Institutional Barrier and the World Income Distribution

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INSTITUTIONAL BARRIER AND THE WORLD INCOME DISTRIBUTION

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Resumo

O objetivo deste artigo é discutir a relação da abertura econômica e do impacto das reformas institucionais na participação do produto de cada país na produção global. Para tanto, é desenvolvido simulações econômicas, a qual é uma abordagem alternativa que utiliza técnicas matemáticas e deduções para resolver um modelo objetivo. A simulação econômica deste trabalho reflete que o nível de abertura econômica é um importante fator de peso para possíveis alterações institucionais nas economias. Nota-se que, nos países com nível de abertura baixa, o custo do capital é o principal entrave para o crescimento econômico. E, naquelas economias com alto nível de abertura, a maior dinâmica compensa os problemas causados pelo custo do capital. Quando comparados os dois tipos de reformas (contínua versus pontual), a reforma "contínua" apresenta um ganho de qualidade mais expressivo do produto relativo do que a reforma "pontual".

Palavras Chave - Crescimento Econômico, Simulação Econômica e Reformas Institucionais.

Abstract

The objective of this paper is to discuss the relationship of the openness and the impact of institutional reforms in the participation of the product of individual countries in global output. Therefore, it is based on economic simulations, a type of alternative approach that uses mathematical techniques and deductions to solve an objective model. The economic simulation of this work reflects that the trade opening level is an important factor of weight for possible institutional alterations in the economies. It is noticeable that, in the countries with low opening level, the cost of the capital is the main setback for the economic growth. And, in those economies with high opening level, the largest dynamics would compensate the problems caused by the cost of the capital. When compared the two types of reforms (continuous versus punctual), the "continuous" reform will bring a more expressive gain quality of the relative product than the "punctual" reform.

Keywords - Economic Growth, Economic Simulation and Institutional Reforms.
JEL: O40; F47; P41.

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1. Introduction

There is a dominant perception that institutions are key for explaining the perennial technical progress, which gained a prominent role for explaining the large differences in output *per capta* among countries (Easterly and Levine, 2002; Barro, 1998; Ranis and Stewart, 2001). There is also a growing perception that we should examine the process of economic growth, its basis and its effects, taking into account the economic interpendence among countries (Helpman, 2004; Acemoglu and Ventura, 2002).

We examine the relationship between trade openness and the institutional quality upon countries' growth performance by working out some economic simulations based on Acemoglu and Ventura's (2002) growth model. In the present case, the numerical computational analysis, which have some advantages over the traditional comparative statistics, will enable us to work out interesting economic scenarios involving changes in trade liberalization and institutional reforms.

Institutions are, here, considered in a broad sense. No doubt, properties rights and the rule of law are crucial features for reducing the risks to investors, that is, for granting good contracts and enforcing them (Easterly and Levine, 2002). The same applies to the existence of undistorted prices for preventing misalocation of domestic resources and promoting market competition (Helpman, 2004; North, 1990; Barro, 1998). Yet, despite the prominent role of sound microeconomic foundation over macroeconomic ones[1], in the long run, we should include the latter in a broad notion of institutional quality. That is why we rather use the concept of Institutional barrier, as better explained in the paper.

The model of Acemoglu and Ventura (2002) consists of a global economy where countries trade intermediate goods based on ricardian characteristics (differences in productivity) and the quality of institutions create conditions for sustained economic growth. Economic simulations enable us to better track behaviors of certain variables, and the main impact analysis are divided, in the present analysis, into two main groups: the first involving economies A (developed economy) and B (economy in the progressive development); and the second involving economies B and C (economy in the stagnant developing). These two main groups are further divided into four tests per group, in which changes in the variable "Institutional Barrier" and the level of trade openness are tested. All the simulations of the economic model will be rotated in Matlab, using the SOR iterative numerical method.

The remainder of this paper is structured into three parts. Section one presents the formulation of the economic model. The second section presents the economic simulations and their results. Finally, we conclude.

2. Structure of the Economic Model

We take Acemoglu and Ventura (2002) model for reference, which consists of an imperfectly competitive ricardian model where international trade is restricted to intermediate goods. Domestic and foreign products are imperfect substitutes, but their market power is limited to the prices of exported goods, not extending to imported goods,

[1] Even episodes of a general macroeconomic statibity among developing countries, which Rodrik (1999) assigns to external shocks amplified by delayed (domestic) stabilization policies, were found out to be better explained by delayed reforms (Cinquetti and Silva, 2008).

since they would be small in the world economy. Otherwise, countries would face flat demand and the accumulation of capital would not affect the terms of trade. That is what makes constant returns to scale compatible with diminishing returns, as consequence of economic growth, or else how international trade grants a stable distribution of world income. In addition, this model consists of a global economy where countries differences in productivity and/or technology. These countries are able to influence the prices of goods they export but not those of imported goods.

In order to describe the model we use an AK^2 model to demonstrate how economic reforms and efficient policies improve trade among countries. Thus, countries that have carried out the necessary reforms have a greater capacity for economic growth than do those who have not. In addition, countries that adopt "irresponsible" economic policies generate unstable growth (Gries and Meierrieksy, 2010; Commander and Nikoloski, 2010; Aisen and Veiga, 2011; Dias and Tebaldi, 2011).

2.1. Institutional Barriers

The variable "Institutional Barrier" proposed in this paper has aim to denominating and expressing mathematically a variable related to the institutional quality of countries, as proposed by Acemoglu (2009). This allows countries to have different levels of productivity because of different technologies and economic policies.

The mathematical formulation of this variable is based on equations Wavelet, and this type of equation is generally used in signal analysis. The purpose of using this formulation is to produce an amplitude component and another component related to a temporal movement.

Thus, we consider the "Institutional Barrier" variable to be:

$$\xi_j(t) = \quad \text{f(macroeconomic stability}^3 \text{ and core microeconomic foundations}^4\text{)}$$

We can then mathematically express it as follows:

$$\xi_j(t) = A.EXP\left[\beta_1.r_j^{bas}(t) + \beta_2.\left(G_j(t) - T_j(t)\right) + \beta_3.\theta_j(t)\right] \qquad (1)$$

and

$$\beta_1, \beta_2, \beta_3 > 0$$

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[2] The AK model is an endogenous growth model, and its name originates from the mathematical representation of the Cobb–Douglas production function:

$Y = AK^{a}L^{1-a}$

where Y represents the total output of the economy, A represents TFP, K is capital, L is work, and the parameter measures the elasticity of output to capital. To display constant returns to scale, we have the special case in which the production function becomes linear to capital. Thus, in this case, the Cobb–Douglas function takes the following form:

$Y = AK$

[3] For more details: (Borio, 2011; Gerry, Lee and Mickiewicz, 2010; Satyanath and Subramanian, 2004; Ocampo, 2005).

[4] In this paper, the core microeconomic foundations are productive efficiency, allocative efficiency, and property rights.

where $r_j^{bas}(t)$ is the basic interest rate of economy j; $G_j(t)$ is government expenditure in the economy j; $T_j(t)$ is government revenue in economy j; t is the period, β_1,β_2,β_3 are the sensitivity parameters of the "Institutional Barrier" variable with regard to monetary, fiscal, and the microeconomic foundations of economy j; A is the history of the "Institutional Barrier" variable in economy j until time t = 0 (this parameter is what determines the initial position of economy j at the beginning of the study); and $\theta_j(t)$ are the microeconomic foundations of economy j. Besides, it is appropriate to comment on the variables located within the brackets of equation (1): those on the left $\left(\beta_1.r_j^{bas}(t)+\beta_2.\left(G_j(t)-T_j(t)\right)\right)$ represent macroeconomic stability (the monetary and fiscal policies of country j) and those on the right $\left(\beta_3.\theta_j(t)\right)$ represent the conditions of the microeconomic distortions of country j. As a result, high values for the basic interest rate, lack of public finances, and high microeconomic distortions cause a relatively high value for the "Institutional Barrier" variable, which would hinder economic development.

2.2. Solution of the Global Economy

The complete characterization of the world distribution of income in steady state is given by the following pair of equations:

The cost of capital[5] of country j:

$$r_j^* = \left[\xi_j\left(\rho_j + g^*\right)\right]^{\frac{1}{\tau_j}} \qquad (2)$$

where r_j^* is the cost of capital, ξ_j is the "Institutional Barrier," ρ_j is the discount rate, g^* is the rate of growth of global output, and τ_j is the openness of the economy. Thus, the higher the "Institutional Barrier," the higher the discount rate, and the lower the trade openness of country j, the higher is its cost of capital.

And the equation for the relative products of country j:

$$y_j^* = \mu_j\left[\xi_j\left(\rho_j + g^*\right)\right]^{\frac{\left(1-\varepsilon_j\right)}{\tau_j}} \qquad (3)$$

$$y_j^* \equiv Y_j(t)/Y(t)$$

where $Y_j(t)$ represents the products of country j and $Y(t)$ represents the products worldwide.

Equation (3) shows that countries that have better levels of technology (high μ_j), lower "Institutional Barrier" values (low ξ_j), and lower discount rates (low ρ_j) are relatively wealthier. It also points out that the elasticity of output with respect to ξ_j and ρ_j depends on the elasticity of substitution among intermediate goods, ε_j, and the level of

[5] Acemoglu (2009), pg 668, says: "Our assumption that each country is small implies that each exports practically all of its production of intermediates and imports the ideal basket of intermediates form the world economy. Consequently $p_j(t) = r_j(t)$ is not only the price of intermediates produced by country j but also its *terms of trade* – defined as the price of the exports of a country divided by the price of its imports".

openness, τ_j.

3. Simulation of the Economic Model

The economic model of Acemoglu and Ventura (2002) demonstrates that the trade openness and institutional barriers are relevant for economic growth. Even so, analysis of the impact of these variables on the product of countries requires a numerical sense. For this purpose, we use a numerical simulation in order to test changes in these two variables.

The model has 11 structural parameters and two main equations. In order to calculate the dynamic trajectories of the endogenous variables of the system we must first set the values of structural parameters. To do so, we assign them numerical values that can be found in real-world economies. Specifically, we consider for the countries of the simulation: (i) that the variables related to macroeconomic stability do not interfere in the products of any of the economies $\left(\left(r_j^{bas}(t)+\left(G_j(t)-T_j(t)\right)\right)=0\right)$; (ii) a global growth rate in steady state (g^*) of 2% per period; (iii) an elasticity of substitution among the intermediate goods in country j and the rest of the world (ε_j) at a value of 2[6]; (iv) an indicator of the relative weights of the products of the countries (μ_j) equal to 1[7]; and (v) discount rates (ρ_j) of 0,7, 0,75, and 0,8 for economies A, B, and C, respectively. The other parameters ξ_j, θ_j, and τ_j are variable parameters, which are the objects tested in the simulation. We also include parameters used in numerical modeling (tol and number of iterations).

In order to present the simulation results, the tests were divided into two main groups: the first involving economies A and B and the second involving economies B and C. These two groups were divided into four tests per group, in which changes were tested in "Institutional Barrier" and the level of trade openness. The parameters of economy B were the same in all tests: $\rho_B = 0{,}75$; $\tau_B = 0{,}35$; and $\theta_B = -0{,}35$. It is worth noting that this economy had already carried out strong institutional reforms. The discount rates of the other two economies (A and C) were also constant during all tests, with values of $\rho_A = 0{,}70$ and $\rho_C = 0{,}80$.

3.1. Tests performed in the simulation of the economic model

The two equations presented in section 2 were run in Matlab using the parameters described above for a time horizon of 20 periods. In order to solve the linear system of this simulation it is necessary to find the inverse of the matrix containing the terms of the trade of the economies; however, this is a task somewhat complicated using direct methods. Thus, it was necessary to use an iterative numerical method to calculate successive approximations to the solution of the system. We chose the SOR Method (Succesive Over Relaxation) using

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[6] The purpose of using the value of 2 for ε_j is not based on any microeconomic assumption, beyond the supposition of Acemoglu and Ventura (2002) that $\varepsilon > 1$ in order to avoid "immiserizing growth." Thus, the value used here is $\varepsilon = 2$ in order to facilitate the simulation, because equation (3) has the exponent $\left(\frac{1-\varepsilon}{\tau}\right)$, and thus, in the simulation, this would be $\left(-\frac{1}{\tau}\right)$.

[7] The values ε_j and μ_j were kept constant for all countries in order to simplify the simulation. In this way, all countries present the same preferences between domestic and imported goods, and related products have the same weight (even technological advances).

a maximum number of iterations, an initial approach and a tolerance for convergence (Judd, 1998).

3.1.1 Description of the test procedures of the simulation of the economic model

In test 1, we tested a change in the behavior of economy A, which initially presented conditions that hindered economic growth ($\theta_A = 0{,}15$) but then (in period 11) carried out institutional reforms ($\theta_A^{'} = -0{,}09$). For test 1, the level of trade openness of economy A was $\tau_A = 0{,}35$. The second test considered the same conditions as the first apart from the level of trade openness of economy A, $\tau_A^{'} = 0{,}70$. The third test showed the same structure as the first. However, the difference here was the absence of institutional reforms, which allowed economy A to waste products until the end of the test. Furthermore, the last test, involving economies A and B, reflected the same test conditions, just by changing the level of trade openness of economy A, $\tau_A^{'} = 0{,}70$.

In tests 5–8, we repeated the same procedure as that used in tests 1 to 4. The difference was that this sequence of tests aimed at "continuous" institutional change in economy C. This initially presented an institutional structure of low quality ($\theta_C = 0{,}3$), with reforms carried out in period 11. Therefore, in test 5, the reforms continued after retirement, with an initial value of $\theta_C^{'} = -0{,}3$, and its conditions improved period to period until the end of the test. Test 6 considered the same conditions as test 5 apart from the level of trade openness of economy C, $\tau_C^{'} = 0{,}70$. Now the test 7 was formed using the same structure set as that of test 5. However, this test no included institutional reforms. Furthermore, in test 8, we used the same test conditions as those in test 7, only changing the trade openness of economy C $\tau_C^{'} = 0{,}70$.

3.2 Simulation results

The last three paragraphs were used to present the tests used in the simulation of the economic model, whereas here, the aim is to discuss the results of these tests. Thus, this item is divided into two sub-items: the first discusses the results obtained by the trade openness of countries, and the second discusses the dynamic behavior of the "Institutional Barrier".

3.2.1 Dynamic behavior of the level of opening of the countries, τ_j :

The first parameter tested was the level of openness of the three economies. Figure 1 displays the results of this test. As mentioned, economy A had low quality before carrying out institutional reforms in period 11. Thereafter there was a recovery in the products for this economy. Note, however, that this change was mild (1,78% gain in the product relative to economy A). This feature is explained by the low value of the level of trade openness of this economy, $\tau_A = 0{,}35$. This is corroborated by comparing Figures 1 and 2: it is clear that the effects of test 2 show a greater intensity than those presented in test 1 (in the second test, the gain in the products in the economy A is 13,31%). This behavior is also seen in comparisons of tests 3 and 4 (Figures 3 and 4), 5 and 6 (Figures 5 and 6), and 7 and 8 (Figures 7 and 8). In this second group of tests on economies B and C, the gain in intensity by increasing the level of openness is even greater than that presented by economies A and B, and the gain in economy C in test 5 is 2,71%, whereas in test 6, it is 22,36%. These results corroborate the

works of: Federici and Montalbano, 2009; Haddad, Lim and Saborowski, 2010; Székely and Sámano, 2012; and Binici, Cheyng and Lai, 2012.

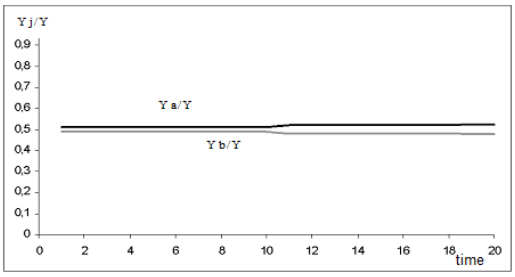

Figure 1 – Results of relative products obtained from test 1.

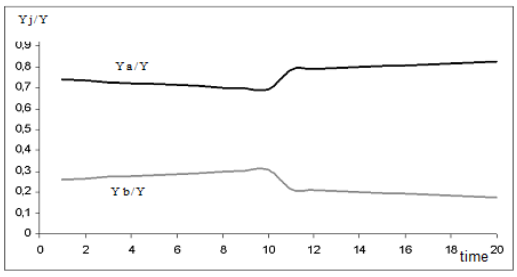

Figure 2 – Results of relative products obtained from test 2.

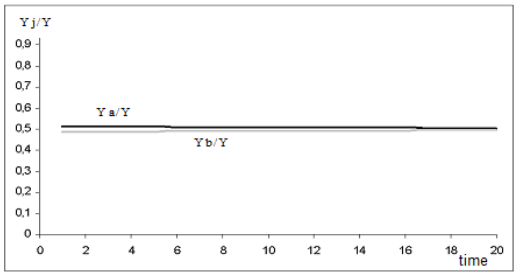

Figure 3 – Results of relative product obtained from test 3.

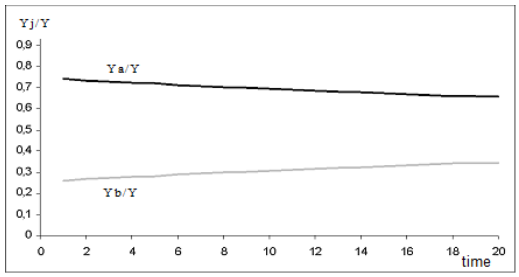

Figure 4 – Results of relative products obtained by test 4.

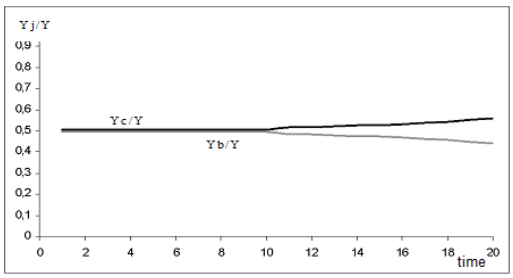

Figure 5 – Results of relative products obtained from test 5.

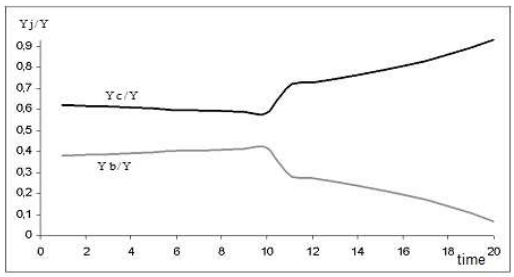

Figure 6 – Results of relative products obtained from test 6.

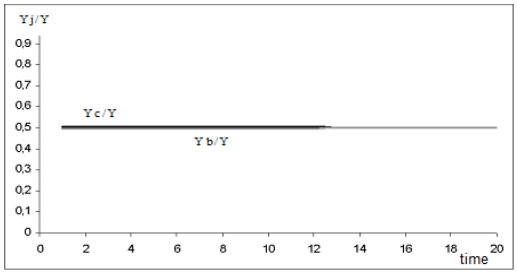

Figure 7 – Results of relative products obtained from test 7.

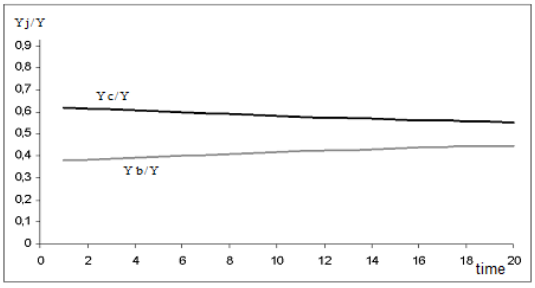

Figure 8 – Results of relative products obtained from test 8.

One explanation for this large difference in value caused by the level of trade openness is presented in the figures that show the results for the cost of capital (Figures 9–12 for economies A and B and Figures 13–16 for economies B and C). We note that the cost of capital is the major impediment to economic development in the tests that have a low level of trade openness (Figures 9, 11, 13, and 15), whereas in the other tests, the most dynamic caused by the greater level of openness makes the "Institutional Barrier" factor relevant to the changes in relative productivity. Therefore, a very open economy that carries out institutional reforms will display more significant gains than a relatively closed economy. Thus, level of openness is a measure of the weight of changes that occur in a

given country. This implies that a country that has relatively greater openness will suffer more during crises and will benefit more in times of prosperity.

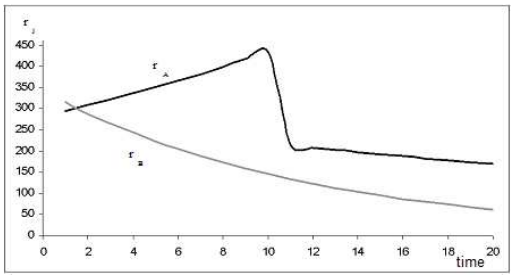

Figure 9 – Results of the cost of capital obtained from test 1.

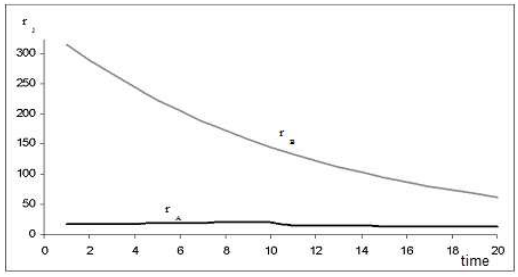

Figure 10 – Results of the cost of capital obtained from test 2.

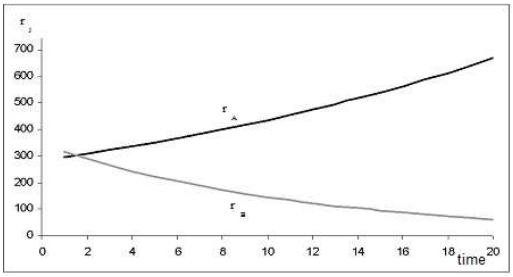

Figure 11 – Results of the cost of capital obtained from test 3.

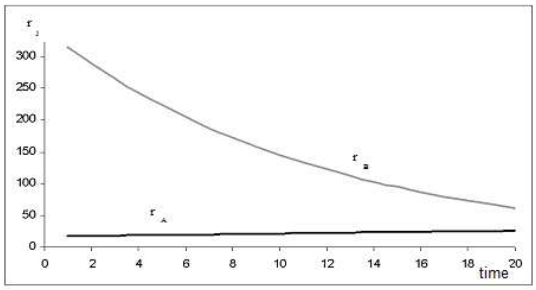

Figure 12 – Results of the cost of capital obtained from test 4.

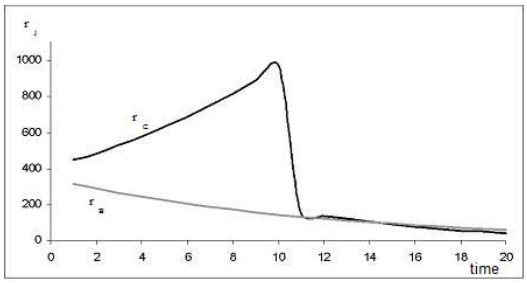

Figure 13 – Results of the cost of capital obtained from test 5.

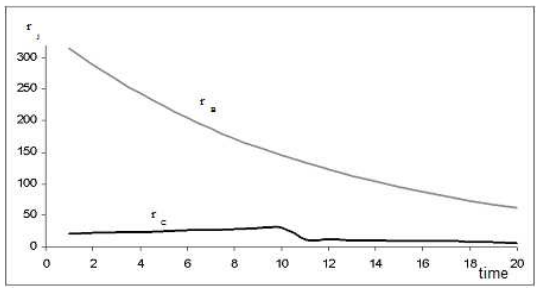

Figure 14 – Results of the cost of capital obtained from test 6.

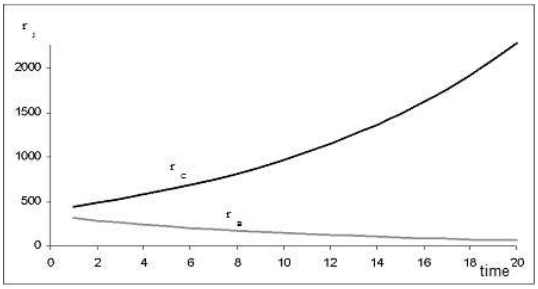

Figure 15 – Results of the cost of capital obtained from test 7.

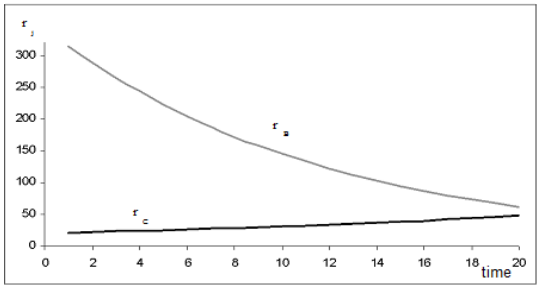

Figure 16 – Results of the cost of capital obtained from test 8.

3.2.2 The dynamic behavior of the "Institutional Barrier" variable of countries, ξ_j :

The second test focuses on the behavior of "Institutional Barrier." As mentioned above, we carried out two types of reforms, namely "punctual" reforms that maintain the same value of θ_j in the post-reform period until the end of the test and "continuous" reforms in which the institutional quality of the economy in question increases each period. Note, by comparing the test 2 (Figure 2) with the test 6 (Figure 6), that the reform "continuous" will

gain a more expressive quality of the relative product on the reform “punctual". Another highlight is the fact that in tests with low level of trade openness (Figures 1, 3, 5 and 7), the economy with lower quality institutional do not require reforms intense and urgent, because even on losing product, this loss is softer than if it had a greater level of openness. Thus, economies that have greater trade openness should be more concerned about the quality of their institutions, because this causes the greatest potential for greater openness. In summary, economies that have low levels of trade openness have lower perceptions of poor institutional quality, whereas economies that have high levels of trade openness, if they suffer quality loss in their institutions, should seek to carry out urgent institutional reforms or face deteriorating economies over time.

4. Conclusion

The primary objective of this paper is to discuss the relationship of the openness and the impact of institutional reforms in the participation of the product of individual countries in global output. The first test scenario would be a reform “punctual” keeping the same value of the post-reform until the end of the test; a second test would be a reform scenario "continuous", in which, each period, increases the quality of institutional economics in question.

The simulated trajectories showed that the level of trade openness is an important factor that affects institutional changes in economies. We have shown that in countries that have low levels of openness, the cost of capital is the main obstacle to economic development, because they use relatively more domestic capital goods compared with intermediate goods in their production. Furthermore, economies that have high levels of trade openness, the greater dynamic offset the problems caused by the cost of capital.

When comparing the two types of reforms, the reform "continuous" will gain a more expressive quality of the product on the reform of the "punctual”. Other conclusion is that the economies that have greater openness should be more concerned about the quality of their institutions, and economies with low level of trade openness, if its were with low institutional quality, there would be no need for reforms intense and urgent.

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