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Timothy Condon
Vittorio Corbo
Jaime de Melo

PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE
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* The World Bank
** Pontificia Universidad Católica de Chile
*** The World Bank

ABSTRACT

This paper uses a computable general equilibrium model to analyze the growth path of the Chilean economy during the 1977-81 period. During that period a comprehensive package of reforms was implemented which included liberalization of international trade and the removal of restrictive labor legislation. As a result of the reforms, Chile closely approximated a free market economy. At the same time, starting in February 1978, the exchange rate was used to bring down the rate of inflation. The net result of the liberalization-stabilization experience was large changes in relative prices and in the structure of production and demand. During 1977-81 the economy had unprecedented economic growth with declining inflation although, towards the end of the period, severe macroeconomic imbalances became evident and in 1982 Chile experienced an abrupt and severe recession.

Taking the real exchange rate as an exogenous policy variable, and using the observed levels of employment growth and foreign capital inflows, this paper compares model-generated growth paths with those of the economy. First, the benchmark simulation path is used to estimate the magnitude and pattern of growth and productivity change during the 1977-81 period. Next counterfactual simulations are used to assess how Chile's economic performance would have differed if: (a) external events had been different; and (b) the profile of foreign capital inflows had been different. The analysis suggests that the macroeconomic imbalances that led to the crisis in 1982 were exacerbated by the large capital inflows and real exchange rate appreciation that resulted from the use of the exchange rate as a stabilization device.

I. INTRODUCTION

Between 1974 and 1981 the Chilean economy recovered from an internal crisis, successfully confronted a large external shock, and undertook a major reform package which spanned commodity and factor markets. As part of the recovery, a fiscal deficit which had reached over 24% of GDP in 1973, was reduced to 0.0% by 1977. Over the same period, the inflation rate came down from more than 600% to 84% and GDP grew at an average annual rate of 7.5%.

As an oil importer, Chile suffered from the successive oil price shocks to which must be added a 30% decline in the price of Chile's major export, copper, over the period 1979-82. Unemployment, moreover, stayed in the 12-14% range while the economy was booming. Furthermore even though gross fixed investment rose from 14% of GDP in 1977 to 18.5% of GDP in 1981, net national savings as a fraction of GDP never exceeded 5.0%. These figures raise the question of what were the proximate sources of growth.

In addition to these macroeconomic developments major relative price shifts took place as a result of the policy reform package: nominal tariffs which averaged around 100% with a high dispersion were brought down through successive reductions to a uniform 10% by early 1979; domestic commodity prices and interest rates were deregulated while a large number of public enterprises (over 500) were returned to private hands and restrictive labor legislation impeding labor mobility was abolished.

A change in the conduct of stabilization policy resulted in the implementation in February 1978 of an active crawling peg exchange rate with a decreasing rate of crawl that culminated with the fixing of the exchange rate in June 1979 while wages were indexed on past inflation. The rate of inflation in the official CPI dropped to 19.8% in 1981 from 40% in 1978, indicating an apparently successful program. Yet, in spite of this and earlier successes,

1982 was one of the worst recession years in recorded Chilean economic history and the Chilean economy is only now emerging from deep recession, having accumulated an increase in gross external debt of $11.5 billion over the period 1978-82 matched by a cumulative current account deficit of $11.4 billion over that same period. Several reasons have been advanced for this collapse ranging from external factors (low copper prices, high international real interest rates, a strong dollar) to faulty policies (opening the capital account too quickly, poorly controlled deregulation of the domestic banking system, wage indexation based on past inflation in a period of deccelerating inflation jointly with a fixed nominal exchange rate policy).

The purpose of this paper is to use a simple multi-sector general equilibrium model to examine the sources of growth of the Chilean economy during the period 1977-1981 and to isolate the relative contribution of various factors towards explaining the collapse of the economy in 1982. Section II outlines the growth record and major relative price and quantity shifts experienced by Chile and notes the main puzzles to be addressed in the paper. Section III outlines the structure of the model used for counter-factual simulation analysis. Section IV uses the model to approximate the likely magnitude of the sources of growth and productivity gains during the 1977-81 period. The results point out that productivity cum capacity utilization growth must have been strong during the period. Finally, Section V sets up some counterfactual experiments to examine the effects of a different external environment and alternative government policies. The experiments suggest that the large and unsustainable external imbalance, which was a major reason for the economy's collapse, was exacerbated by the combination of exchange rate and wage policies adopted in 1979 in the presence of reductions in restrictions to capital inflows.

II. THE RECORD: 1977-82 AND SOME PUZZLES

By 1977 Chile's fiscal deficit had been reduced, inflation had been reduced to 90% and the economy had been growing for two years recuperating from the 1975 recession induced in large part by external shocks, including the world recession and a 50% fall in the copper price. The crisis was behind although the inflation and unemployment rates were still very high by historical standards.

To help focus the presentation, we review in Tables 1-4 the growth record and main quantity and relative price shifts of the period 1977-82 to be simulated with the general equilibrium model. Though not included in our simulations, we include 1982 to indicate how the economy reacted to the macroeconomic imbalance that had developed by 1981. Tables 1 and 2 summarize the growth record of the economy by sector of origin and by expenditure for the period 1977-82. It is immediately apparent that the pattern of growth by sector of origin was highly uneven. Table 1 indicates that the highest growing sectors during the period were construction, trade, and financial services. As shown below, the simulation model has nothing to say about the growth of the financial sector that accompanied the liberalization of the domestic financial market. However, the construction and services sector boom can be attributed to absorption growth exceeding GDP growth which can be captured by the model. Moreover, much of the growth in trade reflects an increasing volume of imports coupled with a rise in trade margins, the latter modelled as exogenously given rates applied to import values. Another important element were the government revenues on foreign trade which more than doubled during the import boom and, by 1981, contributed more to GDP than the mining sector. Table 1 (col. 2) also gives the sectoral aggregation for

Table 1: Chile: Real GDP at Market Prices by Sector of Origin

Sector	a/	GDP by Sector (millions of 1977 pesos)	Annual Percentage Change 1978	1979	1980	1981	1982
Primary	(1)	28.2	-3.5	5.9	4.2	5.0	-1.9
Mining	(2)	23.1	1.7	5.1	5.3	8.1	5.7
Manufacturing	(3)	62.5	9.3	7.9	6.2	2.6	-21.6
Electricity, Gas, and Water	(5)	6.4	7.8	5.8	5.5	2.6	-0.2
Construction	(4)	11.7	8.1	23.9	23.9	21.1	-29.0
Trade	(5)	44.8	20.0	11.0	12.4	6.7	-17.8
Transport and Communications	(5)	15.3	8.4	9.0	11.1	1.1	-9.9
Nonfinancial Services	(5)	72.4	1.1	1.9	0.7	0.5	-5.3
Financial Services	(5)	18.1	20.4	28.0	22.6	16.1	-9.0
Imputed Cost of Banking Services	(5)	-9.1	-0.3	45.6	41.0	29.2	-13.6
Value Added		273.7	10.4	7.2	6.4	4.4	-14.4
Import Taxes		14.0	16.9	19.1	22.4	24.2	-42.8
Total GDP b/		287.7 */	8.2	8.3	7.8	5.7	-14.3

a/ Figures in parentheses denote the aggregation scheme for the model used below.

b/ GDP = value added + import taxes. Components may not sum to total due to rounding.

Source: Indicadores Economicos y Sociales, 1960-1982, Banco Central de Chile p. 23.

the 5-sector model used below. Evidently it can only capture the more salient characteristics of the changing sectoral composition of growth.

Surprisingly for many, the manufacturing sector performed quite well up to 1980. This was unexpected since part of the dismantling of the trade barriers would be expected to lead to a resource shift towards agriculture and mining which had been discriminated against in the period of highly protected industrialization. For other observers, including those who instigated the reforms, it was hoped that the reduction in impediments to trade would lead to improved resource allocation including higher productivity growth and greater technical efficiency. The importance of productivity gains is the subject of Section IV.

Looking at growth from the expenditure side (Table 2a) we get a further confirmation of an economy undergoing major adjustments. Until 1981, exports were growing well above the growth of GDP, but imports were growing at close to 20% per year on average resulting in an increasing absorption to income gap. Private consumption was growing slightly slower than GDP until 1981 and government consumption even experienced a negative growth rate of 8% in 1979. In sum, this left room for a respectable growth rate of investment which accelerated from 23% in 1978 to 31% by 1980.

However, this acceleration in investment growth showed disquieting signs. First it started from a low base in 1977 (14% of GDP). Second the composition of investment between fixed and inventory investment shows that through 1980 an increasing part of the investment effort went into inventory accumulation. Third, the construction component of fixed investment increased its participation in fixed investment. Fourth, the growth rate of investment had fallen back to 5% by 1981 presaging the recession (during that year consumption grew at nearly three times the rate of growth of GDP). Fifth, the

Table 2a: Chile: Real GDP by Expenditure

	Year 1977 (Million of 1977 Pesos)	Annual Percentage Change				
		1978	1979	1980	1981	1982
Private Consumption	209.5	7.5	6.5	6.8	14.3	-14.4
Government Consumption	41.9	6.7	9.2	-8.0	0.2	-7.8
Total Investment of which:	41.5	23.3	29.1	31.5	5.6	-65.4
Domestic Savings	30.7	17.9	27.6	21.2	-41.9	NA
Total Stocks	3.2	96.8	118.0	67.3	-19.7	-179.7
Imports of Goods & Services	59.3	17.5	22.7	18.7	14.8	-32.9
Exports of Goods & Services	64.5	11.9	14.1	14.7	-5.2	10.4
GDP	287.7 1/	8.2	8.3	7.8	5.7	-14.3

Table 2b: Other Macroeconomic Indicators

	Year 1977 (Million of 1977 Pesos)	Annual Percentage Change				
		1978	1979	1980	1981	1982
Employment 2/ of which:	2838	2.7	3.4	3.1	3.2	3.3
Primary 2/	527	0.55	0.56	0.56	0.56	NA
Non-Primary 2/	2311	4.03	3.57	3.76	3.80	NA
Unemployment rate: Greater Santiago (%)	13.2	14.0	13.6	11.8	11.1	22.1
Public Sector Surplus/GDP (%)	0.0	1.8	4.7	5.5	0.8	-3.4

Source: Indicadores Economicos y Sociales 1960-82.
Cuentas Nacionales de Chile, 1960-82.

NA indicates data are not available.
1/ Components may not sum to total due to rounding.
2/ Growth rate per annum.

domestic savings effort was extremely low during the period. Furthermore, the figures in Table 2b show high rates of unemployment in spite of a rapidly growing economy. These figures are puzzling in view of the rising real wages reported in Table 4 and the fact that unemployment during the sixties was about half the rates in Table 2b.

The financing of the import boom is indicated by the balance of payments figures in Table 3. The current account deficit rose from $551 million in 1977 to reach a staggering $4.18 billion in 1981, at which point it was 14.6% of GDP. The current account deficits were financed by increased foreign borrowing. This can be seen by noting in Table 2b the relative unimportance of the government budget deficit during the period. The capital inflows materialized both as a result, on the supply side, of the gradual liberalization of the economy to capital flows -- started in September 1977 when commercial banks were allowed for the first time to borrow externally -- and, on the demand side, as a result of the portfolio shift towards dollar denominated loans in response to the increase in the difference between the peso-denominated and the dollar-denominated real interest rate. Following the establishment of the active crawling peg system in February 1978 and exacerbated with the fixing of the exchange rate in June 1979, capital inflows accelerated. The resulting decrease in the interest rate and the high growth performance of the economy could have also increased perceived permanent wealth and thus expanded expenditures financed by the capital inflow. It is also noteworthy that the current account deficit was more than covered by the capital inflows so that the Central Bank was accumulating international

Table 3: Chile: Balance of Payments (billion current U.S.$)

	1977	1978	1979	1980	1981	1982
Merchandise Trade						
Exports (fob)	2.185	2.460	3.835	4.705	3.960	3.798
Imports (cif)	-2.417	-3.242	-4.708	-6.146	-7.218	-4.023
Net Non-Financial Services	-.029	.114	.279	.287	.076	-.207
Net Financial Services & transfers	-.240	-.419	-.595	-.817	-1.328	-1.950
Current Account	-.551	-1.088	-1.189	-1.971	-4.814	-2.382
Capital Inflows + Errors and Omissions (net of reserves)	.664	1.800	2.236	3.215	4.884	1.217
Change in reserves	.113	.712	1.047	1.244	70	-1.165
Capital Inflows (%) 1/ GDP	4.5	12.6	10.8	11.5	14.4	5.2
Current Account (%) 1/ GDP	4.1	7.1	5.7	7.1	14.6	9.9

Source: Indicadores Economicos y Sociales, 1960-82, p. 237.

1/ Expressed in pesos at the average exchange rate for the year.

reserves. 1/ Capital inflows, which are exogenous to the model, will be viewed as essentially under government control through regulation of the capital account.

For future reference, June 1979 was a major turning point for other reasons as well: not only does it mark the time when restrictions on medium and long-term capital flows were removed, but it is at this date that the value of the peso was fixed in terms of the dollar to $1=39 pesos and that the Plan Laboral stipulating that wage indexation would have as a floor the previous twelve months' rate of inflation was put into effect. Thus major policy changes occurred during the period.

The panorama of major developments is completed by the changes in relative prices and wages described in Table 4. Major relative price changes took place: the strong real exchange rate appreciation, relative price changes between tradables and non-tradables, among tradables and the rise in the wage index in terms of the CPI. Coupled with the changing structure of output and expenditures, the relative price shifts in Table 4 suggest that modelling the Chilean economy of the late seventies should emphasize the role of changes in relative prices. The table also shows divergences between the different measures of the CPI and the different wage indices. It should be clear that the changes observed in Chile during the period under review pose a challenge to the modeller.

1/ It is likely that the magnitude of capital inflows exerted an important influence on the general revaluation of assets (the stock market price index multiplied seven fold between January 1977 and December 1980). These inflows, by relaxing the capital market disequilibrium, probably resulted in a perceived increase in permanent wealth. If this effect was quantitatively important, as Harberger (1982) has suggested, it would contribute towards an explanation of the poor domestic savings performance observed in Table 2.

Table 4: Relative Prices and Wage Indices
(1977=100)

	Row	1978	1979	1980	1981	1982
GDP Deflator 1/	(1)	156	229	296	335	373
Official CPI 1/	(2)	140	187	252	302	332
Corrected CPI 2/	(3)	150	205	276	331	364
Import / Non-tradable Price Index 3/	(4)	104	105	95	79	87
Export / Non-tradable Price Index 3/	(5)	90	104	102	74	73
Price of Tradables/Wages in Manufacturing 3/	(6)	102	97	79	58	66
Copper Price Index 1/	(7)	104	152	167	133	113
Nominal Exchange Rate 1/	(8)	147	173	181	181	236
Official Wages and Salaries Index 1/ 5/	(9)	160	236	346	451	494
Wages and Salaries Index for Non-Agriculture 4/	(10)	158	227	322	383	NA
Real Exchange Rate 3/	(11)	96	103	97	76	82

1/ Source: Indicadores Economicos y Sociales 1960-82.

2/ Corrected by the Cortazar-Marshall index for 1978 and 1979.

3/ Source: Corbo (1984), table 4. The real exchange rate is constructed as the relative price of tradables to non-tradables. Export price index excludes copper.

4/ Wage Bill figures include social security taxes. Source: Cuentas Nacionales de Chile, 1960-1982 and employment figures from Indicadores Economicos y Sociales, 1960-82.

5/ This index does not include social security taxes. The increasing gap between indices in rows (9) and (10) is partly due to the decline in social security tax.

Because the government budget deficit was negligible over the period, the sustained current account deficits observed in Table 3 must be entirely accounted for by changes in investment and private savings. Recent discussions (e.g. Harberger, 1982; Corbo, 1984; Dornbusch, 1984) have emphasized a number of channels which, because they go beyond our analysis by bringing expectations into the picture, should be mentioned before presenting the model. First dissaving may take place because of the combination of the following: a transitory real appreciation, an increase in wealth along with the removal of borrowing constraints mentioned above; an increase in the purchase of consumer durables when their real price is low. Second, a transitory real appreciation will also lead to stockpiling of investment and inventory goods in anticipation of capital gains. Both effects can only be adequately captured with forward-looking agents facing an intertemporal budget constraint (e.g. Sachs, 1981) and will be the subject of a future paper. Given our assumptions about savings and investment, the model presented below should be viewed as investigating the role of other factors, namely relative price changes, in explaining the outcome presented in Tables 1-4.

III. A MULTISECTOR GENERAL EQUILIBRIUM MODEL FOR CHILE

The general equilibrium model of production, trade, and employment used in this paper is of the type described in Dervis, de Melo, and Robinson (1982, chapters 5 and 7). The complete set of equations describing the model is in the appendix. Here we emphasize only the main assumptions about functional forms which guide the determination of relative prices and savings and investment. The model contains five sectors given in Table 1 and

is calibrated to the 1977 base year data. 1/ Output in each sector is a CES function of capital and labor and a Leontief function between value added and intermediates. CES functions also describe aggregation between domestically and foreign produced intermediates of a given sectoral classification, but no substitution takes place across intermediates. Capital equipment, once in place, is fixed, but gross investment responds to intersectoral differences in profit rates.

Figures 1-4 depict the determination of the key relative prices in the model. The numeraire is taken as the GDP deflator (Table 4 row 1) with fixed 1977 output weights. Product differentiation is symmetrically assumed for the allocation of expenditures by all users between imports and domestically produced goods (Armington, 1969) and for the allocation of domestic output between domestic sales and exports (Powell and Gruen, 1968). In Figure 1 the CC curve shows the combination of imports and domestic good use consistent with the given level of the Armington composite good. The trade substitution elasticity determines the shape of the CC isoquant around the initial point, A. Figure 2 shows the distribution of output between domestic and foreign sales according to the constant elasticity of transformation (CET) function. In this model, withdrawal of supply from the home market to exports exerts upward pressure on the home-market price. Export behaviour in all sectors except copper and construction (a nontraded good) is determined by the CET assumption.

The determination of the real product wage is depicted in figure 3 where L^0 represents the labor demand curve. Note that the real wage is

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1/ See Mansur and Whalley (1982), and the discussion by Lau on calibration in general equilibrium models.

The Determination of Key Relative Prices and Magnitudes

Figure 1

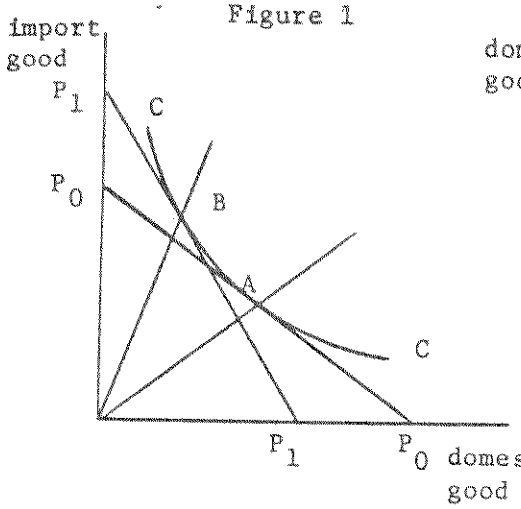


Figure 2

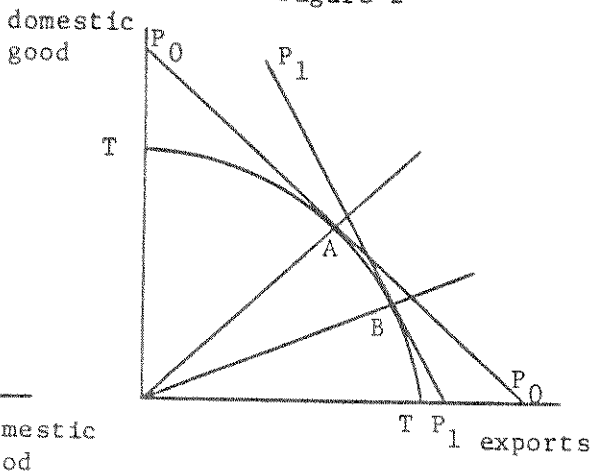
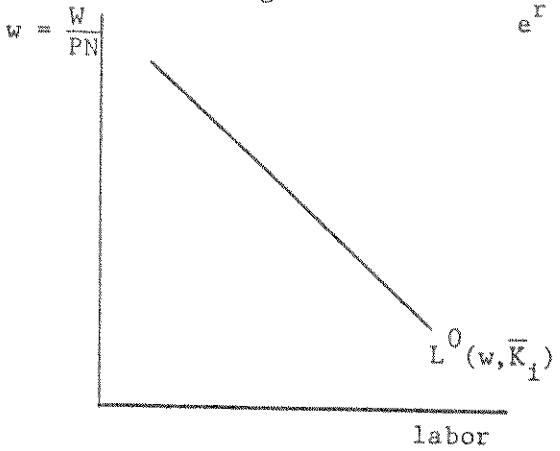


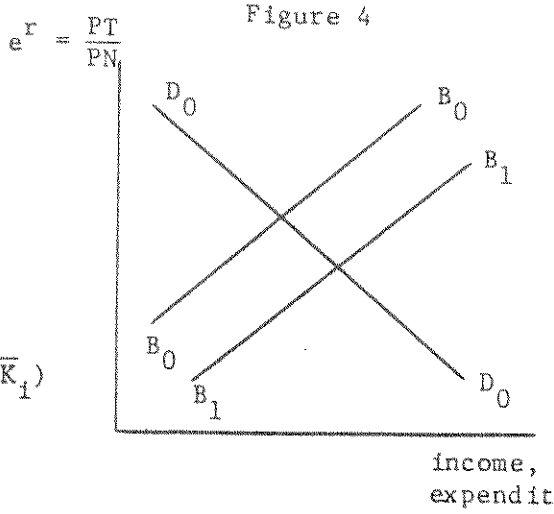
Figure 3



$$PN_i = PS_i - \sum_j a_{ji} P_j$$

$P = f(XD, EM)$
XD = domestic good
EM = imports

Figure 4



e^r = real exchange rate

defined in terms of the value-added price (PN in figure 3). PN is an aggregate of all the prices entering in the model.

Figure 4 shows the relationship between income, expenditures, and the real exchange rate in equilibrium. In figure 4, the real exchange rate -- the price of traded relative to nontraded goods -- is measured on the vertical axis while the horizontal axis measures output and expenditure. The D_oD_o schedule is the locus of income and real exchange rate levels consistent with equilibrium in the domestic goods market. An increase in income increases demand for home goods requiring an increase in their relative price to restore equilibrium. Along the B_oB_o schedule we have external balance for a given level of capital inflows. An increase in capital inflows results in an outward shift of the BB schedule to B_1B_1. The equilibrium level of expenditure rises and the relative price of traded goods falls because at the initial real exchange rate there is excess supply for traded goods. 1/

We assume that investment is determined by available savings. Government savings is determined endogenously after exogenous real government spending on goods and services is subtracted from total government revenue. Foreign savings is equal to the current account deficit which is defined by the left-hand side of equation A-14. Gross private saving behavior depends positively on household income and negatively on foreign capital inflows based on an econometrically estimate equation. This equation is a proxy for several effects not directly captured in the model. First, capital inflows lowered the real interest rate thus raising expenditure. Second, capital inflows,

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1/ The Armington assumption does not permit such a clear distinction between traded and nontraded goods so the description must be restated in terms of goods with varying degrees of tradability. The important point that higher capital inflows require an increase in the relative price of home goods -- a real exchange rate appreciation -- remains valid however.

starting in 1979 affected expectations in several ways. First, the induced wealth effect resulting from the lower real interest rate could have been considered as permanent and thus increase the marginal propensity to spend out of current disposable income. Second, insofar as the resulting real exchange rate appreciation caused by the capital inflow was viewed as temporary, consumers would have intertemporally substituted present for future expenditure in durables which, in the case of Chile, are imported or import-competing.

The model is calibrated to the 1977 benchmark equilibrium data set. The key elasticities are the elasticities of substitution in the production functions, the trade substitution elasticities, and the elasticities of transformation in the CET functions (see Table 6). All elasticities are best guesses and we rely on sensitivity analysis as a check on their reasonableness. Equilibrium is defined as a set of relative prices for goods and factors such that excess demands in all markets are zero.

IV. PRODUCTIVITY GROWTH AND STRUCTURAL CHANGE

One of the puzzles of the Chilean economic record over the period 1977-81 is how growth was achieved given the low observed investment levels and slow employment growth. In this section we use the model to determine the sectoral pattern of productivity cum capacity utilization growth compatible with the observed trajectory of the Chilean economy described in Section II. For this purpose we use the model in the spirit of total factor productivity (TFP) studies. We use CES production functions (see elasticities in table 6) with two inputs: labor and capital. Labor is fixed to actual employment levels in each sector and capital is putty clay but gross investment is reallocated in response to profit rate differentials (see equation A21 in the

Table 5: Exogenous Variables in the Productivity Experiment

1. Foreign Sector

   a. Balance of Payments

      -- Real Exchange Rate, exogenous level 1/
      -- Net capital inflow, exogenous level (Debt Service and Capital Inflow from Table 3).

   b. Trade

      -- Nominal tariff rates, trended to 10% by 1979 and fixed thereafter. Dollar prices of exports and imports from Corbo (1984).
      -- Dollar value of copper exports, exogenous growth rate
      -- 5% p.a. growth of export share in transformation function

2. Production

      -- Input-output coefficients, held fixed at base year levels
      -- Employment by skill category, grows at actually observed growth rates. Skill categories are: Primary + copper (sectors 1 and 2); manufacturing (sector 3); construction (section 4); services (section 5)
      -- Inventory to gross output ratios, set to 2% in copper, 5% in manufacturing and zero elsewhere

3. Consumption-Savings

      -- Institutional and household taxes, held fixed at base year levels
      -- Government expenditure fixed to actual levels in terms of the GDP deflator.
      -- Private composite consumption shares, held fixed at base year levels
      -- Government composite consumption shares, held fixed at base year levels
      -- Private gross savings, rates set to actually observed yearly levels for 1977 and 1978 and determined according to equation A19 of the appendix thereafter.

4. Numeraire:

      -- GDP deflator (with 1977 production weights)

1/ The real exchange rate is the relative price of the dollar expressed in units of account in terms of the numeraire.

Table 6: Parameters and Structure of the Chilean Economy in 1977

Manufacturing	Sectoral Shares in Total Output (percent)	Ratio of Imports to Domestic Goods (percent)	Value Added Ratio	Ratio of Imported Intermediates to Total Intermediates Inputs (percent)	Depreciation Rates	Ratio of Exports Total Output (percent)	Capital Labour Ratio	Elasticity of Substitution	Trade Substitution Elasticity	CET Transformation Elasticity
Primary	11.1	27.2	.54	14.6	3.5	10.5	0.4	0.9	3.00	3.00
Copper	5.9	3.8	.55	17.4	3.5	83.6	1.2	0.9	3.00	2.00
Manufacturing	37.2	37.6	.30	17.5	3.5	7.0	0.2	1.2	3.90	3.00
Construction	4.3	0.0	.49	24.0	3.0	0.0	0.7	1.5	0.50	2.00
Services	41.5	3.9	.64	14.9	3.5	4.6	0.4	1.5	0.50	2.00

appendix). Table 5 summarizes the exogenous variables used for this experiment and Table 6 describes the structure of the economy in 1977 along with assumed elasticities.

We simulated the model calibrating it closely to the pattern and level of sectoral growth rates reported in Table 3. The implied productivity cum capacity utilization growth rates are reported in Table 7. The figures show very high productivity cum capacity utilization growth in the early years. The only exception is construction, a non-tradable sector which only started to grow rapidly in 1979. As a reference for comparison, Elias (1978) estimated economy-wide annual TFP growth rates of 0.85% for the period 1950-60 and 1.2% for the period 1960-74. Schmidt-Hebbel (1981) estimated sectoral Cobb-Douglas production functions over the period 1960-80 allowing for shifts in the Hicks-neutral technical change coefficient for the reform period. He also found a significant upward shift in the rate of technical change for the reform period implying a higher TFP growth rate. Finally Edwards (1983) attributed a 13% increase in the GDP level to the reforms.

Table 7

Growth of Total Factor Productivity Cum Capacity Utilization
(percent per year)

	1977-78	1978-79	1979-80	1980-81
Primary	4.0	4.0	5.0	5.0
Mining	3.0	3.0	3.0	3.0
Manufacturing	8.0	6.0	1.0	1.0
Construction	4.0	10.0	10.0	10.0
Services	7.0	7.0	5.0	5.0

Unfortunately, no capacity utilization measure is available to disentangle the productivity and capacity utilization components from the figures in Table 7. It is difficult to ascertain the extent of idle capacity in the Chilean economy during this period because the drastic changes in relative prices undoubtedly created a lot of economic obsolescence. One may however assume that, as result of the sharp recession of 1975 (13% GDP fall) and the slow recovery of 1976, some idle capacity was present in the non-primary sectors up until 1978. Idle capacity was probably highest in manufacturing branches producing goods that were poor substitutes for imports. For construction and services, it is likely that the high derived rates represent reform-induced gains and the result of sharp demand increases that would have led to the exploitation of economies of scale. This was clearly the case for banking and probably for construction.

To derive an estimate of efficiency gains associated with the reforms, we simulated the model assuming that, in the absence of the reforms, TFP growth would have been 2% p.a. across-the-board, a figure well above the Elias estimates for the period 1960-74. We further allocated one half of the total difference between the gains reported in Table 7, minus 2%, to increases in capacity utilization for the years 1977-79 to manufacturing, construction and services. We also assumed that economy-wide employment growth would have been the same as the observed levels, but that labor could have been reallocated across the non-primary non-copper sectors in response to differences in net marginal labor product values. The results of this simulation show that the cumulative GDP gains from the reform amount to 19.1% of the 1981 simulated output level. In terms of annual growth, this amounts to a yearly increase of 2.3% p.a.

Before using the model to examine the effects of external shocks and

capital inflows, we compare the base run results with actual changes during the period. The exogenous assumptions underlying the base run are the same as those in Table 6 with the exception of the assumption about labor allocation across manufacturing, construction and services.

The prevailing institutional arrangements in the Chilean organized labor market resulted in wage structures determined by non-market clearing considerations, mostly wage indexation based upon past inflation. This applied mainly to non-primary sectors. Therefore, the base run and simulation experiments take into account these considerations by fixing the wage rate in these sectors to the values obtained from the solution discussed in Section IV which was very close to the historical levels reported from the national accounts. This amounts to fixing real wages in terms of the numeraire. Thus employment is endogenously determined by the model for the non-primary non-mining sectors. Productivity cum capacity utilization figures are those in Table 7.

The base run is generated with the exogenous variables and parameters described above and the behavioural specification detailed in the appendix. Tables 8 and 9 provide some comparisons of actual and base run endogenous variables to assess how the base run tracks Chilean growth and structural change. Table 8 compares the actual and predicted figures for private consumption, gross fixed investment, exports, imports and employment. The year to year levels of private consumption, imports and exports are tracked fairly closely while fixed investment is overestimated. Labor growth, at an average annual rate of 5.4% in the model, exceeds the observed rate by 1.4 percentage points. Overall, Table 8 indicates that the model tracks fairly closely most of the expenditure components of GDP over the whole period, although year to year swings are not captured.

Table 8: Actual and Base Run for Macroeconomic Variables

	1977	1978	1979	1980	1981
Private Consumption (billions of 1977 pesos)					
Actual	209.5	225.2	239.9	256.1	292.6
Base Run	209.5	219.5	243.4	267.3	288.1
Fixed Investment (billions of 1977 pesos)					
Actual	38.3	45.0	52.6	64.1	73.5
Base Run	38.3	51.0	56.1	78.8	92.6
Imports (billions of pesos)					
Actual	64.5	75.8	93.0	110.5	126.7
Base Run	64.5	76.8	90.3	110.1	127.5
Exports (billions of pesos)					
Actual	59.3	66.0	75.3	86.1	81.5
Base Run	59.3	63.0	70.0	76.4	84.4
Non-primary Employment Growth (%)					
Actual	----	7.0	1.9	9.6	1.8
Base Run	----	7.3	6.9	7.9	0.0

Table 9: Real GDP by Sector of Origin, Ratio of Actual Base Run Levels (1977 = 1.00)

	1978	1979	1980	1981
Primary and Copper	0.96	0.99	0.98	1.01
Manufacturing	0.99	1.01	0.99	0.96
Construction	0.83	0.93	0.85	0.88
Services	1.01	0.98	0.98	0.94
Import Taxes	1.02	1.05	1.00	1.00
GDP	0.99	0.99	0.98	0.97

Turning to Table 9 it is clear that the model tracks well the movements in GDP by sector of origin. With the exception of the construction sector, each predicted output level is within 6% of the actual figure. The results for the construction sector are conditioned by the outcome for gross fixed investment since there is no final consumption demand for that sector. The savings behaviour built into the model overstates the contribution of domestic saving early in the interval leading to the overprediction of fixed investment growth observed in Table 8 and of the construction output observed in Table 9.

It should be noted that the model's success at tracking export growth is due to the imposition of upward trends on the share of exports in the transformation functions for all non-copper sectors. The rationale for imposing the export trends can be seen when one juxtaposes the substantial real exchange rate appreciation that occurred in Chile with the impressive export growth. It is clear that something other than current relative price movements motivated exporters. Perhaps a medium term outlook was motivated by the higher real exchange rate of 1975-77 which led to the early export growth. This growth was then maintained to keep a foothold in new markets on the expectation that the future would bring more favorable relative prices. The trends represent an effort to capture these effects in the model.

In summary, we conclude from the base run that the general equilibrium simulation model is useful to examine the interactions of relative price changes, growth and structural change in an almost laissez-faire economy. However, because market clearing behaviour is imposed within the period (here assumed to correspond to one year), and because lagged variables do not enter into the model during the period when market clearing takes place, the model does not track closely the year-to-year turning points

induced by the large relative price changes experienced in Chile. Finally, the Chilean experience suggests that high values for price and income elasticities (higher than those usually employed in other CGE applications) are necessary to capture the observed quantity responses to relative price and income changes.

V. EXTERNAL SHOCKS AND CAPITAL INFLOWS: SOME COUNTERFACTUAL POLICY EXPERIMENTS

After a period of high growth in 1977-81, the Chilean economy entered into a deep recession (14.3% GDP drop in 1982 and 2.0% GDP drop in 1983). Many conflicting views have emerged to explain the so-called "failure" of the Chilean experiments. Among these we single out two that can be analyzed using our model. One view maintains that unfortunate external events were largely responsible for the large current account deficits of 1980 and 1981. In accordance with this view, Chile suffered from both a terms of trade loss (due to the decrease in the world price of copper) and an income loss from the rising international interest rate.

A second explanation attributes the recession to the cumulative drop in competitiveness over the period 1977-81. In accordance with this view, the use of the exchange rate as a tool for stabilization policy cum liberalization of the capital account contributed to the explosion of the current account deficit. The drastic reduction in capital flows in 1982 at a time when nominal wage growth was tied to previous inflation resulted in a wage recession (Corbo 1983; Corbo 1984).

To analyze the impact of external shocks we performed this simulation: we assumed that the real price of copper for the period 1978-1981 was

equal to the average real price of copper in the period 1960-1976. 1/ In the same experiment, we also assumed that the real international interest rate for 1978-1981 was equal to the average international real interest rate of the period 1960-76 plus the observed spread of the individual years. 2/ These assumptions resulted in the values of the variables that appear in Table 10 where the base run values are also listed for comparison.

As can be seen from Table 10, the assumption of a fixed international real interest rate would have resulted in higher debt service payments for the years 1978 through 1980, although in 1981 the payments would have been significantly lower. For copper, the assumption of a constant real world price would have resulted in export revenues higher than the observed ones for 1978 and 1981 but lower for 1979 and 1980. Under our assumptions, the net result of both external shocks resulted in a cumulative loss of only U.S.$172 million. Not surprisingly, the imposition of a more favorable external environment results in a negligible change from the base run. However, as seen from Table 10, the direct impact of the unfavorable external environment was felt most strongly in 1981.

To isolate the impact of the 1981 shock, we performed a second experiment in which all exogenous variables were maintained at their base run values through 1980 but for 1981 we assumed a constant real copper price (equal to the 1980 value) and a constant real interest rate (equal to the 1960-76 value). These resulted in a reduction in interest payments of U.S.$342 million, and higher copper export revenues of U.S.$640 million. This

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1/ The price deflator used to compute this price was the U.S. wholesale price index (WPI).

2/ The real interest rate was computed using inflation measured by the U.S. WPI.

experiment resulted in a 1981 real exchange rate 5% above the comparable base year level and a U.S.$1 billion lower current account deficit. The reduction in the current account deficit translates into lower foreign savings and hence lower investment demand maintaining the base run 1981 GDP level.

In the third experiment we inquire into the effects of the large capital inflows. For this purpose we develop an alternative scenario under which capital inflows are kept at 7% of observed current price GDP and the real exchange rate is allowed to vary to clear the foreign exchange market subject to the new pattern of capital inflows which implies that the value of F, the reserve change, is set equal to zero in equation A14. The resulting pattern of capital flows in the base run and in experiment 3 is reported in Table 11. The figures indicate that the cumulative volume of capital inflows fell from $12.80 billion to $7.41 billion in EXP-3, a reduction of 42% from the actual level. The macroeconomic results of this reduction in capital flows are summarized in Table 12. As a result of the reduction in the level of net capital inflows, real GDP grows at an annual rate of 7.4% in EXP-3 compared to 8.4% in the base run.

The closeness of the two nominal exchange rate series through 1979 (recall that the base represents the actual exchange rate which prevailed in Chile during the period) is interesting. Considering that the cumulative current account deficit in the 1977-81 period is reduced by the amount of the decline in capital flows plus the change in reserve losses, i.e. by 39% from the base run level, this result suggests that the actual exchange rate policy in Chile was much closer to being an equilibrium one for an economy receiving the 1977-1979 pattern of capital flows imposed in Experiment 3. The real exchange rate index in Table 12 was nearly identical in both simulations through 1979 reflecting the fact that the patterns of net capital flows

Table 10 : External Price Variables

	1977	1978	1979	1980	1981	Cumu-lative
Copper Price Index						
Base Run	100	104	151	166	133	
EXP-1	100	108	121	138	151	
Copper Export Value						
Base Run	1.28	1.29	1.91	2.20	1.76	8.14
EXP-1	1.28	1.34	1.54	1.82	1.99	7.97
Debt Service 1/ 2/						
Base Run	.290	.419	.595	.817	1.328	3.419
EXP-1	.290	.519	.874	1.042	.986	3.711

1/ Billions of U.S.$.
2/ Debt service payments are net of unrequited transfers.

Table 11: Capital Inflows in the Base Run and EXP-3

	1977	1978	1979	1980	1981	Cumu-lative
Capital Flows (billion U.S.$) Base Run	.66	1.80	2.24	3.22	4.88	12.80
Reserve Loss (F): Base Run	.13	.65	.61	.02	.49	-0.92
Capital Flows + Resrve Losses Base Run	.53	1.15	1.63	3.20	5.37	11.88
Capital Flows: EXP-3	.66	1.07	1.44	1.93	2.31	7.41
Reserve Loss (F): EXP-3	.13	0	0	0	0	.13
Capital Flows + Reserve Losses: EXP-3	1.53	1.07	1.44	1.93	2.31	7.28

(including reserve changes) were similar. Table 12 also reveals a drop in the real exchange rate following the sharp increase in capital inflows in the period when the exchange rate was fixed (June 1979 to 1982). Insofar as these inflows were largely induced by the fixing of the exchange rate, the soundness of this policy must be questioned (Corbo 1984).

Turning to the implications of capital inflows on growth, the lower foreign savings implied by the "reasonable" foreign capital inflow profile translates into a substantial drop in investment demand. In turn, the drop in investment demand results in lower growth of real investment as indicated in Table 12. As a result, the construction boom is slowed down. The construction sector records an annual average growth rate of output of only 14% compared to 23% in the base run.

The large drop in foreign capital inflows starting in 1980 must be interpreted as a decline in foreign savings. When foreign savings are reduced, in the absence of a compensating increase in domestic savings, output growth is reduced, which in turn slows employment growth. Total employment in 1981 in EXP-3 is about 10% less than the level achieved in the base run for the same year.

A further implication of the improvement in the real exchange rate is a slowdown in import growth. By the same token, exports are stimulated by the devaluations. The main beneficiary is the manufacturing sector which benefits doubly from substituting for imports and expanding its level of exports. Compared to the base run, average annual export growth is 13.2% in experiment 3, compared to only 9.2% in the base run. As a result, manufacturing GDP growth is even higher in EXP-3 than the rate achieved in the base run in spite of the overall decline in GDP growth.

Table 12: A Comparison of Selected Enogeneous Variables in the Base Run and EXP-3

	1977	1978	1979	1980	1981	Cumulative
Exchange Rate in Units of the Numeraire						
Base	21.54	31.67	37.25	39.00	39.00	--
EXP-3	21.54	31.92	37.70	41.34	43.53	--
Real Exchange Rate Index (1977=100)						
Base	100	96	95	88	81	--
EXP-3	100	97	97	96	95	--
Current Account (billion U.S.$)						
Base	-.53	-1.15	-1.62	-3.20	-5.37	-11.87
EXP-3	-.53	-1.07	-1.44	-1.93	-2.31	-7.28
Organized Labor Growth (% p.a.)						
Base	--	7.3	6.9	7.9	0.0	5.5
EXP-3	--	6.3	6.4	3.2	-3.2	3.8
Real Investment Growth 1/ (% p.a.)						
Base	--	34.9	8.3	40.8	17.3	24.7
EXP-3	--	45.6	4.6	16.9	-3.3	14.6
GDP Growth (% p.a.)						
Base	--	9.3	8.3	8.9	1.0	8.4
EXP-3	--	9.3	8.4	7.3	4.9	7.4

1/ Fixed investment.

VI. CONCLUSIONS

Using a general equilibrium simulation model, this paper has estimated productivity growth and the role of external shocks and capital inflows in explaining the pattern of growth and structural change in Chile during the period 1977-81. As a result of liberalization reforms, begun prior to this period, Chile was closely approximating a laissez-faire economy which Walrasian general equilibrium models are purported to represent. Subject to the modifications discussed in the body of the paper, the model is a useful tool for analyzing growth and structural change in a laissez-faire economy with large relative price changes.

Our results confirm and extend other findings on the magnitude and sectoral pattern of productivity cum capacity utilization gains during the period. Productivity gains associated with the reforms are estimated to have added about 2 percentage points to average annual GDP growth over the 1977-81 period. The counterfactual simulations belie the importance of external shocks associated with the copper price and international real interest rate swings in explaining the emerging macroeconomic imbalances of 1981. However, it is shown that the main determinant of the macro imbalances that arose in 1981 can be attributed to the unsustainable levels of capital inflows that resulted from allowing the real exchange rate to appreciate through the combination of a fixed exchange rate policy accompanied by relaxation of restrictions on capital flows in the presence of backward wage indexation.

Appendix

Equations in the Fixed Exchange Rate Model

This appendix sets out the model equations in block form. A bar on a variable indicates that the variable is exogenous. In general, i subscripts refer to sectors (5), k subscripts refer to labor categories (4 in the productivity growth simulation; and 2 in the counterfactual policy simulations), and h subscripts refer to households (1).

I. Price Block

$$(A1) \quad PM_i = \overline{PW}_i \, (1 + tm_i) \, (1 + tmv_i) \, (1 + trp_i) \, ER$$

$$(A2) \quad PE_i = \overline{PWE}_i \, (1 + te_i) \, ER$$

$$(A3) \quad PS_i = PD_i \, (D_i / X_i) + PE_i \, (E_i / X_i)$$

$$(A4) \quad P_i = (D_i / X_i) \, [PD_i + PM_i (M_i / D_i)]$$

$$(A5) \quad PN_i = PS_i - \sum_j P_j a_{ji} - td_i \, PD_i$$

$$(A6) \quad \sum_i \Delta_i P_i = \overline{P}$$

PM = domestic price of imports

$\overline{PW}$ = exogenous world price of imports

ER = exchange rate

tm = tariff rate

tmv = import value added tax rate

trp = trade margin rate

PE = domestic price of exports

$\overline{PWE}$ = exogenous world export price

te = export subsidy rate

PS = average sales price

PD = domestic good price

P = composite good price

PN = value added or net sales price

td = indirect tax rate

a_{ij} = input-output coefficient

Δ_i = price index weights equal to base year shares of composite good output

$\overline{P}$ = the price index, equal to level of the GDP deflator

D = output for domestic use

E = exports

M = imports

II. Production and Employment

(A7) $$X_i^S = \overline{A}_i \left[B_{1i}\overline{K}_i^{-\rho_i} + B_{2i}L_i^{-\rho_i}\right]^{-1/\rho_i}$$

(A8) $$L_i = \overline{AL}_i L^{\beta_{ik}}$$

(A9) $$L_k^D = \Sigma_i L_{ik}$$

(A10) $$PN_i \left(\frac{\partial x_i}{\partial L_i} \frac{\partial L_i}{\partial L_{ik}}\right) = W_k$$

(A11) $$L_k^D = L_k^s$$

X_i^S = gross domestic output of sector i

$\overline{A}_i$ = shift parameter in the production function

$\overline{K}_i$ = sectoral capital stock (fixed within a period)

L_i = aggregate labor in sector i

β = value share for Cobb-Douglas sectoral labor aggregation

L_{ki} = labor of type k in sector i

L_k^D = demand for category k labor

L_k^s = supply of category k labor

$\overline{AL}_i$ = shift parameter for Cobb-Douglas labor aggregation function

$B_{1,2}$ = share parameter for capital, labor respectively in CES production function

ρ_i = $\frac{1}{\sigma_i} - 1$ where σ = elasticity of substitution

W_k = nominal wage of labor category k

III. Foreign Trade

(A12) $E_i/D_i = [(PE_i / PD_i) (BE_{2i}/ BE_{1i})]^{\Omega i}$

(A13) $M_i/D_i = [(PD_i / PM_i) (BC_{1i} / BC_{2i})]^{\gamma i}$

(A14) $\sum_i \overline{PW}_i M_i - \sum_i \overline{PWE}_i E_i + \overline{F}_1 = F + \overline{F}_2$

$BE_{1,2}$ = shares of exports and output for domestic use in CET export supply function

Ω_i = elasticity of transformation

$BC_{1,2}$ = shares of imports and output for domestic use in the trade aggregation function

γ_i = trade substitution elasticity

$\overline{F}_1$ = debt service payments to abroad, net of transfers

$\overline{F}_2$ = foreign capital inflows

F = endogenous reserve loss (equals zero if the exchange rate is endogenous)

IV. Income and Investment

(A15) $R_L = \Sigma_k \Sigma_i W_k L_{ki} (1-tl_k)$

(A16) $R_K = \Sigma_i (PN_i X_i - \Sigma_k W_k L_{ki} - \delta_i K_{-1}) (1 - tk_i)$

(A17) $R_G = \Sigma_k \Sigma_i W_k L_{ki} tl_k + \Sigma_i tk_i (PN_i X_i - \Sigma_k W_k L_{ki})$

$+ \Sigma_i tm_i \overline{PW}_i ER M_i + \Sigma_i tmv_i \overline{PW}_i ER M_i (1 + tm_i)$

$- \Sigma_i te_i \overline{PWE}_i ER E_i + \Sigma_i td_i X_i PD_i$

(A18) $TINV = S_p + (R_G - \Sigma_i P_i G_i) - (\Sigma_i \overline{PW}_i ER M_i - \Sigma_i \overline{PWE}_i ER E_i - ER\overline{F}_1)$

(A19) $S_p = \alpha_o \overline{P} + \alpha_1 (R_L + R_k - ER \overline{F}_1) - \alpha_2 \overline{F}_2 ER + \Sigma_i \delta_i K_{-1}$

(A20) $Y_i = \Theta_i TINV$

(A21) $\Theta_i = \Theta_{i-1} + \lambda (r_i - \overline{r})$

(A22) $Z_i = \Sigma_j b_{ij} Y_j / \Sigma_i b_{ji} P_i$

R_L = after-tax labor income

tl_k = tax rate on labor income of category K

tk_i = tax rate on non-wage income of sector i

R_K = after-tax capital income

R_G = government revenue

G_i = sectoral real government consumption; note that $\Sigma_i G_i = \overline{G}$ is fixed exogenously.

TINV = total investment equal to domestic plus foreign saving

Y_i = investment by sector of destination

Θ_i = sectoral investment allocation shares

λ_i = coefficient of adjustment of investment share

$r_i - \overline{r}$ = deviation of sectoral from average rental rate

b_{ij} = capital composition coefficients

Z_i = investment by sector of origin

δ_i = capital stock depreciation rate

V. Product Markets

(A23) $C_i = \overline{g}_i(R_L + R_k - S_p) / P_i + \overline{g}_{zi}\ \overline{G}$

(A24) $V_i = \Sigma_j a_{ij} X_j^s$

(A25) $D_i = d_i\ (Z_i + C_i + V_i)$

(A26) $d_i = \{\overline{AC}_i\ [BC_{1i}(M_i/D_i)^{Ri} + BC_{2i}]\ \}^{-1}$

(A27) $X_i^D = \overline{AE}_i\ [BE_{1i}\ E_i^h + BE_{2i} D_i^h\ ]^{1/h}$

(A28) $X_i^D - X_i^s = 0$

C_i = consumption demand, sector i

g_i = fixed private expenditure shares

g_{zi} = fixed government expenditure shares

V_i = intermediate input demands

d_i = domestic demand ratio

X_i^d = total demand for domestic production

$\overline{AC}_i$ = shift parameter in trade aggregation function

$R = \frac{1}{\gamma} - 1$

$\overline{AE}_i$ = shift parameter in CET transformation function

$h = \frac{1}{\Omega} + 1$

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