

The macrodynamic and distributional effects of debt swaps: a simulation analysis of alternative conversion mechanisms*

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Este trabalho examina os efeitos macrodinâmicos e distributivos de diversos planos alternativos de conversão de dívida, por meio de análise de simulação. São consideradas as implicações de dois mecanismos de conversão, as denominadas trocas de dívida por moeda e de dívida por ações, após um período de contínua tomada de empréstimo, num modelo composto de contratos intercalados, expectativas racionais, uma regra de desvalorização baseada em metas de conta corrente, e gastos públicos endógenos que dependem dos níveis salariais e da taxa cambial.

Os diferenciais do salário nominal e a distribuição de renda são apresentados como variáveis macroeconômicas de relevância; dessa maneira, chama-se atenção para os *trade-offs* desprezados nos modelos anteriores. A maior dispersão salarial e a maior desigualdade de renda podem acarretar perdas de produção (pela maior frequência de negociações de contratos e paralisações de trabalho), prolongar os ciclos de negócios e torná-los mais voláteis. O trabalho demonstra que os efeitos a longo prazo dos mecanismos definidos como trocas de dívida por ações, o qual surte maiores efeitos sobre a dispersão de salários e a desigualdade de renda, podem resultar menos desejáveis que a conversão efetuada por trocas de dívida por moeda.

1. Introduction; 2. The macrodynamic framework; 3. The effects of government borrowing; 4. Conclusion.

1. Introduction

This paper examines the macrodynamic and distributional consequences of debt swaps, for an indebted country, facing a crisis of "negative transfers", when debt-servicing begins to exceed the inflow of funds from abroad.

We analyze the macrodynamic adjustment process and patterns of income distribution following a debt for currency and a debt for equity swap with numerical simulation. The model is a rational expectations model with overlapping wage contracts, an exchange rate rule based on trade balance targets, a government expenditure rule related to the average wage and the exchange rate, and income inequality based on wage dispersion and returns to capital, measured by the coefficient of variation of nominal wages across sectors and the returns to capital. Income inequality

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has negative feedback effects on the level of output supply through the increased labor market tensions which lead to work slowdowns or stoppages.

We draw attention to several ways in which external indebtedness and strategies of adjustment or renewed access to foreign capital, through conversion mechanisms we define as debt-for-equity or debt-for-currency swaps, can affect the dynamics of key macroeconomic variables. First, we allow capital inflows to affect output supply through exponentially declining productivity or infrastructure effects. Secondly, we allow a debt-for-equity swap to increase aggregate demand by an exponentially declining fraction of the total stock of foreign debt, since we assume that foreign creditors have been granted "seniority" on equity. With a debt-for-currency swap a fraction of the total debt is redeemed each period with new currency issues. Our results show that the debt-for-equity swap induces greater instability in output, the trade balance, real wages, the real exchange rate, and income inequality than the debt-for-currency swap.

The next section presents the model. We then discuss the design of our simulation experiments and the results.

2. The macrodynamic framework

To analyze the macroeconomic consequences of the alternative resolution strategies, we have merged a version of the multi-union model of Taylor (1983) with an expanded macro model adapted from Fisher (1984a).

The model consists of six blocks: the goods market; the foreign trade equations and international exchange identities; the financial markets; the price-setting equations; the expectation-formation assumptions; and the wage-setting mechanism.

The model has its origins in the works of Fisher (1977a, 1977b, 1984a, 1984b) with the extensions and modifications appropriate for economic environments with rapid inflation and a policy-determined exchange rate-rule, rather than for flexible exchange rates and exogenous monetary policy. We have included in the present analysis an independent government sector, although this extension would have to be made more extensive when the model is applied to any specific country.

In our description of the variables of the model, lower-case letters denote logarithmic values. A dotted variable is the first difference while a circumflex over a variable represents its rate of change. Variables without a subscript refer to the current-period values. When the subscript t immediately precedes a variable, and the subscript $(t + 1)$ immediately follows it, this notation represents the expected value of the variable at time t for time $t + 1$.

2.1 The goods market

Equations (1) through (4) describe the goods market.

Output supply:

$$y_s = y_0 + \alpha_1 (q_{t-1} - w_{t-1}) + \alpha_2 (q_{t-1} - e_{t-1} - q^*_{t-1}) - \alpha_3 CV_{y,t-1} + \alpha_4 \sum_{i=1}^n \beta^i EXD_{t-i} \quad (1)$$

where $y_0 = \log [(1+r^*)Y_{t-1}]$

Aggregate demand:

$$d = \beta_0 - \beta_1 \log(1 - \hat{p}_{t+1}) + \beta_2 (m^s - m^d) \quad (2)$$

Export function:

$$x = \delta_0 + \delta_1 (e + q^* - q) + \delta_2 (e_{t-1} + q^*_{t-1} - q_{t-1}) \quad (3)$$

where $d_0 = \log[(1+r^*)X_{t-1}]$

Domestic output:

$$Y^d = D + X + G - T + EXD_{t^*} \alpha^* (1 - \lambda) \lambda^{t-t^*} \quad (4)$$

where $EXD_{t^*} = EXD_t$ at time of debt/equity swap
0 if no debt/equity swap

The first equation for output supply (y^s) shows that output depends negatively on the real wage ($w - q$) and the real exchange rate ($e + q^* - q$), as well as (negatively) on the coefficient of variation of income (CV), and positively on the inflows of foreign capital (EXD). We also allow output to grow at a trend rate of growth equal to the world interest rate r^* . The second equation states that domestic private demand (d) depends negatively on the real interest rate ($1 - \hat{p}_{t+1}$) and positively on the excess supply of money ($m^s - m^d$). Equation (3) states that exports (x) depend on relative prices or the real exchange rate in the current and past period. Exports also grow at a trend rate r^* . With this assumption, the export/*gdp* ratio will be constant in the long run. The domestic output demand equation (y^d) is the sum of domestic private demand (D), exports (X), the government budget deficit ($G-T$), and if the policy is undertaken, from the time of the debt/equity swap, the proportion of the debt swapped for claims on domestic output. For each dollar of external debt, α^* is paid, and the demand for domestic output is phased in at the exponentially declining rate $(1-\lambda) \lambda^t$ following t^* , the time of the debt/equity swap.

2.2 The foreign sector

The next three equations are the foreign sector identities:

Imports:

$$IM = Y^d - Y^s \quad (5)$$

Balance of trade:

$$B = (X - IM) (Q/E) \quad (6)$$

Reserve changes:

$$R = B + EXD - I^* EXD_{t-1} \quad (7)$$

Our expression for imports (*IM*), equation (5), is an equilibrium equation which ensures that domestic overall demand will equal domestic supply. There is no behavior equation for imports. Elsewhere, we have assumed an independent import demand function, and allowed inventories to act as a buffer stock in order to equate overall supply and demand [Bigman and McNelis (1988)]. Equations (6) and (7) are the usual accounting identities, for the balance of trade (*B*), changes in reserves (*R*) and the effects of changes in external indebtedness (*EXD*).

2.3 The financial sector

Equations (8) through (10) are the money demand, money supply, and interest rate adjustment equations. Money demand depends on output demand as well as on the nominal interest rate. Money supply is governed by reserve changes, the exogenous component of the monetary base (*GCB*), as well as by fiscal deficits. If there is a debt/currency swap, a portion of the outstanding debt EXD_t is redeemed in local currency at an exponentially declining rate λ . Finally, the domestic interest rate is determined by the world interest rate, the expected rate of devaluation, and by a risk factor positively related to the external debt/gdp ratio.

Money demand:

$$m^d - p = \mu_0 + y^d - \mu_1 I \quad (8)$$

Money supply:

$$M^s = R E + GCB + G - T + EXD_{t^*} \alpha^* (1-\lambda) \lambda^{t-t^*} \quad (9)$$

where $EXD_{t^*} = EXD_t$ at time of debt/currency swap
 $= 0$ if no debt/currency swap

Interest rate adjustment:

$$I = I^* + t \hat{e}_{t+1} + \Phi(EXD/Y) ; \Phi \geq 0 \quad (10)$$

2.4 Price and exchange-rate adjustment

The next three equations describe the evolution of the consumer price index, the price of domestically produced goods, and the nominal exchange rate. We also assume that the expectations of the price level and the exchange rate are formed rationally. We have used the Fair-Taylor method for computing the expected price level in each period. We assume that the expected exchange rate is the expected price level, until a devaluation occurs. Then we assume that the policy rule is known, and that the devaluation will be fully expected until another reversal in exchange rate behavior occurs.

Price dynamics:

$$\hat{p} = \epsilon \hat{q} + (1 - \epsilon) (\hat{e} + \hat{q}^*) \quad (11)$$

Price dynamics (domestically produced goods):

$$\hat{q} = -\eta_0/(y^s - y^f) + \eta_1 \hat{w} + \eta_2 (\hat{e} + \hat{q}^*) - \eta_3 \quad (12)$$

Exchange rate rule:

$$\hat{e} = \begin{cases} \hat{p} & \text{if } B > B^* \\ \epsilon^* & \text{if } B < B^*, \text{ with } \epsilon^* > p \end{cases} \quad (13)$$

The mark-up model given in equation (12) has been analyzed by Bruno (1978), Corbo (1985) and Gordon (1975) in previous studies of open semi-industrialized countries.

2.4 The wage mechanism and income inequality

The next set of equations relate to the behavior of individual wages, the average income, and the income dispersion. There are $(m+1)$ unions, so the wage contour is a vector of $(m+1)$ nominal wages, assume d to be staggered over $(m+1)$ periods. We assume that the membership of the labor force is equally distributed over the $(m+1)$ unions. To simplify our simulation exercises still further, we assume there are 800 workers evenly divided among 8 unions, and there are an additional 100 whose income is from their return on capital earnings. The individual wage negotiated at the present, $W(0,t)$ is fully indexed to the price level, and also reacts to differences between actual output supply and full-employment (or full-capacity) output, y^f . The average wage is simply the mean nominal wage. The income of the worker is the wage income plus returns from the share of the particular working sector in the ownership of capital. The income for the capitalist sector is simply the share of this sector in the returns on capital. Returns to capital are simply output less the wage bill less the trade balance and less whatever claims are given to foreigners in debt/equity swaps. The average income is simply the income given to each group multiplied by $(1/9)$, since each group represents this fraction of the economically active population. The coefficient of variation of income is simply the standard deviation divided by the mean.

Wage contour:

$$[W(m, t), W(m-1, t), \dots, W(1, t), W(0, t)] \quad (14)$$

Individual wage adjustment:

$$W(0,t) = P_{t-1} - \alpha_w/(y^s_{t-1} - y^f_{t-1}) - \alpha_0 \quad (15)$$

Income to each working-class sector:

$$Y(i,t) = W(i, t) + \sigma_i YCAP \quad (16)$$

Total capital returns:

$$YCAP = Y - \sum W(i, t) L_i - B - EXD_{t^*} \alpha^* (1 - \lambda) \lambda t^* - t \quad (17)$$

Where $EXD_{t*} = EXD_t$ at time of debt/equity swap
 0 with no debt/equity swap

Income to capitalist sector:

$$Y_c = \sigma_p YCAP \quad (18)$$

Average income:

$$\bar{Y}_t = [\sum_{i=0}^m Y(i,t) + Y_c] / (m + 2) \quad (19)$$

Coefficient of variation of income:

$$CV_{y,t} = \{ \sum_{i=0}^m [Y(i,t) - \bar{Y}_t]^2 + [Y_c - \bar{Y}_t]^2 / \bar{Y}_t^2 (m + 2) \}^{-1/2} \quad (20)$$

2.5 The government sector

The final two equations describe government spending and taxation.

Government spending:

$$G = \gamma_0 + \gamma_1 \bar{W} + \gamma_2 E \quad (21)$$

Taxation:

$$T = \tau_0 + \tau_1 (P Y) \quad (22)$$

3. The effects of government borrowing

We now turn to the dynamic paths generated by the model under alternative assumptions. We specified the model with numerical parameters and initial conditions based on likely values of a typical small open economy. The constant terms were chosen to insure initial full stock/flow equilibrium.

We set the stage for alternative outcomes from the swaps by creating a constant flow of credit from abroad to domestic residents. However, when the interest payments on accumulated debt began to exceed the new flow of external funds, there are two possible outcomes to this "crisis": (1) to suspend further borrowing, and to swap a portion of the debt for currency, with the rest being forgiven; (2) to swap a portion of the debt for equity claims on existing output, with the rest being forgiven.

At this stage, there are no further reactions from the world credit markets. In all likelihood, however, the resumption of external credit flows is contingent on performance of key macroeconomic variables, so that the behavior of inflation, output, the trade balance and the fiscal deficit following each of these options affect the credit worthiness of the country for future borrowing.

We first examine in detail the dynamic effects of the continued borrowing until the "crisis" occurs. Then we consider the dynamic effects of the two swapping arrangements.

3.1 Continued borrowing from abroad

The model is initially in a steady-state full stock/flow equilibrium, when the external borrowing occurs. Exports and output begin to grow at the world interest rate. We simulated our model with quarterly data, with 1980 I being the beginning of our time horizon. The parameters are not meant to characterize any country in particular.

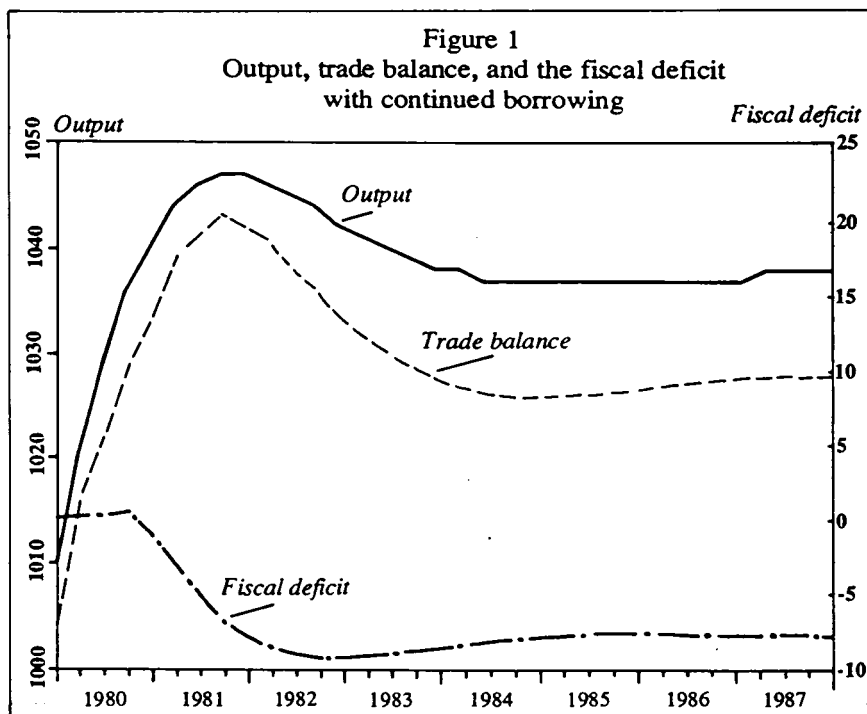
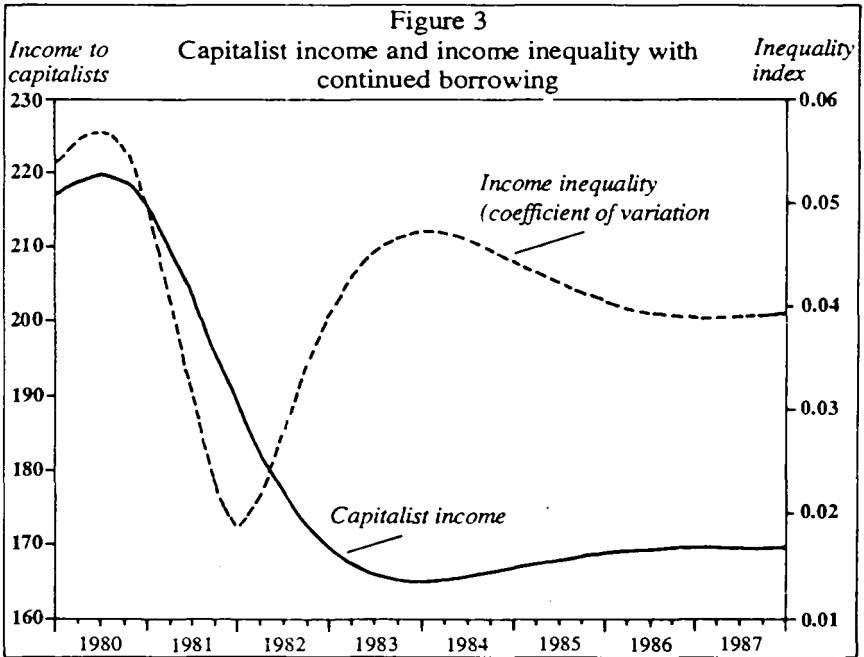
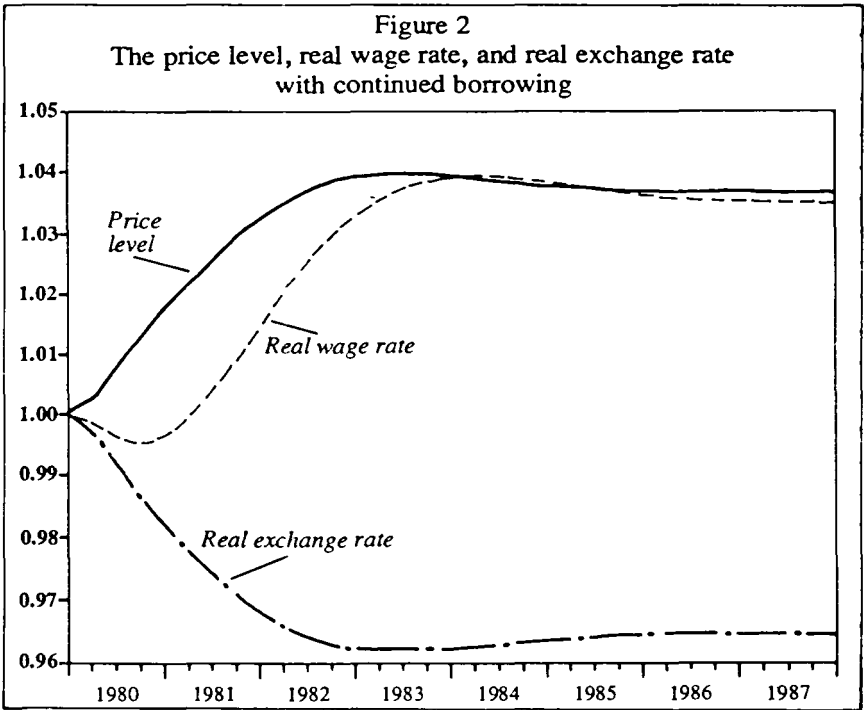


Figure 1 pictures the behavior of output, the trade balance, and the fiscal deficit. We see that there is an increase in output supply at the time of new borrowing, an improvement in the trade balance, and a worsening of the fiscal deficit. Output begins to fall as a result of the decreasing productivity or infrastructure effects from external lending. The trade balance also falls, as a result of increasing domestic absorption, but does not become negative.

Figures 2 and 3 present the behavior of the real exchange rate, the real wage, the price level, as well as income inequality and capitalist income. The real exchange rate appreciates, the real wage increases, but not as fast as the price level, while capitalist income increases slightly and then falls and the index of income inequality goes through a protracted cycle. The changing inequality is due to the effects of the increasing productivity on wages and wage dispersion during the adjustment process. The



wage share first rises relative to capitalist income, and inequality falls, but as output continues to grow while capitalist income falls, the inequality begins to increase once again. The minimum inequality point is at approximately 0.02 with a capitalist income at about 190. Further cuts in capitalist income bring rising inequality.

3.2 Macroeconomic effects of the swaps

The next four figures show the comparative effects of the two debt – swap arrangements.

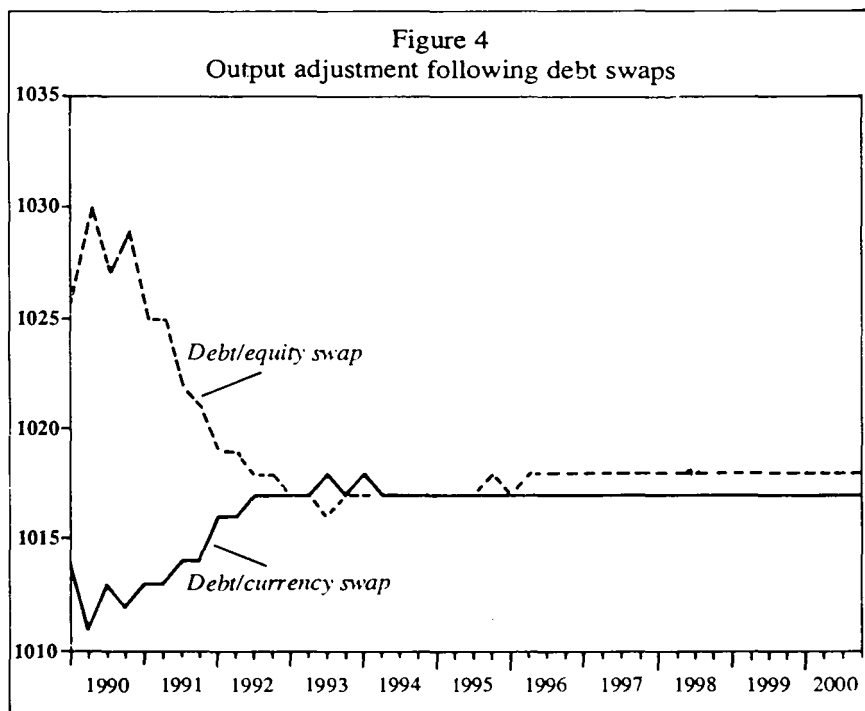
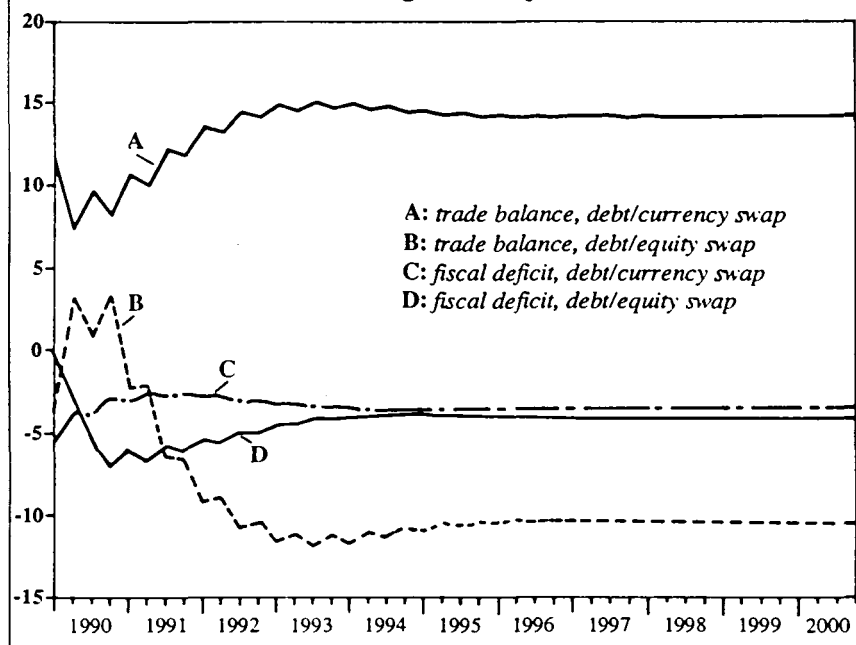


Figure 4 pictures output adjustment. Before the “crisis”, output was approximately 1040. There is a decline under both arrangements as new borrowing is suspended. The fall is greater with the debt/currency swap, but there is a recovery soon afterward, and under both swaps output converges to a level between 1015 and 1020.

Figure 5 shows the adjustment of the trade balance and the fiscal deficit under both policies. The trade balance deteriorates more with the debt/equity swap, since this swap transfers claims on output directly to foreigners, so there is an excess of demand over supply which increases imports. While there is some movement in the fiscal deficit, the long-run effects are about equal, and converge within two years.

Figure 5
Adjustment of trade balance and fiscal deficit
following debt swaps



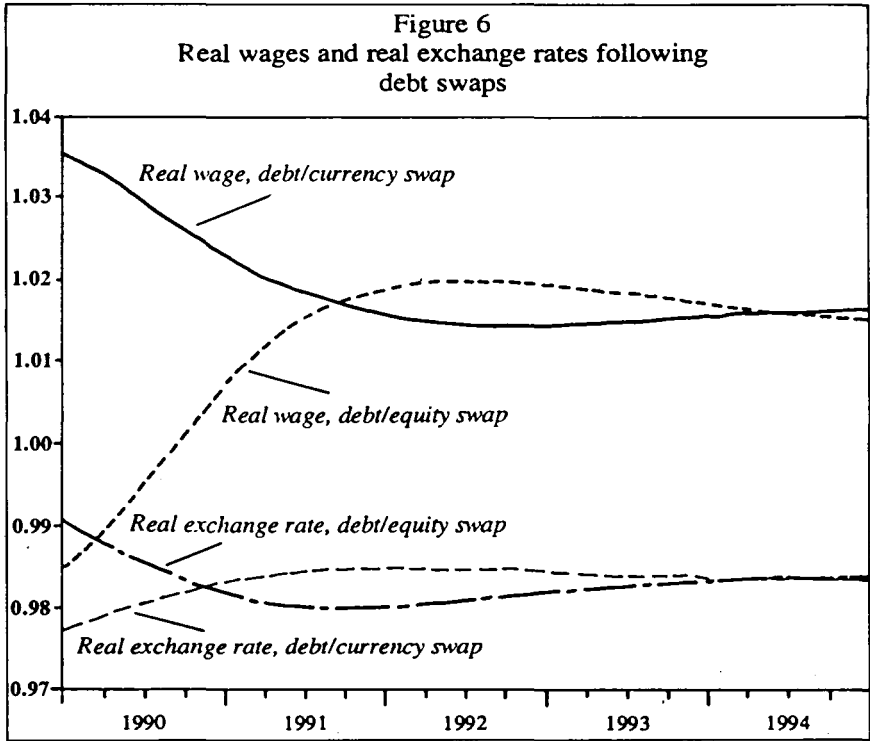
The real wage and real exchange rate effects of the swaps appear in figure 6. The real wage falls more with the debt/equity swaps, since the effect on demand is direct. Both converge to about the same level, but the convergence process is quite prolonged. There are also greater effects on the price level. The long run real exchange – rate effects are about the same, and while there are some differences, with more of a depreciation with the debt/equity swap, the convergence process is not very long.

Finally, figure 7 shows rising and higher long-term inequality with the debt/equity swap, and falling and lower long-term inequality with the debt/currency swap. The rising and higher long-term inequality of the debt/equity swap is due to the transference of profits to foreigners, and the ensuing squeeze on local capitalists' income. The fall of local capitalists' income below a certain level, as shown above, will generate rising inequality, even though the share of labor income relative to capital income may be higher.

3.3 Sensitivity of the results to parameter values

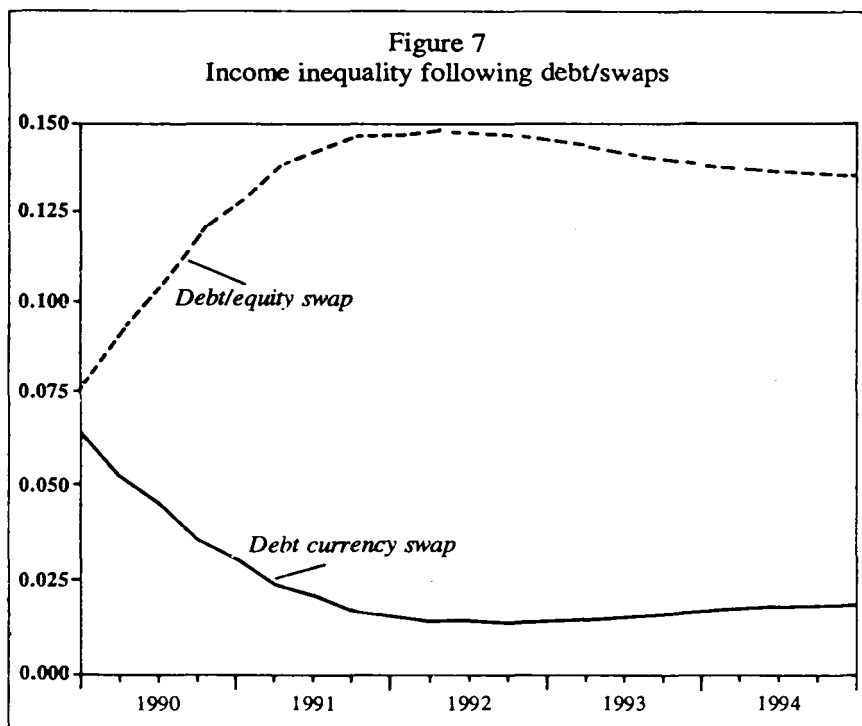
The results reported in this paper are not meant to have any particular generality. Changes in parameter configurations do show that the dynamic paths may change considerably. In particular, the feedback effect of the

coefficient of variation on output supply will have marked effects on the fluctuations and the amplitude of cycles following the crisis and adjustment programs brought about by a suspension of foreign lending (or a cut-off of foreign borrowing). The results are meant to illustrate how inequality can affect the outcomes of debt conversion, depending on the severity of the labor market tensions and their feedback effects on production and supply. Several authors have already drawn attention to the role of inequality in the debt crisis (see Bourguignon, Branson, and de Melo, 1989 and Berg and Sachs 1988), either in a CGE framework, or in a cross-section framework, but not in the context of a macrodynamic model, as we have done. Our results are meant to draw attention to several important parameters and channels by which alternative debt conversion schemes may affect the dynamic adjustment paths of key macroeconomic variables. They are not meant to be conclusive.



4. Conclusion

Our study shows that debt/equity swaps can produce greater inequality, lower real wages, and trade balance problems than produced by a debt/currency swap.



These results are no doubt model sensitive as well as dependent on the parameters and initial conditions. However, the results draw attention to the need for a careful specification of the way in which these swaps affect underlying demand and supply relationships in a macroeconomic framework.

Appendix

The initial conditions for the variables of this paper appear below. The values are not meant to represent the “stylized facts” of any particular economy. We have therefore selected arbitrary indices so that the effects of policy changes on these variables may be easily compared with the initial values in a stationary equilibrium.

The parameter values for the structural equations of the model were based on *a priori* expectations or ordinary values in other studies rather than on empirical estimation. These starting parameter values were used to generate benchmark simulations, and were systematically varied in a sensitivity analysis.

For equation (1) – the output supply equation..., – the elasticity of output with respect to the real wage, α_1 , and the elasticity with respect to the price of domestic goods relative to foreign prices, α_2 , were set at .7 and .1,

respectively. We assume a higher elasticity with respect to current wages because we assume that the labor share of the input mix in production is significantly greater than imported inputs. We have set α_3 , the coefficient of income dispersion, at -0.3 and $\alpha_4 = .1$, with β , the exponentially declining weight set at .9 for the initial period t .

For equation (2), the absorption equation, we assume the elasticity with respect to the real interest rate to be relatively low. Hence $\beta_1 = 0.05$. In the simulation experiments of this paper, the focus of our analysis is on the feedback effects of wage dispersion on inflationary dynamics. For this reason we neglected the effects of government deficits on demand. We set the wealth effect on domestic absorption at a relatively large value in order to capture the feedback effect of monetary effects through reserve inflows on aggregate demand. Hence $\beta_2 = 1.5$.

Symbol	Definition	Value
B	Trade balance	0
CV	Coefficient of income variation	0
D	Domestic demand or absorption	1000
E	Exchange rate	1.0
EXD	External indebtedness	0
G	Government spending	250
GCB	Government borrowing from central bank	0
I	Domestic interest rate	0.03
I*	Foreign interest rate	0.02
IM	Imports	300
M ^d	Money demand	12,000
M ^s	Money supply	12,000
P	Consumer price index	1.0
Q	Domestic price deflator	1.0
Q*	Foreign price index	1.0
T	Tax revenue	250
W	Nominal wage rate	1.0
X	Exports	300
Y ^d	Total output demand	1300
YO	Normal output	1000
Y _c	Capitalist income	160
YCAP	Returns to capital	200
Y ^f	Full employment output	1060
Y ^s	Aggregate supply	1000

In equation (3), the export equation, we assume that the elasticities of current – and past period relative prices of domestic goods to foreign goods add up to a value greater than one. This is equivalent to the Marshall-Lerner condition. Hence $\delta_1 = 1.5$ and $\delta_2 = .5$. For equation (4), the demand equation, we set $\lambda = .5$ and $\alpha^* = .5$.

In the demand for money given by equation (8), we set the interest elasticity of money demand, μ_1 , at 0.1. This assumption is consistent with empirical evidence in several industrialized and semi-industrialized countries. For the interest rate in equation (10) we set the coefficient Φ at .015. We thus assume that there is imperfect capital mobility, due to controls on foreign investment and capital flows.

For equation (10) which determines the evolution of the consumer price index, we set the coefficient with respect to domestic goods prices and foreign prices, ϵ at .5. Similarly, for the evolution of the price of domestic goods, given in equation (12), we set the coefficients for wage changes and foreign price changes, η_1 and η_2 , at .7 and .3 respectively. The excess demand factor η_0 was set at 1.5, and the constant term η_4 was chosen at a value which ensured a steady-state price behavior when $y^s = y^n$.

Equation (13) specifies the rate of devaluation as a function of the policy rule of the government. We assumed in the simulation experiments that the government will follow a purchasing power parity rule and devalue at a rate equal to expected inflation (assuming that foreign inflation is zero). If the trade balance falls below a critical level of -250, we assume that devaluation will proceed at a higher rate, expected inflation plus five percent.

The semi-elasticity of wages with respect to excess demand in the period preceding contract renewal, α_w , was initially set at unity. This parameter appears in equation (15). The constant term α_0 was chosen so as to ensure steady-state wage behavior when $y^s = y^n$.

The parameters for the government expenditure and tax functions are set at the following values: $\gamma_1 = .5$, $\gamma_2 = .5$, and $\tau_1 = .1$. The intercept terms are set at values so that the system is initially in a steady state.

The simulation method used in this analysis is based on the solution methods embedded in Version 13 of the Troll system. The system was set in stationary equilibrium given the initial values by adjustment of the constant terms in the behavioral equations. A full listing of the simulation model and solution algorithm for the rational – expectations version is available from the authors on request.

Abstract

This paper examines the macrodynamic and distributional effects of alternative debt swap arrangements through simulation analysis. We examine the implications of two conversion mechanisms, which we define as a debt-for-currency and a debt-for-equity swap, after a period of continued borrowing, in a model which includes staggered contracts, rational expectations, a devaluation rule based on current account targets and endogenous government spending dependent upon the wage and exchange rate levels.

We introduce the spread of nominal wages and income distribution as relevant macroeconomic variables, and thus draw attention to trade-offs not accounted for in previous models. Higher wage dispersion and greater

income inequality may cause output losses (through more frequent contract negotiation and work stoppages), prolong business cycles, and increase its volatility. The paper shows that the long-term effects of the mechanism we define as debt-for-equity swaps, which has greater effects on wage dispersion and income inequality, may be less desirable than conversion through debt-for-currency swaps.

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