The effects of central banks' independence on inflation outcomes in emerging countries: Does the choice of exchange regime matter?

Jamal Bouoiyour, Refk Selmi

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Abstract: This chapter considers the benefits and the drawbacks of the choice of exchange regime on the central bank independence effects on inflation outcomes. The analysis of data of inflation, central bank independence, exchange regime either fixed or floating and other explanatory variables of twelve emerging countries from 1991 to 2009 provides strong support for the theoretical viewpoint, whereby regulatory separation exerts a substantial effect on inflation dynamic. More precisely, this study explores empirical evidence that low inflation outcomes may be achieved by setting up central bank independence which itself should be accompanied by pegged exchange regime. Furthermore, we note that matter which classification is employed either de facto or de jure, the effect of regulatory separation on inflation outcomes is lower in countries operating under fixed exchange regime than those operating under floating peg. These results do not change substantially when changing the model (i.e. ordinary least squares with two-way fixed effects chosen by Hausman test and Arellano and Bond method or when including the multiplicative interaction terms) or when changing exchange classifications (i.e. de jure and de facto).

Keywords: Exchange regime; inflation; central bank independence.

JEL Classification: E31; E52; E58; F31.

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1. Introduction

The debates relative to the relationship between central banks' independence, exchange regime and inflation dynamic are not recent. The climate of high inflation has brought monetary authorities to worry about the possible effects of exchange rate movements on inflation. In particular, they worried about the possible formation of a vicious circle whereby high exchange rate fluctuations accentuate the expectations of higher inflation level in the future. Hence, the literature survey has developed a large consensus on the linkage between inflation outcomes, exchange regime, central bank's independence and other fundamentals[3] trying to identify the main concepts in inflation outcomes determinants framework.

Alogoskoufis and Smith (1991) found empirical evidence that exchange regimes matter for the persistence of inflation. They demonstrate that fixed exchange rate regime appears to be associated with negligible persistence of inflation volatility, while managed exchange regime is associated with very high inflation persistence. Among the same lines, Dani (2000) added that The institutional structure of the central bank hereafter may have an intense influence on dampening the inflation level when each country is operating under floating exchange system but with an important size portion of its banking sector (e.g. Dani, 2000). Perhaps more importantly, they show that independent central banks and fixed exchange regimes are institutional mechanisms that enable to keep a low level of inflation.

More recently, Colpelovitch and Singer (2007) confirm that the influence of separate agency to mitigate the inflationary pressures is conditional on the degree of flexibility of exchange rate and the size associated to banking sector. In almost the same vein, Guisinger and Singer (2010) argue that monetary authorities' attempt is to keep the stability of prices by adopting a fixed exchange rate system, i.e. this latter serve as a signal of government's lower inflation level.

Regardless of the approach taken, two issues have a great interest in international economics and a special attention from academics: Firstly, to determine the key determinants of inflation pressures, in particular, because in the short run, it is still difficult to identify the reasons behind an increase in inflation rate level and an excessive inflation volatility (e.g. Bleaney and Fielding (2002) and Alfaro (2005)). Secondly, to identify the impact of independent central banks on inflation rate and its evolution under different classifications of

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[3] See Appendix A.

exchange regime (e.g. Guisinger and Singer, 2010), especially because central banks' independence in emerging countries is lower and reforms are infrequent (e.g. Cobham, 2012).

It is conceivable then that various theoretical and empirical studies demonstrate the capacity of central banks to choose the final goals of monetary policy to adjust its policy tools and to operate independent instruments freely in order to track its main objectives such as gradually reducing inflation (i.e. a high level of independence and especially more effective financial regulation of central banks are important to assure price stability). Various questions can be raised then: why do some emerging countries have separate agencies to supervise the central banks and others do not? What impact of supervision does it have on central banks' activities? Does independence of central banks matter in terms of linkage between exchange regime and inflation? Does regulatory separation make a different inflation behavior? What lessons can be drawn as regards the effect of financial regulation on the link between exchange regime and inflation outcomes?

As stated above, several studies assess the question of the linkage between inflation, exchange regime and central bank independence in developed countries (e.g. Canavan and Tommasi (1997), Dani (2000), etc…) in comparison to the literature survey on the relationship between inflation pressures with the degree of democracy and banking sector size (e.g. Colpelovitch and Singer, 2007). Very few works have been advanced on central bank independence effects on inflation in emerging countries (e.g. Zare et al. (2012) and Cobham (2012)) and in our knowledge there are no studies on the relationship between inflation outcomes and regulatory separation by using a panel of emerging countries taking into account the effects of the effects of exchange regime, banking sector size and the level of democracy and then the multiplicative interaction terms between these variables.

To achieve this goal, we derive other testable questions which can bring additional explanations on the possible effects of regulatory separation on inflation dynamic as well as its interaction with the choice of exchange regime: What do central banks of emerging countries actually do? What role does pegged exchange regime play when it comes to the effect of central bank independence and inflation outcomes? What are the hallmarks of the choice of pegged exchange regime? Or what do peg exchange regime' gains in terms of the central bank independence's effect on inflation dynamic? More generally, do fixed or float exchange regime matter for inflation? Does an unfavorable choice of exchange regime can

threaten central banks' independence effects on inflation outcomes? Can the inclusion of democracy and banking sector size make a difference?

Intuitively, this chapter will offer new perspectives on the determinants of inflation outcomes. More precisely, we want to know whether the link between inflation dynamic and financial regulation driver by the dependency or not of the central banks to separate agencies (e.g. Cukierman (1992), Maxfield (1997), Clark (2002), Bodea (2009), etc…) depends intensely on the choice of exchange regime. Hence, the main purpose here is to verify theoretically and empirically if inflation outcomes may be achieved by setting up independent central banks and if this is conditional on the choice of exchange regime as well as the degree of democracy and the banking sector size (e.g. Colpelovitch and Singer, 2007).

The remainder of this chapter proceeds as follows: Section 2 presents a brief overview of inflation trajectory and its interaction with central bank independence in 12 emerging countries [4](Algeria, Egypt, Jordan, Iran, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Sudan and Tunisia) depending on exchange rate regime classifications (i.e. de jure versus de facto)[5]. Section 3 describes the data sets of selected emerging countries that we use to evaluate the relationship between inflation, exchange regime, central bank independence and other explanatory variables. This latter section presents our empirical results and robustness check by using ordinary least squares with two-way fixed effects chosen by Hausman test and Arellano and Bond method with and without multiplicative interaction terms. The last section concludes our paper.

2. Central bank independence, inflation dynamic and exchange regime in emerging countries: An update overview

In emerging countries, the inflation surged fastly across the period from 1990 to 2009 (see Figure 1). This is mainly due to the geopolitical tension such as the Iranian-Iraqian wars in 1988 and Gulf war 1990-1991. In the early 2000s, we note that in the majority of considered countries, the inflation rate has declined. Hereafter, we note that inflation start to increase widely. This may be explained by exogenous shocks to the region, such as

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[4] We choose here some emerging countries with different exchange regimes and central bank structures, but with almost the same inflation behavior.

[5] See Appendix B.

American-Iraqian tension in 2003, which led to higher price for oil, translating itself to other commodity prices on international market and then to exchange rates (see Bouoiyour and Selmi, 2012), reflecting stronger demand from emerging market countries.

Just as the main advantage of central bank independence may be that it allows monetary authorities to maintain stable prices closely associated as mentioned above to the choice of exchange regime, it will be crucial in the following to assess in detail this linkage.

2.1. Central bank's independence and inflation dynamic

In emerging countries, the central banks are the monetary authorities responsible for monetary and exchange policies which operate with various degrees of economic and political autonomy (see Figure 2). They dispose financial instruments that may be private or public to regulate the credit, exchange rate, interest rate and inflation level. They also implement restrictions on banking activities. However, central banks and regulatory agencies emerged as completely separate entities in very few emerging countries (e.g. Cobham, 2012).

Furthermore, it is not easy to determine the effect of regulatory separation on the evolution of inflation level. In this context and according to Copelovitch and Singer (2007) and Dumiter (2009), central bank independence is quite difficult to be assessed and quantified (i.e. there is no single definition or measure of this variable). Nonetheless, a large literature survey on this topic provides evidence that independent central banks foster less volatile inflation rates. Is this viewpoint absolutely true?

As our objective in this study is to clarify the importance of central banks' intervention either is dependent or independent as a key determinant of inflation outcomes, it is important first of all to describe the policies adopted by the central banks of the considered countries in our study period (i.e. from 1990 to 2009).

From 1990 to 1995, the Bank of Algeria is not independent. This is due to the fact that its economy was in bad shape. Many factors constrained the independence of Algerian Bank in that period, such as the high level of unemployment of 30%, a budget deficit of 8.7% and a deficit of balance of trade (e.g. Zaouache and Ilmane, 2008). However, these factors were relaxed in the years 2000; the dinar was more stable against the US dollar, the oil price increased leading to a favorable balance of trade.

In addition and in the considered period, the central banks of Egypt, Iran, Jordan and Lebanon are autonomous entities whose have as main functions to maintain economic stability and developing financial markets. Nevertheless, the central bank of Iran has given more independence in its bank supervisory in comparison to other countries in question (e.g. Cobham, 2012).

Besides, in that period (i.e. from 1990 to 2009), the central banks of Morocco and Tunisia which have almost the same conduct in terms of exchange and monetary policies are autonomous like most of the emerging countries, trying to keep the inflation level in target to retain a competitive position in terms of trade performance (e.g. Bouoiyour and Selmi, 2012). Morocco tries to establish a new regulatory banking act for all credit institutions which succeed in reinforcing the power of the central bank in regulating and supervising the activities of credit institutions (e.g. Cobham, 2012). For Tunisian case, the banking legislation starts by modifying regulatory separation and supervision in 1994. Later on, an amendment which expands the central banks' activity takes place (e.g. Arnone et al. 2006).

Then, Kuwait, Oman, Qatar and Saudi Arabia implement a monetary policy capable of ensuring and achieving price stability and support their currencies either to facilitate a transition toward total convertibility into other currencies, especially the US dollar (cases of Kuwait, Qatar and Saudi Arabia) or to control the movements of nominal exchange rate into foreign exchange rates of its principal partners (case of Oman).

To some extent, the independence of central banks in emerging countries potentially depends on the organization of the banking system, the role of monetary policy, the degree of democracy and the management of the exchange rate. Indeed, the independence of central banks is difficult to be quantified.

To determine this degree, many indicators can be used, including Cukierman index and GMT index[6]. The first one is initiated by Cukierman (1991) presented in Figure 2 which confirms that the central banks' independence in emerging countries is very low with average around 6.28%. We also notice that the overall independence of the central banks of Egypt, Morocco and Tunisia were compared well with other emerging countries. The degree of independence in GCC countries (Kuweit, Qatar and Saudi Arabia) is the lowest in comparison to other emerging countries in question, except Algeria. The second one (e.g. Grilli et al.

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[6] Various indicators of central bank independence are reported in Appendix C.

(1991) and Arnone et al. (2008) show that developed and OECD countries have progressed in terms of political autonomy than economic autonomy, contrary to emerging countries (see Figure 2). Concretely, this figure presents in detail the economic and political independence in the considered countries.

Hence by basing on this index, we show that Morocco and Tunisia which have a medium sized banking sector are characterized by an important level of economic independence. Algeria with its small banking sector considerably dominated by the public sector banks compared well to other countries in terms political independence. The Egypt's banking sector is large relative to the size of its economy distinguished during high economic independence and low political one. The same variable is scored for Iran characterized by a small banking sector considerably dominated by public sector element as having high economic independence and zero political independence. Almost the same thing for Sudan's central bank independence. All considered GCC countries (i.e. Oman, Qatar, Saudi Arabia, and the UAE) are characterized by medium-sized banking sector (except Oman with small banking sector size) and high concentration, particularly the dominance of public sector (except Saudi Arabia with moderate concentration). In these countries, the central bank independence assessed by GMT index as having high economic independence and very low political independence. Saudi Arabia has an overall independence below the average of GCC countries (e.g. Cobham, 2012) but in terms of political independence, the UAE is well above that of Saudi Arabia.

2.2. Exchange regime and inflation dynamic

The emerging countries have adopted various exchange regimes and have modified usually their choice. It is useful and valuable here to compare between de jure exchange rate regimes classified by the IMF and the de facto exchange rate regimes proposed by Reinhart and Rogoff (2004). This allows us to highlight the differences between the statements of the monetary authorities of emerging countries.

Let us start with Algeria. This small open economy adopts a managed float (pegged to euro) in terms of de jure classification, but in practice (i.e. de facto) the Algerian currency is more aligned with the US dollar. In Morocco and Tunisia, the exchange rates are pegged to the Euro, but not aligned to this latter. Nevertheless, the currencies of Jordan, Lebanon, Syria

and Sudan are narrowly aligned in practice with the dollar. However, the Egyptian currency seems to be unaligned with the dollar as well as the euro (de facto). Similarly, Iran is distinguished by a managed float unaligned with the dollar (in practice). Still the GCC countries (mentioned above), in overall, these economies adopt hard pegged exchange rate system to the dollar except Kuwait which recently switch to a peg to a basket of currencies but "dollar still the largest component" (e.g. Cobham, 2012).

Furthermore and from Figure 3, we note that the percentage of emerging countries with de jure fixed exchange rates has been a steady decline since 1990, reflecting a level shift in favor of floating exchange regime from 1990 to 1995. Between 1999 and 2005, this percentage increase by a large gap from 30% to more than 50%. Since 2005, there is a decline from 52% to 47%. The increase in percentage observed between 1995 and 2005 reflects a shifting in favor of fixing exchange regime which may be mainly due to the fear of floating especially after the introduction of euro (the adoption of the euro by several emerging countries (e.g. Algeria, Morocco, Tunisia, etc…) can reverse according to Guisinger and Singer (2010) the overall trend. More interestingly, we note according to Figure 4, that over the last period from 1996 to 2007, the pegged exchange regime still the most adopted regime in emerging countries with 58.19% compared with 88.89% over the period 1977-1985. In contrast, we show an increase on the share of floating exchange regime from 8.15% percent over the period 1977-1985 to nearly 36% in the last sub-period. So, can governments in emerging countries obtain low inflation levels by limiting exchange movements?

To answer this question, it will be important to compare inflation performance under fixed, pegged and float exchange rate arrangements by using two exchange rate classifications (de jure and de facto). Hence, Figure 5 reveals obviously that the de jure and de facto classifications assign the lowest inflation outcomes to the fixed exchange rate and the highest ones associated to the floating exchange regime.

In contrast, Guisinger and Singer (2010) argue that de facto fixed exchange regime is not associated itself to lower inflation rate. More precisely, they advance that only the countries which linked their facto exchange regimes with de jure pronouncements can receive the benefits of inflation control. They explain this idea by the nonlinear nature which distinguishes the relationship between exchange regime and inflation which depends on the assumptions of other variables such as central banks' independence, democracy and banking sector size, etc… Therefore and because building credible monetary policy is a difficult task,

especially in emerging countries (e.g. Arnone et al. 2006), it will be perhaps important to track the same line of Copelovitch and Singer (2007) and Guisinger and Singer (2010) by linking the interaction between central banks' independence, the choice of exchange regime and inflation outcomes with the degree of democracy and the size of banking sector.

2.3. Other determinants of inflation outcomes

Rather than exchange regime and central bank independence which are explained at outset as potential fundamentals of inflation dynamic, there are other determinants which can affect it considerably. For example, it is assessed that under floating exchange regime, the monetary policy would be more vulnerable to the variability of international capital (e.g. Sfia and Mouley, 2009). Therefore, a high degree of capital openness (see Figure 7) would be likely associated with fixed exchange regime leading to low level of inflation outcomes. So, how do emerging countries with more open capital openness interact with inflation? Does capital account openness decrease inflation across emerging countries? And how has opening up the capital account affected inflation?

Furthermore, Copelovitch and Singer (2007) argue that democracy is better able than non-democracy to signal the intention of monetary authorities to keep the stability of prices. Figure 8 presents the level of democracy in the considered countries and indicates that they have not a good position compared to the world. Does this degree of democracy matter for inflation in emerging countries?

Guisinger and Singer (2010) hereafter confirmed that: "The logic is straightforward : the size of the banking sector is an excellent proxy for the potential magnitude of the career costs associated with bank instability", that is to say that the influence of the intervention of central banks on inflation may be less important when the banking sector size is relatively small. Copelovitch and Singer (2007) verified this argument for a panel of twenty three industrialized countries, remains hereafter to evaluate to what extent this viewpoint can be true in the case of emerging countries ?

Among the same context, Figure 9 illustrates the variation in the size of banking sector across the considered emerging countries. Theoretically and empirically (e.g. Copelovitch and Singer, 2007), the banking sector size can magnify the impact of central banks on inflation evolution which is conditional on the choice of exchange regime. Thus, a high level of banking sector size can mitigate the inflationary pressures. But, can the size of banking sector

make a difference in terms of central banks and exchange regime effects on inflation outcomes in emerging countries?

3. Empirical analysis

3.1. *Data and methodology*

To test if the financial regulation is an important factor influencing the monetary policy behavior (in particular, inflation dynamic) and its connection to exchange regime, we use a panel data of twelve emerging countries for the period from 1990 to 2009. Our methodology in this study follows an econometric model based on linear regression with panel corrected standard errors. The dependent variable is the logged five year average inflation rate. The Models 1 and 2 include as explanatory variables, exchange rate regime (i.e. the exchange regime variable takes the value 0 for floating exchange regime and managed float and 1 of fixed exchange regime[7]) by using two classifications strategies (de jure and de facto)[8], the log of GDP and that of GDP per capita, the capital account openness[9], the banking sector size (measured as a domestic private credits provided by the banking sector as a percentage of GDP) and regulatory separation[10] (i.e. a binary variable that takes the value 0 if the central bank is unified and a value 1 if there is a separate agency which supervises the central banks activity).

Thereafter and because we know that there are additional variables whose inclusion can outperform the model, we thought to add interactive term as the study of Copelovitch and Singer (2007). Hence to assess the fact that the effect of central bank independence on inflation outcomes is conditional on the exchange rate regime which itself depends intensely to the size of banking sector and democracy, we include in Models 3 and 4 relatively a two-

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[7] The fixed exchange regime such as currency boards, hard pegs, etc….

[8] The data of exchange rate regimes' classifications are disponible in the IMF's annual report on exchange arrangements and exchange restrictions. See also Appendix B.

[9] This index is disponible in Usherbrooke data; higher values of this latter indicate greater degree of openness. http://perspective.usherbrooke.ca/bilan/statistiques/2

[10] Focusing on the perspective of central bank involvement in banking regulation (Cukierman (1992) and Copelovitch and Singer (2007)), we thought to use as indicator of central bank independence the Cukierman index based on annual observations of central bank involvement for each country, which presents a variable which takes into account the role of the central bank in banking regulation and supervision, noted (CBI). This latter is equal to: 0= if the central bank is not assigned the main responsibility for banking supervision and 1= if the central bank assigned the main responsibility for banking supervision. Data are disponible in IMF's report on regulatory banking sector.

way and three-way multiplicative interaction terms[11] which capture the effects associated to separate on inflation outcomes conditional upon the choice of exchange regime in the first time, and then to the combination between exchange regime, the banking sector size and the degree of democracy.

To regress inflation on exchange regime and regulatory separation taking into account other explanatory variables as like democracy and banking sector size, we thought to use the OLS method. Indeed, this latter is biased for panel, the OLS with fixed or variable effects can be more reasonable. Nevertheless, it is crucial here to address the possibility of endogeneity (i.e. to be clear, there are some reasons to expect that rather than fixed exchange regime can cause lower level of inflation, this latter can also cause exchange regime)[12].

In this context, Coudert and Doubert (2005) confirm that because of endogeneity of the exchange rate regime to inflation, a reverse causality in the inflation regression is more likely, as inflation may play a role in the choice of an exchange rate regime "a country could choose a fixed exchange rate because it already has a low inflation. The opposite mechanism could be true. A country could adopt a peg because of its high inflation, if it expects that the peg could bring more discipline and credibility to the government policy." In this case, the IV method can be more effective. This method consists in finding a variable that affects the exchange rate regime without impacting inflation, this is the instrumental variable. Since it is difficult and sometimes impossible to find this variable, we thought about using the Arellano and Bond method (GMM). In turn, this method assumes that lagged values of the dependent and independent variables also serve as valid instruments under certain restrictions.

3.2. Key results

To evaluate the relationship between inflation, central bank independence, exchange regime and other determinants without and with interactive term, we use in the first step the Ordinary Least Squares method (OLS) with two-way fixed effects chosen by Hausman test without and with multiplicative interactive terms summarized in Tables 1 and 2, respectively. In the second step, we estimate the relationship in question using Arellano and Bond method (GMM) without and with interactive terms summarized relatively in Tables 4 and 5.

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[11] For details about multiplicative interction terms, we can see: http://homepages.nyu.edu/~mrg217/interaction.html.

[12] For more details about the problem of endogeneity, we can see Bouoiyour (2012).

We should add here that we employ in these several models an alternative measure of exchange regime based on the IMF's de jure classification. Unlike this latter classification, we use another measure of exchange regime which is derived from a combination of foreign reserve activity and market exchange rates taking into account the chronologies associated to each countries (Reinhart and Rogoff, 2004). Intuitively, does exchange regime classification matter for the interaction between central bank independence and inflation dynamic?

3.2.1. OLS method

The results of OLS estimates without interactive terms are summarized in Table 1. We notice that the relationship between separate and inflation is statistically insignificant. This may be mainly due to the fact that the linkage between central banks' independence and inflation outcomes is considerably conditional on the choice of exchange regime either fixed or floating, the level of democracy and the size of banking sector as demonstrated by Copelovitch and Singer (2007). It remains then to verify if this viewpoint is true when we include interactive terms taking into account the latter variables.

Hereafter, we show a negative and significant effect of exchange regime (Fixed versus floating) under both classifications either de jure or de facto on inflation, i.e. the inflation levels are lower in countries which choose fixed exchange regimes than those which choose a more flexible exchange regime. In this context, Gupta (2007) argues that countries with severe inflationary pressures frequently choose to adopt a crawling peg regime or a managed float regime characterized by highly anchor in a stabilization objective. Our results are not necessarily built on this finding because the considered countries describe their exchange policies as flexible, which is associated to a high level of inflation while according to Sfia and Mouley (2009): "MENA countries describe themselves as floaters because that is what the International Monetary Fund (IMF) wants to hear, but in reality they intervene massively to adjust their exchange rates. Thus, we can define their attitude as fear of the IMF".

Furthermore, it is remarkable that the coefficient associated to the economic growth is linked negatively and significantly to inflation level, i.e. an increase of GDP of emerging countries is accompanied by lower inflation. This confirms the idea whereby the countries characterized by a small size are more likely to be associated with fixed exchange regime and then would be accompanied with lower inflation outcomes (e.g. McKinnon, 1963). In the

same vein, Sfia and Mouley (2009) advanced that the countries distinguished during a large size or more precisely high level of GDP are more associated to a floating exchange regime which is a key source of inflationary pressures.

Our results also reveal that democracy has a negative and significant effect on inflation dynamic; this can necessarily be due to the very bad position of the emerging countries in terms of the level of democracy (see Figure 8). Concretely, the lack of democracy can lead to political instability. Thus, the level of inflation will be necessarily affected by the extent of political instability, i.e. inflation will be higher in the countries with unstable policy. It is theoretically expected that high level of democracy is associated with lower inflation in lower inequality countries and with higher inflation in higher inequality countries (e.g. Cukierman et al. (1992) and Desai et al. (2003)).

Besides, our results also reveal that the expectation whereby a high degree of current account openness is necessarily linked to lower inflation outcomes is verified. This confirms the viewpoint of Gupta (2007) who shows that "By opening up the capital account, policymakers impart a signal to the private sector that it is willing to suffer the punishment of loose monetary policy in the form of capital outflow. Thus, it alters the private sector expectations about the future monetary policy, which is itself can be inflation reducing." However, we notice an unexpected relationship between banking sector size and logged inflation which is insignificant.

Let us now verify if the sign and significance of different coefficients associated to the various variables used still the same when we include interactive terms.

3.2.2. OLS with interactive terms

When we include the interactive term, we notice that the coefficient associated to central bank independence or separate is negative and highly significant in comparison to other explanatory variables used, but this is mainly conditional on the choice of exchange regime either fixed or floating (Models 1 and 3). This provides a strong support to the argument of Cukierman et al. (1992) who show that inflation outcomes are higher in countries with low central bank independence and that of Gupta (2007) who advance that "the freer is the central bank, the lower is inflation rate." Hence, we confirm empirically the result

theoretically addressed whereby the regulatory separation can be a key fundamental of inflation dynamic in emerging countries.

Although, when we combine the exchange regime, the democracy and the banking sector size variables as two-way or three way-interactive terms, we notice more intense relationship between central bank's independence and inflation. Hence, we show that the independence of central banks in emerging countries will be linked negatively and significantly to inflation level, but conditional to the choice of exchange regime, the degree of democracy and the size of banking sector.

3.2.3. GMM method

Our previous results summarized in Table 1 (OLS without interactive term) show that there is not a significant linkage between regulatory separation and inflation either for fixed or floating exchange regimes. Table 2 (OLS with interactive terms) reveals that the effect of central bank independence on inflation outcomes of countries under fixed exchange regime are lower than those operating under flexible exchange regime (i.e. negative and significant coefficient associated to the variable exchange regime). These results appear robust when we use GMM method without interactive terms under both classifications in question, i.e. de facto and de jure (Table 3). It remains to verify if it is crucial to distinguish between the various classifications of exchange regime or only the choice of exchange regime (fixed or floating) matter when we analyze its relationship with inflation and central bank independence using GMM method with interactive terms to check the robustness of our results summarized in Table 1.

3.2.4. GMM method with interactive terms

By using GMM method with interactive terms, the results obtained support the hypothesis whereby the lower level of inflation is associated to greater central bank independence which is itself closely linked to fixed exchange regime. We also notice that the coefficient associated to exchange regime is negative and statistically significant (i.e. lower values imply that higher degree of exchange fixity decrease the inflation outcomes). We should add here that the results obtained above from OLS method with interactive term (two

or three way) seem robust. From Tables 2 and 4, fixed exchange regime appears favorable in emerging countries to mitigate regulatory separation effects on inflation' levels under both classifications either de jure or de facto.

To confirm our results, we present in Figure 10 the marginal effects of regulatory separation on inflation average depending to the choice of exchange regime (Fixed versus managed or floating regime) under two classifications (i.e. de jure and de facto) trying to check the robustness of our results. We notice that the separation has a negative and significant effect on inflation dynamic under floating exchange rate regimes. Indeed, regulatory separation has a little influence on inflation outcomes under fixed exchange regimes in both de jure and de facto classification. Furthermore, the results reported in Table 5 strongly support this. We show that when the central banks supervise banks under floating exchange regime, the predicted average inflation is 6.38 at 95% confidence level. However, under fixed exchange regime, we notice that the predicted inflation average declines to 4.59.

4. Conclusions

A stable monetary policy aimed at low level of inflation rate can be considered as a main tool and an important condition for sustainable economic growth in emerging countries. The literature survey on this topic (e.g. Desai et al. (2003), Gupta (2007), etc…) considers that independent central banks have lower costs on inflation, but this dependency is conditional especially on the choice of exchange regime.

By analyzing a panel data from twelve selected emerging countries from 1990 to 2009, we show that the inflation outcomes of countries operating under fixed exchange regime are lower, but this should be accompanied by:

 (i) Independent central banks; (ii) more opening current account; (iii) high level of GDP; (iv) high level of democracy and (v) important size of banking sector.

More interestingly, our results reveal that regulatory separation has a little influence on inflation outcomes under fixed exchange regimes than under floating regimes for both considered arrangements, i.e. de facto and de jure classifications. Hence, lower inflation in emerging countries may be achieved by setting up independent central banks but depending to the choice of exchange regime either fixed or floating exchange regime. Our results appear

robust using OLS and GMM methods without and with interactive terms and based on two classifications (i.e. de jure versus de facto).

Nonetheless and as we see contemporaneously, the procurement of a high level of democracy may be considered as a difficult task in the considered countries. Thereafter, the lack democracy which is between 1.77 and 5.33 in considered economies with ranks comparable to the rest of the world between 97 and 160[13] can threaten the central bank independence, inflation outcomes and exchange regime connection. Thus, to tend towards more autonomy of central banks with low degree of democracy and without potential preparation of the pass-through towards pure floating exchange regime will be insufficient to guarantee a continuously or a permanently lower inflation' levels.

Regardless of the results taken above, it seems also important in our own viewpoint to evaluate whether central bank independence is related to the linkage between exchange regime and inflation dynamic under financial crisis (i.e. currency, banking and debt crisis), that can spread to emerging countries affecting widely inflation outcomes. So, this chapter suggests additional questions for future research: Can a suitably independent central bank achieve stable or low levels of inflation under financial crisis? Does this depend on whether the countries in question chose fixed exchange regime or floating exchange regime? If it does, to what extent can emerging countries - that adopt pegged exchange regime[14] - achieve or establish reductions in inflation levels under financial crisis?

The answers to these several questions will automatically enhance our understanding on the interaction between inflation outcomes, the choice of exchange regime and central bank independence. By analyzing the impact of recent financial crisis on this last linkage, we can also detect an explicit nonlinear effect (i.e. structural breaks in the considered link). Whether or not this is the case, we cannot neglect the fact that the effect of regulatory separation on inflation is conditional on the choice of exchange regime either fixed or floating and critically depends on the banking sector size and the degree of democracy.

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[13] See Economist Intelligence Unit :
http://www.sida.se/Global/About%20Sida/S%C3%A5%20arbetar%20vi/EIU_Democracy_Index_Dec2011.pdf

[14] The pegged exchange regime is the most adopted regime in the emerging countries in question.

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Figure 1. Inflation evolution in selected emerging countries
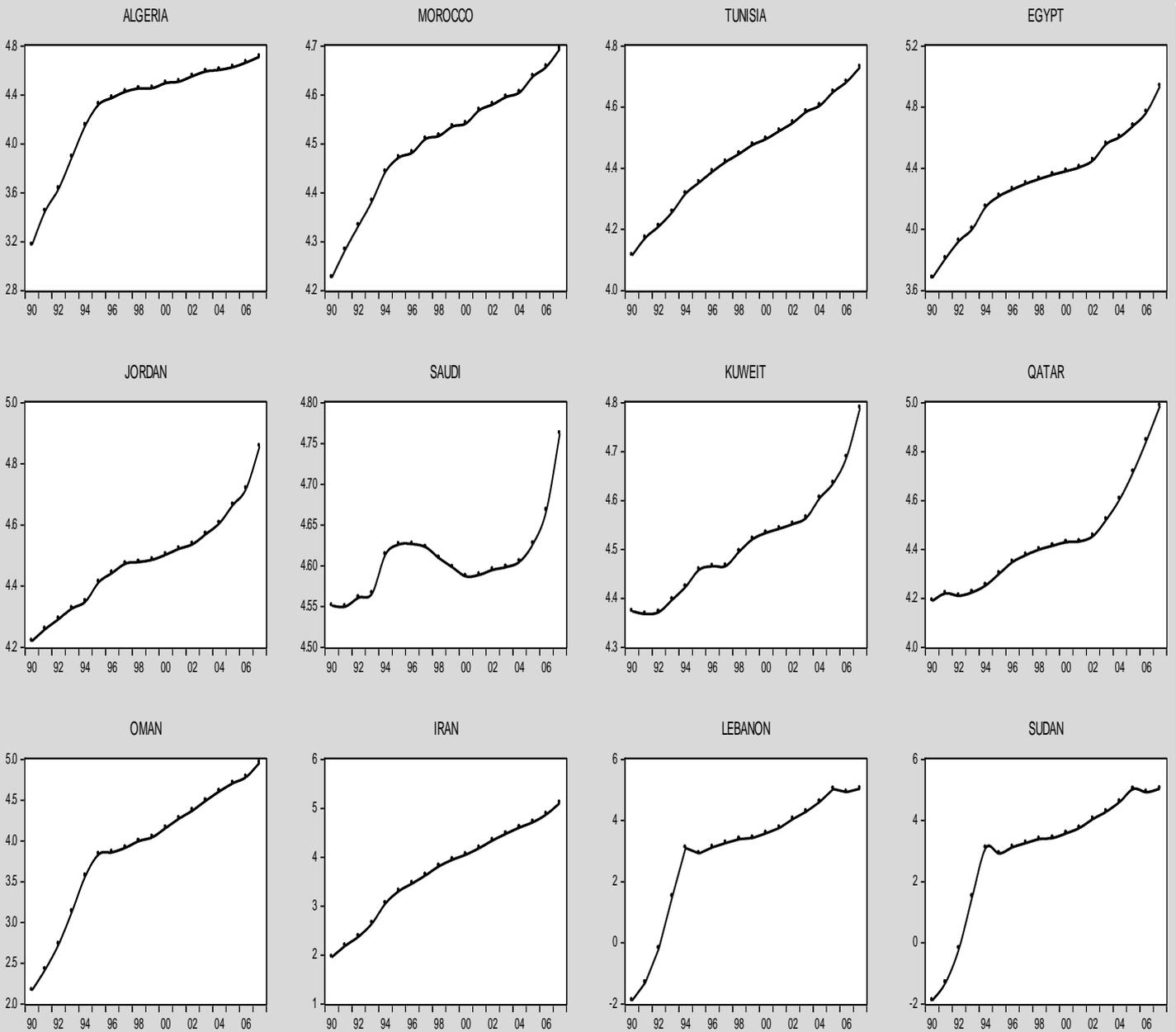
Source: Usherbrooke data (University of Canada): http://perspective.usherbrooke.ca/bilan/statistiques/2

Figure 2. Central banks' independence by using GMT index

1991

Chart labels:
- OECD countries: Overall independence 0.790, Economic independence 0.800, Political independence 0.730
- Emerging countries: Overall independence 0.620, Economic independence 0.800, Political independence 0.500
- Developing countries: Overall independence 0.620, Economic independence 0.740, Political independence 0.560

Legend:
- Overall independence
- Economic independence
- Political independence

2007

Chart labels:
- OECD countries: Overall independence 0.49, Economic independence 0.60, Political independence 0.37
- Emerging countries: Overall independence 0.30, Economic independence 0.31, Political independence 0.24
- Developing countries: Overall independence 0.33, Economic independence 0.50, Political independence 0.21

Legend:
- Overall independence
- Economic independence
- Political independence

<u>Source:</u> Data from IMF (2006) and Arnone et al. (2008).

Figure 3. Central Banks' independence in selected emerging countries
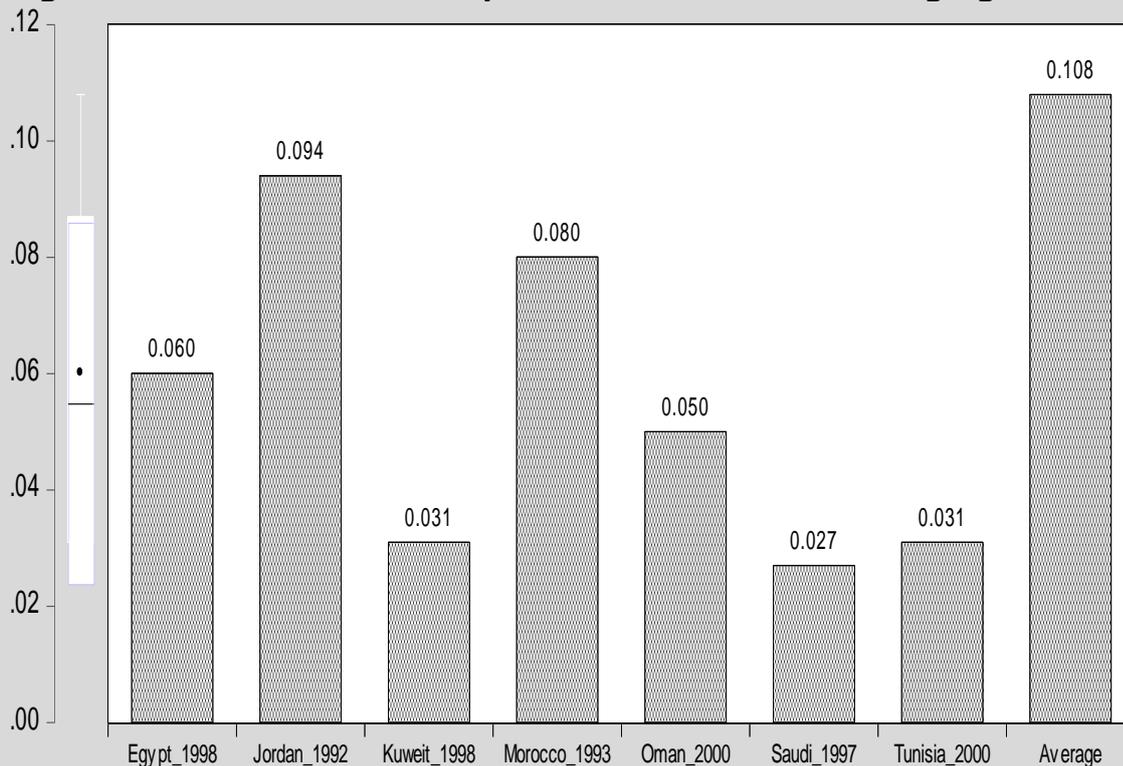
Source: Arnone et al. (2006).

Figure 4. The exchange regime's percentage adopted by emerging countries
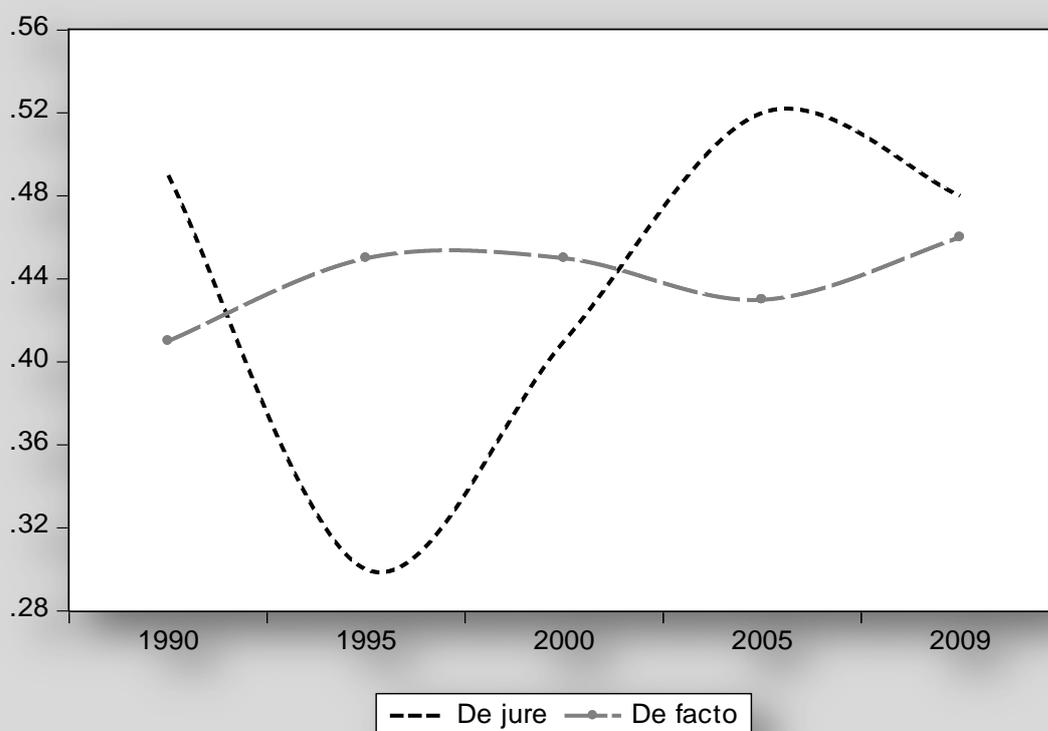
Source: IMF (multiple years) and Reinhart and Rogoff (2004).

Figure 5. Exchange regimes in emerging countries

De jure classification
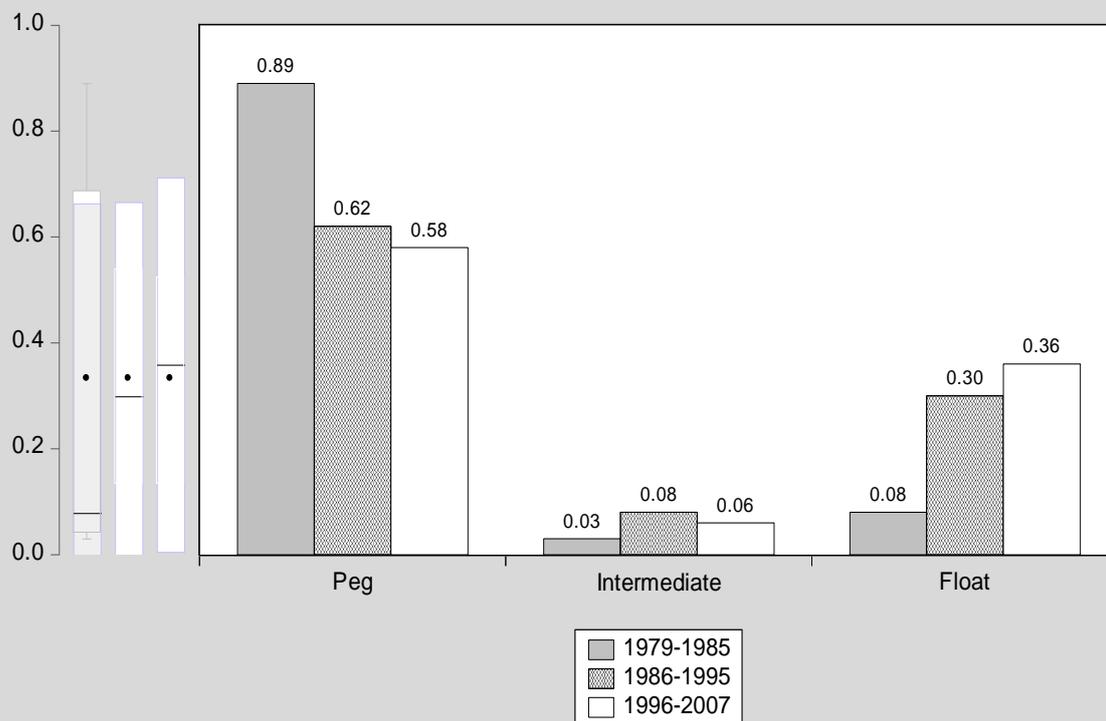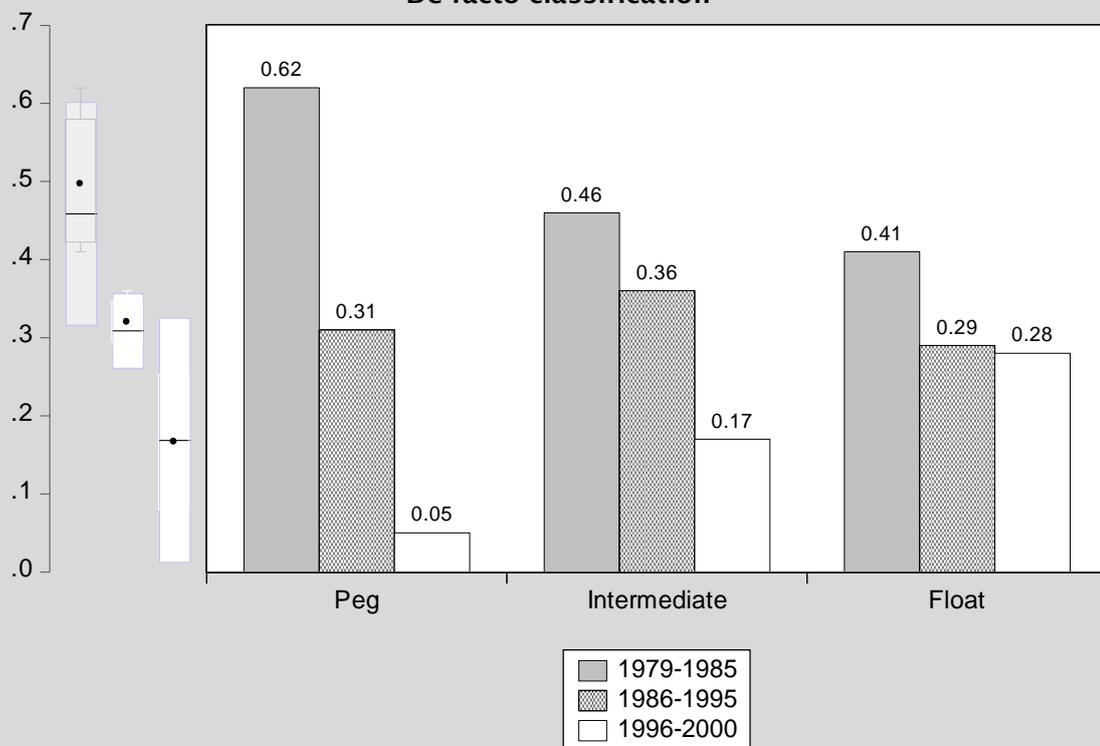
De facto classification

Figure 6. Inflation performance and exchange regime classifications

De jure classification

De facto classification
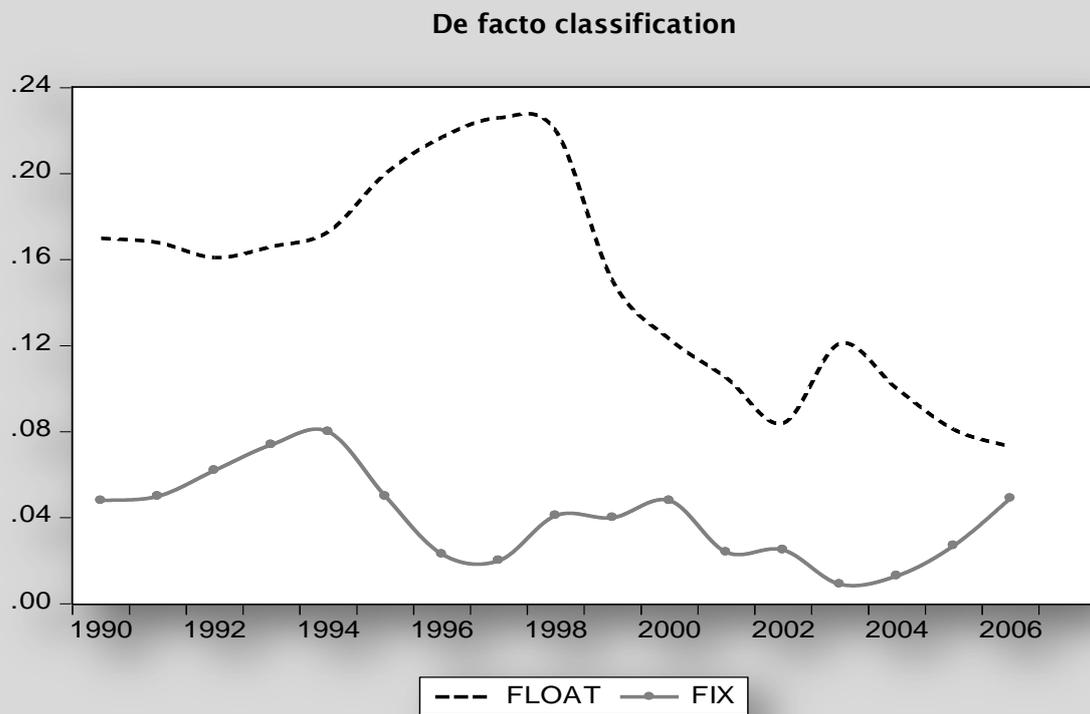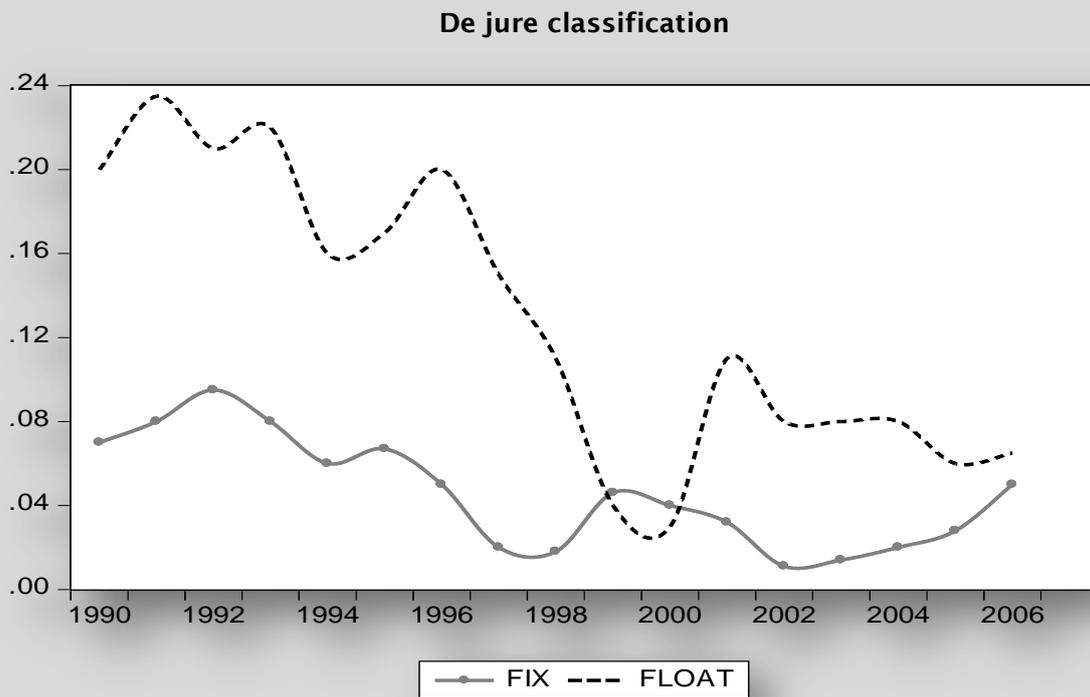
<u>Source:</u> IMF staff, various reports.

Figure 7. Evolution of current account openness and GDP in emerging countries (Normalized data)
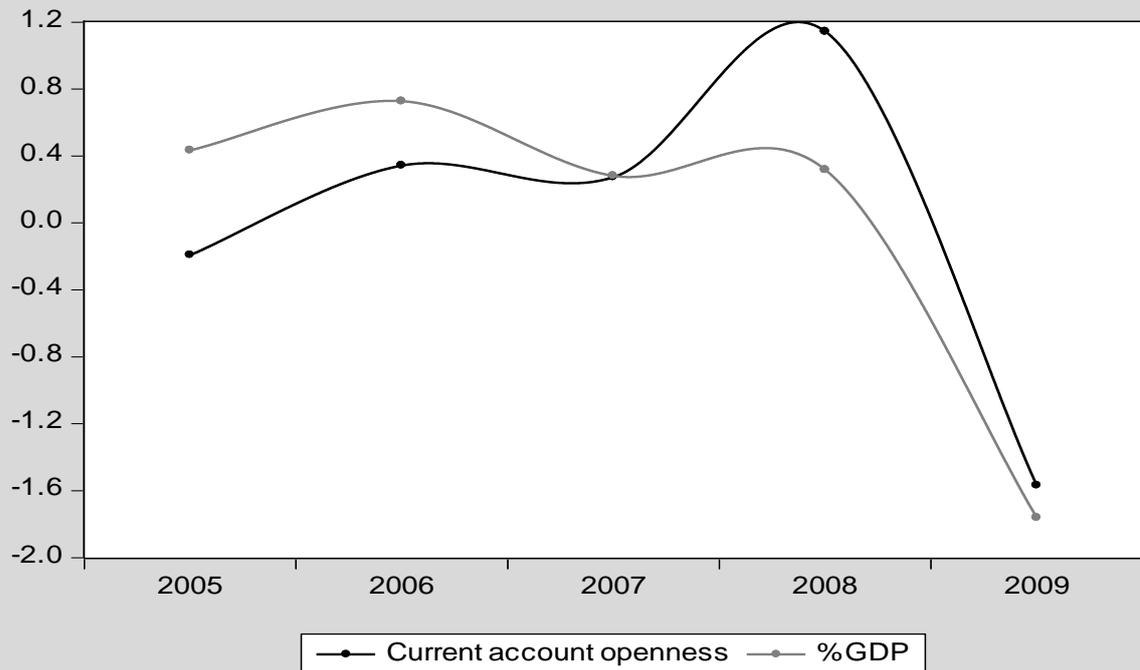
Legend: —●— Current account openness —●— %GDP

Figure 8. Democracy index in selected emerging countries
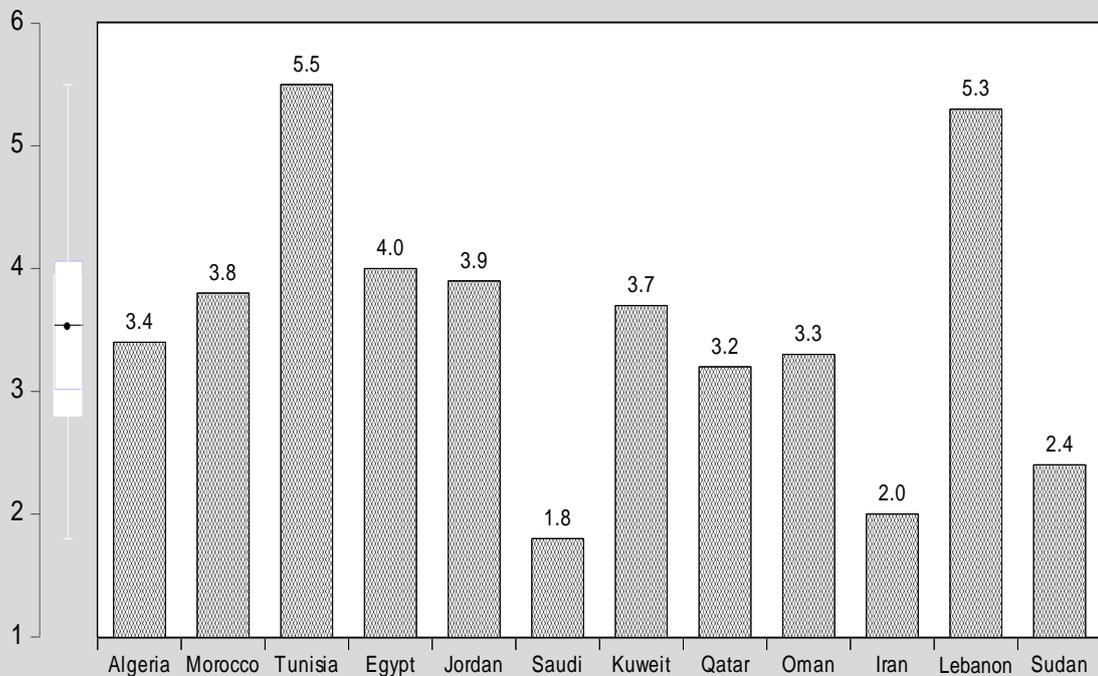
Algeria	Morocco	Tunisia	Egypt	Jordan	Saudi	Kuweit	Qatar	Oman	Iran	Lebanon	Sudan
3.4	3.8	5.5	4.0	3.9	1.8	3.7	3.2	3.3	2.0	5.3	2.4

Figure 9. Banking sector size in selected emerging countries
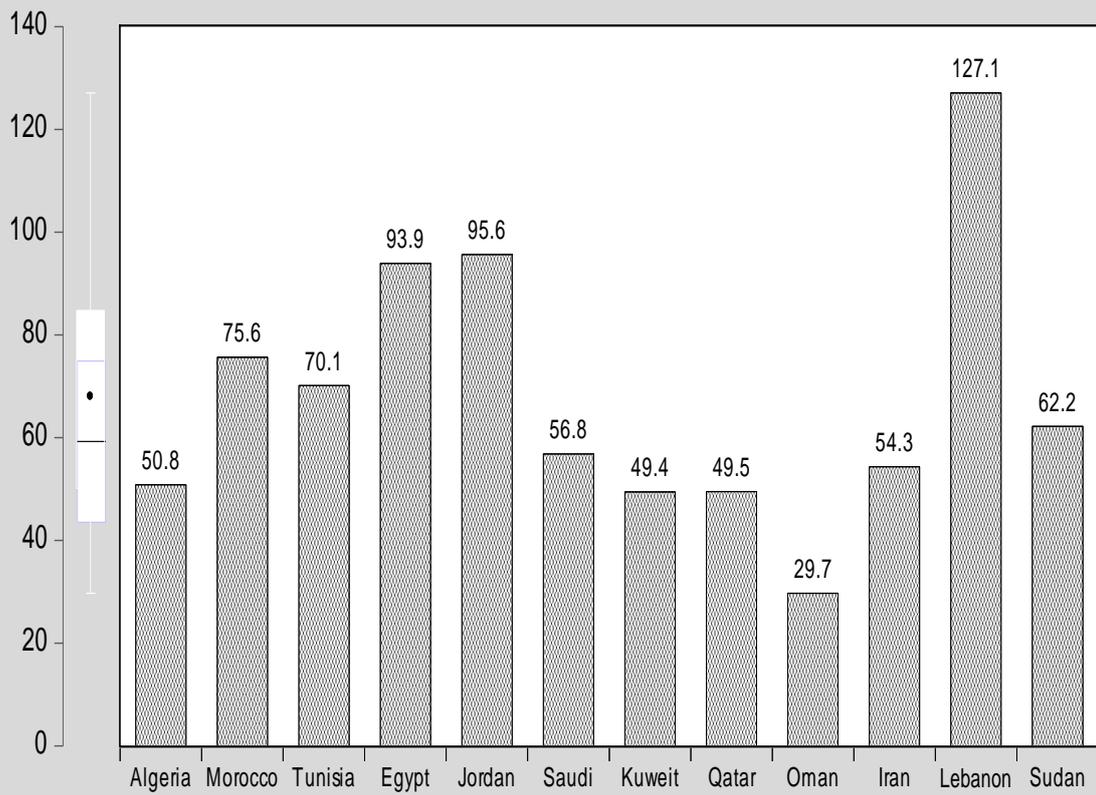
Note: Data from Econstats (http://www.econstats.com/ifs/NorGSc_Mor1_M.htm) and authors's calculations.

Table 1. OLS without interactive terms

Dependent variable: Log (Five year average inflation)

	(1) *De jure*	(2) *De facto*
Constant	-4.014	-6.215
	(-1.180)	(-1.027)
Separate	1.278	1.007
	(1.074)	(1.051)
Exchange regime (Fixed=1 ; Floating=0)	-0.394* (-1.361)	-0.265 (-1.013)
GDP (log)	-0.251***	-0.189**
	(-2.211)	(-2.054)
GDP per capita (log)	-0.106	-0.123
	(-0.590)	(-0.421)
Democracy	0.067	0.079
	(0.420)	(0.631)
Current account openess	-0.017*	-0.024
	(-1.467)	(-1.103)
Banking sector size	0.004	0.001
	(1.046)	(0.885)
R^2	0.41	0.33

Note: Panel corrected standard errors in parentheses; *p<=.10; **p<=.05; ***p<=.01.

Table 2. OLS with interactive terms

Dependent variable: Log (Five year average inflation)

	(1)	(2)	(3)	(4)
	De jure	*De jure*	*De facto*	*De facto*
Constant	-4.260	-3.593**	-6.341***	-6.593*
	(-1.095)	(-2.164)	(-3.240)	(-1.712)
Separate	-1.109**	-0.408**	-1.122***	-0.504*
	(-2.642)	(-2.309)	(-3.395)	(-1.813)
Exchange regime	-0.482*	-0.384*	-0.313	-0.384*
(Fixed=1 ; Floating=0)	(-1.642)	(-1.550)	(-1.122)	(-1.550)
GDP (log)	-0.259**	-0.180***	-0.192**	-0.153**
	(-2.000)	(-3.241)	(-2.392)	(-2.623)
GDP per capita (log)	-0.106	-0.067	-0.101	-0.092
	(-0.582)	(-0.853)	(-0.673)	(-0.589)
Democracy	0.061	-0.065*	0.083	-0.092*
	(0.367)	(-1.535)	(0.812)	(-1.628)
Current account openess	-0.018*	-0.007*	-0.032	-0.017**
	(-1.391)	(-1.926)	(-1.147)	(-2.455)
Banking sector size	0.004	0.012	0.011	0.017
	(1.038)	(0.589)	(1.206)	(0.522)
Exchange regime*Separate	-0.109		-0.213**	
	(-0.139)		(-2.676)	
Exchange regime*Banking*Democracy*Separate		-0.004*		-0.005*
		(-1.414)		(-1.525)
R^2	0.42	0.49	0.38	0.41

Note: Panel corrected standard errors in parentheses; *p<=.10; **p<=.05; ***p<=.01

Table 3. GMM without interactive terms

Dependent variable: Log (Five year average inflation)

	(1)	(2)
	De jure	*De facto*
Constant	-4.092**	-8.107
	(-2.409)	(-0.763)
Separate	-1.184***	-0.622*
	(-7.241)	(-1.724)
Exchange regime	-0.886*	-0.552
(Fixed=1 ; Floating=0)	(-1.763)	(-1.214)
GDP (log)	-0.258***	-0.243**
	(-4.611)	(-2.207)
GDP per capita (log)	0.054	0.060
	(0.636)	(0.558)
Democracy	-0.048*	-0.035*
	(-1.647)	(-1.481)
Current account openess	-0.009*	-0.012
	(-1.513)	(-0.788)
Banking sector size	0.002	0.005
	(1.237)	(1.109)
J-Statistic	1.68 E-20	1.32 E-23

Note: Panel corrected standard errors in parentheses; *p<=.10; **p<=.05; ***p<=.01.

Table 4. GMM with interactive terms

Dependent variable: Log (Five year average inflation)

	(1)	(2)	(3)	(4)
	De jure	*De jure*	*De facto*	*De facto*
Constant	-3.634	-1.902*	-8.015	-8.103*
	(-1.945)	(-1.055)	(-0.945)	(-1.621)
Separate	-1.124***	-0.842***	-0.634*	-0.626***
	(-5.837)	(-3.415)	(-1.806)	(-3.310)
Exchange regime	-0.889	-0.461*	-0.577*	-0.560
(Fixed=1 ; Floating=0)	(-0.701)	(-1.485)	(-1.586)	(-0.533)
GDP (log)	-0.241***	-0.178**	-0.250*	-0.247**
	(-3.820)	(-2.927)	(-1.718)	(-2.122)
GDP per capita (log)	-0.053	-0.063	-0.069	-0.066
	(-0.630)	(-0.784)	(-0.555)	(-1.027)
Democracy	-0.033*	-0.057*	-0.035**	-0.041*
	(-1.420)	(-1.476)	(-2.000)	(-1.819)
Current account openess	-0.008*	-0.009*	-0.016*	-0.009*
	(-1.289)	(-1.548)	(-1.404)	(-1.548)
Banking sector size	0.001	0.0053	0.007*	0.009*
	(1.200)	(1.000)	(1.428)	(1.561)
Exchange regime*Separate	0.210		-0.099***	
	(0.592)		(-2.733)	
Exchange regime*Banking*Democracy*Separate		-0.031*		-0.052*
		(-1.466)		(-1.404)
J-Statistic	4.90 E-19	9.88 E-17	1.37 E-23	1.86 E-23

Note: Panel corrected standard errors in parentheses; *p<=.10; **p<=.05; ***p<=.01.

Figure 10. Conditional marginal effects of central bank independence on inflation outcomes

De jure classification
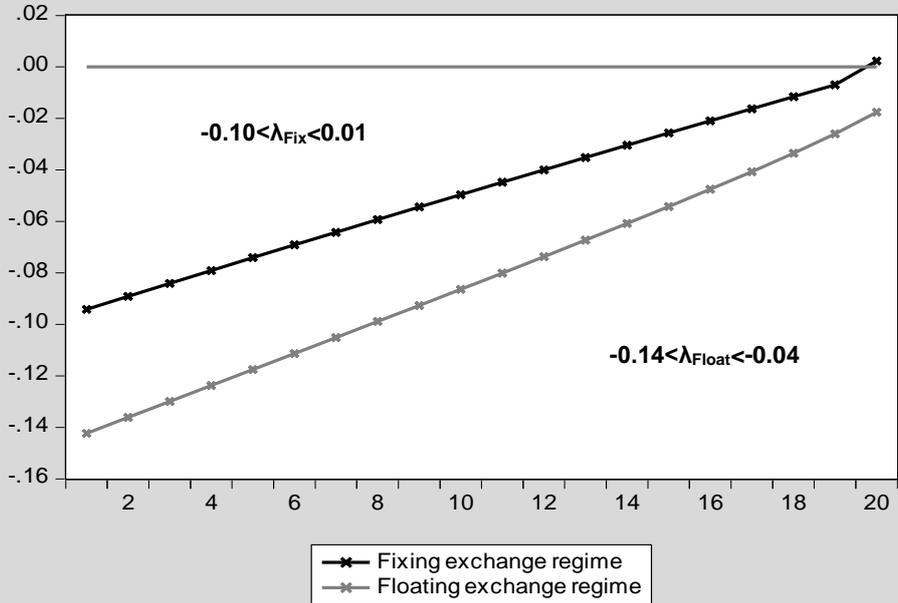

De facto classification
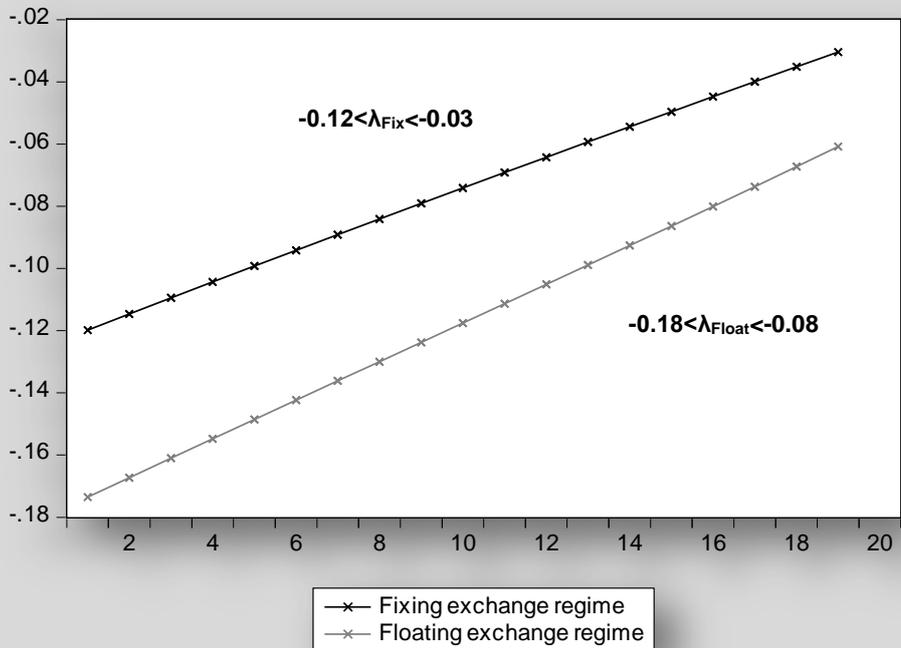
Note: For detailed analysis about the conditional marginal effects, we can see: http://homepages.nyu.edu/~mrg217/interaction.html.

Figure 11. Predicted values of inflation by banking sector size with central bank independence (de jure classification)

X-axis: Domestic private credits as % of GDP; Y-axis: Five years average inflation rate

Fixed exchange regime

Predicted values of inflation

Floating exchange regime
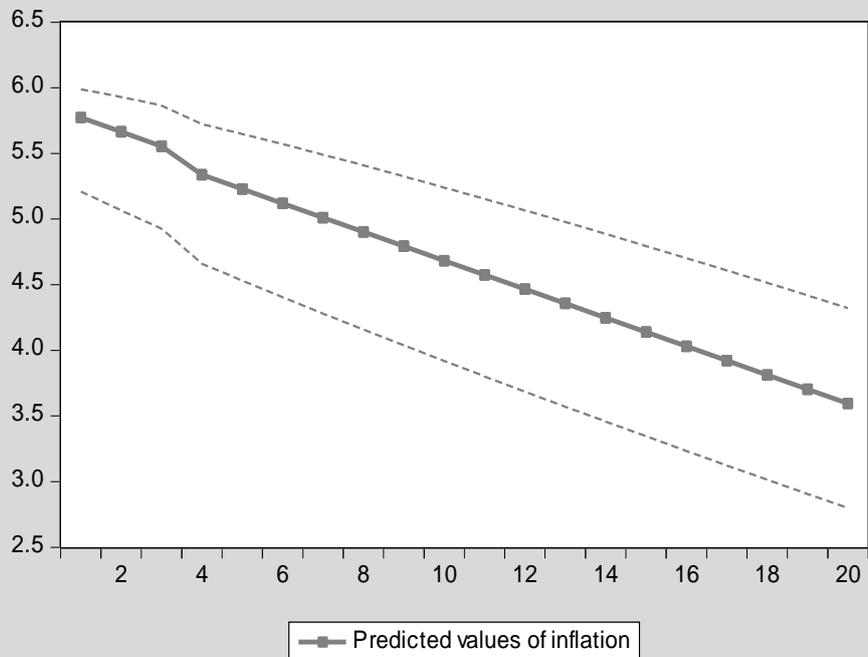
Predicted values of inflation
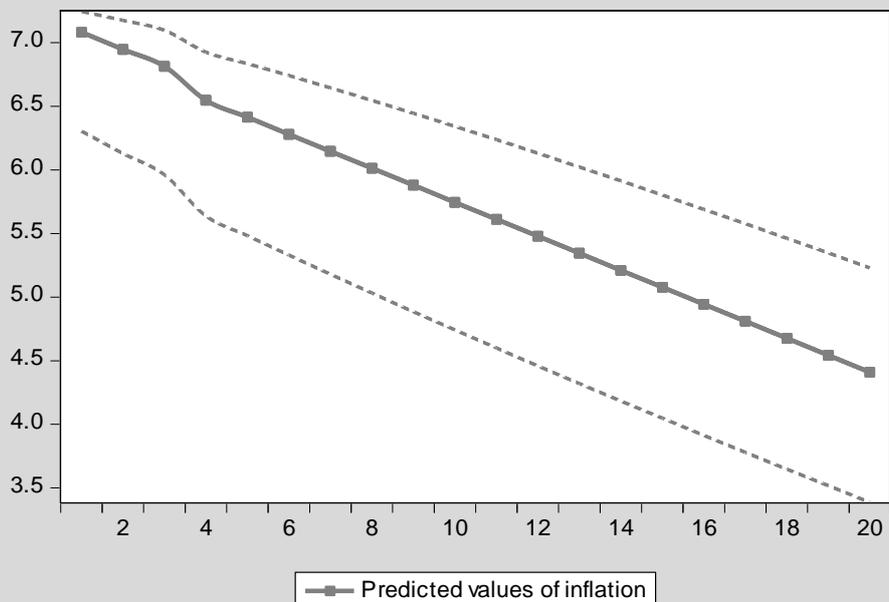
Note: Dashed lines indicate 95% confidence intervals.
Calculations done by using Stata, Clarify software. For more details we can refer to:
http://gking.harvard.edu/publications/clarify-software-interpreting-and-presenting-statistical-results

Table 5. Predicted inflation values conditional on the choice of exchange regime

Exchange rate regime	Does central banks supervise banks?	Predicted average inflation	Confidence interval (95%)
Fixed	Yes (Separate=0)	6.38	4.67-7.12
Floating	Yes (Separate=0)	4.59	3.71-5.74

Appendix A. Predictions concerning the inflation outcomes

Structural characteristics	Empirical predicted inflation
Fixed exchange rate regime	Low inflation average (Sfia and Mouley, 2009)
Floating exchange rate regime	High inflation average (Sfia and Mouley, 2009)
High GDP	Low inflation rate (McKinnon, 1963)
High democracy	Low inflation rate (Copelovitch and Singer, 2007)
High capital openess	Low inflation rate (Gupta, 2007)
Independence of central bank (Separate=1)	Low inflation rate (Copelovitch and Singer, 2007)
Dependence of central bank (Separate=0)	High inflation rate (Dumiter, 2009)
High banking sector size	Low inflation rate (Copelovitch and Singer, 2007)

	Number assigned to category in fine grid	Number assigned to category in coarse grid
Appendix B. Classifications of exchange regimes used in our study		
No separate legal tender	1	1
Pre announced peg or currency board arrangement	2	1
Pre announced horizontal band that is narrower than or equal to +/- 2%	3	1
De facto peg	4	1
Pre announced crawling peg	5	2
Pre announced crawling band that is narrower than or equal to +/- 2%	6	2
De facto crawling peg	7	2
De facto crawling band that is narrower than or equal to +/- 2%	8	2
Pre announced crawling band that is wide than or equal to +/- 2%	9	2
De facto crawling band that is narrower than or equal to +/- 5%	10	3
Moving band that is narrower than or equal to +/- 2%	11	3
Managed floating	12	3
Freely floating	13	4
Freely falling	14	5

Source : Reinhart and Rogoff (2004).

Appendix C. Some independence's indicators

Cukierman's index (CBI)

Focusing on the perspective of central bank involvement in banking regulation (Cukierman (1992) and Copelovitch and Singer (2007)), we can thought to another index, based on annual observations of central bank involvement for each country, which presents a variable which takes account into the role of the central bank in banking regulation and supervision, noted (CBI). This latter is equal to :

0= if the central bank is not assigned the main responsibility for banking supervision.

1= if the central bank assigned the main responsibility for banking supervision.

GMT index

This index is initiated by Grilli et al. (1991). It takes account on both political autonomy and economic autonomy of central banks (CB).

Political autonomy:

1= Governor appointed without government involvement.

2= Governor appointed for more than 5 years.

3= Board appointed without government involvement.

4= Board appointed for more than 5 years.

5= No mandatory participation of government representatives in the board.

6= No governmental approval is required for formulating monetary policy.

7= Requirements forcing CB to pursue monetary stability among its primary objectives.

Economic autonomy:

1= No automatic procedure for government to obtain direct credit facilities from CB.

2= Direct credit facilities extended at market rates.

3= Credit on a temporary basis.

4= Credit of limited amount.

5= CB does not participate in primary market for public debt.

6= CB is responsible for setting the Discount Rate.

7= CB has no responsibility for overseeing the banking sector and shares responsibility with other institutional entities.