Capital Account Liberalization, Institutional Quality and Economic Growth: Theory and Evidence

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Abstract: This paper shows that the effects of capital account liberalization on growth depend upon the environment in which that policy change occurs. A theoretical model demonstrates how the institutional quality of a country, reflecting the extent to which its capital is protected from expropriation, affects the responsiveness of growth to capital account liberalization. In particular, this model predicts a non-monotonic, inverted-U shaped relationship between the amount of time during which the capital account is liberalized and economic growth. A specification drawn from this model is tested by considering the determinants of economic growth over the period 1976 – 1995 for a panel of 71 countries. The estimates of this model strongly support a non-monotonic interaction between capital account liberalization and institutional quality, with 20 percent of the countries, those with better (but not the best) institutions exhibiting a significant relationship between capital account openness and economic growth.

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1. Introduction

Capital account liberalization is so ‘90s. During the first half of that decade, the boom in emerging markets and the success of industrial countries that opened up to international capital flows seemed to point to the importance of this policy as one way for countries to join the global economy. But, in the wake of the economic and financial crises in the latter part of that decade, critics began to question the wisdom of this aspect of liberalization. These critics included well-respected mainstream economists who strongly favor free trade in goods and services but maintained that trade in assets differed fundamentally from trade in “widgets.” In an influential article published in Foreign Affairs in 1998, Jagdish Bhagwati wrote “substantial gains [from capital account liberalization] have been asserted, not demonstrated …” (p. 7). In a similar vein, Dani Rodrik (1999) warned “Openness to international capital flows can be especially dangerous if the appropriate controls, regulatory apparatus and macroeconomic frameworks are not in place.” (p. 30). By the end of the decade, an IMF report stated that the Executive Board of that institution “…has emphasized the substantial benefits of capital account liberalization, but stressed the need to carefully manage and sequence liberalization in order to minimize risks.”¹ Reviewing this topic, Kenneth Rogoff, then the Chief Economist and Director of Research for the IMF, wrote in the December 2002 issue of the IMF’s publication Finance and Development “These days, everyone agrees that a more eclectic approach to capital account liberalization is required.” (p. 55).

Much of the empirical literature on the effects of capital account liberalization on growth suggests that these concerns are warranted. Indeed, until recently, it was difficult to find consistent evidence of a beneficial effect of open capital accounts on economic growth. But a careful reading of the warnings of Rodrik, the Executive Board of the IMF, and Rogoff, for example, does not suggest that open capital accounts cannot have a salutary effect, rather they argue that the environment in which capital account liberalization occurs is a potentially important determinant of its consequences.

This paper investigates how the economic environment in which capital account liberalization occurs affects its impact on economic growth. Section 2 presents a model of capital account liberalization in the presence of expropriation. This model suggests that there is a non-monotonic relationship between the responsiveness of growth to capital account openness and the extent of expropriation of capital. The model offers guidance for an empirical analysis, and this analysis is presented in Section 3. The evidence from this cross-country analysis supports the main prediction of the model concerning a non-monotonic effect of institutional quality on the effect of capital account openness on growth.

2. Capital Account Liberalization, Institutional Quality, and Growth

The model presented in this section illustrates how the effect of capital account liberalization on growth depends upon the quality of particular domestic institutions. Institutional quality in this model represents the extent to which investors are protected

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² See the survey of the literature on capital account openness and growth by Edison, Klein, Ricci and Slok (forthcoming).
from expropriation. Institutional quality affects the impact of the timing of capital account liberalization on the rate of conditional convergence. Institutional quality also influences the effect of time spent with an open capital account on the level of steady state output.

This theory section first presents, in Section 2.1, a neoclassical growth model with two types of capital under the conditions of financial autarky whereby all capital is funded from domestic savings. The rate of expropriation is a parameter of this model. An alternative version of this model, one that includes partial capital mobility (following the contribution of Barro, Mankiw and Sala-i-Martin 1995) is presented next in Section 2.2. Section 2.3 models capital account liberalization by drawing on the solutions for the autarkic and partial capital mobility cases.

The solution presented in Section 2.3 provides a framework for the empirical analysis that follows and guides the specification incorporating institutional quality and capital account liberalization. The model predicts that increasing institutional quality has a non-monotonic effect on the responsiveness of growth to the timing of capital account liberalization. A numerical analysis of the model shows that the effect on growth of the amount of time spent with an open capital account first increases, and then decreases, with improvements in institutional quality. The model also suggests that the rate of conditional convergence increases with an earlier liberalization of the capital account.

2.1 Steady State Output and Growth under Financial Autarky

The model used in this paper has two types of capital, \( K \) and \( H \). Under financial autarky, the situation studied in this subsection, there is little difference in the
characteristics of $K$ and $H$ but, as discussed below, an important difference exists when international borrowing and lending occurs.

The production function for this economy includes $K$ and $H$, as well as $L$, the number of workers, and $E$, the efficiency of labor, and is given by

$$\[1\] \quad Y = K^\alpha H^\beta (EL)^{1-\alpha-\beta}$$

where $Y$ is output and both $\alpha$ and $\beta$ are between 0 and 1. We study the model with the variables expressed in terms of effective units of labor, and define $y = Y / EL$, $k = K / EL$ and $h = H / EL$. Using these variables, the production function is

$$\[2\] \quad y = k^\alpha h^\beta$$

The model attempts to capture the fact that poor institutions lower the return to capital because, with poor institutions, some savings of domestic residents fail to translate to investment because of the malfeasance of governmental or private actors who are not appropriately constrained by law. Institutional quality is negatively related to the amount of expropriation that occurs. This model includes the parameter $\tau$ which represents the rate of expropriation of both types of capital by the government or others ($0 < \tau < 1$), and, therefore, an index for the quality of institutions is $(1 - \tau)$.

The parameter $\tau$ appears in the capital accumulation equations for both $K$ and $H$ under autarky, when both types of capital can only be accumulated only through domestic savings. The capital accumulation equations, expressed in terms of $k$ and $h$, are

$$\text{We assume that } \tau \text{ is the same for both } H \text{ and } K \text{ in order to obtain more analytically tractable results, but allowing } \tau \text{ to differ for } H \text{ and } K \text{ would not alter the basic results of the model.}$$
\[
\begin{align*}
\dot{k} &= s_k y - (\delta + \tau + n + g) \\
\dot{h} &= s_h y - (\delta + \tau + n + g)
\end{align*}
\]

where \( \dot{X} = \frac{dX}{dt} \) for any variable \( X \), \( \frac{\dot{L}}{L} = n \), \( \frac{\dot{E}}{E} = g \), \( s_k \) is the proportion of savings devoted to the formation of \( K \), \( s_h \) is the proportion of savings devoted to the formation of \( H \), and \( \delta \) is the rate of depreciation of both types of capital \( (0 < \delta < 1) \).

The steady state value of output per effective unit of labor of this economy under financial autarky, \( y^*_A \), is

\[
[4] \quad y^*_A = \left( \frac{s_k^\alpha s_h^\beta}{n + g + \delta + \tau} \right)^{\frac{1}{1-\alpha-\beta}}
\]

Naturally enough, steady state output per effective unit of labor in autarky is higher with a higher level of institutional quality (that is, with a lower value of \( \tau \)).

Below we will compare the dynamic path of output per effective worker under autarky and under partial capital mobility. A Taylor-series expansion around the steady state yields the differential equation for output per effective unit of labor under autarky

\[
[5] \quad \frac{\dot{y}}{y} = -(1 - \alpha - \beta)(n + g + \delta + \tau) \left[ \ln(y) - \ln(y^*_A) \right].
\]

Note that this rate of convergence is more rapid if \( \tau \) is larger since, in this case, the steady state level of output per effective worker is lower.\(^4\)

\(^4\) This result is analogous to the effect of the depreciation rate on the speed of convergence in a standard Solow model, whereby an increase in \( \delta \) is associated with faster convergence.


2.2 Steady State Output and Growth with Partial Capital Mobility

With no restrictions on its movement, and no cost of adjustment, capital would move instantaneously to capital-scarce countries and equalize rates of return across nations. A model with this feature would have no meaningful transition dynamics. The results of such a model are obviously at odds with experience.

A more reasonable result is obtained if one assumes partial capital mobility, whereby there is perfect international capital mobility for some types of capital but not for others. Barro, Mankiw and Sala-i-Martin (1995) formalize this concept by assuming that physical capital, $K$, can serve as collateral and, as such, can be fully funded by foreign borrowing. This distinguishes $K$ from $H$, which cannot serve as collateral and can only be accumulated through domestic savings if a country is credit-constrained.5 A country is credit-constrained, in this context, if the overall value of its assets that can serve as collateral, $K$, is less than or equal to the value of its debt, $D$, where $D = (K + H) - A$, and $A$ is the overall value of assets of an economy. In this case, $A \leq H$ and, since $H$ cannot serve as collateral for international borrowing, it can only be generated through domestic savings.6

When $K$ can serve as collateral in international asset trade, the amount of physical capital per effective worker, $k$, is determined by an equilibrium condition that sets the marginal return of capital equal to its marginal cost,

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5 Barro, Mankiw and Sala-i-Martin (1995) identify $H$ as human capital, a natural interpretation since expected future wages typically cannot serve as collateral. It is reasonable, however, to broaden the definition of $H$ to other types of capital as well. For example, differential collateral requirements exist for foreign direct investment and international portfolio investment, a point stressed by Froot and Stein (1991) in their model of the link between the real exchange rate and foreign direct investment.

6 In terms of units of effective labor, an economy is credit constrained if $k \leq d$. 

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\[\frac{\partial y}{\partial k} - (\delta + \tau) = \alpha k^{\alpha - 1} h^\beta - (\delta + \tau) = r^W\]

where \(r^W\) is the (exogenous) world interest rate. This equilibrium condition holds regardless of whether or not a country is capital constrained. An analogous equilibrium condition does not hold for \(h\) in a credit-constrained economy; rather, in this case, the \(\dot{h}/h\) equation given in [3] determines its path of accumulation.

The steady state levels of \(h\) and \(y\) in a credit-constrained economy are obtained by using the equilibrium condition for \(k\), Equation [6], and the steady state value of \(h\) consistent with the equation of motion for that variable in Equation [3]. The steady state level of output per effective unit of labor under this assumption of partial capital mobility, \(y^*_G\), is

\[y^*_G = \left(\frac{\alpha/(r^W + \delta + \tau)^\alpha S_H^\beta}{(n + g + \delta + \tau)^\beta}\right)^{1/(1-\alpha-\beta)}.\]

As in the case under autarky, steady state output per effective unit of labor is higher with a higher level of institutional quality (that is, with a lower value of \(\tau\)) when there is partial capital mobility.

Below it will be shown that the effect of institutional quality on steady state output under autarky relative to its effect under partial capital mobility is an important determinant of the partial derivative of growth with respect to capital account liberalization. The results in [4] and [7] can be combined to yield the ratio of steady state output per effective unit of labor under autarky to its value under partial capital mobility,
where the two expressions for the relative levels of output under autarky and under partial capital mobility are equivalent because

\[
\frac{y^*_A}{y^*_G} = \left( \frac{r^W + \delta + \tau}{r^K_A + \delta + \tau} \right)^{\frac{\alpha}{1-\alpha-\beta}} = \frac{r^W + \delta + \tau}{\alpha s^*_K (n + g + \delta + \tau)}
\]

The results in [8] have two important implications. One implication, evident from the expression after the first equal sign, is that steady state output per effective worker is higher in an economy when it has partial capital mobility, as compared to when it is under financial autarky, if \( r^K_A > r^W \), that is, if that economy has a relative scarcity of capital as compared to the rest of the world. The second implication, drawn from the expression after the second equality in [8], is that the distortionary effects of an increase in \( \tau \) cause a larger decrease in \( y^*_A \) than in \( y^*_G \) if \( r^W > n + g \), a weaker condition than \( r^W > r^K_A \) if \( \alpha > s^*_K \).

Along with a comparison of the steady state under autarky and under partial capital mobility, this model also offers insights about the differences in dynamics between a financially open and a financially closed economy. A Taylor-series expansion around the steady state solution for output in equation [7] yields the differential equation

\[
\dot{\frac{y}{y}} = -\frac{(1-\alpha-\beta)}{(1-\alpha)}(n + g + \delta + \tau)\left[ \ln(y) - \ln(y^*_G) \right].
\]

Comparing this result to the differential equation for an autarkic economy in equation [5], we see that the rate of convergence is more rapid for a country with partial capital
mobility than for a country that operates under financial autarky, a point noted by Barro, Mankiw and Sala-i-Martin (1995).

2.3 **Empirical Specification**

The results presented in Sections 2.1 and 2.2 can be used to provide a framework for the specification of an empirical analysis of the effects of capital account liberalization on growth. The differential equations [5] and [9] can be solved and then combined to obtain an equation that describes the rate of growth of an economy over the period $\theta$ to $T$ that liberalizes its capital account at time $L$ where $\theta \leq L \leq T$ (while $L$ is a variable of this model, $T$ is treated as a fixed parameter). This solution nests the cases of an economy that is open throughout the period ($L = 0$) as well as one that is closed throughout the period ($L = T$).

The solutions for the differential equations for an economy under financial autarky, Equation [5], and for an economy with open capital markets, Equation [9], are

**Autarky**

$$\ln(y(t)) = (\ln(y(0)) - \ln(y_A^*)) \exp(-\lambda(1-\alpha)t) + \ln(y_A^*)$$

**Open**

$$\ln(y(t)) = (\ln(y(0)) - \ln(y_G^*)) \exp(-\lambda t) + \ln(y_G^*)$$

where

$$\lambda = \frac{1-\alpha-\beta}{1-\alpha}(n+g+\delta+\tau).$$

These solutions can be used to determine the average rate of growth of output per effective unit of labor over the period $\theta$ to $T$, $\frac{1}{T} \ln \left( \frac{y(T)}{y(0)} \right)$, when the economy switches from having a closed capital account to having an open capital account at time $L$. This solution is
\[
\frac{1}{T} \ln \left( \frac{y(T)}{y(0)} \right) = -\frac{1}{T} \left[ \left( 1 - e^{-\lambda(T-L)} \right) \ln(y(0)) + \left[ (1 - e^{-(1-L)\lambda L}) e^{-\lambda(T-L)} \ln(y^*_d) + (1 - e^{-\lambda(T-L)}) \ln(y^*_s) \right] \right]
\]

\[
= -\frac{1}{T} C \ln(y(0)) + \frac{1}{T} S
\]

where, in the second line, \( C \) represents the term in curly brackets in the first line (0 < \( C < 1 \)) and \( S \) represents the term in square brackets in the first line (\( S > 0 \)). Equation [10], which motivates the empirical specification used in Section 3, has implications with respect to the effect of the amount of time with an open capital account on the rate of convergence as well as the effect of institutional quality on the responsiveness of growth to capital account liberalization. We next explore these implications.

### 2.3.1 The Responsiveness of Growth to Capital Account Liberalization

The presence of \( S \) in Equation [10] motivates the inclusion in a growth regression of a range of variables, including an indicator of capital account openness. We define this indicator of capital account openness as \( \kappa = \frac{T - L}{T} \).\(^7\) The coefficient on capital account openness in an empirical specification derived from a first-order Taylor series expansion of \( S \) is \( \gamma = \frac{1}{T} \frac{\partial S}{\partial \kappa}(= -\frac{\partial S}{\partial L}) \) where

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\(^7\) It is worth noting that \( \kappa \), the proportion of years that a country has an open capital account, corresponds to a standard indicator of capital account openness used in empirical analyses, and this indicator is used in the empirical analysis presented in Section 3 of this paper. Edison, Klein Ricci and Slok (forthcoming) survey the literature on the effects of capital account openness on growth, and discuss the different indicators of capital account openness used in these studies.
\[\gamma = \lambda e^{-\lambda(T-L)}\left[a e^{-\lambda(1-\alpha)L} \ln\left(y_A^*\right) - \ln\left(y_A^* / y_G^*\right)\right].\]

As shown above, \(\lambda\), \(y_A^*\), and \(y_G^*\) are all functions of \(\tau\), and, as a result, there is a complex relationship between \(\gamma\) and the indicator of institutional quality. We therefore present a numerical analysis of \(\gamma\) using the parameter values employed to perform the calculations in Table 1, along with savings values that give reasonable levels of autarkic interest rates for the two types of capital (\(s_K = 0.1\) and \(s_H = 0.3\)). \(^8\) We plot \(\gamma\) for three different values of \(T - L\) (setting \(r^W = 0.05\)) in Panel A of Figure 1, and plot \(\gamma\) for three different values of \(r^W\) (setting \(T - L = 10\)) in Panel B.

The qualitative relationship between \(\gamma\), the responsiveness of growth to the indicator of capital account openness, and \((1 - \tau)\), institutional quality, is the same for all of the lines plotted in Panels A and B of Figure 1, with each exhibiting an inverted – U shaped relationship between \(\gamma\) and \((1 - \tau)\). The quantitative aspects of this relationship differ across different parameter values. For example, Panel A shows that the ratio of the maximum value of \(\gamma\) to its value when \((1 - \tau) = 1.00\) varies with time spent with an open capital account. The maximum value of \(\gamma\) is larger than its value at \((1 - \tau) = 1.00\) by 36 percent for \((T - L) = 8\), by 19 percent for \((T - L) = 10\), and by 12 percent for \((T - L) = 15\). The results presented in Panel B show that, given time spent with an open capital account, the ratio of the maximum value of \(\gamma\) to its value at when \((1 - \tau) = 1.00\) increases increases

\(^8\) The calculations in Table 1, as well as in Figures 1 and 2 presented below, use the parameter values employed by Barro, Sala-i-Martin and Mankiw (1995) (\(\alpha = 0.3, \beta = 0.5, n = 0.01, g = 0.02, \text{ and } \delta = 0.05\)). These calculations also set \(T = 20\) to match the number of years in the sample used in the empirical analysis presented in Section 3. The dependent variable in [10] is the annual growth rate, whereas in the regressions presented below the regressand is \(\ln(y(1995) / y(1976))\). As will be seen, dividing the values of \(\gamma\) estimated in Section 3 by 20 gives results close to the numerical results presented here.
Figure 1:
Effect of Institutional Quality on Responsiveness of Growth to Capital Account Liberalization
with the world interest rate. The maximum value of $\gamma$ is 26 percent larger than its value when $(1 - \tau) = 1.00$ with a world interest rate of 8 percent. The respective ratios are 19 percent for a world interest rate of 5 percent, and 11 percent for a world interest rate of 2 percent.

Some intuition for the inverted-U shaped relationship between the responsiveness of growth to the indicator of capital account openness and institutional quality can be gained by considering the solution for $\gamma$ in Equation [11], as well as the discussion above concerning the relationship between institutional quality and the steady state values for income under autarky and under partial capital mobility. Equation [11] shows that $\gamma$ increases with an increase in $\ln(y_A^*/y_G^*)$ and decreases with an increase in $\ln\left(\frac{y_A}{y_G}\right)$. The discussion in Sections 2.1 mentions that $\ln(y_A^*)$ increase with $(I-\tau)$. Also, as discussed in Section 2.2, $\ln\left(\frac{y_A}{y_G}\right)$ increases with an increase in $(1 - \tau)$ because the effect of expropriation on steady state output is greater under autarky, when $\tau$ directly affects the accumulation of both $K$ and $H$, than under partial capital mobility, when $K$ can be raised from abroad and its accumulation is not directly affected by $\tau$. There is a relatively large effect on $\ln(y_A^*)$ of an increase in $(I - \tau)$, as compared to its effect on $\ln\left(\frac{y_A}{y_G}\right)$, for lower values of $(I - \tau)$. This gives rise to the positive relationship between $\gamma$ and $(I - \tau)$ in those figures, across the various values of $(T - L)$ and $r^W$, for lower values of $(I - \tau)$. But, when institutional quality is higher, the effect of an increase in $(I - \tau)$ on $\ln\left(\frac{y_A}{y_G}\right)$ dominates its
effect on \( \ln(y^*_A) \) with respect to the calculation of \( \gamma \), and there is a negative relationship between \( \gamma \) and \( (1 - \tau) \).

2.3.2 Convergence

The rate of convergence, as represented by \( C \) in Equation [10], varies with both institutional quality and the amount of time spent with an open capital account. This can be seen by calculating the values of \( C \), and the half lives associated with these values, for various values of \( (T - L) \) and \( (1 - \tau) \). These calculations are presented in Table 1.

The numbers presented in Table 1 demonstrate that the rate of convergence increases, and the associated half-life decreases, with the amount of time spent with an open capital account, given a level of institutional quality. For example, the speed of convergence, as reflected by the half life, of an economy with no expropriation of capital \( (1 - \tau = 1.00) \) is 2.53 years if that economy is continually closed and 1.89 years if that economy is continually open. This result follows from the discussion above that compares the coefficients in Equations [5] and [9] to show that convergence is more rapid in an open economy than in a closed economy.\(^9\)

The numbers presented in Table 1 also demonstrates that the rate of convergence decreases, and the associated half-life increases, with an increase in institutional quality, given the amount of time with an open capital account. For example, compare the half life of an economy that is open throughout the period when there is no expropriation of capital \( (1.89 \text{ years}) \) to that when the \( 1 - \tau = 0.70 \) \( (0.78 \text{ years}) \). This result is consistent

\(^9\) Sachs and Warner (1995) present evidence that convergence is more rapid in open economies than in closed economies, although there definition of “open” is broader and distinct from the definition used here.
with the discussion above concerning, in the autarkic and partial capital mobility cases, the effect of institutional quality on the rate of convergence.

3. Empirical Estimates

This section presents an empirical analysis of the manner in which the interaction between capital account openness and institutional quality affects economic growth. The section opens with a discussion of an empirical specification drawn from the model developed in Section 2. Capital account openness and institutional quality are at the center of this analysis, and Section 3.2 describes the indicators representing these variables employed in this study. The results of the analysis are presented in Section 3.3. As shown in that section, the empirical analysis supports the predictions of the model with respect the non-monotonic relationship between the responsiveness of growth to capital account openness and institutional quality. There is also some evidence that the rate of conditional convergence is faster in economies that have a longer experience with open capital accounts.

3.1 Specification

The model developed in Section 2 guides the empirical analysis presented in this section. In particular, Equation [10] motivates the inclusion of the logarithm of initial output and, by considering a Taylor Series expansion of $S$ around steady state values, the inclusion of a range of other variables including an indicator of capital account openness. Of course, these insights are not new, since virtually all growth regressions include initial output, and the typical strategy of empirical studies of capital account openness on
growth is to simply augment a standard growth specification with an indicator of capital account openness.

But the analysis presented in Section 2 is useful because it points out two ways in which the standard specification may be too restrictive. First, the model presented above suggests that rate of convergence may differ across countries and depend upon both the proportion of years a country had an open capital account and institutional quality. Second, and more central to this analysis, this model also demonstrates that there may be an important non-monotonic interaction between institutional quality and the responsiveness of economic growth to capital account openness.

A specification that is flexible enough to capture differences in rates of convergence associated with differences in capital account openness and institutional quality, as well as a non-monotonic relationship between capital account openness and growth is

\[
\Delta \ln Y_{76-95,i} = \beta_0 \ln Y_{76,i} + \beta_1 (\ln Y_{76,i} \times \kappa_i) + \beta_2 (\ln Y_{76,i} \times Q_i) \\
+ \beta_3 Q_i + \beta_4 \kappa_i + \beta_5 (\kappa_i \times Q_i) + \beta_6 (\kappa_i \times Q_i) + \beta_7 (\kappa_i \times Q_i) + \beta_8 Z_i + \epsilon_i
\]

where \( \Delta \ln Y_{76-95,i} \) is the change in the natural logarithm of real per capita income between 1976 and 1995 of country \( i \), \( \ln Y_{76,i} \) is the natural logarithm of real per capita income in 1976 for country \( i \), \( \kappa_i \) is an indicator of capital account openness of country \( i \), and \( Q_i \) is an indicator of institutional quality for country \( i \). The \( n \times 6 \) matrix \( Z_i \) includes, besides a column of 1’s for the estimation of a constant, variables that are standard in cross-country growth regressions and that are linked to variables included in \( S \) in Equation [10], including the logarithm of the secondary school enrollment rate (a proxy for \( E \)), the average rate of investment to GDP over the years 1974 to 1978 (which, in the steady
state, is related to the variables \( s_{H} \) and \( s_{K} \), and the growth rate of the population between 1976 and 1995 (the parameter \( n \) in the model described above). As is often the case in empirical investigations of growth, one of the columns of the matrix \( Z_{i} \) represents a dummy variable for African countries.\(^{10}\)

One set of tests that we conduct using the results of regressions taking the form of Equation \([12]\) addresses the question of whether the rate of a convergence varies in a systematic way with differences in either capital account openness or institutional quality. The rate of convergence for country \( i \), for which the capital account openness variable is \( \kappa_{i} \) and the value of institutional quality is \( Q_{i} \), is \[ \beta_{0} + (\beta_{1} \times \kappa_{i}) + (\beta_{2} \times Q_{i}) \]. The model presented in Section 2 predicts that both a longer period with an open capital account and a lower level of institutional quality contribute to a faster rate of convergence. Tests of these hypothesis are tests of whether \( \beta_{1} < 0 \) and \( \beta_{2} > 0 \), respectively.

The central focus of the theoretical discussion in Section 2, however, concerns the effect of institutional quality on the responsiveness of growth to capital account openness. The empirical specification \([12]\) reflects the results presented in the theoretical model by including the interaction of the capital account liberalization indicator with the indicator of institutional quality, as well as its squared value and its cubed value. This specification nests a model in which capital account liberalization does not interact with institutional quality (that is, a model in which \( \beta_{5} = 0, \beta_{6} = 0, \) and \( \beta_{7} = 0 \)), a model in which the effect of capital account liberalization on growth varies in a linear fashion with

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\(^{10}\) The model suggests the importance of including the world interest rate as a regressor, but, in a cross-section panel regression, this variable, which is the same for all countries, is subsumed in the constant.

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in institutional quality (in which case $\beta_6 = 0$ and $\beta_7 = 0$), and a model in which this effect varies in a quadratic fashion (a model in which $\beta_7 = 0$).

The inverted-U shaped pattern for $\gamma$ that is observed in the theoretical model in Section 2 can be confirmed with several different patterns of signs for the coefficients. In the case of the cubic-interaction specification (that is $\beta_5$, $\beta_6$, and $\beta_7$ are all statistically significant), a positive value of $\beta_6$ and a negative value of $\beta_7$ provides an estimated pattern of the relationship between the responsiveness of growth to capital account liberalization and institutional quality conforming to the one predicted by theory, that is, one where there is an inverted-U shaped relationship at higher values of $Q$ ($Q$ is strictly positive).

The model presented in Section 2 focuses on the overall effect of capital account liberalization on growth through its effect on the steady state level of output ($S$ in equation [10]). Results presented in Section 2 show that, through the effect on $S$, $\gamma$ exhibits an inverted-U shaped relationship when plotted against institutional quality. The specification presented in [12], however, includes capital account openness interacted with initial income as well as with institutional quality, and the simple partial derivative of growth with respect to capital account openness will include the product $\beta_1 \times \ln Y_{76,7}$. There is the potential for this term to confound the effects of capital account openness on growth through its effect on steady state income because initial income is significantly correlated with institutional quality. Therefore, we first present an estimate of $\gamma$.

11 This is, in fact, what we find in the results reported in Section 3.3. An inverted-U shaped relationship would also be found if $\beta_6$ is negative and $\beta_7$ is positive, but in this case the inverted-U part of the function occurs for smaller values of $Q$. In the quadratic case, where the estimated value of $\beta_7$ is not significant, an inverted-U shaped relationship is obtained if $\beta_6$ is negative.
calculated from a model in which the rate of convergence does not vary with institutional quality and capital account openness (that is, a model like [12] but where β₁ = β₂ = 0). In that case of constant conditional convergence, the estimated value of γ is simply

\[ γ = β₄ + (β₅ × Q_{t}) + (β₆ × Q_{t}^2) + (β₇ × Q_{t}^3). \]

The estimate of γ for the varying conditional convergence specification that does not restrict β₁ and β₂ to be zero and is represented by [12] is

\[ γ = (β₁ × \ln Y_{76,i}) + β₄ + (β₅ × Q_{i}) + (β₆ × Q_{i}^2) + (β₇ × Q_{i}^3). \]

The estimate of γ includes \( \ln Y_{76,i} \) which is itself significantly correlated with \( Q_i \). In Section 3.3, we use the estimated values from the regression

\[ \ln Y_{76,i} = π_{0} + π_{1}Q_{i} + u_{i}, \]

the results of which are reported in Table 3, and calculate the estimated value of γ for [12] as

\[ γ = (β₁ × (π₀ + π₁Q_{i})) + β₄ + (β₅ × Q_{i}) + (β₆ × Q_{i}^2) + (β₇ × Q_{i}^3) \]

While one might expect wide differences in γ across these two specifications that treat convergence in alternative manners, the estimated value of γ is very similar in both cases, as will be demonstrated below.

3.2 Indicators of Capital Account Openness and Institutional Quality

The implementation of the specification presented in the previous section requires the use of indicators of capital account openness and institutional quality. We discuss these indicators in this section.
3.2.1 Indicator of Capital Account Openness

The theoretical model presented in Section 2 includes the parameter $\kappa$ which represents the proportion of years that a country had a continuously open capital account. This parameter closely corresponds to an indicator of capital account openness commonly used in empirical studies of the effects of capital account openness on growth. This indicator is based on information in the *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)* published by the International Monetary Fund. Every issue of the *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)* published between 1967 (which refers to conditions in 1966) and 1996 (which refers to conditions in 1995) includes a summary table in which a single row directly addresses the presence or absence of capital controls; line E.2, labeled “Restrictions on payments for capital transactions.”

A number of cross-country studies, including Grilli and Milesi-Ferretti (1995), Kraay (1998), Rodrik (1998) and Klein and Olivei (1999), construct from this information a variable reflecting the proportion of years in which countries had open capital accounts. We will call this indicator of capital account openness *Share*.  

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12 The 1997 issue of *Annual Report on Exchange Arrangements and Exchange Restrictions* expanded the summary information on capital controls including, for the first time, a distinction between restrictions on inflows and restrictions on outflows. Unfortunately, this new classification system cannot be mapped into the early system, making the use of a panel bridging the pre-1996 and post-1996 data problematic.

13 An alternative empirical indicator of capital account openness has been developed by Dennis Quinn. These indicators record the intensity of controls, but are only available for a limited set of years for non-industrial countries. Edison, Klein, Slok and Ricci (forthcoming) compare *Share* to Quinn’s indicators. Quinn’s indicators for 1973 are used in this paper as instruments in the IV regressions presented below.
Table 2 presents some statistics and information for Share. The IMF publication records that about half of the countries in the data set (36 of the 71 countries for which we have full data) had closed capital accounts throughout this period. Among the 35 countries that had some experience with open capital accounts (a set that includes all 17 industrial countries in the sample), 6 were recorded as having had open capital accounts each year from 1976 to 1995; the United States, Belgium, the Netherlands, Canada, Malaysia and Hong Kong.

It is possible that Share differs from the parameter $\kappa$ in the theoretical model because of an on-again, off-again pattern of capital account liberalization. For example, if Share has the value of 0.5, this could reflect the liberalization of the capital account midway through the sample period and, in this case, it would correspond directly to $\kappa$ in the theoretical model. But Share would also register a value of 0.5 if the capital account were open for the first half of the sample period and then closed for the remainder of the period, or if the capital account were alternatively opened and closed each year of the sample period.

Fortunately, in the large preponderance of observations in the data set, Share corresponds directly to $\kappa$ in the theoretical model. This is clearly the case for the 36 countries that did not have any experience with open capital accounts. It is also the case for the 6 countries that had open capital accounts throughout the period and for which Share equals 1.\(^{14}\) Moreover, most of the 29 countries with values of Share other than 0 or 1 did not have on-again, off-again capital account liberalization but, rather, had one

\(^{14}\) Among these six countries, 4 had open capital accounts at least as early as 1970, Malaysia had an open capital account beginning in 1973 and the Netherlands had an open capital account beginning in 1976.
episode of liberalization in the midst of the sample period and thereafter maintained open capital accounts. This is true for all 14 industrial countries in the sample that had a value of Share greater than 0 but less than 1, as well as for 6 of the 15 non-industrial countries that had a value of Share greater than 0 but less than 1. For example, the two countries for which Share equals 0.05, Norway and Niger, had open capital accounts in 1995 only, two of the four countries for which Share equals 0.1 (Spain and Trinidad and Tobago) had open capital accounts in 1994 and 1995, three of the four countries for which Share equals 0.15 (Argentina, Sweden and Portugal) had open capital accounts from 1993 to 1995, and six of the seven countries for which Share equals 0.2, 0.25, or 0.3 had a period of continuously open capital accounts that included 1995, the last year of the sample.

### 3.2.2 Indicator of Institutional Quality

The indicator of institutional quality in the theoretical model, \((1 - \tau)\), reflects the extent to which investments in capital are protected from expropriation by members of the government or by others. There are a variety of indicators of the quality of institutions in a nation that have been used in empirical research. The analysis in this paper uses a composite indicator, drawing on series constructed by Steve Knack and Philip Keefer of the IRIS Center at the University of Maryland. These series are based on data from the *International Country Risk Guide*, published by the PRS Group.\(^\text{15}\)

The institutional quality indicator used in this paper, \(Q\), is the average of five series in the IRIS data set; Bureaucratic Quality, Control of Corruption in Government, Risk of Expropriation, Repudiation of Government Contracts, and Rule of Law (Law and

Order Tradition). Each of these indicators is available for all years between 1984 and 1995, and components of $Q$ are the averages of each of the five indicators over this period. A higher value for any of the indicators represents a higher quality of an institution so, for example, a higher score for Repudiation of Government Contracts means less of a risk of repudiation and a higher score for Risk of Expropriation means a smaller risk.

Table 3 presents some statistics for $Q$ for the countries in the sample used in the regression. Panel A of this table shows the minimum and maximum values, as well as the values for the 25th, 50th, 75th and 90th percentiles, for the 71 observations in the sample. Panel B presents the regression of the logarithm of income per capita in 1976 on $Q$. This regression shows a highly significant link between the logarithm of initial income per capita and institutional quality. As mentioned above, this estimate is used to evaluate the effect of institutional quality on the responsiveness of growth to capital account liberalization in some specifications of the model. Panel C of Table 2 shows that there is a very high correlation between all five components of the overall indicator of institutional quality. This correlation matrix shows why the results of the estimates presented below are largely unchanged if any single component is used rather than the average of all five, as well as if a different weighting scheme is used to calculate the overall indicator of institutional quality.
3.3 Capital Account Openness, Income and Growth

This section presents estimation results in several ways. The estimated coefficients from regressions along with their standard errors are presented in Table 4. But the central question of interest, how the responsiveness of growth to capital account openness varies with institutional quality, is not immediately apparent from these coefficient estimates. Therefore, the lower panel of Table 4 also includes estimates of $\gamma$ calculated for the 25th, median, 75th and 90th percentile values of $Q_i$. As discussed above, the estimates that are drawn from a specification with a varying rate of convergence employ the results of the regression of $Q_i$ on $\ln Y_{76,i}$ reported in Panel B of Table 2. This table also reports, for each specification, the number of countries that have values of $Q_i$ such that the estimated value of $\gamma$ is significant, and the percentiles spanned by this set of countries.

An even clearer representation of the way in which $\gamma$ varies with $Q_i$ is provided in Figures 2 – 5. Each of these figures plots, for one of the specifications reported in Table 4, the estimated value of $\gamma$ (in a line that includes symbols representing observed values of $Q_i$) along with the associated 95 percent confidence intervals (the boundaries of which are represented by a dashed and a dotted line). Figure 3, presenting the OLS estimates with a varying rate of conditional convergence, plots both the value of $\gamma$ and its associated confidence intervals and the estimated value of $\gamma$ obtained with a constant rate of convergence (represented by symbols in the shape of a diamond unconnected by a line) for the purpose of comparisons. The instrumental variable estimates with the constant convergence and varying convergence specifications, presented in Figures 4 and 5, respectively, also include the OLS values of $\gamma$ (represented by diamonds unconnected
by a line) to facilitate the comparison of the IV and OLS estimates. The lower axis in each of these figures is marked with the minimum, 25th percentile value, median, 75th percentile value, and maximum value of $Q_i$ for the sample used to obtain its estimates. The values of $Q_i$ at which $\gamma$ is significant at the 95 percent level of confidence are marked on the upper horizontal axis of each figure, and a vertical line is drawn at these values. The upper horizontal axis of each figure also denotes the value of $Q_i$ that yields the maximum value of $\gamma$.

The estimates reported in Columns 1 and 2 of Table 4, and represented in Figures 2 and 3, show that capital account openness is a significant determinant of growth over the period 1976 to 1995 for a set of countries with above-median levels of institutional quality. In each of these specifications, the coefficient on $Share_i$ itself, as well as the coefficient on each of the three interaction terms, $Share_i \times Q_i$, $Share_i \times Q_i^2$, and $Share_i \times Q_i^3$, are significant at better than the 95 percent level of confidence. This suggests that a cubic interaction between $Share$ and $Q$, as opposed to no interaction, a linear interaction, or a quadratic interaction, is warranted. The lower panel of Table 4 shows that 17 of the 71 countries in the sample have an estimated value of $\gamma$ that is significant, in the case of constant conditional convergence, and 14 of the 71 countries have a significant estimated value of $\gamma$ in the case of varying conditional convergence. These sets of countries represent those from the 63rd to the 87th percentiles in the constant conditional convergence case, with Mexico at the lower end of this range and Ireland at its upper end. The countries for which there is a significant value of $\gamma$ when the specification allows for varying conditional convergence range from the 62nd to the 80th percentile values of $Q_i$, a range bounded by Chile at the lower end and Belgium at the upper end. The lower panel
of this table, as well as Figures 2 and 3, also indicate that there is not a significant effect
of capital account openness on growth for countries outside of this range (but for the
estimate of \( \gamma \) for Bangladesh, the country with the lowest value of \( Q \), in the case of varying
conditional convergence, a result that is not robust as compared to the case with constant
conditional convergence).

A comparison of the line representing \( \gamma \) and the path traced out by the diamonds
in Figure 3 illustrates that the effect of institutional quality on the responsiveness of
growth to capital account openness is little affected by whether the model is estimated
with constant conditional convergence or varying conditional convergence. These two
estimates of \( \gamma \) track each other very closely. A comparison of the values of \( Q_i \) where \( \gamma \) is
significant at the 95 percent level, as well as where \( \gamma \) reaches its local maximum, also
illustrates the close correspondence of \( \gamma \) estimated through these two methods. The lower
and upper bound values of \( Q_i \) that define the 95 percent confidence interval in the
constant conditional convergence case are 4.64 and 6.51, while in the varying conditional
convergence case these values are 4.89 and 6.68. Also, the value of \( Q_i \) that yields the
maximum value of \( \gamma \) in these two cases are similar; 5.75 in the constant conditional
convergence case, a value close to that of Spain (which has a value of \( Q \) equal to 5.76)
and 5.90 in the varying conditional convergence case, which is close to the value of 5.95
for Portugal. The maximum values of \( \gamma \) that are obtained with these values of
institutional quality are 0.671 in the constant conditional convergence case, and 0.652 in
the varying conditional convergence case.\(^\text{16}\)

\(^{16}\)As noted in footnote 8, there is a close correspondence between the range of maximum
values of \( \gamma \) in the theoretical model and the estimated maximum values of \( \gamma \) since one
needs to divide the estimated values by 20 to match the values shown in Figure 1 and, for
example, 0.66 / 20 = 0.033.
The quantitative effect of having an open capital account is economically meaningful for countries with higher levels of institutional quality. For example, consider two hypothetical countries that are similar along all dimensions, including initial income and their institutional quality. The strongest support for the opening sentence of this paragraph can be made by assuming that $Q$ equals 5.75 for both of these economies, but one maintained capital controls throughout the sample period while the other kept a liberalized capital account. In this case, the estimates from the constant conditional convergence specification suggest that the annual average growth rate of the open economy would be 3.36 percentage points greater than that of the closed economy, and the open economy would be 96 percent bigger than the closed economy after two decades. Of course, this is the maximum difference that is obtained with these estimates. But differences are notable with other assumed values of $Share$ and $Q$ as well. For example, at $Q = 4.64$, the point of the lower 95 percent confidence bound in the estimate with constant convergence, the estimated value of $\gamma$ is 0.357. This suggests a difference of 1.79 percentage points in annual growth between a fully closed and a fully open economy, and a difference of 43 percent in per capita income after two decades. Even comparing an economy that is closed to one that is open only during the second half of the sample yields a difference of 0.893 percentage points in the annual growth rate, a difference that would result in a difference of 20 percent between the continually closed and periodically open economy after two decades.

The estimates in Column 2 of Table 4 suggest there is little support for the hypothesis that an open economy experiences more rapid conditional convergence than a closed economy, since the coefficient on the interaction between initial income and $Share$
is not significant. This coefficient is negative, however, and therefore the point estimate of the rate of convergence is higher (i.e. more negative) for more open economies, as predicted by the theoretical model in Section 2. The theoretical model also predicts that the coefficient on the interaction between initial income and institutional quality is positive since better institutional quality (a larger value of \((1 - \tau)\) in the theoretical model) results in less rapid convergence. The estimates in Column 2 do not support this hypothesis since the estimated coefficient on the relevant interaction term is negative, although one cannot statistically distinguish its point estimate from zero.

Columns 3 and 4 of Table 4 present instrumental variable estimates of the specifications estimated by OLS in Columns 1 and 2, respectively. Figures 4 and 5 plot the estimates of \(\gamma\) using instrumental variables, along with their 95 percent confidence intervals. The diamonds unconnected by a line in these figures represent the respective OLS estimates of \(\gamma\) using the same sample and specification. The instruments used in these estimates include \(Share\) for the period 1970 to 1974, similarly constructed indicators of current account openness, multiple exchange rate regime, and surrender of export proceeds, the average of trade divided by GDP over the period 1970 to 1974, Quinn’s indicator of the intensity of capital account controls in 1973 and his indicator of the intensity of current account controls for that year, and a set of regional dummy variables. These instruments are used for \(Share\) as well as the interactions of \(Share\) with institutional quality.  

The lower panel of Columns 3 and 4 in Table 4 show that fewer countries have a significant estimated value of \(\gamma\) with IV estimates than with OLS estimates, a result

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17 The \(R^2\) in the first-stage regression for \(Share\) is 0.64 in both the constant conditional convergence and the varying conditional convergence estimates.
partially due to the smaller sample available for the IV estimates. Figures 4 and 5 also show, however, that over the range of values of $Q$ for which $\gamma$ is significant in the IV estimates, or even over the larger range of values of $Q$ for which $\gamma$ is significant in the OLS estimates, the IV and OLS estimates of $\gamma$ track each other closely.

4. Conclusion

The debate over the consequences of capital account liberalization tends to be painted in broad strokes of black and white. This paper suggests a more nuanced approach, one that allows for shades of gray. It is reasonable to expect that the effect of capital account liberalization on economic growth varies with the environment in which it occurs. The model in this paper confirms that there is a logical framework supporting this expectation since, in this model, the effect of capital account openness on growth varies with the degree of expropriation. This model suggests an empirical specification, one that can be implemented with data on capital account openness and institutional quality. The estimates from this model demonstrate that an open capital account can make an economically meaningful contribution to economic growth, and this effect is statistically significant. But, as predicted by the theory presented earlier in the paper, this estimated effect varies with institutional quality. In particular, the effect of capital account openness on growth is found to be statistically significant for only about 20 percent of the countries in the sample, and these countries tend to be ones with better (though not the best) institutions. There is a strong correlation between institutional quality and income per capita, and the countries that tend to significantly benefit from capital account liberalization are mostly upper-middle-income countries.
At a policy level, the results presented in this paper answer, to some extent, the critics of capital account liberalization who assert that its benefits have not been demonstrated. But the model and empirical results presented here do not offer an unqualified endorsement of capital account liberalization either. Instead, the main message of this paper is that the environment in which this policy takes place can have an important effect on its consequences.
References


Table 1: 
Convergence Speeds, Capital Account Openness, 
and Institutional Quality: Theory 

Convergence Coefficients and *Half Lives*

<table>
<thead>
<tr>
<th>Institutional Quality, $(1 - \tau)$</th>
<th>Years with an Open Capital Account $(T - L$ where $T = 20)$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>0</strong></td>
</tr>
<tr>
<td><strong>0.70</strong></td>
<td>0.781</td>
</tr>
<tr>
<td></td>
<td>0.89</td>
</tr>
<tr>
<td><strong>0.75</strong></td>
<td>0.733</td>
</tr>
<tr>
<td></td>
<td>0.95</td>
</tr>
<tr>
<td><strong>0.80</strong></td>
<td>0.674</td>
</tr>
<tr>
<td></td>
<td>1.03</td>
</tr>
<tr>
<td><strong>0.85</strong></td>
<td>0.601</td>
</tr>
<tr>
<td></td>
<td>1.15</td>
</tr>
<tr>
<td><strong>0.90</strong></td>
<td>0.513</td>
</tr>
<tr>
<td></td>
<td>1.35</td>
</tr>
<tr>
<td><strong>0.95</strong></td>
<td>0.405</td>
</tr>
<tr>
<td></td>
<td>1.71</td>
</tr>
<tr>
<td><strong>1.00</strong></td>
<td>0.274</td>
</tr>
<tr>
<td></td>
<td>2.53</td>
</tr>
</tbody>
</table>

Top value in each cell represents $C$ in Equation [10], 
Bottom value (in italics) represents associated half life. 
Parameter values: $\alpha = 0.3$, $\beta = 0.5$, $n = 0.01$, $g = 0.02$, $\delta = 0.05$
### Table 2: Capital Account Openness Indicator

*Share* = proportion of years with open capital accounts  
(from IMF *Exchange Arrangements and Exchange Restrictions*)  
71 observations, 36 = 0, 35 ≠ 0.

<table>
<thead>
<tr>
<th>Percentiles (for non-zero cases)</th>
<th>25&lt;sup&gt;th&lt;/sup&gt;</th>
<th>50&lt;sup&gt;th&lt;/sup&gt;</th>
<th>75&lt;sup&gt;th&lt;/sup&gt;</th>
<th>90&lt;sup&gt;th&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.15</td>
<td>0.35</td>
<td>0.85</td>
<td>1.00</td>
</tr>
</tbody>
</table>

### Table 3: Institutional Quality Indicator and Its Components

#### A. Statistics of Composite Institutional Quality Indicator

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Percentiles</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25&lt;sup&gt;th&lt;/sup&gt;</td>
<td>50&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>2.449</td>
<td>3.777</td>
<td>4.358</td>
</tr>
</tbody>
</table>

#### B. Regression of ln(GDP<sub>1976</sub>) on Composite Institutional Quality Indicator

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>ln&lt;sub&gt;Y&lt;/sub&gt;&lt;sub&gt;1976&lt;/sub&gt;,i</th>
<th>R&lt;sup&gt;2&lt;/sup&gt; = 0.769</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.299</td>
<td>0.772</td>
<td></td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(0.244)</td>
<td>N = 71</td>
</tr>
</tbody>
</table>

#### C. Correlation of Components of Composite Institutional Quality Indicator

<table>
<thead>
<tr>
<th>Bureaucratic Quality</th>
<th>Control of Corruption</th>
<th>Risk of Expropriation</th>
<th>Government Reputation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bureaucratic Quality</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control of Corruption</td>
<td>0.9998</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Risk of Expropriation</td>
<td>0.9996</td>
<td>0.9991</td>
<td>1.00</td>
</tr>
<tr>
<td>Government Reputation</td>
<td>0.9998</td>
<td>0.9994</td>
<td>0.9999</td>
</tr>
<tr>
<td>Rule of Law</td>
<td>0.9999</td>
<td>0.9999</td>
<td>0.9994</td>
</tr>
</tbody>
</table>
Table 4: Growth, Capital Account Liberalization, and Institutional Quality

<table>
<thead>
<tr>
<th></th>
<th>1: OLS</th>
<th>2: OLS</th>
<th>3: IV</th>
<th>4: IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnY&lt;sub&gt;1976,i&lt;/sub&gt;</td>
<td>-0.396</td>
<td>-0.094</td>
<td>-0.295</td>
<td>0.068</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(0.136)</td>
<td>(0.258)</td>
<td>(0.138)</td>
<td>(0.469)</td>
</tr>
<tr>
<td>lnY&lt;sub&gt;76&lt;/sub&gt;×Share</td>
<td>-0.175</td>
<td>0.386</td>
<td>(0.374)</td>
<td>(0.806)</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(0.258)</td>
<td>(0.469)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lnY&lt;sub&gt;76&lt;/sub&gt;×Q</td>
<td>-0.060</td>
<td>-0.096</td>
<td>(0.044)</td>
<td>(0.091)</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(0.138)</td>
<td>(0.469)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q&lt;sub&gt;i&lt;/sub&gt;</td>
<td>0.439</td>
<td>0.859</td>
<td>0.439</td>
<td>1.147</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(0.097)</td>
<td>(0.355)</td>
<td>(0.187)</td>
<td>(0.634)</td>
</tr>
<tr>
<td>Share</td>
<td>12.325</td>
<td>14.781</td>
<td>15.905</td>
<td>23.136</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(5.925)</td>
<td>(6.139)</td>
<td>(24.166)</td>
<td>(21.153)</td>
</tr>
<tr>
<td>(Share&lt;sub&gt;i&lt;/sub&gt; x Q&lt;sub&gt;i&lt;/sub&gt;)</td>
<td>-8.388</td>
<td>9.211</td>
<td>12.049</td>
<td>17.544</td>
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<tr>
<td>Q&lt;sub&gt;i&lt;/sub&gt;</td>
<td>(3.863)</td>
<td>(3.539)</td>
<td>(15.393)</td>
<td>(13.532)</td>
</tr>
<tr>
<td>Share&lt;sup&gt;2&lt;/sup&gt;xQ&lt;sub&gt;i&lt;/sub&gt;</td>
<td>1.861</td>
<td>2.000</td>
<td>2.848</td>
<td>3.770</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(0.806)</td>
<td>(0.750)</td>
<td>(3.122)</td>
<td>(2.657)</td>
</tr>
<tr>
<td>Share&lt;sup&gt;3&lt;/sup&gt;xQ&lt;sub&gt;i&lt;/sub&gt;</td>
<td>-0.131</td>
<td>-0.137</td>
<td>-0.210</td>
<td>-0.259</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(0.054)</td>
<td>(0.050)</td>
<td>(0.205)</td>
<td>(0.170)</td>
</tr>
<tr>
<td>ln(School)</td>
<td>0.058</td>
<td>0.043</td>
<td>-0.074</td>
<td>-0.041</td>
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<tr>
<td>(s.e.)</td>
<td>(0.093)</td>
<td>(0.099)</td>
<td>(0.178)</td>
<td>(0.182)</td>
</tr>
</tbody>
</table>

Evaluating Overall Effect, γ<sub>i</sub>, for i at listed percentiles of Q<sub>i</sub>

<table>
<thead>
<tr>
<th>25&lt;sup&gt;th&lt;/sup&gt; Percentile</th>
<th>0.118</th>
<th>0.082</th>
<th>-0.192</th>
<th>-0.798</th>
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</thead>
<tbody>
<tr>
<td>(s.e.)</td>
<td>(0.246)</td>
<td>(0.230)</td>
<td>(0.725)</td>
<td>(0.890)</td>
</tr>
<tr>
<td>50&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
<td>0.249</td>
<td>0.163</td>
<td>0.367</td>
<td>-0.209</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(0.203)</td>
<td>(0.200)</td>
<td>(0.599)</td>
<td>(0.797)</td>
</tr>
<tr>
<td>75&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
<td>0.592</td>
<td>0.622</td>
<td>-0.077</td>
<td>0.342</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(0.198)</td>
<td>(0.193)</td>
<td>(0.489)</td>
<td>(0.760)</td>
</tr>
<tr>
<td>90&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
<td>-0.151</td>
<td>0.026</td>
<td>-1.384</td>
<td>-0.689</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>(0.236)</td>
<td>(0.204)</td>
<td>(1.184)</td>
<td>(1.417)</td>
</tr>
<tr>
<td># w/sig. + effect percentiles</td>
<td>17</td>
<td>14</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>63&lt;sup&gt;rd&lt;/sup&gt; – 87&lt;sup&gt;th&lt;/sup&gt;</td>
<td>62&lt;sup&gt;nd&lt;/sup&gt; – 80&lt;sup&gt;th&lt;/sup&gt;</td>
<td>78&lt;sup&gt;th&lt;/sup&gt; – 88&lt;sup&gt;th&lt;/sup&gt;</td>
<td>83&lt;sup&gt;rd&lt;/sup&gt; – 88&lt;sup&gt;th&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.732</td>
<td>0.745</td>
<td>0.61</td>
<td>0.68</td>
</tr>
<tr>
<td>no. of obs.</td>
<td>71</td>
<td>71</td>
<td>59</td>
<td>59</td>
</tr>
<tr>
<td>Bold = sig. &gt; 95% level of conf., Italic = sig. at 90% - 95% level of conf.</td>
<td></td>
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</tr>
</tbody>
</table>
Figure 4
Constant Conditional Convergence

Composite Indicator of Institutional Quality

IV Estimate

Gamma, IV estimate Gamma, OLS estimate
95% C.I., Conv. varies 95% C.I., Conv. varies

Figure 5
Varying Conditional Convergence

Composite Indicator of Institutional Quality

IV Estimate

Gamma, IV estimate Gamma, OLS estimate
95% C.I., Conv. varies 95% C.I., Conv. varies