Capital Account Policies, IMF Programs and Growth in Developing Regions

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ABSTRACT

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This paper develops an adaptive learning model under uncertainty that examines evolution of capital account polices over time and across developing regions. In the framework, countries' past experiences and IMF programs influence policymakers' beliefs about the impact of capital account liberalization on growth, under the 'Mundell's trilemma constraint. The model, calibrated to data for Africa, Latin America and developing Asia, reflects relatively well capital account policies adopted in 1980-2010. It shows that even more developed countries with liberalized capital accounts may revert to controls under large output shocks. The outcomes of capital account switches are better and closer to policymakers' expectations in countries with the IMF programs, underscoring the role of complementarity of policies.

JEL Classification: F43, O4, O43, O55

Keywords: adaptive learning, dynamics of capital account policies, growth, IMF programs

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I. Introduction

Africa, as other developing regions, has experienced a surge in private capital inflows since the early 2000s (Dorsey et al., 2008; AfDB et al., 2013). Large capital inflows and their sudden reversals can lead to inflation, growth and exchange rate volatility and even crisis. They thus require appropriate policies. Capital controls are one of the measures that can address capital flows volatility, but come with substantial cost (Edwards, 1999; IMF, 2013a).[2]

How prepared are the African policymakers to make the most out of capital inflows while mitigating their cost? Until recently, managing volatile capital flows has not created a major policy challenge for the continent, not even during the global financial crisis (Kasekende et al., 2010).[3] This is because the relatively stable foreign direct investment (FDI) inflows account for most of capital inflows. However, given the trend towards Africa's deeper integration into the global financial markets, its frontier market countries are becoming increasingly vulnerable to global financial shocks (IMF 2013a). Effective management of the financial integration and the volatile capital flows is becoming a policy priority.

This paper models the impact of uncertain growth outcomes on capital account policies in the adaptive learning framework. In this framework, policymakers choose capital account policies (liberalization or controls) while taking into account the net growth payoffs. Their choices are constrained by the 'Mundell's trilemma' – the ability to reach only two goals among financial liberalization, fixed exchange rate and monetary autonomy. The model is simulated with parameters which reflect policymakers' initial beliefs about the impact of capital account policies on growth and are updated each period for actual outcomes.

The paper explores the ability of an adaptive learning framework to reflect capital account liberalization paths in Africa, Latin America and developing Asia. The impact of policies on growth level and volatility has been widely debated. The views have changed over time:

> '…The IMF once advocated the removal of all controls on outflows and inflows in the heydays of the Washington Consensus in the 1990s. The Asian Crisis of 1997-1998, however, initiated a slow process of conversion that culminated with the IMF's recent decision to explicitly and openly support the imposition of controls on capital inflows.....' (Jinjarak et al., 2012)

The adaptive learning framework reflects relatively well countries' paths of capital account policies. Even countries' with liberalized account may introduce capital controls when hit by large output shocks. Finally, the model predicts policy switches more accurately when the IMF programs are included, underscoring the importance of complementarity of policies.

The paper is organized as follows. Section II reviews the literature and Section III presents key facts. Section IV outlines the model while Section V carries out policy analysis. Section VI studies the impact of IMF programs and Section VII concludes.

II. The Literature Review

The results of theoretical and empirical literature on the capital account policies and growth in developing countries are mixed (Prasad and Rajan, 2008). On the one hand, liberalizing

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[2] The other measures are macro-prudential regulations, foreign exchange interventions and/or the policy rate.
[3] Ncube et al. (2012) document the transmission channels from US to South Africa, which was one of the African countries impacted by the financial crisis through the portfolio flows channel.

capital flows can promote growth and employment through financial deepening and better allocation of resources (Kose, at al., 2009). On the other hand, financial liberalization raises uncertainty and can lead to excessive risk taking, resulting in more frequent financial crises (Tornell and Westermann, 2005; Brixiová et al., 2010). Predictions of the theoretical literature are also ambiguous. As Rancière et al. (2012) show, the productivity gains from allocative efficiency need to be balanced with losses from higher incidence of crises.

Over time, policymakers' views on capital account policies have evolved from favoring liberalization under the Washington consensus to recognizing usefulness of capital flow restrictions in specific circumstances. The global financial crisis reinforced the message that full capital account liberalization may not be the right goal for all countries at all times. In fact, IMF (2013b) acknowledges usefulness of capital account controls during a financial crisis or when the crisis is imminent. Studies show that depending on the shocks, either capital controls or liberalization can be optimal (Farhi and Werning, 2013).

Africa has pursued gradual capital account liberalization. Regulations of capital flows are complex, with many restrictions. The capital account liberalization raises uncertainty about growth and other outcomes for several reasons. First, capital controls alter the overall economic environment, but the impact on incentives and outcomes will be known only with time. Second, capital flows raise exposure of the economy to external shocks. Third, due to their pro-cyclicality, capital flows exacerbate negative shocks to the domestic economy.

The application of the adaptive learning framework to macroeconomic issues, and especially capital account policies, in developing countries has been scarce scarce. Building on the adaptive learning models of Bicaba and Coricelli (2014) and Buera et. al. (2011), this paper contributes to closing this knowledge gap.[4] The adaptive learning framework is suitable for developing countries that receive severe and frequent shocks (e.g. conflicts, political crises, weather), impacts of which are difficult to predict. The structural weaknesses that permeate developing countries further destabilize the policymakers' expectations.[5] The paper is also related to the long-standing debate on rules vs. discretion in policymaking (Kydland and Prescott, 1977). The adaptive learning approach leaves room for discretion where policymakers can adjust their choices with new information and thus correct for past errors.

The paper seeks to answer the following questions:
- (i) Does adaptive learning framework capture paths of capital account policies in developing regions, including the delayed liberalization in Africa?
- (ii) When may countries with liberalized capital accounts introduce controls?
- (iii) How do IMF programs impact countries' learning about capital account policies?

III. Stylized Facts

III.1. Policy uncertainty

Policymakers in developing regions face a greater uncertainty than those in advanced economies regarding the impact of policies on growth. This is also shown in the discrepancy

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[4] This model differs from Bicaba and Coricelli (2014) as follows: (i) it analyzes developing countries, (ii) it includes the impact of IMF programs, positing that developing countries can learn from their IMF interactions; (iii) it includes the period of the latest (2009) global financial crisis and its aftermath.

[5] The importance of adaptive learning for capital account management has been found in Prasad and Rajan (2008) who posit that countries will liberalize their capital account when the risks of doing so are low.

between the forecast and actual growth in 1990 – 2011 (Table 1). Such uncertainty makes the learning framework relevant for Africa and developing countries in general.

*Table 1*. Estimates of bias forecasts of GDP

	1990 - 2011	1990 - 2011 (without outliers)
		(percentage points)
Advanced Economies	0.07	0.10
Africa	-0.77	-0.43
Developing Asia	-0.02	0.18
Latin America	-0.24	-0.12

Source: Genberg and Martinez (2014).

III.2 Increased capital account openness

The capital account openness is measured with the *de facto* and the *de jure* indicators. The "*de facto*" openness is the sum of capital inflows and outflows relative to the GDP, while the "*de jure*" openness covers regulations.[6] In Africa, the *de jure* openness is outpacing the *de facto* one, as countries have been experiencing liberalization without financial integration.

Figure 1. Evolution of the regional share of capital account liberalization
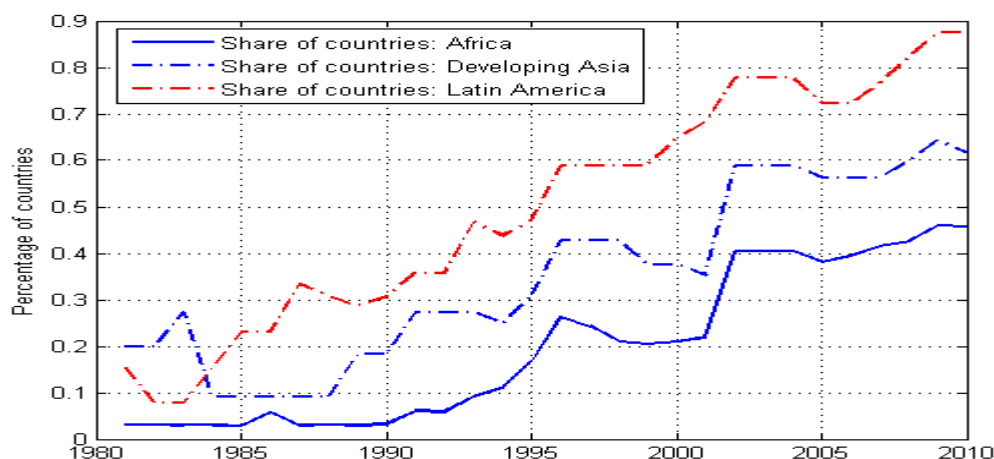
Source: Authors' calculations based on Shrindler (2009) database.

We consider an economy to be liberalized when both the *de facto* and the *de jure* indicators of capital openness show so. The periods of *de facto* capital account liberalization are constructed by identifying the episodes of major capital inflows (i.e. important changes in the trend of capital inflows).[7] According to this criterion eighteen (18) African economies liberalized their capital accounts as of 2012. Africa exhibits overall trend towards capital

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[6] As in Chinn and Ito (2008), this variable is obtained from the IMF's Annual Report on Exchange Arrangements and Restrictions. Specifically, it is obtained through the first standardized principal component of the variables that indicate (1) the presence of multiple exchange rates, (2) restrictions on current account transactions, (3) on capital account transactions, (4) and the requirement of the surrender of export proceeds.

[7] The date of structural break is identified through Andrews-Zivot test and the multiple structural breaks test. The 'de facto' index signals the year when a country has liberalized. To avoid the potential false signals of liberalization, the Andrew-Zivot identification is supplemented by a threshold analysis. Therefore, a country is financially liberalized at year t if total capital inflows has a trend break at or before t and there is at least one year with a capital inflows-to-GDP ratio greater than 5% at or before t (see Rancière et al. 2006).

account liberalization (Figure 1), but the speed of liberalization differed across countries. For example, Mauritius and Zambia fully liberalized in the early 1990s, but Angola, Tunisia and Tanzania kept strong restrictions in place during 1995-2005.[8]

III.3 Factors impacting capital account liberalization

Several factors can explain capital account liberalization. Key among them are (i) restrictions due to the Mundell's impossible trinity and (ii) uncertainty about growth benefits of liberalization.[9] The scope for liberalization in the 1980s and 1990s has been limited by the 'fear of floating' and by rules and convergence targets of various regional economic zones. The acceleration of capital account liberalization in Africa during the early 2000s may be related to debt relief and the associated conditions under the IMF programs.

a. Mundell's trilemma

Figure 2. Evolutions of Mundell's Trilemma in Developing Regions, 1970 - 2010

Figure 2a. Africa
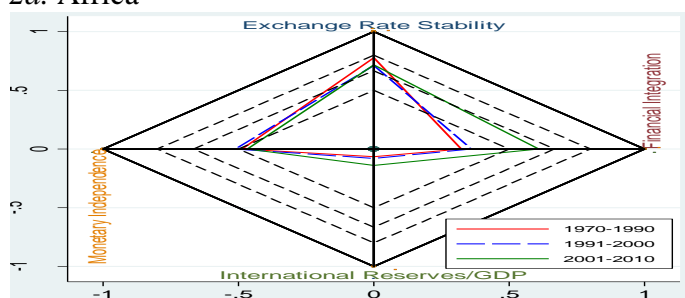
Figure 2b. Developing Asia
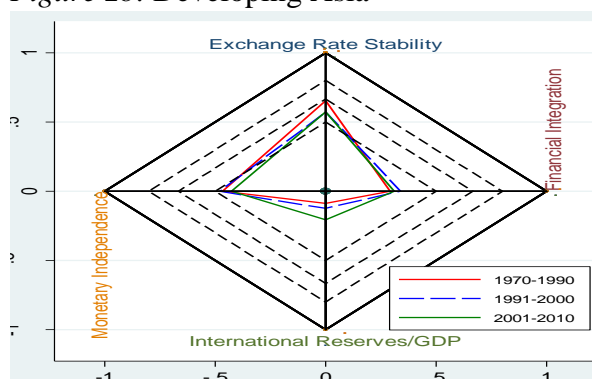
Figure 2c. Latin America
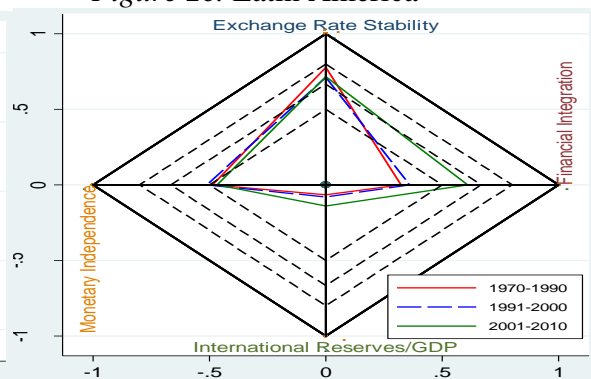
Source: Authors' calculations based on Aizenman, Chinn and Ito (2012) database. In this case, the indices range from 0-1 and consitute weighted average for Africa. The origin represents zero monetary independence, pure float, zero international reserves, and financial autarky.

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[8] Capital account restrictions in Tunisia and Tanzania did not change during 1995 - 2005. Tanzania partially liberalized capital account in the 1990s but retained restrictions on portfolio investment. Angola has re-imposed some restrictions on FDI inflows in 2003, but removed restrictions on direct investment liquidation in 2004.

[9] The Mundell's trilemma (impossible trinity) posits that a country can achieve only two policy objectives out of financial integration, exchange rate stability and monetary independence (Aizenman, 2011). Three indexes are used to describe the trilemma, ranging from 0-1. Higher values of exchange rate stability index indicate more stable movement of the exchange rate against the currency of the base country (Aizenman et al., 2012).

In Africa, outside of the countries which entered common monetary areas (WAEMU, CEMAC and CMA), the goal of monetary independence was an important constraining factor. This reflects a relatively high frequency of shocks in Africa that independent monetary policy can help mitigate. African policymakers in low income countries also value exchange rate stability. In contrast, capital account liberalization was the least important factor in Africa's trilemma configuration (Figure 2).

b. Uncertain growth payoffs

Capital account liberalization involves trade-offs between higher longer term growth due to improved allocative efficiency and lower growth related to financial crises and the uncertainty that they bring about.[10] Rancière et al. (2006) posit that over the long run, the pro-growth effects of financial deepening outweigh the negative effects of crises.

Table 2. Financial crises, capital account openness, and growth, 1970 - 2010

	Capital Account Status			Open economies		
	Open	Closed	Difference [a]	After	Before	Difference [a]
Real GDP per capita growth (percent)	1.896	0.694	1.201**	1.424	0.622	0.802[c]
Real investment growth (percent points)	0.2029	0.009	0.194	0.002	-0.0735	0.0755
Growth volatility (Standard deviation)	8.894	5.439	2.673**	10.421	4.449	2.342***
Current account balance (% GDP)	-5.442	-6.381	-0.939***	-3.952	-6.158	-2.469***
Crises (frequency)	**0.025**	**0.095**	**-0.070*****	**0.035**	**0.131**	**-0.096*****
Terms of trade volatility (Standard deviation)	26.323	49.19	1.869***	21.074	47.970	2.276 ***

Sources: Authors' calculations. Note: (*), (**) and (***) indicate that statistics are significant at 10%, 5% and 1%, respectively, and 'c' indicates that statistics are above but close to 10%. (a) The test of volatility difference uses the ratio of variances.

Table 3. Capital account regime and growth cost of financial crises

			Open economies	
Capital Account Status	Open	Closed	After	before
Crises	-5.366	-0.360	-5.366	0.106
Currency crises	0.434	0.187	0.434	0.244
Banking crises	-9.251	-0.054	-9.251	-0.254
Debt crises	-4.211	-2.253	-4.211	-1.211

Source: Authors' calculations based on the AfDB and World Bank databases. **Note:** The growth cost is computed by taking the average growth during the 4 years after the financial crisis occurred (the crisis year is included). Any type of financial crisis (debt, currency or banking crises) is considered.

In Africa capital openness is associated with higher longer term growth than capital controls, despite cost of financial crises (Table 2 and 3). Capital controls have not reduced Africa's financial fragility. In fact, financial crises have been more frequent in countries with closed than liberalized accounts.[11] However, crises that occurred after liberalization tend to be severe and more costly in terms of per capita growth than crises before liberalization.

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[10] Clearly, besides capital account policies other factors impact growth outcomes. Since the impact of capital account policies is still subject of discussions, we focus on this topic.

[11] These observations can be explained by composition of capital flows. FDI inflows, which are relatively stable, have comprised most of the capital flows to Africa, while the more unstable portfolio flows have been sparse.

c. IMF programs

As already underscored in Joyce and Noy (2008), IMF programs are not systematically associated with capital account liberalization. This is confirmed by analysis of specific IMF programs which shows that some types of programs (SBA and EFF) had a negative (and statistically significant) impact on capital account openness in Africa (Table 4).

Table 4. IMF programs and capital account openness

	Africa			Latin America			Developing Asia		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
SBA5[t-3,t+3]	-0.176***			-0.151***			-0.224***		
	(0.0180)			(0.0417)			(0.0470)		
PRGF5[t-3,t+3]		0.0848***			0.280***			0.106**	
		(0.0210)			(0.0624)			(0.0531)	
EFF5[t-3,t+3]			-0.148***			-0.133***			-0.0746
			(0.0298)			(0.0456)			(0.0618)
Observations	1,352	1,352	1,352	589	589	589	391	391	391
N	44	44	44	19	19	19	13	13	13
Fixed effects and constant	YES	YES	YES	YES	YES	YES	YES	YES	

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. This table shows the results of a linear probability model linking capital account openness and IMF programs. This model controls for individual effects. SBA5 is a dummy variable for IMF Stand-by-Arrangement in effect for at least 5 months in a particular year. PRGF5 is a dummy variable for IMF Poverty Reduction and Growth Facility Arrangement in effect for at least 5 months in a particular year. EFF5 is a dummy variable for IMF Extended Fund Facility Arrangement in effect for at least 5 months in a particular year.

IV. The Model

This section presents a model in which policymakers update their beliefs about growth impact of capital account policies. The beliefs are also impacted by the adoption of IMF programs. These beliefs then in turn impact policymakers' choices of capital account policies.

IV.1 The Environment

The choice of capital account policies consists of two options – to either liberalize capital account or impose controls. Policies are chosen every period, so as to maximize the expected level of per capita GDP.

Let θ_{it} denote indicator at time t, $\theta_{it} \in [0,1]$, where $\theta_{it} = 1$ when policymakers in country i choose capital account liberalization and $\theta_{it} = 0$ when they adopt capital controls. In this model, the payoff associated with each policy option comprises a benefit and a cost. Denoting Y_{it} to be the per capita GDP in country i at time t , $y_{it} = \log Y_{it} - \log Y_{it-1}$ is the growth rate. Policymakers, who have their jobs for one period, choose θ_{it} to solve:

$$\underset{\theta_{it} \in [0,1]}{Max} \ U_{it} = E_{it-1}\left[\log Y_{it} - \theta_{it} Z_{it}\right]$$

Further, 'stronger capital accounts' and accumulation of international reserves prior to the global financial crisis have increased Africa's resilience to external shocks (Elhiraika and Ndikumana, 2007).

$$\text{s.t.} \quad y_{it} = \theta_{it} y_{it}^L + (1 - \theta_{it}) y_{it}^A = \theta_{it} \beta_i^L + (1 - \theta_{it}) \beta_i^A + \varepsilon_{it} \qquad (1)$$

$$a_i^e T_{it}^e + a_i^m T_{it}^m + a_i^\theta \theta_{it} + \zeta_{it} = \overline{\lambda}$$

where Z_{it}, is the cost of capital account liberalization and E_{it-1} denotes expectations. Further, $\varepsilon_{it} \rightarrow N(0, \Sigma)$ and $\varsigma_{it} \rightarrow N(0, \sigma_\zeta^2)$. The maximization is subject to (i) policymakers' perceived relationship between capital account policy choices and GDP growth and (ii) the constraint imposed by the Mundell's trilemma. Policymakers solve the problem given equation (1) as if these beliefs will not change in the future.

The policymakers' perceptions about relationship between policy choices and GDP growth are derived from payoffs associated with each policy option. Specifically:

Capital liberalization option, with payoffs: $y_i^L(t) = \dfrac{d(\log Y_{it}^L)}{dt} = \beta_i^L dt + \varepsilon_i^L(t)$, and

Capital control option, with payoffs: $y_i^A(t) = \dfrac{d(\log Y_{it}^A)}{dt} = \beta_i^A dt + \varepsilon_i^A(t)$

where y_{it} is the observed GDP per capita growth, y_{it}^L and y_{it}^A are the growth rates attributed to liberalization and capital control policies respectively, and β_i^L and β_i^A are the perceived effects of capital account liberalization and control in country i, respectively. From the payoffs, policymakers form beliefs about the dynamics of GDP per capita growth as follows:

$$y_{it} = \theta_{it} y_{it}^L + (1 - \theta_{it}) y_{it}^A = \theta_{it} \beta_{it}^L + (1 - \theta_{it}) \beta_{it}^A + \varepsilon_{it} \qquad (2)$$

Equation (2) implies that policymakers perceive capital account policies to be a linear function of the real GDP per capita growth. ε_{it} denotes errors in the policymakers' perceptions or the unexplained part of growth. The errors arise because capital account policies are not the only sources of growth and the policymakers do not know the exact effects of each capital account policy. In choosing policies, the policymaker considers also the relative cost (in terms of growth) of capital openness relative to capital controls.

The costs associated with capital account liberalization, Z_{it}, can be described as:

$$Z_{it} = F_{it} + u_{it}; u_{it} \rightarrow N(0, \eta_i^2) \quad \text{and} \quad F_{it} = \pi K_{it} \qquad (3)$$

with a deterministic part, F_{it}, a stochastic part u_{it}; K are the determinants of the cost of policy and parameters π describe how these determinants are related to policy costs. The dispersion of the unobserved component of costs is country specific ($Var(u_{it}) = \eta_i^2$), reflecting that countries have different degrees of resilience to unobserved negative shocks.

The decision to liberalize capital account is constrained by the Mundell's trilemma, that is by the exchange rate regime (T_{it}^e) and the degree of monetary independence T_{it}^m:

$$a_i^e T_{it}^e + a_i^m T_{it}^m + a_i^\theta \theta_{it} + \zeta_{it} = \bar{\lambda} \qquad (4)$$

where $\bar{\lambda}$ is a constant and homogenous target characterizing the policy constraints and ζ_{it} denotes a set of random shocks to the trilemma. These shocks are normally distributed with zero mean and with variance σ_ζ^2: $\zeta \rightarrow N(0, \sigma_\zeta^2)$. Moreover, the Mundell trilemma constraint $\bar{\lambda}$ is the same across countries. However, the way domestic policymakers achieve the trilemma configuration varies i.e. $a_i^k \neq a_j^k \qquad k = e, m, \theta \qquad and \quad i \neq j$.

Agents treat the parameters of their decision model as constant when they form decision rules, but update them according to actual observations. Thus, the timing of events is as follows: at the end of time *t-1*, policymakers in country *i* observe the past policy choices and the associated GDP growth rates, and update their beliefs about β_i^L and β_i^A accordingly.

IV.2. Equilibrium

Policymakers arrive at an equilibrium decision rule for capital account policies by solving (4). They choose to pursue capital account liberalization policies *(i.e. $\theta_{it} = 1$)* if the expected gain in growth rates associated with this policy exceeds the cost.[12] That is,

$$\theta_{it} = \begin{cases} 1 & if \quad E_{it-1}(\beta_i^L) - E_{it-1}(\beta_i^A) - Z_{it} - \delta[(a_i^e T_{it}^e + a_i^m T_{it}^m + \zeta_{it}) - \bar{\lambda}] > 0 \\ 0 & Otherwise \end{cases} \qquad (5)$$

The equilibrium policy rule is defined as the optimal time allocated to capital account liberalization (or to capital control).[13] In equilibrium, policymakers' expectations must be consistent with actual probability of liberalizing:

$$E(\theta_{it} = 1 | D^{t-1}) = \Phi\left(\frac{E_{it-1}(\beta_i^L) - E_{it-1}(\beta_i^A) - F_{it} - \delta[(a_i^e T_{it}^e + a_i^m T_{it}^m) - \bar{\lambda}]}{\eta_i^2 + \delta^2 \sigma_\zeta^2}\right) \qquad (5')$$

where E is an expectation operator, D^{t-1} is policy decision taken at *t-1* , Φ is a normal distribution function, and $E_{it-1}(\beta_i^L) - E_{it-1}(\beta_i^A)$ the expected gain from capital account liberalization.[14] The probability that capital account liberalization policies will be adopted is high when policymakers are optimistic about the growth effect of these policies, that is when

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[12] The proof of the existence of this equilibrium is available upon request from the authors. It is based upon the policy decision following a cutoff rule which is continuous and strictly monotonic in $E(\beta)$.

[13] Assuming that the measure of countries is normalized to one, the share of countries dedicated to the policy option $\theta_{it} = 1$ at time t, α_{it}, can be expressed as the probability that $\theta_{it} = 1$: $\alpha_{it} = E(\theta_{it}) = \Pr(\theta_{it} = 1)$.[13]

[14] This decision framework is similar to the rule derived in Buera et al., (2011) and Bicaba and Coricelli (2014).

$$\frac{dE\left(\theta_{it}=1\middle|D^{t-1}\right)}{d\left[E_{it-1}\left(\beta_i^L\right)-E_{it-1}\left(\beta_i^A\right)\right]}>0. \tag{6}$$

The growth benefits of capital account liberalization are adjusted for the cost associated with complying with the Mundell trilemma. Specifically, δa_i^e and δa_i^m indicate the costs of fixed exchange rates and independent monetary policy, respectively. The constraint in (4) implies that for $a_i^e, a_i^m > 0$ probability of capital account liberalization decreases with the higher exchange rate stability. Policymakers in countries with fixed exchange regime are expected to prefer capital controls to liberalization. Similarly, a greater monetary independence lowers the chance that policymakers would opt for capital account liberalization.

IV.3 Learning

In this model, we posit that for behavior of policymakers, especially in developing countries, rational expectations are a too strong assumption. Policymakers make errors, either in their expectations about workings of the economy or its parameters. Their expectations about the impact of policies on outcomes change over time. Likelihood of errors is even higher in Africa given the frequent shocks impacting the continent.

We assume that policymakers do not know the exact effects of capital account liberalization on growth.[15] Instead, they form expectations about the effect of each capital account policy option. Their perceptions are described by Equation (1). Since β^L and β^A are unknown, policymakers form initial beliefs about them. These priors are updated recursively, as:

$$\hat{\beta}_t = \hat{\beta}_{t-1} + g_t \times \left[y_t - E\left(y_t\middle|y_{t-1}\right)\right]$$
$$P_t = P_{t-1} + X_t\Sigma^{-1}X_t \tag{7}$$

where $\tilde{\varepsilon}_{t-1}$ -- derived as $E\left(y_t\middle|y_{t-1}\right)=X_t\hat{\beta}_{t-1}$ and $y_t - E\left(y_t\middle|y_{t-1}\right)=\tilde{\varepsilon}_{t-1}$ -- is the perception error of policymakers at time t-1; $X_t = \left(\theta_t, 1-\theta_t\right)^{'}$ is a vector collecting new data on results of capital account policies, and $\beta_{t-1}=\beta(t-1)$ and $\beta_t = \beta(t)$ denote the policymaker's prior and posterior beliefs about β and $d\beta_t = \beta_t - \beta_{t-1}$ indicates changes in these beliefs, while $g_t = P_t^{-1}X_t^{'}\Sigma^{-1}$ describes the sequence of gains from learning. Finally, Σ is the variance-covariance matrix and P is the inverse of beliefs' covariance matrix. In (7) parameter g_t describes 'speed of learning', or how quickly domestic policymakers adjust their expectations (perceptions) about the growth effects of capital controls or liberalization.[16]

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[15] Assuming uncertainty about the gains of capital account liberalization is plausible since robust support for large quantifiable benefits or costs of international financial integration has been missing (Rey, 2013).

[16] As $g_t \to 0$, agents perceive all changes as temporary and their model converges to the true data generating process of the economy: $\hat{\beta}_t = \hat{\beta}_{t-1}$ (see Buera et al., (2011) for the properties of g_t).

The timing is such that policymakers form their beliefs about the effects of liberalization (or no liberalization) at t-1. The decision to liberalize or not is taken based on these beliefs. These beliefs are updated at *t* with new information. Policymakers will switch to the alternative policy option in the presence of a large negative shock to growth.

V. Results

This section presents the results. Estimations are carried out with unbalanced panel data. The updating of policymakers beliefs is country-specific.

V.1 Parameterization -- Policymakers' initial beliefs

To derive the initial beliefs of policymakers about the impact of capital account policies on growth, we consider a sample of 45 African countries during 1980-2010. Since the information on de jure capital account liberalization (i.e. regulations and policies) is limited to 2006, the 'de jure' measure is supplemented by the 'de facto' one for 2007 - 2010. This allows us to include the period of the global financial crisis. We also compare Africa's experience with those of Latin America (19 countries) and developing Asia (18 countries).[17] The initial policymakers' priors using observed data from 1960-1980 (Table 5). In 1980, African policymakers viewed capital controls as optimal, since countries with capital controls posted higher growth that those that liberalized, i.e. $\beta_0^L < \beta_0^A$. Moreover, a number (15) of Africa countries experienced debt crisis during 1980-1985, worsening the already negative perceptions about impacts of financial liberalization.

Table 5. Estimates of prior beliefs

Parameters	Distribution	Priors			
		Whole sample	Africa	Developing Asia	LAC
β^L	$\beta_{i0}^L \rightarrow N(\overline{\beta}_{i0}^L, \eta_\beta^2)$	0.02185	0.00949	0.03699	0.02965
β^A	$\beta_{i0}^A \rightarrow N(\overline{\beta}_{i0}^A, \eta_\beta^2)$	0.01803	0.01630	0.01495	0.02178
η_β		0.02	0.02	0.02	0.02
$\overline{f}$	$f_i \rightarrow N(\overline{f}, \eta_f^2)$	0	0	0	0
ω_f		0.02	0.02	0.02	0.02
a	$\alpha \rightarrow Uniform$	-	-	-	-
π	$\pi \rightarrow Uniform$	-	-	-	-
$\overline{\sigma}^2$		1.367e-07	2.458e-07	5.481e-08	4.310e-08
$var(\overline{y})$		6.731e-08	1.014e-07	3.473e-07	1.131e-08
$v_i = \left[\dfrac{var(\overline{y})}{\overline{\sigma}^2} \right]^{1/2}$	$v_i \rightarrow IG(s_v, d_v)$	0.70166	0.64223	0.3973	0.51230

V.2 Cost of capital account policies

In this section, we analyze determinants of cost of capital account liberalization, namely the level of development (GDP per capita), the degree of financial development, the occurrence of currency crises, and the stock of international reserves. While at the outset the priors of African policymakers were largely in favor of capital controls, policymakers in developing Asia leaned more in favor of capital account liberalization. The uncertainty about these priors (measured by variance) was higher in African countries than in the other regions.

In this model, the costs are expressed in relative terms, that is as a proportion of GDP per capita growth. The parameters (π) of the cost function ($F_{it} = \pi K_{it} + u_{it}$) are estimated using the Maximum Likelihood Estimator. Once the decision rule of policymakers is formulated and their beliefs about the growth impact of each policy option (β_i^L and β_i^A) are obtained, a nonlinear probabilistic model is estimated. In addition, we control for countries fixed effects in order to account for cross country differences in capital account liberalization.

Table 6 shows the posterior estimates of the cost parameters. Economic development (measured by GDP per capita) is a key determinant of cost of capital account liberalization. As countries develop and their institutions improve, they can open capital accounts without incurring high costs. The literature on the timing of capital account liberalization emphasizes that a developed banking system, effective prudential regulations, and sound institutions are prerequisites for countries to benefit from large capital flows (McKinnon 1993).

Table 6. Determinants of the costs of capital account liberalization

	Africa	**LAC**	**Developing Asia**
Determinants of cost (π)	1	2	3
Currency crisis $[t, t+3]$	-0.0001	0.0016	-0.0032
	(0.0014)	(0.0019)	(0.0027)
Financial development	-0.0270	-0.0023	0.0135
	(0.0096)	(0.0049)	(0.0100)
GDP per capita	-0.0087	-0.0016	-0.0066
	(0.0026)	(0.0034)	(0.0045)
Monetary constraints (a)			
Exchange rate stability	0.0084	0.0003	0.0047
	(0.0026)	(0.0016)	(0.0045)
Monetary independence	-0.0049	0.0033	0.0171
	(0.0031)	(0.0032)	(0.0092)
Reserves over GDP	-0.0329	-0.0426	-0.1431
	(0.0082)	(0.0212)	(0.0253)
Number countries			
N	45	19	18

Note: This table reports the posterior estimates parameters of the cost function (π) and the trilemma configuration $a = (\delta a_i^e, \delta a_i^m)'$. In brackets are the standard deviations of these parameters.

The second determinant is the financial development captured by the ratio of credit to domestic private sector over GDP. The results suggest that in African countries with a developed domestic financial system and financial markets' friendly policies are on average

associated with a lower cost of liberalization. In contrast, when policymakers adopt capital account liberalization in a context of under-developed domestic financial system, they expose their economy to costly financial crises, as in Calvo and Mendoza (2000). The study by Aoki et al. (2010) shows the adjustment to liberalization of international financial transaction depends upon the degree of domestic financial development. For poor countries with weak policies and institutions, a key lesson is that capital account liberalization works well if implemented with other sound policies (Arteta, Eichengreen and Wyplosz, 2003)

In Africa, the Mundell trilemma configuration differs from the configuration in other regions. In developing Asia, for example, a high degree of monetary independence increases the cost of liberalizing capital account. As a result, Asia's policymakers are less likely to liberalize their capital accounts. Further, by increasing the stock of international reserves by 1% of GDP, African policymakers can reduce the potential growth cost of capital account liberalization. In other words, when the stock of reserves accumulated is high, policymakers perceive capital account liberalization as more beneficial in terms of growth.
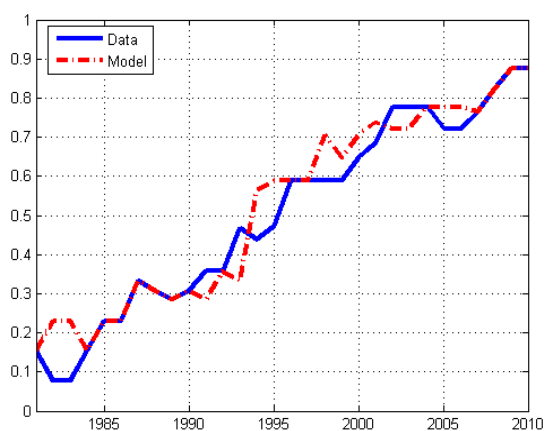
V.3 Model's predictive quality

This section examines whether learning has been an important factor in the dynamics of capital account policies in Africa and in other developing regions.

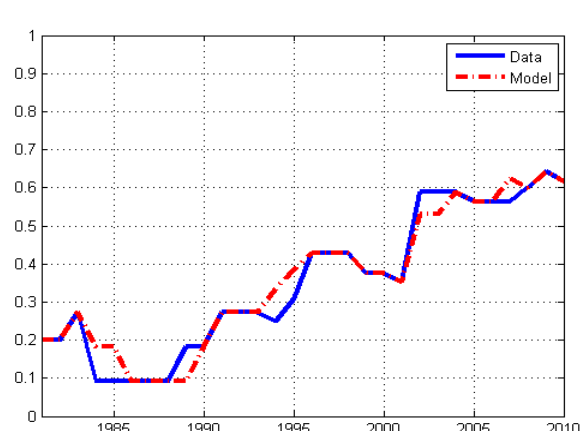*Figure 6.* Predictive quality of the model

6a. Africa
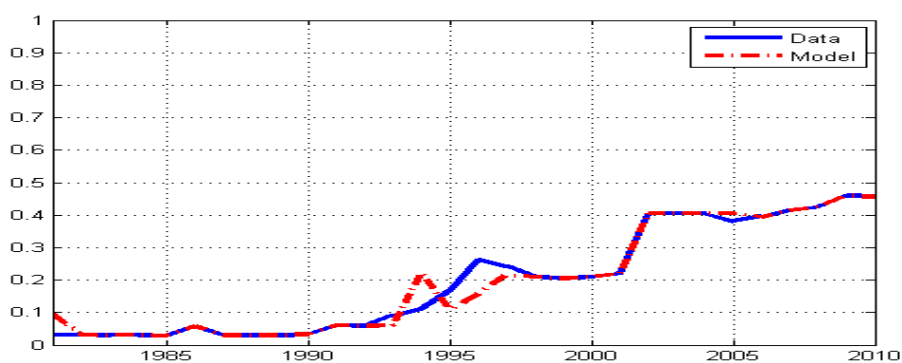
6b. Latin America   6c. Developing Asia

Note: This figure reports the predicted and actual share of liberalized economies in different regions.

Figure 6 reports the actual (solid) and predicted (dash line) shares of economies with liberalized capital account.[18] It illustrates that the model predicts relatively well the very low share of African economies with liberalized capital accounts in the 1980s as well as the acceleration of liberalization in the early 2000s. The predictive quality of the model could be further analyzed by evaluating its behavior of the model in real time i.e., how the model tracks the actual changes in capital account policies.

In Africa, About 50 percent of actual policy switches in capital account policies at time t in Africa are well predicted by the model, while about 60 percent of changes are well predicted at time t+2. The model performs even better in explaining the policy changes in developing Asia, since 62 percent of changes in policies are well predicted at t (without a delay). Finally, for Latin American countries, the adaptive learning framework does not perform as well in explaining the observed changes in policies. In fact, only 6 percent of capital account policy changes that occurred at time t are well predicted, without any delay, by the model (Table 7).

Table 7. Measures of fit of the baseline model

Predictive quality	Africa	Latin America	Developing Asia
Share of good prediction	0.9864	0.9442	0.9799
Predictions in real time			
■ At time t	0.5000	0.0625	0.6154
■ At time t+1	0.4545	0.3750	0.6154
■ At time t+2	0.5909	0.5625	0.7692
Number of countries	45	19	18

V.4 Learning and evolution of beliefs

The difference between the perceived growth under capital account liberalization and under capital account controls ($\beta_t^L - \beta_t^A$) is a key decision parameter for each policymaker. A positive difference indicates that policymaker perceives capital liberalization as preferred policy option to capital controls. Figures (7a) and (7b) depict the evolution of the most frequent difference ($\beta_t^L - \beta_t^A$) i.e. the mode observed at time t. The lightest shaded areas correspond to the 10 - 90th percentiles of the distribution, while the darkest shade denotes the 40 - 60th percentiles. Until 1999 most African policymakers did not perceive liberalization of capital flows as an optimal policy in terms of growth effects, as $\beta_t^L - \beta_t^A$ remained negative.

We analyze the accuracy of African policymakers' expectations about the growth effects of policies, through evolution of the variance of $\beta_t^L - \beta_t^A$ over time, where a high variance means a high uncertainty of expectations. At the beginning of the 1980s, beliefs about the growth effects of each policy option were highly inaccurate, but adaptive learning contributed to improving the accuracy of expectations over time. The accelerated liberalization from the mid-1990s reflects better growth performance of liberalized economies (Figure 7a and 7b).

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[18] The model-predicted values correspond to the sequence of one-step-ahead predictions of each specification. For instance, the value for 2000 in figure 6a represents what the model predicts for the share of economies with liberalized capital accounts in Africa, given the information on GDP growth and policies up to 1999. The value also assumes that in 2000 shock to the costs associated with capital account policies was zero for each African country. This follows from the condition (3) that $Z_{it} = F_{it} + u_{it}; u_{it} \rightarrow N(0, \eta_i^2)$.

Latin American policymakers were from the outset more positive about capital account liberalization than their African counterparts, and they kept this positive outlook over time. The accuracy of their forecasts also markedly improved over time (Figures 7c and 7d). In contrast, in developing Asia the preference for capital account liberalization has fallen in 1980s, and only gradually increased afterwards.

Figure 7. Africa: Evolution of beliefs about the effects of capital account liberalization
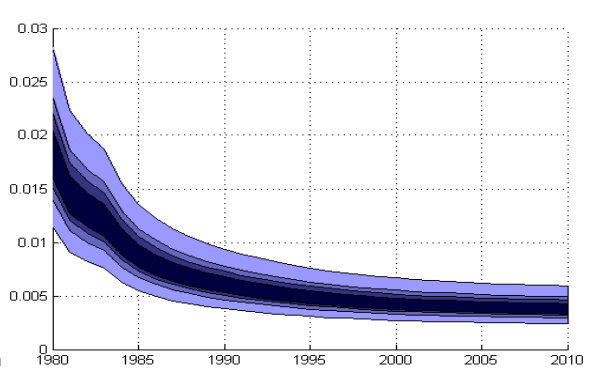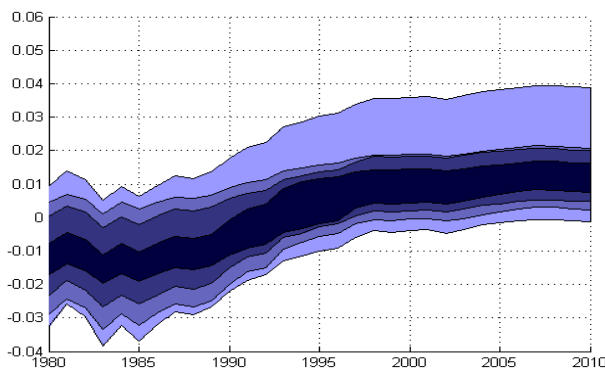
(a) Evolution of beliefs (expectations)   (b) Precision of beliefs (expectations)
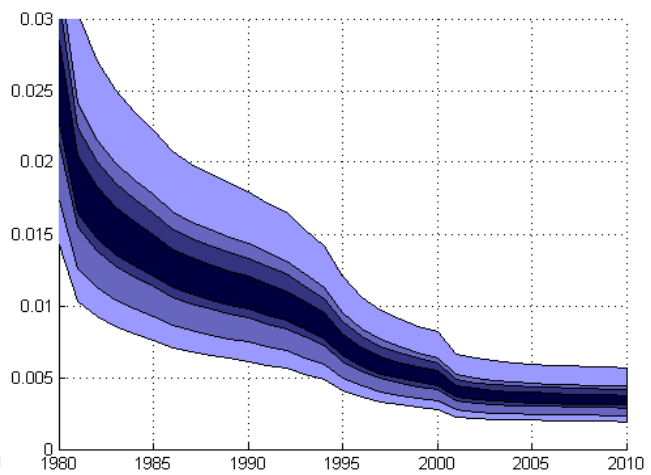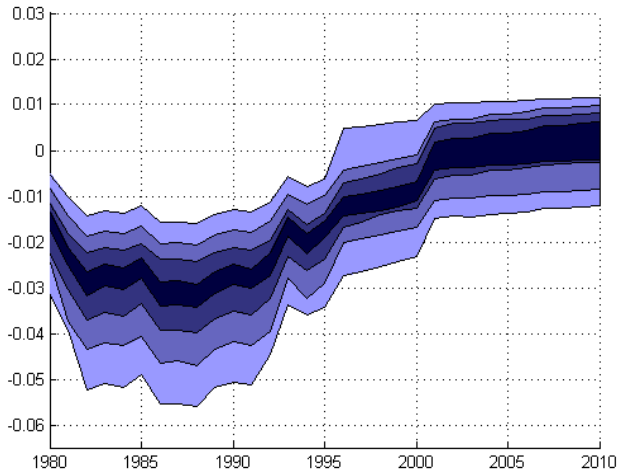
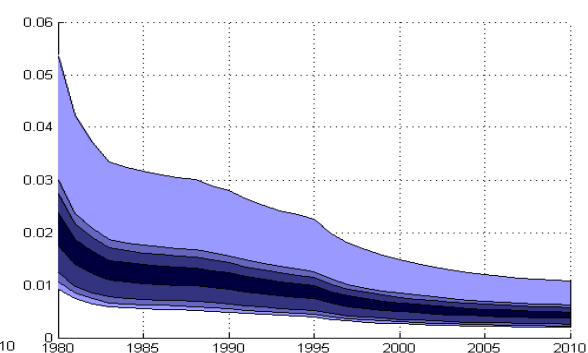
Latin America

(c) Evolution of beliefs (expectations)   (d) Precision of beliefs (expectations)
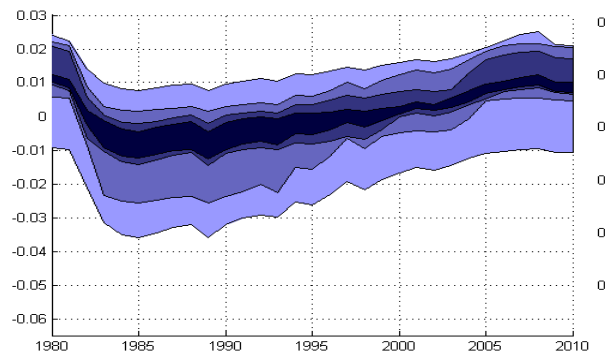

Developing Asia

(e) Evolution of beliefs (expectations)   (f) Precision of beliefs (expectations

Note: Figure (a) reports the mode of the difference between the expected growth under capital account liberalization and under capital control. Figure (b) reports the variance of this difference. This variance indicates the uncertainty about the beliefs.

The main difficulty in showing the role of IMF programs is that IMF loans tend to be made in response to economic problems. Participation in an IMF program is thus a joint decision between a member country and the IMF. Two reasons may explain why the traditional learning framework used in this paper changes

VI. The Impact of IMF Programs

The key challenge in showing the role of IMF programs in capital account policiesis is that in the presence of IMF programs the learning changes. First, the IMF programs can modify the policymakers' perceptions about the net growth gains from capital account liberalization. Indeed, since IMF programs are often adopted when the economies are facing challenges, their adoption is motivated by the need for improvement. Second, IMF programs can directly decrease (or increase) the cost of capital account liberalization, as they are accompanied by conditionality (in terms of macroeconomic targets or structural benchmarks).

A variable (κ_{it}) captures the adoption (or not) of an IMF program such that:

$$\kappa_{it} = \begin{cases} 1 & if \quad IMF \quad program \quad adopted \\ 0 & \quad Otherwise \end{cases} \tag{8}$$

The policymakers have the following options: (i) either they adopt liberalization with the IMF program, or (ii) liberalization without IMF program, or (iii) capital control with the IMF program (iv) or capital controls without IMF program (Table 9).

Table 9. Matrix of policy options

IMF program	Capital account policy	
	($\theta_{it} = 1$)	($\theta_{it} = 0$)
($\kappa_{it} = 1$)	$z^{(1,1)}$	$z^{(1,0)}$
($\kappa_{it} = 0$)	$z^{(0,1)}$	$z^{(0,0)}$

The policymakers' perceptions evolve as follows:

$$y_{it} = \beta_i^{A'}\left(1 - z_{it}\right) + \beta_i^{L'} z_{it} + \varepsilon_{it}^{z} \tag{9}$$

where $\beta_i^{L'}$ is belief about the effects of capital account under an IMF program and $\beta_i^{A'}$ is policymaker's belief under the alternative policy option. In Table 10, we recalculated the priors of policymakers about the growth effects of capital account policies in 1990. Under the IMF programs, African policymakers initially perceived capital account liberalization as damaging to growth. The least optimistic initial beliefs about future growth are observed for the policy option $z^{(1,1)}$ (i.e. liberalized capital account and the presence of IMF program) and the best initial perception is observed for the policy option $z^{(0,0)}$ (i.e. closed capital account and the absence of IMF program).

Table 10. Definition and derivation of priors

Parameters	Distribution	Africa
β^L: liberalized capital account and IMF program ($z^{(1,1)}$)	$\beta_{i0}^L \rightarrow N\left(\bar{\beta}_{i0}^L, \eta_\beta^2\right)$	-0.0235735
Alternative		0.0067273
β^A: Control without IMF program ($z^{(0,0)}$)	$\beta_{i0}^A \rightarrow N\left(\bar{\beta}_{i0}^A, \eta_\beta^2\right)$	0.0145313
Alternative		-0.004278
β^A: Control with IMF program ($z^{(0,1)}$)	$\beta_{i0}^A \rightarrow N\left(\bar{\beta}_{i0}^A, \eta_\beta^2\right)$	-0.0035649
Alternative		0.0107821
$\beta^{L'}$: Liberalized without IMF program ($z^{(1,0)}$)	$\beta_{i0}^{L'} \rightarrow N\left(\bar{\beta}_{i0}^{L'}, \eta_\beta^2\right)$	0.0111825
Alternative		0.0061
$\bar{\sigma}^2$		5.938e-07
$\text{var}(\bar{y})$		2.057e-07
$v_i = \left[\dfrac{\text{var}(\bar{y})}{\bar{\sigma}^2}\right]$	$v_i \rightarrow IG(s_v, d_v)$	0.5885364

Note: the priors are computed over the period 1970-1990.

The main finding is that predictive quality of the model increases with the IMF programs. Figures (8a) and (8b) depict the evolution of beliefs for countries under IMF programs (8a) and for countries without such programs (8b). First, there is a constant improvement in beliefs about future growth in favor of capital account liberalization. Even if they started with a weak economic situation, countries which adopted IMF programs and capital account liberalization have improved their perceptions. Second, the adoption of liberalization is faster with IMF programs, this could be due to perception, conditionalities or both.

Figure 8. Evolution of beliefs: the role of IMF programs
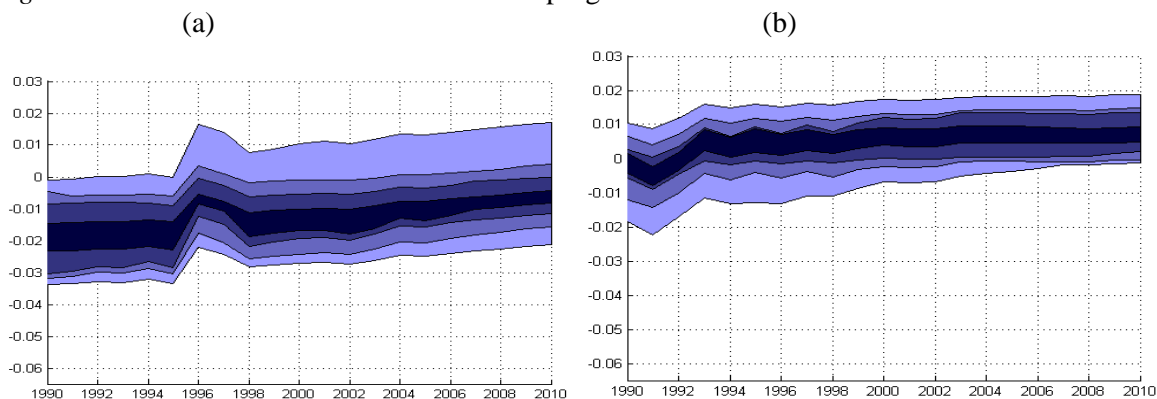
Note: (a) beliefs under 'open capital account and IMF programs' vs. beliefs under 'capital controls and IMF program'. (b) Beliefs under 'opened capital account without IMF programs a' vs. beliefs under 'capital control without IMF program'.

Finally, the learning model predicts more accurately capital account policy switches in countries with an IMF program than in countries without one. Indeed, the model successfully predicts 16 percent of policy switches contemporaneously and 41 percent of policy switches at *t+1*. In contrast, in countries without an IMF program, the model predicts only 5 percent of switches at time t and 15 percent at time t+1. In other words, policymakers learn more when there is an IMF program in place (Table 11).

Table 11. Predictive quality of the model in presence of IMF programs

	Prediction of $z^{(1,1)}$	Prediction of $z^{(1,0)}$
Overall good prediction	0.933	0.94
Prediction in real time of policy switches		
At t	0.1622	0.0488
At t+1	0.4054	0.1463
At t+2	0.2973	0.2439

Note: $z^{(1,1)}$ is a binary variable associated with liberalized capital account and the presence of IMF program and $z^{(1,0)}$ with liberalized capital account and the absence of IMF program.

VII. Conclusions

This paper explored interactions between growth and capital account policies in developing regions during 1980 – 2010, utilizing an adaptive learning framework. In this framework, policymakers choose capital account policies to maximize real GDP growth per capita, under uncertainty about the net growth payoffs. Their choices are constrained by the 'Mundell's trilemma', that is the ability to reach only two policy goals among financial liberalization, fixed exchange rate and monetary autonomy. Policymakers update their beliefs about the impact of capital account policies on growth based on information obtained from actual growth outcomes and through IMF programs. The model was then initially simulated with parameters calibrated to data in Africa, Latin America and developing Asia during 1960 – 1980. After that, the parameters were updated for actual outcomes every year.

The adaptive learning approach reflects relatively well Africa's path of capital account liberalization, including its delay in comparison with other regions.[19] According to the model, the accuracy of policymakers' beliefs about the impacts of capital account policies on growth has improved over time. One of the findings is that even countries' with liberalized account could revert to capital controls in the presence of particularly large output shocks. Further, the outcomes of capital account switches are closer to policymakers' expectations in countries with the IMF programs. However, IMF programs contain a number of policy measures besides changes in capital account regimes, pointing to the need for complementarity of policies. Capital account policies in Africa tend to change more often than in other regions, creating policy uncertainty for economic agents. This underscores the importance of building stronger policymaking institutions and rules in the region to mitigate this high volatility.

Future research could utilize the adaptive learning framework to examine impact of other policies managing capital flows. The example includes the interactions of capital controls with instruments such as macro-prudential regulations, foreign exchange interventions and/or setting of the policy rate, and their impact on growth and other key macroeconomic variables.

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[19] Other factors, such as limited capacity to establish conditions for capital account liberalization, played a role.

References

African Development Bank, Organization for Economic Cooperation and Development, Economic Organization for Africa and United Nations Development Programme (2013), *African Economic Outlook 2013,* AfDB: Tunis, OECD: Paris, ECA: Addis Ababa and UNDP: New York.

Ahmed, S. and Zlate, A. (2013), 'Capital Flows to Emerging Market Economies: A Brave New World?', Board of Governors of the Federal Reserve System International Finance Discussion Paper, No. 1081.

Aizenman, J. (2011), 'The Impossible Trinity – from the Policy Trilemma to the Policy Quadrilemma', mimeo, University of California, Santa Cruz.

Aizenman, Joshua, Menzie D. Chinn, and Hiro Ito (2012). "The Impossible Trinity' Hypothesis in an Era of Global Imbalances: Measurement and Testing."*La Follette School of Public Affairs Working Papers* 2012-007 (2012).

Aoki, K., Benigno, G., and Kiyotaki, N. (2010). *Adjusting to capital account liberalization*. Centre for Economic Policy Research.

Arteta, C., & Eichengreen, B. and Wyplosz, C. (2003), 'When Does Capital Account Liberalization Help More than It Hurts?'. *Economic Policy in theInternational Economy: Essays in Honor of Assaf Razin, ed. by Helpman, E. and Sadka, E (Cambridge, United Kingdom, Cambridge University Press).*

Bicaba, Z. T. and Coricelli, F. (2014), 'Learning to open up: capital account liberalization in the post-Bretton Woods era', mimeo.

Brixiová, Z.; Vartia, L. and Wörgötter, A. (2010), 'Capital Flows and the Boom-Bust Cycle: The Case of Estonia', *Economic Systems*, Vol. 34(1), 55-72.

Buera, F. J., A. Monge-Naranjo, and G. E. Primiceri (2011), 'Learning the wealth of nations,' *Econometrica*, 79, 1-45.

Calvo, G. A., and Mendoza, E. G. (2000). Capital-markets crises and economic collapse in emerging markets: an informational-frictions approach. *American Economic Review*, 59-64.

Chinn, M. D. and Ito, H. (2008), 'A New Measure of Financial Openness', *Journal of Comparative Policy Analysis,* Vol. 10 (3), 309 - 322.

Dorsey, T. W.; Tadesse, H. ; Singh, S.; Brixiova, Z. (2008), 'The Landscape of Capital Flows to Low-Income Countries', IMF Working Paper No. 08/51.

Edwards, S. (1999), 'How effective are capital controls?', *Journal of Economic Perspectives* Vol. 13, 65–84.

Farhi, E. and Werning, E. (2012), 'Dealing with the Trilemma: Optimal Capital Controls with Fixed Exchange Rates,' NBER Working Paper No. 18199.

Genberg, H. and Martinez, A. (2014), 'On the Accuracy and Efficiency of IMF Forecasts: A Survey and Some Extensions', Independent Evaluation Office Background Paper BP/14/04.

International Monetary Fund (2008), 'Private Capital Flows to Sub-Saharan Africa: Financial Globalization's Final Frontier?', IMF Regional Outlook for sub-Saharan Africa 2008 (April), IMF: Washington, DC.

International Monetary Fund (2013a), 'Managing Volatile Capital Flows: Experiences and Lessons for Sub-Saharan African Frontier Markets', *IMF Regional Outlook for sub-Saharan Africa 2013* (October), IMF: Washington, DC.

International Monetary Fund (2013b), 'Guidance Note for Liberalization and Management of Capital Flows', IMF: Washington, DC.

Jinjarak, Y., Noy, I. and Zheng, H. (2012), 'How Effective Were the 2008-2011 Capital Controls in Brazil?', Vox, November 22, 2012.

Joyce, J. P. and Noy, I. (2008), 'The IMF and the Liberalization of Capital Flows', *Review of International Economics,* 16(3), 413–430.

Kasekende, L., Brixiova, Z. and Ndikumana, L. (2010), 'Africa: Africa's counter-cyclical policy responses to the crisis', *Journal of Globalization and Development* 1.1 (2010).

Kose, A. M., Prasad, E. S., and Terrones, M. E. (2009), 'Does openness to international financial flows raise productivity growth?', *Journal of International Money and Finance*, Vol. 28(4), 554-580.

Kydland, F. E., and Prescott, E. C. (1977), 'Rules rather than discretion: The inconsistency of optimal plans,' *The Journal of Political Economy*, 473-491.

McKinnon, R. I. (1993). *The order of economic liberalization: Financial control in the transition to a market economy*, JHU Press.

Ncube, M.; Ndou, E., and Gumata, N. (2012), 'How are the US Financial Shocks Transmitted into South Africa? Structural VAR evidence,' AfDB Working Paper 157.

Prasad, E. S. and Rajan, R. (2008), 'A Pragmatic Approach to Capital Account Liberalization', NBER Working Paper No. 14051.

Ranciere, R. and Tornell, A. (2012), 'Financial Liberalization and Production Efficiency', mimeo.

Ranciere, R., Tornell, A. and Westermann, F. (2006), 'Decomposing the effects of financial liberalization: Crises vs. growth,' *Journal of Banking & Finance* 30.12 (2006): 3331-3348.

Rey, H. (2013). Dilemma not Trilemma: The global financial cycle and monetary policy independence. In *Jackson Hole Economic Symposium.*

Tornell, A. and Westermann, F. (2005), *Boom-Bust Cycle and Financial Liberalization*, MIT Press.