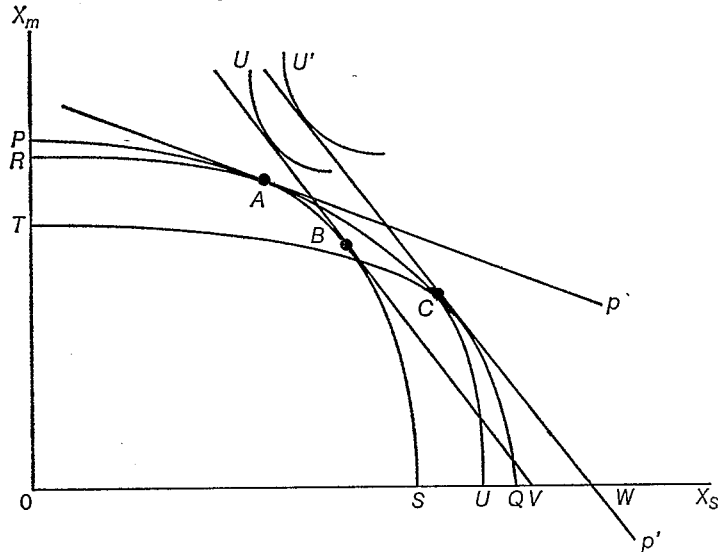
Full factor mobility requires that sufficient time be allowed for the depreciation of specific factors without replacement in declining sectors, and new additions to the endowments of factors specific to other sectors. Skilled labor can also be mobile between sectors through retraining. For many types of human capital, however, it may be argued that depreciation and training/retraining take considerably longer than it takes for the corresponding sector-specific capital to depreciate. This is most clearly the case in the skill-intensive service industries such as engineering, financial services, and health. Moreover, where there exist international markets for physical capital goods, medium-run sectoral mobility can be enhanced by exchange in such markets. Social and cultural factors, on the other hand, restrict a similar international exchange of skilled labor. With this rationale, we focus hereafter on labor skill specificity, assuming a length of run in which capital is intersectorally mobile.

Consider a small open economy with two tradeable goods sectors, manufactures ( $M$ ) and services ( $S$ ). Three factors of production are found in the economy: capital ( $K$ ), which is mobile between sectors, and two types of skilled labor, each specific to a different sector (let  $L_m$  be used in sector  $M$  and  $L_s$  in sector  $S$ ). Production functions exhibit diminishing returns to variable factors and profit maximization implies that the rate of factor payment will be equal to the factor's marginal product. The mobility of capital distributes itself between the sectors until its rate of return is equalized in both sectors. Product prices ( $P_m$  and  $P_s$ ) are exogenous and are equal to the unit cost of production. For the moment, assume also that factor prices are perfectly flexible such that full employment prevails in all factor markets.

In this simple model the effects of manipulation of  $L_m$  and  $L_s$  are readily analyzed. Given that the control over these quantities in Singapore rests primarily with the government, through its training and immigration policies, it is appropriate to ask under which circumstances should action be taken to redistribute the labor force between skill categories. Clearly, such action would be justified if substantial changes in relative market wages were anticipated. In rapidly growing economies continuous skill upgrading is required to avoid extraordinary scarcity in some labor markets.

One justification for the acceleration of this process is the anticipation of external "shocks" such as changes in technology or the terms of trade. A surge in services technology observed abroad, for example, would foreshadow catch-up once-and-for-all total factor productivity (TFP) improvements confined to the Singapore economy. Alternatively, the Report of the Economic Committee (Ministry of Trade and Industry [21]) predicts slower trade in merchandise in the future, and identifies international tradeable services as a pillar of future growth. This implies the anticipation of greater growth in demand for Singapore's exported services than for its exported merchandise and hence a shift in the terms of trade favoring the services sector. In the above theoretical framework, this can be modelled as a rise in  $P_s$  relative to  $P_m$ .

Fig. 1. Effects of a Services Boom



These exogenous changes cause some sectors to boom and some to lag, affecting relative demand for the various types of sector-specific skilled labor. This can be clearly illustrated by applying the simple model to the case of a services boom—say a shift in the terms of trade raising  $P_s$ .<sup>4</sup> At the initial allocation of capital between the two sectors, the marginal revenue product of capital in sector S rises relative to that in sector M. This induces an outflow of capital from sector M until its marginal product is once again equalized in both sectors. Since a fixed endowment of  $L_m$  is now being used in combination with a smaller amount of capital,  $K_m$ , the rate of payment to  $L_m$  falls in terms of any numeraire. Conversely,  $W_s$  increases in terms of any numeraire as a result of a greater amount of capital in sector S. From a policy perspective, the rise of  $W_s$  relative to  $W_m$  has important implications: first, it reflects the increase in demand for  $L_s$  relative to  $L_m$ ; second, the relative returns to human capital investment have shifted in favor of  $L_s$ . Thus, there are now reasons for a government empowered to manage the supplies of  $L_s$  and  $L_m$  to permit an increase in the relative endowment of  $L_s$ .

Abstracting from the costs of human capital formation, the gains arising from increasing the endowment of  $L_s$  relative to  $L_m$  can also be demonstrated as in Figure 1, where the shift in factor endowments changes the shape of the production possibilities frontier and equilibrium occurs at a social indifference curve associated with a higher welfare level. With  $X_m$  (the output of sector M) drawn on the vertical axis and  $X_s$  (the output of sector S) drawn on the horizontal axis, PQ shows the production possibilities frontier whereby both capital and skilled labor are freely mobile between the sectors. This is the production possibilities frontier of the

<sup>4</sup> While the analysis offered here examines the case of a terms of trade shift, the same can be shown for a TFP change favoring one sector relative to another, as well as for an increased in capital endowment favoring the relatively capital-intensive sector.

Heckscher-Ohlin (HO) framework in the international trade literature. This "HO" production possibilities frontier is the envelope of all production possibilities frontiers each drawn for a given fixed allocation of skilled labor between  $S$  and  $M$ , with capital as the only mobile factor (denote these as the specific factors or "SF" production possibilities frontiers).<sup>5</sup>

Given an initial terms of trade represented by the price line  $p$ , national income (and welfare) is maximized with production at point  $A$ , with a  $L_s/L_m$  ratio such that the "SF" production possibilities frontier  $RS$  applies. Suppose that a boom occurs in sector  $S$ , in the form of a favorable terms of trade shift. The price line is now  $p'$ , and under the original  $L_s/L_m$ , endowment ratio, production shifts to point  $B$ . A reallocation of skilled labor in the direction of raising the  $L_s/L_m$  ratio can now raise national income. The best such reallocation, assuming production remains efficient, yields point  $C$ , where national income is maximized. At this point, the  $L_s/L_m$  ratio is consistent with the "SF" production possibilities frontier given by  $TU$ . The social welfare gain associated with the shift from  $RS$  to  $TU$  is given by the difference in the utility levels between the social indifference curves  $U'$  and  $U$ , but a practical indicator of this gain is provided by the rise in national income given by  $WV$  when measured in terms of  $X_s$ .

Whether the economy should be pushed all the way to point  $C$  still depends on the cost of shifting the "SF" production possibilities frontier from  $RS$  to  $TU$ , which in turn, depends on the process of human-capital formation. An appropriate response by the government to the terms of trade shock must, however, relocate production on that "SF" production possibilities frontier which touches the "HO" production possibilities frontier somewhere along  $AC$ . In other words, the  $L_s/L_m$  ratio should be raised. In a growing economy (with an expanding labor force),  $L_s$  should be increased at a faster rate than  $L_m$ . Here, it should be noted that the guide for strategic manpower policy lies essentially in knowing the effects of exogenous shocks such as this shift in the terms of trade, on the structure of relative wages.

In the above general equilibrium model with booming sector effects, the burden is placed on the flexibility of real wages to ensure full employment of each sector-specific skilled labor. However, this situation would not prevail were rigidities in absolute and relative real wages to exist, as in Singapore under the NWC wage guidelines of the 1979–83 period. Where only a downward rigidity (below recommended increases) occurs, excess demand for each type of labor may be removed by real wages rising above recommended increases. Unless recommended wage relativities are finely tuned, some excess supply must generally remain resulting in less-than-full employment in some sectors.

Given neoclassical production functions, any less-than-full employment situation arising out of a rigid wage system must also lower the real returns to the given stock of physical capital and therefore the incentives for further investment. The losses in national income and its growth are obvious under these circumstances. Further-

<sup>5</sup> The envelope relationship between the "HO" production possibilities frontier and the "SF" production possibilities frontier is derived analytically by Mayer [15]. For all the "SF" production possibilities frontiers, the overall skilled-labor force ( $L_m + L_s$ ) is held constant.

more, although the appearance of a more capital-intensive economy may well result from general real wage increases, it comes at the expense of reduced employment levels. NWC wage guidelines, emphasizing as they do across-the-board increments, are therefore unlikely to be more than blunt instruments at best in the process of labor force restructuring (see [14, p. 36]). As is evident from the quantitative analysis which follows, wage policy with rigid relativities is most effective as an instrument for income redistribution.

### III. THE CGE MODEL

To relax the restrictive assumptions necessary for graphical analysis and to more closely approximate the economic environment in which manpower policy decisions are made in Singapore we have opted to use a computable general equilibrium model. Such models readily allow a number of the generalizations essential to the representation of skilled and unskilled labor markets with limited intersectoral labor mobility. These include extensive disaggregation of sectors and primary factors, a mix of mobile and sector-specific factors, and intersectoral linkages through intermediate goods markets.

The model used is an extension of that introduced in Tyers [22] which manipulates a simple social accounting matrix (SAM) in response to changes in factor endowments, production technologies, the terms of trade, or indirect taxation.<sup>6</sup> Its analytical formulation generalizes that of Boadway and Treddenick [3] to multiple primary factors. It is solved iteratively using a Walrasian adjustment algorithm across all the factor markets. The model is summarized algebraically in Appendix A.

It has seven sectors and seven factors of production, five of which are sector-specific. Capital and unskilled labor are homogeneous and are used in all sectors. Each sector uses at most one of five types of skilled labor, and the "commerce" and "financial and business services" sectors are assumed to share the same skilled labor. Table I summarizes the factors of production used in each sector. Neoclassical perfectly competitive product and factor markets are assumed and profit-maximizing firms and utility-maximizing households in the model act independently to jointly determine general equilibrium outcomes. Each sector produces only one good which is perfectly substitutable for the corresponding good produced abroad. Production functions are Cobb-Douglas in primary factors and fixed coefficients are assumed for intermediate inputs.<sup>7</sup> Households, corporations, and government are combined in the model into the aggregate of institutions, which derives income from selling factor services and from tariff revenue. Expenditure decisions maximize utility for a given level of income, assuming Cobb-Douglas utility functions. Hence, income and price elasticities of demand are assumed to

<sup>6</sup> See Pyatt [19] for a review of such models. A more recent version of the same model, which allows for imperfect competition, is presented by Gunasekera and Tyers [8].

<sup>7</sup> The assumption of unitary elasticities of substitution in production is readily relaxed by postulating CES production functions. In the absence of better information on these elasticities, simpler Cobb-Douglas functions serve well enough.

TABLE I  
FACTORS OF PRODUCTION USED IN EACH SECTOR, AND SKILL-INTENSITY

	Capital	Unskilled Labor	Manufacturing Labor	Utilities and Construction Labor	Financial and Commercial Labor	Transport and Communications Labor	Other Services Labor	Skilled Labor Intensity (%)
1. Agriculture, mining, and low-skill manufacturing	X	X						0
2. High-skill manufacturing	X	X	X					25
3. Utilities and construction	X	X		X				26
4. Commerce	X	X			X			27
5. Transport and communications	X	X				X		21
6. Financial and business services	X	X			X			31
7. Other services	X	X					X	59

Note: Labor force disaggregation is discussed in Appendix B. The intensity of skilled-labor use is simply the value added share of skilled labor in each industry, as derived from the SAM in Table II.

hold unit values. All sectors produce tradeable goods except the utilities and construction sector. For these tradeable sectors, excess demand in the rest of the world for Singapore's exports and the corresponding excess supply of imports are given by constant elasticity functions of border prices expressed in foreign currencies. The exchange rate adjusts endogenously to obtain current account balance.

The parameters of the model are derived from a benchmark SAM for the year 1983 (see Table II). This SAM is simplified to accord with the assumptions of the model. A more complete version is available in Ng [18]. The model is calibrated so as to reproduce this benchmark SAM as the reference general equilibrium solution. Appendix B lists the data sources from which the SAM and the parameters of the model more generally, are derived. In counterfactual experiments, the model proceeds from the reference general equilibrium to a new general equilibrium solution. Once convergence is achieved, a new internally consistent SAM is assembled.

#### IV. EXOGENOUS SHOCKS WITH FIXED LABOR FORCE STRUCTURE

So long as the economy is on its production possibility envelope ( $PQ$  in Figure 1) no reallocation of labor between skill groups is necessary, unless the economy is shocked in such a way that either the terms of trade or the production possibility envelope are altered. The exception to this is the case in which unskilled labor is transformed into skilled labor. Then there is a net increase in the human capital stock and hence a net outward shift in the envelope is possible. In this case, of course, the gains in production must be weighed against the cost of the transformation. In Singapore and other rapidly growing developing countries, however, changes in technology and the capital stock are comparatively rapid. Labor policy, particularly as it affects skill levels and their sectoral distribution, must be made in anticipation of such changes. We have therefore arranged a feasible though hypothetical set of shocks to the terms of trade, the physical capital endowment, and total factor productivity which provide a context within which to examine manpower and wages policies.

These are (i) an expansion in services relative to manufacturing trade (shift in the external terms of trade favoring the services sectors) simulated by a 5 per cent lateral shift in the rest of the world's excess demand functions for the "transport and communications" and the "other services" sectors, and a 10 per cent shift in the rest of the world's excess demand function for the "financial and business services" sector; (ii) technological catch-ups in all sectors, simulated by local improvements in total factor productivity ranging between 10 per cent in the "utilities and construction" sector and 20 per cent in the "financial and business services";<sup>8</sup> and (iii) the further accumulation of physical capital as a consequence of

<sup>8</sup> The hypothetical changes (in per cent) in total factor productivity actually introduced are as follows: 1. agriculture, mining, and low-skill-intensive manufacturing=12.5; 2. high-skill-intensive manufacturing=12.5; 3. utilities and construction=10.0; 4. commerce=12.5; 5. transport and communications=15.0; 6. financial and business services=20.0; and 7. other services=15.0.



TABLE  
THE BENCHMARK

Incomes to	Factors of Production						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Factors of production:							
Capital (1)							
Unskilled labor (2)							
Manufacturing labor (3)							
Financial/commerce labor (4)							
Utilities/construction labor (5)							
Transport/communications labor (6)							
Other services labor (7)							
Institutions (8)	18,413	8,181	1,486	3,595	1,312	993	2,168
Production sectors:							
Agricultural/mining/low-skill manufacturing (9)							
High-skill manufacturing (10)							
Utilities/construction (11)							
Commerce (12)							
Transport/communications (13)							
Financial/business services (14)							
Other services (15)							
Rest of world current account (16):							
Agricultural/mining/low-skill manufacturing							
High-skill manufacturing							
Utilities/construction							
Commerce							
Transport/communications							
Financial/business services							
Other services							
Total (17)	18,413	8,181	1,486	3,595	1,312	993	2,168

local and foreign investment, amounting to a net increase in the endowment of 20 per cent. The general equilibrium outcomes from each of these shocks indicate the relative fortunes of each type of labor in the economy. Were these shocks to represent changes in the economic environment which are anticipated by the government, the changes in wage relativities predicted by the model would suggest the appropriate direction of any strategic manpower policy response.

II  
SAM, 1983

Expenditure by									
Institutions		Production Sectors					ROWCA	Total	
(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
	1,953	3,743	2,431.6	3,378.3	2,947.3	3,524.6	434.7		18,413
	2,300	640	1,214	1,390.1	866	639.4	1,077.2		8,181
		1,486							1,486
				1,744.4		1,850.4			3,595
			1,312						1,312
					993				993
							2,168		2,168
511									36,659
3,066	8,243	1,492	1,284	884	166	263	751		16,148
586	1,866	27,198	3,715	311	1,621	352	872		36,520
9,682	300	397	77	235	115	223	281		11,309
5,383	581	522	396	748	282	249	197	3,325	11,681
1,543	260	296	94	1,166	2,876	404	80	3,922	10,640
3,060	561	675	766	1,622	562	1,807	366	297	9,715
2,214	84	71	20	204	212	349	197	3,071	6,423
5,850									5,850
4,765									4,765
36,659	16,148	36,520	11,309	11,681	10,640	9,715	6,423	10,615	

A. *The Effects of Services Trade Expansion*

The shifts in global excess demand for the products of the three favored services sectors cause favorable changes in their terms of trade. The resulting scenario is typical of those analyzed in the booming sector literature: substantial expansion in both output and exports from the favored sectors and a real revaluation (of about

TABLE III  
CHANGES IN ECONOMIC STRUCTURE FOLLOWING EXPANSION IN SERVICES TRADE

	Real Gross Value of Output	Net Exports (Imports)	Employment of Mobile Factors	
			Unskilled Labor	Physical Capital
1. Agriculture, mining, and low-skill manufacturing	-18	(26)	-16	-19
2. High-skill manufacturing	-5	(11)	-4	-7
3. Utilities and construction	1	—	1	0
4. Commerce	-10	-34	-8	-11
5. Transport and communications	22	46	27	23
6. Financial and business services	9	276	11	8
7. Other services	10	17	15	12

Source: Analysis using the model described in the text.

Note: The favored sectors (5, 6, and 7) experience lateral shifts in the rest-of-the world's excess demand functions of 5, 10, and 5 per cent, respectively.

a per cent). The expansion of the service sectors causes a "resource pull" effect which draws mobile factors from other sectors, while the revaluation reduces the international competitiveness of those other sectors and so they contract. These effects are clear from Table III, which shows the composite "agriculture, mining, and low-skill manufacturing" sector to decline the most. Note, however, that the "utilities and construction" sector is comparatively unaffected. This is because, although the services expansion stimulates the demand for the products of this sector (as intermediate inputs), they are explicitly nontraded goods, so that the expansion cannot come from imports. The terms of trade change is favorable to the economy as a whole and so real GDP increases (by 1.5 per cent) as do the rewards to skilled labor specific to the booming sectors. The real wage of skilled labor in the "transport and communications" sector increases the most (by 25 per cent). Since the commerce sector is not favored by the terms of trade change, as we have simulated it, that sector contracts. Its skilled labor, which is mobile to the "financial and business services" sector, does not enjoy any significant change in its real wage. These results therefore suggest that, were the expansion in services trade the only anticipated external shock, priority should be given in manpower policy to the development of skills specific to the "transport and communications" and "other services" sectors.

#### B. *The Effects of the Combined Exogenous Shocks*

When the expansion in services trade is combined with our hypothetical improvements in total factor productivity in all sectors and an expansion in the stock of physical capital, the effects on economic structure and GDP are substantially larger. All these changes favor the net-exporting services sectors more than

TABLE IV  
CHANGES IN ECONOMIC STRUCTURE FOLLOWING THE COMBINED EXOGENOUS SHOCKS

	Real Gross Value of Output	Net Exports (Imports)	Employment of Mobile Factors	
			Unskilled Labor	Physical Capital
1. Agriculture, mining, and low-skill manufacturing	-3	(63)	-23	-8
2. High-skill manufacturing	25	(22)	5	19
3. Utilities and construction	25	—	9	23
4. Commerce	11	-19	-8	7
5. Transport and communications	57	92	39	54
6. Financial and business services	33	403	11	25
7. Other services	23	17	7	21

Source: Analysis using the model described in the text.

Note: The exogenous shocks are increased global excess demand for exported services, technological catch-ups in all sectors, and increased physical capital endowment, as detailed in Section IV of the text.

the import-competing sectors but the large (20 per cent) increase in the physical capital stock ensures that there is expansion even in the import-competing "high-skill manufacturing" sector (Table IV). The net effects cause contraction only in the "agriculture, mining, and low-skill manufacturing" sector, where the "resource pull" and "competitiveness" (real revaluation) effects outweigh the gains in total factor productivity and from more abundant physical capital.

Real GDP expands by a total of 26 per cent, about half of which is due to the changes in total factor productivity and most of the remainder to the expansion in the capital stock. Since no expansion in the overall labor force is yet assumed to accompany these shocks, all real wages rise. Once again, the largest increase is in the wage of skilled labor in the "transport and communications" sector (60 per cent). That of unskilled labor rises by 20 per cent and the wages of all other skill groups increase by about a quarter.

Were all three exogenous shocks to be anticipated, these shifts in the pattern of wage relativities indicate that returns to the transformation of unskilled into skilled labor are greatly enhanced and that skilled labor specific to the "transport and communications" sector should receive the first priority.

## V. EVALUATING MANPOWER POLICY

To illustrate the use of our proposed approach to labor market policy, we examine one possible manpower planning strategy which might be adopted in anticipation of the shocks introduced in Section IV. Let us imagine that, in the time it takes for the shocks to be fully manifest, normal population growth would see a net

TABLE V  
LABOR FORCE COMPOSITION UNDER ALTERNATIVE MANPOWER POLICIES

Labor Type	1983 Endowment (1,000 Man-Years)	Growth with Constant Composition		Growth with Restructuring		
		Endowment (1,000 Man-Years)	Share of Total (%)	Endowment (1,000 Man-Years)	Change (%)	Share of Total (%)
Unskilled	854	939	73	924	8	72
Skilled	316	347	27	362	15	28
Manufacturing	68	75	5.8	76	12	5.9
Financial and commercial	110	120	9.3	123	13	9.6
Utilities and construction	23	26	2.0	27	16	2.1
Transport and communications	39	43	3.3	47	21	3.7
Other services	76	84	6.5	90	17	7.0
Total labor force	1,170	1,287	100.0	1,287	10	100.0

Sources: The initial (1983) labor force composition is derived as explained in Appendix B. The modifications due to manpower policy are hypothetical.

Note: Both alternative policies are based on an increase in the overall labor force of 10 per cent. In the first case, all labor types are increased by the same proportion. The second policy increases the endowments of each type of labor by amounts which depend upon the predicted changes in wage rates following the exogenous shocks discussed in Section IV.

TABLE VI  
CHANGES IN ECONOMIC STRUCTURE DUE TO THE EXOGENOUS SHOCKS  
COMBINED WITH ALTERNATIVE MANPOWER POLICIES

(%)

	Growth with Constant Composition		Growth with Restructuring	
	Value Added	Employment	Value Added	Employment
1. Agriculture, mining, and low-skill manufacturing	-16	-6	-22	-16
2. High-skill manufacturing	27	10	28	10
3. Utilities and construction	35	16	35	16
4. Commerce	16	2	18	2
5. Transport and communications	61	30	67	37
6. Financial and business services	37	19	38	20
7. Other services	38	16	45	22

Source: Analysis using the model described in the text.

Note: The exogenous shocks are increased global excess demand for exported services, technological catch-ups in all sectors, and increased physical capital endowment, as detailed in Section IV of the text. The alternative manpower policies affect labor force size and composition only, as indicated in Table V.

increase in the labor force of 10 per cent. Policies directed at education, training, and immigration might then be tuned to ensure that the growth of skilled exceeds that of unskilled labor and that, in particular, the supply of skilled workers in the "transport and communications" sector is increased most. One such manpower planning strategy is documented in Table V.

Our hypothetical strategy of growth with restructuring has 60 per cent of the increase in the labor force accruing to the skilled categories. The endowments of those types of skilled labor atop the hierarchy of proportional real wage changes receive larger increases. In what follows, we compare this strategy with one ensuring the same growth in the overall labor force but with unchanged composition—the supply of each type of labor is expanded equally.

The sectoral structure of the economy is substantially affected by the combination of the increase in the overall labor force with the exogenous shocks (Table VI). The additional effects due to manpower restructuring, concentrated as they are within only 10 per cent of the labor force, are smaller and more localized. Nevertheless, restructuring considerably accelerates the decline in the composite "agriculture, mining, and low-skill manufacturing" sector and the growth in the "transport and communications" and "other services" sectors. It clearly contributes to the objectives of the existing Singaporean policy, as articulated by Lim and Associates [14].

The effects of manpower restructuring on national income and its distribution are summarized in Table VII. With only labor force growth and no exogenous

TABLE VII  
CHANGES IN NATIONAL INCOME AND ITS DISTRIBUTION  
DUE TO ALTERNATIVE MANPOWER POLICIES

	GDP	GDP at Factor Cost <sup>a</sup>	Factor Rewards (per Unit) <sup>b</sup>		
			Physical Capital	Unskilled Labor	Skilled Labor
No exogenous shocks:					
Growth with constant labor force structure	4.8	4.7	4.1	-3.5	-4.5
Growth with labor force restructuring	5.5	5.4	4.6	-2.8	-5.6
With exogenous shocks:					
Growth with constant labor force structure	31	31	10	16	22
Growth with labor force restructuring	33	32	11	17	20

Source: Analysis using the model described in the text.

Note: The exogenous shocks are increased global excess demand for exported services, technological catch-ups in all sectors, and increased physical capital endowment, as detailed in Section IV of the text. The alternative manpower policies affect labor force size and composition only, as indicated in Table V.

<sup>a</sup> GDP at factor cost differs from GDP only in that it excludes import tariff revenue.

<sup>b</sup> Since no unemployment is created, the factor rewards (per unit of endowment) are the rate of return on physical capital and the market-clearing wage rates.

shocks, GDP grows on the strength of higher returns to physical capital, but real wages decline.<sup>9</sup> The addition of manpower restructuring further enhances this overall economic growth because moving workers into higher-skill jobs improves average labor productivity. Of course, the real wages of skilled workers must decline unless industry expansion affects their demand.<sup>10</sup> When the exogenous shocks are introduced, overall economic growth is very much larger. This time both labor and capital are beneficiaries. And since the shocks favor the skill-intensive sectors most, skilled labor is the greatest beneficiary. Once again, manpower restructuring enhances the growth. It also moderates the increases in the real wages of skilled labor, improving the relative wage of unskilled labor and the returns to capital.

Note that the absolute and proportional increase in national income due to restructuring is larger in the presence of favorable economic shocks. This is not

<sup>9</sup> In the benchmark SAM, about half the total value added accrues to physical capital, with the remainder divided nearly equally between unskilled and skilled labor. See Table II.

<sup>10</sup> This illustrates the strategy advocated in the Report of the Economic Committee [21]: wage restraint (meaning declining real wages or slow real wage growth), combined with improvements in the skill-composition of the labor force. It is a legitimate approach where declining population growth is expected, especially from the viewpoint of industry (capital-owners).

TABLE VIII  
INDEX OF RECOMMENDED AND ACTUAL REAL WAGES AND  
TOTAL LABOR COST (TLC), 1979-82

	Recommended		Actual	
	Wages	TLC	Wages	TLC
1979	100	100	100	100
1980	104	106	104	106
1981	109	113	110	113
1982	119	124	122	127

Sources: [13, Tables 7.3, 7.10]; International Monetary Fund, *International Financial Statistics Yearbook* (Washington, D.C., various years), CPI figures, line 64.

simply due to the increase in scale due to those shocks. It follows from the simple theory in Section II that there are further gains arising from adding more rapidly to the types of skilled labor experiencing greater proportionate real wage increases when there are exogenous shocks.

## VI. EVALUATING WAGES POLICY

In Singapore, the total labor cost (TLC) comprises not only wages but also payroll taxes and contributions to the employers' Central Provident Fund (CPF) and the Skills Development Fund (SDF). While there exists no formal centralized wage-setting mechanism, the government has been able to influence wage settlements via NWC recommendations (see footnote 1) and its power to set the rates of compulsory taxes and contributions to the CPF and SDF.

Our interest is to examine the effects of increases in real labor costs of the order of those recommended (and implemented) in the "wage correction" period (1979-91). These increases are quantified in Table VIII. Drawing on the analysis and data provided by Lee (Tsao) [13], we are able to estimate the recommended three-year real TLC increase for unskilled and skilled labor at 23.7 and 18.5 per cent, respectively (see [18] for details). The difference between the two stems from a fixed absolute component in NWU recommended increases.

The Walrasian structure of our model complicates the solution procedure where price rigidities and disequilibrium are present. Fixing real wages exogenously virtually ensures at least some unemployment. Solutions are obtained by specifying levels of employment for each type of labor, by trial and error, until the target real wage increases are arrived at. In the process, wage rates are occasionally permitted to rise above the target level in order to remove any excess labor demands. By this method, we measure the economic impacts of the recommended wage increases (in combination with the 10 per cent increase in the overall labor force) with and without the exogenous shocks of Section IV.<sup>11</sup>

<sup>11</sup> The 10 per cent labor force increase is similar in magnitude to the increase which might be achievable in three years, combining natural increments with immigration. We do not presume to reproduce the "wage correction" period, however. Note that the model is based on data for 1983.



TABLE IX  
THE UNEMPLOYMENT EFFECTS OF WAGE INCREASES WITH  
ALTERNATIVE MANPOWER POLICIES

Labor Type	Rates of Unemployment <sup>a</sup>		
	No Exogenous Shocks with Constant Labor Force Structure	With Exogenous Shocks <sup>b</sup>	
		With Constant Labor Force Structure	With Labor Force Restructuring
Unskilled	39	13	9
Skilled	33	3	4
Manufacturing	20	0	3
Financial and commercial	29	8	10
Utilities and construction	32	0	2
Transport and communications	11	0	0
Other services	64	0	0
Total labor force	37	10	8

Source: Analysis using the model described in the text.

Note: The real wage increases introduced are listed in Table VIII while the alternative manpower policies are given in Table V. Note that, in all three cases listed, the total labor force expands by 10 per cent.

<sup>a</sup> The rates of unemployment are based on the total endowment of each type of labor. No account is taken of changes in participation rates or repatriation of unemployed non-Singaporean labor.

<sup>b</sup> The exogenous shocks are increased global excess demand for exported services, technological catch-ups in all sectors, and increased physical capital endowment, as detailed in Section IV of the text.

When the wage increases are applied with only the 10 per cent expansion in the overall labor force, their effects on unemployment are substantial, as indicated in Table IX. About a third of both the skilled and the unskilled labor forces are unemployed at the higher wages. When the exogenous shocks are applied, however, most of this extra labor is absorbed. Indeed, when manpower restructuring is also added, the unemployment of unskilled labor falls to 9 per cent (of the order of the rate of unskilled foreign worker participation in the Singapore economy). In the case of skilled workers, the rate is small whether manpower restructuring is introduced or not. It is certainly lower than the corresponding skilled foreign worker participation rate.<sup>12</sup> This suggests that large wage increases like those being applied during the "wage correction" period could have been sustained without significant unemployment of Singaporeans, provided other economic circumstances were sufficiently favorable.

Estimates of the effects of the wage increases on economic structure are provided in Table X, for the case in which the exogenous shocks are added. Whether or not manpower restructuring is introduced, the structural change which results is

<sup>12</sup> This is roughly 7 per cent for unskilled workers and 15 per cent for skilled workers according to data presented by Lim and Associates [14]. These shares are derived by dividing the data in Table 6.7 at a wage rate of S\$1,000 per month.

TABLE X  
CHANGES IN ECONOMIC STRUCTURE DUE TO THE EXOGENOUS SHOCKS  
COMBINED WITH BOTH WAGE AND MANPOWER POLICIES

(%)

	Real Wage Increases with Constant Labor Force Structure		Real Wage Increases with Labor Force Restructuring	
	Value Added	Employment	Value Added	Employment
1. Agriculture, mining, and low-skill manufacturing	-37	-35	-36	-34
2. High-skill manufacturing	33	9	30	8
3. Utilities and construction	28	6	29	7
4. Commerce	11	-9	10	-9
5. Transport and communications	66	28	72	35
6. Financial and business services	32	9	33	10
7. Other services	37	11	44	18

Source: Analysis using the model described in the text.

Note: The exogenous shocks are increased global excess demand for exported services, technological catch-ups in all sectors, and increased physical capital endowment, as detailed in Section IV of the text. The alternative manpower policies are given in Table V, while the wage increases are listed in Table VIII.

substantial. To gauge the effects of the wage increase alone, compare the columns of Table X with the corresponding columns of Table VI. The outstanding result is a very much accelerated decline in the combined "agriculture, mining, and low-skill manufacturing" sector. There are significant losses of (or smaller increases in) employment in that sector as well as in "utilities and construction," "commerce," and "financial and business services."<sup>13</sup>

In the presence of wage increases, labor force restructuring causes the expansion of the "transport and communications" and "other services" sectors. In this respect the results are similar to the case in which wages are set to clear all the labor markets (Table VI). There is one important difference, however. In this case, the manpower policy does not cause the further contraction of the "agriculture, mining, and low-skill manufacturing" sector. Now that sector is able to draw on a pool of unemployed unskilled workers at the regulated wage. Its unit labor cost is therefore not raised by manpower restructuring.

<sup>13</sup> Footnote 1 caveat associated with these results. When the wage increases are applied, the total capital stock is held constant. Since the increases are greatest for unskilled labor, capital is redistributed to more skill-intensive sectors, resulting in real expansion in the "high-skill manufacturing" and the "transport and communications" sectors. In practice, following the wage increase, the return on capital abroad might be more attractive than that in these sectors. Hence, the larger responses by these sectors to exogenous shocks in columns one and three in Table X (with the wage increases) compared with the corresponding columns in Table VI (without them) may be unrealistic.

TABLE XI  
CHANGES IN NATIONAL INCOME AND ITS DISTRIBUTION DUE TO  
BOTH WAGE AND MANPOWER POLICIES

	GDP	GDP at Factor Cost	Factor Rewards (per Unit) <sup>a</sup>		
			Physical Capital	Unskilled Labor	Skilled Labor
No exogenous shocks:					
Real wage increase with constant labor force structure	-16	-15	-10	-26 (23)	-12 (18)
With exogenous shocks:					
Real wage increases with constant labor force structure	26	27	7	15 (23)	24 (24)
Real wage increases with labor force restructuring	28	28	7	19 (23)	22 (21)

Source: Analysis using the model described in the text.

Note: The exogenous shocks are increased global excess demand for exported services, technological catch-ups in all sectors, and increased physical capital endowment, as detailed in Section IV of the text. The alternative manpower policies are given in Table V, while the wage increases are listed in Table VIII.

<sup>a</sup> These are payments to factors *per unit of total endowment*. Unemployment is assumed to come first to non-Singaporeans, who are deducted from the labor force in this calculation (up to 7 per cent of the unskilled and 15 per cent of the skilled labor force). The corresponding real wage increases are given in parentheses.

Thus the wage increases do appear to achieve one of the government's stated objectives. They aid the restructuring of the economy away from low-skill industries. By itself, however, this seems a shallow objective. Underlying it may be the idea that future growth depends on skill-intensive industries combined with a more highly skilled labor force. But the wage surge made no contribution to labor force restructuring. In fact, by narrowing the difference between the wages of unskilled and skilled workers, it probably reduced the incentives for individuals to upgrade their skills. To the extent that it yielded an economy more intensive in capital and skilled labor it did so at the risk of substantial labor dislocation.

A clue to the political agenda which yielded the "wage correction" is evident from an examination of the impacts on national income and its distribution, summarized in Table XI. In the absence of favorable exogenous shocks, the wage increases cause national income to contract. Unit factor rewards decline for all factors, even labor, when these are calculated per unit of each factor endowment. Clearly, the only beneficiaries are those workers who remain in their jobs and enjoy the higher real wages.

In the more realistic case in which exogenous shocks accompany the wage increases, national income expands and all unit factor rewards increase. But it

is instructive to compare the results in Table XI with those in Table VII. Without manpower restructuring, the only unit factor reward which rises due to the wage increase is that of skilled labor, and that only marginally. The salient result of the wage increase is that, at the cost of some 5 per cent of GDP, the incomes of 87 per cent of the unskilled labor force (the share of unskilled workers remaining in employment, which is two-thirds of the total labor force) are raised by an extra 7 per cent while those of capital-owners achieve a level which is lower by 3 per cent.

As in the case without the wage increases (Table VII) manpower restructuring expands the overall economy, increasing unit rewards to unskilled labor. But the economy is still 5 per cent poorer than it would be in the absence of the wage increases. These results suggest that, whatever the stated objective of the wage increases, the salient outcome is a costly redistribution of income from capital-owners to workers, particularly unskilled workers.<sup>14</sup>

## VII. CONCLUSION

The approach to labor market policy canvassed in this paper applies especially to economies (such as Singapore) which experience rapid growth and wherein governments have control over human resources development. The assumption of sector-specificity of skilled labor is useful when changes in the economic environment are occurring more rapidly than would permit the easy intersectoral mobility of skills. Furthermore, it facilitates the application of results from the "booming sector" literature to the analysis of changes in labor endowments and labor productivity and of the distributional impacts of shocks affecting sectors with specific skilled labor.

Our application of a simple computable general equilibrium model with sector-specific labor to Singapore's manpower planning problem illustrates an approach with considerable potential. The scale of our study is, of course, too small to draw firm policy conclusions. Improvements needed for its more direct application to policy design include greater disaggregation, at least sufficient to permit sector specific factors other than labor, the formal estimation of elasticities of substitution between skilled and unskilled labor and other factors in each sector, and better representation of the international mobility of some forms of skilled labor and capital. Also, the disaggregation of the labor force by skill level would be better informed by data on education or occupation, rather than depending solely on intra-sectoral salary differentials as we have done. All these improvements are readily supported by modern modelling methods. They require only the resources to marshal the necessary information.

The limited scale of our study notwithstanding, the illustrative results we obtain lend support to Singapore's recent move away from the use of a form of central

<sup>14</sup> Indeed these results underestimate the extent of the overall economic cost. In our model the endowment of capital is fixed but the domestic real return to capital is reduced by the wage increases. If the capital stock were permitted to shrink (in favor of better returns abroad), the levels of unemployment would be larger and overall payments to labor smaller than indicated in Table XI.

wage fixation as an instrument of sectoral and labor force restructuring. Such a policy can be costly in terms of domestic product and labor dislocation. But the gains from expanding skilled labor, particularly that suitable for employment in the "transport and communications" sector, are clearly demonstrated, even if anticipated changes in service trade and technological catch-ups in the manufacturing and services sectors do not eventuate. It is therefore reassuring that the thrust of economic policy in Singapore has shifted toward more direct approaches to the fostering of skills development, technological improvements, and investment in physical capital.

Nevertheless, some wage rigidity (at least in terms of relativities) is likely to remain. The results presented here suggest that the economic losses which stem from such rigidities can be mitigated significantly through the restructuring of the skill distribution of the labor force. Raising the skilled labor supply to booming sectors faster than to lagging sectors, for example, provides quantity adjustment to the shocks which induced the boom, thereby easing the pressure on relative wages to adjust to clear all labor markets. Where such rigidities exist, an approach like that presented here may be helpful in directing the adjustment in skilled labor supply.

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## APPENDIX A

## MODEL EQUATIONS

*Production*

$$X_i = b_i K_i^{\alpha_i} L_i^{\beta_i} S_i^{\delta_i} = X_{ji}/a_{ji}, \quad i, j = 1, \dots, n, \quad (1)$$

where

$X_i$  = output of sector  $i$ ,

$b_i$  = a positive constant,

$K_i$  = amount of capital used in sector  $i$ ,

$L_i$  = amount of unskilled labor used in sector  $i$ ,

$S_i$  = amount of skilled labor used in sector  $i$ ,

$X_{ji}$  = total amount of  $X_j$  used in the production of  $X_i$ ,

$a_{ji}$  = the fixed input-output coefficient for the use of  $X_j$  in the production of  $X_i$ .

The exponents  $\alpha_i$ ,  $\beta_i$ , and  $\delta_i$  are output elasticities of factor inputs; each is equal

to its corresponding factor's share in value added in the sector. Constant returns to scale require that  $\alpha_i + \beta_i + \delta_i = 1$ .

### Unit Factor Demands

$$k_i = b_i^{-1} [(\alpha_i/\beta_i)(w/r)]^{\beta_i} [(\alpha_i/\delta_i)(d_i/r)]^{\delta_i}, \quad i = 1, \dots, n, \quad (2)$$

$$l_i = b_i^{-1} [(\beta_i/\alpha_i)(r/w)]^{(\alpha_i+\delta_i)} [(\alpha_i/\delta_i)(d_i/r)]^{\delta_i}, \quad i = 1, \dots, n, \quad (3)$$

$$s_i = b_i^{-1} [(\alpha_i/\beta_i)(w/r)]^{\beta_i} [(\delta_i/\alpha_i)(r/d_i)]^{(\alpha_i+\beta_i)}, \quad i = 1, \dots, n, \quad (4)$$

where  $k_i$ ,  $l_i$ , and  $s_i$  are the demands for capital, unskilled labor, and skilled labor, respectively, per unit of output.

$w$  = wages of unskilled labor,

$r$  = rate of payment for capital services,

$d_i$  = wages to skilled labor used in sector  $i$ .

A subscript is attached to the wages of skilled labor because these can differ between sectors due to sector specificity. If any two sectors,  $i$  and  $j$ , use the same type of skilled labor then  $d_i = d_j$ .

### Prices

Markets are assumed competitive and hence prices equal marginal production costs.

$$P_i = rk_i + wl_i + d_i s_i + \sum_j a_{ji} P_j, \quad i, j = 1, \dots, n. \quad (5)$$

Or, in matrix notation,

$$\mathbf{P} = [\mathbf{I} - \mathbf{A}]^{-1}(\mathbf{r}\mathbf{k} + \mathbf{w}\mathbf{l} + \mathbf{D}\mathbf{s}), \quad (6)$$

where the underlined variables are vectors,  $\mathbf{I}$  is the  $(n \times n)$  identity matrix,  $\mathbf{A}$  is the matrix of input-output coefficients  $[a_{ij}]$ , and  $\mathbf{D}$  is a  $(n \times n)$  matrix with zero off-diagonal terms and diagonal entries consisting of wages of skilled labor in each sector.

### Total Income

This is just value added (payments to all primary factors) plus net transfers to households from tariff and export tax revenue.

$$Y = rK + wL + \sum_j d_j S_j + \sum_i P_i (t_i^x E_i + t_i^m M_i), \quad i = 1, \dots, n, \quad (7)$$

where  $K$ ,  $L$ , and  $S_j$  = fixed endowments of capital, unskilled labor, and skilled labor, respectively,

$t_i^x$  = export tax rate for sector  $i$ ,

$t_i^m$  = tariff rate for the import of sector  $i$  products,

$E_i$  = quantity of exports from sector  $i$ ,

$M_i$  = quantity of imports of the product of sector  $i$ .

If every sector uses a different skilled labor, then there are as many types of skilled labor as there are sectors. In this case, some skilled labor is shared between two sectors, as Table I suggests.

#### *Domestic Consumer Demand*

Maximization by households of Cobb-Douglas utility subject to budget constraints yields

$$P_i Q_i = \varepsilon_i Y, \quad i = 1, \dots, n, \quad (8)$$

where

$Q_i$  = domestic consumer demand,  
 $\varepsilon_i$  = expenditure share of the  $i$ th sector product.

#### *Foreign Trade*

For tradeable goods and services, excess demand and supply in the rest of the world has constant elasticity.

$$E_i = E_i^0 [P_i(1 + t_i^x)/e]^{\eta_i}, \quad i = 1, \dots, n, \quad (9)$$

$$M_i = M_i^0 [P_i(1 - t_i^m)/e]^{\mu_i}, \quad i = 1, \dots, n, \quad (10)$$

where

$\eta_i$  = world export demand elasticity,  
 $\mu_i$  = world import supply elasticity,  
 $E_i^0, M_i^0$  = constant terms of the respective functions,  
 $e$  = the exchange rate (the price of foreign currency).

#### *Current Account Balance*

$$\sum_i P_i(1 + t_i^x)E_i - \sum_i P_i(1 - t_i^m)M_i = 0, \quad i = 1, \dots, n. \quad (11)$$

#### *Total Final Demand*

$$X_i = \sum_j a_{ij} X_j + Q_i + E_i - M_i, \quad i, \dots, n. \quad (12)$$

Or, in matrix notation,

$$\mathbf{X} = [\mathbf{I} - \mathbf{A}]^{-1}(\mathbf{Q} + \mathbf{E} - \mathbf{M}). \quad (13)$$

## APPENDIX B

### DATA SOURCES AND CALIBRATION

#### *Details and Data Sources for SAM Construction*

A few features of the reference SAM need clarification:

1. "Households" include the "owners" of the various types of labor as well as of capital.



APPENDIX TABLE I  
 INDUSTRIES INCLUDED UNDER EACH SECTOR, BY THE SINGAPORE  
 INDUSTRIES/COMMODITY CLASSIFICATION

1. Agriculture, mining, and low-skill manufacturing	001-044, 047, 048, 060-063, 066-071, 075, 079-081, 087-090, 098-106, 108, 109, 112, 120, 122-129
2. High-skill manufacturing	045, 046, 049-059, 064, 065, 072-074, 076-078, 082-086, 091-097, 107, 110, 111, 113-119, 121
3. Utilities and construction	130-134
4. Commerce	135-137
5. Transport and communications	138-147
6. Financial and business services	148-162
7. Other services	163-175

2. The manufacturing sector has been split into low-skill and high-skill manufacturing according to average remuneration per man-year. Industries paying above S\$17,000 per man-year are considered high-skilled. Details of the industries included in each sector are presented in Appendix Table I.

3. Payment to labor in each sector is split into payments to skilled and unskilled labor according to earnings data. For each sector, the sum of gross monthly payments to those earning above S\$1,000 per month is estimated to give total monthly payments to skilled labor; for those earning below S\$1,000 per month, the sum of monthly earnings gives the corresponding payments to unskilled labor. The proportion of compensation paid to skilled versus unskilled labor is then calculated and used to divide "compensation of employees" in the I-O tables. These proportions are not available for the two manufacturing sectors, however. It is assumed that low-skill manufacturing does not use any skilled labor whereas, for high-skill manufacturing, the ratio of "payments to unskilled labor" to "payments to skilled labor" is set at 3/7, placing it between the "other services" and the "financial and business services" sectors in terms of skilled-labor-intensity in production.

Data sources for the SAM are: 1. Department of Statistics, *Singapore Input-Output Tables, 1983*; 2. Department of Statistics, *Yearbook of Statistics Singapore, 1983/84*; 3. Ministry of Labour, *Report on the Labour Force Survey of Singapore, 1983*; 4. Ministry of Labour, *Singapore Yearbook of Labour Statistics, 1986*; 5. Ministry of Trade and Industry, *Economic Survey of Singapore, various years*.

*Calibration of Model*

Most of the parameters in the model can easily be drawn from the internally consistent working SAM in Table II of the text. For example, the Cobb-Douglas form of the production function for each sector enables us to identify its share parameters directly from observed value added share data contained in the SAM. The parameters of the Cobb-Douglas utility functions are similarly derived from the SAM's expenditure share data. The world export demand and import supply elasticities, however, are key parameters which cannot be derived from observed data (in the SAM). Reliable estimates are also not available. Thus, they are assigned "best guess" values. Import supply for both the net importing sectors is given an elasticity of 60. Export demand elasticities for the net exporting sectors are set at  $-30$ . From the SAM, it is evident that Singapore is a net importer in the international goods market but a net exporter in international services trade. In setting the trade elasticities, it is assumed that Singapore is small in international goods trade but comparatively large in international services trade. Despite Singapore's smallness in world manufacturing trade, sub-infinite elasticities are used to reflect the medium-run orientation of the analysis.