DEVELOPMENT ALTERNATIVES UNDER CONDITIONS OF REDUCED EXTERNAL DEPENDENCY

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1. INTRODUCTION

The purpose of this paper is to make a quantitative analysis of development alternatives faced by the Chilean Economy in the period 1970–1975, when objectives of full employment and reduced external dependency are considered as first-priority targets in the economic program.[1] The analysis will put special emphasis on the reformulation of the role that the foreign sector should play within that strategy. In particular, the implications of a strategy based on export promotion (as an alternative to the more traditional import-substitution policies) will be studied by using a multisectoral programming model. A description of the model used in the study is given in section 2.

In section 3, four growth alternatives for the Chilean Economy are presented: alternative (1) represents the historical growth pattern; alternative (2) is called "Full Employment through Internal Savings and Import Substitution"; alternative (3) is "Full Employment through External Aid"; and, alternative (4) is "Full Employment through Export Promotion and Reduction in the External Dependency in the Economy."

In section 4, the sectoral implications of alternative (4) are discussed, giving special emphasis to the relative priorities of different export-promotion, import-substitution, and investment programs in the economy. The results are compared with existing qualitative analysis.[2]

Section 5 deals with a determination of the "optimal" diversification in Chilean exports. The alternatives discussed here are the concentration of the export drive in the sector of highest productivity (copper) versus the alternative of diversifying the export structure, mainly by increasing nontraditional exports in the manufacturing sector. Under what conditions one is preferable to the other, and what are the main macroeconomic effects attached to each one, are two basic questions that we attempt to answer in this section.

2. THE MODEL

The quantification of the development strategies for the Chilean economy is done using a 15-sector optimizing model.[3] The model has 116 variables and 104

[1] The other objective of high priority is income redistribution. Because of methodological problems, it was introduced only in a "passive" way in our study. That is, we assume a redistributive tendency in favor of wage and salary earners similar to the one observed between 1960 and 1969, a period in which the participation of these groups in national income increased from 46.7 to 51.1 percent.

[2] See, for example, CORFO [Industrial Development Corporation], División de Planificación Industrial, *Bases de Discusión de una Estrategia de Desarrollo Industrial para la Década del 70*, Santiago, 1970.

[3] The basic model was developed jointly with Peter B. Clark, when we both worked in ODEPLAN (Oficina de Planificación Nacional de Chile), with the collaboration of Mario Gómez, Ricardo Infante, and Ana María Jul. The present application is solely the responsibility of the author, however. The computational aspects were carried out by Adriana Francos and Eugenio Mardones.

constraints. It is solved for one terminal year, 1975. It is basically a static model, although some dynamic characteristics are included in the investment function. The equations of the model are given in the Appendix.

The external sector is specified in the model by distinguishing between competitive and noncompetitive imports by origin and destination. There exists the possibility of choice in the way foreign exchange is allocated among competitive imports.

Exports are determined by the model within exogenously determined minimum and maximum bounds specified by sector. In one sector (copper), a price-elasticity of demand for copper in the world markets is introduced. A linearly approximated relationship between net foreign-exchange revenues from copper and the quantum of copper exports is deduced from the elasticity function. Given that copper exports constitute between 70 and 80 percent of total export revenues in Chile, a high proportion of exports is determined by considering not only supply but also demand factors.[4] Both the tariff structure that affects imports and subsidies for exports are explicitly taken into account, differentiated by sector.

Intermediate demand is calculated by means of a RAS-adjusted input-output matrix. Among the components of final demand, both sectoral consumption and investment are determined endogenously. Sectoral consumption is calculated by means of expenditure elasticities of demand. Investment is a function of capital-output ratios per sector, increases in sectoral production, investment lags per sector, and interplan and postterminal growth rates in capacity.

Employment is specified as a function of average labor productivities per sector and the levels of sectoral output. Three scarce resources are considered: capital, labor, and foreign exchange. These act as constraints on the maximization of consumption in the terminal year. The model is solved by means of the linear programming technique, using an IBM 360/50 computer.

The statistical information used to estimate the parameters in the model corresponds to the period 1960–1968, although exogenous projections are also included. Parametric variation is used whenever there is high uncertainty as to the future value of some key parameters, due to expected structural changes. The data is available in other documents.[5]

3. The Solution of the Model

The model is solved taking 1970 as the base year and 1975 as the terminal year. Four development patterns are examined with the model. In three of them, the objective of reduced external dependency is given high priority (alternatives (1), (2), and (4)). An additional objective of full employment is introduced in alternatives (2), (3), and (4). In what follows, we will briefly describe the results for these alternative patterns.

A. Alternative (1): Traditional Growth Pattern

This first alternative represents the introduction of a target of reduced external dependency within a framework of traditional behavior of the economy, as far as

[4] Most programming models consider only supply factors in the specification of exports, due to either methodological or data problems.

[5] See Alejandro Foxley, "Structural Disequilibria and Alternative Growth Patterns for the Chilean Economy, 1970–1980," Ph.D. dissertation, University of Wisconsin, 1970.

generation of internal savings and employment is concerned. There is no employment target here.

The maximum savings rate that the economy could generate under these conditions is the historical one (0.15), and the employment level is the one that the economy would spontaneously generate. The goal of decreasing external dependency is introduced by allowing a maximum net foreign indebtedness per year of 80 million dollars (298 million 1965 escudos).[6]

The results, appearing in the first column of Table 1, show an unsatisfactory growth rate in GDP (4.2 percent), a more than proportional expansion of consumption with respect to GDP (4.4 percent), a high unemployment rate (7.6 percent), and a net import desubstitution (the proportion of domestic production in total supply decreases by 1.4 percent).

TABLE 1
FOUR DEVELOPMENT STRATEGIES: MACROECONOMIC RESULTS, 1970–1975
[monetary values in millions of 1965 escudos]

	Alternative (1)[1] (1)	Alternative (2)[1] (2)	Alternative (3)[1] (3)	Alternative (4)[2] (4)
Balance of payments gap	298	290	1,187	298
Marginal savings rate	0.15	0.30	0.15	0.26
Gross domestic product	27,766	30,595	30,560	30,744
(annual growth rate)	0.042	0.061	0.061	0.061
Private consumption	19,992	21,176	22,366	21,551
(annual growth rate)	0.044	0.055	0.066	0.059
Gross domestic investment	4,492	6,137	5,699	5,911
(annual growth rate)	0.051	0.114	0.098	0.106
Imports	4,586	4,589	5,376	4,866
(annual growth rate)	0.064	0.064	0.096	0.076
Exports	4,935	4,935	4,935	5,212
(annual growth rate)	0.065	0.065	0.065	0.076
Internal savings	4,194	5,039	4,614	5,613
(average rate over GDP)	0.151	0.191	0.151	0.183
Unemployment rate	0.076	0.000	0.000	0.000
Supply balance $[X/(X + M)]$	0.858	0.876	0.847	0.857
Change in supply balance $[X/(X + M)]$	−0.014	0.03	−0.025	−0.012
Average investment rate over GDP	0.162	0.201	0.186	0.192
Net incremental capital-output ratio	2.122	2.084	1.900	1.945
Gross incremental capital-output ratio	3.875	3.293	3.075	3.106

[1] Exports specification fixed.
[2] Exports specification variable.

B. Alternative (2): Full Employment Through Internal Savings and Forced Import Substitution

From the results given above, it becomes clear that the reduction in external indebtedness is not a viable objective, as long as consumption tendencies in the economy are such that the marginal savings rate does not increase with respect to the historical pattern. Low internal savings and reduced external savings cannot but result in slow growth and high unemployment.

[6] Net indebtedness per year in the period 1960–1968 was 150 million dollars.

We will now explicitly introduce a full-employment target in the model. Exports are fixed exogenously, and there is no savings constraint. The model then increases consumption and GDP up to the point at which it reaches full employment, using whatever internal savings are required and the available (exogenously predetermined) external savings. Results are shown in column (2), Table 1. We can see that full employment and reduced external dependency are compatible only if the marginal savings rate increases to 0.30. If this rate were achievable, the economy could sustain a growth rate of 6.1 percent a year, which would allow the absorption of the unemployed by 1975.[7] This type of growth pattern is characterized by a rapid increase in investment (11.4 percent a year) and a moderate increase in consumption as compared to the expansion in GDP.

Another characteristic of the development process would be its reliance on import substitution as the basic mechanism for growth in the economy; 87.6 percent of total supply would be generated by internal production, whereas in alternative (1), this proportion reached only 85.8 percent.

There are two critical questions concerning this alternative. One refers to the efficiency of a forced import-substitution process (and, thus, the convenience of pursuing such a course); while the second refers to the feasibility of a marginal savings rate as high as implied here (0.30).

With respect to the import-substitution process, there is increasing evidence in the literature showing that there are a number of negative effects associated with the forced import-substitution policies pursued by most Latin American economies in the past.[8] They refer mainly to an increased degree of both economic and technological inefficiency associated with indiscriminate import substitution, as well as to consumption liberalization, which prevents the economy from achieving the higher savings rates required for accelerating growth.[9]

As far as the feasibility of maintaining marginal savings rates on the order of 0.30 is concerned, several studies show that for a great number of countries, such rates have not been obtained in the past.[10] The analysis of both aspects tends to cast some doubts on the feasibility and convenience of pursuing a development strategy like the one implied in alternative (2).

If the marginal savings rate cannot be increased to 0.30, the other alternatives open for the attainment of full employment would be: (a) to finance the growth rate required for full employment through external resources, which implies eliminating the reduction in external dependency as an objective in the economic program; (b) to accept this objective and to achieve full employment through a combination of internal effort (savings up to a "feasible" level) and foreign-exchange generation through export-promotion policies. These two constitute alternatives (3) and (4), which we now discuss.

[7] We are not considering the disguised unemployed here.

[8] See papers by A. Bianchi, M. C. Tavares, and O. Sunkel in A. Bianchi, ed., *Ensayos de Interpretación Económica* (Santiago de Chile: Editorial Universitaria, 1969). See also J. Power, "Import Substitution as an Industrialization Strategy." *Philippine Economic Journal*, Spring 1967; K. Griffin and J. Enos, *Planning Development* (Reading, Mass.: Addison-Wesley, 1970), Chapter 5; D. Felix, *Beyond Import Substitution, A Latin American Dilemma*, Harvard Economic Development Report No. 30, 1966.

[9] See J. Power, *op. cit.*

[10] See H. Chenery and A. Strout, "Foreign Assistance and Economic Development," *American Economic Review*, Sept. 1966.

C. Alternative (3): Full Employment by Increasing External Dependency

In this alternative, we assume a marginal savings rate not different from the historical one. Full employment would be achieved through a massive inflow of foreign aid.

The model's results (appearing in Table 1, column (3)) show that a net inflow of foreign resources equivalent to 300 million dollars per year would be required to reach full employment by 1975. This would imply almost doubling the total external debt accumulated up to 1970.

By looking at the model's results, it can be seen that this kind of strategy results in a fast growth in imports (at a rate of 9.6 percent a year). This facilitates consumption liberalization, which could achieve a growth rate of 6.6 percent per year. Let us recall that the growth in consumption for the same expansion in GDP under alternative (2) was only 5.5 percent a year, the residual being used to increase the savings rate up to 0.30.

Summing up, alternative (3) implies an acceleration in the process of increased external dependency in the Chilean economy, and a fast rate of expansion in consumption, which could presumably prevent the economy from increasing savings in the future.

D. Alternative (4): Full Employment Through an Opening Up of the Economy and Internal Effort

So far, we have specified the model with fixed exports. Export potential was determined by considering both historical trends and some new projects.[11] These figures were introduced exogenously into the model.

In this fourth alternative, we assume a flexibility in the structure of production such that exports could be expanded over the predetermined level given by ODEPLAN's estimates. This additional expansion would take place only if it represents the best alternative use for existing resources. Formally, this is measured in the model through the dual solution, where resources are allocated according to their scarcity values (shadow prices).

The practical way of measuring the optimal expansion in exports is by relaxing the assumption of fixed exports and allowing the model to choose the level of sectoral exports between predetermined minimum and maximum bounds (± 5 percent from the ODEPLAN estimates). Results are shown in column (4), Table 1. They indicate that it is possible to achieve full employment if the marginal savings rate is increased to 0.26, and if, at the same time, exports grow at 7.6 percent per year, instead of the 6.5 percent growth rate assumed in ODEPLAN's figures.

Given that, in this alternative, the model is free to choose both exports and competitive imports levels, the results indicate a preference (in the aggregate) for export expansion vis-à-vis import substitution, which is negative in the solution. On the other hand, the marginal savings rate is within what has been observed for other countries.[12] In the next section, we will analyze in detail the sectoral implications of the strategy implicit in alternative (4).

[11] Figures given by the External Sector Unit, ODEPLAN.

[12] See Chenery and Strout, *op. cit.*

TABLE 2
EXPORT SELECTION THROUGH PARAMETRIC VARIATION OF INTERNAL SAVINGS
[$F = 0$; subsidies for exports included in costs and price elasticity for copper]

MSR (1)	P_f (2)	P_{GDP} (3)	P_s (4)	$P_f + P_{GDP} - P_s$ (5)	$P_{Agriculture}$ (6)	P_{Copper} (7)
0	2.649	.0	1.533	1.116	↓2.048	↓1.358
.00124	2.585	.002	1.463	1.124	↓1.977	↓1.326
.03312	2.617	.048	1.461	1.204	↓1.978	↓1.343
.04762	2.441	.057	1.207	1.291	↓1.782	↓1.256
.05367	2.433	.064	1.187	1.310	↓1.768	↓1.252
.05673	2.390	.064	1.127	1.327	↓1.730	↕1.225
.09531	2.403	.105	1.099	1.409	↓1.729	↑1.221
.15423	2.599	.196	1.270	1.525	↓1.869	↑1.322
.16213	2.606	.205	1.267	1.546	↓1.862	↑1.325
.20572	2.725	.275	1.335	1.665	↓1.966	↑1.387
.21585	2.765	.295	1.367	1.693	↓1.996	↑1.408
.22771	2.790	.310	1.361	1.739	↓1.993	↑1.422
.25178	2.759	.309	1.225	1.843	↓1.882	↑1.414
.29158	2.008	.186	0.638	1.556	↓2.006	↑1.093
.29466	1.307	.026	0.087	1.246	↓1.995	↑0.781
.29538	1.205	.0	0.0	1.205	↓1.986	↑0.734

4. EXPORT PRIORITIES

The previous section has shown that the objectives of maximum growth, full employment, and reduced external dependency are only compatible if the Chilean economy is able to substantially increase savings in the next five years while, at the same time, undertaking a significant export effort. In this section, we shall consider the sectors in which the export efforts should be concentrated.

We shall examine this problem assuming a net flow of foreign financing equal to zero by 1975. Parametric variation of the marginal savings rate from 0.0 to full employment will allow us to determine export priorities. Thus, it is possible that whenever savings are very scarce, the marginal effort in terms of export expansion will take place: (a) in those sectors where there is idle capacity; (b) in sectors where the cost of generating an additional unit of foreign exchange is the lowest. As savings and the growth rate of the economy increase, some sectors utilize all existing capacity to meet internal demand and the expense of expanding production for exports is not worth undertaking. Alternatively, in other sectors, even with no idle capacity, the benefits associated with export expansion are higher than the costs of production and of using scarce resources, and consequently, exports should be increased to the maximum level. This kind of evaluation is done within the general equilibrium framework provided by our multisectoral optimizing model.

Export priorities according to the availability of savings can be deduced from the results shown in Table 2. These results are complemented by Tables 3, 4, and

TABLE 2 (*concluded*)

$P_{Other\ Mining}$ (8)	$P_{Food,\ Textiles}$ (9)	$P_{Wood,\ Paper}$ (10)	$P_{Nonmet.\ Min.}$ (11)	$P_{Basic\ Metals}$ (12)	$P_{Chemicals}$ (13)	$P_{Metallurgical}$ (14)
↑0.737	↓1.618	↓1.593	0.681	↑1.106	↕1.116	↑0.862
↑0.722	↓1.568	↓1.541	0.667	↑1.089	↓1.311	↑0.842
↑0.825	↓1.578	↓1.561	0.758	↑1.124	↓1.345	↑0.959
↑0.994	↓1.445	↓1.463	0.905	↑1.222	↕1.291	↑1.147
↑1.019	↓1.436	↓1.459	0.926	↑1.253	↑1.292	↑1.174
↑1.010	↓1.408	↓1.440	0.918	↑1.242	↑1.280	↑1.164
↑1.034	↓1.411	↓1.463	0.938	↑1.271	↑1.309	↑1.190
↑1.119	↕1.525	↓1.581	1.015	↑1.375	↑1.416	↑1.290
↑1.120	↑1.524	↓1.583	1.016	↑1.377	↑1.418	↑1.329
↑1.184	↑1.605	↕1.665	1.776	↑1.454	↑1.497	↑1.405
↑1.202	↑1.631	↑1.689	1.870	↑1.477	↑1.520	↑1.427
↑1.209	↑1.633	↑1.706	1.879	↕1.739	↑1.530	↑1.474
↑1.183	↑1.565	↑1.693	1.827	↓2.733	↑1.494	↑1.595
↑1.019	↕1.556	↑1.487	1.469	↓2.151	↑1.281	↑1.386
↑0.834	↓1.464	↕1.246	1.107	↓1.578	↑1.044	↑1.145
↑0.862	↓1.445	↓1.206	1.057	↓1.496	↑1.012	↑1.106

5, which show the optimal investment, imports, and import-substitution programs per sector.

The first column in Table 2 gives the marginal savings rate (*MSR*), which varies from 0.0 up to the point when full employment is reached. Points where the solution of the model is accompanied by a change in base are indicated in that column. The next three columns indicate the shadow prices of scarce resources (P_f = shadow price of foreign exchange; P_{GDP} = shadow price of GDP; P_s = shadow price of savings). Column (5) is obtained by adding columns (2) and (3) and subtracting column (4). It measures the net benefits associated with an increase of one unit in foreign-exchange availability, produced by the export expansion.

These benefits are composed of a direct factor, which is the increase in consumption (the objective function) produced by one additional unit of foreign exchange (P_p), and an indirect benefit through the expansion in GDP. Given that a higher GDP implies higher savings, and that this is a scarce resource, expanding exports allows an increase not only in the supply of foreign exchange but also in that of savings. This effect is measured through the shadow price of GDP (P_{GDP}).

From the point of view of costs, these include the social cost of production for each productive sector including all inputs but capital (P_i = shadow prices given in columns (6) to (14) in Table 2) and the opportunity cost of capital measured through the shadow price of savings (P_s).

The equation that relates costs and benefits is:

$$P_F + P_{GDP} \geq P_i + P_s, \quad \text{or}$$

$$P_F + P_{GDP} - P_s \geq P_i.$$

TABLE 3
SECTORAL INVESTMENT PROGRAMS
[cumulative 1970–1975 in millions of 1965 escudos]

MSR	Agriculture	Copper	Other Mining	Food, Textiles	Wood, Paper	Nonmetallic Minerals	Basic Metals	Chemicals	Metallurgical
.0	492	1,071	–	321	438	–	–	–	–
.001	497	1,072	–	322	439	–	–	–	–
.033	589	1,077	–	353	467	–	–	43	–
.047	635	1,088	–	367	479	–	–	66	–
.053	619	1,089	–	365	482	–	–	121	–
.056	629	1,089	–	368	485	–	–	141	–
.095	563	1,593	–	362	500	–	–	187	–
.154	779	1,594	–	428	565	–	–	569	–
.162	830	1,594	–	468	572	–	–	576	–
.205	1,031	1,596	–	531	637	–	–	772	225
.215	1,000	1,600	–	522	843	–	–	769	206
.227	1,065	1,601	–	543	864	25	–	825	280
.251	1,234	1,602	–	593	912	86	–	912	464
.291	1,488	1,614	–	672	995	191	213	1,069	767
.294	1,483	1,617	–	646	1,033	206	260	1,089	822
.295	1,510	1,616	–	655	947	214	279	1,099	849

TABLE 4
COMPETITIVE IMPORTS BY SECTOR
[millions of 1965 escudos]

MSR	Agriculture	Copper	Other Mining	Food, Textiles	Wood, Paper	Nonmetallic Minerals	Basic Metals	Chemicals	Metallurgical
.0	407 ↑	–	116 ↕	767 ↑	115 ↑	31 ↕	203 ↑	410 ↑	940 ↕
.001	407 ↑	–	117 ↕	766 ↑	115 ↑	31 ↕	203 ↑	410 ↑	939 ↕
.033	403 ↑	–	125 ↕	759 ↑	114 ↑	37 ↕	201 ↑	406 ↑	887 ↕
.047	400 ↑	–	134 ↕	754 ↑	113 ↑	40 ↕	144 ↕	404 ↑	908 ↕
.054	405 ↑	–	137 ↕	764 ↑	114 ↑	41 ↕	144 ↕	409 ↕	917 ↕
.057	405 ↑	–	139 ↕	763 ↑	114 ↑	42 ↕	144 ↕	396 ↕	922 ↕
.095	429 ↑	–	147 ↕	808 ↑	121 ↑	47 ↕	153 ↕	398 ↕	996 ↕
.154	415 ↑	–	179 ↕	783 ↑	117 ↑	63 ↕	161 ↕	176 ↕	1,109 ↑
.162	422 ↑	–	181 ↕	795 ↑	119 ↑	65 ↕	162 ↕	179 ↕	1,126 ↑
.206	411 ↑	–	203 ↕	774 ↑	116 ↑	82 ↑	196 ↕	92 ↕	1,097 ↑
.216	428 ↑	–	205 ↕	806 ↑	121 ↑	85 ↑	201 ↕	105 ↕	1,141 ↑
.228	424 ↑	–	212 ↕	799 ↑	120 ↑	85 ↑	212 ↑	82 ↕	1,131 ↑
.252	411 ↑	–	227 ↕	775 ↑	116 ↑	82 ↑	205 ↑	58 ↕	1,098 ↑
.292	396 ↑	–	259 ↕	746 ↑	112 ↑	79 ↑	198 ↑	16 ↕	1,056 ↑
.294	387 ↑	–	263 ↕	729 ↑	109 ↑	77 ↑	193 ↑	5 ↕	1,032 ↑
.295	381 ↑	–	264 ↕	717 ↑	107 ↑	76 ↑	190 ↑	–	1,016 ↑

NOTE: The arrows indicate whether imports are at the upper (↑) or lower (↓) bound; or at intermediate levels (↕).

TABLE 5
IMPORT SUBSTITUTION, DOMESTIC SHARE IN TOTAL SUPPLY

MSR	Agriculture	Copper	Other Mining	Food, Textiles	Wood, Paper	Nonmetallic Minerals	Basic Metals	Chemicals	Metallurgical
.0	.834	1.0	.811	.874	.854	.874	.591	.628	.474
.001	.834	1.0	.811	.874	.854	.874	.592	.628	.475
.033	.836	1.0	.800	.876	.855	.856	.608	.635	.501
.047	.837	1.0	.788	.877	.856	.848	.699	.638	.496
.054	.836	1.0	.784	.876	.855	.845	.697	.643	.493
.057	.836	1.0	.782	.876	.855	.844	.697	.650	.492
.095	.829	1.0	.774	.870	.850	.830	.685	.654	.474
.154	.835	1.0	.740	.875	.853	.793	.670	.763	.451
.162	.834	1.0	.738	.874	.852	.787	.669	.761	.447
.206	.838	1.0	.717	.879	.855	.751	.634	.802	.470
.216	.834	1.0	.715	.874	.862	.744	.630	.797	.460
.228	.836	1.0	.708	.875	.863	.750	.620	.807	.467
.252	.841	1.0	.695	.880	.865	.764	.623	.818	.485
.292	.847	1.0	.667	.887	.868	.784	.652	.836	.508
.294	.849	1.0	.664	.887	.870	.789	.661	.840	.515
.295	.850	1.0	.662	.889	.869	.793	.665	.843	.519

Exports are profitable if benefits are equal to, or higher than, costs.[13] By comparing column (5) in Table 2 with columns (6) to (14), one can learn in which sector there is a net benefit over costs associated with export expansion. In the sector where the net benefit is positive, the model chooses to expand the export activity to the maximum level. This is indicated in Table 2 by means of an upward-oriented arrow. The reverse occurs if costs are higher than benefits. When the arrow points in both directions, it denotes that costs equal benefits at the margin, so that export activity is at an intermediate level between the upper and lower bounds. Priorities for export selection are determined by examining Tables 2, 3, 4, and 5 jointly.

The behavior of the main sectors is as follows:

1. Noncopper mining exports always have a high priority (they are at the maximum level irrespective of the availability of savings). This is due to the existence of unutilized capacity in the sector. The latter fact is verified by observing in Table 3 that net investment is always zero in this sector. Exports constitute an adequate mechanism to dispose of excess production. (This sector includes mainly nitrates, coal, and iron ore.)

2. Basic metals also show the existence of an exportable surplus up to a marginal savings rate of 0.22. At this level, the growth of the economy is such that production with existing capacity is totally used to supply the expanding internal demand. At this point, exports go to the lower bound and it is more efficient to expand imports to the maximum level (see Table 4) as a cheaper way of meeting internal demand. When the *MSR* goes up to 0.29, the relative abundance of savings makes new additions to capacity in the sector profitable (as can be seen in Table 3).

3. In the metallurgical sector, there seems to be enough productive capacity available to permit meeting internal demand, while at the same time expanding exports to the maximum. This occurs whenever the savings rate is not significantly higher than the historical rate (0.15). When *MSR* reaches 0.20, the higher growth in the economy generates additional internal demand that could be supplied either by reducing exports or by investing to increase the productive capacity in the sector (notice that imports are already at the maximum, see Table 4). The model shows that export activity is profitable enough to make the cost of new investment worthwhile, instead of reducing the supply of foreign exchange by decreasing exports. The cost-benefit calculation for export activity is shown in detail in Table 2.

4. Export activity in the copper sector is always profitable. We can observe in Table 3 that even when savings are very scarce ($MSR = 0.0$), big investments in the copper sector are indicated in the model's solution (see Table 3, the column for copper under $MSR = 0.0$). This investment should be undertaken in order to increase exports to the maximum. However, due to limits in productive capacity, the maximum bound for exports can only be reached when *MSR* is higher than

[13] It should be noticed that the specific form of the cost-benefit equation depends on the substitutions done in the model (that is to say on the form of the tableau in the LP problem). It is possible that by means of additional substitutions in the system of equations, one would get a simpler expression where all benefits (direct and indirect) were measured through only one shadow price (the foreign-exchange shadow price). The same could be done with the cost equations.

0.053. Given that this is way below the historical *MSR* (0.15), it is clear that exports should be expanded to the maximum in the range for *MSR* that is relevant.

5. The chemical industry sector is another where programs of export expansion seem efficient, regardless of the value for *MSR* (see Tables 2 and 3).

6. In the agricultural sector, exports stay at the minimum level and imports at the maximum (see Tables 2 and 4). This behavior is explained by insufficient productive capacity even to satisfy internal demand. The model's results suggest the convenience of high investments in the sector in order to reduce the deficit with respect to internal demand. At any rate, the remaining deficit is met by importing food products.[14]

7. As far as the traditional consumption industries (food, textiles, leather products, and so on) are concerned, new additions to capacity are very significant, as can be seen in Table 3. However, as long as the *MSR* is below 0.154, the new investment is good enough to meet internal demand, but not to expand exports (see Tables 2 and 4). When savings increase over $MSR = 0.154$, it is possible to undertake additional investment so as both to satisfy internal demand and to push exports to the upper boundary.

When the economy approaches full employment ($MSR = 0.25$), exports in this sector go to the lower bound (see Table 2). This is due to the fact that this is a relatively labor-intensive activity. When labor becomes a scarce resource, it is more convenient to expand capital-intensive activities, like the metallurgical sector. If we look at Table 3, we can see that for high *MSR*, investment in the metallurgical sector goes up very rapidly. At the same time, exports in the food and textiles sector go to the lower bound. Thus, when full employment is reached, there is a reallocation of resources away from labor-intensive sectors and into capital-intensive activities.

Sectoral Priorities: Exports, Investment, Import Substitution

The preceding analysis makes possible some general conclusions as to the sectoral priorities of export, import-substitution, and investment activities. These are summarized in Table 6. By looking at this table, it can be concluded that:

1. There are sectors where investment programs have a low priority, since idle capacity exists in them. Exports are a good way of disposing of excess supply. These are noncopper mining and basic metals. The metallurgical sector shows the same behavior up to $MSR = 0.20$, where new investment for exports becomes profitable.

2. There are sectors where new additions to capacity have the highest priority. They are agriculture, food and textiles, wood and paper products, and copper. Even when savings are very scarce, investment seems to be desirable in these sectors, although for different reasons, according to each particular case: in the

[14] This result might be surprising, particularly with respect to exports. Two comments might be relevant: (a) this sector does not include food products with some degree of processing, since they appear in sector 4 (Food, Textiles); these are the products that should generate more foreign exchange per unit of resources utilized; (b) the high degree of aggregation hides the fact that within the agricultural sector some exports should be expanded to the maximum level; in others, it might be more efficient not to expand. In this sense, our analysis is not particularly useful when it deals with all the agricultural sector as one aggregate.

TABLE 6
SECTORAL PRIORITIES

Investment	Exports	Import Substitution
Agriculture, copper, food and textiles, wood and paper	Copper	Chemicals
Chemicals	Chemicals	Metallurgical
Metallurgical	Food and textiles	Basic metals
Nonmetallic minerals	Wood and paper, metallurgical	
Basic metals	Basic metals, other mining [1]	
Other mining	Agriculture	

[1] Maximum exports due to excess capacity.

agricultural sector, in order to meet internal demand; in food and textiles, and wood and paper, for the same reason but also to increase exports. Investment in the copper sector, on the other hand, seems profitable whatever the availability of savings.[15]

3. In the chemical and metallurgical sectors, both export-promotion and import substitution programs seem to be justified, with a higher priority for the chemical industry, since it does not start with excess capacity, as is the case with the metallurgical industry.

4. New net investment and import substitution seems justified in basic metals only when the economy approaches full employment.

The preceding results are, in general, coincident with qualitative studies done by the Industrial Development Corporation (CORFO) in Chile.[16]

5. Concentrating or Diversifying Exports

By looking at the results of the previous section and comparing the resultant composition of exports in the final year with the composition in the initial year, it can be seen (in Table 7) that export diversification tends to increase.

We have come to this result, however, by putting an upper boundary on export expansion, including copper. We cannot, then, conclude from the previous results that a strategy of export diversification is in any sense "better" than one in which the export effort is concentrated mainly in copper. From the theoretical point of view, there are good arguments in favor and against one or the other strategy.[17]

The case for copper could be made along the following lines: it is a high-productivity sector, facing favorable conditions in the world markets; it could, thus, generate a surplus big enough to be used to finance export diversification in a second stage.

[15] We have introduced a fixed price for copper in the world markets, 55 cents per pound. If the price is lower, the conclusions might be different, as will be shown in the next section.

[16] See CORFO, *op. cit.*

[17] See A. M. Jul. *Diversificación de Exportaciones, el Caso Chileno*, Memoria de Prueba, Escuela de Economia, U. de Chile, 1969; Daniel Schydlowsky, *Latin American Trade Policies in the 1970's: A Perspective Appraisal*, Harvard Economic Development Report No. 150, 1970; O. Sunkel, *op. cit.*

TABLE 7
EXPORT STRUCTURE
[monetary values in millions of 1965 escudos]

	1970		1975	
	Level	Percent	Level	Percent
Agriculture	116	3.3	128	2.6
Copper	2,211	62.2	3,102	61.0
Other mining	402	11.3	444	8.7
Food and textiles	159	4.5	224	4.5
Wood, paper	127	3.6	386	7.6
Nonmetallic minerals	6	0.2	2	–
Basic metals	50	1.4	80	1.6
Chemicals	31	0.9	116	2.3
Metallurgical	59	1.7	120	2.4
Construction	0	–	0	–
Energy	2	–	2	–
Housing	7	0.2	9	0.2
Transportation	172	4.8	172	3.4
Education and health	2	–	2	–
Commerce, service, etc.	208	5.9	266	5.3
Total	3,552	100	5,053	100

Arguments against export concentration relate to the degree of vulnerability in the economy when it relies basically on one product to supply its need for foreign exchange. This vulnerability is due to price fluctuations in the world markets (short run) and to the limit imposed on the investment rate (long run). This limit appears when the domestic economy does not have a significant capital-goods sector and must rely on imports to increase the investment rate in the economy. If the strategic export sector (in this case copper) is not able to grow fast enough, this puts a limit on the rate of expansion in the supply of foreign exchange and consequently on the investment rate.[18]

Export diversification usually implies increasing exports of manufactures. These are justified, from the social cost-benefit analysis: (a) if there is idle capacity or unemployed labor: here the social cost of exporting would be zero;[19] (b) if economies of scale, knowledge of markets, and technology can be developed fairly rapidly so that a competitive position can be gained in the world markets.

From what has been said in the previous paragraph, it is quite clear that export diversification is a process which is not to be pushed as far as possible, irrespective of the importance of the variables mentioned above.

Under what conditions would it be better for Chile to concentrate the export effort on expansions in copper production? Alternatively, what factors would make a diversification strategy more favorable?

Let us again use the multisectoral model to attempt an answer to some of these questions. We will eliminate now the exogenous limit on copper exports

[18] See O. Sunkel, *op. cit.*

[19] The Argentine case is one where export of manufactures seem to be closely related to the degree of capacity utilization in the industrial sector. See David Félix, *Subsidies, Recession and Non-traditional Industrial Exporting in Argentina*, Harvard Economic Development Report No. 107, 1968.

and will allow the model to choose the optimal equilibrium point for copper exports. This equilibrium point depends on: (a) the world market price for copper before Chile's expansion in copper exports; (b) the amount by which that price is affected by the decision of Chilean producers (this is measured through the introduction of a price elasticity of demand for copper in the world markets and a linearly approximated function that relates net foreign-exchange revenues from copper to quantities of copper exported); (c) the opportunity cost of resources in terms of alternative uses in other sectors.

The optimal expansion point for copper determines not only the quantity to be exported, but also the equilibrium price in the world market after the Chilean expansion.[20] It also implies a structure of sectoral exports compatible with the copper expansion, and "optimal" from the point of view of efficiency in the use of scarce resources in the economy (capital, labor, foreign exchange).

Five experiments were undertaken to determine export diversification, given five different initial prices for copper in the world market.[21] Presumably, if the initial price is very high, a greater degree of concentration on exports would be justified. The reverse should occur when the price goes down.

The experiments maintain the objective of reduced external dependency. We assume that net external savings are zero in 1975. The assumption is made also that the marginal savings rate is 0.15 (historical).

Results for copper prices going from 65 cents per pound to 45 cents are summarized in Table 8. There we show the optimal export structure for each initial price, and also the equilibrium price after expansion.[22]

For initial prices equal to 65 and 60 cents, profitable expansions in copper would be of the order of 33 percent and 27 percent respectively, with respect to the "normal" levels for 1975 if the expansion does not occur.

The export composition corresponding to the initial prices of 65 and 60 cents is such that the only sectors other than copper whose exports would be at the maximum level would be noncopper mining, basic metals, and the metallurgical industry. These are precisely the sectors characterized by the existence of idle capacity, as we have seen in the previous section of this paper. In other words, for copper prices over 60 cents, the optimal degree of diversification in exports would be that which allows for maximum utilization of existing capacity, but in which new investment effort for exports is concentrated basically in one sector, that is, copper. A "concentrated structure" for exports seems to be the best under these conditions.

If the initial price is 55 cents, the profitable copper expansion would be in the order of 20 percent, which would be accompanied by a higher degree of export diversification. Under these conditions, it would be profitable to start new investment projects for exports in the chemical sector. Exports would be at the maximum level, according to the model's results, in this sector.

[20] A detailed description of the methodology may be found in Alejandro Foxley and P. B. Clark, "Rentabilidad Social de Nuevas Expansiones en el Cobre Chileno," *Estudios de Planificación*, CEPLAN [Center of Studies on National Planning], Santiago, 1972.

[21] This initial price reflects the medium-term equilibrium price if there are no additional expansions on the part of Chile or the other producers, except that which maintains their share of the market.

[22] Under the assumption that other producers do not retaliate when Chile expands—that is, that they expand only at the rate given by the increase in demand. See Foxley and Clark, *op. cit.*

TABLE 8
EXPORT STRUCTURE FOR DIFFERENT COPPER PRICES, 1970–1975
[millions of 1965 escudos; $F = 0$; $MSR = 0.15$]

Sector	65¢ (52¢[1])		60¢ (49¢[1])		55¢ (46¢[1])		50¢ (46.5¢[1])		45¢ (42¢[1])	
	LIM. E.	Exports	LIM. E.	Exports	LIM. E.	Exports	LIM. E.	Exports	LIM. E.	Exports
Agriculture	MIN	128	MIN	128	MIN	128	MIN	128	MIN	128
Copper	MIN-MAX	3,980	MIN-MAX	3,803	MIN-MAX	3,641	MIN	2,821	MIN	2,821
Other mining	MAX	444	MAX	444	MAX	444	MAX	444	MAX	444
Food, textiles	MIN	160	MIN	160	MIN	160	MAX	224	MAX	224
Wood, paper	MIN	227	MIN	227	MIN	227	MIN	227	MIN	227
Nonmetallic minerals		2		2		2		2		2
Basic metals	MAX	124	MAX	124	MAX	124	MAX	124	MAX	124
Chemicals	MIN	63	MIN	63	MAX	116	MAX	116	MAX	116
Metallurgical	MAX	120	MAX	120	MAX	120	MAX	120	MAX	120

NOTE: LIM. E. indicates whether exports are at the maximum (MAX), minimum (MIN), or intermediate level (MIN-MAX).
[1] Equilibrium price after expansion.

Finally, for prices below 55 cents, a strategy of further diversification would be preferred, as can be seen in Table 8, under the columns corresponding to 50 cents and 45 cents for the price of copper.

There are other effects connected with the process of concentrating exports in one sector that are worth mentioning. They refer to the structure of production and the level of employment obtained.

In Table 9, we give macroeconomic results for two runs of the model where the same growth rate in GDP is obtained: in one case, by diversifying exports; in the other, by concentrating them in the copper sector. When the diversified scheme is pursued, a greater balance between the GDP and consumption growth is achieved (4.2 percent and 4.4 percent respectively). Also, sectoral production seems to be more balanced, and perhaps the most important effect, a lower level of unemployment is reached. This last result would indicate that, given the existence of unemployed labor in the economy and the full-employment objective, a policy of export diversification could very well be justified even for high copper prices if one considers the employment effects attached to it.

TABLE 9
CONCENTRATION VERSUS DIVERSIFICATION IN EXPORTS, 1970–1975

	Diversification	Concentration
MSR	0.15	0.15
F	298	0
Copper price (cents)	42	60
GDP growth rate	0.042	0.043
Sectoral growth rates:		
Agriculture	0.029	0.007
Copper	0.059	0.107
Food, textiles	0.034	0.020
Basic metals	0.025	0.0
Metallurgical	0.029	0.0
Import growth rates	0.064	0.116
Consumption growth rates	0.044	0.054
Unemployment rate	0.076	0.092

APPENDIX

Equations of the Multisector Linear Programming Model

(1.0) $$X_i + d_i \cdot \tilde{M}_i + d_i \hat{M}_i \geq \sum_j a_{ij} \cdot X_j + C_i + G_i + I_i + S_i + E_i + \sum_j d^{M}_{15,j} \cdot M_j$$

(2.0) $$C_i = -\bar{c}_i + y_i C$$

(2.1) $$\sum_i C_i + \bar{c}_d + y_d C = C$$

(3.0) $$G_i = g_i \cdot \bar{G}$$

(4.0) $$I_i = N_i + R_i$$

(4.1) $$N_j \geq b_j[X_j \cdot (1 + P_j)^{\theta_j} - \bar{X}_j(0) \cdot (1 + i_j)^{\theta_j}]$$

(4.2) $$N_i = \sum_j K^i_j \cdot b_{ij} \cdot N_j$$

(4.3) $$K^i_j = P_j(1 + P_j)^{\theta_j - 1}/(1 + P_j)^{\theta_j} - (1 + i_j)^{\theta_j - t}$$

(4.4) $$R_j = r_j \cdot X_j$$

(4.5) $$R_i = \sum_j b_{ij} \cdot R_j$$

(4.6) $$\Delta S_i = K_i^s \left[\sum_j (s_{i_j} + s_j^T) \Delta X_j + s_j^T \Delta M_j \right]$$

(5.0) $$\tilde{M}_i = \sum_j \tilde{m}_{ij}^A \cdot x_j + \tilde{m}_i^C \cdot C_i + \tilde{m}_i^B \cdot I_i + \tilde{m}_i^G \cdot \bar{G}$$

(5.1) $$V = F + \sum f_j E_j - \bar{T}\bar{E} - \sum_j \tilde{M}_j - \sum_j \bar{e}_j$$

(5.2) $$\hat{M}_i \leq \hat{m}_i \cdot V$$

(5.3) $$M_i = \tilde{M}_i + \hat{M}_i$$

(6.0) $$E_{iMIN} \leq E_i - E_{iMAX}$$

(6.1) $$Y_{N2} = e_2 + f_2 E_2$$

(7.0) $$\sum_j M_j - F - \sum_j f_j E_j \leq -\bar{T}\bar{E} + \bar{E}\bar{T} - \sum_j \bar{e}_j$$

(7.1) $$F \leq \bar{F}$$

(8.0) $$A^N = \sum_j K_j^I \cdot N_j + \sum_j R_j + \sum_j k_j^s (s_j + s_j^T) \Delta X_j + \sum_j k_j^s \cdot s_j^T \cdot \Delta M_j - F + \bar{E}\bar{T}$$

(8.1) $$A^N - t^N \cdot Y \leq A^{-N}(0) - t^N \cdot \bar{Y}(0)$$

(9.0) $$L_j = l_j \cdot X_j$$

(9.1) $$\sum_j L_j \geq (1 - u)\bar{L}$$

(10.0) $$Y = C + \bar{G} + \sum_j K_j^I \cdot N_j + \sum_j R_j + \sum_j K_j^s (s_j + s_j^T) \Delta X_j + \sum_j K_j^s s_j^T \Delta M_j - \sum_j M_j + \sum_j f_j E_j + \bar{E}\bar{T} + \sum_j \bar{e}_j$$

(0.0) $$Max: C$$

Variables and Parameters of the Model

- a_{ij} Input-output coefficients for domestic plus imported intermediate goods
- b_j Average capital-output coefficient in sector j; b_{ij} = distribution matrix
- $\bar{c}_i$ The constant term of the consumption function for expenditure on good i
- $\bar{c}_d$ Constant term for the nonworker's expenditure for domestic servants
- d_i Coefficient of distribution (one plus the tariff plus the commercialization cost) of imports of type i
- $d_{15.J}^M$ Aggregate commercialization coefficient for all imports estimated as a fixed proportion of the total CIF value of imports
- $\bar{e}_i$ Constant term of the linear function approximating the price-elastic foreign-exchange revenue function for exports of sector i
- f_2, f_1 Marginal coefficient of the foreign-exchange revenue function, used especially to reflect the effect of a change in the price of copper ($i = 2$) and other goods (i) exported to new markets (e.g., f_p is used for the cellulose project)
- g_i Fixed proportion government expenditure for goods from sector i (where government expenditures for factor payments—value added—is denoted by $g_g \cdot v_g$)
- i_j Vector of intraplan rates of growth of production (i.e., in the first years)
- K_j^I Stock-flow conversion factor, as defined by equation (4.3)
- K_i^s Stock-flow conversion coefficient for the inventory level of national goods in sector i
- l_j Inverse of the productivity of labor employed in sector j

$\hat{m}_i$ Distribution coefficient of foreign exchange, among different sectors of origin for competitive imports measured in CIF

$$\sum_i m_i = 1.0$$

(This allows a certain amount of positive substitution of imports in some sectors, negative in others)

$\tilde{m}_{ij}^A$ Technical coefficient of noncompetitive intermediate imports, measured on CIF prices

$\tilde{m}_i^B, \tilde{m}_i^C, \tilde{m}_i^G$ Coefficient for noncompetitive imports of capital goods, consumption goods, and government expenditure for goods from sector i, measured in CIF prices

θ_j Average gestation period (lag) for capital information by sector j

P_j Vector of postterminal rates of growth of production in sector j

q_i Expenditure elasticity per capita (or per family) for goods from sector i

r_j Replacement coefficient estimated as a proportion of the gross value of production in each sector j

r'_j Reciprocal of the average useful life of the stock of capital in sector j

s_i Stock to output coefficient of goods in process or finished products from sector i

s_i^T Stock to output coefficient of transactions stock held by retailers and wholesalers

t Number of years in the plan

t^N Maximum marginal-savings rate for aggregate national savings

u Maximum unemployment rate

y_d Marginal propensity to consume domestic services

$$y_i = q_i \frac{\bar{C}_i^0}{\bar{C}^0}$$

A^N Gross national savings

C_i Private consumption of goods from sector i

C Total consumption expenditure in the terminal year

E_i Total exports of goods from sector i constrained between the minimum and maximum values

F Foreign capital inflow, equal to the deficit on current account of the balance of payments at constant prices

G_i Total government consumption expenditure for goods from sector i. Payments to factors (wages, salaries, rent, and interest payments) are included in a special sector as G_v

I_i Gross investment demand for capital goods of sector i

L_j Employment in sector j

M_i Total imports, at CIF prices, of goods from sector i

$\tilde{M}_i$ Noncompetitive imports of goods from sector i, at CIF prices ($i = j$)

$\hat{M}_i$ Competitive imports at CIF prices

N_j Net investment by destination accumulated during the planning period (5 years)

R_j Replacement investment destined for sector j

ΔS_i Change of stocks of national origin for goods of sector i

V Balance of foreign exchange remaining after financing the noncompetitive imports, at CIF value

X_i Gross value of production in sector i

ΔX_i Change in the gross value of production in sector i during the period of the plan

Y Gross domestic product in the terminal year in variable prices, i.e., including the effect of variable prices in the foreign sector

$\bar{A}^N(0)$ Gross national (internal) savings in the initial year

$\bar{C}^0$ Total consumption expenditure in the initial year

$\bar{C}_i^0$ Consumption of goods from sector i in the initial year

$\bar{F}$ Maximum external financing at constant prices (exogenously determined)

$\bar{G}$ Total government spending in the terminal year

$\bar{G} = g_i G_i$ (i = number of sectors plus payment to factors used by the government)

$\bar{L}$ Available labor force in terminal year

$\bar{P}$ Population in the terminal year

$\bar{P}^0$ Population in the initial year

$\bar{X}_j(0)$ Value of production in the base year of sector j

$\bar{Y}^0(0)$ Gross domestic product in the initial year

$\bar{YE}$ Net remittances (interest, profits) paid abroad