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Stabilizing the domestic price level under fluctuating terms of trade

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Working Paper No. 179

Stabilizing the Domestic Price Level
under Fluctuating Terms of Trade*

by
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I. Introduction*

1. Reduction of a money-financed fiscal deficit reduces inflation, though, when inflationary expectations decline only slowly, real input cost increases cause unemployment and production losses.¹ By preannouncing the exchange rate, the authorities may stabilize expectations and facilitate further advances towards a target inflation rate without invoking a stabilization crisis. The feasibility of such policy crucially depends on the condition that the exchange rate and monetary instruments are not necessary for external equilibrium. A sudden decline in the terms of trade, for example, would require the tapping of foreign exchange reserves, additional capital inflows or a real exchange depreciation. If reserves are depleted and external finance is not forthcoming in sufficient amounts, the authorities inevitably must either deflate the economy, devalue the nominal rate or find some other policy with like effects on the real exchange rate. Trade taxes and subsidies, for example, would have inflationary effects comparable to those of a currency devaluation. They would, therefore, also be considered a dishonoring of the exchange rate announcement. Deflation would disappoint expectations, with the likely consequence of rising unemployment and production losses. The same uneasy choice would be made should the real effective exchange rate appreciate unexpectedly or capital flows reverse for some external reason.
2. The recent growth of world commodity price instability has amplified terms of trade fluctuations for a number of developing countries which concentrate on the export of a few leading

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¹ Thanks are due to Philippa S. Dee, Hermann Dick, Juergen B. Donges, Hans-Joachim Huß, and Roland Vaubel.

commodities or depend on food imports.¹ For such countries it would be important to know whether foreign exchange reserves and capital movements can be relied upon to insulate the real exchange rate against terms of trade fluctuations. If not, unconditional preannouncement can hardly stabilize inflationary expectations as these are subsequently disappointed. The question still remains as to whether the authorities should rather fix the nominal exchange rate or opt for stabilizing the price level by adjusting money supply to changes in demand. If conditional announcement would work - i.e. the exchange rate is announced subject to a factor of correction should the terms of trade deviate from trend by a specified amount - it would complement a policy directed at the price level target. If not, the issue is one of the real side implications of both alternatives.

Like all members of the International Monetary Fund, commodity exporting countries are entitled to draw on the compensatory financing facility when export earnings fall below trend. Although there is a time lag in discharging the compensatory amounts, the drawing right provides easy access to non-concessionary external finance. Up to the limit set by the Fund, the drawing right substitutes for nationally held reserves of foreign exchange. The feasibility of insulating the real exchange rate against the instability of world commodity markets, in principle, could be secured by raising the limit. The desirability of doing so, however, must be questioned. As with all reserves, there is an unresolved problem of management under uncertainty - a given price change can be iden-

¹ By 1980 a single commodity accounted for at least 40% of total export earnings in 60 member countries of the International Monetary Fund. That commodity was crude petroleum, another mining product or an agricultural product in 22, 15, and 23 countries respectively (International Monetary Fund 1982). While the fluctuation index for the unit values of manufactured goods increased from 0.0343 in the 1950-69 period to 0.0538 in the 1969-79 period, the index for all primary commodities as a group increased from 0.0479 to 0.1764 between the same periods (Adams and Behrman 1982).

tified as either a deviation from trend or a trend shift ex-post only. Furthermore, there may be long-run costs of stabilizing the real exchange rate in commodity exporting countries. These would occur should stabilization remove otherwise existing incentives for export diversification. Sector rates of return to capital outside the commodity sector are stabilized along with the real exchange rate. Depending on the structural pattern of rates of return fluctuations, investors might then have less opportunity to reduce the expected variance on returns by diversifying their portfolio.

3. In this paper a general equilibrium model of Chile will be applied to quantify (a) the requirements for real exchange rate stabilization in a commodity exporting country, (b) the implications of nominal exchange rate and price level stabilization, and (c) short-run benefits and long-run costs of using compensatory finance. The analysis will be done under conditions of both a closed and an open capital account. The recent Chilean experience, which will be sketched in chapter II, provides an almost ideal case for such endeavour. The model will be outlined in chapter III and documented in the Appendix. Results will be presented in chapter IV and conclusions drawn in chapter V.

II. The Chilean Case¹

4. Use of the exchange rates as a stabilization tool in Chile and the other countries of the so-called Southern Cone of Latin America during the 1970s has been called the "greatest innovation" (Sjaastad). Chile pursued the policy for 54 months - much longer than both Argentina and Uruguay. The unscheduled devaluation in June 1982 in the midst of a severe recession is also now discrediting the more orthodox economic reforms implemented from 1975 onwards: trade liberalization, fiscal

¹ This section draws on Sjaastad (1983) and on unpublished papers by Corbo and Zahler.

discipline, privatization of public sector enterprises, replacement of an unfunded government-operated social security scheme by a fully-funded privately-operated system and, of late, the opening-up of capital markets. Theoretically, at least, these measures in the spirit of economic liberalism are not connected to the specific exchange rate policy chosen. Notwithstanding, such sweeping reforms could hardly have been accomplished under conditions of a stabilization crisis.

5. In mid 1975, government spending was reduced across-the-board by 25%, thus eliminating the fiscal deficit. The annual inflation rate of the consumer price index subsequently dropped from 379% in 1975 to 114% in 1977. As inflationary expectations were slow to decline, however, real input costs went up, increasing the unemployment in Greater Santiago to 17% and rendering further advances along this road politically infeasible. With the intention of stabilizing expectations the authorities, in December 1977, adopted a policy of preannouncing the nominal exchange rate. Devaluations were gradually reduced in size until the Peso was pegged to the US Dollar in June 1979. Up to mid 1981, the policy met with remarkable success: by this time the inflation rate had reached the international level and the unemployment rate of Greater Santiago had fallen to 9%. This positive effect on the real side occurred despite an increased real exchange rate. It was made possible by a growth of private external financing which was not publicly guaranteed. Total net capital inflow increased from 0.6 billion Dollars in 1977, the year before capital market liberalization, to 4.8 billion Dollars or 14.5% of GDP in 1981.
6. A series of external shocks originating with US monetary policy and with the world recession reached Chile in 1981-82:

- the Dollar appreciated against the currencies of Chile's other trading partners, thus raising Chile's effective real exchange rate
- the US inflation rate declined, leading to further real exchange rate appreciation
- rising Dollar interest rates rapidly increased the debt servicing burden in Chile's current account, since private external finance was mostly of a short-term nature
- within two years the real price of copper dropped by 25%. Since copper sales, net of trade margins, account for about one half of total export earnings, this exerted a heavy blow to the current account
- with the signs of a crisis, the international banking community became uneasy, noting, i.a., that the capital inflow was not being followed by an increase in the ratio of investment to GDP. Reluctance to extend further credit and to roll over existing short-term loans resulted in a serious liquidity problem.

7. The combined effect of these shocks was a strong revaluation of the effective real exchange rate at a time when a sharp devaluation was required to correct the external disequilibrium. With a fixed nominal rate, the shocks resulted in an unexpected reduction of the inflation rate - the rate turned negative in the first months of 1982. Deflation was accompanied by dramatic real wage and real interest rate increments. Chilean law, until quite recently, indexed wages to past inflation rates, thus automatically increasing the real wage in periods of price level stabilization. Even without such indexing, however, the real wage would have increased, though to a lesser extent. Since wage contracts were sealed according to inflationary expectations for the ongoing period, an unexpected drop in the actual rate would require a downward

revision of existing contracts just for keeping the real wage constant - let alone reducing it so as to adjust to the re-trenched foreign value of domestic labour. Such short-run revision of contracts is at best extremely difficult to accomplish. Unless accompanied by changes in exchange rate expectations, the real interest rate tends to increase when the inflation rate falls. With a credible exchange rate preannouncement, then, the domestic nominal rate should be determined by the foreign rate, i.e. the domestic real rate should have increased as it did. In the case of Chile, however, there seemed to exist a once-for-all opportunity to offset this effect by eliminating the large interest rate spread between Peso and Dollar loans. The spread is believed to be due to a maze of controls restricting competition in the financial sector. Since liberalization of the capital market was slow to unfold, the spread did not give way in time to neutralize the effect of price level stabilization on the real interest rate. In this sense, there is an inconsistency in the Chilean economic reform package.

The increase in real wages and real interest rates, while the external situation called for a reduction of production costs, brought about unemployment and production losses. The unemployment rate of Greater Santiago jumped above 25% and the rate of growth of GDP turned from +7.5% in 1980 to an estimated -13% in 1982. With external pressures persisting, the authorities had no choice but to abandon the fixed exchange rate.

III. The Analytical Approach

III.1 Model Structure

8. The following paper solely deals with world copper market instability as the source of external disturbances to the Chilean economy. Other external shocks as listed in paragraph 6 are

not considered in a formal way. The paper analyzes quantitatively the alternatives for stabilization under the condition of a fluctuating copper price. Despite the stochastic nature of the disturbance, the analytical approach need not be a stochastic one. In order for an announced policy to be trustworthy, the authorities must visibly be prepared for the worst expected case, since otherwise exchange rate expectations will induce capital flows and render achievement of the target impossible. The worst expected case is defined here as that negative deviation of the world copper price from its five-year moving average which could occur with a probability of 5% under the assumption of normal distribution. Based on annual copper prices between 1970 and 1979, this amounts to a price decline of 41.37% as calculated by the average deviation plus two standard deviations.¹ The paper proceeds by projecting the comparative-static short-run effects of this shock as well as of the policies applied for stabilization.

The center-piece of the analytical approach is a quantitative general equilibrium model of Chile which has been used for investigating various aspects of the Chilean commodity problem.² The model is extended here so as to allow for changes in the capital account balance. The model belongs to the class of neo-classical price responsive general equilibrium models paying close attention to microeconomic theory.³ As such it is parti-

¹ World Bank 1980.

² Dick et al (1982) on alternative stabilization targets (employment, absorption, exchange rate), Gerken (1983) on export diversification.

³ See Dixon et al. 1982. Major behavioural postulates are: (i) Producers choose their commodity and factor inputs to minimise production costs of a given output subject to three level constant returns to scale industry production functions. At the first level is the Leontief assumption of no substitution between input categories or between them and an aggregate of the primary factors. At the second level are CES functions describing substitution between domestic and imported sources of each input category and between the three primary factors (aggregate labour, fixed capital, natural resources). At the third level are CES functions describing substitution between different occupations within the aggregate labour category. (ii) Households choose their consumption to maximise an additive nested utility function subject to an aggregate budget constraint. The nests of commodity categories contain CES functions describing substitution prospects in consumption between domestic and imported sources of each category.

cularly appropriate for an open free market economy, explaining trade flows and the composition of domestic activity by relative prices and substitution prospects. Models of this class centre around an input-output system of accounts which facilitates the inclusion of many types of commodity and factor flows: commodity inputs from domestic and imported sources to current production, to capital creation, to households, government and exports, and industry inputs of primary factors which include different types of labour, fixed capital and a sector-specific factor. Added to the real side is a monetary equilibrium condition linking the balance of payments to the domestic monetary base.

9. Trade flows and variations in the rate of return to capital are central to the subject matter of this study. Sector disaggregation must, therefore, emphasize differences with respect to the export share of domestic production, the import share of domestic demand and the cost shares of factors (see Table 1). On the basis of the 67-sector input-output table of Chile in 1977, the economy is disaggregated into eight sectors each producing one homogeneous good.¹ Natural resource based sectors (agriculture, copper mining, other mining) are distinguished separately. Likewise, a domestic sector characterized by a small export and import share is singled out (services). Activities competing moderately against foreign substitutes (agriculture, food processing) are separated from activities competing strongly, either in the world market (other mining, export oriented light manufacturing) or at home (import competing light manufacturing, heavy manufacturing). Lastly, import competing manufacturing activities are grouped according to different cost shares of imported intermediates.

¹ Presidencia de la República.

Table 1 Structure of Economic Activity, Production Costs and Trade in Chile 1977

Sector	Sectoral Shares in Total			Cost Shares in Domestic Production							Trade Shares		Relative Wage ⁷	Import Protection ⁸
	GDP	Workforce	Exports	Copper	Other Inter- mediates Domes- tic	Im- ported	Labour	Fixed Capital	Natu- ral Re- sources	Indi- rect Ta- xes, Net	Exports ⁵	Imports ⁶		
Agriculture	.103	.079	.054	-	.419	.038	.115	.198	.198	.032	.061	.085	.631	.042
Copper Mining	.066	.065	.464	.067	.290	.094	.204	.171	.171	.003	.836	.036	.920	-
Other Mining	.018	.027	.055	-	.341	.133	.299	.125	.125	-.023	.342	.624	1.095	.050
Food Processing	.081	.066	.076	-	.619	.096	.082	.142	-	.061	.058	.093	.760	.036
Light Manufacturing														
- Import Competing ¹	.080	.090	.039	.010	.490	.142	.149	.154	-	.055	.038	.204	.894	.085
- Export Oriented ²	.018	.021	.070	-	.593	.055	.137	.196	-	.019	.294	.056	.943	.094
Heavy Manufacturing ³	.050	.063	.058	.027	.484	.264	.100	.071	-	.054	.064	.494	.952	.104
Services ⁴	.584	.589	.184	-	.323	.050	.289	.282	-	.056	.042	.034	1.104	.001

¹ Manufacture of consumer good except wood products, cork, and paper. - ² Manufacture of wood products, cork, and paper.
³ All other manufacturing industries. - ⁴ Construction, utilities, distribution, private and public services. - ⁵ Share of exports in total demand for domestic production. - ⁶ Share of imports in total domestic consumption. - ⁷ Ratio of sectoral to economy-wide average wage. - ⁸ Ad valorem rates of import protection.

Source: Presidencia de la República.

III. 2 System of Equations

10. The model is written as a set of structural equations linear in all growth rates, allowing it to be solved by simple matrix methods. The equations are listed in Table A1, the variables and coefficients are defined in Tables A2 and A3 respectively. Table A1 partitions the equations into six groups:

(1) Final demands. Households, capital creators, government and foreign sources demand both domestic and imported commodities. Substitution between goods of different source is always induced by changes in relative prices of these goods. The extent of substitution, for a given relative price change, is determined by the specific substitution or cross-price elasticity. Households can substitute between domestic and imported sources of their consumption goods (equation (1)). They can also substitute between different commodity categories within their consumption bundles (2). Producers of capital goods can switch their demand between domestic and imported sources of supply (3). Government demands for imported and domestic commodities are related to real consumption expenditure. Finally, equation (5) indicates that provision is made for Chilean exports to influence world commodity prices.

(2) Industry inputs. Chilean industries can substitute between domestic and imported sources of their intermediate inputs, between the primary factors labour, fixed capital, natural resources, and between different labour occupations in producing their outputs (6-9). The extent of substitution for a given change in relative prices is governed by the relevant substitution elasticities.

(3) Zero pure profits. Since constant returns to scale production technology and competitive behaviour is assumed in the derivation of the structural equations, profits can accrue only to factors of production. Industry output prices must equal production costs: intermediate costs from domestic and imported sources, occupational labour costs and fixed capital and land costs (10). The price of a unit of capital creation in each industry must equal its production costs (11). Note that capital creation does involve primary factors indirectly, via their content in intermediate inputs. The selling prices of import commodities must equal the costs of importing (12). Finally, the revenue from exporting must equal the cost of doing so (13).

(4) Market clearing. Supply must equal demand for domestically produced commodities (14), occupational labour (15), fixed capital (16) and natural resources (17). Note that (15)-(17) simply require that factor employment levels are satisfied. Full employment assumptions are not imposed.

(5) Money and the balance of payments. The money supply is seen as a constant multiple of the monetary base, which is in turn decomposed into a domestic component (credit to the private and public sectors) and the foreign exchange reserve component. Money demand is determined by income (GDP) and by the opportunity costs of holding money (expected inflation and the nominal interest rate). Equation (18) requires nominal supply to equal nominal demand, implicitly assuming that demand for real cash balances is divided between groups according to their share in GDP. International reserves change by the consolidated balance of current and capital accounts (19). Capital flows respond to the differential between do-

mestic and foreign nominal interest rates, adjusted for exchange rate changes (20). In most developing countries international capital flows are controlled. Chile liberalized the capital market in 1978. Model experiments will be done for both cases (see section 11). The balance on current account equals the difference between export earnings on the one side and import payments and net transfers to the rest of the world on the other side. In equation (21), all transfers except debt service payments are assumed constant. Sectoral import volumes, total import payments in foreign currency and total export earnings in foreign currency are defined in equations (22), (23) and (24).

(6) Miscellaneous equations. Most equations in this group are definitional in character. Their structure is for the most part self-explanatory. Of these, however, equations (25)-(27), which determine the allocation of investment across industries, require further comment.¹ They follow from the assumption that (a) investment takes one period to install,² (b) investors have an expected rate of return schedule from new investment which is downwards sloping and (c) aggregate investment is allocated across industries to equate expected rates of return.

III.3 The Experiments

11. The analysis proceeds with a set of comparative-static model experiments. In each experiment the conditions for a specific short-run equilibrium are imposed via the model closure, i.e.

¹ See also Dixon et al (1982).

² Since the model is of a one period comparative-static nature, this means that endogenous investment in the model's solution period does not augment the economy's capital stock in that period.

by assigning values to a selection of exogenous variables (see Table A4).¹ The solution matrix gives the relative or absolute deviation of all endogenous variables from the values which would have occurred without the commodity price change or the diversification policy. Solutions for a selected set of macroeconomic, balance of payments and sectoral variables are listed in Table 2.

The following conditions are common to all experiments. World copper demand contracts by 41.37%. Nominal wages are considered as sticky in the short-run and changes in expectations do not enter wage contracts within the period under study. Wage indexing is not taken into account. Natural resources are treated as sector-specific and in constant supply. The short-run perspective, moreover, also implies constant sectoral capital stocks. Any output response must therefore occur via changes in sectoral labour and intermediate inputs. Foreign interest rates, foreign inflation rates, import prices as well as the world demand for all goods except copper remain constant. The investigation is thus restricted to copper market instability as the source of external disturbance.

All experiments are performed in two versions. The nominal interest rate is fixed in version A and monetary equilibrium is ensured by endogenous changes in domestic credit supply (equation (8)). The parameter β in equation 20, furthermore, is set to zero thus not allowing exchange rate variations to influence capital flows. The intent of version A is to capture

¹ From Tables A1 and A2 we see that there are $4gh + 11g + 9h + rh + 2r + 17$ equations in $4gh + 15g + 11h + rh + 2r + 24$ variables. The model is first closed by assigning values to a selection of $4g + 2h + 7$ variables. Solution values for the endogenous variables are then obtained by matrix methods.

the case of a controlled capital market. In version B domestic credit supply is fixed and the nominal interest rate moves. The parameter β is set to one. Variations of the exchange rate and of the interest rate differential will, therefore, induce capital flows. The intent of version B is to capture the case of a liberalized capital market.

Three experiments are carried out by setting exogenously two of the three variables foreign exchange reserves, the exchange rate and the domestic price level. The other variable moves so as to meet the balance of payments condition (equation 19). The requirements for both sticking to the preannounced exchange rate and satisfying inflationary expectations in spite of the external shock are explored with the aid of the first experiment. Nominal exchange rate and price level changes are set to zero, i.e. the real exchange rate is fixed. The second and third experiments are designed so as to examine the choice between exchange rate and price level stabilization in case the real exchange rate must be allowed to fluctuate. Reserve changes in both experiments are set to zero, the nominal exchange rate is fixed in the second and the price level is fixed in the third experiment, thus enforcing deflation or devaluation respectively.

Because of its linear structure, the model allows the implications of combined policies to be derived by simple extrapolation. Without any further experiments we can, therefore, investigate the consequences of using the compensatory financing facility of the IMF. The numerical results are listed in Table 3.

IV. Results

IV.1 Real exchange rate stabilization

12. In the first experiment the authorities are assumed to stick to the preannounced exchange rate and to comply with price level expectations thereby not allowing the real exchange rate to depreciate in the face of worsening terms of trade. The loss in copper export earnings consequently plays havoc with foreign exchange reserves in the case of a controlled capital market (Table 2, column IA). According to the model simulation, 676 million US Dollars flow out, a sum equivalent to 5.9% of GDP, 31% of annual export earnings, 159% of total reserves and 352% of the compensatory amount to which Chile is entitled under the IMF-facility (where all figures are relative to the model base year 1977). Although money demand contracts along with GDP by 5.59%, monetary equilibrium at the target price level still requires an expansion of domestic credit by 111.38%. If accomplished, such policy would almost completely insulate the non-copper economy against the copper price shock, as can be seen from the model solutions for real absorption, aggregate employment, aggregate imports, non-copper exports and rates of return to capital outside the copper sector. What small changes occur can be explained by the influence of copper or the copper industry through such variables as the consumer price index, input demand and output supply. However, it is difficult to conceive of a situation in which reserve outflows of the magnitude indicated by the model would not inspire exchange rate expectations to depart from the announced rate. The authorities would find it extremely difficult to maintain the capital market controls, and capital outflows motivated by expectations, if not by interest rate differentials, would force a devaluation.

Table 2 Short-run Effects¹ of the Copper Price Shock² and of Price Level and Exchange Rate Stabilization Policies in Chile

Variable	Fixed exchange rate Fixed price level		Fixed exchange rate Fixed reserves		Fixed price level Fixed reserves	
	IA	IB	IIA	IIB	IIIA	IIIB
Macroeconomic aggregates						
Real GDP	-5.59	-5.58	-7.56	-8.09	-5.76	-5.80
Real domestic absorption	0.50	0.53	-7.56	-9.73	-5.76	-7.18
Employment	-0.77	-0.77	-7.18	-8.91	-2.96	-3.46
Domestic price level ³	O(EX) ⁹	O(EX)	-4.50	-5.71	O(EX)	O(EX)
Exchange rate, nominal	O(EX)	O(EX)	O(EX)	O(EX)	4.80	5.90
Interest rate, nominal ⁴	O(EX)	11.28	O(EX)	-5.99	O(EX)	-2.52
Domestic credit supply	111.38	O(EX)	-23.08	O(EX)	-11.01	O(EX)
Balance of payments ⁵						
Foreign exchange reserves ⁶	-676	-335	O(EX)	O(EX)	O(EX)	O(EX)
Capital inflow ⁶	0.00	403	0.00	-214	0.00	-182
Balance on current account ⁶	-676	-738	0.00	214	0.00	182
Aggregate imports	-0.30	-0.28	-10.64	-13.43	-9.15	-11.17
Copper exports	-45.67	-45.66	-45.26	-45.15	-45.09	-44.96
Non-copper exports	-0.78	-0.81	18.85	24.15	21.47	26.56
Sector rates of return to capital ^{7,8}						
Agriculture	0.02	0.01	1.58	2.00	2.19	2.69
Copper mining	-21.26	-21.26	-19.38	-18.88	-18.73	-18.15
Other mining	-0.02	-0.02	3.75	4.80	6.47	7.95
Food processing	0.08	0.08	-0.12	-0.17	-0.03	-0.05
Light manufacturing						
- import competing	0.23	0.23	-0.15	-0.25	0.16	0.14
- export oriented	-0.01	-0.01	2.20	2.79	2.81	3.46
Heavy manufacturing	0.52	0.52	-0.38	-0.62	-0.33	-0.53
Services	0.19	0.20	-3.57	-4.59	-2.58	-3.21

¹ Model projections. All projections are in relative percentage changes unless otherwise noted. -
² Shift in world copper demand by -41.37%. - ³ Consumer price index. - ⁴ Absolute change measured in percentage points. - ⁵ In foreign currency values. - ⁶ In million US Dollars of 1977. -
⁷ Absolute change measured in percentage points. - ⁸ See Footnotes to Table 1 for delineation of sectors. - ⁹ Denotes variables exogenously set to zero.

Source: Own calculations.

13. A liberalized capital market mitigates the drain on foreign exchange reserves. The authorities can allow interest rates to rise so as to adjust money demand to contracting supply (Table 2, column IB). With constant exchange rate expectations, this would induce a capital inflow thus reducing the reserve outflow and, in turn, the interest rate adjustment required. Under the interest rate elasticities of money demand and capital inflow specified in the model, the net reserve outflow would drop to 310 million US Dollars and the interest rate would have to rise by 11.28 percentage points. Debt service payments would raise the current account deficit by 62 million US Dollars compared to the closed capital market case. Since the model does not link the nominal interest rate to the real side, the solutions on real macroeconomic aggregates, on trade and on sector rates of return are almost equal to those of the closed market case.

The balance of payments implications obviously depend on the interest rate elasticity of capital inflow, reliable estimates of which are extremely difficult to come by. The figure for ψ_5 inserted in the model (1 billion Pesos or 0.31% of base year GDP) is made up from nothing but intuition. If the true elasticity is lower, the model results indicate infeasibility of real exchange rate stabilization also under capital market liberalization. The net reserve outflow might still inspire expectations of exchange rate changes. Even without such expectations the drastic rise in the nominal interest rate required for inducing capital inflow likewise raises the real interest rate and is thereby likely to have depressing repercussions on the real side of the economy, effects which are not included in the model.¹ With a higher

¹ Note that a rather high interest rate elasticity of money demand has been specified for the experiments ($\psi_4 = 2, 3$). A lower elasticity would imply an even more dramatic rise in the interest rate, though a smaller reserve outflow.

interest rate elasticity of capital inflow, naturally, there is less need for concern over external balance. Note, however, that the inflow would still have to cover at least the current account deficit calculated by simulation IA plus debt service payments. Asking the international capital market for more than 5% of GDP may be difficult in a situation of depressed commodity export earnings.

14. Sector rates of return to capital were shown to be remarkably stable in all but the copper sector. A comparison with the solutions of the further experiments reveals the direction into which real exchange rate stabilization tends to influence trade structure. Leaving aside distinctions between different experiments, a general pattern of sectoral solutions for rates of return to capital emerges. Basically, sector results are determined by the export share of domestic sales and the import share of domestic purchases: Capital return in copper mining is directly hit by the price shock; the services sector must face the shrinking domestic demand without being able to compete against foreign substitutes either at home or abroad; sectors with a high import share of domestic purchases but a low export share of supply (food processing, import competing light manufacturing, heavy manufacturing) can approximately make good for a smaller domestic market by increasing their market share. The other export oriented primary and secondary sectors, however, gain from their improved competitiveness on the world market.

Real exchange rate stabilization removes a strong market incentive for diversifying investments from both the commodity sector and the domestic sector into other international sectors, most notably the export oriented sectors of agriculture, non-copper mining and light manufacturing. Investors

have less opportunity to reduce the variance of expected returns by engaging in activities yielding inversely fluctuating rates of return to capital. By holding down fluctuations in the domestic sector, real exchange rate stabilization tends to reduce the trade share in GDP. By attenuating fluctuations in export oriented sectors, stabilization increases export concentration. The economy is thus growing more vulnerable against world commodity market instability, in turn requiring more stabilization measures.

IV.2 Price or exchange rate stabilization under fixed reserves

15. Defending the reserve stock against an export earnings shortfall calls for an adjustment of the real exchange rate. Leaving aside substitutes, there is a choice between deflation with fixed exchange rates, or depreciation with a fixed price level, if exports are to be enhanced and imports to be curbed. Under both options nominal domestic credit supply contracts or nominal interest rates fall in order to maintain monetary equilibrium in the face of decreasing nominal GDP. Although the general direction of real side effects is the same under both exchange rate and price level fixity, and in both the controlled and the liberalized capital market case, the model solutions reported in Table 2 reveal conspicuous differences in magnitude.
16. In the second experiment the authorities honour the exchange rate announcement but disappoint expectations with respect to the price level. Simulation results for the controlled capital market case (Table 2, column IIA) indicate that the price level must fall by 4.50% in order to balance the current account via reduced imports (-10.64%) and additional non-copper exports (+18.85%). With nominal wages fixed according to pre-

vious inflationary expectations, the real wage increase delivers a severe blow to aggregate employment (-7.18%). Real GDP subsequently falls by more than the amount dictated by terms of trade considerations alone.¹

In the liberalized capital market, the nominal interest rate declines as both the domestic and the foreign component of money supply are fixed and the income component of money demand is reduced by the copper price decline (Table 2 column IIB). Capital outflow then calls for a stronger real exchange rate depreciation so as to activate the current account, the domestic price level falls by 5.71% instead of 4.50%. All real effects, subsequently, are more pronounced than under capital market controls - aggregate employment, for example, now contracts by 8.91% following a real wage increase of 5.71% in the face of a terms of trade decline of 18.60%. Return to capital picks up in export oriented sectors and is subdued in sectors with a domestic share of sales. These results, of course, do not indicate that liberalization of the capital market leaves the economy more susceptible to terms of trade shocks. They just point out that the authorities would have to watch domestic credit supply. Reducing supply by more than 23.08% - as can easily be deducted from a comparison of solutions in columns IIA and IIB - all macro-economic results would be improved in the liberalized vis-a-vis the closed capital market case. The results on sector rates of return to capital would be less diversified since the real exchange rate would be devalued by a smaller percentage.

¹ Given the copper share in export earnings (0.46) and the export share in GDP (0.29), the terms of trade effect can be calculated from the copper price decline after the recovery caused by shrinking Chilean exports (-37.59%) and the price decline of non-copper exports induced by expanding supplies (-1.89%). With import supply assumed to be perfectly elastic, terms of trade decline by 13.31% and GDP by 5.31%.

17. In the third experiment the price level is kept constant and the currency must depreciate in order to defend external equilibrium. The simulation results for the controlled capital market case (Table 2, column IIIA) indicate a devaluation of the nominal and the real exchange rate by 4.80%. Real depreciation under a fixed price level is thus only slightly different from the one required under a fixed exchange rate. The wage mechanism, however, substantially modifies the real side effects. A constant real wage now reduces the employment result from -7.18% to -2.96%.¹ GDP, real absorption, and imports subsequently fall by a smaller percentage while more resources are available for export production. There is also an improvement in the results for sector rates of return. Most notably, capital in sectors competing on the world market earns higher benefits than under a fixed exchange rate.

In the liberalized capital market case (Table 2 column IIIB), again, all real effects are more pronounced than under capital market controls, unless domestic credit supply is reduced. Real depreciation must be strong enough to offset capital outflow due to both expected devaluation and a lower nominal interest rate. A comparison with fixed exchange rate solutions (column IIB) discloses the overriding importance of the real wage effect also in the case of a liberalized capital market. The employment and the GDP results, i.a., improve from -8.91% to -3.46% and from -8.09% to -5.80% respectively. Further, all sector rates of return shape up. If policies are directed to the price level instead of the exchange rate target, only a rather moderate restriction of domestic credit supply (more than 11.01%) is sufficient to turn around the results for the liberalized vis-a-vis the closed capital market case.

¹ For constant aggregate employment the terms of trade shock would have to be counteracted by real wage decline.

18. Comparing solutions between the fixed exchange rate and fixed price level experiments, a rather clear result emerges. When policies are directed to price level stability, an adverse commodity price shock does less harm to employment, absorption and GDP. The shock, furthermore, provides a stronger incentive for diversifying investments into other export oriented sectors.

IV.3 Using compensatory finance

19. Chile would have been entitled to draw up to 192 million US Dollars from the compensatory financing facility of the International Monetary Fund in 1977, the model's base year, should export earnings have fallen below trend sufficiently. The authorities could well have allowed an equivalent outflow of national foreign exchange reserves without inspiring exchange rate expectations. When domestic policies are directed toward the price level target, compensatory finance can be used to mitigate the impact of an adverse terms of trade shock on the nominal exchange rate as well as on all real side variables by allowing for a temporary addition to the deficit on current account.

The implications of using the facility in the closed and the liberalized capital market are laid out in columns IVA and IVB of Table 3. Thanks to the linear structure of the model the results can be calculated as weighted averages of the solutions of experiments IA, IIIA and IB, IIIB respectively. According to the figures obtained, compensatory finance has rather moderate effects when the capital account is closed whereas the change in results is dramatic when the account is open. Real absorption, for example, improves from -5.76% to -3.98% in the closed capital market case but from -7.18%

Table 3 Short-run¹ Effects of Drawing on the Compensatory Financing Facility of the IMF in Case of the Copper Price Shock²

Variable	Fixed price level	
	IVA	IVB
Macroeconomic aggregates		
Real GDP	-5.71	-5.67
Real domestic absorption	-3.98	-2.77
Employment	-2.34	-1.92
Domestic price level ³	O(EX)	O(EX)
Exchange rate, nominal	3.44	2.52
Interest rate, nominal ⁴	O(EX)	5.39
Domestic credit supply	23.75	O(EX)
Balance of payments ⁵		
Foreign exchange reserves ⁶	-192(EX)	-192(EX)
Capital inflow ⁶	0.00	153
Balance on current account ⁶	-192	-345
Aggregate imports	-6.64	-4.93
Copper exports	-45.25	-45.36
Non-copper exports	15.15	7.05
Sector rates of return to capital ^{7,8}		
Agriculture	1.57	1.15
Copper mining	-19.45	-19.93
Other mining	4.63	3.38
Food processing	0.00	0.02
Light Manufacturing		
- import competing	0.18	0.19
- export oriented	2.01	1.47
Heavy manufacturing	-0.09	0.07
Services	-1.79	-1.26

For Footnotes see Table 2

Source: Own calculations.

to -2.77% in the liberalized case. The figures for employment are from -2.96% to -2.34% and from -3.46% to -1.92% respectively. The rate of nominal and real exchange rate depreciation goes down from 4.80% to 3.44% in the case of a closed capital market but from 5.90% to 2.52% in the case of an open account, consequently stabilizing sector rates of return to capital to different degrees. The relative difference in results is, of course, brought about by an increase in the nominal interest rate due to the contraction in the foreign component of money supply. The induced capital inflow allows for a substantially higher deficit on current account.

The short-run benefits of compensatory finance, therefore, grow much stronger when liberalization is extended to the capital market. In this case, compensatory finance may also look more dispensable, because the authorities could reduce domestic credit supply, i.e. contract the domestic instead of the foreign component of money supply, with an intention to wholly finance the current account deficit by capital inflow. They would, however, have to allow for a more drastic increase in nominal and real interest rates. Furthermore, creditworthiness may be impaired in times of a shortfall in export earnings.

The structural pattern of sector rates of return to capital under real exchange rate fluctuations has already been discussed in paragraph 14. Stabilization weakens an incentive for diversifying investment from the commodity and the domestic sectors into other international sectors. Since the use of compensatory finance tends to inhibit export diversification, it would certainly not be optimal to waive the limit on the drawing right altogether. If society demands the short-run

benefits of stabilization, compensatory finance might rather be conditioned to an explicit export diversification policy substituting for the market incentive lost.¹

V. Summary and Conclusions

20. Preannouncement of the nominal exchange rate was used as a stabilization tool in Chile for more than four years before it was abandoned in the midst of a severe recession in June 1982. The recession resulted from external shocks originating in both the monetary policy of the United States and the world market for Chile's leading export commodity: the real exchange rate appreciated at a time when worsening terms of trade dictated a depreciation. If the nominal exchange rate is to be used as a stabilization tool, however, it must be dispensable for external equilibrium. In this paper the focus was on the commodity problem. Is it feasible for a country exposed to wide fluctuations in world demand for its leading export commodity to use unconditional exchange rate preannouncement as a tool for stabilizing inflationary expectations? If not, what are the real side implications of either sticking to the announcement or adjusting the exchange rate in a way required for price level stabilization? Should compensatory financing of export earnings shortfalls be expanded?

A quantitative general equilibrium model of Chile was applied to investigate these issues. Though the commodity problem is stochastic in nature, only comparative-static solutions for the worst expected case were taken into consideration. This can be defended on the basis that preannouncement can stabilize expectations only when the authorities are visibly prepared for such a case.

¹ Gerken (1983).

21. The first experiment revealed that with a controlled capital market, the authorities cannot accomplish both the exchange rate and the inflation target without depleting domestic foreign exchange reserves by far more than can be compensated for under the IMF facility. If nominal wage cuts cannot be used to take care of the real exchange rate problem, the policy is not feasible. The announced rate simply would not be trusted under a massive reserve outflow. In the liberalized capital market case the depletion of reserves is less severe and, given a higher interest rate elasticity of capital inflow than the one inserted in the model, might even be avoided. There may be doubts, however, as to whether a capital inflow of more than 6% of GDP will be forthcoming in a situation of depressed export prices.

If the real exchange rate is to be adjusted, either price level or nominal exchange rate expectations will be disappointed. As nominal wages are fixed in the short-run according to inflationary expectations formed previously, real wages will rise under a fixed exchange rate and remain constant under a policy aimed at price level stability. The second and the third experiment reveal that cyclical swings caused by commodity price fluctuations will be much more pronounced when monetary policy is directed toward the nominal exchange rate instead of the domestic price level. More than four percentage points, for example, are added to the rate of unemployment which would be obtained under price level stability. Sector rates of return to capital, on the other hand, fluctuate somewhat less in the fixed exchange rate case thereby providing less incentive for export diversification. On the basis

of real side implications, fixing the nominal exchange rate is shown to be the inferior alternative. There would be a case for exchange rate announcement if it could be made conditional on events in the world commodity market.

Considering, however, the fragile knowledge on relevant elasticities, the conclusion as yet is negative for both conditional and unconditional announcement in a country exposed to the instability of world primary commodity markets. The model results suggest rather that policies which discourage export diversification in the long-run should be avoided.

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Table A1 The Chilean Model Equations: A Linear System in Percentage Changes¹

Identifier	Equation ^{2,3}	Subscript Range	Number	Description
<u>1. Final Demands</u>				
(1)	$x_{is}^{(3)} = x_i^{(3)} - \sigma_i^{(3)} (p_{is} - \sum_{s=1}^2 S_{is}^{(3)} p_{is})$	$i=1, \dots, g$ $s=1, 2$	2g	Household demands for commodities by source
(2)	$x_i^{(3)} = q + \epsilon_i (c - q) + \sum_{k=1}^g \eta_{ik} p_k$	$i=1, \dots, g$	g	Household demands for commodities undifferentiated by source
(3)	$x_{(is)j}^{(2)} = y_j - \sigma_{ij}^{(2)} (p_{is} - \sum_{s=1}^2 S_{(is)j}^{(2)} p_{is})$	$i=1, \dots, g$ $s=1, 2$ $j=1, \dots, h$	2gh	Demands for inputs to capital creation
(4)	$x_{is}^{(5)} = c_R$	$i=1, \dots, g$ $s=1, 2$	2g	Other (mainly government) demands
(5)	$p_{i1}^e = - \gamma_i x_{i1}^{(4)} + f_{i1}^{(4)}$	$i=1, \dots, g$	g	Export demands
<u>2. Industry Inputs</u>				
(6)	$x_{(is)j}^{(1)} = z_j - \sigma_{ij}^{(1)} (p_{is} - \sum_{s=1}^2 S_{(is)j}^{(1)} p_{is})$	$i=1, \dots, g$ $s=1, 2$ $j=1, \dots, h$	2gh	Demands for intermediate inputs
(7)	$x_{vj}^p = z_j - \sigma_j^p (p_{vj}^p - \sum_{v=2}^3 S_{vj}^p p_{vj}^p - S_{1j}^p p_1^p)$	$v=2, 3$ $j=1, \dots, h$	2h	Demands for fixed capital (v=2) and land (v=3)
(8)	$x_{1j}^p = z_j - \sigma_j^p (p_1^p - \sum_{v=2}^3 S_{vj}^p p_{vj}^p - S_{1j}^p p_1^p)$	$j=1, \dots, h$	h	Demands for aggregate labour
(9)	$x_{1,q,j}^p = x_{1j}^p - \sigma_{1,j}^p (p_{1,q}^p - \sum_{q=1}^r S_{1,q,j}^p p_{1,q}^p)$	$q=1, \dots, r$ $j=1, \dots, h$	rh	Demands for labour of each occupation
<u>3. Zero Pure Profits Conditions</u>				
(10)	$p_{j1} = \sum_{i=1}^g \sum_{s=1}^2 H_{(is)j}^{(1)} p_{is} + \sum_{q=1}^r H_{1,q,j}^p p_{1,q}^p + \sum_{v=2}^3 H_{vj}^p p_{vj}^p$	$j=1, \dots, h$	h	- in production
(11)	$\pi_j = \sum_{i=1}^g \sum_{s=1}^2 H_{(is)j}^{(2)} p_{is}$	$j=1, \dots, h$	h	- in capital creation
(12)	$p_{i2} = p_{i2}^m + t_i + \phi$	$i=1, \dots, h$	g	- in importing
(13)	$p_{i1} = p_{i1}^e + v_i + \phi$	$i=1, \dots, g$	g	- in exporting
<u>4. Market Clearing</u>				
(14)	$z_j = \sum_{i=1}^h B_{(i1)j}^{(1)} x_{(i1)j}^{(1)} + \sum_{i=1}^h B_{(i1)j}^{(2)} x_{(i1)j}^{(2)} + B_{i1}^{(3)} x_{i1}^{(3)} + B_{i1}^{(4)} x_{i1}^{(4)} + B_{i1}^{(5)} x_{i1}^{(5)}$	$j=1, \dots, g$	g	- domestically produced commodities
(15)	$l_q = \sum_{j=1}^h B_{1,q,j} x_{1,q,j}^p$	$q=1, \dots, r$	r	- labour of each occupation
(16)	$k_j = x_{2j}^p$	$j=1, \dots, h$	h	- capital
(17)	$n_j = x_{3j}^p$	$j=1, \dots, h$	h	- land

Table A1 continued The Chilean Model Equations: A Linear System in Percentage Changes¹

Identifier	Equation 2,3	Subscript Range	Number	Description
<u>5. Money and the Balance of Payments</u>				
(18)	$S_d^{m_d} + S_f^{m_f} = \psi_2 gdp - \psi_3 w - \psi_4 \Delta P^{(rd)}$		1	Supply equals demand for money
(19)	$m_n^f = \frac{1}{M_n^f} 100(\Delta B + \Delta K)$		1	Change in foreign reserves
(20)	$\Delta K = \psi_5 (\Delta P^{(rd)} - \Delta P^{(rw)} - \beta \frac{\phi}{\psi_4})$		1	Capital inflow
(21)	$100\Delta B = Ee - Mm - 100\Delta KP^{(rw)} - 100\Delta P^{(rw)}K$		1	Balance on current account
(22)	$x_{i2} = \sum_{j=1}^h B_{(i2)j}^{(1)} x_{(i2)j}^{(1)} + \sum_{j=1}^h B_{(i2)j}^{(2)} x_{(i2)j}^{(2)}$ $B_{i2}^{(3)} x_{i2}^{(3)} + B_{i2}^{(5)} x_{i2}^{(5)}$	$i=1, \dots, g$	g	Sectoral import volume
(23)	$m = \sum_{i=1}^g (p_{i2}^m + x_{i2}) M_{i2}$		1	Foreign currency imports
(24)	$e = \sum_{i=1}^g (p_{i1}^e + x_{i1}^{(4)}) E_{i1}$		1	Foreign currency exports
<u>6. Miscellaneous</u>				
(25)	$r_j = Q_j (p_{2j}^p - \pi_j)$	$j=1, \dots, h$	h	Rate of return to capital
(26)	$y_j = k_j + B_j (r_j - \lambda)$	$j=1, \dots, h$	h	Industry investment
(27)	$\sum_j (\pi_j + y_j) T_j = i$		1	Investment budget (nominal)
(28)	$P_1^p = \sum_{q=1}^r p_{1,q} S_{1,q}$		1	Price of labour in general
(29)	$P_k = \sum_{s=1}^2 S_{ks}^{(3)} P_{ks}$	$k=1, \dots, g$	g	General price of goods to households
(30)	$\epsilon^{(3)} = \sum_{i=1}^g \sum_{s=1}^2 w_{is}^{(3)} p_{is}$		1	Consumer price index
(31)	$\epsilon^{(2)} = \sum_{j=1}^h T_j \pi_j$		1	Capital goods price index
(32)	$c_R = c - \epsilon^{(3)}$		1	Aggregate real consumption
(33)	$i_R = i - \epsilon^{(2)}$		1	Aggregate real investment
(34)	$i_R = c_R$		1	Relationship between real consumption and investment
(35)	$l = \sum_{q=1}^r l_q \psi_{1q}$		1	Aggregate employment

Table A1 continued The Chilean Model Equations: A Linear System in Percentage Changes¹

Identifier	Equation ^{2,3}	Subscript Range	Number	Description
(36)	$\kappa = \sum_{j=1}^h k_j \psi_{2j}$		1	Aggregate capital stock
(37)	$p_{1,q}^P = f_1$		r	Allows for exogenous setting of wages
(38)	$gdp = S_c c + S_i i + S_g \sum_{s=1}^2 \sum_{i=1}^g (x_{is}^{(5)} + p_{is}) S_{is}^{(5)} + S_e e - S_m m$		1	Nominal GDP
(39)	$gdp_R = gdp - S_i \epsilon^{(2)} - (S_c + S_g) \epsilon^{(3)}$		1	Real GDP

Total equations = $4gh + 11g + 9h + rh + 2r + 17$

¹ The variables and coefficients are defined in Tables A2 and A3. - ² The model distinguishes 8 domestic industries each producing its respective commodity i.e., g and h = 8. Hence $p_{j1} = p_{i1}$, $j = 1, \dots, h$. (Labels for these are given in Table 1). The labour market is divided into two occupational categories, i.e., r = 2. The superscript s denotes the source of the commodity, s = 1 (domestically produced), s = 2 (imported). The superscript v denotes the type of primary factor; v = 1 (aggregate labour), v = 2 (fixed capital), v = 3 (land). - ³ The nomenclature of variable superscripts is as follows. Superscript "P" denotes a primary factor quantity or price, superscript "m" a foreign price for imports (cif) and superscript "e" a foreign price for exports (fob). Superscript (1) denotes the use of that variables in current production, (2) in capital creation, (3) by households, (4) exports and (5) by other (mainly government) demands. Note that there is no superscript on the local prices of domestic and imported commodities (the p_{is}). That is, the price of a commodity is assumed to be the same in all domestic end uses.

Table A2 Chilean Model Variables

Variable ¹	Number	Description ²
$x_{is}^{(3)}$	2g	Household demands for domestic and imported goods
$x_i^{(3)}$	g	Household demands for goods undifferentiated by source
p_{is}	2g	Price of good i from source s
q	1	Number of households
c	1	Aggregate nominal household expenditure
p_k	g	Price of consumer goods by type but not by source
$x_{(is)j}^{(2)}$	2gh	Demands for inputs (domestic and imported) for capital creation
y_j	h	Capital creation by using industry
$x_{is}^{(5)}$	2g	Other (mainly government) demands for domestic and imported goods
c_R	1	Aggregate real household expenditure
p_i^e	g	F.o.b. foreign currency export prices
$x_{i1}^{(4)}$	g	Export demands
$f_{i1}^{(4)}$	g	Export demand shift variable
$x_{(is)j}^{(1)}$	2gh	Demands for inputs (domestic and imported) for current production
z_j	h	Industry outputs
x_{vj}^p	3h	Industry demands for labour in general, fixed capital and land
p_{vj}^p	2h	Rental prices of capital (v=2) and land (v=3) in each industry
p_l^p	1	Economy wide price of labour in general
$x_{l,q,j}^p$	rh	Demands for labour by occupation and industry
$p_{l,q}^p$	r	Price of labour by occupation
π_j	h	Costs of units of capital
p_{12}^m	g	C.i.f. foreign currency prices for competing imports
t_i	g	One plus the ad valorem rates of protection on imports
ϕ	1	Exchange rate (Chilean peso/foreign currency (\$ US))
v_i	g	One plus ad valorem rates of export subsidies
l_q	r	Employment by occupation
k_j	h	Industry capital stocks
n_j	h	Industry natural resources

Table A2 continued Chilean Model Variables

Variable ¹	Number	Description ²
$\varepsilon^{(3)}$	1	Consumer price index
w	1	Expected inflation
gdp	1	Nominal gross domestic product
gdp _R	1	Real gross domestic product
m _n ^d	1	Domestic component of money
m _n ^f	1	Foreign component of money
$\Delta P^{(rd)}$	1	Nominal Peso interest rate
$\Delta P^{(rw)}$	1	Nominal Dollar interest rate
ΔB	1	Balance on current account
ΔK	1	Balance on capital account
x _{i2}	g	Commodity import volume
m	1	Foreign currency value of imports
e	1	Foreign currency value of exports
r _j	h	Industry rates of return to capital
λ	1	Economy-wide expected rate of return
i	1	Aggregate nominal investment
$\varepsilon^{(2)}$	1	Investment goods price index
i _R	1	Aggregate real investment
z	1	Aggregate employment
κ	1	Economy's aggregate capital stock
f ₁	1	Shift terms for economy-wide wage

Total variables: 4gh + 15g + 11h + rh + 2r + 24

¹ The variable subscript range is as follows: i,k = 1,...,g; s = 1,2; v = 1,2,3; j = 1,...,h; q = 1,...,r. - ² All variables are in percentage changes except ΔB , ΔK , $\Delta P^{(rd)}$ and $\Delta P^{(rw)}$ which are expressed in first differences.

Table A3 Coefficients of the Chilean Model

$\sigma_i^{(3)}$ $\sigma_{ij}^{(1)}$ $\sigma_{ij}^{(2)}$	<p>CES import-domestic substitution elasticities for good i in household consumption ($\sigma_i^{(3)}$), intermediate usage in industry j for current production ($\sigma_{ij}^{(1)}$), and as inputs to capital creation ($\sigma_{ij}^{(2)}$). A common value of 2.0 was assigned to all these elasticities. This value, while judgemental, is consistent with estimates from the few published studies in this area.</p>
σ_j^P $\sigma_{1,i}^P$	<p>CES substitution elasticities among primary factors (σ_j^P), and amongst occupational labour ($\sigma_{1,j}^P$) in industry j. Since relative wages between occupations were assumed fixed in all experiments the values assigned to $\sigma_{1,j}^P$ (1.0 for all j), exert no influence on the results. The following values for σ_j^P were used, 1. Agriculture (0.31), 2. Copper mining (0.20), 3. Other mining (0.51), 4. Food processing (1.0), 5. Light manufacturing (import competing) (1.0), 6. Light manufacturing (export oriented) (1.0), 7. Heavy manufacturing (1.0), 8. Services (0.43). The values for sectors 1,3 and 8 were drawn from the econometric estimates in Behrman (1972), the value for sector 2 from the supply elasticity reported in Lasaga (1981). Values for the remaining sectors are based on the estimates reported in Corbo and Meller (1979).</p>
ϵ_i } η_{ik} }	<p>Expenditure (ϵ_i) and cross price (η_{ik} $i \neq k$) elasticities in household consumption for good i. Estimates for ϵ_i were obtained from the Chilean household demand studies reported in Lluch, Powell and Williams (1977) and Taborga (1978). The estimates used for each of the eight commodity groups are, 1. (0.60), 2.-4. (0.75), 5. (1.10), 6. (1.41), 7. (1.62), 8. (1.18). Since the underlying household utility functions are assumed to be additive, the matrix of uncompensated own price (η_{ii}) and cross price (η_{ik}) consumer demand elasticities were obtained from</p>

Table A3 continued Coefficients of the Chilean Model

$$\eta_{ii} = \frac{\epsilon_i}{w} - \epsilon_i \alpha_i \left(1 + \frac{\epsilon_i}{w}\right)$$

$$\eta_{ik} = - \epsilon_i \alpha_j \left(1 + \frac{\epsilon_j}{w}\right) \quad i \neq k$$

Where w is the Frisch parameter and α_j are household budget shares calculated from the 1977 input output table. The estimate of w (-2.525) was obtained using the relationship between per capita GDP and Frisch parameter values estimated by Lluch, Powell and Williams (1977).

γ_i

Reciprocals of the foreign demand elasticities for Chilean export commodity i . For all commodity categories except copper, the "small country" assumption was approximated by assigning a small value (0.05) to the respective γ_i 's. For copper, a value of 0.5 was used. This value is based principally on the world price elasticity of demand for copper and the Chilean share in world copper exports.

$\left. \begin{matrix} Q_j \\ B_j \\ T_j \end{matrix} \right\}$

Industry investment parameters. Q_j is the ratio of the gross (before depreciation) to the net (after depreciation) rate of return in industry j . B_j is the reciprocal of the elasticity of the expected rate of return schedule for industry j times the ratio of its gross investment to its following year capital stock. T_j is the share of total investment accounted for by industry j . T_j was obtained from the 1977 Chilean input-output table. Q_j and B_j are judgemental.

$\left. \begin{matrix} \psi_{1q} \\ \psi_{2j} \end{matrix} \right\}$

Respectively the share of aggregate employment accounted for by occupation q and the share of the economy's aggregate capital stock in industry j . The percentage share of skilled (52.2) and unskilled (47.8) workers was obtained from República de Chile, encuesta nacional del empleo. Values for ψ_{2j} were calculated by using information given in the 1977 Chilean input-output table.

Table A3 continued Coefficients of the Chilean Model

$\left. \begin{array}{l} S_c \\ S_i \\ S_g \\ S_c \\ S_m \end{array} \right\}$	<p>Respectively the shares of GDP accounted for by aggregate consumption, investment, other (mainly government) domestic, export and import demand. The shares, which sum to unity, were obtained from the 1977 Chilean input-output table.</p>
$\left. \begin{array}{l} S_{(is)j}^{(1)} \\ S_{(is)j}^{(2)} \end{array} \right\}$	<p>Shares of good i from source s (domestic or imported) in industry j's purchases of i for current production (1), and capital creation (2). Obtained from the 1977 Chilean input-output table</p>
$S_{is}^{(3)}$	<p>Share of the value of good i from source s in the total purchase of good i by households. Obtained from the 1977 Chilean input output table.</p>
$\left. \begin{array}{l} S_{vj} \\ S_{1,q,j} \end{array} \right\}$	<p>Respectively the share of primary factor v in the total primary factor costs of industry j and the share of labour by occupation q in industry j's total labour costs. Obtained from the 1977 Chilean input-output table.</p>
$\left. \begin{array}{l} H_{(is)j}^{(1)} \\ H_{1,q,j}^P \\ H_{2j}^P \\ H_{3j}^P \\ H_j^T \end{array} \right\}$	<p>Respectively the shares of industry j's production costs represented by intermediate inputs of good i from source s, labour inputs of occupation q, fixed capital, land, and net indirect taxes. Obtained from the 1977 Chilean input-output table.</p>
$\left. \begin{array}{l} B_{(i1)j}^{(1)} \\ B_{(i1)j}^{(2)} \\ B_{i1}^{(3)} \\ B_{i1}^{(4)} \\ B_{i1}^{(5)} \end{array} \right\}$	<p>Respectively the share of the total sales of domestic good i absorbed by, inputs to industry j for current production (1), and for capital creation (2), by households (3), exports (4), and other (mainly government) demands (5). Obtained from the 1977 Chilean input-output table.</p>

Table A3 continued Coefficients of the Chilean Model

$B_{i2}^{(1)}$ $B_{i2}^{(2)}$ $B_{i2}^{(3)}$ $B_{i2}^{(5)}$	<p>Respectively the share of the total sales of imported good i absorbed by, inputs to industry j for current production (1) and for capital creation (2), by households (3), exports (4), and other (mainly government) demands (5). Obtained from the 1977 Chilean input-output table.</p>
$B_{1,q,j}$ $S_{1,q}$	<p>Share of the economy's employment of occupation q accounted for in industry j, and cost share of labour of type q in the economy's total labour cost respectively. Obtained from the 1977 Chilean input-output table.</p>
$S_{is}^{(5)}$	<p>Share of aggregate other demands accounted for by other demand for good i from source s. Obtained from the 1977 Chilean input-output table.</p>
M_{i2} E_{i1} M E	<p>The share of total foreign currency costs accounted for by imported good i (M_{i2}), the share of total foreign currency export earnings accounted for by exported commodity i (E_{i1}), the aggregate foreign currency value of imports (M), and the aggregate foreign currency value of exports (E). Obtained from the 1977 Chilean input-output table.</p>
$W_{is}^{(3)}$	<p>Expenditure weight of good i from source s in the model's index of consumer prices. Obtained from the 1977 Chilean input-output table.</p>
S_d S_f	<p>Respectively the shares of domestic and foreign component in total money supply. Obtained from IMF International Financial Statistics.</p>
M_n^f	<p>Base period reserve stocks. Obtained from IMF International Financial Statistics.</p>
ψ_2 ψ_3 ψ_4	<p>Respectively the elasticities of money demand with respect to GDP, expected inflation and with respect to an absolute change in the nominal interest rate. ψ_3 plays no role in the model results since the variable w is set to zero in all experiments. ψ_2 is set to 1.0, ψ_4 to 2.3.</p>

Table A3 continued Coefficients of the Chilean Model

ψ_5 Elasticity of capital inflow with respect to an absolute change in the difference between the Peso and Dollar interest rate subject to exchange rate expectations. Rational expectations are assumed. ψ_5 is set to 1 billion Pesos of the base year.

Table A4 Exogenous Variable Selection and Values for Each Experiment

Variable ¹	Number	Experiments					
		IA	IB	IIA	IIB	IIIA	IIIB
k_j	h	0	0	0	0	0	0
n_j	h	0	0	0	0	0	0
q	1	0	0	0	0	0	0
f_1	1	0	0	0	0	0	0
t_i	g	0	0	0	0	0	0
v_i (i=1-6)	2 } g	0	0	0	0	0	0
$x_{i1}^{(4)}$ (i=7,8)		0	0	0	0	0	0
p_{i2}^m	g	0	0	0	0	0	0
$f_{i1}^{(4)}$ (i=1,3-8)	g	0	0	0	0	0	0
$f_{i1}^{(4)}$ (i=2)		-41.37	-41.37	-41.37	-41.37	-41.37	-41.37
w	1	0	0	0	0	0	0
$\Delta P^{(rw)}$	1	0	0	0	0	0	0
$\Delta P^{(rd)}$	1	0		0		0	
m_n^d	1		0		0		0
m_n^f	1			0	0	0	0
ϕ	1	0	0	0	0		
ε (3)	1	0	0			0	0

A set of $4g + 2h + 4$ exogenous variables is common to all experiments, 3 further variables are specific for each experiment.

¹ For variable labels see Table A2. - ² The model is allowed to explain exports for the major export commodities, i.e., those whose sales pattern is such that their domestic prices can be regarded as being set by their corresponding world prices. For other commodities, exports are determined exogenously with the model endogenising the corresponding export subsidy/tax variable.