Capital Account Liberalization, Selection Bias, and Growth

by

Katy Bergstrom

June 2012

Acknowledgements

I would like to thank my supervisor, Dr. Kuntal Das, for his valuable help and direction with this project. I would like to thank Dr. Adam Honig and Dr. Reuven Glick for supplying data on the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions.* I would also like to thank Dr. Martin Schindler for supplying his latest dataset on measurements of capital account liberalization.

Abstract

The recent Global Financial Crisis has reignited the debate surrounding the benefits and costs of capital account liberalization. To add further insight to this debate, we attempt to identify the impact of capital account liberalization on growth: what growth rates would liberalized countries have achieved if they had not liberalized? To answer this question properly we must control for sample selection bias, as the countries that choose to liberalize may not be random. It may be the case that countries with relatively sound economic policies, strong financial sectors, and political stability choose to liberalize because they have the fundamentals in place to benefit from capital account liberalization. In contrast, countries lacking strong institutions may choose to keep their capital accounts closed. To eliminate this bias, we employ a relatively new methodology to the field of international economics, Propensity Score Matching. We conclude that based on our results for the whole sample of countries, capital account liberalization is associated with higher growth rates. When we split our sample into Non-OECD and OECD countries we find a significant, positive effect on growth for Non-OECD countries but cannot conclude the effect for OECD countries.

Contents

1. Introduction 1
2. Methodology 5
   2.1. The Treatment Effect and Selection Bias 6
   2.2. Propensity Score Matching 7
   2.3. Matching Methods 8
      2.3.1. Nearest Neighbour Matching 8
      2.3.2. Radius Matching 9
      2.3.3. Kernel Matching 10
3. Measurements of Capital Account Liberalization 10
   3.1. Construction of the Capital Account Liberalization Measure 12
4. Estimating Propensity Scores 15
   4.1. Benchmark Probit Model 15
   4.2. Augmented Probit Model 18
5. Estimating Overall Treatment Effects 20
   5.1. Treatment Effects for all Countries 20
   5.2. Treatment Effects for OECD and Non-OECD Countries 21
      5.2.1. OECD Countries 21
      5.2.2. Non-OECD Countries 23
   5.3. Treatment Effects from 1990 Onwards 24
6. Conclusion 26
7. Appendix A 30

Tables and Figures

Table 1: Correlation Matrix of Capital Account Liberalization Measures 14
Table 2: Benchmark Probit Estimates for the period 1970-2006 17
Table 3: Augmented Probit Estimates for the period 1984-2006 19
Table 4: Matching Results for Annual Growth Rates for all Countries 21
Table 5: Matching Results for Average Five Yearly Growth Rate for all Countries 21
Table 6: Matching Results for Annual Growth Rate for OECD Countries 22

Table 7: Matching Results for Average Five Yearly Growth Rate for OECD Countries 22
Table 8: Matching Results for Annual Growth Rate for Non-OECD Countries 23
Table 9: Matching Results for Average Five Yearly Growth for Non-OECD Countries 23
Table 10: Matching Results for Annual Growth Rate for all Countries from 1990-2006 25
Table 11: Matching Results for Average Five Yearly Growth Rate from 1990-2006 25

Figure 1: Nearest Neighbour Matching 9
Figure 2: Radius Matching 10
Figure 3: Distribution of IMF Measure, *AREAER*, over 1995-2006 13

1. Introduction

Over the last quarter of a century international capital flows have grown remarkably, fuelling global expansion. According to Schindler (2009), cross-border financial asset holdings have risen from under 50 percent of world GDP in 1970 to over 300 percent in 2006, and have doubled over just the last ten years. These developments are often attributed to increased integration in world financial markets through the removal of restrictions placed on international capital flows. This process is known as capital account liberalization. However, the recent Global Financial Crisis has put globalization on hold, with several emerging market economies witnessing a sharp increase in the volatility of cross-border capital flows. According to the Institute of International Finance, net private flows to emerging markets dropped from a high of $1.3 trillion in 2007 to $530 billion in 2009. This has reignited the debate on the benefits and drawbacks of capital account liberalization.

The benefits of capital account liberalization are usually based around standard efficiency arguments. Economic theory suggests that countries that choose to liberalize are able to allocate resources more efficiently, taking advantage of more profitable investment opportunities overseas and borrowing at more favourable rates. As a result countries may be able to increase their Gross National Product (GNP). Capital account liberalization may also promote financial development. Exposure to international competition and foreign intermediaries may improve a country's domestic financial system via the introduction of international standards as well as through the potential threat of "flight to quality" posed by foreign banks. The size of the financial sector and the quality and range of services on offer may also increase leading to many positive flow on effects. [1] It has also been suggested that financial liberalization may lower the cost of capital through increased risk diversification and reduced financing constraints.[2] Lastly, open capital markets provide an important source of additional funding, which may be particularly beneficial for developing countries to undertake much needed investment projects.

However, many argue that financial integration has gone too far causing international capital markets to become extremely volatile, with excessive booms and busts of capital flows exacerbating bubbles and financial crises. Stiglitz (2000) suggests that capital account

[1] See Klein and Olivei (2008) and Summers (2000) who investigate financial integration and the improvement in financial intermediation.
[2] See Bekaert, Harvey and Lunbald (2005) who address the relationship between capital costs and financial integration.

liberalization has been carried out too hurriedly without first putting into place an effective regulatory framework.

> "one might compare capital account liberalization to putting a race car engine into an old car and setting off without checking the tires or training the driver. Perhaps with appropriate tires and training, the car might perform better; but without such equipment and training, it is almost inevitable that an accident will occur. One might actually have done far better with the older, more reliable engine: performance would have been slower, but there would have been less potential for an accident."
>
> Stiglitz, J. (2000). Capital Market Liberalization, Economic Growth, and Instability. *World Development, 26*(8), 1075-1086.

His argument is supported by the fact that the frequency and severity of crises over the last thirty years have increased dramatically, and that the two large developing countries to suffer the least and continue with strong growth after the Global Financial Crisis, China and India, both have strong restrictions on capital flows.

Given this controversy, many empirical studies have focused on the determinants of capital account liberalization and its consequences on economic welfare. Unfortunately, the results of these studies have been mixed at best. This paper will examine the effect of capital account liberalization on growth in an attempt to contribute to this debate.

A common explanation as to why empirical studies do not obtain robust results supporting the benefits of financial integration is that capital account liberalization may increase a country's vulnerability to adverse external shocks and currency crises. Glick and Hutchison (2005) and Glick, Guo and Hutchison (2006) investigate this possibility by examining whether legal restrictions on international capital flows are associated with greater currency stability. However, they find that restrictions on capital flows do not effectively insulate economies from currency problems; rather, countries with more liberalized regimes are less prone to speculative attacks. Edison, Klein, Ricci and Sløk (2002) also propose several reasons for this wide divergence in results. They suggest this divergence may reflect the difference in the country coverage, sample period, measures of capital account liberalization, and applied methodology. They also question the efficacy of capital controls and their ability to restrict capital flows. Lastly, they suggest that the sample of countries that choose to liberalize may not be random leading to biased estimates of the impact of capital account openness on economic welfare. It may be the case that countries with sound economic policies, strong financial sectors, and political stability choose to liberalize because

they have the fundamentals in place to enjoy the benefits of liberalization. Whereas, countries lacking good institutions may choose to keep their capital accounts closed as they do not have the facilities in place to take advantage of the benefits of liberalization. In theory, however, the bias could work in the opposite direction. Countries with low growth may choose to liberalize because of assumed growth enhancing effects, resulting in a weaker correlation between growth and liberalization. Thus, estimation techniques will need to account for possible sample selection bias.

Edison, Klein, Ricci and Sløk (2002) go on to investigate the effect of financial integration on growth, using a wide range of measures of capital account liberalization, a large sample period, and different estimation techniques, in an attempt to obtain a robust set of results. They run standard Ordinary Least Squares (OLS) growth regressions followed by Instrumental Variable (IV) estimation, using the latter approach to eliminate possible selection bias. They suspect that high growth countries with better institutions are more likely to liberalize, causing the observed correlation between growth and liberalization to overestimate the impact of capital account openness. They investigate this effect for developing versus industrialised countries, and for countries in different areas. Their results are mixed suggesting a more pronounced positive effect among industrialized countries than developing countries. They find no evidence of an upward bias when comparing OLS coefficients to IV.

Honig (2008) also uses both OLS and IV estimation to examine the effects of liberalization on growth. Honig suspects that low growth countries liberalize in order to stimulate growth, causing the observed correlation between growth and liberalization to underestimate the impact of capital account openness. In addition, Honig suspects that good institutions are needed to ensure that countries enjoy the benefits of liberalization. Thus, he controls for both institutional characteristics and the level of financial development when investigating possible growth effects. Using different instruments to Edison, Klein, Ricci and Sløk (2002), Honig finds that IV estimates show a significant positive relationship between capital account liberalization and growth, yet there is little evidence that the effect is stronger for countries with better institutions. His results suggest the presence of a downwards bias when comparing OLS coefficients to IV.

Like Honig (2008) and Edison, Klein, Ricci and Sløk (2002), we suspect selection bias could play a role in distorting the estimated effects of financial liberalization on growth.

However, given the lack of consensus between these two studies on the presence and direction of this bias, and the potential problem associated with selecting an appropriate instrument, we would like to use an estimation technique other than IV to remove sample selection bias. Thus, we implement a relatively new methodology to the field of international economics, Propensity Score Matching (PSM). This methodology was developed precisely for the problem we face, to account for estimation bias, and has mainly been used in medical and labour economics literature. As far as we know, this methodology has never been used in this context before, although Glick, Guo and Hutchison (2006) use PSM to investigate whether capital account liberalization increases the probability of the onset of a currency crisis. Glick, Guo and Hutchison essentially match control countries (those that have not liberalized their capital accounts) with treated countries (those that have liberalized their capital accounts) based on a set of observable characteristics in order to determine whether there is a difference in the likelihood of a currency crises between matched pairs. Using this basic intuition, we implement a similar procedure, however, we compare growth rates across matched countries.

Our analysis involves matching a sample of 131 countries over the period 1970-2006 based on a set of observable characteristics. Our observable characteristics include variables that we suspect to influence whether a country will liberalize or not. We firstly estimate a probit equation to investigate which characteristics play a role in determining the likelihood of liberalization. Using these results, we implement three matching methods (nearest neighbour, kernel, and radius matching) to determine whether or not liberalization does in fact cause countries to experience higher growth rates as suggested by economic theory. In addition, we also examine if the effects are significantly different between OECD and Non-OECD countries. Furthermore, we look at the effects for a shorter sample period of 1990-2006, as this is the period in which many countries began to significantly open their capital accounts.

Our results from matching all countries over the entire period suggest that, even after controlling for sample selection bias, capital account liberalization is associated with higher growth rates. When we split our sample into OECD and Non-OECD countries, we find that capital account liberalization has a strong, positive effect on growth for Non-OECD countries only. These results are robust to changes in matching methods and probit specifications. We cannot conclude the effect on growth for OECD countries.

Our results for the period 1990-2006 compared to the results for the entire sample period are not robust across probit specifications. Hence, we cannot conclude whether the effect of liberalization on growth was stronger in the more recent years. We do however find that for this more recent period, the long-term benefits of capital account liberalization on growth are smaller than the short-term, suggesting the benefits of liberalization get percolated very quickly. We also find that the degree of financial development and quality of institutions are starting to play a more important role in determining the associated benefits of capital account liberalization.

The paper is structured as follows. Section 2 discusses the matching methodology in greater detail. Section 3 investigates the different measures of capital account liberalization, in particular the data on external restrictions in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*. Section 4 investigates how we estimate the propensity scores using benchmark and augmented probit models and presents these results. Section 5 presents and discusses our main matching results for the paper, measuring the effects of capital account liberalization on growth controlling for selection bias. Section 6 concludes the paper.

2. Methodology

We seek to identify the impact of capital account liberalization on economic growth: what growth rates would liberalized countries have achieved if they had not liberalized? Our goal is to establish the effect of this treatment (capital account liberalization) that is not randomly assigned. However, the lack of random assignment means that countries with different levels of the treatment variable can systematically differ in important ways other than just the observed treatment. Since we have non-experimental data, we cannot distinguish the effect of treatment from the bias generated by a non-experimental estimator.[3]

As is well known in the literature, a simple Ordinary Least Square (OLS) regression may not identify the true impact of capital account liberalization. If any component of the unobservables is correlated with capital account liberalization and the outcome variable "growth", the OLS coefficients will be biased and inconsistent. Two main methods used in

[3] See Smith and Todd (2001).

the literature to correct for this selection bias are the selection on observables (matching) and the selection on unobservables (Heckman and IV). Both these methods differ on the identification assumptions and on how the selection correction is implemented. The success of either Heckman or, even more so, IV, hinges very strongly on the availability of a "good instrument" (or what the Heckman procedure refers to as an "exclusion restriction").[4] We will use matching techniques to address the issue of the bias arising from self-selection. To the best of our knowledge, this technique has not been used to assess the effect of capital account liberalization on growth.

Propensity Score Matching (PSM) technique, first proposed by Rosenbaum and Rubin (1983), is an alternative to regression techniques. It is a non-experimental approach and increasingly preferred for evaluating treatment impacts. Unlike regressions, matching has the advantage that it does not require the researcher to assume linear relations between treatment, covariates, and outcomes. The common practice is to employ an assumption regarding the determinants of participation into a programme and, thus, eliminate the selection bias by conditioning on these observable variables. The following section explains the propensity score matching techniques in detail.

2.1 The Treatment Effect and Selection Bias

Ideally, we would like to estimate the average treatment effect (ATT) of capital account liberalization on growth. The ATT is defined as follows:

$$ATT = E[Y_{i1}|D_i = 1] - E[Y_{i0}|D_i = 1] \tag{1}$$

where D={0,1} is the targeting dummy where a value of 1 indicates exposure to treatment (capital account liberalization), Y_{i0} is the growth rate of country *i* if country *i* does not undergo treatment, and Y_{i1} is the growth rate of country *i* if country *i* undergoes treatment. Thus, the ATT is the difference between expected growth rates with and without liberalization for those countries that actually participated in capital account liberalization. The fundamental

[4] Honig (2008) and Edison, Klein, Ricci and Sløk (2002) both use IV approach to eliminate potential sample selection bias, but by using different instruments obtain contradicting results on the presence and direction of this bias.

difficulty with estimating the ATT is that the second term in Equation (1) is not observable. We cannot observe the expected growth rates of countries that have liberalized had they not chosen to liberalize. However, if the choice to liberalize is completely random, then one can obtain the ATT by simply comparing the mean growth rate of countries that did liberalize with those that did not. Unfortunately, if the choice to liberalize is not random then this method would give biased estimates. This problem is referred to as sample selection bias.

2.2 Propensity Score Matching

To address the problem of sample selection bias, we use Propensity Score Matching to estimate the effect of capital account liberalization on growth. The basic idea behind PSM is to mimic a randomized experiment by pairing treated countries with non-treated countries with similar observable characteristics. The key assumption needed to apply matching methods is the conditional independence assumption. This assumption requires that, conditional on a vector of observable characteristics, X, the growth rate will be independent of treatment status: $(Y_0, Y_1 \perp D|X)$. In other words, conditional on this vector X, the expected growth rate in absence of capital account liberalization would be the same for paired countries. If this assumption holds, then the difference in growth rates between paired countries will be an appropriate estimate for the effect of capital account liberalization on growth. Thus, Equation (1) can be rewritten as:

$$ATT = E[Y_{i1}|D = 1, X_i] - E[Y_{i0}|D = 0, X_i] \tag{2}$$

where $[Y_{i0}|D = 0, X_i]$, which has replaced $E[Y_{i0}|D = 1, X_i]$, is observable.

The relevant set of characteristics, X, should include variables that are co-determinants of both capital account liberalization and growth. Matching based on a range of characteristics will be difficult due to the multi-dimensionality of the procedure. Fortunately, Rosebaum and Rubin (1983) showed it was possible to match on the probability of liberalization conditional on X, the propensity score, which is a scalar quantity. The propensity score, defined by Rosebaum and Rubin (1983), is the conditional probability of receiving treatment given pre-treatment characteristics:

$$p(X) = Pr\{D = 1|X\} = E\{D|X\} \quad (3)$$

where p(X) is the propensity score. Thus, our propensity score is the likelihood that given a set of characteristics, X, a country will have an open capital account.

To estimate the propensity scores, we will use a simple probit model explaining the likelihood of capital account liberalization conditional on the vector of right hand side variables, X. In order to apply matching methods, we must ensure that both the Balancing Hypothesis and Common Support Conditions are met. The Balancing Hypothesis is satisfied when observations with the same propensity score have the same distribution of observable characteristics independent of treatment status. Following Dehejia and Wahba (2002), we check a necessary condition for the Balancing Hypothesis by grouping countries into intervals with similar propensity scores referred to as propensity score strata. We test that the means of the right hand side variables between treated and non-treated countries do not differ. The Common Support Condition requires that for each value of X there is a positive probability of both being treated and untreated $(0 < p(X_i) < 1)$. The Common Support Condition ensures that there is sufficient overlap in the characteristics of the treated and untreated to find adequate matches. Ensuring that these conditions are met, we can estimate the ATT as:

$$ATT = E[Y_{i1}|D = 1, p(X_i)] - E[Y_{i0}|D = 0, p(X_i)] \quad (4)$$

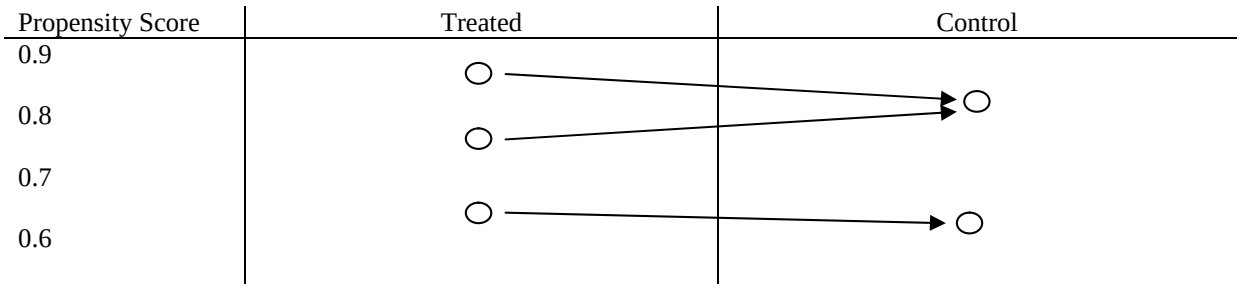
2.3 Matching methods

In order to match countries based on proximities of propensity scores, we implement three different matching algorithms. These algorithms include Nearest Neighbour, Radius, and Kernel Matching. Each method has its own advantages and disadvantages, and by using all three methods we can check the robustness of our results.

2.3.1 Nearest Neighbour Matching

This is the most straightforward method of matching. A country from the treatment group is paired with a country from the control group which has the closest propensity score. We will use nearest neighbour matching with replacement meaning that the control country can be used as a match more than once. By doing so the average quality of replacement will increase and the bias will decrease. Allowing replacement reduces the number of distinct control countries used to determine the treatment effect, and thereby increases the variance of the estimator.[5] Thus, replacement involves a trade-off between variance and bias. The treatment effect is calculated as the simple average of the differences in outcomes (growth rates) across the paired matches. See Figure 1 for a simple diagram illustrating nearest neighbour matching.

Figure 1: Nearest Neighbour Matching

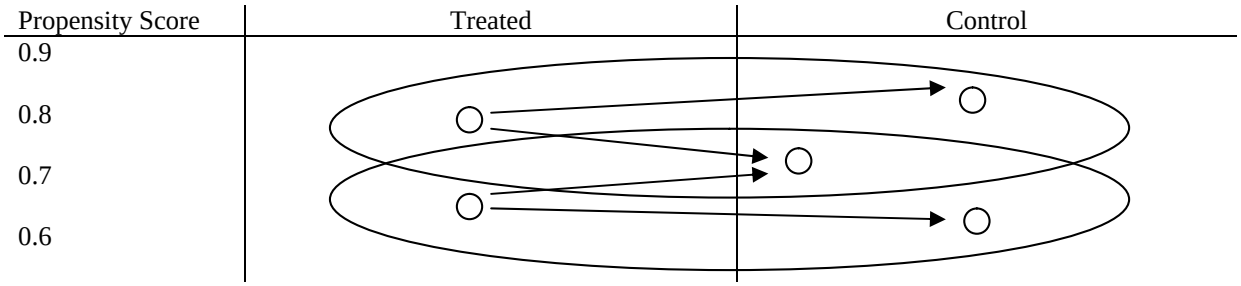


2.3.2 Radius Matching

Radius matching specifies a maximum propensity score distance (radius) in which the control countries can be matched to a treated country. It avoids the risk of bad matches that can occur in the nearest neighbour method if the closest neighbour is far away. Radius matching not only uses the closest neighbour within a specified region, but all the other control observations within that region too. The treatment effect is calculated as an average of the difference in outcomes weighted according to the number of control observations used in the construction of each matched pair. See Figure 2 for a simple diagram illustrating radius matching.

[5] See Smith and Todd (2005).

Figure 2: Radius Matching



2.3.3 Kernel Matching

Kernel matching is a nonparametric matching estimator that compares the outcome of each treated observation to a weighted average of the outcomes of all control observations, with the highest weight being placed on the control observations with the closest propensity scores to the treated observation. The benefit of this approach is that more information is used. The treatment effect is calculated as a simple average of all the individual weighted averages.

3. Measurements of Capital Account Liberalization

There are many different approaches used to measure the financial openness of a country. The majority of measures are generally qualitative and rule-based (de jure measures), however, there have been some attempts to go beyond the presence of legal restrictions and measure the enforcement of capital controls (de facto measures). Rule based indicators determine whether laws controlling capital flows are in place, and attempt to distinguish between the intensity with which capital account restrictions are imposed. However, they are unable to measure whether these laws are actually enforced or whether they effectively stem the flow of capital. De facto measures attempt to quantify the limits placed on capital account transactions from the value of economic variables. Thus, de jure measures pick up the presence of restrictions, whilst de facto measures attempt to measure the outcome from these restrictions. The difficulty with de facto measures is finding a suitable variable to quantify the extent of capital account restrictions.

The most widely used measure of capital account liberalization is a de jure index from the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)* measuring over 60 different types of controls from 1967. This report includes the variable labelled "Restrictions on payments for capital transactions", which up until 1995 was a binary measure based on information from the report. A value of one indicated an open capital account, whilst a value of zero indicated a closed capital account. After 1995 the format of this variable changed and is now calculated based on thirteen separate categories for the controls on capital transactions, and moreover, makes a distinction between controls on inflows and outflows.[6] Thus, after 1995 the *AREAER* variable takes on values between zero and one.

There are many other de jure measures of capital account liberalization; however, the majority of these measures are constructed from the IMF's *AREAER.* For example, the Quinn (1997) variable is a commonly used measure constructed by careful reading of the narrative descriptions in the *AREAER*. The more recent Chinn Ito (2007) measure, *KAOPEN*, also uses the IMF's *AREAER* in an attempt to measure the extensity of capital controls on cross-border flows. Johnston and Tamirisa (1998) use the new disaggregated components in the *AREAER* to create a time series of capital controls, and the Share variable uses the *AREAER* to measure the proportion of years that a capital account is judged free of restrictions. Although all these measures draw on the same underlying source, they differ in terms of how, and to what extent, they extract information from the *AREAER.*

More recently, there have been attempts to move away from the standard IMF's *AREAER* to obtain more detailed measures of the restrictions on international capital flows. The Schindler (2009) dataset is one of the most recent datasets containing several de jure restrictions for a range of categories of assets and liabilities for the period 1995-2005. Although being a de jure index, the asset categories that Schindler focuses on are those that constitute the majority of global cross-border asset holdings. Thus, the dataset broadly reflects the structure of global de facto financial integration.

[6] The following categories include: capital market securities; money market instruments; collective investment securities; derivatives and other instruments; commercial credits; financial credits; guarantees, sureties, and financial backup facilities; direct investment; liquidation of direction investment; real estate transactions; personal capital movements; provisions specific to commercial banks and other credit institutions; and provisions to institutional investors. These categories are in turn disaggregated in the new *AREAER.* See Tamirisa (1998) and Miniane (2004) for a descriptive overview and statistical analysis on the disaggregated data of *AREAER* after 1995.

There are also a variety of de facto measures available, such as those published by Lane and Milesi-Ferretti (2006). This is an extensive dataset containing information about the composition of international financial positions, which attempts to measure any external shocks to assets and liabilities. Ranciere, Tornell and Westermann (2006) also generate a de facto measure based on the identification of country-specific trend breaks in private capital flows. Although it may seem preferable to measure actual performance rather than published regulations, there are many practical challenges associated with quantitative measures.[7] In our analysis we will focus on the *AREAER* de jure measure; however, we realize the limitations associated with this measure and will discuss these further in the following section.

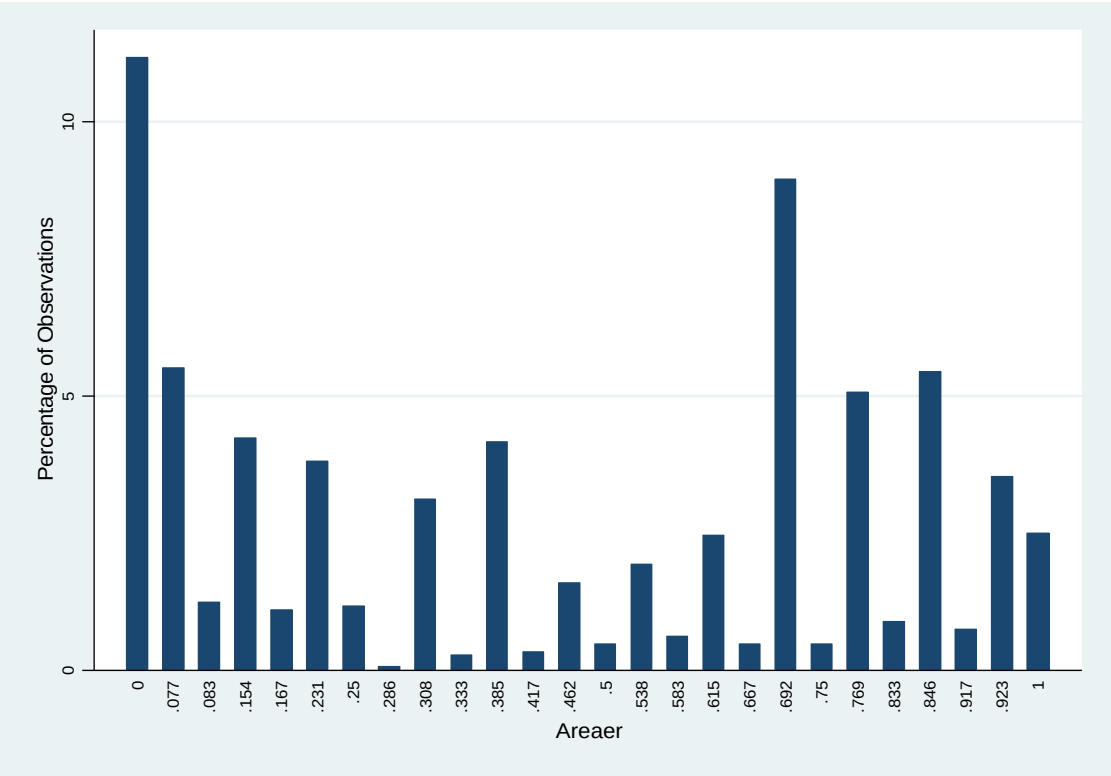
3.1 Construction of the Capital Account Liberalization Measure

Propensity Score Matching requires our treatment variable to be binary. We will, therefore, use the IMF's *AREAER* as our measure of capital account liberalization. We have data for this variable over the period 1970-2006 for 131 countries.[8] After 1995 this variable takes on values between zero and one, so we have to dichotomize it for this period. Figure 3 shows the distribution of the *AREAER* variable after 1995. As we can see, the majority of observations take on the value zero. Thus, we dichotomize this variable for the years after 1995 by setting it to zero if it takes on the value of zero or setting it to one if it takes on any value greater than zero. Glick, Guo and Hutchison (2006) dichotomize the *AREAER* variable in a slightly different manner. They define the capital account to be restricted if controls were in place in five or more of the subcategories and "financial credits" was one of the categories restricted. This is very similar to using 0.5 as a cut-off value. We feel that a zero cut-off makes more intuitive sense, as we are effectively comparing countries with strictly closed capital accounts to those with some degree of openness. We also tried a 0.5 cut-off but found that a lot of countries that were open in 1995 (and many years before that) suddenly switched to being closed in 1996. We highly doubt this swing in liberalization reflected changes in countries' capital account policies and was more likely to do with the cut-off specification. This problem was greatly reduced when we chose zero as our cut-off value.

[7] See Kose, Prasad, Rogoff and Wei (2009) who address the difficulties associated with measuring de facto integration.

[8] See Table A1 in Appendix A for the list of countries and Table A2 for the number of countries with open and closed capital accounts over the period 1970-2006.

Figure 3: Distribution of IMF Measure, *AREAER*, over 1995-2006



We are aware of the concerns of the quality of the IMF variable. Being a dichotomous de jure measure, it limits the amount of information it can convey on the magnitude and enforcement of capital controls. Ideally, for robustness, we would like to match countries based on several different measures of capital account liberalization. However, given the majority of other measures are not binary, it is too difficult to implement matching methods. We have attempted to dichotomize both the Quinn and Schindler variable, *KA*, and apply matching methods; however, the balancing properties were not satisfied.[9] We do find, however, that the Quinn, Schindler and Chinn Ito measures are strongly positively correlated with the *AREAER* variable. This suggests that although the *AREAER* measure is coarse, it is still a good overall indicator of capital account liberalization. Table 1 presents the correlations between these measures. It is worth noting that the correlations between the *AREAER* variable and the Quinn and Schindler variables decrease when we dichotomize the *AREAER* variable after 1995. This is to be expected as we effectively lose some of the information conveyed by the *AREAER* variable by dichotomizing it.

[9] The *KA* variable, constructed in Schindler (2009), is an overall aggregated measure of the restrictions on capital accounts constructed from the restrictions on six main asset categories that Schindler believes to constitute the majority of global asset holdings.

Table 1: Correlation Matrix of Capital Account Liberalization Measures

	AREAER (original)	*AREAER* (zero cut)	Quinn	Schindler *KA*	Chinn Ito *KAOPEN*
AREAER (original)	1				
AREAER (zero cut)	0.826	1			
Quinn	0.645	0.643	1		
Schindler, *KA*	0.850	0.439	0.803	1	
Chinn Ito, *KAOPEN*	0.817	0.639	0.743	0.789	1

Note: *AREAER* (original) is the IMF measure before dichotomization and *AREAER* (zero) is the dichotomized IMF measure using a zero cut-off. All correlations are significant at a 5 percent significance level.

Another limitation when using the *AREAER* variable is that, by being an aggregated indicator, we are unable to distinguish between the controls placed on different asset categories. Using the Schindler dataset, we are able to investigate the composition of restrictions on the six main asset categories that constitute the majority of de facto flows. These categories include: shares or other securities of a participating nature; bonds or other debt securities; money market instruments; collective instruments; financial credits; and direct investment. Furthermore, we can investigate the restrictions on the direction of flows (inflows versus outflows) for each category. We find that over the period 1997 to 2005 the mean restrictions placed on each category are very similar relative to one another and do not change significantly over time.[10] This suggests that countries which are broadly categorized as closed have capital controls on every category, and, therefore, we do not lose much by using the *AREAER* variable as a gross measure of capital account liberalization.

Thus, we believe that our dichotomous *AREAER* variable is a reliable indicator and will be an overall sufficient measure of capital account liberalization. The issue of having to use a dichotomous variable is one of the drawbacks of PSM, and like any other estimation technique there are always some limitations.

[10] See Figures A1 and A2 in Appendix A which illustrate the composition of the restrictions placed on the assets that make up the Schindler dataset.

4. Estimating Propensity Scores

In this section we estimate the propensity scores using a benchmark and augmented probit model. In doing so we are able to examine the determinants of capital account liberalization. We will estimate each probit model for three samples of countries; our pooled sample containing all 131 countries, OECD countries, and Non-OECD countries. [11]

4.1 Benchmark Probit Model

We estimate the propensity score for each country by a benchmark probit equation explaining the likelihood of a country having a liberalized capital account. We consider a range of characteristics likely to be a co-determinant of both capital account liberalization and growth. [12] Our selection of variables is guided by several studies, specifically those by Glick, Guo and Hutchison (2006), Alensina, Grilli and Milesi-Ferretti (1994), Bartolini and Drazen (1997b), Grilli and Milesi-Ferretti (1995), and Johnston and Tamirisa (1998). Johnston and Tamirisa (1998) investigate several theoretical determinants of capital controls. They suggest countries suffering from a weak balance of payments are more likely to impose capital controls to restrict the outflow of capital. Furthermore, they suggest that the overall openness of an economy may affect the intensity of capital controls. Specifically, more open economies are less likely to impose capital controls because there are more opportunities to circumvent capital controls, and, more generally, the liberalization of certain components of the capital account, such as trade finance, is complementary to trade liberalization. Bartolini and Drazen (1997b) link a high degree of restrictions on capital flows with high world interest rates.[13] They suggest this causality is explained by developing countries removing restrictions on capital flows when the cost of doing so is low i.e. only a small outflow of capital occurs when world interest rates are low. Lastly, Alensina, Grilli and Milesi-Ferretti (1994) and Grilli and Milesi-Ferretti (1995) found that countries with larger levels of government consumption (as a ratio of GDP) are more likely to impose capital controls. One possible explanation of this causality proposed by these two studies is that governments with a larger share in economic activity have a greater incentive to impose capital controls for fiscal reasons. This idea is

[11] See Table A1 in Appendix A for a list of the OECD and Non-OECD countries.
[12] See Table A3 in Appendix A for a description and source of the characteristics used in both benchmark and augmented probit models.
[13] Bartolini and Drazen (1997b) measure world interest rates by taking a weighted average of annual real interest rates in the G7 industrialized countries.

linked to the political instability of the country, as countries suffering from severe political instability may be more inclined to impose capital controls in order to preserve the domestic tax base, specifically inflation tax, which may be one of the government's only viable tax instruments.

Following these studies, we include two macroeconomic variables, two economic variables, and a political variable. The macroeconomic variables are current account as a percentage of real GDP, and the U.S. real interest rate. We expect countries with larger current account deficits to be more likely to impose restrictions on their capital accounts, and there to be a strong, positive link between restrictions on capital flows in developing countries and the U.S. real interest rate.[14] The two economic variables we include are government consumption as a percent of real GDP, and openness to world trade (measured by the sum of exports and imports as a percentage of real GDP). We expect countries with high levels of government consumption and closed international trade to be more likely to restrict capital flows. Finally, we include a measure of political regime, polity2, from the PolityIV dataset. We expect countries with more democratic practices (higher values of polity2) to pursue financial integration. Equation (5) illustrates our benchmark probit equation:

$$\begin{aligned} Cap_Lib_{i,t} \; = \; & \beta_0 \; + \; \beta_1 (CA/GDP)_{i,t-1} + \; \beta_2 (US\ Real\ Interest\ Rate)_{i,t-1} \\ & + \; \beta_3 (Openness/GDP)_{i,t} \; + \; \beta_4 (Govt\ Consumption/GDP)_{i,t-1} \\ & + \; \beta_5 (Polity2)_{i,t} + \; \varepsilon_{i,t} \end{aligned} \tag{5}$$

It is important to only choose a set of characteristics that are unaffected by participation (or anticipation of it). For this reason we lag many of the explanatory variables in the probit model to ensure the variable has not been influenced by anticipation of participation.

Using this benchmark specification, we estimate three probit models for the pooled, OECD, and Non-OECD countries. Table 2 presents the results. Looking at the pooled results, we can see that the coefficients of current account, trade openness, and polity2 all have the expected signs and are highly significant. The coefficients of the U.S. real interest rate and government consumption have the expected signs but are not statistically significant. Thus,

[14]Like Glick, Guo and Hutchison (2006), we use U.S. real interest rates as a proxy for Northern real interest rates.

we can conclude that countries that undertake a large range of democratic practices, have lower current account deficits, and have a greater openness to trade are more likely to liberalize their capital accounts. The percentage of observations correctly predicted is reasonable with a success rate of 63% and the overall fit of the regression is reasonable with a pseudo R^2 of 0.091.[15]

Looking at the results for the Non-OECD countries, we see that all of the coefficients have the expected signs and are highly significant, whereas, the only significant coefficients for the OECD probit are for the polity2 and current account variables. This suggests that the OECD countries that are more likely to liberalize are those that undertake more democratic practices and have larger current account surpluses (or smaller deficits). It is also worth noting that the coefficient of the polity2 variable is much larger for the OECD probit than the Non-OECD, suggesting that democratic practices play a much larger role in determining the likelihood of liberalization for OECD countries compared to Non-OECD countries.

Table 2: Benchmark Probit Estimates for the period 1970-2006

	Pooled	OECD	Non-OECD
Current Account/GDP, t -1	**1.085*** **	**2.205*** **	**0.897*** **
	(0.136)	(0.454)	(0.140)
U.S. Real interest rate, t -1	-0.432	0.973	**-0.903** **
	(0.388)	(0.818)	(0.451)
Government Consumption, t-1	-0.145	-0.298	**-0.341* **
	(0.158)	(0.357)	(0.190)
Trade Openness, t	**0.257*** **	0.059	**0.293*** **
	(0.026)	(0.070)	(0.031)
Polity2, t	**1.732*** **	**6.260** **	**1.442*** **
	(0.131)	(2.508)	(0.144)
Number of observations	3044	736	2308
Percentage of observations predicted correctly	62.55	63.04	65.55
Pseudo R squared	0.091	0.085	0.095

Note: Our dependent variable is our dichotomized *AREAER* variable. Coefficients reported are the marginal effects indicating the percentage change in probability of capital account liberalization for an infinitesimal change in each independent variable. Bootstrapped standard errors (replications 500) are reported in parentheses. *, **, and *** indicate the significance level of 10%, 5% and 1%, respectively.

[15] It is important to realize that the pseudo R^2 is a different measure to the standard OLS R^2. It has been shown that a pseudo R^2 around 0.2 is comparable to an OLS adjusted R^2 of 0.7. See Louviere, Hensher and Swait (2000).

4.2 Augmented Probit Model

It has been suggested that capital account liberalization may be acting as a proxy for other economic variables, specifically, institutional quality and the degree of financial development. For example, Honig (2008) suggests that in order for a country to experience the benefits of capital account liberalization, they must have good institutions in place. Hence, it may be the case that only countries with sound institutions choose to liberalize. Johnston and Tamirisa (1998) also suggest countries with developing financial markets and institutions may be more inclined to impose capital controls for both prudential reasons and protection of domestic industries. Thus, we would like to be able to control for these variables in our probit models and matching methods to ensure we are estimating the independent effect of capital account liberalization on growth.

We estimate an augmented probit model by including a measure of financial development and institutional quality. This comes at the cost of a reduced sample size. We expect countries with more developed financial markets and better political institutions to pursue capital account liberalization. For our financial development measure, we use M2 as a percentage of GDP. [16] We interpret higher values of this ratio as an indicator of greater financial development. Secondly, we include an overall measure of institutional quality, *InstitutionQual*. This measure, constructed in Honig (2008), is a proxy for corruption, the degree to which contracts are enforced, and government effectiveness. It is constructed as a simple average of three variables from the International Country Risk Guide. These variables include: *Bureaucracy Quality*, which measures the quality of the bureaucracy, and independence from political pressure; *Corruption*, which measures the ability to influence government officials, and the power they hold; and *Law and Order*, which assesses the effectiveness of the legal system, and obeying of law. The higher the value of *InstitutionQual*, the better the political institutions. Our augmented probit model is shown in Equation (6):

$$\begin{aligned} Cap_Lib_{i,t} = {} & \beta_0 + \beta_1(CA/GDP)_{i,t-1} + \beta_2(US\ Real\ Interest\ Rate)_{i,t-1} \\ & + \beta_3(Openness/GDP)_{i,t} + \beta_4(Govt\ Consumption/GDP)_{i,t-1} \\ & + \beta_5(Polity2)_{i,t} + \beta_6(InstitutionQual)_{i,t} + \beta_7(M2/GDP)_{i,t-1} + \varepsilon_{i,t} \end{aligned} \quad (6)$$

[16] M2 as a percentage of GDP is used as a measure of financial development by Honig (2008).

Using this augmented specification, we estimate three probit models for the pooled, OECD, and Non-OECD countries. These results are presented in Table 3. By including the institutional quality variable, we reduce the sample period to 1984-2006. Looking at the results for all countries, we see that the coefficient of the institutional quality variable and the financial development variable are both positive and significant as expected. Thus, we can conclude that countries with greater financial development and better institutions are more likely to liberalize their capital accounts. It is also worth noting that the coefficients of all the explanatory variables have the expected signs and are highly significant (except for the current account variable which is not significant). The same conclusion can be made when we look at the results for Non-OECD countries. The OECD results, however, show that the effect of institutional quality is not significant. Thus, we can conclude that institutional quality does not play a role in determining the likelihood of liberalization for OECD countries.

Table 3: Augmented Probit Estimates for the period 1984-2006

	Pooled	OECD	Non-OECD
Current Account/GDP, t -1	0.226	-0.952	0.340
	(0.190)	(0.743)	(0.210)
U.S. Real interest rate, t -1	**-3.641*** **	**-5.770*** **	**-3.185*** **
	(0.671)	(1.565)	(0.656)
Government Consumption, t-1	**-0.603** **	-0.518	**-0.766*** **
	(0.255)	(0.599)	(0.285)
Trade Openness, t	**0.222*** **	-0.14714	**0.287*** **
	(0.036)	(0.119)	(0.046)
Polity2, t	**1.006*** **	**8.579*** **	**0.773*** **
	(0.201)	(3.243)	(0.219)
Institutional Quality, t	**5.067*** **	1.973	**3.158* **
	(1.475)	(4.697)	(1.895)
M2/GDP, t -1	**0.275*** **	**0.235* **	**0.194*** **
	(0.054)	(0.135)	(0.067)
Number of observations	1697	294	1403
Percentage of observations predicted correctly	63.76	75.51	61.94
Pseudo R squared	0.106	0.237	0.085

Note: See footnote for Table 2.

5. Estimating the Overall Treatment Effects

In this section we employ all three matching methods described earlier (nearest neighbour, kernel, and radius matching) to estimate the effect capital account liberalization has on growth. For each matching method we impose the common support condition and check to see if the balancing property holds. Specifically, for radius matching we choose a radius of 0.005.[17] We match countries based on the propensity scores generated by our two probit models (benchmark and augmented) and then estimate the treatment effect for two different specifications of growth. These specifications include annual GDP growth per capita and average five yearly GDP growth per capita.[18] We use the latter specification to ensure that we estimate the full effects of capital account liberalization on growth, which may not be evident in a one year period. We firstly estimate the average treatment effects (ATTs) for all countries over the whole sample period. We then split our sample into OECD and Non-OECD countries to see if the treatment effect differs between the two groups. Lastly, we estimate the treatment effect over the period 1990-2006.

5.1 Treatment Effects for all Countries

Tables 4 and 5 present the ATTs for all countries for annual growth and average five yearly growth, respectively. We find that all but two of the treatment effects are positive and significant, and the balancing property is satisfied for each method. [19] Not only this, but for each measure of growth, the treatment effects across the three matching methods for both the benchmark and augmented specifications are of a similar magnitude. This consistency across the matching methods suggests that our results are robust. We also find that the treatment effect for five yearly growth is greater than that for annual growth. This is to be expected, as not all of the effects of capital account liberalization on growth will be seen immediately. Thus, we can conclude that countries that do liberalize their capital accounts are likely to experience higher growth rates than countries that do not. Specifically, the annual growth rate in countries with liberalized capital accounts, compared to those with capital controls, is

[17] This is the size of the radius chosen by Glick, Guo and Hutchison (2006) who were guided by Persson (2001).

[18] We generate the average five yearly growth by calculating the growth in GDP over every 5 year period between 1970-2006 and divide by 5 (we generate 35 observations). We overlap the periods to ensure that our growth variable does not block out the years in which liberalization of countries occurred.

[19] The two ATTs calculated using the nearest neighbour method for annual growth are not significant. Also see Table A5-A10 in Appendix A which shows that the balancing property holds for all three matching methods using both the benchmark and augmented probit specification.

approximately 0.47 percentage points higher (based on the benchmark kernel matching method). The average five yearly growth rate in countries with liberalized capital accounts, compared to those with capital controls, is approximately 0.76 percentage points higher (based on the benchmark kernel matching method). It is also worth noting that within each table there is little difference between the augmented and benchmark results. This suggests that capital account liberalization is not just acting as a proxy for good institutions; they appear to have an independent effect on a country's growth rate.

Table 4: Matching Results for Annual Growth Rate for all Countries

	Nearest Neighbour Matching	Kernel Matching	Radius Matching (0.005)
Areaer (Benchmark)	0.329	**0.471*** **	**0.466*** **
	(0.221)	(0.164)	(0.160)
Areaer (Augmented)	0.474	**0.422***	**0.432** **
	(0.322)	(0.236)	(0.219)

Note: The sample period for the augmented probit is 1984-2006 due to the inclusion of an institutional quality and financial development variable. Bootstrapped standard errors (based on 100 replications of the data) for ATTs are reported in parentheses. *, **, and *** indicated the significance level of 10%, 5% and 1%, respectively.

Table 5: Matching Results for Average Five Yearly Growth Rate for all Countries

	Nearest Neighbour Matching	Kernel Matching	Radius Matching (0.005)
Areaer (Benchmark)	**0.660*** **	**0.757*** **	**0.712*** **
	(0.176)	(0.123)	(0.116)
Areaer (Augmented)	**0.851*** **	**0.833*** **	**0.822*** **
	(0.222)	(0.162)	(0.160)

Note: See footnote for Table 4.

5.2 Treatment Effects for OECD and Non-OECD Countries

5.2.1 OECD Countries

An issue that arises with many previous studies is whether the effect of capital account liberalization differs between industrialised countries and developing countries. We classify countries as industrial if they are current members of the OECD. We run the same matching

algorithms as above for both the benchmark and augmented probit specifications, but this time we split the dataset into OECD countries and Non-OECD countries. Tables 6 and 7 present the annual growth and five yearly growth treatment effects for OECD countries, respectively.

Table 6: Matching Results for Annual Growth Rate for OECD countries

	Nearest Neighbour Matching	Kernel Matching	Radius Matching (0.005)
Areaer (Benchmark)	-0.014	0.009	-0.021
	(0.305)	(0.173)	(0.223)
Areaer (Augmented)	*0.097*	0.517	*0.209*
	(0.616)	(0.428)	(0.664)

Note: The sample period for the augment probit is 1984-2006 due to the inclusion of an institutional quality and financial development variable. ATTs reported in italics did not meet the balancing property. Bootstrapped standard errors (based on 100 replications of the data) for ATTs are reported in parentheses. *, **, and *** indicated the significance level of 10%, 5% and 1%, respectively.

Table 7: Matching Results for Average Five Yearly Growth Rate for OECD countries

	Nearest Neighbour Matching	Kernel Matching	Radius Matching (0.005)
Areaer (Benchmark)	0.0697	0.133	0.157
	(0.212)	(0.125)	(0.142)
Areaer (Augmented)	*-0.002*	*0.251*	*-0.112*
	(0.426)	(0.316)	(0.469)

Note: See footnote for Table 6.

The treatment effects estimated for OECD countries are insignificant for all matching methods for both the benchmark and augmented specifications. However, it is important to note that the balancing property was not met for nearly half of these matching methods (these are the ATTs presenting in italics). This is most likely due to the severely reduced sample size preventing us from finding a sufficient number of adequate matches.[20] Thus, we cannot conclude the effect of capital account liberalization on growth for OECD countries using this methodology.

[20] For the benchmark specification the sample size drops from 3044 to 736 observations, and for the augmented specification the sample size drops from 1697 to 294 observations.

5.2.2 Non-OECD Countries

Tables 8 and 9 present the annual growth and five yearly growth treatment effects for Non-OECD countries, respectively. Interestingly, all but one of the estimated ATTs are significant and positive.[21] As expected the ATTs for the average five yearly growth rates are larger than those for the annual growth rate. It is also worth noting that the ATTs are larger for the Non-OECD countries than for the pooled countries. This is most likely due to the presence of OECD countries in the pooled sample. Finally, we must mention that for a few of the matching algorithms the balancing property was not met. However, for the majority of matching methods the balancing property has been met, and the treatment effects do not differ significantly between those methods that satisfy the balancing property and those that do not. Therefore, we can conclude that Non-OECD countries that choose to liberalize are likely to experience higher growth rates than those that do not. Specifically, the annual growth rate in Non-OECD countries with liberalized capital accounts, compared to those with capital controls, is approximately 0.58 percentage points higher (based on the benchmark kernel matching method). The average five yearly growth rate in Non-OECD countries with liberalized capital accounts, compared to those with capital controls, is approximately 0.98 percentage points higher (based on the benchmark kernel matching method).

Table 8: Matching Results for Annual Growth Rate for Non-OECD countries

	Nearest Neighbour Matching	Kernel Matching	Radius Matching (0.005)
Areaer (Benchmark)	***0.613****	**0.578****	**0.873*****
	(0.322)	(0.249)	(0.232)
Areaer (Augmented)	*0.563*	**0.530***	**0.534***
	(0.375)	(0.276)	(0.309)

Note: See footnote for Table 6.

Table 9: Matching Results for Average Five Yearly Growth Rate for Non-OECD countries

	Nearest Neighbour Matching	Kernel Matching	Radius Matching (0.005)
Areaer (Benchmark)	***0.952*****	**0.982*****	**0.974*****
	(0.239)	(0.123)	(0.251)
Areaer (Augmented)	**0.974*****	**1.062*****	**1.194*****
	(0.245)	(0.185)	(0.182)

Note: See footnote for Table 6.

[21] The nearest neighbour ATT for the augmented specification in Table 8 is not significant.

5.3 Treatment Effects from 1990 Onwards

Since the early 1990s and up until the mid 2000s, financial integration has become an increasingly popular trend. Thus, we would like to investigate the effect of capital account liberalization on growth for the period 1990-2006. We suspect the effect will be greater for this more recent period. Tables 10 and 11 present these matching results. We find all but one of the treatment effects are positive and significant. However, because of our reduced sample size a few of the matching methods do not satisfy the balancing property.[22] However, the ATTs for the matching methods that do satisfy the balancing property are close in magnitude and significance to those that do not satisfy this property. Therefore, we can conclude that over this more recent period, countries that liberalize their capital accounts are more likely to experience higher growth rates than those that do not.

When comparing these results to those presented in Tables 4 and 5, we find that for the benchmark specification the ATTs are greater for the smaller sample period. This suggests that the effect of capital account liberalization on growth, at least for the benchmark specification, is greater for the period 1990 onwards than for the whole sample period, as expected. However, this is not supported by the augmented specification, in which the difference between the ATTs for the two periods is not sizeably different. Thus, we cannot conclude whether the effects of capital account liberalization on growth have been stronger in the more recent years. It is worth noting that unlike our previous results in Tables 4 and 5, the ATTs for five yearly growth are actually less than the ATTs for annual growth, suggesting the long-term benefits of liberalization on growth are less than the short-term. This could be the result of the widespread liberalization since the 1990s, causing the beneficial effects to get percolated very quickly. Prior to that, this might not have been the case since capital markets were not as integrated.

Lastly, it is important to note that within Tables 10 and 11, the magnitudes of ATTs for the benchmark specification are greater than those for the augmented specification. Thus, after controlling for institutional quality and financial development, the effect of capital account liberalization on growth is not as profound. This suggests that in more recent years, the quality of political and financial institutions have started to play a more integral role in determining the benefits of capital account liberalization. This is most likely due to the

[22] The nearest neighbour method for the augmented specification in Table 10 is not significant. Reducing our sample period from 1970-2006 to 1990-2006 causes our sample size to drop from 3044 to 1715 observations for the benchmark specification and from 1697 to 1322 observations for the augmented specification.

increasing sophistication of financial markets over the last decade, requiring more advanced financial institutions to be in place.

Table 10: Matching Results for Annual Growth Rate for all Countries from 1990-2006

	Nearest Neighbour Matching	Kernel Matching	Radius Matching (0.005)
Areaer (Benchmark)	***0.926****	**0.850*****	**0.782*****
	(0.269)	(0.218)	(0.251)
Areaer (Augmented)	0.315	**0.448***	**0.564****
	(0.365)	(0.267)	(0.288)

Note: See footnote for Table 6.

Table 11: Matching Results for Average Five Yearly Growth Rate for all Countries from 1990-2006

	Nearest Neighbour Matching	Kernel Matching	Radius Matching (0.005)
Areaer (Benchmark)	***0.817****	**0.804*****	**0.753*****
	(0.214)	(0.130)	(0.140)
Areaer (Augmented)	***0.513*****	**0.568*****	**0.502****
	(0.229)	(0.179)	(0.213)

Note: See footnote for Table 6.

6. Conclusion

In the late first decade of the 2000's we witnessed one of the biggest catastrophes to hit global financial markets. As a result, markets all around the world are still suffering the consequences. The Global Financial Crisis has reignited the debate on whether the benefits of capital account liberalization outweigh the costs. Those for liberalization argue countries that open up their capital accounts will set the stage for more rapid development, whilst their opponents question these advantages and, furthermore, argue that financial integration leads to greater volatility and increased spread of risk in financial markets.

In this paper we analyse the effect of capital account liberalization on growth. We do so by implementing a relatively new methodology to the field of international economics, propensity score matching, to account for the possibility of sample selection bias. It may be the case that countries with relatively sound economic policies, strong financial sectors, and political stability choose to liberalize because they have the fundamentals in place to benefit from capital account liberalization. In contrast, countries lacking strong institutions may choose to keep their capital accounts closed. Thus, we implement three matching techniques (nearest neighbour, kernel, and radius matching) specifically designed to account for estimation bias.

We firstly evaluate the treatment effects of capital account liberalization on growth using data from 131 countries over the period 1970-2006. Our results suggest that, even after controlling for sample selection bias, capital account liberalization is associated with higher growth rates. That is, when two countries have the same likelihood of maintaining an open capital account, and one country imposes controls and the other does not, the country without controls will be more likely to experience higher growth. These results are robust to changes in matching methods and to changes in the probit equations used to predict the likelihood of liberalization. We can also conclude that it is unlikely that capital account liberalization is acting as a proxy for the presence of good institutions and greater financial development, as we control for these variables in our augmented probit models and still find strong, significant treatment effects.

We further our investigation to evaluate the treatment effects of financial integration on growth for OECD and Non-OECD countries. We cannot conclude the effect of liberalization on growth for OECD countries. However, we do find that capital account liberalization has a strong, positive effect on growth for Non-OECD countries. The results for

Non-OECD countries are robust to changes in matching methods and probit specifications. Moreover, controlling for institutional quality and financial development does not alter the magnitude or significance of the treatment effects.

Lastly, we evaluate the treatment effects for the smaller period of 1990-2006. We suspect that the effect of capital account liberalization will be stronger for this shorter sample period, compared to the entire sample period (1970-2006), as this is when a large movement toward financial globalization occurred. However, when we compare the ATTs across these two periods, we cannot conclude whether the effect of capital account liberalization on growth has been stronger in the more recent years. However, this comparison does highlight some interesting results. It appears that for the more recent period the effect of capital account liberalization on average 5 yearly growth is less than that on annual growth (whereas, the opposite is true for the entire sample period). This suggests that since the 1990s the beneficial effects of liberalization get percolated very quickly. Finally, we note that for this more recent period our treatment effects differ in magnitude between probit specifications. Our results suggest that once controlling for institutional quality and financial development, the effect of capital account liberalization on growth is not as strong. This suggests that institutional quality and the level of financial development in a country are starting to play a more integral role in determining the magnitude of the benefits of financial liberalization.

We conclude that based on our results for all countries over the entire sample period, capital account liberalization is associated with higher growth rates. When we split our sample into Non-OECD and OECD countries we find a significant, positive effect on growth for Non-OECD countries but cannot conclude the effect for OECD countries. Our results also suggest that in more recent years the long-term benefits of liberalization on growth are smaller than the short-term. Furthermore, there is evidence that both the degree of financial development and the quality of institutions are starting to play a more important role in determining the associated benefits of capital account liberalization.

References

Alensina, A., Grilli, V., and Milesi-Ferretti, G. (1994). The political economy of capital controls. *CEP Discussion Papers dp0169, Centre for Economic Performance, LSE.*

Bartolini, L. & Drazen, A. (1997b). Where liberal policies reflect external shocks, what do we learn? *Journal of International Economics, 42,* 249-273.

Bekaert, G., Harvey, C., & Lunblad, C. (2005). Does financial liberalization spur growth? *Journal of Financial Economics, 77,* 3-55.

Chinn, M., & Ito, H. (2007). A new measure of financial openness. *Journal of Comparative Policy Analysis, 10*(3), 309-322.

Dehejia, R., & Wahba, S. (2002). Propensity score-matching methods for nonexperimental causal studies. *The Review of Economics and Statistics, 84*(1), 151-161.

Dooley, M. (1996). A survey of literature on controls over international capital transactions. *International Monetary Fund Staff Papers, 43*(4).

Edison, H., Klein, M., Ricci, L., & Sløk, T. (2002). Capital account liberalization and economic performance: survey and synthesis. *International Monetary Fund Staff Papers, 51*(2), 220-256.

Glick, R., Guo, X., & Hutchison, M. (2006). Currency crises, capital-account liberalization, and selection bias. *The Review of Economics and Statistics, 88*(4), 698-714.

Glick, R., & Hutchison, M. (2005). *Journal of International Money and Finance, 24,* 387-412.

Grilli, V., and Milesi-Ferretti, G. (1995). Economic effects and structural determinants of capital controls. *International Monetary Fund Staff Papers, 42*(3), 517-551.

Honig, A. (2008). Addressing causality in the effect of capital account liberalization on growth. *Journal of Macroeconomics, 30,* 1602-1616.

Johnston, R., & Tamirisa, N. (1998). Why do countries use capital controls? *International Monetary Fund Working Paper, 181.*

Klein, M., & Olivei, G. (2008). Capital account liberalization, financial depth, and economic growth. *Journal of International Money and Finance,27,* 861-875.

Kose, M., Prasad, E., Rogoff, K., & Wei, S. (2009). Financial globalization: a reappraisal. *International Monetary Fund Staff Papers, 56*(1), 8-52.

Lane, P., & Milesi-Ferretti, G. (2007). The external wealth of nations mark II: revised and extended estimates of foreign assets and liabilities. *Journal of International Economics, 73*(2), 223-250.

Louviere, J., Hensher, D., & Swait, J. (2000). Stated choice methods: analysis and application. *Cambridge University Press.*

Lucas , R. (1990). Why doesn't capital flow from rich to poor countries? *The American Economic Review, 80*(2), 92-96.

Miniane, J. (2004). A new set of measures on capital account restrictions. *International Monetary Fund Staff Papers, 51*(2), 276-308.

Persson, T. (2001). Currency unions and trade:how large is the treatment effect? *Economic Policy (October),* 435-448.

Quinn, D. (1997). The correlates of change in international financial regulation. *American Political Science Review, 913,* 531-551.

Ranciere, R., Tornell, A., & Westermann, F. (2006). Decomposing the effects of financial liberalization: crises vs. growth. *Journal of Banking and Finance, 30,* 3331-3348.

Rosenbaum, P., & Rubin, D. (1983). The central role of the propensity score in observational studies for casual effects. *Biometrika, 70*(1), 41-55.

Schindler, M. (2009). Measuring financial integration: a new dataset. *International Monetary Fund Staff Papers, 56*(1), 222-238.

Smith, J., & Todd, P. (2001). Reconciling conflicting evidence on the performance of propensity-score matching methods. *The American Economic Review, Papers and Proceedings of the Hundred Thirteenth Annual Meeting of the American Economic Association, 91*(2), 112-118.

Smith, J., Todd, P. (2005). Does matching overcome LaLonde's critique of nonexperimental estimators? *Journal of Econometrics, 125*(1-2), 305-353.

Stiglitz, J. (2000). Capital market liberalization, economic growth, and instability. *World Development, 28*(6), 1075-1086.

Summers, L. (2000). International financial crises: causes, prevention and cures. *The American Economic Review, 90*(2), 1-16.

Tamirisa, N. (1999). Exchange and capital controls as barriers to trade. *International Monetary Fund Staff Papers, 46*(1), 69-88.

Appendix A

Table A1: Countries

OECD			
Australia	France	Japan	Sweden
Austria	Greece	Mexico	Switzerland
Belgium	Hungary	Netherlands	Turkey
Canada	Iceland	New Zealand	United Kingdom
Chile	Ireland	Norway	United States
Denmark	Israel	Portugal	
Finland	Italy	Spain	
Non-OECD			
Albania	Cyprus	Liberia	Saudi Arabia
Algeria	Dominica	Madagascar	Senegal
Antigua and Barbuda	Dominican Republic	Malawi	Seychelles
Argentina	Ecuador	Malaysia	Sierra Leone
Bahamas, The	Egypt, Arab Rep.	Mali	Singapore
Bahrain	El Salvador	Malta	South Africa
Bangladesh	Estonia	Marshall Islands	Sri Lanka
Belize	Ethiopia	Mauritania	St. Kitts and Nevis
Benin	Fiji	Mauritius	St. Lucia
Bhutan	Gabon	Mongolia	Sudan
Bolivia	Gambia, The	Morocco	Swaziland
Botswana	Ghana	Mozambique	Syrian Arab Republic
Brazil	Grenada	Myanmar	Thailand
Brunei Darussalam	Guatemala	Namibia	Togo
Bulgaria	Guinea-Bissau	Nepal	Trinidad and Tobago
Burkina Faso	Guyana	Nicaragua	Tunisia
Burundi	Honduras	Niger	Uganda
Cameroon	Hong Kong SAR, China	Nigeria	United Arab Emirates
Cape Verde	India	Oman	Uruguay
Central African Republic	Indonesia	Pakistan	Vanuatu
Chad	Iran, Islamic Rep.	Panama	Venezuela, RB
China	Jamaica	Papua New Guinea	Vincent & the Grenadines
Colombia	Jordan	Paraguay	Zambia
Comoros	Kenya	Peru	Zimbabwe
Congo, Dem. Rep.	Kiribati	Philippines	
Costa Rica	Latvia	Romania	
Cote d'Ivoire	Lesotho	Rwanda	

Table A2: The Number of Countries Liberalized and Closed over 1970-2006

Year	Non-Liberalized	Liberalized	Total
1970	44	11	55
1971	44	11	55
1972	113	17	130
1973	111	20	131
1974	110	20	130
1975	110	20	130
1976	110	20	130
1977	109	22	131
1978	108	23	131
1979	106	25	131
1980	107	24	131
1981	105	26	131
1982	106	25	131
1983	105	26	131
1984	107	24	131
1985	107	24	131
1986	108	23	131
1987	108	23	131
1988	106	25	131
1989	105	26	131
1990	105	26	131
1991	102	29	131
1992	99	32	131
1993	95	37	132
1994	89	42	131
1995	86	45	131
1996	10	121	131
1997	9	122	131
1998	14	117	131
1999	17	114	131
2000	18	113	131
2001	18	113	131
2002	17	114	131
2003	17	114	131
2004	17	114	131
2005	12	118	130
2006	12	119	131

Note: we use the *AREAER* zero cut-off measure to distinguish between liberalized and closed countries.

Table A3: Variable Descriptions and Sources

Variable	Description and Source
Probit Regression Variables	
Current Account/GDP (%)	Sum of net exports of goods, services, net income and net current transfers as a percentage of GDP. Source: World Development Indicators (WDI)
U.S. Real Interest Rate	The U.S. lending rate adjusted for inflation as measured by the GDP deflator. Source: WDI
Govt. Consumption	General government final consumption expenditure which includes all government current expenditures for purchases of goods and services. It also includes most expenditures on national defence and security, but excludes government military expenditure. Source: WDI
Openness	Exports plus imports divided by GDP. Source: WDI
Polity 2	Combines the two measures, Autocracy and Democracy, to give an overall measure of political regime. Ranges from -10 to 10 where a higher value represents a country with more democratic practices in place. Source: PolityIV
Institutional Quality	Averages the three variables Bureaucracy quality, Corruption, and Law and Order. Bureaucracy quality, scale 0-4, where a higher value represents higher quality. Corruption, scale 0-6, where a lower value represents a higher degree of corruption in government. Law and Order, scale 0-6, where a higher value represents more effective legal systems. Source: International Country Risk Guide
M2/GDP (%)	Money and quasi money (M2) as a percentage of GDP. Money and quasi money comprise the sum of currency outside banks, demand deposits other than those of central government and the time, savings, and foreign currency deposits of resident sectors other than the central government. Source: WDI
Growth Measures	
GDP per capita growth (annual %)	Annual percentage growth rate of GDP per capita based on constant 2000 U.S. Dollars. Source: WDI
GDP per capita growth (5 yearly %)	Average five yearly growth rate of GDP per capita based on constant 2000 U.S. Dollars. Source: WDI.

Figure A1: Composition of Restrictions on Inflows for Schindler Asset Categories in 1997 and 2005

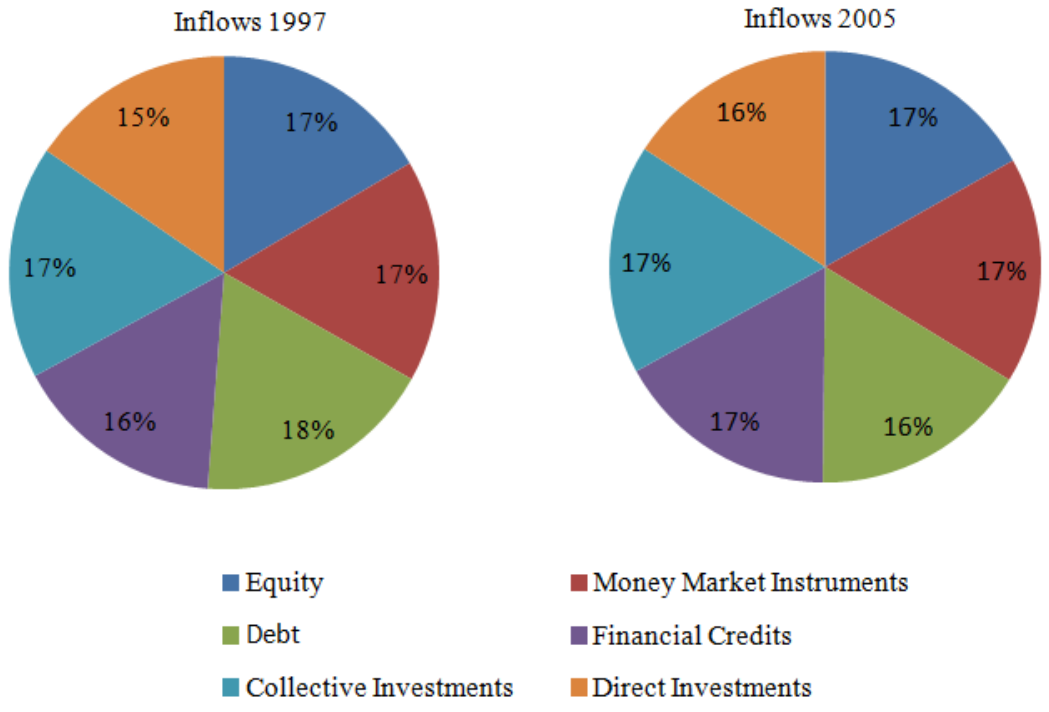


Figure A2: Composition of Restrictions on Outflows for Schindler Asset Categories in 1997 and 2005

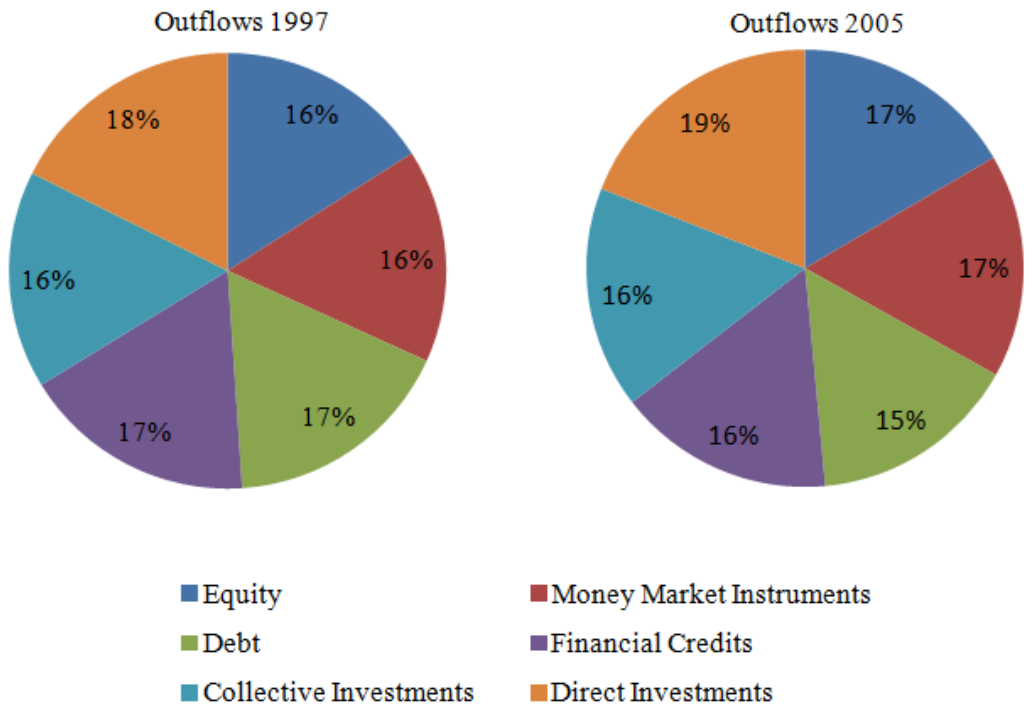


Table A4: Descriptive Statistics for Pooled, Control and Treated Countries over 1970-2006

Variable	Pooled	Control	Treated
Current Account/GDP (%)	-3.547	-4.418	-2.560
U.S. Real Interest Rate	4.315	4.389	4.597
Govt. Consumption/GDP (%)	16.150	15.736	16.459
Openness	75.893	65.376	85.496
Polity 2	1.502	-0.027	3.577
Institutional Quality	3.031	2.704	3.283
M2/GDP (%)	42.283	34.346	51.714
GDP per capita growth (annual %)	1.858	1.426	2.306
GDP per capita growth (average 5 yearly %)	1.906	1.518	2.296

Note: Table reports the sample mean of variables for the pooled sample of countries, the treatment group and the unmatched control group using *AREAER* zero cut-off to categorize countries.

Table A5: Sample Characteristics of Treated and Control Groups before and after Nearest Neighbour Matching using the Benchmark Probit Specification

Variable	Sample	Mean of Treated	Mean of Control	t-Statistic	p>t
Current Account/GDP, t -1	Unmatched	-1.720	-4.353	9.72	0.00
	Matched	-1.803	-1.480	-1.20	0.23
U.S. Real interest rate, t -1	Unmatched	4.755	5.037	-3.24	0.00
	Matched	4.762	4.885	-1.34	0.18
Government Consumption/GDP,t-1	Unmatched	16.164	15.616	2.30	0.022
	Matched	16.185	16.181	0.02	0.99
Openness, t	Unmatched	77.684	62.583	10.37	0.00
	Matched	76.213	74.672	0.98	0.33
Polity2, t	Unmatched	4.694	1.025	14.24	0.00
	Matched	4.724	4.769	-0.18	0.86

Note: Table reports the mean of variables for the treatment group, for the unmatched control group and for the matched control group. t-Statistics for difference of means between the treatment group and the control groups are reported in the 5th column and the associated p-value is reported in the 6th column. The balancing property is met as the t-statistic is insignificant (greater than 0.1) for the difference of means between matched countries.

Table A6: Sample Characteristics of Treated and Control Groups before and after Matching using the Benchmark Probit Specification

Variable	Sample	Mean of Treated	Mean of Control	t-Statistic	p>t
Current Account/GDP, t -1	Unmatched	-1.720	-4.353	9.72	0.00
	Matched	-1.803	-1.579	-0.83	0.41
U.S. Real interest rate, t -1	Unmatched	4.755	5.037	-3.24	0.00
	Matched	4.762	4.796	-0.36	0.72
Government Consumption/GDP,t-1	Unmatched	16.164	15.616	2.30	0.02
	Matched	16.185	16.299	-0.46	0.65
Openness, t	Unmatched	77.684	62.583	10.37	0.00
	Matched	76.213	74.39	1.18	0.24
Polity2, t	Unmatched	4.694	1.025	14.24	0.00
	Matched	4.724	4.663	0.24	0.81

Note: See footnote of Table A5.

Table A7: Sample Characteristics of Treated and Control Groups before and after Matching using the Benchmark Probit Specification

Variable	Sample	Mean of Treated	Mean of Control	t-Statistic	p>t
Current Account/GDP, t -1	Unmatched	-1.720	-4.353	9.72	0.00
	Matched	-2.042	-1.742	-1.14	0.26
U.S. Real interest rate, t -1	Unmatched	4.755	5.037	-3.24	0.00
	Matched	4.782	4.825	-0.47	0.64
Government Consumption/GDP,t-1	Unmatched	16.164	15.616	2.30	0.02
	Matched	16.183	16.228	-0.18	0.86
Openness, t	Unmatched	77.684	62.583	10.37	0.00
	Matched	74.308	73.834	0.31	0.76
Polity2, t	Unmatched	4.694	1.025	14.24	0.00
	Matched	4.660	4.552	0.42	0.67

Note: See footnote of Table A5.

Table A8: Sample Characteristics of Treated and Control Groups before and after Nearest Neighbour Matching using the Augmented Probit Specification

Variable	Sample	Mean of Treated	Mean of Control	t-Statistic	p>t
Current Account/GDP, t -1	Unmatched	-2.076	-3.582	4.38	0.00
	Matched	-2.425	-2.339	-0.26	0.79
U.S. Real interest rate, t -1	Unmatched	4.837	5.503	-7.10	0.00
	Matched	4.912	5.022	-1.21	0.23
Government Consumption/GDP, t-1	Unmatched	14.980	14.481	1.70	0.09
	Matched	15.007	15.129	-0.43	0.67
Openness, t	Unmatched	77.542	60.630	8.27	0.00
	Matched	74.151	73.185	0.52	0.60
Polity2, t	Unmatched	4.401	1.549	8.83	0.00
	Matched	4.356	4.622	-0.90	0.37
Institutional Quality, t	Unmatched	3.069	2.622	8.53	0.00
	Matched	3.033	3.072	-0.72	0.47
M2/GDP, t-1	Unmatched	50.580	35.226	10.13	0.00
	Matched	47.424	48.217	-0.51	0.61

Note: See footnote of Table A5.

Table A9: Sample Characteristics of Treated and Control Groups before and after Kernel Matching using the Augmented Probit Specification

Variable	Sample	Mean of Treated	Mean of Control	t-Statistic	p>t
Current Account/GDP, t -1	Unmatched	-2.076	-3.582	4.38	0.00
	Matched	-2.425	-2.554	0.39	0.70
U.S. Real interest rate, t -1	Unmatched	4.837	5.503	-7.10	0.00
	Matched	4.912	5.052	-1.54	0.12
Government Consumption, t-1	Unmatched	14.980	14.481	1.70	0.09
	Matched	15.007	15.035	-0.10	0.92
Openness, t	Unmatched	77.542	60.630	8.27	0.00
	Matched	74.151	74.822	-0.36	0.72
Polity2, t	Unmatched	4.401	1.549	8.83	0.00
	Matched	4.356	4.398	-0.14	0.89
Institutional Quality, t	Unmatched	3.069	2.622	8.53	0.00
	Matched	3.033	3.065	-0.59	0.55
M2/GDP, t-1	Unmatched	50.580	35.226	10.13	0.00
	Matched	47.424	46.556	0.59	0.56

Note: See footnote of Table A5.

Table A10: Sample Characteristics of Treated and Control Groups before and after Radius Matching using the Augmented Probit Specification

Variable	Sample	Mean of Treated	Mean of Control	t-Statistic	p>t
Current Account/GDP, t -1	Unmatched	-2.076	-3.582	4.38	0.00
	Matched	-2.503	-2.491	-0.04	0.97
U.S. Real interest rate, t -1	Unmatched	4.837	5.503	-7.10	0.00
	Matched	4.927	5.061	-1.46	0.15
Government Consumption, t-1	Unmatched	14.980	14.481	1.70	0.09
	Matched	15.020	15.053	-0.12	0.91
Openness, t	Unmatched	77.542	60.630	8.27	0.00
	Matched	73.584	74.021	-0.23	0.82
Polity2, t	Unmatched	4.401	1.549	8.83	0.00
	Matched	4.284	4.474	-0.63	0.53
Institutional Quality, t	Unmatched	3.069	2.622	8.53	0.00
	Matched	3.0142	3.0613	-0.88	0.38
M2/GDP, t-1	Unmatched	50.580	35.226	10.13	0.00
	Matched	45.644	45.561	0.06	0.95

Note: See footnote of Table A5.