A Bayesian Approach to Quantifying Capital Account Restrictions in Small States

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Abstract

Capital account liberalisation can potentially have important effects on the economy. Numerous techniques have been employed in the literature to quantify these restrictions. Unfortunately, theory does not provide any assistance as it relates to choose between these approaches. This paper proposes a Bayesian approach to index construction. Essential the technique starts with the position that there is no particular reason why one should or should not use a given variable to quantify capital account restrictions. As a result, the paper takes random draws from the potential database of indicators and uses these to construct indices. This approach allows one to assess the potential effects of differences in index specification as well as explain inconsistencies reported in the published literature.

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1. Introduction

Capital account liberalisation could have important effects on the availability of investment funds, stock prices, market volatility, inflation, economic growth, trade and policy discipline. However, before empirical work on the effects of liberalisation on small states can be attempted, one must obtain quantifiable indicators of capital account liberalisation.

Many techniques have been employed in the literature to quantify restrictions on capital flows. There are three broad approaches: ex-post macroeconomic indicators, regression-based indices and qualitative indices of capital control legislation. The ex-post indicators (for example, net capital flows) assume that in the presence of capital controls, cross border flows would be zero or miniscule. Thus, a rise in capital flows would suggest that the country might have liberalised its capital control regime. Alternatively, regression-based indices derive capital account liberalisation indicators by comparing estimated regression estimates to those postulated by economic theory. Finally, qualitative indices usually take the form of dummy variables, assuming a value of one, for example, in the presence of some form of capital account restriction and zero otherwise.

Unfortunately, theory does not provide guidance as it relates to the choosing among these potential indicators. As a result, most authors in the field tend to use a wide variety of indicator specifications (see (Moore, 2010)). This paper attempts to address this shortcoming in the area by proposing a Bayesian approach to index construction. Essentially, the approach starts with the position that there is no particular reason why one should or should not use a given variable to quantify capital account restrictions. As a result, the paper takes random draws from the potential

database of indicators and uses these to construct indices. This approach allows one to assess the potential effects of differences in index specification and can not only provide an indication of liberalisation, but also explain inconsistencies reported in the published literature.

The remainder of this paper is organised as follows. After the introduction, Section 2 presents a summary of the approaches used by previous authors to quantify capital account restrictions. Section 3 then outlines the empirical approach employed to construction the indicators of capital account openness small states. The results obtained from the Bayesian averaging technique are discussed in Section 4. An assessment of its effects on economic growth is also provided in this section. Section 5 concludes with a summary of the results.

2. Quantifying Capital Controls

Country-level studies of capital account liberalisation are restricted somewhat by the difficulty of aggregating policies across countries and time, as the intensity, coverage and type of controls can vary. Economic researchers have therefore employed numerous types of indicators in an attempt to quantify capital controls. These proxies can be categorised into three groups: ex-post macroeconomic indicators, capital account restrictiveness indices and regression-based indices.

2.1 Ex-post Macroeconomic Indicators

Based on the notion that capital controls restrict capital flows, Eken (1984), Feldman (1986) and Levich (1987) propose that the integration of capital markets can be evaluated by the quantity of capital flow across borders. Therefore, a larger volume of cross-border transactions is reflective of greater capital market openness; to allow for cross-country comparisons, most authors express capital flows as a ratio of gross domestic product. In a similar vein, Lane and Milesi-Ferretti (2001) utilise annual estimates of portfolio and direct investment assets and liabilities as a ratio of gross domestic product. These measures of capital account restrictions, however, tend to be correlated with the monetary, fiscal or exchange rate policy stance, the returns offered by domestic markets and even political circumstances.

Assuming that uncovered interest parity holds, one alternative to these measures is the difference between onshore (r) and offshore (r^*) interest rates. If E_t is the expectations operator and $E_t S_{t+T}$ is the expected value at time t of the spot exchange rate S at $t+T$, the uncovered interest rate parity hypothesis can be written as:

$$E_t S_{t+T}(1+r_t^*) = S_t(1+r_t)\,. \tag{1}$$

Equation (1) states that given expected exchange rates, onshore interest rates should equilibrate to offshore interest rates. This notion is exploited by Eken (1984), Ito (1986), Frankel and MacArthur (1988), Zevin (1992) and Obstfeld (1993), to name a few. Unfortunately, this approach cannot be applied to a wide cross section of countries, as currency forward markets are not typically available. In addition, most empirical studies reject the uncovered interest rate hypothesis (Lothian & Wu, 2003).

2.2 Capital Account Restrictiveness Indices

Given the drawbacks of the macroeconomic indicators approach, as an alternative indices of capital controls can be employed to track all changes in restrictions within and between countries. One of the simplest of these indices is a dummy variable that takes a value of one if a country has restrictions on capital outflows and zero if it does not. This information is usually derived from various editions of the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. In pre-1996 reports, there is a summary table for each country that directly identifies the existence or non-existence of capital controls (line E.2) called "Restrictions on Payments for Capital Transactions". An index of the proportion of years in which countries had an open capital account could also be employed. (see Grilli and Milesi-Ferretti (1995); Rodrik (1998); Klein and Olivei (1999)). Edison, Klein, Ricci and Sløk (2004) refer to this measure as the share. However, the measure is subject to the criticism that a value of 0.5 is consistent with an open capital account in either the beginning or end of the 10-year period.

In 1996, the IMF revamped its reporting procedures and presented more details on exchange arrangements and controls: 13 categories (some of which are further disaggregated) are presented compared to six in the pre-1996 reports. Given the additional data available, many authors have therefore attempted to build indices using these additional details. Johnston and Tamirisa (1998), for example, built indices for 45 countries by calculating a simple average of all the 0/1 dummies for each of the new components, while authors such as Haggard and Maxfield (1996), Quinn (1997), Montiel and Reinhart (1999), Brune, Garrett and Guisinger (2001) and Miniane (2004) adopted more sophisticated coding approaches. The fundamental flaw of these approaches,

however, is that two independent researchers coding the data may not necessarily arrive at the same measure of capital account restrictiveness.

Rather than assessing the laws on capital receipts and payments, Bekaert (1995), Buckberg (1995), Bakaert and Harvey (1995), Kim and Singal (2000) and Henry (2000) all use the 0/1 dummy approach to indicate whether or not a country has opened its equity/stock markets to foreign investors. To identify the liberalisation dummy, the authors use information on official liberalisation dates, the introduction of American Depository Receipts, an increase in the International Finance Corporation's Investibility index (the ratio of market capitalisation of stocks that foreigners can legally hold to total market capitalisation) by more than 10 percentage points, the date of the introduction of country funds or the date of a regime change obtained from a regime-switching model of net US capital flows.

2.3 Regression-Based Indices

A third group of capital account restrictiveness indicators are those derived from regression-based models. Most regression-based indices of capital account restrictions begin with some basic theoretical model from which an empirical prediction is derived. Feldstein and Horioka (1980) exploit the idea that in a closed economy the return on savings is the national marginal product of capital. As a result, domestic savings or investment only increases if the return on capital is high enough to persuade agents to postpone their consumption. Once capital is perfectly mobile, however, savings will leave or enter the country if there is a divergence between domestic and foreign rates of return. With free movement of capital between countries,

net-of-tax rates of returns should be equalised across countries and the correlation between savings and investment should be relatively weak.

To test this hypothesis, Feldstein and Horioka (1980) assess the relationship between savings rates and investment rates for a group of 21 OECD countries and annual data from 1960 to 1974. The estimated equation is of the form:

$$\left(\frac{I}{Y}\right)_i = \alpha + \beta\left(\frac{S}{Y}\right)_i \tag{2}$$

where $\left(\frac{I}{Y}\right)_i$ is the ratio of gross domestic investment to gross domestic product of country i and $\left(\frac{S}{Y}\right)_i$ is the corresponding ratio of gross domestic savings to gross domestic product. In a world of perfect capital mobility the value of β should reflect the magnitude of the country's share of total world capital, 0 if the country is very small. Feldstein and Horioka (1980), report that β was very close to 1 for various definitions of savings. This close correlation between savings and investment therefore implies that there exist restrictions on capital flows between developed countries. Dooley, Frankel and Mathieson (1987) argue that tests of savings-investment correlations are joint tests of several hypotheses, many of which have very little connection to capital mobility or capital controls. These tests can be influenced by deviations from purchasing power parity, exchange rate risk, limited integration of domestic financial markets, the effects of government policies, and/or when the economy is near a steady state where imbalances are small.

Using a similar idea to Feldstein and Horioka (1980), Edwards and Khan (1985) estimate the degree of capital mobility by utilising information from an interest rate determination equation.

If the capital account were completely closed, domestic market-clearing interest rate (i) would be given by the weighted sum of the uncovered interest parity interest rate, i^*, and the domestic market clearing rate, $\tilde{i}$:

$$i = \psi i^* + (1-\psi)\tilde{i}, \qquad 0 \le \psi \le 1. \tag{3}$$

The coefficient ψ can be employed as an index of capital mobility. It is bounded between zero (perfect capital immobility) and one (perfect capital mobility). It is impossible to directly estimate $\tilde{i}$, however, Edwards and Khan (1985) exploit a demand for money equation to identify Equation (3). Most estimates of ψ are within the 0 to 1 range, but are unexpectedly high. Another criticism of the framework is that it does not provide an adequate explanation of how the averaging of closed and open economy interest rates arise from the behaviour of individuals.

Korajczyk (1996) and Levine and Zervos (1998) also derive an interest rate indicator of capital account openness. Assume that there exists a weighted portfolio of stocks with excess returns denoted by P. One can estimate a regression of the following form:

$$R_{it} = \alpha_i + b_i P_t + \varepsilon_{it}, \quad i = 1,2,\ldots,m; \quad t = 1,2\ldots,T, \tag{4}$$

where m is the number of assets, t the time periods, and R is the excess return on asset i or the return on asset m above the risk-free rate. If markets are perfectly integrated, then the intercept, α_i, should be zero:

$$\alpha_1 = \alpha_2 = \cdots = \alpha_m = 0. \tag{5}$$

The estimates of α_i from Equation (5) can therefore be employed as measures of financial integration. One can argue, however, that the above equation does not adequately capture financial integration, as returns will vary according to the characteristics of the underlying assets.

3. Methodology

3.1 Econometric Modelling Approach

The empirical literature surveyed in the previous section, put forward numerous potential indicators of capital account restrictions. In addition, theory provides little or no guidance to help sort between all of the various approaches. As a result, a Bayesian approach to estimating the indicators of capital account restrictions is employed. Intuitively, the approach makes random draws from the set of potential indicators that are then employed to form indicators of capital account restrictions in place in the particular country.

Let I_j be an index with a specific set of potential indicator variables. The prior probability of specification j is therefore given by:

$$P(I_j) = \left(\prod_{i=1}^{k_j} I_{ji} \frac{\bar{k}}{K} \right) \left(\prod_{i=1}^{k_j} \left(1 - I_{ji}\right) \left(1 - \frac{\bar{k}}{K}\right) \right) \tag{6}$$

where k_j are the number of included variables in index j, $\bar{k}$ is the prior mean model size, K is the total number of potential indicators and I_{ji} is the ith element of the vector. Assuming that each variable has an equal probability of inclusion, Equation (2) can be simplified to:

$$P(I_j) = \left(\frac{\bar{k}}{K} \right)^{k_j} \left(1 - \frac{\bar{k}}{K} \right)^{K - k_j} \tag{7}$$

The number of potential indicators variables, K, is 11 and the number of variables included in every model, k_j, is fixed to 1,3 and 6.[2]

[2] Other values for k_j were considered. However, the results did not change appreciable. These are available upon request.

The expected index estimates is therefore the posterior mean conditional on model *j*, or in other words, the unweighted average of the indices:

$$p(\tilde{I} \mid I^{obs}) = \sum_{j} p(\tilde{I} \mid I_j, I^{obs}) p(I_j \mid I^{obs}) \tag{8}$$

where the I^{obs} are the observed indicators, $\tilde{I}$ is the predicted index. The posterior mean is therefore related to the posterior probabilities of each model given the data as well as predictive probabilities of the index from each model. All routines in the paper are written in the Ox 6.1 (Doornik (2009)).

3.2 Data

One of the main problems encountered by researchers looking at small states is the lack of data. To ensure comparability of the macroeconomic indicators a single international data source was employed: World Bank's World Development Indicators. Observations on the indicators of capital account liberalisation are derived for the period 1960 to 2009. However, because of data limitations some variables are not available for the entire sample period.

The countries classified in this study as small states are those presently included in the list used by the United Nations Department of Economic and Social Affairs. These countries include six Sub-Saharan African territories, fourteen Latin American and Caribbean states, and twelve East Asia and Pacific countries and one country from Middle and North Africa and South Asia. Of

these islands, five can be classified as high-income, thirteen as upper middle income, with the remainder classified as either low income of low middle income.

Table 1: Countries Included in Database

	Income Group	*Region*
Republic of Fiji	Upper middle income	East Asia & Pacific
Republic of Kiribati	Lower middle income	East Asia & Pacific
Republic of the Marshall Islands	Lower middle income	East Asia & Pacific
Republic of Palau	Upper middle income	East Asia & Pacific
The Independent State of Papua New Guinea	Lower middle income	East Asia & Pacific
Republic of Singapore	High income: nonOECD	East Asia & Pacific
Solomon Islands	Low income	East Asia & Pacific
Democratic Republic of Timor-Leste	Lower middle income	East Asia & Pacific
Kingdom of Tonga	Lower middle income	East Asia & Pacific
Tuvalu	Lower middle income	East Asia & Pacific
Republic of Vanuatu	Lower middle income	East Asia & Pacific
Samoa	Lower middle income	East Asia & Pacific
Antigua and Barbuda	Upper middle income	Latin America & Caribbean
Commonwealth of The Bahamas	High income: nonOECD	Latin America & Caribbean
Belize	Lower middle income	Latin America & Caribbean
Barbados	High income: nonOECD	Latin America & Caribbean
Commonwealth of Dominica	Upper middle income	Latin America & Caribbean
Dominican Republic	Upper middle income	Latin America & Caribbean
Grenada	Upper middle income	Latin America & Caribbean
Republic of Guyana	Lower middle income	Latin America & Caribbean
Jamaica	Upper middle income	Latin America & Caribbean
St. Kitts and Nevis	Upper middle income	Latin America & Caribbean
St. Lucia	Upper middle income	Latin America & Caribbean
Republic of Suriname	Upper middle income	Latin America & Caribbean
Republic of Trinidad and Tobago	High income: nonOECD	Latin America & Caribbean
St. Vincent and the Grenadines	Upper middle income	Latin America & Caribbean
Kingdom of Bahrain	High income: nonOECD	Middle East & North Africa
Republic of Maldives	Lower middle income	South Asia
Union of the Comoros	Low income	Sub-Saharan Africa
Republic of Cape Verde	Lower middle income	Sub-Saharan Africa
Republic of Guinea-Bissau	Low income	Sub-Saharan Africa
Republic of Mauritius	Upper middle income	Sub-Saharan Africa
Democratic Republic of São Tomé and Principe	Lower middle income	Sub-Saharan Africa
Republic of Seychelles	Upper middle income	Sub-Saharan Africa

The liberalisation indicators utilised in this study are FDI inflows (% GDP), FDI outflows (% GDP), FDI Inflows+FDI Outflows (% GDP), net capital flows (% GDP), portfolio flows (% GDP), portfolio flows excluding transactions related to foreign authorities (% GDP), correlation between foreign and domestic interest rates, Feldstein-Horioka β, Edwards-Khan ψ and the existence of capital controls. Foreign interest rates are proxied by the interest rate on US one-month certificate of deposits, while domestic interest rates is the rate paid by commercial banks on deposits. To estimate the Feldstein-Horioka β, estimates of savings and investment as a proportion of GDP are taken from the WDI database. Values for β are obtained using a rolling three-year window. The estimate of $\tilde{\imath}$ is obtained by inverting a money demand function (real money regressed on an intercept, interest rates, real income and lagged real money balances). Real money are derived by deflating the money supply by the GDP deflator, real GDP is used as the proxy for income. A rolling ten-year window is employed.

Obtaining information on the qualitative variable, the existence of capital controls was derived from various sources. Initially, information on the existence of capital controls is also obtained from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (various issues). The table in the IMF's report only provided data for less than half of the small states in the database. Observations for the other countries therefore had to be taken from other sources. Official policy decree dates are used, when they are available from the website of each country's stock exchange, central bank, IMF Article IV Report or other reputable sources. The United States' State Department's website, which provides summaries of economic and social developments, was also employed. These dates are then used to generate the dummy variable for the date of the removal of capital controls.

4. Results

4.1 Capital Account Restrictions in Small States

This section of the study presents the results from employing the approach outlined in Section 3 to derive estimates of the indicator of capital account restrictions. All analysis is done using 1000 draws from the database. Figures 1-3 therefore provide the estimates of the liberalisation indicator assuming that 1, 3 or 6 variables are used to form the indicator variable. All variables are standardized (demeaned and divided by the standard deviation) before calculating the un-weighted average. A value above 0 therefore indicates that some of the indicators are suggesting that capital account restrictions have eased since the previous period. The mean value of the indicator is provided along with the standard error bars.

Figures 1-3 indicate that there is no clear trend in liberalisation over the period. Whether a single indicator or a group of indicators is employed, the index mainly fluctuated around its mean value, prior to 1995. The figures also suggest that the smaller the number of indicators employed, the greater the likelihood of obtaining false positives, i.e. the index imply that capital account restrictions have declined even if this is not the case. When six variables are employed to generate the indicator, the width of the error bands decline, signifying less uncertainty with regards to the liberalisation indicator. In addition, the volatility in the liberalisation indicator also declines.

Figure 1: Indices of Capital Account Controls ($k = 1$)

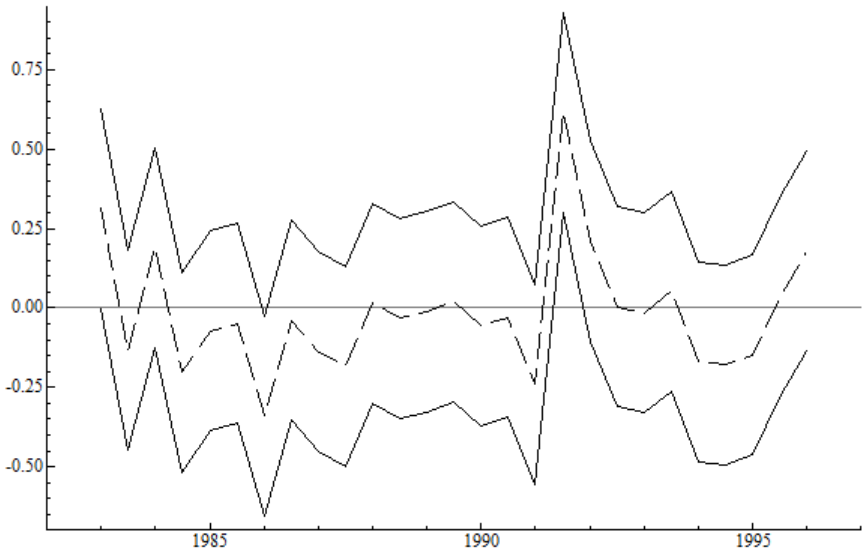


Figure 2: Indices of Capital Account Controls ($k = 3$)

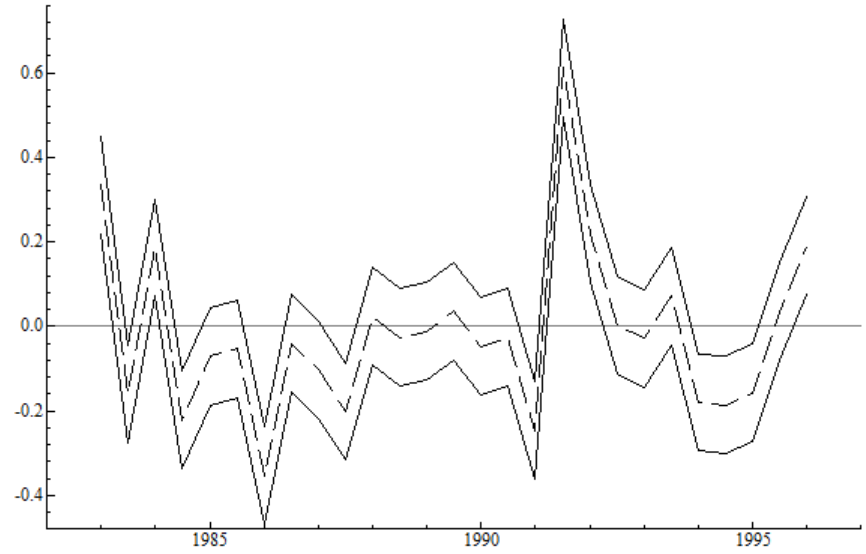
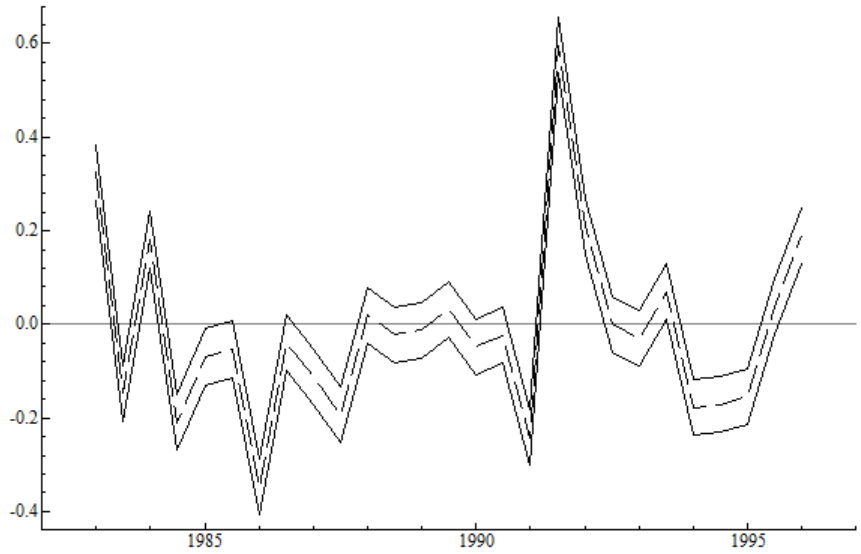


Figure 3: Indices of Capital Account Controls ($k = 6$)



The figures above can generally be broken down into three phases: (1) pre-1986; (2) late 1980s and early 1990s, and; (3) late 1990s. In the pre-1986 period, most small states seemed to have been utilising more restrictive capital account policies, with the index declining during most of this period. In contrast, the figures imply that during the late 1980s and early 1990s that some of these controls would have been removed during this period. However, in the wake of the global recession of the early 1990s, the Bayesian estimates of the capital account restrictiveness seems to suggest that some states would have experienced some enhanced restrictiveness during this period. By the late 1990s, however, there was a clear upward trend in the capital account restrictiveness indices. This finding was robust to various specifications of the restrictiveness indicator.

4.2 Capital Account Controls and Economic Growth in Small States

One of the main reasons for removing capital controls is the expected rising in the national standard of living. Less restrictive policies should lead to greater foreign investment flows and thereby enhance the productive capacity of the nation. The approach suggested in the current study is particularly well suited to assessing the likely effects of capital account restrictiveness on national incomes.

Much of the literature to date has provided inconclusive evidence in relation to the potential effects of removing capital controls on economic growth (see Moore, (2010)). One of the main reasons is the wide variety of indicators employed in the literature. In this study, at each stage of the replication, an indicator of capital account restrictions (KA_{it}) is calculated. This indicator is then employed in the growth regression of the following form:

$$\ln(y_{it}) - \ln(y_{it-1}) = \alpha_i + \beta_1 \left(\frac{I_{it}}{Y_{it}}\right) + \beta_2 KA_{it} + u_{it} \quad (9)$$

where y_{it} is real income, $\frac{I_{it}}{Y_{it}}$ is the ratio of investment to income and u_{it} is an error term, assumed to have normal properties. Following Levine and Renelt (1992) only the share of investment in GDP is included in the regression, as this tends to be the most robust determinant in cross-country growth regressions.

There are two variables of interest from Equation (5): the coefficient estimate β_2 and the t-statistic on the coefficient. If the t-statistic exceeds the critical value, it would suggest that removing capital account restrictions have robust impact on economic growth in small states. The scaled (the t-statistic divided by the 5 percent critical value) t-statistic is plotted, with values

above one signifying that the impact of capital controls was statically significant. If the variable has a robust impact on growth, the next question assessed is its directional impact. A positive value would be evidence that removing capital controls enhance growth, while a negative coefficient estimate could suggest that removing controls in small states might negatively impact on the national standard of living.

The statistical significance of the capital account restrictiveness indicator in Equation (9), evaluated for various specifications of the indicator, are provided below. Equation (9) is estimated using a pooled model specification and the least squares dummy variable (LSDV) specification. The pooled model specification results are provided first. In general, the results provided in Figures 4-6 suggest that when a small number of variables are employed to derive estimates of capital account restrictiveness then the impact of growth was not statistically significant in most regressions. In contrast when a larger number of variables were employed (e.g. 6 variables), then the probability of obtain statistically significant relationship rises. This might tend to explain the conflicting results, as it relates to the relationship and capital account restrictions in the literature. Those papers that use more complex indicators of capital account restrictions, (e.g. (Quinn, 1997)), would have a higher probability of obtaining positive associations than those papers that use more simple indicators (e.g. (Rodrik, 1998)). As it relates to small states, however, the results suggest that the impact of liberalisation is likely to be statistically insignificant.

Figure 4: Significance of Capital Controls Variable in Growth Regression ($k = 1$), t-statistic/1.96

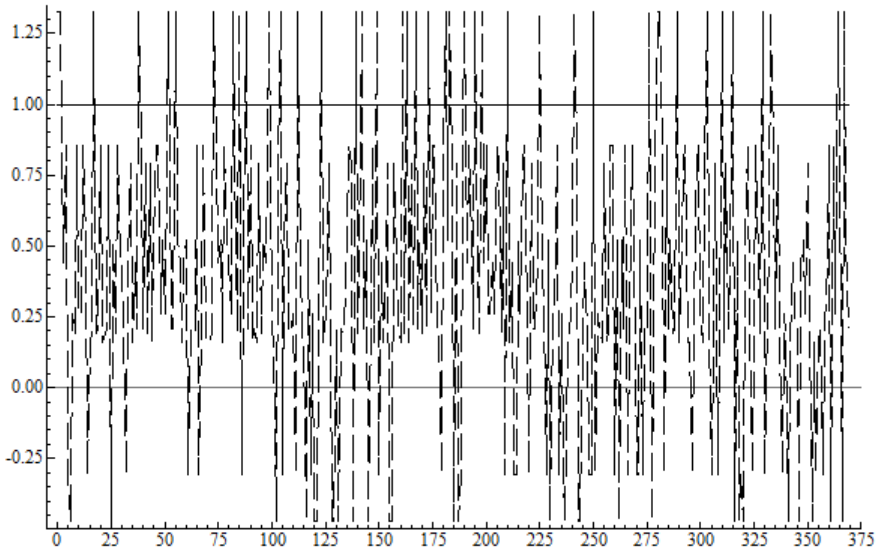


Figure 5: Significance of Capital Controls Variable in Growth Regression ($k = 3$), t-statistic/1.96

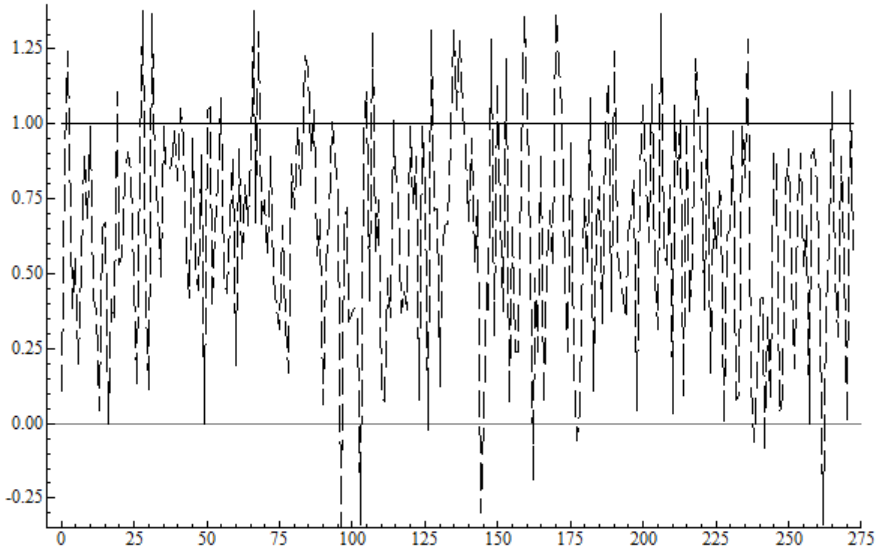
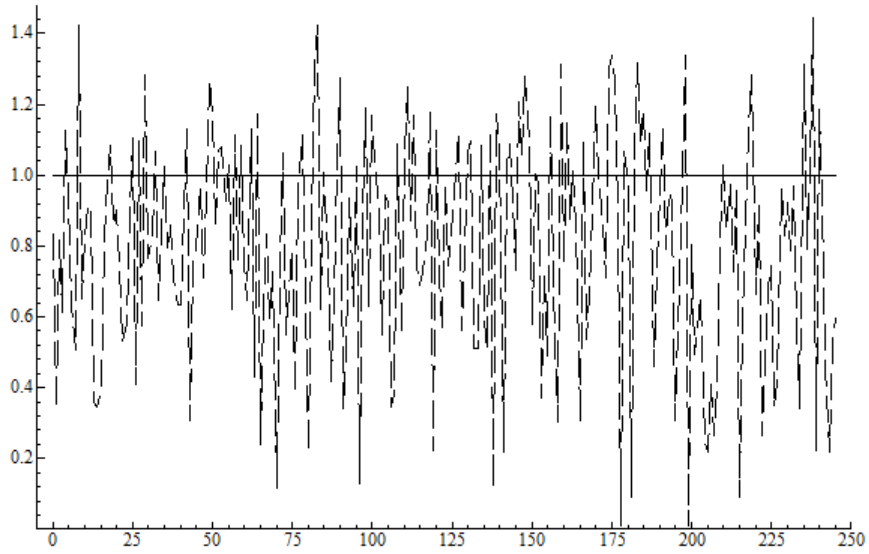


Figure 6: Significance of Capital Controls Variable in Growth Regression ($k = 6$), t-statistic/1.96



As it relates to the directional impact of opening the capital account, the results are provided in Figures 7-9. The coefficient of interest, β_2, was positive in most replications. Moreover, as additional variables are employed to calculate the indicator, the likelihood of a positive coefficient estimate rises. The size of the impact on growth also changes based on the specification of the capital account openness indicator. For specifications where 1 or 3 variables were employed, the impact of opening the capital account on growth was 0.1-0.5 percent to 0.2-0.6 percent per year, respectively. In comparison, when 6 variables were employed to estimate the indicator, the estimated impact of opening the capital account on growth was 0.4-1 percent per year.

Figure 7: OLS Coefficient Estimates for Capital Account Controls ($k = 1$)

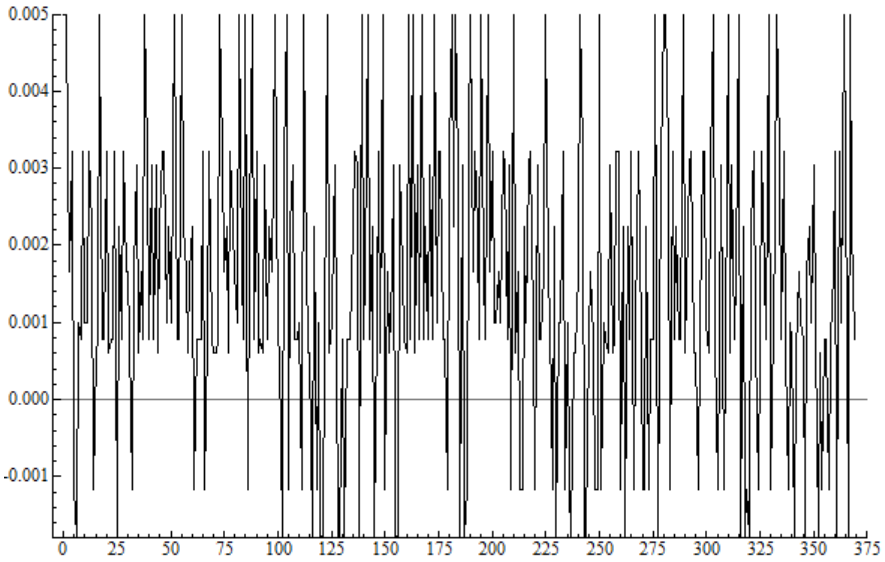


Figure 8: OLS Coefficient Estimates for Capital Account Controls ($k = 3$)

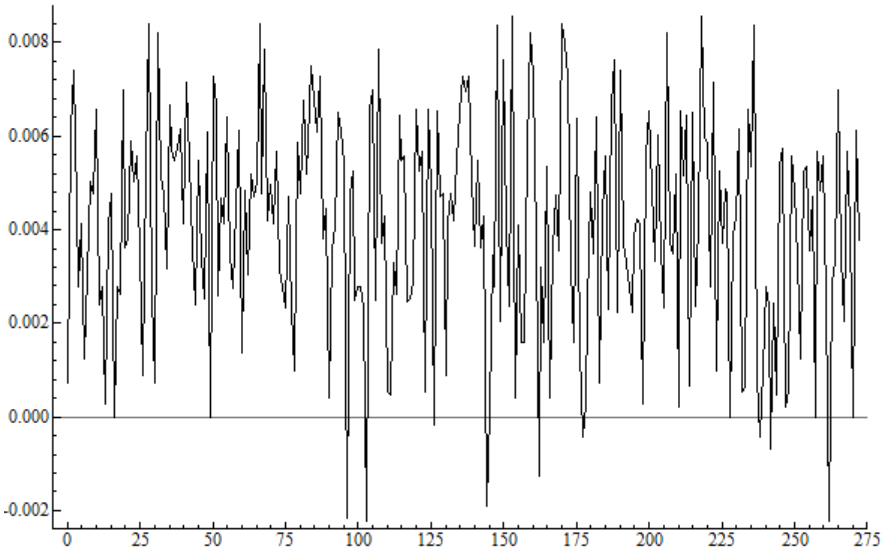
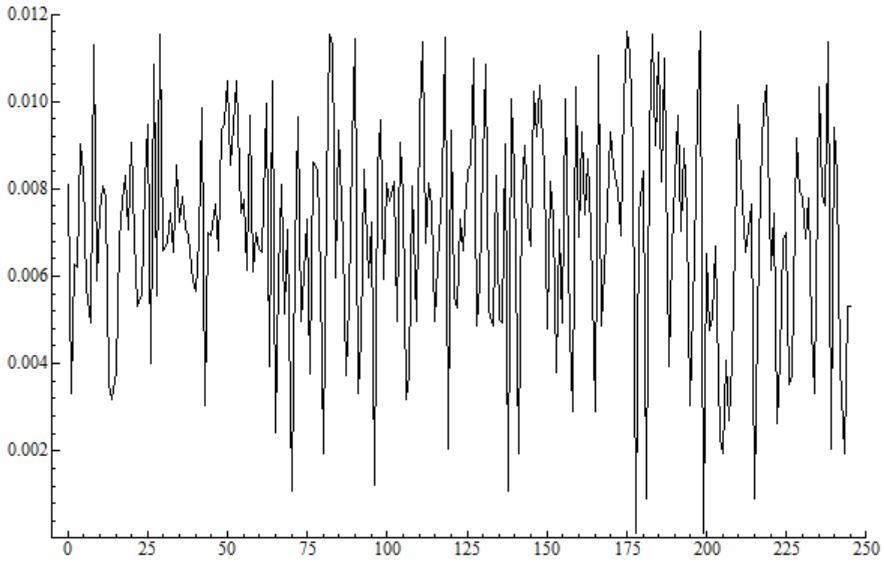


Figure 10: OLS Coefficient Estimates for Capital Account Controls ($k = 6$)



As a further evaluation of the robustness of results, Equation (5) was also estimated using the LSDV model specification.[3] This model specification explicitly takes account of the differences across country, by augmented the basic regression model with deterministic dummies for each country. Results obtained from this approach were quite similar to those reported here. The main difference was in terms of the statistical significance of the liberalisation indicator. The model usually finds that the impact of the indicator on economic growth at each replication stage was about 0.5 of a percentage point higher than those obtained earlier.

[3] Results available from the author upon request.

5. Conclusions

Theoretically, opening a country's capital account could have potentially important effects on a country's standard of living. One of the main problems with assessing the potential importance of capital account liberalisation is the difficulty of deriving a consistent indicator that is applicable to every country and time period. Using data on 34 small states between 1960 and 2009, this paper derives 11 indicators of capital account liberalisation in these countries. Three broad groups of indicators are presented: ex-post macroeconomic indicators, regression-based indicators and qualitative indices.

This study therefore proposes a Bayesian approach to index construction based on Bayesian averaging, which builds indices of capital account restrictiveness by sampling from a wide cross-section of potential indicators. The study finds that most small states appeared to have removed some capital account restrictions since 1995. These results were robust to model specification changes, but indicators based on a wider cross-section of potential input variables had lower levels of uncertainty. Augmenting a basic cross-country growth equation with the indicator suggested that liberalisation has a statistically insignificant but positive impact on per capita GDP growth in small states.

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Appendix (Not for Publication)

Figure 11: Significance of Capital Controls Variable in LSDV Growth Regression ($k = 1$), t-statistic/1.96

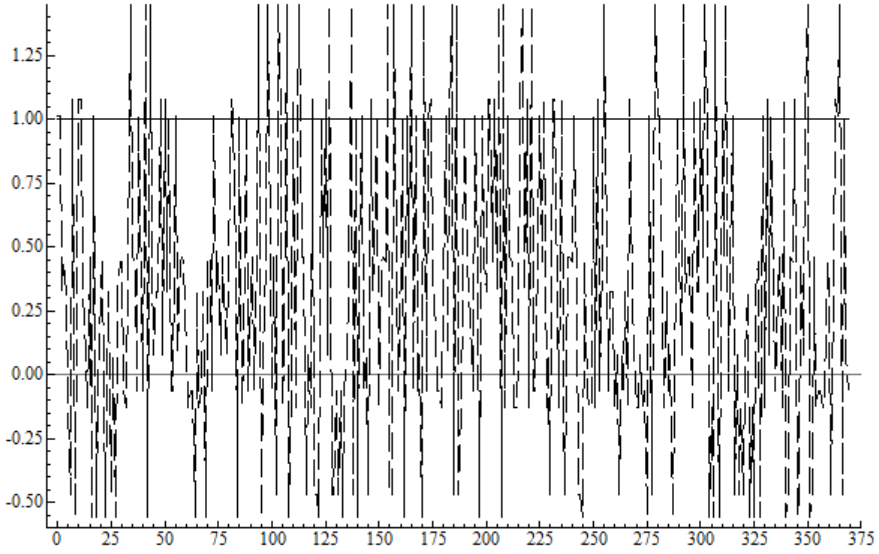

Figure 12: Significance of Capital Controls Variable in LSDV Growth Regression ($k = 3$), t-statistic/1.96

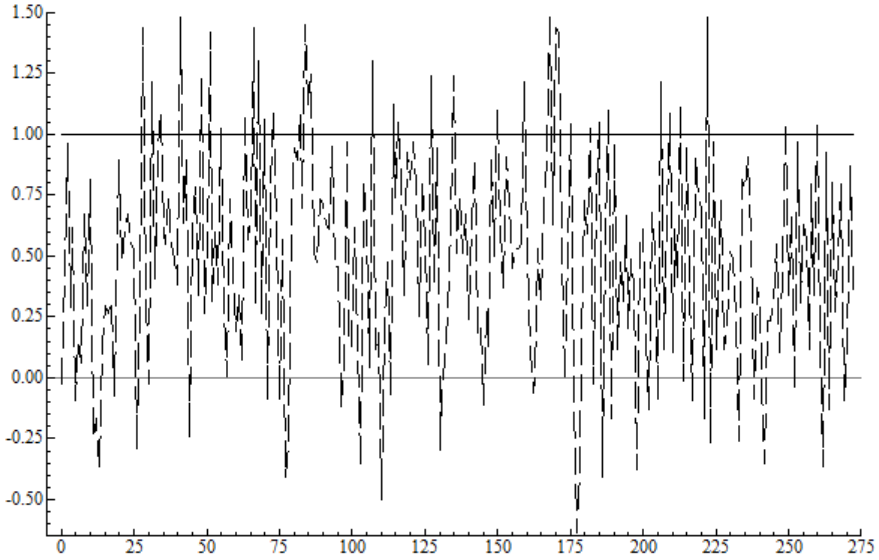

Figure 13: Significance of Capital Controls Variable in LSDV Growth Regression ($k = 6$), t-statistic/1.96

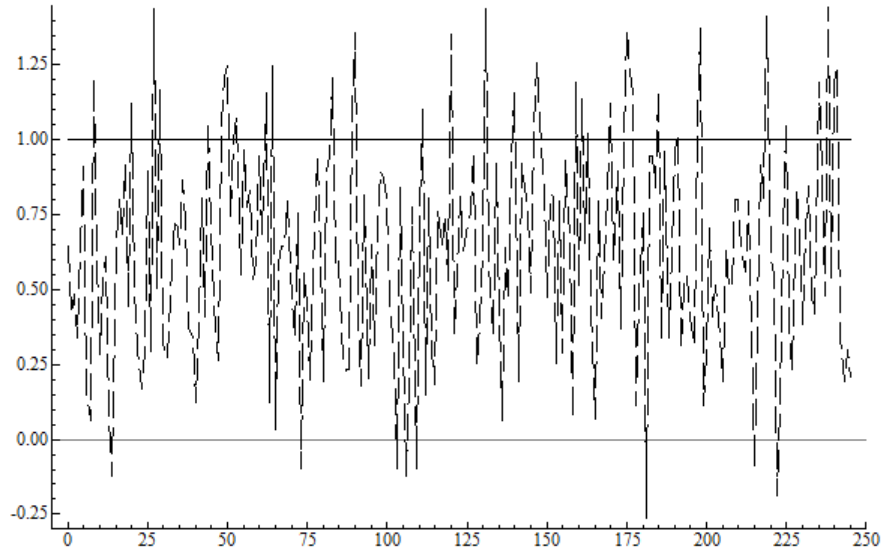

Figure 14: LSDV Coefficient Estimates for Capital Account Controls ($k = 1$)

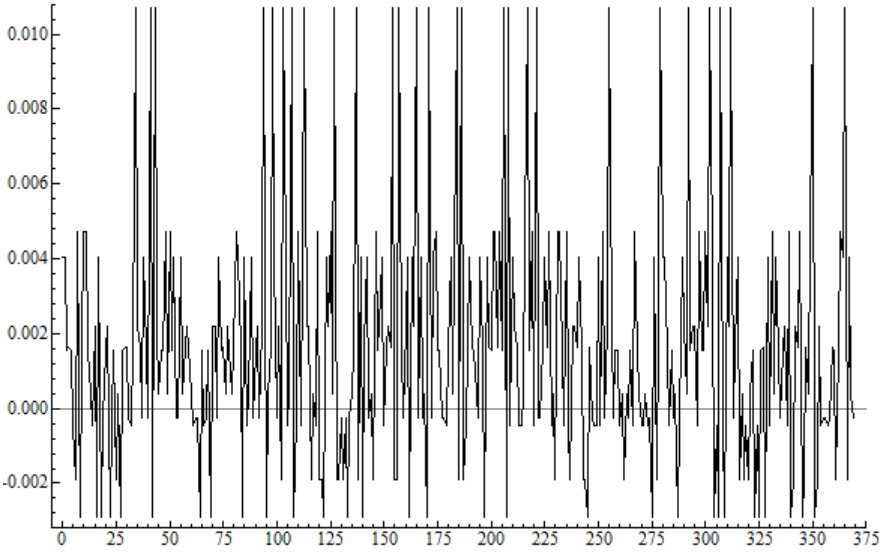

Figure 15: LSDV Coefficient Estimates for Capital Account Controls ($k = 3$)

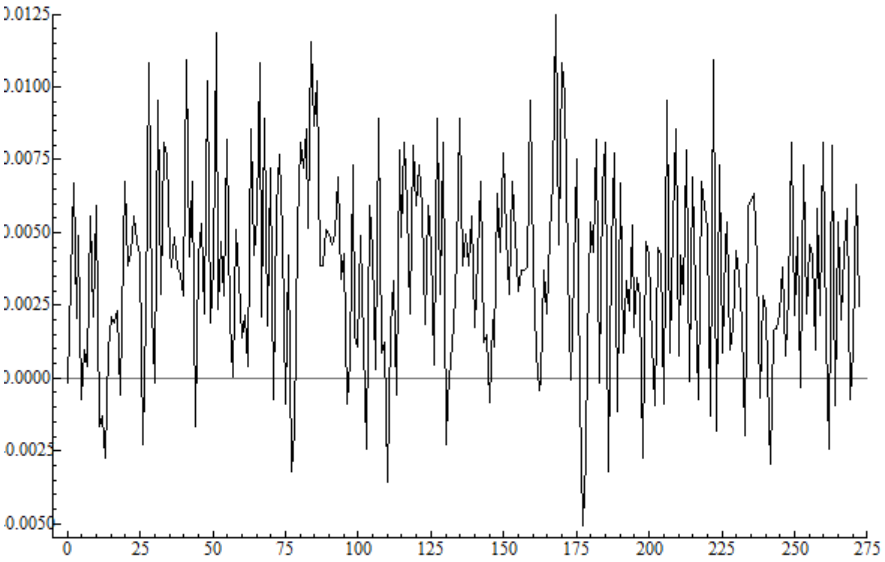

Figure 15: LSDV Coefficient Estimates for Capital Account Controls ($k = 6$)