Capacity Utilization, External Debt and Capital Controls in Emerging Economies

An analysis based on computational simulations *

Inácio Guerberoff**
José Luís Oreiro ***

Abstract: This article analyzes the effects of capital controls over the economy’s level of external fragility. First of all, we present a Post-Keynesian Macroeconomic Model, which introduces capital controls as a choice variable of economic policy. For computer simulation, we have selected a set of plausible values – in economic terms - for the structural parameters of the model. Based on these parameters, we analyze the degree of economy’s fragility to external shocks as, for example, variations in the level of international rate of interest and in the level of international trade flows. Based on this framework, we conclude that capital controls may contribute to reduce the volatility of external debt (as a ratio of GDP) to exogenous shocks, but amplifies the effects of these shocks over the level of capacity utilization. In this context, desirability of capital controls is conditional to society’s preferences over capacity utilization and external debt volatility. If society has a stronger aversion to output volatility than to external debt volatility, capital controls should not be used. However, if society has a stronger aversion to external debt volatility than to output volatility, capital controls can improve social welfare.

Key Words: Capital controls, post keynesian economics, macroeconomic dynamics.

Jully, 2004

** Graduate Student in Economics at Universidade Federal do Paraná, Curitiba, Brazil. E-mail: i@nacio.com.br. Website: http://i.nacio.com.br
*** Director of the Graduate Program in Economics at Universidade Federal do Paraná, Curitiba, Brazil and CNPq Researcher. E-mail: joreiro@ufpr.br. Website: www.joseluisoreiro.een.br.
"It is ideas, not vested interests, which are dangerous for good or evil" (J.M.Keynes)

1 – Introduction

The discussion on capital controls in Brazil and in the world has been made based with a ideological bias – it is argued, for example, that its adoption would represent, for the country that adopts them, an exclusion from international capital flows and, consequently, of the benefits of the process of financial globalization – or with a purely technical bias, which advocates the impossibility of an effective implementation of any form of controls, given the capacity of the investors to by-pass the established regulations (cf. Edwards, 1999). Such discussion does not seem to take in consideration that some recent experiences of capital controls had reached – in some degree – success in some countries, as Chile and Malaysia, as recognized by a recent study made by the staff of the IMF (Ariyoshi et al., 2000). In other words, the arguments against the intervention of the State in the movements of capitals between frontiers seem to be supported more in preconceptions of ideological nature than in solid theoretical and empirical arguments.

Nowadays, considering the typical financial/exchange instability of the recent world-wide experience, even conservative agencies, like the IMF, accepts the possibility, in certain circumstances, of the temporary use of certain types of capital controls. Even in the mainstream of economics profession, many economists have criticized the benefits of the process of financial liberalization (Tobin, 1978; Rodrik, 1998; Stiglitz, 1999 and 2000) and defended the introduction of capital controls to increase the autonomy of the monetary policy and to reduce the external vulnerability of the emerging economies.

In the Brazilian case, the recent experience of exchange instability, since the Asian crisis, has disclosed the difficulties of manegement of the macroeconomic policies in a country with high dependence of foreign capitals, weak currency and an open capital account. A new style of economic policy becomes necessary to create conditions for a sustainable and financially stable economic growth. The adoption of some mechanisms of capital controls may help in the implementation of this policy, together with others.

Even though the reasons presented by its defenders may be correct reasons for the introduction of capital controls, a deeper analysis on the desirability of these controls would demand the construction of a complete macroeconomic model, where the effect of capital controls on variables like the degree of capacity utilization, external indebtedness and net exports could be evaluated. In fact, the debate on capital controls has been lead sometimes based in a purely empiricist bias, where the effect of capital controls on the macroeconomic performance of selected countries are availed with little or no theoretical content at all; sometimes based in a simple theoretical framework, in which the secondary and/or of long-run effects of these controls are not evaluated.
In this context, the objective of this article is to increase our understanding of the macroeconomic effects of the introduction of capital controls through the construction of a complete macroeconomic model. The model that we will present will be used to answer two basic questions:

a) What is the impact of capital controls on time path of selected economic variables like degree of capacity utilization, external indebtedness as ratio of the GDP, domestic rate of interests and net exports as a ratio of GDP?

b) The capital controls can reduce the *external fragility of the economy*, that is, can reduce the sensitivity of the economy to external shocks as, for example, variations in the international rate of interests or variations in trade flows?

To achieve this target, we will proceed in two stages. Initially we will specify the structure of the theoretical model from which this analysis will be lead, verifying the conditions of existence and stability of the long-run equilibrium positions. The initial objective of these simulations is to deduce a set of economically reasonable values for the parameters of the structural equations of the model.

In the second stage, we will use the values deduced in the first stage to analyze the sensitivity of the economy to external shocks under different levels of capital controls.

The present article is divided in four sections including this introduction. In section 2 we will present the basic structure of the theoretical model used throughout this article. Section 3 is dedicated to the simulation exercises. The conclusions are presented at section 4.

2 – External indebtedness and Capital controls in a post-Keynesian macroeconomic model.

The model that will be developed in the present section is an extension of the model presented in Oreiro (2004). The original version of the model consider an economy in the which (i) investment in fixed capital is positively influenced by the ratio of external debt to GDP, due to the positive effect of a greater diversity of finance sources over *borrower’s risk*; (ii) perfect capital mobility in the sense of Mundell (1968) and Fleming (1962), i.e it is valid the so-called "uncovered interest rate parity"; (iii) the nominal exchange rate is fixed and; (iv) the country-risk is endogenous, varying with the external debt as ratio of the GDP.

In the version of Oreiro’s model presented here, we will consider an economy that has *capital controls* in the form of taxes over entry and/or exit of financial applications of the country.

2.1 Structure of the model and the short-term equilibrium

Let us consider an economy where firms operate in oligopolized markets, determining their prices based in a fixed *mark-up* over direct production costs, composed by labour costs and imported materials. (cf.Taylor, 1983). So we have:

\[ p = (1 + \tau)[wb + ep^*a_o] \]  

(l)
Where: $p$ is the domestic price level, $w$ is the rate of nominal wage, $p^*$ is the international price level, $e$ is the nominal exchange rate, $b$ is labour requirement per unit of output, $a_o$ is the requirement of imported raw materials per unit of output and $\tau$ is the rate of mark-up.

Let $r$ be the rate of profit and $u$ the degree capacity utilization. It can be demonstrated that the profit rate is given by:

$$r = \frac{\tau}{1+\tau}u \quad (2)$$

The goods market is in balance when the condition below is true:

$$pC + pI + pE = pX \quad (3)$$

Where: $pC$ is the nominal value of the expenses in consumption, $pI$ is the nominal value of the expenses in investment, $pE$ is the nominal value of the net exports and $pX$ is the nominal value of the real income.

We will assume the existence of two social classes – capitalists and workers – which differentiates among themselves based on the origin of their income – profits or wages – and based on the propensity to consume out of available income. In this context, we will assume that the workers "consume everything that they earn" so that its propensity to consume is equal to one. On the other hand, the capitalists consume a fraction $c_p$ of their income (which are constituted solely of profits), saving a fraction $s_p = (1-c_p)$ of profits. This way, the nominal value of consumption demand is given by:

$$pC = wbX + (1-s_c)rpk \quad (4)$$

Substituting (4) in (3) we have, after some algebra, that:

$$\frac{I}{X} + \frac{E}{X} - s_c - \frac{\tau}{1+\tau} - qa_o = 0 \quad (5)$$

The investment function is composed by three elements: an autonomous component ($\alpha_o$), one that depends on the difference between the rate of profit and rate of interests ($\alpha_1[r-i]$) and finally a component that depends on the external indebtedness as ratio of GDP ($\alpha_z z^y$). We will assume that an increase in external indebtedness as ratio of the GDP will result in an increase less than proportional in investment, that is, $\psi<1$.

$$\frac{I}{X} = \alpha_o + \alpha_1[r-i] + \alpha_z z^y \quad 0<\psi<1 \quad (6)^2$$

---

1 Or either, its propensity to save is equal the zero.

2 Regarding the micro foundations of this investment function see Oreiro (2004).
The net exports function has an autonomous element ($\varepsilon_0$) and another element that depends inversely on the level of capacity utilization, since an increase in economic activity will raise imports, leaving gross exports unchanged. We have the following equation:

$$\frac{E}{X} = \varepsilon_0 - \varepsilon_1 u \quad (7)$$

In a context where capital mobility is not perfect due to the existence of capital controls, the domestic rate of interest can diverge from the level determined by the uncovered interest rate parity. One of the reasons for the introduction of capital controls is exactly to give more autonomy to the conduction of monetary policy. Capital controls allows a greater degree of freedom to fix domestic interest rates in accordance to domestic objectives.

This way, we will assume that the domestic interest rate is formed by a weighed average between the "desired interest rate" of the Central Bank, that is, the level of the domestic interest rate that is compatible with the attendance of the objectives of the domestic economic policy, and the value given by the "uncovered interest rate parity". This weighted average reflects the level of capital controls. The bigger are these controls, greater is the weight of the rate of interests desired by the Central Bank in the determination of the effective value of the domestic rate of interests.

Let $\tilde{i}$ be the desired interest rate of the Central Bank and $i^* + \rho$ (where $i^*$ is the international rate of interests and $\rho$ the value of country-risk) the domestic interest rate compatible with the "uncovered interest rate parity" in the absence of capital controls and assuming a regime of fixed exchange. The domestic rate of interest can be determined by the following equation:

$$i = (1 - k)(i^* + \rho) + k \tilde{i} \quad ; \quad 0 < k < 1 \quad (8)$$

In respect to country-risk, we will assume that it possesss a minimum level, equal to risk premium demanded by investors from sovering debt of countries with "investment grade". This minimum level of risk will be obtained, in the present model, when the external debt as ratio of the GDP is zero. For positive values of the external debt as ratio of the GDP, the risk premium is an increasing function of the level of the external indebtedness. In other words, the risk premium is endogenous, so we have that:

$$\rho = \rho_0 + \rho_1 z \quad ; \quad \rho_1 > 0 \quad (9)$$

Substituting (9) in (8), we get the following expression:

$$i = (1 - k)(i^* + \rho_0 + \rho_1 z) + k \tilde{i} \quad (10)$$

Substituting (10) in (6), we get an equation that determines investment as ratio of real GDP as function of the external indebtedness and the profitability:

$$\frac{I}{X} = \alpha_0 + \alpha_1 [r - (1 - k)(i^* + \rho_0 + \rho_1 z) - k\tilde{i}] + \alpha_2 z^\nu$$
Placing $u$ in evidence in equation (2) and substituting the resultant in (7), we get:

$$
\frac{E}{X} = \varepsilon_0 - \varepsilon_1 \frac{(1+\tau)}{\tau} r \quad (7a)
$$

Substituting (6a) and (7a) in (5), and placing $r$ in evidence we get the following expression:

$$
r = \frac{1}{(\varepsilon_1 m^{-1} - \alpha_1)} \left[ (\alpha_2 z^\psi - \alpha_1 (1-k) \rho_1 z) + \Theta - \alpha_1 [k \bar{i} + (1-k) (i^* + \rho_0)] \right] \quad (11)
$$

Where $q = \frac{ep*}{p}$ is the real rate of exchange and $m = \frac{\tau}{1+\tau}$ is the share of profits in income and $
\Theta \equiv \alpha_0 + \varepsilon_0 - \epsilon \cdot \alpha q : m - qa_0$.

Equation (11) shows the value of current rate of profit for which the good market is in equilibrium, that is, for which aggregate demand is equal to real income. It’s the *short run equilibrium value* of the profit rate.

The short-run equilibrium will be stable if $\varepsilon_1 m^{-1} - \alpha_1 > 0$.

Differentiating (11) with respect to $r$ and $z$, we get the following expression:

$$
\frac{\partial r}{\partial z} = \frac{1}{(\varepsilon_1 m^{-1} - \alpha_1)} \left[ \psi \alpha_2 z^{\psi-1} - \alpha_1 (1-k) \rho_1 \right] \quad (12)
$$

The signal of $\frac{\partial r}{\partial z}$ will depend on $\psi \alpha_2 z^{\psi-1} - \alpha_1 (1-k) \rho_1$, which varies depends on $z$. This way, while $z$ increases $\frac{\partial r}{\partial z}$ will pass from positive to negative, characterizing a nonlinear relation between the profitability and the indebtedness. A possible shape of for the curve realting $r$ and $z$ is shown in Figure 1:

![Figure 1](image)

**Figure 1 - Profitability as a function of the indebtedness**

From (12) we know that $\frac{\partial r}{\partial z} > 0$ if the following condition is satisfied:
2.2 Long run dynamics and multiple equilibrium

To analyze the long-run dynamics of this economy, we will initially assume that goods market adjusts slowly to the divergences between aggregate demand and real income. This way, the dynamics of the profit rate is explained by the following differential equation:

\[ \dot{r} = \gamma (E DB) \quad (14) \quad ; \quad \gamma < \infty. \]

Where:

\[ E DB = (\alpha_1 - \varepsilon, m^{-1})r + (\alpha_2 z^\nu - \alpha_1 (1-k) \rho \beta) + \Theta - \alpha_1 (k \tilde{\tau} + (1-k)(i^* + \rho_o)) \]

is the excess of demand in the goods market.

According to Simonsen and Cysne (1995), the differential equation that describes the dynamics of the external debt is given by:

\[ \dot{D} = i^e D - H \quad (15) \]

Where: \( D \) is the accumulated external indebtedness, \( H \) is the net transfer of resources from abroad and \( i^e \) is the interest rate on external debt.

Differently from the domestic rate of interest, the external interest rate is not changed by capital controls, being determined, therefore, from the following equation:

\[ i^e = i^* + \rho \quad (16) \]

Differentiating \( z \) with respect to time, we get the following expression:

\[ \dot{z} = \frac{\dot{D}}{X} - \frac{X}{X} \frac{D}{X} \quad (17) \]

Substituting (15) in (17) and assuming that the rate of growth of real income is \textit{exogenous} and equal to \( g \), we get the following expression:

\[ \dot{z} = (i^e -g)z - \frac{H}{X} \quad (18) \]

The net transfer of resources from abroad is nothing more than, in the economy in consideration, the value of net exports. So, the final expression for the dynamics of the external debt as ratio of the GDP is given by:

\[ z < \left( \frac{\psi \alpha_2}{\alpha_1 (1-k) \rho} \right)^{\frac{1}{1-\psi}} = z^* \quad (13) \]

---

3 This assumption is necessary since the model presented here does not possess a equation capable to determine the rate of growth of GDP. The usual assumption of post-Keynsian growth and distribution models is that the rate of growth of capital stock is equal to the rate of growth of income. However, as capacity utilization is an endogenous variable in this model, then this equality will only hold in steady-state. Out of \textit{steady-state}, the degree of capacity utilization can change over time, making the rate of growth of real income to be greater or smaller than the rate of growth of capital stock.
\[
\dot{z} = (i^* + \rho_0 + \rho_1 z - g)z - \varepsilon_0 + \varepsilon_1 m^{-1} r \quad (19)
\]

In steady-state the rate of profit and the external indebtedness are constant through time. So, to analyse the long-term equilibrium, we define two locus: \( \dot{r} = 0 \) and \( \dot{z} = 0 \), whose shape are given respectively by the following equations:

\[
\left( \frac{\partial r}{\partial z} \right)_{r=0} = -\frac{\mu \alpha z^{\gamma-1} - \alpha_1 (1 - k) \rho_1}{(\alpha_1 - \varepsilon_1 m^{-1})} \quad (20) \quad \left( \frac{\partial r}{\partial z} \right)_{\dot{z}=0} = -\frac{(i^* + \rho_0) - g + 2 \rho_1 z}{\varepsilon_1 m^{-1}} \quad (21)
\]

Previously we demonstrated that the locus that describes the combinations of \( r \) and \( z \) for which the goods market is in equilibrium has a shape given by Figure 1. In the equation (21) we can see that – assuming \( gzi > + + \rho \rho \rho \rho \gamma \) , condition for which \( i > g \) is enough – the locus that describes the combinations of \( r \) and \( z \) for which the external debt is constant through time is downward sloping for all values of \( z \).

This way, one of the possible configurations of the long-run equilibrium of the economy in consideration would be the one in figure 2.

![Figure 2 - Long-run equilibrium positions](image)

In figure 2 we visualize the existence of two positions of long-run equilibrium. The first one is characterized by a high profitability (\( r_1 \)) and a low level of external indebtedness (\( z_1 \)) – which we will call equilibrium with low indebtedness - and the second is characterized by a low profitability (\( r_0 \)) and high level of external indebtedness (\( z_0 \)).

2.3 - Analysis of stability in the case where \( \gamma < \infty \).

We will use the trace-determinant methodology to analyze the stability of the system.

---

\[\text{We are assuming that the balance of the invisible balance not-factors is equal the zero.}\]
The Jacobian matrix of the system is given by:

\[
J = \begin{pmatrix}
\frac{\partial r}{\partial r} & \frac{\partial r}{\partial z} \\
\frac{\partial z}{\partial r} & \frac{\partial z}{\partial z}
\end{pmatrix} = \begin{pmatrix}
\gamma (\alpha_1 - \varepsilon_1 m^{-1}) & \gamma (\psi \alpha_2 z^{\psi - 1} - \alpha_1 (1 - k) \rho_1) \\
\varepsilon_1 m^{-1} & \left( i^* + \rho_0 - g \right) + 2 \rho_1 z
\end{pmatrix}
\]

Where:

\[
\gamma (\alpha_1 - \varepsilon_1 m^{-1}) < 0 \quad (22) \quad \gamma (\psi \alpha_2 z^{\psi - 1} - \alpha_1 (1 - k) \rho) \quad (23)
\]
\[
\left( i^* + \rho_0 - g \right) + 2 \rho_1 z > 0 \quad (24) \quad \varepsilon_1 m^{-1} > 0 \quad (25)
\]

The values of the determinant and the trace of the matrix are:

\[
DET(J) = (22) * (24) - (23) * (25) \quad TR(J) = (22) + (24)
\]

The system will be unstable of the saddle path type if determinant of the Jacobian matrix is negative (cf. Takayama, 1993).

If (23) is greater than zero, the determinant will be negative. Dividing (23) by gamma and isolating \( z \), we have:

\[
z < \left( \frac{\psi \alpha_2}{\alpha_1 (1 - k) \rho} \right)^{\frac{1}{1 - \psi}} = z^* \quad (26)
\]

From (26) we observe that the equilibrium with low indebtedness, that is at left of \( z^* \), is necessarily unstable of the type saddle path.

If equilibrium with high indebtedness is at right of \( z^* \), it may be stable, depending on the trace of the Jacobian matrix. For this equilibrium to be stable is necessary that the trace be negative. We have, then, that:

\[
\gamma (\alpha_1 - \varepsilon_1 m^{-1}) \left( i^* + \rho_0 - g \right) + 2 \rho_1 z
\]

This will occur if:

\[
z < \frac{\gamma (\alpha_1 - \varepsilon_1 m^{-1}) - \left( i^* + \rho_0 - g \right)}{2 \rho_1} = z^{**} \quad (27)
\]

The condition (27) is necessary but not a sufficient condition for stability of the system. Moreover it is necessary that determinant is positive, that is, \( z > z^* \). In other words, the equilibrium with high indebtedness will be stable if \( z^* < z^{**} \). For this to occur the following condition must be true:

\[
\left( \frac{\psi \alpha_2}{\alpha_1 (1 - k) \rho_1} \right)^{\frac{1}{1 - \psi}} < \frac{\gamma (\alpha_1 - \varepsilon_1 m^{-1}) - \left( i^* + \rho_0 - g \right)}{2 \rho_1}
\]

Placing \( g \) in evidence, we have:
\[ g > 2(1-k)\rho_1 \left( \frac{\psi \alpha_z}{\alpha_1 (1-k) \rho_1} \right)^{\frac{1}{1-\psi}} \left[ \gamma \left( \alpha_1 - \varepsilon_i \right) + i^* + \rho_0 \right] = g^* \] (28)

For the equilibrium with high indebtedness to be stable is necessary that the rate of growth of real income be bigger than a certain critical level \( g^* \), which depends, among others variables, on the level of capital controls. If this condition is not true, the equilibrium with high indebtedness will also be unstable.

2.4 – **Analysis of Stability in the case where** \( \gamma \to \infty \).

We will now drop the hypothesis that goods market adjusts slowly to a situation of excess of demand, that is, we will assume that the degree of capacity utilization is always equal to its short-run equilibrium value. This way, the dynamic system previously presented will be reduced to only one differential equation – the expression (19) – where the dynamics of the external indebtedness depends only on the value assumed from the variable \( z \), since the profit rate will have assumed its equilibrium value, being a nonlinear function of \( z \) in accordance with the equation (12).

In this context, the analysis of the stability of the system is simplified. This happens because the economy will be operating continuously on the locus \( \dot{r} = 0 \) and its dynamic will be given only from equation (19). If the economy operates in a point of the locus \( \dot{r} = 0 \) above the locus \( \dot{z} = 0 \), the combination of profitability and external indebtedness will be such that the external debt as ratio of the GDP will *increase* through time (Figure 3). However, if the economy operates in a point over the locus \( \dot{r} = 0 \) below the locus \( \dot{z} = 0 \), then the combination of profitability and external indebtedness will be such that the external debt as ratio of the GDP will *diminish* through time. This way, the equilibrium with high indebtedness will be **stable**, while the equilibrium with **low indebtedness** will be **unstable**. This means that if the initial level of external indebtedness is higher than the one of the balance with low indebtedness, the economy will *converge to a position of long-run equilibrium* characterized by high external indebtedness.

![Figure 3 - Dynamics with instantaneous adjustment in the goods market](image-url)
3 – Computational simulation of the Theoretical Model.

In this section we will, after the choice of the values for the parameters, analyze the equilibrium values for the endogenous variables of the model: profitability and external debt as ratio of the GDP. The simulation of an economic model with numerical values makes possible to analyze some quantitative properties of the model, as well as verify the economical plausability of the dynamics studied in the qualitative analysis. Starting with a theoretical model written in mathematical form, we use reasonable numbers for the parameters of the behavioral functions of the model. Some of these parameters, however, are of an unknown magnitude. For these parameters, we use the methodology of Samuelson’s correspondence principle (cf. Samuelson, 1947), that is, we will use the values that are needed for the time path of economic variables to be realistic.

For example, attributing values for the "observable" parameters of the model based on what seems reasonable for a country like Brazil, and adjusting the values of the parameters for which no a priori estimate can be made based on the conditions of existence of the equilibriums with low and high indebtedness; we verify that the stability of the equilibrium with high indebtedness in the case where \( \gamma < \infty \) would only be possible with unreasonable values for the parameters of the model. In effect, the attendance of the condition (28) demands that the rate of growth of the real GDP to be significantly bigger that 6 %. Still, if we add the necessary condition that the equilibrium point with high indebtedness to be situated in the region between \( z^* \) and \( z^{**} \), we need a rate of growth of the GDP of 24% a year! This way, we have a model without stable equilibrium for reasonable parameter values. So, to keep the plausibility of the parameter values, the numerical analysis will be made only for the case of instantaneous adjustment in the goods market.

3.1 – The process of choice of the values of the parameters.

Starting from the principle that the values of the parameters must be reasonable in economic terms and considering that the economy under analysis is an emerging country, that possess a high level of (but not perfect) capital mobility and a high external indebtedness; we considered the following set of parameters in the simulation exercises:

---

5 This attribution is made on the basis of the existing countable estimates regarding the values of the same ones.
In Table 1 the values of the parameters $\rho_0$, $\rho_1$, $\varepsilon_1$, and $\gamma$ had been chosen in a way to allow the existence of two positions of long-run equilibrium, such as in the theoretical model presented in the previous section. The other parameters had been chosen based on reasonable values for an emerging economy as, for example, the Brazilian economy. Using $k = 0.1$ get the result presented in Figure 4:

![Figure 4 - Curves with the parameters used in the simulations and k=0.1](image)

In Figure 4, we see the existence of two equilibrium positions. In the first one, with low indebtedness, the relation debt/GDP is equal to 0.75% and the profitability is 16.65%. In the second, with high external indebtedness, the relation debt/GDP is of 52.75% and profitability of 7.03%.
3.2 Comparative statics for the case where $\gamma \rightarrow \infty$ for different scenarios

As seen in section 2.4, relaxing the assumption of slow adjustment in the goods market, we have the occurrence of stability in the equilibrium with high indebtedness. In fact, when running the dynamic simulation with the same initial parameters of the analysis of section 3.3 and using the instantaneous adjustment in the goods market, we verify, for example, that the rate of profit converges to a steady-state value in the long-term.

Figure 5 - Profitability in time

Figure 5 shows only the behavior from $t=20$ in order to point the small damped oscillations that occur due to the adjustment caused by the dynamics of the external indebtedness (equation (19)).

We will now analyze the effects of different scenarios for external parameters over the equilibrium positions of the economy.

The tables in page 16 shows the results of these simulations. Each table analyzes the impacts of variations in one determined exogenous variable. Table 2, for example, shows the values of equilibrium in three scenarios: the standard scenario for international rate of interest used in the work ($i^* = 0.02$), an increase of 0.5 percentile point ($i^* = 0.025$) and a fall of 0.5 percentile point ($i^* = 0.015$). In each one of the three cases, the table informs the equilibrium values of $r$ and $z$ in the cases of absence of capital controls ($k=0$) and in the case of partial capital controls ($k=0.1$). For example, when $i^* = 0.015$ and with capital controls the values of equilibrium of the profitability and of the indebtedness they are 5.87% and 57.24%, respectively.

The tables also shows the percentile variations in the endogenous variables in relation to the basic case (enhanced in the tables with the edge in boldface) in fields $\Delta r_i/r$ and $\Delta z_i/z$ and $\Delta r_z/r$ and $\Delta z_z/z$. The variations with subscript 1 (for example $\Delta r_i/r$) relate to the first case of variation (that is, the value to the right of the basic case), and with subscript 2 (for example $\Delta z_z/z$ ) relates to the second case of variation. For example, we can see in Table 3 that, when the autonomous component of net exports passes from...
11.00 = \epsilon_0 to \epsilon_1 in the absence of capital controls, the equilibrium profit rate increases in 19.15%, and the equilibrium debt has a -38.37% fall.

Scenario 1 – Variations in the international rate of interest

We analyze the impact of a variation (up and down) of international interest rate \((i^*)\) in 0.5 percentile points. The results are presented in Table 2.

We see here an interesting result: when the international interest rate increases the equilibrium profitability increases and the equilibrium debt decreases. It is important to stand out that we are analyzing an equilibrium position, and not instantaneous effects. Initially, as a result of the increase in \(i^*\), there is a reduction of the profitability. Because the profitability is smaller than the one that leads to the equilibrium of debt, the economy starts a trajectory of reduction of debt and increase in profitability, that results in a smaller debt and a bigger profitability than the initial values.

Scenario 2 – Variations in trade flows

The variable of the model that reflects changes in international trade is \(\epsilon_0\), the autonomous component of net exports, given that the term \(\epsilon_1 u\) reflects imports, that are induced by variations in the degree capacity utilization.

The first comment that can be made on the results (see Table 3) is the huge impact of changes in exports over equilibrium values. This happens because the profitability that balances the goods market is more sensible to net exports than the one that balances the debt\(^6\). This behavior can be visualized in the comparative graph of the two situations (Figure 6).

---

\(^6\) An alteration of \(\Delta \epsilon_0\) in \(\epsilon_0\) modifies \(r\) of balance in \(\frac{\Delta \epsilon_0}{\epsilon_1 m^{-1} - \alpha_1}\) in \(\hat{r} = 0\), and \(\frac{\Delta \epsilon_0}{\epsilon_1 m^{-1}}\) in \(\hat{z} = 0\). As \(\epsilon_1 m^{-1} - \alpha_1 > 0\), \(\alpha_1 > 0\), we have that \(\frac{\Delta \epsilon_0}{\epsilon_1 m^{-1} - \alpha_1} < \frac{\Delta \epsilon_0}{\epsilon_1^{-1}}\), resulting, of this form, in \(\Delta r_{|\hat{r}=0} > \Delta r_{|\hat{z}=0}\).
In a context of depression in international markets, the presence of capital controls improves the response of the level of activity to the new situation in equilibrium. On the other hand, the reduction of the equilibrium indebtedness is smaller. In the case of an increase in exports, however, we observe the opposite. In section 3.5 we analyze these different behaviors from the perspective of the social welfare.

3.3 Welfare Analysis

The results gotten in the simulations on section 3.2 allowed the observation of cause and effects relations for qualitative analysis and conjunctural considerations. The results obtained while comparing the situations with and without capital controls were, however, non-conclusive. In cases like variation of the international rate of interest, the capital controls intensified the variation in the rate of capacity utilization, but on the other hand it reduced the variation in the external indebtedness.

Welfare analysis of capital controls demands, therefore, a method of quantification of it. For this, initially we will assume that society desires stability of the endogenous variables of the model (activity level and external indebtedness). The weight that the society gives for these variations, however, can change. Two cases illustrate this behavior: German society, for example, seems to show a very low tolerance for the oscillations in the inflation levels, probably because of two traumatic moments in its history – the hiperinflations of 1923 and 1948. The North American society, on the other hand, seems to show little tolerance with high oscillations in unemployment rate, due to the experience of the 1929 crisis.

This way, we will analyze the different levels of welfare for changing weights that societies can give to the volatileness of two variables of the model.
Results of the simulations for the case \( r \rightarrow \infty \)

<table>
<thead>
<tr>
<th>( K = 0 )</th>
<th>( K = 0.1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( i' = 0.02 )</td>
<td>( i' = 0.025 )</td>
</tr>
<tr>
<td>( r )</td>
<td>10.61%</td>
</tr>
<tr>
<td>( z )</td>
<td>41.13%</td>
</tr>
</tbody>
</table>

Table 2 - Variations in the international interest rate

<table>
<thead>
<tr>
<th>( K = 0 )</th>
<th>( K = 0.1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \varepsilon_0 = 0.11 )</td>
<td>( \varepsilon_0 = 0.1 )</td>
</tr>
<tr>
<td>( r )</td>
<td>10.61%</td>
</tr>
<tr>
<td>( z )</td>
<td>41.13%</td>
</tr>
</tbody>
</table>

Table 3 - Variations in the world commerce
The volatileness of $z$ for a change of economic scenario is the difference between the greater and the lesser value that it can take and is given by the equation (29). In the same way, the volatileness of $r$ in a change of economic scene is given by the equation (30):

$$V_z = \left| \frac{\Delta z_1}{z} - \frac{\Delta z_2}{z} \right| \quad (29) \quad V_r = \left| \frac{\Delta r_1}{r} - \frac{\Delta r_2}{r} \right| \quad (30)$$

We will assume that the cost of the volatileness on these variables for the society increases with their value. This means that a change of 2% in a variable has a social cost bigger than the double of the cost of a 1% alteration. We will call the weight that the society gives for the volatileness of the level of capacity utilization $\Omega_z$ and for the volatileness of the external indebtedness $\Omega_r$. Our social cost function given by:

$$CS = \Omega_r V_r^2 + \Omega_z V_z^2 \quad (31)$$

Welfare can be given by the negative of the social cost:

$$BE = -CS \quad (32)$$

Joining (29) and (30) in (31) (remembering that, when taking a square leaves the need to use the module) and substituting in (31) we have the following welfare equation:

$$BE = - \left( \Omega_z \left( \frac{\Delta z_1}{z} - \frac{\Delta z_2}{z} \right)^2 + \Omega_r \left( \frac{\Delta r_1}{r} - \frac{\Delta r_2}{r} \right)^2 \right) \quad (33)$$

We now analyze two cases of societies’s preferences: aversion to volatileness in the external indebtedness and aversion to volatileness in the capacity utilization.

<table>
<thead>
<tr>
<th>Variations in $i^*$</th>
<th>Welfare</th>
<th>Variations in $\varepsilon_0$</th>
<th>Welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>$K=0$</td>
<td>-0.11004</td>
<td>-1.90378</td>
<td>$K=0$</td>
</tr>
<tr>
<td>$K=0.1$</td>
<td>-0.10775</td>
<td>-1.71665</td>
<td>$K=0.1$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variations in $i^*$</th>
<th>Welfare</th>
<th>Variations in $\varepsilon_0$</th>
<th>Welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>$K=0$</td>
<td>-0.07608</td>
<td>-0.85847</td>
<td>$K=0$</td>
</tr>
<tr>
<td>$K=0.1$</td>
<td>-0.1699</td>
<td>-1.73347</td>
<td>$K=0.1$</td>
</tr>
</tbody>
</table>

Table 4 - Aversion to volatileness in the external indebtedness

Table 5 - Aversion to volatileness in the level of capacity utilization

**Case 1: Aversion to volatileness in the external indebtedness**

In this case we take the following values for the parameters: $\Omega_z = 0.75$ and $\Omega_r = 0.25$.

The results shown in Table 4 show that, in a society with aversion to volatileness in the external indebtedness, capital controls increases welfare in the case of variations in the international interest rate and in the case of changes in the autonomous component of net exports.
Case 2: Aversion to volatileness in the level of capacity utilization

In this case we take the following values for the parameters: $\Omega_z = 0.25$ and $\Omega_r = 0.75$. The results can be seen in Table 5.

In the case of society with aversion to volatileness in the level of capacity utilization, the absence of capital controls resulted in a greater welfare.

4 – Conclusion

The present work had the objective of making a theoretical analysis of the impact of capital controls in an emerging economy. The methodology used to reach this objective was of to run a computer simulation of a theoretical model.

The results had shown that the effects of capital controls in a economy can be very complex.

As the results relating to changes in the volatileness of the macroeconomic variables were not immediately conclusive, we have to made a welfare analysis that showed that the option for capital controls depends on the level of society’s aversion to the volatileness of different macroeconomic variables. In this context, if the society have a strong aversion to the volatileness of the external then capital controls will be preferable to a situation perfect capital mobility. However, if society have a strong aversion to the volatileness of the degree of capacity utilization, giving little value to the volatileness of the external debt then absence of capital controls will be the choice that maximizes the welfare of society.

This way, the choice between capital controls and capital mobility cannot be based solely on technical arguments, because it depends on social preferences.

References


