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A SIMPLE MACRO MODEL FOR A
SEMI-INDUSTRIALIZED ECONOMY
FACING A BINDING EXTERNAL CONSTRAINT

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ABSTRACT

This work uses a macroeconomic (Keynesian) model for a small open economy to describe the short run functioning of the economy when it faces a dominant external restriction. The main conclusions are the following: (1) In the model, a devaluation can be counterproductive considering that (i) in an economy without complete wage indexation, a devaluation produces a reduction of real wages, a contraction of consumption and a decline in aggregate demand, and (ii) a devaluation can produce a deterioration in the commercial balance in the short run if the price elasticity of the commercial balance is low enough. (2) When the economy enters a situation of external disequilibrium, to overcome this disequilibrium, the combination of exchange and fiscal policy which minimizes the decline in income depends on the magnitude of the devaluation. (3) In an economy in which the export industries use imported goods for their production, the potential impact of a uniform increase in tariffs on income is ambiguous. The income effect of the tariff increase will be positive if (i) the cost of production of the domestic goods which are (imperfect) substitutions of the goods exchanged through the market is relatively labor intensive; (ii) the imports are relatively more price elastic than the exports, and (iii) the positive income effect increases as the initial commercial deficit does. (4) When a small open economy encounters a limited external restriction, there is a tradeoff between increases in real wages and increases in the level of employment.

RESUMEN

En este trabajo se utiliza un modelo macroeconómico (keynesiano) para una pequeña economía abierta, que describe el funcionamiento de la parte real de la economía en el corto plazo, cuando ésta enfrenta una restricción externa dominante. Las principales conclusiones de este trabajo son las siguientes: (1) En el modelo, una devaluación puede ser contraccionaria en el corto plazo, al considerar los siguientes dos efectos: (i) En una economía sin indexación completa de salarios, una devaluación produce una reducción de salarios reales, una contracción del consumo y una caída de la demanda agregada. (ii) Una devaluación puede producir un deterioro de la balanza comercial en pesos en el corto plazo si las elasticidades precio de la balanza comercial son suficientemente pequeña. (2) Cuando la economía presenta una situación de desequilibrio externo, para eliminar éste, la combinación de política cambiaria y fiscal que minimiza la caída del producto depende de la magnitud de la devaluación. (3) En una economía en que las industrias exportadoras utilizan insumos importados en su producción, el efecto potencial de un aumento uniforme de aranceles sobre el producto es ambiguo. El efecto del aumento de aranceles sobre el producto será positivo si: (i) El costo de producción de los bienes domésticos que son sustitutos (imperfectos) de los bienes transables en los mercados es relativamente intensivo en trabajo. (ii) Las importaciones son relativamente más elásticas a precios que las exportaciones. (iii) Mientras mayor sea el déficit inicial de la balanza comercial. (4) Cuando una pequeña economía abierta enfrenta una restricción externa limitante, hay un "tradeoff" entre aumentos del salario real e incrementos del nivel de empleo.

INTRODUCTION

Latin American economies have undergone a radical change in their macroeconomic regimes since the beginning of the eighties. They have moved from a situation characterized by abundant foreign credit, appreciated real exchange rates, significant current account deficits and high levels of domestic activity, to a situation of strict foreign credit rationing, adjustment of the current account through internal recession, unemployment and devaluation. Furthermore, all this occurs in a context of high external indebtedness.

Given the internal and external imbalances observed at present, Latin American economies will be conditioned by a severe restriction in external resources. In fact, policies oriented towards reducing internal imbalance through increased aggregate demand --to expand output and employment-- will require to increase imports; however, the increase in imports

will be limited by the availability of foreign exchange. Hence different questions arise: In which way could both imbalances be reduced simultaneously? How could output and employment be increased in a way consistent with the external constraint? What mechanisms could be used to relax the severity of the external restrictions? How effective are devaluations to improve the trade balance and to produce the required substitution in the demand for foreign goods to domestic goods? Should devaluation go together with restrictive demand policies as is suggested by the IMF (International Monetary Fund)? What limitations does the restriction of external resources impose on the wage policy? These and other questions are at the center of academic and economic policy discussions in countries that are currently facing severe external restriction in conditions of low economic activity and high unemployment.

The purpose of this paper is to examine these issues using a short run Keynesian macroeconomic model for a small open economy facing a dominant external constraint.

The paper has four sections: Section I lays out the assumptions and equations of the model. In section II we discuss exchange rate and fiscal policies and their interaction; in this respect, IMF policies are reassessed. In section III we analyze the wage policy and the nature of the trade-off between real wages and employment when a dominant external constraint prevails. Section IV provides a short summary of the main conclusions. In each section the impact of the different policies is quantified, using elasticity values and parameters which are plausible for

the Chilean economy.

I. THE BASIC MODEL

The structural model is a Keynesian model for a small open economy, and is directed at examining the performance of the real sector of the economy in the short run. To this effect absorption and elasticities approaches are combined; i.e., income level and relative prices constitute the main adjustment mechanisms of this model 1/. Since it is a model focused on the short run, productive capacity is assumed to be fixed; additionally, investment is assumed to be exogenously determined. A crucial assumption in this model is that locally-produced tradeable goods are imperfect substitutes for those traded in international markets; i.e., the Law of One Price does not prevail.

Output Y is determined by aggregate demand. Four components of aggregate demand are considered. (i) Consumption C is a direct function of the total real wage bill; i.e., the nominal wage rate, w, multiplied by the level of employment, E, is deflated by the price level, P. (ii) The autonomous component, G, includes government expenditure and investment. (iii) Exports, X, are a direct function of relative price π_X and the income of the rest of the world, Y*. (iv) Imports, M, are an inverse functions of relative price π_M and a direct function of domestic income Y.

1/ Dornbusch (1980) suggests the use of a similar model.

Income level $\quad:\quad Y = C + G + X - M$ $\qquad(1)$

Consumption function $:\quad C = C\,(\frac{w}{P}\,E)$ $\qquad(2)$

Exports function $\quad:\quad X = X\,(\pi_X,\ Y^*)$ $\qquad(3)$

Imports function $\quad:\quad M = M\,(\pi_M,\ Y)$ $\qquad(4)$

The equation for the balance of payments (in dollars), B, corresponds to the sum of the trade balance and an exogenous component of the net capital flow, F (which includes foreign debt servicing).

Balance of payments $\quad:\quad B = P_X^* X - P_M^* M + F$ $\qquad(5)$

The existence of an external constraint implies that the balance of payments must have at least a level of foreign currency B_r; i.e., $B \geq B_r$. Then, if there is a fixed exchange rate regime, this leads to $dB = 0$ (see Dreze and Modigliani, 1981).

The employment level in the short run is a function of the output level; the effect of changes real wages affect employment through their impact on aggregate demand.

Employment function $\quad:\quad E = E\,(Y)$ $\qquad(6)$

Price level P is a geometric average between wages, w, and the exchange rate, e.

Price level $\quad:\quad P = w^\alpha\,e^{1-\alpha}$ $\qquad(7)$

Relative prices π_X and π_M correspond to the ratios (in local currency) of external (P_X^* and P_M^*) and domestic prices of tradable goods.

$$\pi_X = \frac{eP_X^*}{P_X} \qquad(8)$$

$$\pi_M = \frac{eP_M^*}{P_M} \tag{9}$$

where the domestic prices of the exporting and import-competitive industries can be expressed as:

$$P_X = w^{\alpha_X} e^{1-\alpha_X} \tag{10}$$

$$P_M = w^{\alpha_M} e^{1-\alpha_M} \tag{11}$$

The expressions of π_X and π_M use the assumption that tradeable goods produced locally are imperfect substitutes for those traded in international markets (see Branson, 1984) [1]/.

The equations for internal prices P_X and P_M (expressions 10 and 11) are in fact cost equations. Unitary prices are determined by labour costs (w) and the cost of imported inputs (e); a unitary price of imported inputs has implicitly been assumed. (It is also assumed that the mark-up does not vary in the short run; therefore it is omitted from these prices equations).

II. EXCHANGE RATE AND FISCAL POLICY

The model described in the previous section will be used to examine the impact of a devaluation and fiscal policy on output, assuming a fixed nominal wage rate.

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[1]/ For further discussion with respect to this assumption, see Goldstein and Khan (1985).

1. Internal and external balance

The concept of internal balance used here corresponds to the notion of the locus of the combinations of e/w, Y, that produce equilibrium in the internal goods market.

Combining equations (2), (6), and (7), the consumption function can be expressed as:

$$C = C \left(\frac{w}{e}, Y\right) \tag{12}$$

This consumption function depends on relative prices and real income level [1]. In this case, a devaluation produces a decline in the real wage (it is implicitly assumed here that there is no wage indexation) and, therefore, a decrease in consumption [2]. In this way, we have a simple mechanism showing the contractionary effect of a devaluation in the short run [3].

Net exports are a function of the real exchange rate, and domestic and foreign income. Then

$$NX = NX \left(\frac{e}{w}, Y, Y^*\right) \tag{13}$$

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[1] See Dornbusch (1980) for a different derivation of a consumption function with the same structure as that one of expression (12).

[2] Additionally, it is implicitly assumed that the marginal propensity to consume of the recipients of profits is lower than that of the workers.

[3] In the literature, various mechanisms have been suggested through which a devaluation has contractionary effects in the short run: (i) The existence of a trade balance deficit when devaluation occurs. (ii) The redistributive effect induced by devaluation among groups with different marginal propensities to consume. (iii) The fiscal effect of devaluation. (iv) The decline in real monetary balances produced by a devaluation. (v) The increase in the domestic price of imported inputs and its impact upon aggregate supply. See Krugman and Taylor (1978), Solimano (1984), and van Wijnbergen (1984).

Equilibrium in the domestic goods market is given by:

$$Y = C \left(\frac{w}{e}, Y\right) + G + NX \left(\frac{e}{w}, Y, Y^*\right) \qquad (14)$$

The total differential dY (assuming that Y^* remains constant) will be:

$$dY = \frac{\partial C}{\partial(e/w)} d(e/w) + \frac{\partial C}{\partial Y} dY + dG + \frac{\partial NX}{\partial(e/w)} d(e/w) + \frac{\partial NX}{\partial Y} dY \qquad (15)$$

As $NX = X \left(\frac{e}{w}, Y^*\right) - M \left(\frac{e}{w}, Y\right)$, then $\underline{1}/$ $\frac{\partial NX}{\partial Y} = - m$, where m is the marginal propensity to import. Let $s = 1 - \frac{\partial C}{\partial Y}$ be the marginal propensity to save. Then, if expression (15) is divided by d(e/w), we have:

$$\frac{dY}{d(e/w)} \bigg|_Y = \frac{\dfrac{\partial C}{\partial(e/w)} + \dfrac{\partial NX}{\partial(e/w)} + \dfrac{dG}{d(e/w)}}{s + m} \qquad (16)$$

In expression (16), $\dfrac{dY}{d(e/w)}\bigg|_Y$ represents the slope of the locus of the points of internal balance (internal equilibrium of the goods market) on the plane (Y, e/w). The denominator of expression (16) is positive. In this work the simplifying assumption that $\dfrac{dG}{d(e/w)} = 0$ will be used. Devaluation implies a reduction in real wages and, therefore, a decline in consumption; for this reason, $\dfrac{\partial C}{\partial(e/w)}$ is negative. Thus, a sufficient condition for a devaluation to be contractionary in the short run would be that $\left|\dfrac{\partial C}{\partial(e/w)}\right| > \left|\dfrac{\partial NX}{\partial(e/w)}\right|$ for the case in which the Marshall-Lerner condition is satisfied. If the Marshall-Lerner condition is not satisfied, a devaluation would deteriorate the trade balance (expressed in local currency, i.e. pesos); then we would have that $\dfrac{\partial NX}{\partial(e/w)}$ would be

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$\underline{1}/$ It is implicitly assumed that P_X^* and P_M^* are unitary.

negative, and it would not be necessary for the previous inequality to hold in order for a devaluation to have a contractionary impact. It will be assumed that one of these two conditions prevails, which would imply that the locus of the internal goods market equilibrium would have a negative slope on plane $(Y, e/w)$.

External balance is obtained from the balance of payments (equation 5). The total differential of that expression, dB (considering $P_X^* \underline{1/}$, P_M^* and F as constants) will be:

$$dB = \frac{\partial B}{\partial (e/w)} \, d(e/w) + \frac{\partial B}{\partial Y} \, dY \tag{17}$$

The existence of a limiting external constraint implies that $dB = 0$; i.e., the economy will move through the locus of external equilibrium points. In this way it will be possible to fulfil two different purposes: on the one hand, the economy will not operate beyond what is allowed by the availability of external resources; on the other, all external resources are used to expand aggregate demand.

Thus, making $dB = 0$, and as $\frac{B}{Y} = -\frac{M}{Y} \eta_{MY}$ where η_{MY} is the income elasticity of imports, we have that

$$\left. \frac{dY}{d(e/w)} \right|_B = -\frac{\frac{\partial B}{\partial (e/w)}}{\frac{\partial B}{\partial Y}} = \frac{\frac{\partial B}{\partial (e/w)}}{\frac{M}{Y} \eta_{MY}} \tag{18}$$

In expression (18), the denominator is positive. On the other hand, a devaluation has a positive impact on the trade balance measured in dollars. Therefore, slope $\left. \dfrac{dY}{d(e/w)} \right|_B$ of equation (18) is positive.

1/ In the Chilean case, copper is the main export product, and Chilean producers are price takers in the world copper market; therefore, P_X^* is being used instead of P_X. In the case of imports, Chile is a price taker.

Consequently the locus of the points of external equilibrium has a positive slope on the plane (Y, e/w).

Figure 1 shows the internal balance of the goods market, II, and the external equilibrium of the balance of payments, EE, on the plane (Y, e/w). The slope of internal balance II is given by equation (16) and the slope of external equilibrium EE is given by equation (18).

The points above and to the right of the internal balance II are points where there is an excess supply of goods, while in the points below II there is an excess demand of goods. The points above and to the left of the external equilibrium of the balance of payments EE are points where there is a surplus in the balance of payments while in the points below there is a deficit in the balance of payments.

2. Inter-relationship between exchange and fiscal policies

Let us assume that the economy is at the intersection of the internal and external equilibrium; i.e, on point A of fig. 1. In this case, the level of production would be Y_o and the level of relative prices would be $(e/w)_0$ 1/. Let us now consider the impact of a devaluation; let $(e/w)_1$ be the new level of relative prices.

When devaluation occurs, given an output level Y_o the economy moves to point P. In this point P we have a surplus in the balance of payments and an excess supply in the goods market. Due to the contractionary effect of the devaluation in the short run, the economy will move to-

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1/ The level of output Y_o corresponds to a situation where there is unemployment in the labor market.

wards point Q in order to restore equilibrium in the internal goods market. Thus, we have a decrease in the level of output from Y_o to Y_1; but on the other hand, at point Q, the balance of payments shows a surplus. Therefore, the economy has external resources which could be used to expand the level of production.

By keeping the new level of relative prices $(e/w)_1$ constant, the economy could move towards point R, restoring external equilibrium; the level of production would expand to Y_2. To take the economy to point R, it would be necessary to shift the locus of internal equilibrium II. To this effect an expansionary fiscal policy could be used, which in the case of this model would involve increasing the (exogenous) level of expenditure, G.

In short, when an economy faces a binding external constraint, it cannot move towards the points that are to the right and below external equilibrium EE; however, it is convenient for it to move through the locus EE in order to use at all times any surplus of external resources that might become available. In order for the economy to move from A to R (fig. 1) avoiding a fall in output in the short run, it becomes necessary for a devaluation to be coupled with an <u>expansionary</u> fiscal policy.

Let us now derive the required magnitude of the increase in government expenditure G which should go together with a devaluation in order to keep the economy on the locus EE.

By making dB = 0 in equation (17), the condition that the economy will move through the locus of external equilibrium EE is ensured.
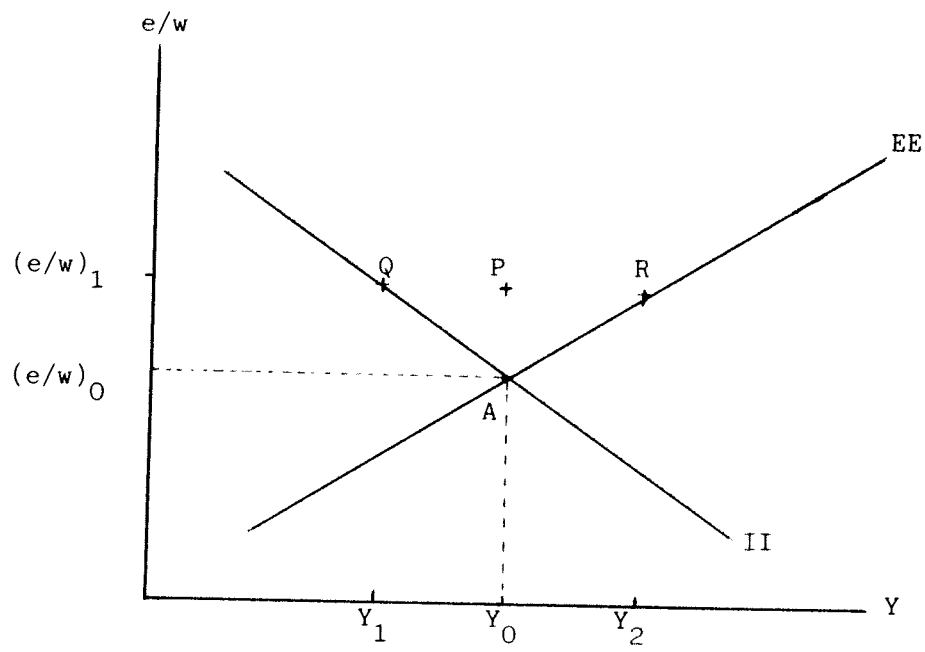
Figure 1

If we substitute in this expression, equation (15) corresponding to the value of dY for the internal goods equilibrium, it becomes possible to obtain a relationship between the exchange policy and the fiscal policy; i.e., between d(e/w) and dG. Thus, using expressions (16) and (18) we arrive at:

$$\frac{1}{s+m} \, dG = \frac{dY}{d(e/w)}\bigg|_B \, d(e/w) - \frac{dY}{d(e/w)}\bigg|_Y \, d(e/w) \tag{19}$$

In expression (19), $\frac{dY}{d(e/w)}\bigg|_B$ represents the slope of external equilibrium EE and $\frac{dY}{d(e/w)}\bigg|_Y$ represents the slope of internal equilibrium II; it should be remembered that while the first of these slopes is positive, the second is negative. Therefore, expression (19) means that the expansionary fiscal policy accompanying a devaluation required to keep the economy on the locus of external equilibrium should take the following two elements into consideration: On the one hand, it would have to compensate the contractionary effect of devaluation in the short run; on the other hand, it would have to make use of the surplus of external resources generated by the devaluation.

3. A quantification of the effects of the exchange and fiscal policies

In this section an empirical application will be made of the theoretical elements developed in the previous section. To this effect the potential and real effect of a devaluation in the short run will be calculated, as well as the change required in fiscal expenditure so that the economy can move through the locus of the points of external equili-

brium EE. For this purpose, numerical values that are plausible for the Chilean economy will be used 1/.

The <u>potential</u> effect of a devaluation on the level of output can be obtained directly from the balance of payments equation (5). Considering the income of the rest of the world Y^*, the net flow of external capital, F, and international prices P_X^* and P_M^* as constants (and making them equal to one), and assuming that there is no wage indexation, the total differential of B (equation 5) will be:

$$dB = \frac{\partial X}{\partial \pi_X} \frac{\partial \pi_X}{\partial e} de - \frac{\partial M}{\partial \pi_M} \frac{\partial \pi_M}{\partial e} de - \frac{\partial M}{\partial Y} dY = 0$$

Using the following elasticy notation:

$$n_{MY} = \frac{\partial M}{\partial Y} \frac{Y}{M} \; ; \qquad n_{X,\pi_X} = \frac{\pi_X}{X} \frac{\partial X}{\partial \pi_X} \; ; \qquad n_{M,\pi_M} = \frac{\pi_M}{M} \frac{\partial M}{\partial \pi_M}$$

$$n_{\pi_X, e} = \frac{e}{\pi_X} \frac{\partial \pi_X}{\partial e} \; ; \qquad n_{\pi_M, e} = \frac{e}{\pi_M} \frac{\partial \pi_M}{\partial e} \; ; \qquad n_{Ye} = \frac{e}{Y} \frac{dY}{de}$$

Then, the previous expression is reduced to:

$$n_{Ye} = \frac{\left(\frac{X}{M}\right)\left(n_{X,\pi_X}\right)\left(n_{\pi_X, e}\right) - \left(n_{M,\pi_M}\right)\left(n_{\pi_M, e}\right)}{n_{MY}} \tag{20}$$

Expression (20) can be simplified even further using the elasticities of relative prices π_X and π_M with respect to the exchange rate.

1/ Most of the values used correspond to selections from different empirical studies on the Chilean economy; De Gregorio (1984); Jadresić (1985); Meller (1984); Solimano (1983, 1984). In some cases gross ad hoc estimates have been made, using recent information concerning Chile's macroeconomic evolution.

To this effect equations (8), (9), (10) and (11) must be used $\underline{1}/$. Then, the potential elasticity of income with respect to the exchange rate will be:

$$n_{Ye}\bigg|_{B} = \frac{\frac{X}{M} n_{X,\ \pi_X} \alpha_X - n_{M,\ \pi_M} \alpha_M}{n_{MY}} \tag{21}$$

The denominator of expression (21) is the income elasticity of imports, which is positive. In the numerator of equation (21), the price elasticity of exports is positive while the price elasticity of imports is negative. Therefore, the potential elasticity of income with respecto to a devaluation is positive; this corresponds to the fact that the trade balance measured in foreign currency (dollars) of a small economy $\underline{always}$ improves after a devaluation.

In terms of the algebraic development of the previous section, potential elasticity $n_{Ye}\bigg|_{B}$ is associated with the possible shift of the economy from point P to point R in fig. 1; however, in order for this to happen in the short run, it is necessary for the locus of internal equilibrium II to shift by using an expansionary fiscal policy.

To quantify expression (21) the following values will be used:

$$\frac{X}{M} = 0.65; \quad n_{X,\ \pi_X} = 0.2; \quad n_{M,\ \pi_M} = -0.4; \quad \alpha_X = \alpha_M = 0.6; \quad n_{MY} = 1.4$$

$\underline{1}/$ Calculating the logarithmic differential of the price expressions and using the previous assumptions that P_X^*, P_M^* and nominal wages w are constant, we have:

$$n_{\pi_X,\ e} = \alpha_X \qquad\qquad n_{\pi_M,\ e} = \alpha_M$$

Coefficients α_X and α_M represent the share of labor in the unitary cost of the local production of exportable and importable goods, respectively.

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Thus, the numeric expression of (21) will be $n_{Ye}\big|_B = 0.227$. This means that a 10% nominal devaluation has a 2.27% potential impact on output expansion. In this calculation of the elasticity n_{Ye} we have considered exclusively the effect of devaluation on production costs due to the increase in imported inputs; i.e., the effect of the variations in nominal wages has not been considered, because it has been assumed that there is no wage indexation 1/.

The <u>effective</u> impact of a devaluation on real income in the short run, corresponds to the required fall in output which is consistent with the equilibrium in the goods market. This effect is obtained from the equilibrium of the internal goods market (equation 14). Assuming that Y^*, G and w remain constant, total differential dY (equation 14) will be:

$$dY = \frac{\partial C}{\partial (w/P)}\ \frac{\partial (w/P)}{\partial e}\ de + \frac{\partial C}{\partial Y}\ dY + \frac{\partial NX}{\partial e}\ de + \frac{\partial NX}{\partial Y}\ dY$$

Using the notation of elasticities, and the marginal propensities to save and to import, we have that:

$$(s + m)\ dY = \frac{C}{e}\ n_{C,\ w/P}\ n_{w/P,e} + \frac{NX}{e}\ n_{NX,e}$$

Let $\xi_{Ye}\big|_Y = \frac{e}{Y}\ \frac{dY}{de}$ be the effective elasticity of income with respect to the exchange rate. In terms of the algebraic development of the previous section, $\xi_{Ye}\big|_Y$ is associated with the contractionary displacement of the economy from point P to point Q (fig. 1). Then,

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1/ See Solimano (1984) and van Wijnbergen (1984) for the effect of devaluation considering wage indexation.

$$\xi_{Ye}\bigg|_Y = \frac{\left(\frac{C}{Y}\right) \eta_{C,w/P} \; \eta_{w/P,e} + \left(\frac{NX}{Y}\right)\eta_{NX,e}}{s + m} \tag{22}$$

Expression (22) can be simplified by examining the impact of a nominal devaluation on the real wage; i.e., by calculating elasticity $\eta_{w/P,e}$ [1]/. Then equation (22) becomes:

$$\xi_{Ye}\bigg|_Y = - \frac{\left(\frac{C}{Y}\right) \eta_{C,w/P} \; (1 - \alpha) + \left(\frac{NX}{Y}\right)\eta_{NX,e}}{s + m} \tag{23}$$

In expression (23) the denominator is positive. In the numerator, the first term is negative, because the real wage elasticity of consumption is positive. The sign of the second term of the numerator will depend on whether the Marshall-Lerner condition is satisfied or not (in the short run). If the Marshall-Lerner condition is not satisfied, then the contractionary impact of devaluation on consumption through the decline in real wages is increased by the deterioration of the trade balance (measured in pesos).

To quantify expression (23) the following values will be used [2]/:

$$\frac{C}{Y} = 0.30; \quad \alpha = 0.6; \quad s + m = 0.50; \quad \eta_{C,w/P} = 1.0; \quad \frac{NX}{Y} \eta_{NX,e} = -0.05$$

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[1]/ Calculating the logarithmic differential of expression (7) and assuming that nominal wages are constant, we have:

$$\eta_{w/P,e} = - (1 - \alpha)$$

In this case, a nominal devaluation produces a fall in real wages equal to the relative participation of imported goods in the general price level.

[2]/ A Keynesian multiplier for an open economy equal to 2 will be used. Implicitly, we are using a 0.35 marginal propensity to import, which is consistent with the 1.4 income elasticity of imports. We are considering the part of consumption that is related to the wage bill; in the Chilean case consumption represents around 65% of total product and remunerations constitute nearly 45% of total income.

Thus, the numeric expression of (23) will be: $\left.\xi_{Ye}\right|_Y = -0.34$. This means that a 10% nominal devaluation has, in the short run, a 3.4% contractionary impact on the level of output. Of this high percentage, approximately 70% corresponds to the decline in consumption that is induced by the reduction in real wages due to devaluation (when there is no wage indexation). In other words, a 10% nominal devaluation produces a 4% decline in the real wage, which generates a 2.4% contraction of output; furthermore, there is an additional 1% contraction of output due to the deterioration in the trade balance (in pesos) generated by the devaluation. In this case, the non-fulfilment of the Marshall-Lerner condition would account for only 30% of output contraction observed after a devaluation.

We will now examine the magnitude of the fiscal policy which should accompany the devaluation in the short run so that the potentially expansionary impact (on output) can become effective. Combining equations (19), (21), and (23 and making $\frac{dG}{G} = \hat{G}$, $\frac{de}{e} = \hat{e}$, we get:

$$\hat{G} = (s + m) \frac{Y}{G} \left[\left.\eta_{Ye}\right|_B - \left.\xi_{Ye}\right|_Y\right]\hat{e} \tag{24}$$

In expression (24), elasticity $\left.\eta_{Ye}\right|_B$ is positive because it is the impact of a devaluation on the balance of payments measured in dollars; on the other hand, elasticity $\left.\xi_{Ye}\right|_Y$ is negative, because it the contractionary impact produced by devaluation on aggregate demand (in the short run). From here we can infer that $\hat{G}$ is positive. Thus, for a small open economy with unemployment which wishes to move through the locus of ex-

ternal equilibrium, a devaluation must be complemented by an <u>expansionary</u>

fiscal policy.

To quantify expression (24) the following values will be used:

$$s + m = 0.50; \quad \frac{Y}{G} = 3; \quad \eta_{Ye}\Big|_B = 0.227; \quad \xi_{Ye}\Big|_Y = -0.34. \quad \text{Then,} \quad \hat{G} = 0.8505 \, \hat{e}.$$

Therefore, a 10% nominal devaluation should be complemented by an 8.51%

increase in expenditure G so that the economy can move through the locus

of external equilibrium EE 1/.

4. A comparison with IMF policies

One of the characteristics of IMF programmes is that an exchange

policy of devaluation usually goes with a contractionary fiscal policy.

Let us examine, then the cause of the differences between the combination

of exchange and fiscal policies suggested by the IMF and our model.

There are two main assumptions in the IMF logic that lead to com-

plementing a devaluation with a contractionary fiscal policy: (i) The

economy is in a situation of full employment. (ii) Devaluation has an

expansionary impact on output. Let us consider the effect of these two

assumptions separately.

In order for a devaluation to have a positive impact on the out-

put level in the short run, it is a necessary condition that the Marshall-

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1/ An aspect not included in this work is the mechanism utilized
to finance this increase in government expenditure G. If the income elas-
ticity of taxes is assumed to be 1.35, then a devaluation of 10% (together
with the expansive fiscal policy suggested by equation 23) will produce a
2.27% output expansion which would generate a 3.06% increase in tax reve-
nue. If it is assumed that initially there is a balanced budget, 5.45% of
the new fiscal expenditure would remain unfinanced. Therefore, the expan-
sive fiscal policy accompanying a 10% devaluation would generate a fiscal
deficit amounting to 1.8% of the GDP (Gross Domestic Product).

Lerner conditions be met 1/. This type of situation is illustrated in fig. 2 2/. The external equilibrium is represented by EE; in this case, due to the fulfilment of the Marshall-Lerner condition, internal equilibrium II has a positive slope on plane (Y, e/w) 3/.

The intersection of internal equilibrium II and external equilibrium EE is point A for which output level is Y_0 and the relative price exchange rate/wage is $(e/w)_0$. Let us suppose that there is a devaluation and that the new exchange rate is $(e/w)_1$. The economy would then move immediately from A to P (see fig. 2). At this point there would be a surplus in the demand of goods, which would have to be eliminated by an increase in the level of production from Y_0 to Y_1; the economy would then have to move towards point Q in order to restore the balance in the internal goods market.

Consequently, in this case, where devaluation has an expansionary effect on aggregate demand, it would have an effective (and not potential) impact on the increase of output. At point Q there is internal equilibrium and a surplus in the balance of payments.

1/ The effect of a fall in real wages on consumption is generally omitted.

2/ See Dornbusch (1980) for the derivation of the slopes for internal equilibrium II and external equilibrium EE in fig. 2, and the existing relation between those slopes. Note that these derivations do not include the role of relative prices in the expenditure function.

3/ Note that for the explanation that follows, it is necessary that II should have a (positive) slope greater than that of EE. This type of result is only valid for the case analyzed in Dornbusch (1980).

Let us now introduce the other main assumption of the IMF program; the economy is in a situation of full employment. This means that the level Y_0 in fig. 2 is a level of production where there is full employment. Since there would be a situation of excess demand at point P, this would generate inflationary pressure. To eliminate this inflationary pressure, it would be necessary to reduce aggregate demand. This would be attained by a contraction in fiscal expenditure, which would shift internal equilibrium II towards the left (and upwards) to position II' (fig. 2). This new internal equilibrium II' would guarantee that point P would be the new position of equilibrium in the economy.

In short, according to the IMF economic programme, a devaluation accompanied by a contractionary fiscal policy would take the economy from A to P (fig. 2). The economy would maintain its level of full employment output Y_0; devaluation would produce a surplus in the balance of payments, and fiscal policy would avoid any inflationary pressure.

According to our model, a devaluation accompanied by a contractionary fiscal policy would have a double contractionary effect. In this case, a contractionary fiscal policy shifts downwards and to the left the locus II of internal equilibrium towards II' (see fig. 3). Then, the output level falls from Y_0 to Y_2, while devaluation alone would produce a reduction of output to a level close to Y_1.

An implicit assumption, crucial in all the previous analysis, is the point at which the economy is located at the beginning of the process. We have assumed up to now that the economy is at point A, which corresponds to the intersection between the internal and the external equili-
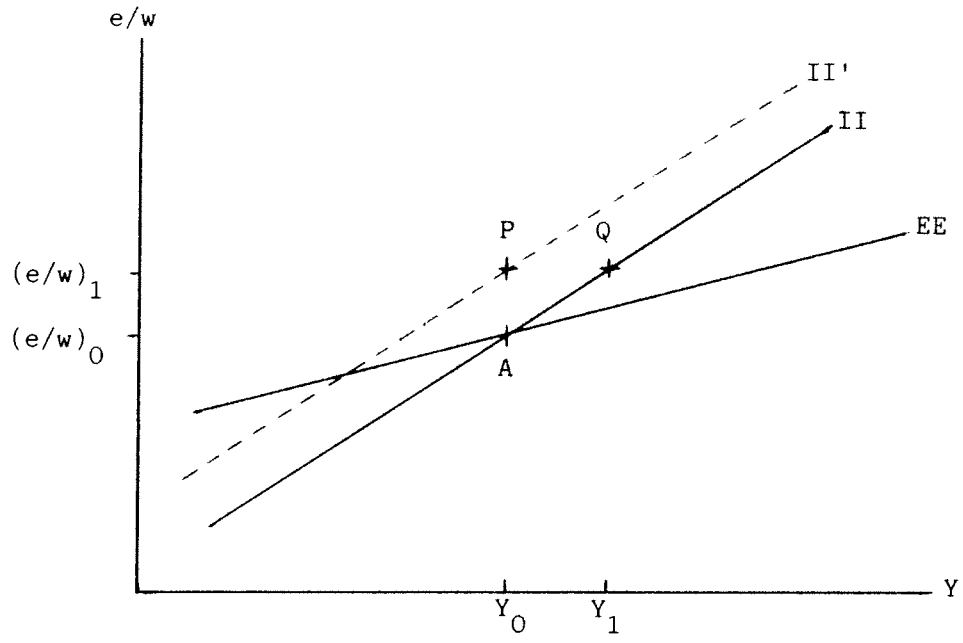
Figure 2

brium. But if the economy were in a state of equilibrium, then why would a country have to go to the IMF? Countries request the presence of the IMF when they have a problem of external disequilibrium.

In fig. 3, point J represents a situation of external imbalance where there is a deficit in the balance of payments, coexisting with internal equilibrium at output level Y_j; the relative price exchange rate/wage in the economy is $(e/w)_j$. In this case, to restore external equilibrium, a devaluation would have to be complemented by a contractionary fiscal policy when the new exchange rate level is less than the one prevailing in point A; i.e., $(e/w)_1 < (e/w)_0$. In fact, the increase in the exchange rate from $(e/w)_j$ to $(e/w)_1$, involves a shift in the economy from point J to P; in order to restore the (internal) equilibrium of the goods market, the economy will move from P to Q. But in Q there is still an external deficit, which would have to be eliminated by a contractionary fiscal policy that would shift II towards II', and the economy would move towards Q'. thus reestablishing the external equilibrium with an output level Y_1.

But if the magnitude of the devaluation implemented in J is such that the exchange rate reaches $(e/w)_2$, where $(e/w)_2 > (e/w)_0$, a contractionary fiscal policy would have an unnecessarily deflationary effect. In fact, a devaluation in J increasing $(e/w)_j$ to $(e/w)_2$ would involve a movement of the economy from J to R. If this devaluation were complemented by a contractionary fiscal policy that would shift locus II towards II', the economy would move from R to Q" (see fig. 3) with an output level Y_2. Thus, an "over-shooting" in the exchange rate accompanied by
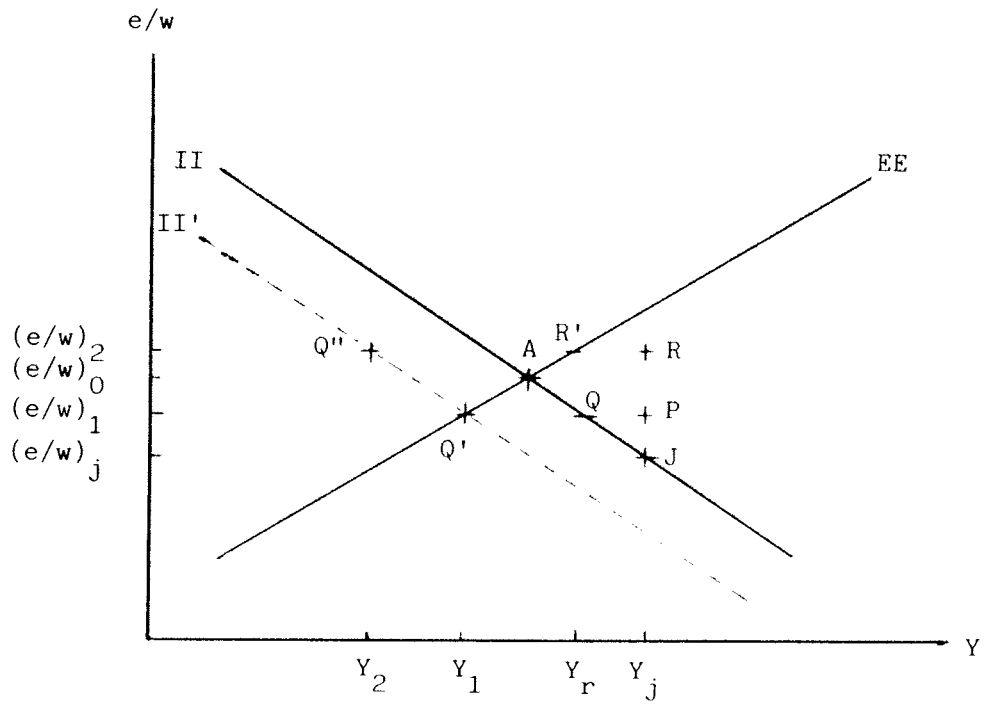
Figure 3

a contractionary fiscal policy, would produce a deflationary "over-kill" in the short run. In this case of "over-shooting", an expansionary fiscal policy might allow the economy to stay at R' (on locus EE) restoring in this way the external equilibrium, and with an output level Y_r (greater than Y_2).

To summarize, when the economy is in a situation of external disequilibrium, in order to elimminate this, the combination of exchange rate and fiscal policies that would minimize the decline in output depends on the magnitude of the devaluation. If the devaluation involves a new exchange rate which is smaller (greater) than that consistent with internal and external equilibrium, this devaluation should be complemented by a contractionary (expansionary) fiscal policy. If the devaluation involves a new exchange rate which is equal to the equilibrium one, no complementary fiscal policy is required.

III. WAGE POLICY

The key relative price in our model is e/w. Thus, a change in this relative price in order to increase the international competitiveness of a country, can be attained either by an increase in the exchange rate (devaluation) or by a reduction in nominal wages.

1. Reduction in nominal wages

Let us consider the potential effect on output of a reduction in nominal wages. The (nominal) wage elasticity of output, n_{Yw}, has a simi-

lar expression to that of the output elasticity with respect to the exchange rate (equations 20 and 21).

$$n_{Yw} = \frac{-\left(\frac{X}{M}\right) n_{X,\pi_X} \alpha_X + n_{M,\pi_M} \alpha_M}{n_{MY}} \tag{24}$$

In the numerator of expression (24), the price elasticity of exports is positive, whereas the price elasticity of imports is negative. Thus, the numerator has a negative sign; since the denominator is positive then n_{Yw} has, in a non-ambiguous manner, a negative sign.

Comparing equations (21) and (24), a reduction in nominal wages would have exactly the same potential effect on output as a nominal devaluation. This implies that a devaluation without wage indexation (constant nominal wages) would be equivalent to a reduction in nominal wages.

Expression (24) is useful to analyze the case of an increase in nominal wages when the economy faces an external restriction 1/. The main point here is that the deficit in the balance of payments originated by an increase in nominal wages must be compensated by a contraction in the level of output, to avoid the violation of the external constraint faced by the economy.

2. The trade-off between real wages and employment

An increase in wages will have an adverse effect on international competitiveness, and due to the presence of an external constraint, there will be a trade-off between increases in the level of employment and in-

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1/ This is the problem analyzed by Dreze and Modigliani (1981) for the Belgian economy.

creases in the real wage, in the context of the Keynesian model used in this work.

Let us first consider the effect of the real wage on the level of real output; thereafter, the trade-off between employment and the real wage will be examined.

To obtain the effect of real wages on output we have:

$$\eta_{Y,w/P} = \frac{\eta_{Yw}}{1 - \eta_{Pw}} \tag{25}$$

Then, substituting (24) in (25) we have the effect of the variations in real wages on output when a dominant external constraint prevails,

$$\eta_{Y,w/P} = - \frac{\left(\frac{X}{M}\right) \eta_{X,\pi_X} \alpha_X - \eta_{M,\pi_M} \alpha_M}{(1 - \eta_{Pw}) \eta_{MY}} \tag{26}$$

In expression (26) the numerator and the denominator are positives. Therefore, in a non-ambiguous manner, $\eta_{Y,w/P} < 0$; i.e., an increase in real wages, when there is a dominant external constraint, reduces output. This result is due to the real appreciation of the exchange rate following an increase in real wages; this generates a loss of international competitiveness, and therefore, a contraction in the level of domestic goods output.

Let us now examine the effect of variations in the real wage on employment. To obtain this effect we have that $\eta_{E,w/P} = \eta_{EY} \cdot \eta_{Y,w/P}$. Then, equation (26) becomes:

$$\eta_{E,w/P} = -\frac{\left[\left(\frac{X}{M}\right) \eta_{X,\pi_X} \alpha_X - \eta_{M,\pi_M} \alpha_M\right] \eta_{EY}}{(1 - \eta_{Pw}) \eta_{MY}} \tag{27}$$

The sign of expression (27) is, in a non-ambiguous manner, negative. To illustrate the magnitude of the trade-off between real wages and employment, the same values of the coefficients of the previous expressions will be used; additionally, $\eta_{EY} = 0.60$; $\eta_{Pw} = 0.6$. Then, $\eta_{E,w/P} = 0.34$.

The real wage elasticity of employment obtained in expression (27) is empirically greater than the values obtained traditionally through the econometric estimation of uni-equational labor demand models (see Meller, 1984, and Solimano, 1983). In the Chilean case, when there is a dominant external constraint, a 5% increase (decrease) in real wages would produce a 1.7% decline (increase) in employment (in the short run). This value is smaller than that obtained by Cortázar (1984) [1].

IV. CONCLUSIONS

The main conclusions of this paper are the following:

1. In the Chilean case, a devaluation has a contractionary impact in the short run, i.e., a 10% nominal devaluation produces a 3.4% drop on the level of output. The non-fulfilment of the Marshall-Lerner condition accounts for only 30% of the output contraction, while the re-

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[1] The main difference between the value obtained by Cortázar (1984) and that of this study is due to the fact that Cortázar (1984) uses an output-employment elasticity of 1.0, whereas a value of 0.6 is used here.

maining 70% corresponds to the decline in consumption that is induced by the reduction in real wages.

2. When the economy has an external deficit, the adequate combination of exchange and fiscal policies to restore the Balance of Payments equilibrium which minimizes the decline of output depends on the magnitude of the devaluation. Thus, an "over-shooting" in the exchange rate, together with a contractionary fiscal policy, would produce an unnecessarily deflationary impact in the short run. In general, if devaluation involves a new exchange rate which is smaller (greater) than that consistent with internal and external equilibrium, this devaluation should be complemented by a contractionary (expansionary) fiscal policy.

3. The Chilean empirical evidences shows that when there is a dominant external constraint, there is an increase in the trade-off between real wages and employment; however, the magnitude of the trade-off is not very acute. The short-run elasticity of employment with respect to the real wage is 0.34.

APPENDIX

DYNAMIC STABILITY OF THE MODEL

The model used in this paper can be represented by the equations:

$$\bar{B} = B \ (e/w, \ Y, \ Y^*, \ F)$$

$$Y^d = Y^d \ (e/w, \ G, \ Y^*) = Y$$

The aim of this annex is to study the stability properties of

the model in the context of a steady state equilibrium.

For this purpose, we will introduce the following two differential equation that describe the dynamic paths of the real exchange rate and output.   Let $\dot{X} = \dfrac{dX}{dt}$.

Dynamics of the real exchange rate

$$(\tfrac{\dot{e}}{w}) = \phi(B) \qquad\qquad \phi(0) = 0 \qquad\qquad\qquad (A.1)$$
$$\phi' < 0$$

$$(\tfrac{\dot{e}}{w}) = \phi[B(e/w, Y, Y^*, F)]$$

Dynamics of output

$$\dot{Y} = \Psi(Y^d - Y) \qquad\qquad \Psi(0) = 0 \qquad\qquad\qquad (A.2)$$
$$\Psi' > 0$$

$$\dot{Y} = \Psi[Y(e/w, G, Y^*) - Y]$$

Linearizing the system of equations (A.1) and (A.2) around the values of the steady-state real exchange rate, $(\overline{e/w})$ and the level of the steady-state output, $\overline{Y}$, we have:

$$
\begin{bmatrix} (\dot{\overline{e/w}}) \\[2em] \dot{Y} \end{bmatrix}
=
\begin{bmatrix} \dfrac{\partial\phi}{\partial(e/w)} & \dfrac{\partial\phi}{\partial Y} \\[1.5em] \dfrac{\partial\Psi}{\partial(e/w)} & \dfrac{\partial\Psi}{\partial Y} \end{bmatrix}
\begin{bmatrix} e/w - (\overline{e/w}) \\[2em] Y - \overline{Y} \end{bmatrix}
\qquad (A.3)
$$

The Ruth-Hurwicz conditions ensuring that the system of differential equations (A.3) be stable require that the trace of the Jacobian be negative and the determinant positive; then

$$\underset{(-)}{\frac{\partial\phi}{\partial(e/w)}} + \underset{(-)}{\frac{\partial\Psi}{\partial Y}} < 0$$

$$\frac{\partial \phi}{(e/w)} \cdot \frac{\partial \Psi}{\partial Y} - \frac{\partial \Psi}{\partial (e/w)} \cdot \frac{\partial \phi}{\partial Y} > 0$$

$$(-) \qquad (-) \qquad (-) \qquad (-)$$
$$(+)$$

The trace condition is met, because the surplus in the balance of payments tends to increase with an increase in e/w, which reduces $(\dot{e/w})$; i.e., $\frac{\partial \phi}{\partial (e/w)} < 0$. In a similar way, an increase in Y creates an excess supply in the goods market, which reduces $\dot{Y}$; i.e., $\frac{\partial \Psi}{\partial Y} < 0$.

The condition of the positive determinant is unambiguously met if the devaluation is expansionary; that is, if $\frac{\partial \Psi}{\partial (e/w)} > 0$. If the devaluation is contractionary, the system will be stable as long as

$$\frac{\partial \phi}{\partial (e/w)} \frac{\partial \Psi}{\partial Y} > \frac{\partial \Psi}{\partial (e/w)} \frac{\partial \phi}{\partial Y}$$

The conditions imposed on the structure of the economy for this to occur are: (i) The trade balance (in dollars) should not be too inelastic with respect to the real exchange rate. (ii) The quantity adjustment in the goods market should be relatively fast. (iii) The income elasticity of the trade balance should not be too high.

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