Monetary Integration In The Presence Of Heterogeneous Countries: How Much Does It Cost For Maghreb Countries?

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Abstract:

This paper tries to evaluate the likely consequences of creating a hypothetical monetary union between various Maghreb Countries[†]. More specifically, basing on an optimization exercise and giving the economic, financial and institutional structures in these countries, it attempt to assess the cost of implementing a common monetary policy conducted by a potential supranational central bank in terms of inflation and output variability.

The results show that the implementation of a common monetary policy is not beneficial, especially for Algeria where the variability of inflation and activity is more important than in Morocco and Tunisia. Thus, the creation of a monetary union would not be useful and the heterogeneity of these economies could be costly.

Keywords: Monetary transmission mechanism, monetary policy, exchange rate regimes, Heterogeneity, optimization, Maghreb

JEL Classification: E30, E37, E40, E47, E50, F30, F31, F37

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[†] We limit our analysis to Algeria, Morocco and Tunisia.

Introduction:

During the last two decades, Maghreb Countries (MC) have been engaged in a commercial liberalization process and promoted the openness of financial systems. They have gradually deregulated trade and progressively opened the financial markets to foreign investors. At the same time, and whilst monetary issues took a back seat in favor of trade and financial ones, many maghrebian actors recently expressed an interest in launching a monetary union. Indeed, the creation of a single currency and a common central bank has been two of the main concerns of the union of Maghreb banks since 2002. Moreover, since 2008, the general secretary of the Arab Maghreb Union (AMU) started to put in place a Maghreb economic and monetary community project via the completion of detailed research in collaboration with the African Development Bank (BAD).

At first glance, the idea of a monetary integration could be very useful for the MC as far as it could be accompanied by a better allocation of resources. Indeed, a zone where goods & services, capital and workers move freely could be an engine for trade, investment and growth[‡].

However, monetary unions can give rise to a number of problems and could incur significant costs for the affected countries[§]. In particular, the implementation of a common monetary policy would not be suitable for all MC given the presence of economic, financial and institutional differences between them which complicate the monetary transmission mechanism and impede policy decision processes.

The theory of optimum currency area (OCA), initiated by Mundell (1961), is considered as the main theoretical framework enumerating the criteria that ensure the success of a monetary union project. These are labour mobility, wage flexibility, trade openness, financial integration, etc[**]. Mundell's theory involved several phases, each of which was characterized by some advances and limits[††].

The main limitation of the theoretical literature of OCA is the absence of formalization. For instance, except few works[‡‡], the literature has not developed models that take into consideration the interaction between positive and negative aspects of monetary integration. Even empirical literature may be reproached for being static inasmuch as it deals only with

[‡] For a successful example of a monetary union, see the document prepared by HM treasury (2003).
[§] For a typical example such as the eurozone, see cartapanis (2010).
[**] See McKinnon (1963), Kenen (1969), Jonhson (1970), Ingram (1973), Magnifico (1974).
[††] See Mongelli (2002).
[‡‡] See McCallum (1996), Bayoumi (1994) and Ricci (1997).

short-term adjustment mechanisms which guarantee the viability of the monetary union but conceal the structural problems that could arise if a heterogeneous monetary transmission mechanism (MTM) is in action.

Accordingly, our aim here is to surpass these limits and evaluate the likely consequences of creating a hypothetical monetary union in heterogeneous countries characterized by economic, financial and institutional differences.

The rest of the paper is organized as follow. Section 1 offers an empirical illustration of the heterogeneity of Maghreb Countries via a reduced form model. Section 2 evaluates, through an optimization exercise, the cost of implementing a common monetary policy in the presence of this heterogeneity. Finally, section 3 concludes and offers main policy recommendations.

On the heterogeneity of Maghreb Countries: empirical evidence

The model:

We try to prove empirically the heterogeneity of MC by estimating an hybrid reduced form model for each country. This model is composed mainly of two equations: a demand equation (IS curve) which identifies the relationship between output gap and many other variables, and a supply equation (Phillips curve) illustrating the relationship between inflation and different regressors[§§]. It is presented as follow:

$$y_t = A(L)y + B(L)\Pi + C(L)e + D(L)B + fy_{t+1} + \eta_t \qquad (1)$$

$$\Pi_t = F(L)\Pi + G(L)y + H(L)P + K(L)e + l\Pi_{t+1} + \varepsilon_t \qquad (2)$$

Where y , π , e , B and P refer respectively to output gap, inflation deviation, nominal effective exchange rate (NEER), real money base and the Brent price[***]. $A(L)$, $B(L)$, $C(L)$, $F(L)$, $G(L)$, $H(L)$ et $K(L)$ are optimal lags which differ from one country to another[†††]. η_t and ε_t are error terms.

It is important to note that the first equation translate the effect of monetary policy, inflation and exchange rate on the real sphere. An inflation increase (decrease) is often accompanied by a decrease (increase) in demand and then in real activity. Similarly, depreciation (appreciation) of the exchange rate implies an increase (decrease) of the import prices comparing to the domestic ones which improve (decrease) competitiveness and acts positively

[§§] For more details pertaining to hybrid models, see Fuhrer (2000), Estrella et Fuhrer (2002), Rudebusch (2002) and Rudd et Whelan (2003).

[***] Except output gap and inflation deviation, all variables are expressed in pourcentage

[†††] These optimal lags are determined basing on Hannan and Quinn (HQIC) criteria.

(negatively) on output. Finally, a restrictive (expansive) monetary policy, which induces money base shortage (increase), acts negatively (positively) on the demand components and then reduces (increases) activity. We then expect Π and e associated coefficients to be positive while B coefficient proves to be negative.

However, the second equation show the way output gap, Brent price and exchange rate could act on prices. An accelerated (decelerated) demand often causes inflationist (deflationist) pressures. Similarly, an increase (decrease) of oil prices affects positively (negatively) domestic prices, especially in oil-dependent countries. Finally, an exchange rate depreciation (appreciation), resulting from an expansive (restrictive) monetary policy, bring up (down) inflationist risks. So, we expect y, P and e associated coefficients to be positive[‡‡‡].

Sources of heterogeneity:

The model allows us to find various sources of heterogeneity between countries. In particular, the demand equation describes the way monetary and exchange rate policies could influence activity, thus giving an idea about divergence of financial and economic structure.

For instance, more the economy is bank dependant, more a shift in monetary policy affects the balance sheets of banking sector and the financing conditions of enterprises, thus influencing further the activity. Similarly, following monetary impulse, bank reaction capacities prove to be limited whenever banking sector is competitive. This is because banks are "price taker" and could not influence market conditions after monetary choc.

Besides, the effect of exchange rate policy on demand depends on the structure of the economy, notably the degree of openness. More specifically, more the country is open, more an exchange rate depreciation affects competitiveness and growth.

However, the supply equation depicts the effect of demand, oil price and exchange rate on domestic inflation, thus giving an idea about divergence of productive structure and institutional frameworks.

For example, the impact of exchange rate variation on inflation translate the so-called *exchange rate pass-through* which depends on the weight of tradable sector comparing to non tradable one as well as the importance of monetary authority engagement toward price stability.

[‡‡‡] The exchange rate and the Brent price are considered as exogenous. We suppose that these variables follow an AR (1) specification.

Similarly, the effect of output on inflation depicts the market power of local stakeholders as well as labor market characteristics. Indeed, an increase in growth boosts inflation in a case where competition is low and labor market is rigid.

Data :

The series of our variables are quarterly and cover the period 1990-2010. They are extracted from IFS-IMF (2011), WDI-WB (2012) as well as Chelem-CEPII (2011) databases. All these series are stationary basing on Augmented Dickey-Fuller (1981) and Phillips-Perron (1986) tests[§§§], so we do not differentiate it in the regression.

Output gap is obtained following this methodology: first, we apply Goldstein and Khan (1976) algorithm for the annual GDP series in order to get quarterly data. Second, by using Hodrick Prescott filter, we decompose the new series into cycle and trend. Finally, we substract potential GDP from current one.

Inflation deviation is measured by the difference between Consumer Price Index (CPI) growth and an inflation target. This target is approached by a four quarter moving average inflation rate.

NEER is defined as the number of foreign unities expressed in terms of national currency. So, an increase (decrease) in this indicator is synonym of appreciation (depreciation).

Real money base is approached by the growth rate of base money in real terms. So, we obtain this variable by deflating nominal money base before calculating a growth rate.

Results:

Our model is estimated basing on « *SURE* » technique (*Seemingly Unrelated Regression Estimator*). This technique allows a simultaneous estimation of the two equations, thus taking into consideration the endogeneity of the variables and the correlation of errors.

The main results are as follows:

-Insert Table 1 about here-

[§§§] The results of stationarity tests are available upon request.

These results show that the crucial coefficients[****] are different, so that the effect of various policies (notably monetary and exchange rate policies) on activity and inflation is not homogeneous, which confirm the heterogeneity of MC.

For the extent of monetary policy on the real sphere, it is more important for the case of Algeria than that for Morocco or Tunisia. This is probably because of the specificities of financial structure in the former country which expose it more to money base variation than in the latter ones. Particularly, the small size and weakness of Algerian firms renders the effect of monetary policy on activity more important. Similarly, the absence of substitutable funds to bank financing and the low access to financial markets make the effect of monetary policy on investment and consumption more visible.

-Insert Table 2 about here-

However, the effect of money base on output gap is less important in Morocco and Tunisia (especially in the former country). This result could be linked to the dynamism that characterized the Moroccan financial market giving the opportunity to banks to attract substitutable funds to reserve deposits[††††]. It could also be linked, for the Tunisian case, to the situation of excess liquidity that characterized the banking system during the 2000's[‡‡‡‡].

-Insert Table 3 about here-

We could also noticed that, contrary to what we could obtain from countries characterized by economic openness, the effect of exchange rate variation on activity is not significant for Algeria and Tunisia while it is low and with opposite sign for Morocco. For the two formers countries, arguments linked to financial account control and absence of full money convertibility could be mentioned. We could add, for the Algerian case, other factors such as the presence of parallel exchange market and the statistical weakness. However, for the latter country, it is probably the importance of openness and the significance of foreign debt amount that make an appreciation of exchange rate beneficial for the country. Indeed, this appreciation reduces the cost of foreign products in the one hand (price effect) and decreases the debt value in the other hand (balance sheet effect) which *in fine* could acts positively on output.

[****] We concentrate on two parameters (one in each equation). The first one translates the effect of money base on activity while the second one traces the effect of activity on inflation. The other parameters are not without importance and will be analyzed briefly.

[††††] The solidity of the banking sector could also be mentioned as part of the explanation of the difference in output gap sensibility to monetary policy decisions.

[‡‡‡‡] After January 2011, the situation of the tunisian banking system was worsened and the central bank has been pushed to intervene many times to offer liquidity and to save the financial system from a systemic crisis.

-Insert Table 4 about here-

In the three countries, differences are also visible for the sensibility of inflation to output gap shifts. In fact, this sensibility is more important in Morocco while it is low in Algeria and Tunisia. An increase in the output gap accelerates inflation in the former while it does not significantly affect prices in the two latter. Such result could reflect more pronounced labor market rigidity in Morocco than that in Algeria or Tunisia. In this frame, we could remind that the power of labor union in Morocco is often linked to an harmonized relationship with government than that of a real labor conditions negotiations between influencing parties. This harmonized relationship could be a factor of labor market rigidity instead of flexibility.

The divergence of the impact of output gap on inflation could also reflect the differences of economic structures in these countries. In Tunisia for example, the weak relationship between growth and inflation could be explained by the presence of industry (semi-finished products) and services (tourism) of which the capacity adaptation to choc is important.

We could finally notice from the results that the Brent price do not constitute a significant determinant of inflation in the three countries. Two main arguments could be invoked: first, these countries are not simply oil importers but exports important quantity of crude oil, and, second, they subsidize consumption of energy products.

-Insert Table 5, 6 & 7 about here-

Finally, for the three countries, contrary to the effect of exchange rate on activity, an appreciation of the exchange rate pushes prices to decrease (especially in Morocco). The presence of this *pass-through effect* prove that, despite the absence of total financial account liberalization and full currency convertibility, the dynamic of domestic inflation depends on exchange rate shifting. This result is theoretically expected given the importance of tradable sector where the prices often align the world one after an exchange rate choc (Neaime 2008).

Monetary integration in Maghreb Countries: how much does it costs?

Methodology:

We attempt here to assess the cost of implementing a common monetary policy conducted by a potential supranational central bank in terms of inflation and output variability given the aforementioned heterogeneity of the MC[§§§§].

[§§§§] We limit our analysis to Algeria, Morocco and Tunisia.

In order to do that, we attempt first to optimize for each country a monetary policy rule which minimize a central bank loss function. This optimization exercise is based on an original program defined under *Dynare*. The objective of such exercise is to get theoretical moments and loss function value for each country (especially output and inflation variance).

Afterwards, we aggregate data[*****] and apply the same optimization method led on a national case in order to bring out a common monetary policy. This policy is applied thereafter for each country, so that we finally obtain the new theoretical moments and the final loss function value. The comparison between the two loss functions (loss function obtained from the optimization exercise based on national data and the one obtained from the aggregated data) allow us to evaluate the consequences of implementing a common monetary policy in the presence of heterogeneous countries.

The monetary rule is simple and coherent with many precepts proposed in the literature. We retain the following one[†††††] :

$$B_t = a + \varphi B_{t-1} + \alpha y_t + \beta \prod_t$$

Where a is the potential growth of the economy[‡‡‡‡‡], φ is a smoothing parameter of the monetary policy[§§§§§], α and β correspond respectively to the weight attributed to activity and inflation by the central bank[******].

Formally, in order to obtain an optimal monetary rule, we should resolve the following program:

$$\begin{cases} \min\ E(L_t) = \lambda E(\prod_t)^2 + \psi E(y_t)^2 \\ X = A(L)X + \varepsilon_X \end{cases}$$

In other words, we have to minimize a loss function given the model of the economy. Here, L is the los function and B is the monetary policy instrument (money base)[†††††††]. The system

[*****] Aggregation take into consideration each country GDP weight.

[†††††] We understand that a trade-off between efficiency and simplicity is mandatory. For Artus et al (1999), a monetary rule owes to be sufficiently simple in order to be communicated and controlled without difficulties. This means that it could probably be preferable to not introduce some variables.

[‡‡‡‡‡] This variable is approached by the average growth rate of the potential GDP.

[§§§§§] The smoothing parameter expresses the desire of central bank to avoid financial instability that could emerge from multiple variations of monetary policy instrument. It could also translate the wish of central bank to improve reputation and transparency. Therefore, we fix it at 0.8.

[******] The financial asset prices are not taken into consideration given the shallowness of the financial markets in these countries (especially in Algeria and Tunisia).

resolution allows determining the response function $B = f(X_{t-i})\ \forall\ i = 0 \ldots \infty$ where X_{t-i} is the vector of pertinent variables.

We suppose that $\lambda = \psi = 1$ which express the monetary authority identical desire to reduce either differences of inflation or output gap from their target levels.

Our monetary rule translates then the behavior of the central bank in terms of money base. Basically, monetary authorities raise their money base when the output gap decreases (situation where current production is near or inferior to potential production) and the inflation gap diminish (situation where current inflation is near or inferior to its target value). Inversely, they reduce money base when output gap increases and inflation gap deepens. So, we expect α and β coefficients to be negative.

Our optimization exercise tries to determine the value of α and β following many steps executed under *Dynare*. These steps consist of:

1. The declaration of the variables. During this step, the values obtained from the SURE estimation are attributed to each parameter;
2. The declaration of the model. During this step, all equilibrium conditions are written exactly the way we write it "by hand";
3. The computation of the deterministic steady state. During this step, we provide numerical initial conditions or approximated values and *Dynare* automatically compute the exact values;
4. The specification of the innovations and their matrix of variance–covariance. During this step, shocks are associated to the residuals obtained after model estimation;
5. The definition of the loss function, the associated central bank preferences (λ and ψ) as well as the parameters to be optimized (α and β).

Results:

Before assessing the cost of launching a monetary union in the MC where a common monetary rule is applied, it is useful to note that the optimization exercise for each country shows that both central bank of Algeria and Morocco have to react more aggressively to activity than to inflation while central bank of Tunisia have to react first to inflation then to

[††††††] In the three Maghreb countries, interest rate is not (or seldom) used to conduct monetary policy. Among the reasons explaining this fact is the absence of effective money market. For an idea about base rule specification, see McCallum (1996) and for interest rate rule, see Taylor (1993, 1998).

activity. Indeed, in the case where production corresponds to its potential value, an increase of 1% in activity pushes the central bank of Algeria (Morocco) to decrease money base about 0.12% (0.62%). Similarly, in the case where inflation corresponds to its target value, an increase of 1% in inflation pushes the central bank of Algeria (Morocco) to decrease money base about 0.07% (0.03%). However, central bank of Tunisia has to decrease money base by 0.86% (0.76%) whenever inflation (output) get away from its target by 1%.

-Insert table 8 about here-

Moreover, by aggregating data and optimizing a unique monetary policy, results show that the common central bank has to react more aggressively to inflation than to output[‡‡‡‡‡‡]. More specifically, in the case where inflation (output) corresponds to its target (potential) value, an increase of 1% in inflation pushes the central bank to decrease money base about 1.1% (0.32%).

-Insert table 9 about here-

As regards the main objective of the paper (applying the common monetary policy rule to each MC and computing the net loss function), our results show that, pursuing a monetary rule that focuses primarily on inflation prove to be detrimental, especially for Algeria. Indeed, this country is the main loser given that the net loss value is the highest among MC (+7.84 while it is about +1.18 for Tunisia and +0.01 for Morocco).

This result is probably related to economic structure issues. In fact, given that Algeria is a rental economy based on oil while Morocco and Tunisia have diversified economies, we could imagine that shocks which affect monetary union (grouping together these three countries) would be asymmetric. So, conducting a common monetary policy in the presence of heterogeneous countries is quite complicated and costly.

-Insert table 10 about here-

Conclusion and some policy recommendations:

In this paper, we attempted to assess the cost of implementing a common monetary policy conducted by a potential supranational central bank in terms of inflation and output variability given the heterogeneity of Maghreb Countries.

We illustrated first this heterogeneity through an estimation of a reduced form model containing a demand and supply equation. These estimations showed that the financial system characteristics (weight of banking sector, importance of financial markets, etc), the productive

[‡‡‡‡‡‡] Estimation results for the aggregated model are available upon request.

structure (competition degree, price inertia, firm size, etc) as well as the institutional setting (labor market characteristics, regulation extent, etc) are different across MC.

Second, we tried to evaluate the cost of applying a common monetary policy given the identified heterogeneity. To do that, we optimized a monetary rule for each country as well as a common rule for the zone taken as a whole. We applied this latter rule to each country and we observed the evolution of theoretical moments as well as central bank loss functions.

The optimization results showed that the implementation of a common monetary policy is not beneficial, especially for Algeria where the variability of inflation and activity is more important than in Morocco and Tunisia and thus the creation of a monetary union would be costly given the characteristics of each economy.

Our results refute clearly the idea that a monetary integration process in MC would be successful. For being so, this process has to be preceded by many steps completed in the short and medium-term. In that frame, these countries have to continue their gradual openness process, maintain their macroeconomic stability, strengthen their trade linkages, diversify their production, coordinate their economic policies, resolve their political problems and reinforce the AMU. Such efforts could push these countries to converge and then to form an homogeneous zone.

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Appendix:

Table 1: Estimation results for Maghreb Countries

	Algeria	Morocco	Tunisia
Equation 1			
Output gap			
L1	1.485 (0.901)	.109*** (.017)	.78*** (.055)
L2	-0.988 (0.878)	- .238*** (.035)	-.814*** (.061)
L3	1.005*** (.016)	.129*** (.018)	.896*** (.054)
F1	.253*** (.003)	.358*** (.001)	.324* (.189)
Inflation			
L1	-.069 (.59)	-.022* (.011)	.157 (.356)
L2	.349* (.57)	-.017 (.012)	-.493* (.364)
L3		-.024** (.012)	-.0406 (.376)
L4		.001 (.012)	.422 (.337)
Exchange rate			
L1	-.065 (.231)	-.013 (.014)	.123 (.21)
L2		-.003 (.014)	.32 (.194)
L3		.025*** (.011)	-.259 (.200)
Money Base			
L1	.489 (.23)	.001 (.003)	.050*** (.025)
L2	.311 (.248)	.0002 (.003)	.046* (.027)
L3	.321 (.223)	.001 (.003)	.052** (.026)
L4	.495*** (.224)	.005** (.002)	-.013 (.026)
Intercept	.224*** (.045)	-.002* (.001)	.041*** (.006)
Observations	79	79	79
R^2	0.97	0.97	0.91
Equation 2			
Inflation			
L1	.239*** (.103)	-.123 (.107)	.396*** (.105)
L2	-.033 (.103)	-.123 (.11)	.575* (.103)
L3		.034 (.113)	-.305*** (.106)
L4		.115 (.107)	.248*** (.098)
F1	.316*** (.100)	-.164* (.106)	.384*** (.098)

Output gap			
L1	-.004 (.003)	-.142 (.159)	-.029*** (.014)
L2	.009* (.006)	.283* (.195)	.003 (.018)
L3	-.004 (.003)	-.142 (.166)	.034*** (.014)
Brent			
L1	.002 (.017)	-.006 (.007)	.001 (.003)
L2	-.013 (.016)	.004 (.006)	-.002 (.003)
Exchange rate			
L1	-.02 (.044)	.096 (.136)	.014 (.064)
L2	-.067 (.042)	.22 (.134)	-.171*** (.058)
L3	-.103*** (.0404)	-.252*** (.106)	.078 (.058)
Intercept	.0265*** (.008)	.0236** (.013)	.004*** (.001)
Observations	79	79	79
R^2	0.48	0.25	0.49
Equation 3			
Exchange rate			
L1	.317*** (.102)	.418*** (.100)	.121* (.090)
Constante	-.012* (.006)	.001 (.0009)	-.004*** (.001)
Observations	79	79	79
R^2	0.1	0.17	0.015
Equation 4			
Brent			
L1	.182* (.107)	.201** (.107)	.208** (.107)
Intercept	.0189 (.015)	.0184 (.015)	.018 (.015)
Observations	79	79	79
R^2	0.04	0.04	0.04

*Values in Brackets are standard errors. ***, **, * represent respectively 1%, 5% and 10% significance level.*

Table 2: Some indicators of direct financing in Algeria (1999-2010)

	1999	2008	2010
Number of listing firms	2	2	3
Market Capitalization (in % of GDP)	0.0059	0.002	0.008
Turnover ratio	0.12	0.10	-

Source : FEMISE (2009), COSOB (2010)

Table 3: Some indicators of direct financing in Morocco and Tunisia (1999-2010)

	Maroc			Tunisie		
	Market Capitalization (in % of GDP)	Turnover ratio	Number of listing firms ***(in % of population)***	Market Capitalization (in % of GDP)	Turnover ratio	Number of listing firms ***(in % of population)***
1996	20.01	5.15	0.01	20.56	5.42	0.03
1999	34.79	9.07	0.01	10.34	6.92	0.04
2001	31.87	8.64	0.01	12.02	21.29	0.04
2003	22.24	6.29	0.01	9.61	9.15	0.0
2005	34.53	8.44	0.01	8.34	8.52	0.04
2007	58.52	36.3	0.02	10.56	15.02	0.04
2009	82.54	32.69	0.02	13.29	28.39	0.04
2010	71.83	18.37	0.02	21.72	21.67	0.05

Source: Beck et al (2012)

Table 4: External debts in the Maghreb (1995-2010)

		1995	2000	2003	2005	2007	2009	2010
External debt (in % of GNI)	***Algeria***	83.52	48.75	36.04	17.34	4.32	3.82	3.39
	Morocco	75.06	57.34	37.31	27.52	27.66	26.42	28.14
	Tunisia	62.99	61.02	76.56	65.45	60.79	58.15	51.09
Short term debt (in % of external debt)	***Algeria***	0.79	0.87	0.61	3.05	12.93	27.92	33.7
	Morocco	0.83	7.6	6.88	4.21	9.34	9.17	7
	Tunisia	12.1	14.06	19.35	17.53	19.49	22.11	23.06

Source : WDI, World Bank (2012)

Table 5: Imports and Exports composition in Algeria

	Imports (in % of total Imports)	Exports (in % of total Exports)
Food	17.5%	0.21%
Energy	2.2%	98.3%
Raw materials	3.26%	0.32%
Semi-finished products	22.9%	1.18%
Agriculture equipments	0.7%	0.01%
Industrial equipments	37.2%	0.1%
Consumer goods	13.97%	0.03%

Source: IMF (2011): Direction of Trade Statistics

Table 6: Imports and Exports composition in Morocco

	Importations (en % du total des importations)	Exportations (en % du total des exportations)
Food, beverages and Tobacco	8.59%	19.79%
Energy	21.78%	2.45%
Crude products	6.3%	11.07%
Semi-finished products	22.23%	27.84%
Equipements	20.4%	6.46%
Consumer goods	20.66%	32.39%

Source: IMF (2011): Direction of Trade Statistics

Table 7: Imports and Exports composition in Tunisia

	Importations (en % du total des importations)	Exportations (en % du total des exportations)
Agri business	6.37%	5.47%
Energy	10.37%	9.98%
Raw materials and semi-finished products	29.10%	24.37%
Equipements	20.41%	8.29%
Consumer goods	33.75%	51.87%

Source: IMF (2011): Direction of Trade Statistics

Table 8: Optimization results for each Maghreb Country

	Algeria	Morocco	Tunisia
$\|\alpha\|$	0.12	0.62	0.76
$\|\beta\|$	0.07	0.03	0.86
Variance of output gap	10.25	0.34	27.78
Variance of inflation	0.39	1.32	4.2
Variance of money base	0.56	14.99	42.67
Variance of NEER	0.52	0.41	0.78
Loss function	10.65	1.67	31.99

Table 9: Optimization results for the Maghreb zone

$\|\alpha\|$	0.32
$\|\beta\|$	1.1
Variance of output gap	0.73
Variance of inflation	0.09
Variance of money base	0.41
Variance of NEER	1.12
Variance of output gap	0.83

Table 10: Common monetary rule: consequences for each Maghreb Country

	Algeria $\|\alpha\| = 0.32$ $\|\beta\| = 1.1$	**Morocco** $\|\alpha\| = 0.32$ $\|\beta\| = 1.1$	**Tunisia** $\|\alpha\| = 0.32$ $\|\beta\| = 1.1$
Variance of output gap	18.09	0.45	28.33
Variance of inflation	0.39	1.52	1.97
Variance of money base	0.41	0.41	0.41
Variance of NEER	1.12	1.12	1.12
Loss function	18.49	1.97	30.4
Loss function variation	+7.84	+0.3	+1.18