McKinnon's Complementarity Hypothesis: Empirical Evidence for the Arab Maghrebean Countries

Amaira Bouzid[1]

This study aims to verify the financial repression theory's assumptions for the Arabic Maghrebean countries during a time period ranging from 1973 to 2003. First, the interest rates in the Arab Maghrebean countries were regulated. Moreover, the low and administered interest rate discourages savings, retards the efficient allocation resources, increases the segmentation of financial markets, constrains investment and in term lowers the economic growth rate. This paper is to provide empirical evidence concerning neoliberal hypothesis for Tunisia, Algeria and Morocco. The money demand and investment function are estimated in static long-run formulations (cointegration regression) as well as in the dynamic formulation (VECM).

Keywords: Neo-liberal Hypothesis, Cointegration Test, Vectoriel Error Correction Model, Arab Maghrebean Countries
JEL Classifications: E44, F43, G18, O16

[1] **Amaira Bouzid,** University of Tunisia, email: am_bouzid@yahoo.fr

1.Introduction

In 1973, R. I. McKinnon and E. S. Shaw are argued that the repressed financial markets (low and administered interest rates, domestic credit controls, high reserve requirements and concessional credit practices) discourages savings, retards the efficient allocation resources, increases the segmentation of financial markets, constrains investment and in term lowers the economic growth rate. The essential message of the McKinnon-Shaw thesis is that a low or negative real rate of interest discourages savings and hence reduces the availability of loanable funds, constrains investment, and in turn lowers the rate of economic growth.

On the contrary, an increase in the real interest rate may induce the savers to save more, which will enable more investment to take place and which would exert a positive effect on the economic growth. This idea was adopted by great international institutions such as the International Monetary Fund (IMF) and the World Bank.

Thus, many developing countries have implemented financial liberalization policies with the aim to delete the repressed regime. The financial liberalization policies were aimed at liberalizing interest rates by switching from an administered interest rate setting to a market-based interest rate determination; reducing controls on credit by gradually eliminating directed and subsidized credit schemes; developing primary and secondary securities markets; enhancing competition and efficiency in the financial system by privatizing nationalized commercial banks. This suggests a basic complementarity between the accumulation of money balances and physical capital accumulation. In the McKinnon-Shaw model, the success of the financial liberalization process depends to the following hypothesis: (i) the effective deepening of the financial sector, (ii) a positive correlation between the saving and the real interest rate, and (iii) a perfect complementarity between the money demand and investment.

The present study is organized as flows: in section II we develop the McKinnon-Shaw complementarity hypothesis. The empirical evidence (specify models and results) is presented in section III and IV. In the finally section we synthesis some conclusions and policies recommendations.

2. McKinnon's complementarity hypothesis

McKinnon-Shaw complementarity's hypothesis can be represented by the following two equations:

$$\frac{M}{P} = f(Y, \frac{I}{Y}, (d - \pi^a))$$

(1)

Equation (1) is the standard long-run real money demand function.

With Y : Real income

$\frac{I}{Y}$: Investment rate

d : Nominal interest rate

π^a : Anticipated inflation rate

$(d - \pi^a)$: Real interest rate

$\rightarrow \frac{\partial(\frac{M}{P})}{\partial Y} \rangle 0$: represents the money demand of transaction. An increase in the income generates a strong monetary detention.

$\rightarrow \frac{\partial(\frac{M}{P})}{\partial(\frac{I}{Y})} \rangle 0$: This partial derivative represents the money demand for investment. An increase of investment rate allows a strong money detention. In other words, the investment increases the monetary saving. It is an important condition of success of financial liberalization policy for the transmission of the investment to the saving.

$\rightarrow \quad \frac{\partial(\frac{M}{P})}{\partial(d-\pi^a)} \rangle 0$: a positive real interest rate allows a greater money demand.

However, McKinnon complementarity's hypothesis appears in the following investment function:

$$\frac{I}{Y} = f(r,(d-\pi^a))$$

(2)

Equation (2) is a private investment function.

r: the physical capital average current rate

Where $\frac{\partial(\frac{I}{Y})}{\partial r} \rangle 0$ and $\frac{\partial(\frac{I}{Y})}{\partial(d-\pi^a)} \rangle 0$

Thus, the complementarity's hypothesis seen in the partial derivatives following:

$$\frac{\partial(\frac{M}{P})}{\partial(\frac{I}{Y})} \rangle 0$$

(3)

And

$$\frac{\partial(\frac{I}{Y})}{\partial(d-\pi^a)} \rangle 0$$

(4)

Equations (3) and (4) suggest that it is not the cost of capital but the availability of finance that constrains investment in financially repressed economies. When the real deposit rate increases, investment increases as well because the financial constraint is relaxed. However, the traditional theory suggests the reverse, that is, that an increase in interest rate reduces investment.

For Shaw, the investment (I) is a decreasing function of real interest rate (r) and the saving is an increasing function of economic growth rate (g) and real interest rate (r):

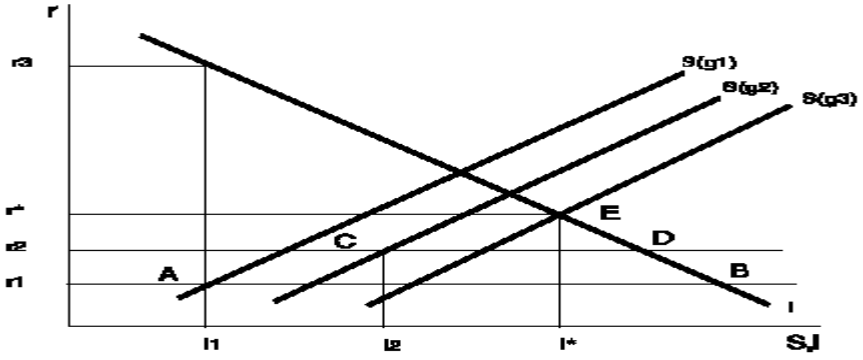
$$I = I(r) \qquad \frac{\partial(I)}{\partial(r)} \langle 0 \tag{5}$$

$$S = S(r, g) \qquad \frac{\partial(S)}{\partial(r)} \rangle 0; \quad \frac{\partial(S)}{\partial(g)} \rangle 0 \tag{6}$$

Since the McKinnon-Shaw thesis of « financial repression » appear in 1973 has simplified in figure below.

Figure 1

Financial repression, saving and investment



Source: Venet (2000)

3. The empirical methodology

The empirical specificity of McKinnon's complementarity hypothesis can be represented by the following system:

$$\begin{cases} Log\left(\frac{I}{Y}\right) = \alpha_0 + \alpha_1 Log\left(\frac{Y}{P}\right) + \alpha_2 Log\,(i-\pi) + \alpha_3 Log\left(\frac{M}{P}\right) \\ Log\left(\frac{M}{P}\right) = \beta_0 + \beta_1 Log\left(\frac{Y}{P}\right) + \beta_2 Log\,(i-\pi) + \beta_3 Log\left(\frac{I}{Y}\right) \end{cases}$$

(7)

Where $\left(\frac{I}{Y}\right)$: Investment rate

$(i-\pi)$: Real interest rate

Y: Gross Domestic Product

M: Nominal money demand

P: General Price level index

For the financial liberalization theory, the complementarity hypothesis holds true if the following partial derivatives are positive:

$$\frac{\partial(\frac{I}{Y})}{\partial(d-\pi^a)} = \alpha_2 \rangle 0 \text{ and } \quad \frac{\partial(\frac{M}{P})}{\partial(\frac{I}{Y})} = \beta_3 \rangle 0$$

The passage of the static to dynamic relations is obtained by an auto-regression model:

$$\begin{cases} Log\left(\frac{I}{Y}\right)_t = \alpha_0 + \sum_{j=0}^{n} \alpha_j X_{t-j} + \sum_{i=1}^{p} \phi_i Log\left(\frac{I}{Y}\right)_{t-i} \\ Log\left(\frac{M}{P}\right)_t = \beta_0 + \sum_{j=0}^{n} \beta_j Z_{t-j} + \sum_{i=0}^{m} \gamma_i Log\left(\frac{M}{P}\right)_{t-i} \end{cases}$$

(8)

With $X_t = \{ Log\left(\frac{Y}{P}\right)_t, Log\left(\frac{M}{P}\right)_t, Log(i-\pi)_t \}$

$Z_t = \{ Log\left(\frac{Y}{P}\right)_t, Log\left(\frac{I}{Y}\right)_t, Log(i-\pi)_t \}$

The long term elasticities for the system (8) are as follows:

$\sum\alpha_j \Big/ \left(1-\sum\phi_i\right)$ and $\sum\beta_j \Big/ \left(1-\sum\lambda_i\right)$

In terms of the first differences, rewritten as:

$$\begin{cases} \Delta\, Log\left(\frac{I}{Y}\right)_t = \alpha_0 + \sum_{i=0}^{n} \alpha_i \Delta X_{t-i} \\ \Delta\, Log\left(\frac{M}{P}\right)_t = \beta_0 + \sum_{j=0}^{p} \beta_j \Delta Z_{t-j} \end{cases}$$

(9)

In addition, lagged residuals from the cointegration regression are also included set of explanatory variables-this term is referred to as an ECM term- the statistical significance of the ECM term is that it measures the deviation of the dependant variable from its long-run trend. In other words, it represents the self-correcting mechanism of the system for deviation from its long-run trend. The general form of the ECM is as follows:

$$\begin{cases} \Delta\, Log\left(\frac{I}{Y}\right)_t = \alpha_0 + \sum_{i=0}^{n} \alpha_i \Delta X_{t-i} + \gamma_i ECM_{t-1} \\ \Delta\, Log\left(\frac{M}{P}\right)_t = \beta_0 + \sum_{j=0}^{p} \beta_j \Delta Z_{t-j} + \gamma_j ECM_{t-1} \end{cases}$$

(10)

Where ECM is the error correction model term

$$\Delta X_t = \left\{\Delta\, Log\left(\frac{Y}{P}\right)_t, \Delta\, Log\left(\frac{M}{P}\right)_t, \Delta\, Log\,(i-\pi)_t, \Delta\, Log\left(\frac{I}{Y}\right)_{t-1}\right\}$$

$$\Delta Z_t = \left\{\Delta\, Log\left(\frac{Y}{P}\right)_t, \Delta\, Log\left(\frac{I}{Y}\right)_t, \Delta\, Log\,(i-\pi)_t, \Delta\, Log\left(\frac{M}{P}\right)_{t-1}\right\}$$

4. Tests and results

The first step toward testing the complementarity hypothesis of McKinnon is to determine the order of integration of all the variables used in the analysis.

Unit root tests

The ADF class of unit root tests is applied to the first difference of each variable for the period 1973–2003. As shown in table 1, the ADF tests applied to the first difference of the data series reject the null hypothesis of non stationarity for all the variables used in the analysis. The calculated values for the ADF tests are found to be less than the critical values at the 1% level, which suggests that the order of integration for all the variables is unity (*I*[1]); that is, that all series are stationary in first difference with the exception of the real money demand (Morocco) and the growth rate of real per capita income (Morocco and Tunisia), which are indeed *I*(0).

Table 1

Unit Root Tests for Relevant Variables, 1973-2003

Algeria

Variables	Levels			First Differences			Order
	DF	DW	R^2	DF	DW	R^2	
Log (I/Y)	-0.60	2.02	0.01	-6.26	1.69	0.64	1
Log (Y/P)	0.76	1.96	0.21	-2.20	1.86	0.22	1
Log (M_1/P)	-1.47	2.16	0.16	-5.37	2.01	0.68	1
Log (M_2/P)	-1.19	2.00	0.08	-5.52	2.06	0.61	1
Log (d-π)	-1.19	2.17	0.47	-2.89	2.23	0.82	1

Morocco

Variables	Levels			First Differences			Order
	DF	DW	R^2	DF	DW	R^2	
Log (I/Y)	0.06	2.04	0.04	-4.78	2.20	0.52	1
Log (Y/P)	3.25*	2.00	0.28	-3.39	2.21	0.71	1
Log (M_1/P)	-1.39	2.19	0.31	-5.45	2.13	0.77	1
Log (M_2/P)	3.47*	2.46	0.08	-1.64	2.29	0.36	1
Log (d-π)	-1,16	1,58	0,09	-7,57	1,39	0,77	1

Tunisia

Variables	Levels			First Differences			Order
	DF	DW	R^2	DF	DW	R^2	
Log (I/Y)	-0.25	1.93	0.10	-3.72	2.04	0.38	1
Log (Y/P)	3.77*	2.04	0.00	-2.04	2.17	0.41	1
Log (M_1/P)	-1.57	2.06	0.29	-5.41	2.06	0.77	1
Log (M_2/P)	-1.56	2.10	0.17	-5.12	2.13	0.69	1
Log (d-π)	-0.68	2.39	0.10	-6.72	2.20	0.77	1

Critical values tests DF: 1% -2,71
5% -1,97
10% -1,62

Cointegration tests

The cointegration regression of the investment functions and demand of money functions are estimated with ordinary least squares (OLS), and the results are reported in the Table 2.

The multivariate regression of real money demand with real income, real interest rate and investment rate as arguments are found to be cointegrated (see equation 4, Algeria). For investment functions as arguments are found to be cointegrated for Algeria and Morocco (see equations 2 and 1, respectively).

Table 2

Cointegration tests

Cointegration tests, data static, *Algeria*

Equations	Variables	Constant	Log (Y/P)	Log (d-π[a])	Log (I/Y)	Log(M_1/P)	Log(M_2/P)	R^2	DW
1	Log (I/Y)	-15.99	3.47	0.01		- 0.43		0.08	1.68
2	Log (I/Y)	6.48	- 0.50	- 0.01			0.04	0.01	1.44
3	Log(Mi/P)	-44.25	8.02	0.04	- 0.18			0.97	2.34
4	Log(M_2/P)	-59.29	9.67	0.04	0.03			0.97	2.80

Cointegration tests, data static, Morocco

Equations	Variables	Constant	Log (Y/P)	Log (d-π^a)	Log (I/Y)	Log(M_1/P)	Log(M_2/P)	R^2	DW
1	Log (I/Y)	5.12	- 0.12	- 0.005		0.036		0.29	0.99
2	Log (I/Y)	4.43	0.006	- 0.004			-0.052	0.31	1.01
3	Log(Mi/P)	-31.22	6.87	0.09	- 0.42			0.91	1.70
4	Log(M_2/P)	-32.14	7.11	0.08	- 0.68			0.91	1.73

Cointegration tests, data static, Tunisia

Equations	Variables	Constant	Log (Y/P)	Log (d-π^a)	Log (I/Y)	Log(M_1/P)	Log(M_2/P)	R^2	DW
1	Log (I/Y)	4.12	0.54	0.038		- 0.219		0.23	0.82
2	Log (I/Y)	3.18	0.57	0.035			- 0.182	0.24	0.81
3	Log(Mi/P)	-2.46	3.58	0.156	- 0.59			0.91	0.57
4	Log(M_2/P)	-7.79	4.49	0.173	- 0.78			0.91	0.46

Dynamic Vectoriel Error Correction Model

The results of the VECM are showed the coefficients of the ECM term in the investments functions are fairly stable (-0,68) and statistically significant for Algeria. This finding is not checking for Morocco and Tunisia. Although, the coefficients bear are positive sign and statistically none significant.

The coefficients of the ECM term in the money demand functions are negative sign (-0,50 and -0,37 respectively) and statistically significant for Tunisia, but is not checking for Morocco and Algeria.

The statistical significance of this coefficient indicates that market forces are in operation to restore long-run equilibrium following a short-run disturbance due to the introduction of recent financial-sector reforms.

5. Conclusion

The objective of this paper is to examine empirical analysis concerning McKinnon-Shaw complementarity's hypothesis for Arab Maghrebean countries to using annual time-series data for the period

1973 to 2003. The coefficients of the investment ratio in the money demand function (M_2/P) are positive only for Algeria (equation 4). An increase in the real interest rate would lead to accumulate of the money balances. Our findings are confirmed with Laumas (1990), Thornton (1990), Thornton and Poudyal (1990).

Concluding, McKinnon-Shaw complementarity hypothesis are checked only for Algeria, but are not checked for Morocco and Tunisia. Thus, the fundamental results show that the hypothesis are valued, if the financial system is good developed and structured.

References

Beck T., Demirguç-Kunt A. and Levine R. (2000): « A New Database on Financial Development and Structure », *World Bank Economic Review*, 14(3), pp: 597-605.

Burkett P. et Dutt A.K. (1991): « Interest Rate Policy, Effective Demand and Growth in LDC's », *International Review of Money Finance and Banking*, n°1/2, pp: 127-153.

Demirguç-Kunt A. et Levine R. (1996a): « Stock Markets, Corporate Finance, and Economic Growth: an Overview », *the World Economic Review*, vol. 10, N°2.

Dutt A.K. (1991): « Interest Rate Policy in LDC's: A Post Keynesian view », *Journal of Post Keynesian Economics*, winter 1990-1991, Vol. 13, n°2, pp: 210-232.

Gablis V. (1977): « Financial Intermediation and Economic Growth in less developed countries: A theoretical Approach », *Journal of Development Studies*, Vol13, n°2, Janvier 1977, pp 58-72.

Galindo A., Schiantarelli F. and Weiss A. (2003): « Does Financial Liberalization Improve the Allocation of Investment? Micro Evidence from Developing Countries», *Working Paper* 503, October, 55p. http://fmwwww.bc.edu/ec-p/wp503.

Galindo A., Micco A. et Ordonez G. (2002): « Financial Liberalization and Growth: Empirical Evidence », *Inter-American Development Bank*, March 2002, 31p.
Granger C. W. J. and Newbold P. (1974): « Spurious Regression in Econometrics», *Journal of Econometrics* 2, pp: 111–20.
Kaminisky G. and Schukler S. (2003): « Short-Run Pain, Long-Run Gain: The Effects of Financial Liberalization», *Working Paper 9787*, 33p. http://dsl.nber.org/papers/w9787
Kapur B. (1976): « Alternative Stabilization Policies for Less-Developed Economies», *Journal of Political Economy*, Vol 84, n°4, Août, pp. 777-795.
King R. and Levine R. (1993a):« Finance, Entrepreneurship and growth: Theory and Evidence», *Journal of Monetary Economics*, Vol. 32, n°3, pp 513-542.
Mac Kinnon RI. (1973): «Money and capital in economic development », *The Brookings Institution*, Washington.
Mathieson DJ. (1979): «Financial Reform and Capital Flows in a Developing Economy », *IMF Staff Papers*, Vol 26, n°3, September, pp: 450-489.
Mathieson DJ. (1979): «Financial Reform and Stabilization policy in a Developing Economy », *Journal of Development Economics*, Vol 7, n°3, September, pp: 359-395.
Maxwell J. Fry (1978): « Money and Capital or Financial Deepening in Economic Development », Journal *of Money, Credit and Banking* 10, November, pp: 464–75.
Patrick K. W. (1992): «Savings, the Rate of Interest and Growth in a Small Open Economy: The Trinidad and Tobago Experience», *Social and Economic Studies* 41, December, pp: 1–24.
Pentti S., Helmut L. and Carsten T. (2004): «Break Date Estimation and Cointegration Testing in VA Processes with Level Shift», www.google.fr, 94p.

Prem S. L. (1990): « Monetization, Financial Liberalization, and Economic Development », *Economic Development and Cultural Change* 38, January, pp: 377–90.
Shaw E.S. (1973): «Financial Deepening in Economic Development», Oxford University Press, New York.
Thornton J. (1990): «The Demand for Money in India: A Test of McKinnon's Complementarity Hypothesis », *Savings and Development* 14, pp: 153–58.
Thornton J. and Poudyal S. R. (1990): «Money and Capital in Economic Development: A Test of the McKinnon Hypothesis for Nepal », *Journal of Money, Credit and Banking* 22, August, pp: 395–99.
World Bank (2005): World Development Indicators.