A Test of the Interruption of Foreign Borrowing on a Target Small Open Economy

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Abstract

This paper examines a simple open economy version of both the Solow and the Ramsey growth models. In addition, it undertakes a linear intervention analysis to examine the effect of the financial embargo on the time path of the economic growth rate of South Africa. Based on both the theoretical and the empirical models, the writer concludes that the financial embargo of 1986-1991 on South Africa had only a temporary negative effect on the time path of the economic growth rate of the country.

Keywords

International economic growth; exogenous growth models; economic sanctions; South Africa.

INTRODUCTION

This paper examines the effects of the interruption of foreign borrowings as an external shock on the time path of the economic growth rate of South Africa; a special case of a small open economy. In this paper the researcher examines the open economy version of both the Solow and the Ramsey models. In addition, the researcher also undertakes linear intervention analysis to examine the effect of the financial embargo on the time path of the economic growth rate of South Africa until 2000. Based on both the theoretical and the empirical models, the paper concludes that financial embargo of 1986-1991 on South Africa has had a temporary negative effect on the time path of the economic growth rate and the economy will be sustained in the long run. This paper is expected to add to the literature of economic sanctions on South Africa because it is the first study of *its type* that examines the effect of an external shock; more specifically a financial embargo on the dynamic of the economy of South Africa.

The paper first presents a framework of relevant theoretical models, followed by an intervention analysis to examine the effect of financial embargoes of 1986-1991 exogenously on the time path of the economic growth of South Africa until 2000.

THE THEORETICAL FRAMEWORK

Assuming firms produce a single commodity Y by means of capital K and labor N, and that technology effects comprise a Cobb-Douglas function with constant return to scale:

$$Y = K^{\alpha} N^{1-\alpha}, \qquad (2\text{-}1)$$

That domestic residents save a certain fraction of their income…

$$S = s.\ (Y - r_w D), \qquad (2\text{-}2)$$

With perfect capital mobility, the interest rate under the autarky r equals the interest rate paid on foreign debt r_w….

$$r = r_w, \qquad (2\text{-}3)$$

The current account deficit, B equals the net exports X plus the interest outflow $r_w D$….

$$B = -X + r_w D = -X + rD, \qquad (2\text{-}4)$$

Foreign borrowing B adds to the foreign debt D….

$$\dot{D} = B, \qquad (2\text{-}5)$$

Investment adds to the stock of capital….

$$\dot{K} = I, \qquad (2\text{-}6)$$

And neglecting the technological progress and the depreciation rate to simplify discussions….

$$n > r_w s, \qquad (2\text{-}7)$$

Equation (2-7) is the stability condition for the steady state.

In the Ramsey model, a household maximizes utility within an infinite horizon….

$$\max U_0 = \int_0^{\infty} e^{-\rho t} \ln (C).\ dt,$$

Subject to:

$$\dot{D} = C + I + r_w D - F(K,N) \qquad (2\text{-}8)$$

$$\dot{K} = I$$

$$\lim_{t \to \infty} e^{-\rho t} D = 0,$$

Superscript *t* is eliminated to reduce notation.

And a logarithmic utility function is used to simplify the analysis. If we impose an installation cost to the analysis, so equation (2-8) becomes,

$$\dot{D} = C + I\,[1 + T(I/K)] + r_w D - F(K,N) \qquad (2\text{-}8)'$$

Let $T(0)$, the installation function have the properties of the installation function according to Blanchard and Fischer (1996), P. 59[i]

The transitional dynamics of the effect of the financial embargo of 1986-1991 on the economic growth of South Africa

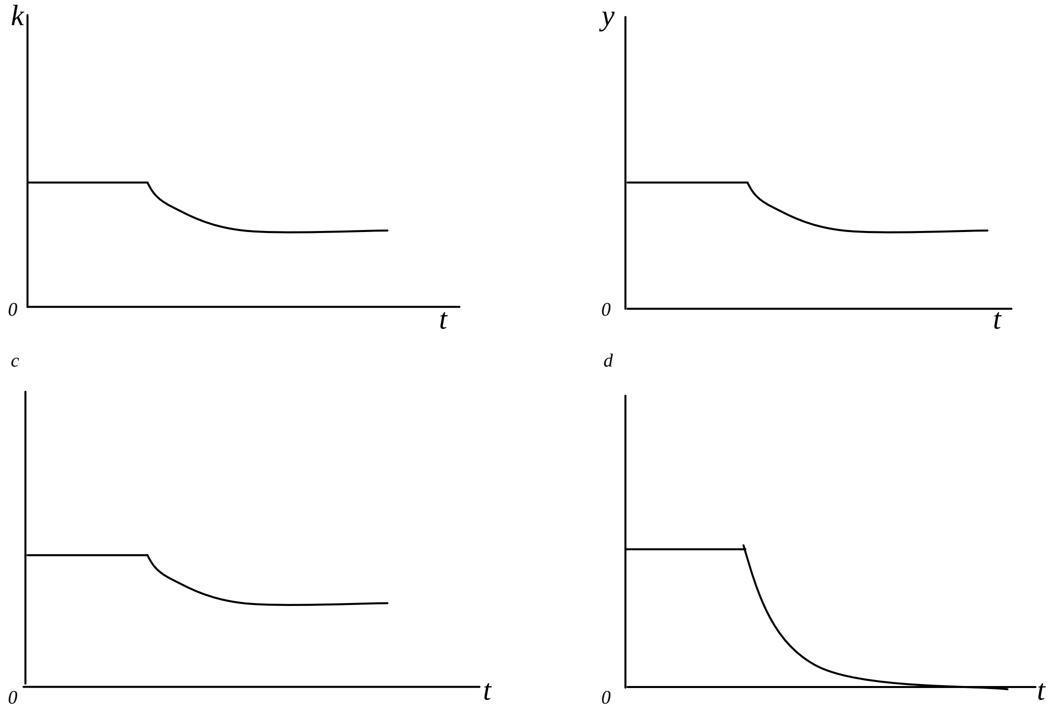
a) The transitional dynamic in the simple open economy version of the Solow model:

At the beginning, the economy is in steady state. There exists perfect capital mobility. Per capita capital stock and per capita foreign debt are constant. Then, suddenly, lenders impose a financial embargo. More exactly, the foreign borrowing will be zero $b = -x + rd = 0$[ii].

In the transitional period, $i=\dot{d}+ nd+s(y-rd)$. After imposing the financial embargo,
$b = 0$ then $d + nd = 0$[iii], then $i = s(y-rd)$.

Thus after imposing the financial embargo i decreases from $i = b + s(y-rd)$ to $i = s(y-rd)$. Per capita capital stock next period will decrease. Per capita output next period will decrease[iv]. Per capita income will decrease as well. This will lead to a reduction in the per capita consumption and saving. The decrease in the per capita capital stock leads to an increase in the marginal product of capital. This may attract more foreign capital[v]. However, with the persistence of the financial embargo, it will be no new inflow of foreign capital. Eventually the economy approaches a new steady state[vi]. Per capita capital stock stops to adjust $dk/dt = 0$. Per capita capital stock, per capita output, and per capita consumption have stabilised at lower levels. Per capita debt becomes zero. The same effect will happen to per capita net exports[vii]. Figure *2.1* illustrates this mechanism.

Figures 2.1: The effect of the financial embargo on the per capita variables in the long run



Thus, the interruption of foreign borrowing has no effect on the long run economic growth rate in the small open economy version of Solow model with perfect capital mobility. Any change on the economic growth rate will be in the short run only. Preventing any new foreign borrowing will lead to: per capita capital stock, per capita output, and per capita consumption will settle down in the long run whereas per capita foreign debt is eliminated. The new steady state is the steady state of the closed economy. Yet, in the case of South Africa, the financial embargo has been imposed from 1986 to 1991. Then, after imposing the financial embargo and according to the above analysis, investment will decrease as a result of the interruption of foreign borrowing and then the capital stock will be affected negatively in the following period. Same effect will happen to the output and to the income and then consumption and saving will decrease. This process will continue until the end of the embargo. In the end of the embargo in 1991 and according to our theoretical analysis, the increase in the marginal product of capital from one side and the gradual openness for foreign capital inflow from the other side will attract more foreign capital to the country. Foreign debt will be accumulated gradually. Investment will start to increase and then capital in the next period will increase. Output and income will increase as well. Consumption and saving will also increase. The economy will return back to its open economy position after the end of the embargo. This analysis is explained in detail below as part of the examination the effect of the embargo of 1986-1991 on South Africa on the time path of the economic growth of the country.

b) The transitional dynamic in the simple open economy version of the Ramsey model:

If the installation cost for investment is zero and $n > 0$, then a one-time increase in per capita foreign debt leads to a one-time increase in per capita net exports and a one-time increase in per capita consumption and with $n > r_w.s$, saving will increase for a one-time period only. The adjustment will be relatively static since the momentary equilibrium is the same as the equilibrium in the steady state as we saw in figure 2-2.[viii] Yet, if the installation cost for investment is higher than zero, then the transitional dynamic of the financial embargo will be different. Figures 2-2 and 2-3 illustrate the effect of both the permanent financial embargo and the temporary financial embargo consecutively.

According to the previous figures and assuming that the economy is in the saddle path in the beginning, perfect capital mobility does exist, and per capita capital stock and per capita foreign debt are constant. Then, suddenly, lenders impose a financial embargo. More exactly they interrupted totally the foreign borrowing of the debtor, and then per capita net exports will cover exactly the interest payment. In the transitional period, the investment will reduce. As figure 2-7 shows, the interruption of foreign borrowing shifts the $(dq/dt = 0)$ locus to the left since the shadow price of capital q is a function of the rate of investment. The steady state of the economy shifts from E to E'. The new steady state per capita capital stock is lower than the initial steady state per capita capital stock. The new saddle path is ss'. With the initial capital stock given by k^*, the path of adjustment is composed of a jump at time 0 from E to A, and a movement over time from A to E'. The rate of investment is negative on the adjustment path, returning to zero as the economy moves to the new lower steady state per capita capital stock. Intuitively speaking, the first jump from E to $\boldsymbol{A}$ is a result of receiving new information of a financial embargo at time 0, the shadow price of capital q decreases from E to A, investment ratio becomes negative. Capital decumulates. The marginal product of capital in production will increase. In the same time, the marginal cost for disinvestments decreases sine the installation cost depends on the ratio of investment to capital. As a result, the shadow price of capital *q* increases along the adjustment path until it reaches 1 with a zero investment ratio at a new lower steady state of per capita capital stock.

Figure (2-2)
The effect of a sudden permanent financial embargo shock on Dynamics of investment and capital.

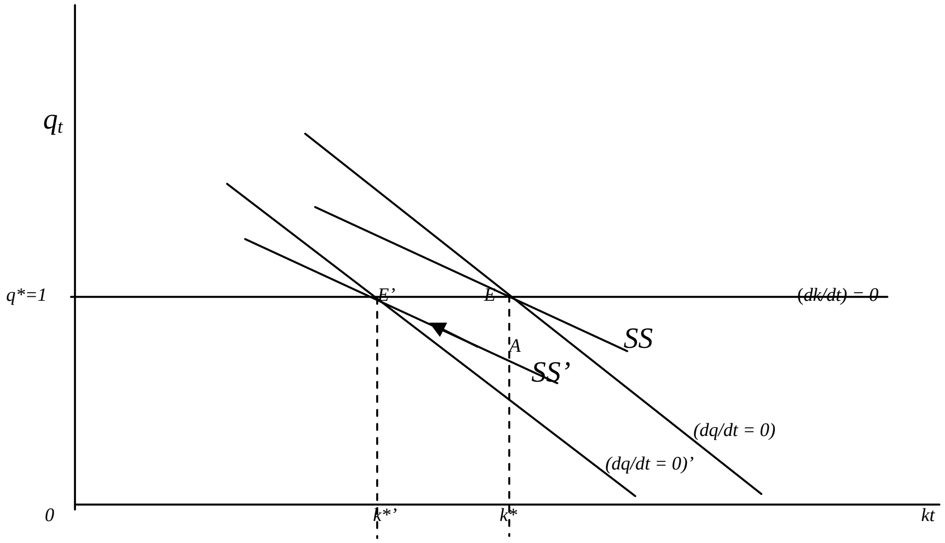
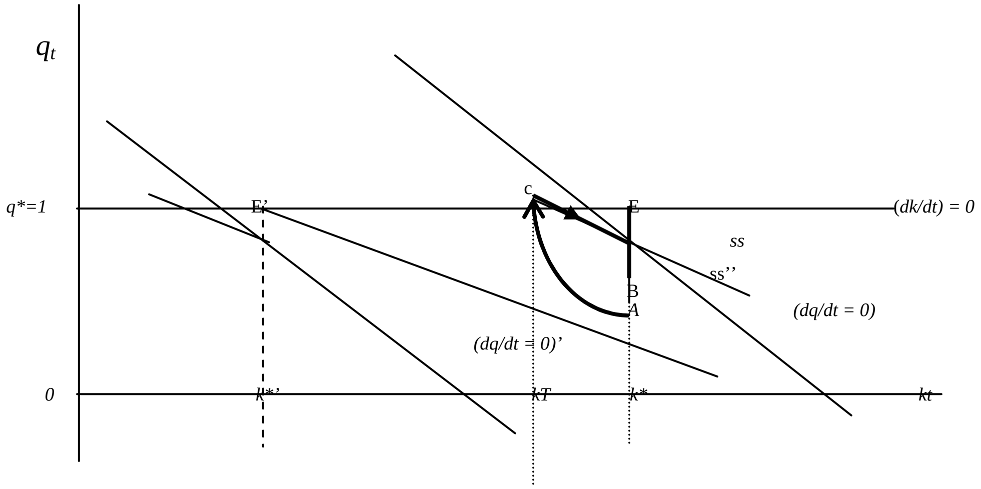


Figure (2-3)
The effect of a sudden temporary financial embargo on Dynamics of investment and capital.



Thus, a sudden permanent financial embargo leads to a permanent reduction in per capita capital stock. Per capita output must be at lower level in the new steady state. In addition, and according to figure 2-7, the present discounted value of current and future trade surplus is zero.

The discounted values of the two areas *DCN* and *ANB* must be equal and opposite in sign. The new level of consumption is determined by the same condition that the present value of the hatched area above and below it is equal and since foreign borrowing becomes zero as a result of imposing the financial embargo, interest payment becomes zero in the long run.

On the other hand, and according to figure *2-3*, at the beginning, the economy is assumed to be in the stable path. There exists perfect capital mobility. Per capita capital stock and per capita foreign debt are constant. Then, suddenly, lenders impose a financial embargo that is expected to be temporary. More exactly, the foreign borrowing will be zero for a determined period of time and then targeting lenders will lift the embargo in the end of this period. Agents understand at time *0* that the change is only for the duration of the period *(0,T)* so that at time $T > 0$, when lenders end the embargo, this action has been fully anticipated and there is no surprise. Then the analysis will include two types of financial shock: first, a sudden financial embargo at time *0* for the duration of the period *(0,T)*. Second, a fully anticipated lifting the embargo at time *T*. As soon as the interruption of the foreign borrowing occurs, ($dq/dt = 0$) locus shifts to the left since the shadow price of capital q_t is a function of the rate of investment. The stable path *SS* will shift down too instantaneously and temporarily to *SS'*. The shadow price q_t decreases to the point *B*, which lies above *SS'*. The rate of investment becomes negative. Per capita capital stock decumulates and that q_t begins to increase. The process follows the path *BC* in figure *(2-3)*. At time *T*, when the financial embargo is lifted, with no information being received since the time of lifting the embargo is announced before and no further jump will happen. The stable path relevant for subsequent adjustments in q_t and k_t beyond time *T* is the path ss, the original stable path. After time *T*, the q_t and k_t follow the stable path *CE* in figure *(2-3)* to the original steady state equilibrium at *E*. At E, the shadow value q_t reverts to *1*, but with the same stock of per capita capital.

Thus, the temporary fully interruption of foreign borrowing will not affect the per capita capital in the long run and also, it will not affect economic growth in the long run.

Empirically speaking and according to the data of South Africa, the international embargo of the mid-1985 was temporary in its nature, thus it should be also temporary in its effect on the economy of South Africa according to the above theoretical analysis.

EFFECTS OF FINANCIAL EMBARGO ON ECONOMIC GROWTH: EVIDENCE FROM SOUTH AFRICA TIME SERIES

Using an intervention models and time series data from 1970 to 2000, this section provides a test of whether the financial embargo imposed on South Africa from 1986 to 1991 has had a significant effect on the time path of the economic growth of the country. The results indicate an evidence of only a temporary negative impact of embargoes on South Africa economic growth.

Data

The main variables of interest:

- The economic growth rate of South Africa (*growth*), where *growth* equals the difference between the logarithm of per capita GDP in the current period and the logarithm of per capita GDP in its previous period.

- The change in per capita foreign debt of South Africa over time *ddot*. Where *ddot* equals the difference between the per capita foreign debt in the current period and the per capita foreign debt in its previous period.

The data for *growth* and *ddot* are from 1971 to 2000. The data for both variables are deflated using the GDP deflator, with 1995=100 as in the *International Financial Yearbook (2001).*[ix] All values are in millions of Rand.

The empirical results

The empirical study comprises several steps:[x]

First a test for the unit roots of the relevant variables; *growth* and *ddot*, followed by a linear intervention analysis to examine the effect of the sanctions against South Africa on each of the variables in question. The general form of the model estimated for each variable is

$$Y_t = a_0 + A(L)Y_{t-1} + c_0 Z_t + B(L)\,\varepsilon_t\,, \tag{3-1}$$

Where Z_t is the dummy variable that presents the financial embargo of 1986-1991; emb_t,

$$emb_t = \begin{cases} 1 & 1986 \le t \le 1991 \\ 0 & \text{Otherwise} \end{cases}$$

Second, the addition to the model of a pulse dummy variable to control the spike of 1985 that appears in the data.[xi] The modified model for the variables is….

$$Y_t = a_0 + A(L)Y_{t-1} + c_0\, emb_t + c_1\, spike_{1985} + B(L)\,\varepsilon_t\,, \tag{3-2}$$

$$Spike_{(1985)} = \begin{cases} 1 & 1985 \\ 0 & \textit{Otherwise} \end{cases}$$

Third, a repeat of the third step, excluding the period before 1980 that includes the instable period of the Soweto uprising in South Africa (1976-1979).

Finally, an examination of the effects of the embargo on the time path of each variable and an explanation of the results. Table (3-1) summarizes the final results.

From Table (3-1) below, it can be concluded that, the embargo has had a significant negative effect on the time path of *ddot* in both periods of analysis; however, it has significant negative effect on the time path of the economic growth rate of South Africa in the second period of analysis only. All best fit intervention models exhibit convergence after the end of the embargo since the summation of ε s equates to zero for all models.

According to each best-fit intervention equation for the above variables in Table (3-1), the embargo affects only the intercept parameter of each equation. It shifts the intercept parameter downward and then the intercept parameter returns back to its initial level after the end of the embargo. The forecast of each best-fit intervention model confirms this finding.

Hence, the embargo that is imposed against South Africa during the period (1986-1991) is temporary in its nature and temporary in its effect on the economic growth rate of South Africa.

Table (3-1)
Best-fit intervention model for *growth* and *ddot* during the period (1976-2000) and (1983-2000)

	Growth		Ddot	
Sample	1976-2000	1983-2000	1976-2000[xii]	1983-2000[xiii]
C	0.003845 (0.409949) (0.6860)	0.004938 (0.981966) (0.3440)	36.58940 (2.99687) (0.0069)	42.43285 (11.21384) (0.0000)
Embargo$_t$	- 0.031476 (-1.42009) (0.1703)	-0.024655 (-2.05505) (0.0605)	-74.2697 (-2.6339) (0.0155)	-78.99176 (-9.15949) (0.0000)
Spike$_{1985}$	0.792923 (19.36413) (0.0000)	0.760037 (20.73601) (0.0000)	136.5567 (2.70851) (0.0132)	87.21619 (2.510806) (0.0249)
ε_{t-1}				-0.891870 (-5.88158) (0.0000)
ε_{t-2}		-0.687560 (-5.04972) (0.0002)		
ε_{t-5}	- 0.911874 (-25.0713) (0.0000)	-0.979866 (-3302.49) (0.0000)	-0.86507 (-20.749) (0.0000)	
AIC	-6.420336	-6.334584	7.795281	7.457802
SC	-6.222859	-6.087259	7.990301	7.655662
Adj R^2	0.953026	0.957095	0.525023	0.692608

- Residuals approximate white noise at lags from 1 to 12 in Q-statistic for all models.

SUMMARY AND CONCLUSION

The open economy versions of both the Solow model and the Ramsey model have been used to examine the effect of the financial embargo on the time path of the economic growth rate of South Africa. The theoretical analysis concluded that the growth will not be affected in the long run according to the stability of the saddle path in both models. The linear intervention analysis supported these assumptions and found only a temporary negative effect of the embargo of 1986-1991 on the time path of the economic growth rate of South Africa until 2000. The best fit intervention models exhibited convergence in the long run. Thus both the theoretical and empirical analyses show evidence of sustainability in the long run. The reasonable interpretation of this result is that the embargo provided a significant external shock to the economy in the short-term but not in the longer-term.

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NOTES

[i] *“The installation cost is nonnegative and convex, with a minimum value of zero when investment is equal to zero: both investment and disinvestment are costly.” Blanchard and Fischer (1996), p.g. 59*

[ii] $x = rd \neq 0$.

[iii] *Where* $d = b - nd$, *then* $b = d + nd$ *and then* $d = 0$ *in the steady state, then nd will be zero after imposing the embargo. If we apply the case of South Africa, we find that South Africa stopped to pay interest payment as a result of imposing the financial embargo on it.*

[iv] $y = k^{\alpha}$.

[v] *Since with competitive markets* $r = f'(K)$. *Now there is no perfect capital mobility any more and the domestic interest rate will differ from the foreign interest rate.*

[vi] *In the new steady state,* $s.f(k) = nk$, *the same steady state in the closed economy since* $r_w d$ *will become zero. Per capita net exports will become zero too. Per capita foreign debt is vanished since there is no accumulation of per capita foreign debt.*

See Hufbauer & others, 1990, p.g. 70. And Kaempfer and Lowenberg, 1992, p.g. 80.

[vii] *Since, per capita debt will vanish in the long run and rd will vanish as a result.*

[viii] *See Carlberg, Ibid for this point.*

[ix] *Walt and Wet (1993) also deflated all their data using the GDP deflator and measured all variables in Rand.*

[x] *Version 3.1 and 4.1 of E-VIEWS are used for all the empirical work.*

[xi] *The measure of the report for the GDP deflator is changed from 1985, hence, I had to control for change in order to avoid any biased result.*

[xii] *When we excluded the year of 2000, the result did not change. The year of 2000 did affect the analysis.*

[xiii] *When we excluded the year of 2000, the result did not change. The year of 2000 did affect the analysis.*