

# Potential Growth in Asia and Its Determinants: An Empirical Investigation

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This paper contributes to the literature on growth in Asia in several respects. I provide estimates of potential growth for 21 Asian economies using an aggregate supply model with time-varying parameters and a Kalman filtering methodology. My estimates indicate that the actual growth slowdown experienced by many of these economies in the 2000s is associated with a falling trajectory in potential growth. Relying on Bayesian model averaging, I select robust determinants of potential growth and find that the latter is driven by the technology gap, trade, tertiary education, and institutional quality, as well as by working-age population growth. Effective reforms in these areas can help counterbalance declines in potential growth in Asia. I also investigate the relationship between business cycle features and potential growth, finding that higher volatility in actual growth has significantly negative effects on potential growth. Thus, stabilization policies can have beneficial effects on Asian economies' long-term growth performance.

*Keywords:* Asian economies, Kalman filter, potential growth

*JEL codes:* C23, O40, O47

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## I. Introduction

Many Asian economies have enjoyed a remarkable growth performance over the last 3 decades. With annual growth rates often close to 8%–10%, the People's Republic of China (PRC) and Southeast Asian economies, in particular, have been referred to as growth miracles and their experience has fueled a growing debate in the economic literature regarding the determinants of this performance and whether it can be replicated in other emerging economies. Growth theory indicates that, in the long run, economies tend to grow at a rate consistent with the full utilization of productive resources, which is known as the natural or potential growth rate (see, for example, Blinder and Solow 1973, León-Ledesma and Thirlwall 2002). Short-term shocks can lead to temporary deviations from the potential growth rate that give rise to changes in unemployment and inflation. Over time, these changes will be corrected via the adjustment of relative prices, and growth will return to its potential

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rate. There is wide agreement that the persistently high growth rates characterizing Asian economies reflect their high potential growth rates.

Though still generally higher than that of other emerging and advanced economies, average growth in Asia has declined in the last decade. In many cases, growth performance seems to have deteriorated since the 2008–2009 global financial crisis. This raises the question of whether such a decline reflects a transitory (though persistent) deviation of actual growth from the potential growth rate, or if it signals a fall in the potential growth rate itself. If Asian economies are entering a new phase of permanently lower long-run growth, there will be implications for a number of economic and social policies.

This paper proposes an empirical investigation of the issues discussed above. I estimate the potential growth rate for a sample of 21 Asian economies, relying on an unbalanced panel of annual data over the period 1960–2014. Given my interest in the dynamics of potential growth in Asia, my approach is based on a time-varying parameter aggregate supply (AS) model that is consistent with the concept of the natural growth rate proposed by Harrod (1939) and its relation to Okun's Law and the Phillips curve. I consider different versions of the AS model and estimate it via a Kalman filtering methodology to obtain time-series estimates of Asian economies' potential growth rates. I find that the potential growth rate of most Asian economies has been on a downward trajectory since the 2000s, and that this pattern either continued or worsened during 2008–2014. In most cases, the estimated potential growth rate was lower in 2014 than during 2000–2007. Given that actual growth will tend to return to the potential growth rate in the long term, this outcome raises concerns regarding the growth performance of Asian economies in the medium to long term, and reinforces the need to investigate the determinants of potential growth.

To carry out this task, I rely on a larger panel of annual data for 69 advanced and emerging economies over the period 1960–2014. The objective is to obtain more efficient and reliable estimates, exploiting the additional information that is available beyond the data in the sample of 21 Asian economies. From an econometric viewpoint, my search for robust determinants of potential growth is based on a recently proposed methodology for model selection: the Bayesian model averaging (BMA) approach developed by Magnus, Powell, and Prüfer (2010) for the estimation of classical linear regression models with uncertainty about the choice of the explanatory variables. Harrod's natural growth rate is defined as the sum of the growth rates of labor productivity and the labor force. I introduce (trend) working-age population growth (used as a proxy for labor force growth) in the model as a fixed regressor, while letting BMA estimations select the additional robust regressors. I find that out of 35 variables considered, seven are considered to be robust determinants of potential growth. My estimates confirm that the growth rate of the working-age population has a direct relationship with potential growth, as suggested by theory, with a 1% increase in this variable leading a similar increase in the potential growth rate. The implication is that, as with advanced economies,

aging populations will gradually become a significant drag on (potential) growth in emerging Asian economies such as the PRC. Other variables that play a significant role in shaping the trajectory of the potential growth rate include a proxy for the technology gap (as measured by an economy's differences with the United States [US]), a measure of tertiary education levels, proxies for labor market rigidity, and proxies for institutional quality (as measured by indexes for perceived government efficiency and accountability). Integration with the world economy via trade and financial links is also important and has the expected positive impact on potential growth. In particular, the effects of financial integration depend on the quality of institutions. I find that economies characterized by lower perceived regulatory quality enjoy positive effects from greater connection to international financial markets, but these gains gradually disappear as institutional quality increases. Overall, the results indicate that effective economic policy interventions and, more generally, improvements in institutional quality (e.g., more flexible labor markets, more efficient and accountable government) have the potential to positively affect the trajectory of potential growth, thus counteracting the effects of the recent slowdown in many Asian economies.

Next, I turn to the question of whether the 2008–2009 global financial crisis left persistent, or even permanent, scars on the potential growth rates of Asian economies. For this to be the case, potential growth should be endogenous with respect to the actual growth rate (or, more generally, business cycle features such as deviations of the actual from the potential growth rate and growth volatility). I investigate this hypothesis using two different approaches and find that a higher volatility of actual growth with respect to the potential growth rate has a significantly negative impact on the latter. This result suggests that policy measures leading to a more stable macroeconomic and growth environment can have long-lasting positive effects on growth performance. On the other hand, my estimates do not provide evidence indicating that short-term deviations from actual growth affect the potential growth rate, either positively or negatively. Taken at face value, this result indicates that the effects of the 2008–2009 global financial crisis on potential growth rates in Asia, however deep and persistent, will not be permanent.

The remainder of the paper is organized as follows. The next section describes the model and empirical methodology used to estimate the potential growth rates of my sample of Asian economies. Section III is devoted to the investigation of the determinants of potential growth. Section IV considers the relationship between business cycle features and the dynamics of the natural or potential growth rate. Section V concludes.

## **II. Model and Estimation Methodology**

The concept of the natural rate of growth was formally introduced in growth theory by Harrod (1939), who defined it as the sum of the growth rates of the labor

force and labor productivity, both of which were assumed to be exogenous. This implies that Harrod's natural rate of growth is the particular growth rate associated with full employment and a stable inflation rate. As such, the role played by the natural growth rate is twofold: it is both the trend growth rate of the economy and the short-term upward limit to (noninflationary) growth that turns cyclical expansions into recessions.

Since the natural growth rate is defined as the sum of the growth rates of labor productivity and the labor force, unemployment will rise whenever the actual rate of growth ( $g_t$ ) falls below the natural rate, and it will fall when  $g_t$  rises above  $g^N$ ; that is, the natural rate of growth is the particular growth rate consistent with a nonchanging unemployment rate. Thus, a simple estimation framework to pin down the value of  $g^N$  is provided by the following specification of Okun's Law:

$$\Delta U_t = \sigma - \zeta g_t \quad (1)$$

where  $\Delta U_t$  is the percentage change in the unemployment rate  $U_t$ , and  $g_t$  is the growth rate of output.

This specification has been widely used in the literature to estimate  $g^N$  for economies and regions and, among other things, to investigate its possible endogeneity (see, for example, León-Ledesma and Thirlwall 2002, Lanzafame 2010). For my purposes, the specification in equation (1) presents two drawbacks. It produces a single estimate of the natural or potential growth rate for the time period under analysis, while I am interested in studying its evolution over time. Thus, I rely on a time-varying-parameter approach to estimate a time series for  $g_t^N$ ; on the other hand, unemployment (including underemployment) and labor market data in general are notoriously unreliable for some of the economies in my panel. To address this, I link Harrod's definition of  $g^N$  to the relationship between unemployment and growth, and estimate the natural or potential growth rates of Asian economies relying on an AS model. Since in the long run, unemployment will be constant when it is equal to the nonaccelerating inflation rate of unemployment, the natural growth rate can be defined as the growth rate consistent with  $U_t = U_t^N$  and, thus,  $\Delta U_t = 0$ . I formalize this in Okun's relation as

$$U_t = U_t^N - \beta_t (g_t - g_t^N) \quad (2)$$

where the Okun coefficient ( $\beta_t$ ) and the nonaccelerating inflation rate of unemployment ( $U_t^N$ ) are assumed to be time varying. The relationship between inflation and unemployment is given by the following Phillips curve in which

$$\pi_t = \pi_t^e - \gamma_t (U_t - U_t^N) \quad (3)$$

where  $\pi_t$  and  $\pi_t^e$  are, respectively, the actual and expected inflation rates, while  $\gamma_t$  is a time-varying parameter. Combining equations (2) and (3), I get

$$\pi_t = \pi_t^e + \phi_t (g_t - g_t^N) \quad (4)$$

where  $\phi_t = \beta_t \gamma_t$ . The specification in equation (4) formalizes an AS model with time-varying parameters.

To estimate the model in equation (4), I need an estimate of the expected inflation rate,  $\pi_t^e$ . Since there is very limited availability of time-series data for expected inflation, I model  $\pi_t^e$  as a function of the actual inflation rate ( $\pi_t$ ), assuming two possible specifications. The first is in equation (5), where expected inflation in time  $t$  is a time-varying function of actual inflation in  $t$ :

$$\pi_t^e = \alpha_t \pi_t + \varepsilon_t \quad (5)$$

where  $\alpha_t$  is a time-varying parameter reflecting the public's degree of accuracy in forecasting inflation and  $\varepsilon_t$  is an independent normally distributed error term, with zero mean and constant variance. The estimated model in this case is

$$g_t = g_t^N + \frac{(1 - \alpha_t)}{\phi_t} \pi_t + \varepsilon_t \quad (6)$$

The second specification assumes an extreme form of adaptive expectations in which expected inflation in  $t$  is equal to actual inflation in  $t - 1$  plus a random error term:

$$\pi_t^e = \pi_{t-1} + \varepsilon_t \quad (7)$$

and the relative model is

$$g_t = g_t^N + \frac{1}{\phi_t} \Delta \pi_t + \varepsilon_t \quad (8)$$

Equations (6) and (8) can both be specified in state-space form. Specifically, the measurement equations are

$$g_t = \mu_t + \beta_t \pi_t + \varepsilon_t \quad (6')$$

$$g_t = \mu_t + \beta_t \Delta \pi_t + \varepsilon_t \quad (8')$$

with  $\mu_t = g_t^N$ . Following standard practice in the literature (see, for example, Harvey 1989), to capture possible level breaks or trend patterns, the transition equations are

assumed to follow a unit root:

$$\mu_t = \mu_{t-1} + v_t \quad (9)$$

$$\beta_t = \beta_{t-1} + v_t \quad (10)$$

Following Romer (1993), I take account of the possible effects of the degree of openness on the slope of the Phillips curve, and thus of the AS models in equations (6') and (8'), and also consider the following transition equation for  $\beta_t$ :

$$\beta_t = \beta_{t-1} + \kappa m_t + v_t \quad (11)$$

where  $m_t$  is the share of imports in gross domestic product (GDP). For each economy, I select the most appropriate version of the model according to the significance of the estimated parameters and rely on the Akaike Information Criterion.<sup>1</sup>

My estimation is carried out relying on the Kalman filter recursive algorithm, which is commonly used in the literature to obtain optimal estimates for state variables in models with time-varying parameters (see, for example, Lanzafame and Nogueira 2011). More specifically, to obtain a time series for the potential growth rate  $g_t^N$ , I apply the Kalman smoothing procedure, which uses all the information in the sample to provide smoothed-state estimates. This procedure differs from Kalman filtering in the construction of the state series, as this technique uses only the information available up to the beginning of the estimation period. Smoothed series tend to produce more gradual changes than filtered ones and, as discussed by Sims (2001), they provide more precise estimates of the actual time variation in the data.

Figure 1 below presents estimated potential growth rates and actual growth rates for 12 Asian economies, including the region's four most developed economies and eight largest economies. The corresponding graphs for all other Asian economies are included in Figure A.1 in the Appendix.

Overall, the Kalman smoother seems to perform well in fitting the data, both in terms of the significance of the regressors and in providing a realistic approximation for the long-run growth paths of Asian economies. The estimates show the potential growth rate as being more stable than the actual growth rate, as well as being fairly high and/or increasing in the 1980s and 1990s for most economies, which is in line with expectations. It can also be seen that in most cases, the estimated potential growth rate declined in the 2000s and with few exceptions, this trend either remained stable or worsened during the period 2008–2014. Comparisons between the mean

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<sup>1</sup>As an alternative, I also considered a different model augmented with financial factors along the lines of Felipe, Sotocinal, and Bayudan–Dacuyucuy (2015). This turned out to be the most appropriate model only in the cases of Thailand and Singapore.

Figure 1. Actual and Potential Growth Rates in Select Asian Economies

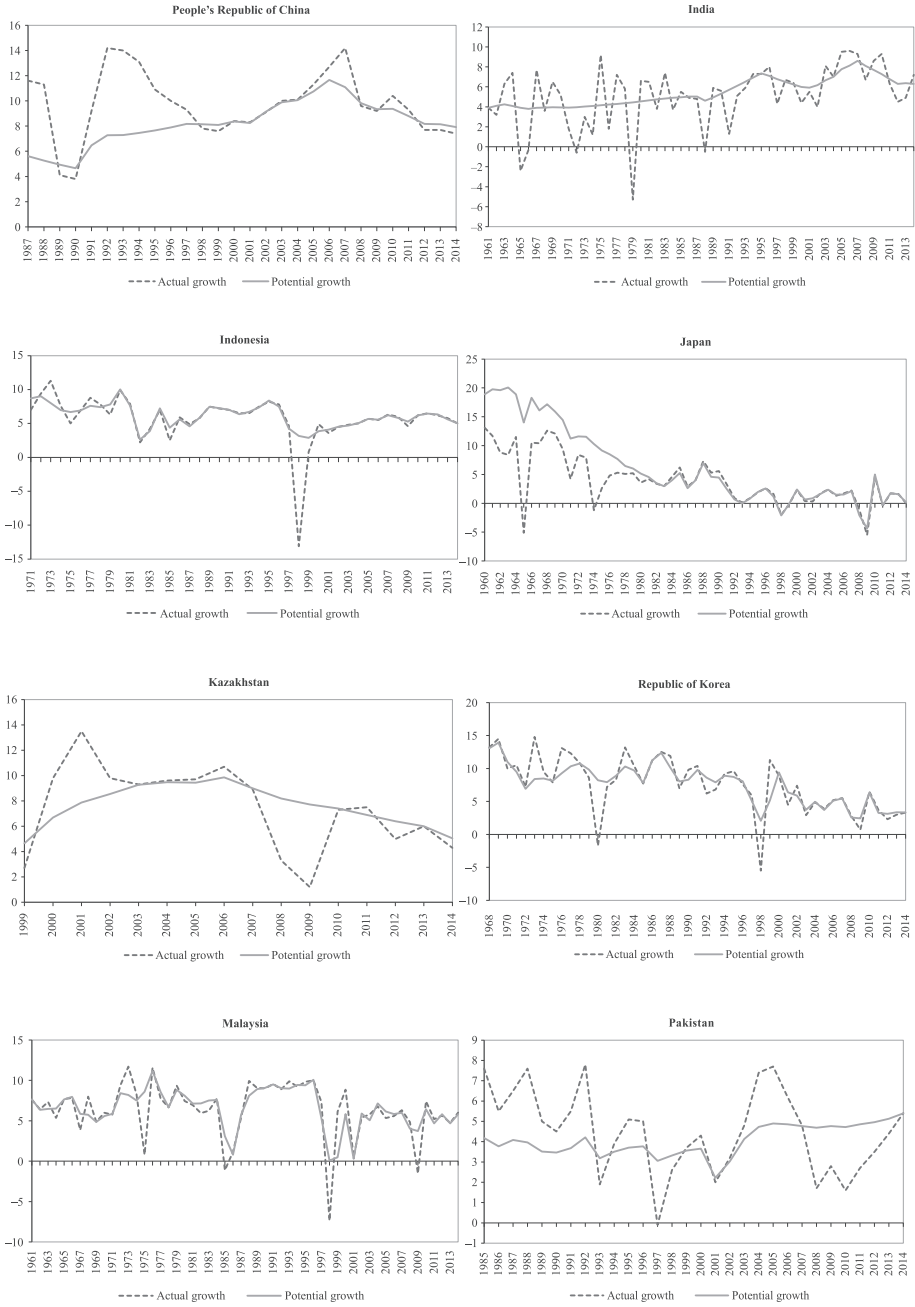
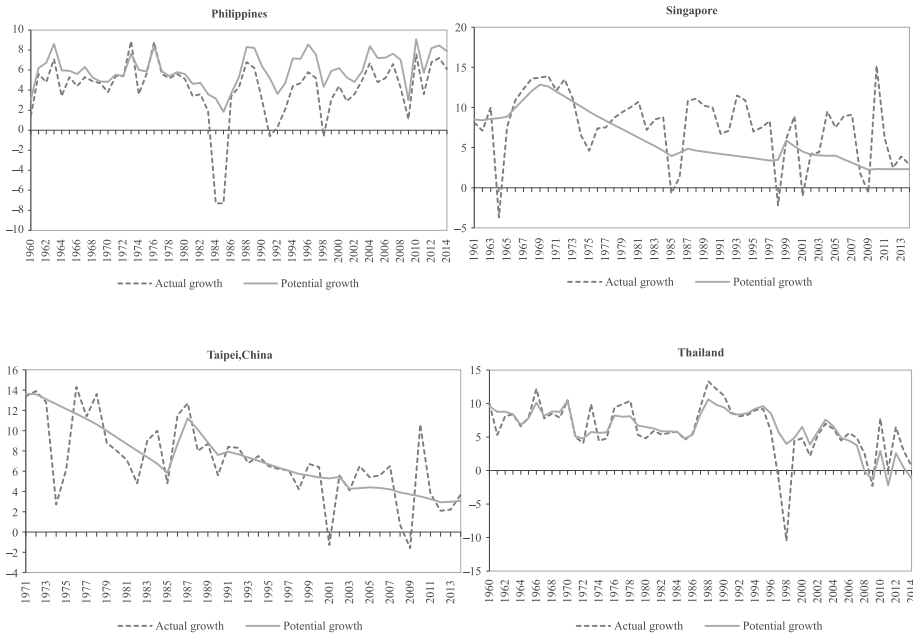


Figure 1. *Continued.*



Source: Author's calculations.

values for the 2000–2007 and 2008–2014 periods (and the 2014 estimates), which are reported in Table 1, confirm that this is the case.

As mentioned, a falling potential growth rate has significant negative consequences for an economy that can be particularly difficult to cope with in an emerging economy. Thus, an analysis of what drives potential growth and whether its determinants may be influenced by policy interventions is of critical importance for emerging Asian economies.

### III. Determinants of Potential Growth

Having obtained time-series estimates for  $g_t^N$  for all Asian economies in my panel, in this section, I turn to the investigation of the determinants of the potential growth rate. My objective is to obtain robust and reliable estimates of variables that are significantly correlated with the potential growth rate. To achieve this, I extend the unbalanced panel to a group of 69 economies to include several other emerging and advanced non-Asian economies. The list of economies included in the panel is presented in Table A.1 in the Appendix.

My definition of potential growth is consistent with Harrod's (1939) concept of the natural growth rate represented as the sum of the growth rates of labor productivity and the labor force; thus, in my search for the main drivers of  $g_t^N$ , I



Table 1. Mean Estimates of Potential Growth Rates  
(%)

	Azerbaijan	Bangladesh	Cambodia	PRC	Hong Kong, China	India	Indonesia
2000–2007	17.90	5.84	9.26	9.90	4.83	7.03	4.95
2008–2014	5.26	5.97	7.42	8.80	3.01	6.97	5.81
2014	3.03	6.12	7.08	7.91	2.25	6.29	5.01
	Japan	Kazakhstan	Republic of Korea	Malaysia	Pakistan	Philippines	Singapore
2000–2007	1.63	8.77	5.58	5.27	4.04	6.58	4.05
2008–2014	0.24	6.81	3.49	5.02	4.93	7.06	2.36
2014	0.15	5.05	3.33	5.81	5.40	7.90	4.10
	Sri Lanka	Taipei,China	Tajikistan	Thailand	Turkmenistan	Uzbekistan	Viet Nam
2000–2007	6.67	4.70	8.46	5.44	15.48	6.12	7.38
2008–2014	5.58	3.34	6.93	0.15	11.03	8.34	6.01
2014	6.84	3.06	6.74	2.90	10.28	8.13	6.06

PRC = People's Republic of China.

Source: Author's calculations.

need to take account of both of its components. As mentioned, labor market data are not entirely reliable for Asian economies and emerging economies in general. Therefore, I proxy labor force growth using data on working-age population growth, duly filtered to purge short-term variability (e.g., transitory migration flows) and obtain a better estimate for potential long-term labor force growth.<sup>2</sup> However, the search for the determinants of productivity growth is more complex and many possible determinants are considered in the literature.

Faced with this issue, a number of recent studies have implemented various model selection procedures to ascertain which variables have a robust association with economic growth (see, for example, Fernández and Steel 2001; Sala-i-Martin, Doppelhoffer, and Miller 2004). In this paper, I rely on the version of the BMA approach developed by Magnus, Powell, and Prüfer (2010) for the estimation of classical linear regression models with uncertainty about the choice of the explanatory variables. This estimator fits the model nicely and the approach used in this paper is based on a classical linear regression framework with two subsets of explanatory variables: (i) The “focus regressors,” which are explanatory variables always included in the model for theoretical reasons or other considerations about the phenomenon under investigation. In my case, the growth rate of the working-age population (*gwap*) is one such focus regressor; and (ii) The “auxiliary regressors,” which are additional explanatory variables whose inclusion in the model is less certain. The problem of model uncertainty and variable selection arises because

<sup>2</sup>I rely upon the frequency domain filter developed by Corbae, Ouliaris, and Philipps (2002) and Corbae and Ouliaris (2006).

different subsets of auxiliary regressors can be excluded from the model to improve (in the mean-squared error sense) the unrestricted ordinary least squares estimates. When there are  $k_2$  auxiliary regressors, the number of possible models to be considered is  $2^{k_2}$ . The BMA estimator provides a coherent method of inference on the regression parameters of interest by taking explicit account of the uncertainty due to both the estimation and the model selection steps. The BMA estimator uses conventional noninformative priors on the focus parameters and the error variance, and a multivariate Gaussian prior on the auxiliary parameters. The unconditional BMA estimates are obtained as a weighted average of the estimates from each of the possible models in the model space, with weights proportional to the marginal likelihood of the dependent variable in each model. An auxiliary regressor is considered to be robust if the  $t$  ratio on its coefficient is greater than 1 in absolute value or, equivalently, the corresponding one-standard error band does not include zero. Alternatively, researchers can rely on their posterior inclusion probabilities. Masanjala and Papageorgiou (2008) suggest that a posterior inclusion probability of 0.5 corresponds approximately to a  $t$  ratio of 1 in absolute value.<sup>3</sup>

Despite being a useful tool for establishing a set of robust regressors given a large set of possible explanatory variables, the BMA approach also has some weaknesses. Ciccone and Jarocinski (2010), for example, show that the results of BMA estimations can be highly sensitive to measurement errors. Ghosh and Ghattas (2015) show that high collinearity in three or more covariates tends to push the posterior inclusion probabilities downward and that all collinear variables may be falsely excluded.<sup>4</sup> Sala-i-Martin, Doppelhofer, and Miller (2004) note that the BMA approach's emphasis on marginal measures of variable importance make it difficult (if not impossible) to detect dependence among explanatory variables. They stress that the extent of interdependence between explanatory variables will affect the posterior inclusion probability of any given model, as well as the form of the posterior probability distribution of variables over the model space.

To deal with these issues, I implement a hybrid two-stage approach. In the first stage, I exploit the properties of the BMA methodology by Magnus, Powell, and Prüfer (2010) to assess the robustness of possible determinants of potential growth. Since some of the variables in my data set have very high correlations, I implement successive BMA estimation procedures to eliminate redundant indicators from the analysis and further reduce the model space by removing variables that are not robust. In doing this, I estimate multiple specifications of the model by adding highly collinear robust determinants (e.g., institutional quality variables) one at a

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<sup>3</sup>While the BMA helps deal with model uncertainty, it does not deal with issues of causality. Thus, the definition of regressors as robust should be intended as indicating that they are significantly correlated with potential growth.

<sup>4</sup>In particular, Ghosh and Ghattas (2015) note that strong collinearity leads to a multimodal posterior distribution such that if there are three or more highly collinear variables, the median probability model could potentially discard all of them.

time. In the second stage, the robust determinants that are identified using the BMA approach are used as regressors in a fixed effects panel data regression to gauge their effects on potential output growth. I also consider the possible presence of nonlinearities and test separately for the significance of interaction effects between an index of financial integration (selected as a robust determinant of potential growth by the BMA methodology) and institutional quality variables, which is in line with the literature on the nonlinearity of effects of financial openness on economic growth. I also examine whether there is a statistically significant interaction effect between institutional quality and the technology gap with the US, which is another regressor defined as robust by the BMA approach.

A detailed description of the two stages and the associated results are presented in the next section.

#### A. BMA and Fixed Effects Results

I consider 35 potential determinants of  $g_t^N$ , including the focus regressor  $gwap$ . These potential determinants and their definitions and data sources are presented in Table A.2 in the Appendix. Since the potential growth rate is the particular rate toward which actual growth tends in the long run, the set of determinants of potential growth I consider reflects a broad set of variables typically deemed to affect actual growth in the long run. To control for the presence of fixed effects, I applied the forward-orthogonal-deviation transformation to the data before implementing the BMA procedure. The number of possible determinants considered is much larger than those included in a typical growth regression, but my data set contains variables that can be considered to be close alternatives (e.g., proxies for education, openness, and institutional quality) and are highly correlated. Thus, as well as using all 35 variables at once, I also carried out BMA regressions using subsets of the various proxies to reduce the computation burden and the number of auxiliary regressors, as well as to lessen the impacts of the presence of correlated regressors in the BMA analysis. I then excluded from the final specification the ones that never turned out to be robust. Following this approach, I reduced the number of possibly robust auxiliary regressors to 13. The BMA results for this specification are reported in Table 2.

As can be seen, out of the 13 auxiliary regressors, only seven are selected by the BMA approach as robust determinants of potential growth with a posterior inclusion probability equal to or greater than 0.5: (i) gross enrollment ratio in tertiary education (*es3enrot*); (ii) technology gap vis-à-vis the US (*gap*); (iii) degree of labor market rigidity (*lamrig*); (iv) and (v) two indexes reflecting aspects of perceived institutional quality (voice and accountability index, *voa*; government efficiency index, *goveff*); (vi) trade-to-GDP ratio (*trade*); and (vii) a proxy of integration into international financial markets (ratio of overall financial flows with respect to GDP, *integr*).

Table 2. Bayesian Model Averaging Estimates

	Coefficient	SD	t_stat	pip	1-SD Band	
<i>gwap</i>	0.697	0.273	2.560	<b>1.000</b>	0.424	0.970
<i>agremph</i>	0.002	0.013	0.160	0.070	-0.011	0.015
<i>di16merdt</i>	-0.459	0.683	-0.670	0.380	-1.142	0.224
<i>es10schom</i>	0.295	0.395	0.750	0.430	-0.101	0.690
<i>es1enrop</i>	-0.006	0.020	-0.310	0.130	-0.026	0.014
<i>es2enros</i>	0.004	0.011	0.380	0.180	-0.007	0.016
<i>es3enrot</i>	-0.089	0.021	-4.240	<b>1.000</b>	-0.110	-0.068
<i>finref</i>	0.046	0.572	0.080	0.060	-0.526	0.618
<i>gap</i>	0.031	0.030	1.040	<b>0.610</b>	0.001	0.061
<i>goveff</i>	2.276	0.759	3.000	<b>0.970</b>	1.517	3.035
<i>integr</i>	-0.002	0.001	-2.550	<b>0.940</b>	-0.003	-0.001
<i>lamrig</i>	-1.328	1.245	-1.070	<b>0.610</b>	-2.573	-0.083
<i>trade</i>	0.029	0.009	3.160	<b>0.980</b>	0.020	0.038
<i>voa</i>	0.712	0.829	0.860	<b>0.500</b>	-0.118	1.541

Model space: 8,192 models

pip = posterior inclusion probability, SD = standard deviation.

Note: Bold signifies a pip exceeding 0.5.

Source: Author's calculations.

In the next step of my empirical investigation, I exclude from the analysis the variables that turned out not to be robust using the BMA estimation and, relying on the standard fixed effects technique, estimate the following model for all economies in my panel as well as for the subpanel of Asian economies:

$$g_{it}^N = \eta_i + \theta_1 gwap_{it} + \theta_2 es3enrot_{it} + \theta_3 gap_{it} + \theta_4 goveff_{it} + \theta_5 intergr_{it} + \theta_6 lamrig_{it} + \theta_7 trade_{it} + \theta_8 voa_{it} + \xi_{it} \quad (12)$$

To control for the effects of the possible presence of cross-sectional dependence in the error term, I rely on Driscoll and Kraay (1998) for standard errors, which assume the error structure to be heteroskedastic, autocorrelated (up to some lag), and possibly correlated between the groups. As such, Driscoll–Kraay standard errors are robust to very general forms of temporal dependence and/or cross-sectional dependence due to, for example, spatial correlation or time effects.

The results from equation (12), reported in the first two columns on the left-hand side of Table 3, are very much in line with expectations for all economies and Asian economies, even though the latter are based on a fairly small sample size. In particular, the coefficient on *gwap*, which is the elasticity of potential output with respect to the working-age population, is significant and very close to 1, suggesting that a 1% increase in the working-age population leads to a 1% increase in potential output growth. This is consistent with the definition of the natural or potential growth rate used in this paper and indicates that *gwap* is a good proxy for the potential long-run growth rate of the labor force. The signs of all other variables are also as expected, with the possible exception of tertiary enrollment (*es3enrot*) and

Table 3. Determinants of  $g_t^N$ : Fixed Effects Estimations

	All Economies	Asian Economies	All Economies	
<i>gwap</i>	1.002**	0.942 <sup>^</sup>	0.867**	1.157**
<i>es3enrot</i>	-0.052	-0.155**	0.158**	0.163**
<i>es3enrot_sq</i>	-	-	-0.001**	-0.002**
<i>gap</i>	0.069**	0.097 <sup>^</sup>	0.042*	0.073*
<i>gap_polstab</i>	-	-	-	-0.006*
<i>goveff</i>	1.147*	2.824*	0.963*	1.361**
<i>integr</i>	-0.003**	-0.001	-0.003	0.004 <sup>^</sup>
<i>integr_regq</i>	-	-	-	-0.003**
<i>lamrig</i>	-1.619*	-8.757**	-1.933**	-2.924**
<i>trade</i>	0.054**	0.063**	0.082**	0.065**
<i>trade_sq</i>	-	-	-0.0001**	-0.0001**
<i>voa</i>	1.456**	-1.070*	0.726*	1.651 <sup>^</sup>
<i>dummy0814</i>	-	-	-2.432**	-2.727**
Constant	-0.995	7.120	-5.014**	-5.576**
F-statistic for $H_0 : \theta_1 = 1$	0.00	0.01	0.39	0.51
No. of economies	61	18	61	61
No. of observations	655	188	655	425

Notes: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level, respectively. Variables instrumented with first lag. Standard errors from Driscoll and Kraay (1998) used.  
Source: Author's calculations.

the financial integration index (*integr*), both of which enter the regression with a negative sign.

These last results are somewhat puzzling and warrant further investigation, which I carry out by modifying the model in two steps to allow for some form of nonlinearity.<sup>5</sup> In the first step, I start by assessing whether the regressors in equation (12) may affect potential growth nonlinearly. Extending the model with the introduction of various quadratic terms, I find that this is the case for both *es3enrot* and *trade*. Interestingly, the coefficient on the quadratic term *es3enrot\_sq* is negative, but once this is included in the model, *es3enrot* enters with a significantly positive sign; that is, enrollment in tertiary education affects  $g_t^N$  positively, but its impact decreases as *es3enrot* rises. The outcomes for *trade* and *trade\_sq* are the same. Moreover, the evidence of a significant downward shift in potential growth during 2008–2014 due to the global financial crisis points to the possibility of a structural break in the  $g_t^N$  series for many economies. To control for this, I introduce an intercept dummy variable (*dummy0814*) equal to 1 for the period 2008–2014 and zero otherwise. The dummy turns out to be negative and strongly statistically significant. These changes to the benchmark model result in the specification in the third column in Table 3, where I can see that all other results remain fairly similar. In particular, the financial integration index (*integr*) still enters with a negative sign, even though it is not significant.

<sup>5</sup>Because of the small panel size, the estimation of this extended model is not feasible for the subpanel of Asian economies.

In the second step of the benchmark model extension, I consider whether institutional quality may affect potential growth not only directly, as indicated by the significant coefficients on *goveff*, *lamrig*, and *voa*, but also via indirect channels. It has been suggested that the effects of integration on international financial markets may depend on institutional quality (see, for example, Kose et al. 2009). Similar arguments have been advanced on the potential benefits associated with technology spillovers. To explore this possibility, I interact the *gap* and *integr* variables with a number of proxies for the quality of institutions. If (on average) the impacts of the technology gap and integration indexes depend on institutional quality, then the interaction terms should turn out to be significant. I find that this is the case when the *gap* variable is interacted with the index of political stability (*gap\_polstab*), while the effects of *integr* on the potential growth rate appear to depend significantly on regulatory quality (*regq*). Results are reported in the last column of Table 3.

The estimates show that once the interaction terms are introduced as variables on the right-hand side, *integr* turns positive and is significant at the 10% level, while *gap* remains positive and significant too; the interaction terms are always negative and significant. The interaction terms are constructed as simple products of the gap and integration indexes with the institutional quality indexes:  $gap\_polstab = gap \times polstab$  and  $integr\_regq = integr \times regq$ . As such, the sign, size, and significance of the effect of *gap* and *integr* on the potential growth rate will vary according to the value of the institutional quality index. Using *regq* and *integr* as an example, if  $\theta_5$  is the estimated coefficient on *integr* and  $\theta_{5,1}$  the estimated coefficient on *integr\_regq*, then the overall impact of financial integration is given by  $(\theta_5 + \theta_{5,1} \times regq)$ . The size and significance of this product will vary for different values of *regq*. The institutional quality indexes range from -2.5 (weak) to 2.5 (strong) to reflect governance performance. To test for the effect of the financial integration index, I can conduct a series of F-tests to determine whether  $(\theta_5 + \theta_{5,1} \times regq)$  is significantly different from zero for different values of *regq*.

The F-tests conducted show that, when taking into account institutional quality via the interaction term, the overall impact of financial integration is positive and significant for  $regq < (0.5)$ . This indicates that financial integration has larger positive effects on potential growth for economies with weaker institutions, thus acting as a substitute for high-quality institutions. For emerging economies with weaker institutions, including some of the Asian economies in my sample, the implication is that successful integration into international financial markets may bring about significant long-term growth benefits by raising the potential growth rate. Meanwhile, the *gap* variable has a positive and significant impact on potential growth for the entire range of *polstab* values, but again its effect is smaller for economies with better institutions (as proxied by greater political stability). This is not surprising since emerging economies, which can be expected to reap larger benefits from technology spillovers, are also characterized by lower *polstab* values.

The BMA procedure and the estimates reported in Table 3 depict a fairly clear picture of the main determinants of potential growth. From a policy viewpoint, the main result of this analysis is that institutional quality and other supply-side characteristics matter for potential growth. Structural reforms in these areas can significantly improve long-term growth performance. In the next section, I address the question of whether demand-management policies can play a role too.

#### IV. Business Cycles and the Endogeneity of Potential Growth

Standard macroeconomic theory assumes business cycles and potential growth as separate phenomena. As a result, business cycle features such as the depth of a recession are deemed to have no significant effects on long-term economic growth. Recent theoretical and empirical contributions, however, have challenged this view (see, for example, Christopoulos and León-Ledesma 2014), while the length and significant economic impacts of the 2008–2009 global financial crisis have reignited the debate on the relationship between short- and long-term growth. This issue takes on particular importance in Asia as the PRC and other economies have seen their growth performance deteriorate between 2008 and 2014 to the point that it has been argued this may be the beginning of a “new normal” for growth patterns in Asia (see, for example, Asian Development Bank 2016). If potential growth is, at least to some extent, endogenous with respect to actual growth and its short-term cyclical features, this view may be shown to be correct and the growth slowdown in Asia may be structural.

As mentioned, León-Ledesma and Thirlwall (2002) develop an econometric framework that allows us to estimate Harrod’s natural growth rate ( $g^N$ ) and test for its endogeneity with respect to the actual growth rate ( $g$ ). The methodology is based on two steps. First, an estimate of  $g^N$ , which is assumed to be constant over time, is produced using the version of Okun’s Law specified in equation (1) and the condition that  $g_t = g^N$  when  $\Delta U_t = 0$ . Next, a reversed version of the Okun’s Law relation is augmented with a dummy variable ( $D_t^{gdev}$ ) that takes the value of 1 when  $g_t$  is greater than the estimated  $g^N$  ( $gdev_t = g_t - g^N > 0$ ) and zero otherwise. Thus, the following model is estimated:

$$g_t = \eta - \psi \Delta U_t + \lambda D_t^{gdev} + \varepsilon_t \quad (13)$$

If the estimated  $\hat{\lambda}$  is positive and significant, then the actual growth rate needed to keep unemployment constant in boom periods ( $g_t > g^N$  or, equivalently,  $gdev_t > 0$ ) has risen. That is, the actual growth rate has pulled up the natural growth rate.

Relying on the definition of  $g_t^N$  used in this paper, I construct a test for the endogeneity hypothesis, which is very much in line with the methodology of León-Ledesma and Thirlwall (2002). I start by noticing that since  $g_t^N$  is defined as

the particular growth rate consistent with a stable inflation rate, the estimated  $\alpha$  in equation (14) below is expected to be equal to zero, while the estimate of  $\beta$  should be positive:

$$gdev_t = \alpha + \beta \Delta\pi_t + \varepsilon_t \quad (14)$$

Rising inflation ( $\Delta\pi_t > 0$ ) should be associated with an actual growth rate higher than the potential growth rate ( $gdev_t > 0$ ) so that  $\beta > 0$ ; meanwhile, a stable inflation rate ( $\Delta\pi_t = 0$ ) is expected to correspond to  $gdev_t = 0$ , so that  $\alpha = 0$ . Introducing  $D_t^{gdev}$  to equation (14), I obtain

$$gdev_t = \alpha + \beta \Delta\pi_t + \lambda D_t^{gdev} + \varepsilon_t \quad (15)$$

A positive estimate of  $\lambda$  in equation (15) is expected as  $D_t^{gdev} = 1$  when  $gdev_t > 0$ . In addition, the size of  $gdev_t$  in boom periods ( $gdev_B$ ) will be given by the sum of the two estimates  $\hat{\alpha}$  and  $\hat{\lambda}$ . Since  $gdev_B$  is determined by the changes in actual and potential growth during booms ( $gdev_B = \Delta g_B - \Delta g_B^N$ ), I can test the null hypothesis  $H_0 : gdev_B - \Delta g_B = 0$ —if the latter is rejected, it follows that  $\Delta g_B^N$  is significantly different from zero. That is, rejection of the null indicates that the potential growth rate rises when  $g_t > g_t^N$  (or, equivalently,  $gdev_t > 0$ ), which is in line with the endogeneity hypothesis proposed by León-Ledesma and Thirlwall (2002). Allowing substantially more degrees of freedom than estimations based on my benchmark model, this testing framework makes it feasible to obtain efficient estimates of the model parameters for the subpanel of Asian economies. In addition to the usual fixed effects estimator, I can also rely on the mean-group estimator (Pesaran and Smith 1995) to allow for parameter heterogeneity.

I also investigate the endogeneity of the potential growth rate introducing the dummy  $D_t^{gdev}$  in my benchmark model. Just as in the testing framework proposed by León-Ledesma and Thirlwall (2002), a positive and significant coefficient on  $D_t^{gdev}$  would support the hypothesis that potential growth is, at least to a certain extent, endogenous to the actual growth rate. Concurrently, I also explore the possibility that other business cycle features may play a role by including in the model as additional regressors the following two variables: (i)  $gdev5_t$ , which is the average deviation of actual growth from the potential growth rate ( $gdev_t = g_t - g_t^N$ ) over the previous 5 years; and (ii)  $gdev5sd_t$ , which defines the standard deviation of  $gdev_t$  over the previous 5 years.<sup>6</sup>

Table 4 reports the estimates based on the first approach to testing the endogeneity hypothesis as formalized in equation (15). Independently of whether I

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<sup>6</sup>I also considered the first lag of  $gdev_t$  (predetermined with respect to  $g_t^N$ ) and the standard deviation of actual growth over the previous 5 years as alternative variables to capture business cycle features. These turned out not to be significant in my estimations and therefore the results are not reported.



Table 4. Tests of the Endogeneity Hypothesis

	Fixed Effects Estimations			
	All Economies		Asian Economies	
	$\Delta\pi$	0.030	0.015	0.051*
$D^{gdev}$	-	2.209**	-	2.859**
Constant	-0.096	-1.138**	-0.353**	-1.669**
Estimate of $gdev_B$	-	1.071**	-	1.189**
t-statistic on $H_0 : gdev_B - \Delta g_B = 0$	-	0.031	-	-0.012
No. of economies	69	69	21	21
No. of observations	2,456	2,456	671	671
	Mean Group Estimations			
	All Economies		Asian Economies	
	$\Delta\pi$	0.068**	0.045*	0.054*
$D^{gdev}$	-	1.721**	-	2.325**
Constant	-0.034	-0.891**	-0.100	-1.306**
Estimate of $gdev_B$	-	0.830**	-	1.019*
t-statistic on $H_0 : gdev_B - \Delta g_B = 0$	-	-0.210	-	-0.182
No. of economies	69	69	21	21
No. of observations	2,456	2,456	671	671

Notes: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level, respectively. Variables instrumented with first lag. Standard errors from Driscoll and Kraay (1998) used. To avoid undue influence from high-inflation episodes, years with average inflation rates higher than 25% for the “All Economies” specifications and higher than 45% for the “Asian Economies” specifications are excluded from the estimations.

Source: Author’s calculations.

refer to the fixed effects or mean group estimates, the estimations for all economies and Asian economies estimations both return clear-cut results. As expected, the dummy variable  $D_t^{gdev}$  turns out always to be positive and highly significant, as does  $gdev_B$ . However, the null hypothesis that  $gdev_B$  is not significantly different from  $\Delta g_B$  is never rejected, implying that there is no significant evidence of an increase in potential growth ( $\Delta g_B^N > 0$ ) during boom periods.

Table 5 reports the results from my investigation of the endogeneity hypothesis using the second approach outlined above that relies on my benchmark model. As can be seen,  $D_t^{gdev}$  turns out to be positive but not statistically significant. This outcome is consistent with the results in Table 4 as I again do not find significant evidence supporting the endogeneity hypothesis for potential growth. Moreover, there is no significant evidence that deviations of the actual from the potential growth rate (proxied by  $gdev5_t$ ) play a significant role. This result implies that, however deep and persistent, the decline in actual growth associated with the 2008–2009 global financial crisis can be expected not to leave permanent scars on long-term growth. An additional implication is that an economic policy intervention to boost short-term growth above the potential growth rate will not affect the latter significantly. Indeed, my results indicate that, by increasing growth volatility, this type of policy intervention may actually indirectly harm long-term growth

Table 5. The Endogeneity Hypothesis: Fixed Effects Estimations

	All Economies	Asian Economies
<i>gwap</i>	1.229**	3.687**
<i>es3enrot</i>	0.124**	0.156
<i>es3enrot_sq</i>	-0.001*	-0.004*
<i>gap</i>	0.075 <sup>^</sup>	0.013
<i>gap_polstab</i>	-0.008 <sup>^</sup>	0.005
<i>goveff</i>	1.194*	-1.198
<i>integr</i>	0.004	0.005
<i>integr_regq</i>	-0.003*	-0.010 <sup>^</sup>
<i>lamrig</i>	-2.812*	-12.869**
<i>trade</i>	0.081**	0.165**
<i>trade_sq</i>	-0.0001*	-0.0003*
<i>voa</i>	2.017 <sup>^</sup>	-0.836
<i>dummy0814</i>	-2.825**	-2.009**
<i>D<sup>gdev</sup></i>	0.154	0.192
<i>gdev5</i>	0.026	0.152
<i>gdev5sd</i>	-0.191*	-0.314*
Constant	-5.712**	7.964 <sup>^</sup>
F-statistic for $H_0 : \theta_1 = 1$	1.14	13.22*
No. of economies	61	18
No. of observations	421	121

Notes: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level, respectively. Variables instrumented with first lag. Standard errors from Driscoll and Kraay (1998) used.

Source: Author's calculations.

performance. I find that *gdev5sd* turns out to be robustly significant and enters with a negative sign, both in the “All Economies” and the “Asian Economies” estimations in Table 5, which is in line with other evidence in the literature (see, for example, Ramey and Ramey 1995).

Therefore, the analysis carried out in this section suggests that the effects of demand-management policies aimed at increasing actual growth above the potential growth rate will not affect the trajectory of the latter and will be short-lived at best. To have a positive impact on long-term growth performance, demand-management policies should aim at stabilizing the actual growth rate as close as possible around the path of potential growth.

## V. Conclusions

Focusing on the performance of Asian economies over the period 1960–2014, this paper contributes to the empirical literature on potential growth in several respects. I provide estimates of potential growth for 21 Asian economies using an AS state-space model with time-varying parameters and a Kalman filtering methodology. My estimates appear to fit well with the growth experiences of Asian economies and indicate that the actual growth slowdowns experienced by many

of these economies in the 2000s can be associated with the falling trajectories of their potential growth rates. Next, I investigate the determinants of potential growth using a larger panel of 69 advanced and emerging economies and data for 35 possible growth determinants. Relying on the BMA selection procedure, I select seven variables that, together with the growth rate of the working-age population, can be considered robust determinants of potential growth. The results are in line with expectations and indicate that potential growth is influenced by various aspects of institutional quality, the technology gap with the US, trade, and tertiary education, as well as by the growth rate of the working-age population. In particular, I find that the effects of integration with international financial markets are positive and significant only for economies with weak institutions.

With the objective of providing evidence regarding the possible effects of the 2008–2009 global financial crisis on the dynamics of the potential growth rate, I extend the benchmark model to include proxies for business cycle features. I also carry out a new test of the endogeneity hypothesis proposed by León–Ledesma and Thirlwall (2002). My results indicate that deviations of actual growth from the estimated potential growth rate do not have a significant impact on potential growth itself, which is in line with the hypothesis that recessions and booms do not have long-lasting effects on long-term growth performance. On the other hand, I find that actual growth volatility with respect to potential growth does have a significant negative effect on  $g_t^N$ . This indicates that policies aimed at stabilizing actual growth in the proximity of the potential growth rate can have beneficial effects on an economy’s long-term growth performance.

Overall, the evidence gathered supports the hypothesis that Asian economies may have entered a new era of slower potential and actual growth rates. My results also suggest that appropriate changes in economic policies and institutions can play a significant role in lifting the potential growth rate. If these are carried out effectively, the “new normal” in Asia may come to resemble previous growth patterns more than would otherwise have been expected.

## References

- Asian Development Bank. 2016. *Asian Development Outlook*. Manila.
- Abiad, A., E. Detragiache, and T. Tressel. 2010. A New Database of Financial Reforms. *IMF Staff Papers* 57 (2): 281–302.
- Barro, R., and J.-W. Lee. 2001. International Data on Educational Attainment: Updates and Implications. *Oxford Economic Papers* 53 (3): 541–63.
- . 2013. A New Data Set of Educational Attainment in the World, 1950–2010. *Journal of Development Economics* 104 (2013): 184–98.
- Blinder, A. S., and R. M. Solow. 1973. Does Fiscal Policy Matter? *Journal of Public Economics* 2 (1973): 319–37.
- Campos, N., and J. Nugent. 2012. The Dynamics of the Regulation of Labor in Developing and Developed Economies since 1960. IZA Discussion Paper 6881. Bonn: IZA.

- Castellacci, F., and J. Natera. 2011. A New Panel Dataset for Cross-Economy Analyses of National Systems, Growth, and Development. Norwegian Institute of International Affairs Working Paper 783. Oslo: Norwegian Institute of International Affairs.
- Chinn, M., and H. Ito. 2006. What Matters for Financial Development? Capital Controls, Institutions, and Interactions. *Journal of Development Economics* 81 (1): 163–92.
- Christopoulos, D., and M. A. León-Ledesma. 2014. Efficiency and Production Frontiers in the Aftermath of Recessions: International Evidence. *Macroeconomic Dynamics* 18 (6): 1326–50.
- Ciccone, A., and M. Jarocinski. 2010. Determinants of Economic Growth: Will Data Tell? *American Economic Journal: Macroeconomics* 2 (4): 222–46.
- Corbae, D., and S. Ouliaris. 2006. Extracting Cycles from Non-Stationary Data. In D. Corbae, S. N. Durlauf, and B. E. Hansen, eds. *Econometric Theory and Practice: Frontiers of Analysis and Applied Research*. New York: Cambridge University Press.
- Corbae, D., S. Ouliaris, and P. C. B. Phillips. 2002. Band Spectral Regression with Trending Data. *Econometrica* 70 (3): 1067–109.
- Driscoll, J. C., and A. C. Kraay. 1998. Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data. *Review of Economics and Statistics* 80 (4): 549–60.
- Felipe, J., N. Sotocinal, and C. Bayudan-Dacuycuy. 2015. The Impact of Financial Factors on the Output Gap and Estimates of Potential Output Growth. ADB Economics Working Paper Series No. 457. Manila: Asian Development Bank.
- Fernández, E. L., and M. F. J. Steel. 2001. Model Uncertainty in Cross-Economy Growth Regressions. *Journal of Applied Econometrics* 16 (5): 563–76.
- Ghosh, J., and A. Ghattas. 2015. Bayesian Variable Selection Under Collinearity. *The American Statistician* 69 (3): 165–73.
- Gwartney J., R. Lawson, and J. Hall. 2014. *Economic Freedom of the World Annual Report*. [http://www.freetheworld.com/datasets\\_efw.html](http://www.freetheworld.com/datasets_efw.html)
- Harrod, R. F. 1939. An Essay in Dynamic Theory. *The Economic Journal* 49 (1939): 14–33.
- Harvey, A. 1989. *Forecasting: Structural Time Series Models and the Kalman Filter*. Cambridge, UK: Cambridge University Press.
- Kose, M., E. Prasad, K. Rogoff, and S. Wei. 2009. Financial Globalization: A Reappraisal. *IMF Staff Papers* 56 (1): 8–62.
- Lane, P., and G. Milesi-Ferretti. 2007. The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004. *Journal of International Economics* 73 (2): 223–50.
- Lanzafame, M. 2010. The Endogeneity of the Natural Rate of Growth in the Regions of Italy. *International Review of Applied Economics* 24 (5): 533–52.
- Lanzafame, M., and R. Nogueira. 2011. Credibility in Emerging Economies: Does Inflation Targeting Matter? *The Manchester School* 79 (6): 1080–98.
- León-Ledesma, M. A. 2002. Accumulation, Innovation, and Catching-Up: An Extended Cumulative Growth Model. *Cambridge Journal of Economics* 26 (2): 201–16.
- León-Ledesma, M. A., and A. P. Thirlwall. 2002. The Endogeneity of the Natural Rate of Growth. *Cambridge Journal of Economics* 26 (4): 441–59.
- Magnus, J. R., O. Powell, and P. Prüfer. 2010. A Comparison of Two Model Averaging Techniques with an Application to Growth Empirics. *Journal of Econometrics* 154 (2): 139–53.
- Masanjala, W. H., and C. Papageorgiou. 2008. Rough and Lonely Road to Prosperity: A Reexamination of the Sources of Growth in Africa Using Bayesian Model Averaging. *Journal of Applied Econometrics* 23 (5): 671–82.

Pesaran, H., and R. Smith. 1995. Estimating Long-Run Relationships from Dynamic Heterogeneous Panels. *Journal of Econometrics* 68 (1): 79–113.

Psacharopoulos, G. 1994. Returns to Investment in Education: A Global Update. *World Development* 22 (9): 1325–43.

Ramey, G., and V. A. Ramey. 1995. Cross-Economy Evidence on the Link Between Volatility and Growth. *The American Economic Review* 85 (5): 1138–51.

Romer, D. 1993. Openness and Inflation: Theory and Evidence. *The Quarterly Journal of Economics* 108 (4): 869–903.

Sala-i-Martin, X., G. Doppelhofer, and R. I. Miller. 2004. Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates Approach. *American Economic Review* 94 (4): 813–35.

Sims, C. 2001. Comments on Sargent and Cogley’s Evolving Post-World War II US Inflation Dynamics. *NBER Macroeconomics Annual* 16 (2001): 373–79.

**Appendix**

**Table A.1. Economies Included in the Analysis**

Asian economies	Azerbaijan; Bangladesh; Cambodia; People’s Republic of China; Hong Kong, China; India; Indonesia; Japan; Kazakhstan; Republic of Korea; Malaysia; Pakistan; Philippines; Singapore; Sri Lanka; Taipei,China; Tajikistan; Thailand; Turkmenistan; Uzbekistan; Viet Nam
Other emerging economies	Algeria, Argentina, Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, Hungary, Mexico, Morocco, Panama, Peru, Poland, Qatar, Saudi Arabia, South Africa, Turkey, Uruguay, Venezuela
Advanced economies	Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, The Netherlands, New Zealand, Norway, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States

Source: Author’s compilation.

**Table A.2. Variables and Data Sources**

Variable	Definition	Source
<i>gn</i>	Potential growth rate estimate	Author’s estimates using WDI–IFS data
<i>g</i>	Actual growth rate	WDI–IFS data
<i>gdev</i>	<i>g-gn</i>	Author’s calculations
<i>gdev5</i>	Average of <i>g_dev</i> over previous 5 years	Author’s calculations
<i>gdev5sd</i>	Standard deviation of the <i>g_dev5</i> over the previous 5 years	Author’s calculations
<i>Gwap</i>	Growth rate of working-age population (aged 15–64 years)	Author’s calculations using WDI–IFS data

**Auxiliary regressors used for the BMA selection procedure**

1	<i>di16merdt</i>	R&D expenditures as a percentage of GDP	CANA Database (v. Jan 2011) by Castellacci and Natera (2011); original source: UNESCO, OECD, RICYT
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*Continued.*

Table A.2. *Continued.*

Variable	Definition	Source
2 <i>es1enrop</i>	Gross enrollment ratio (primary): ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the primary level	CANA Database (v. Jan 2011) by Castellacci and Natera (2011); original source: UNESCO
3 <i>es2enros</i>	Gross enrollment ratio (secondary): ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the secondary level	CANA Database (v. Jan 2011) by Castellacci and Natera (2011); original source: UNESCO
4 <i>es3enrot</i>	Gross enrollment ratio (tertiary): ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the tertiary level	CANA Database (v. Jan 2011) by Castellacci and Natera (2011); original source: UNESCO
5 <i>es10schom</i>	Mean years of schooling: average number of years of school completed in population over the age of 14 years	CANA Database (v. Jan 2011) by Castellacci and Natera (2011); original sources: Barro and Lee (2001) and World Bank's WDI (national accounts data)
6 <i>es12educ</i>	Public expenditure on education: current and capital public expenditure on education	CANA Database (v. Jan 2011) by Castellacci and Natera (2011); original source: UNESCO
7 <i>es14teacr_plus</i>	Primary pupil–teacher ratio: number of pupils enrolled in primary school / number of primary school teachers	CANA Database (v. Jan 2011) by Castellacci and Natera (2011); original source: UNESCO
8 <i>ghc</i>	Percentage growth rate in index of human capital per person based on years of schooling (Barro and Lee 2013) and returns to education (Psacharopoulos 1994)	Author's calculations using PWT 8.1 data
9 <i>econglob</i>	Index of Globalization: long distance flows of goods, capital, and services, and information, and perceptions that accompany market exchanges measured on a scale ranging from 0 (lowest) to 10 (highest)	KOF Index of Globalization
10 <i>overallglob</i>	Overall Globalization Index: weighted average of <i>econ_glob</i> , <i>soc_glob</i> , and <i>pol_glob</i> on a scale ranging from 0 (lowest) to 100 (highest)	KOF Index of Globalization
11 <i>agremph</i>	Employment in agriculture (% of total employment)	International Labour Organization, Key Indicators of the Labour Market database; Global Employment Trends Dataset (2014)
12 <i>indemph</i>	Employment in industry (% of total employment)	International Labour Organization, Key Indicators of the Labour Market database; Global Employment Trends Dataset (2014)

*Continued.*

Table A.2. *Continued.*

Variable	Definition	Source
13 <i>serempsh</i>	Employment in services (% of total employment)	International Labour Organization, Key Indicators of the Labour Market database; Global Employment Trends Dataset (2014)
14 <i>gap100</i>	Technology gap variable: 1 minus the ratio of the level of labor productivity vis-à-vis that of the US in purchasing power parity terms, multiplied by 100; labor productivity computed as a ratio ( <i>rgdpo/emp</i> ), where <i>rgdpo</i> is output-side real GDP at chained purchasing power parity (in millions of 2005 US dollars) and <i>emp</i> is number of persons engaged (in millions); follows specification proposed by León-Ledesma (2002)	Author's calculations using PWT 8.1 data
15 <i>gckemp</i>	Percentage growth rate of the capital-labor ratio	Author's calculations using PWT 8.1 data
16 <i>lmr</i>	Index of labor market regulations measuring economic freedom (e.g., market forces determine wages and the conditions of hiring and firing, government refrains from the use of conscription) on a scale ranging from 0 (lowest) to 10 (highest)	Gwartney et al. (2014) EFW 2014 Annual Report
17 <i>lamrig</i>	Index of labor market rigidity on a scale ranging from 0 (lowest) to 3 (highest); data for 2004–2013 are from the World Bank's Doing Business database, pre-2004 data are from the LAMRIG database from Campos and Nugent (2012); since the index exhibits very little variation, annual values are assumed constant over the 5-year periods considered by Campos and Nugent (2012); Campos and Nugent (2012) state the LAMRIG index is consistent with the World Bank's Doing Business database	World Bank's Doing Business database; LAMRIG database from Campos and Nugent (2012)
18 <i>cocorr</i>	Control of Corruption Index reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as the capture of the state by elites and private interests on a scale measuring governance performance ranging from –2.5 (weak) to 2.5 (strong)	World Bank's Worldwide Governance Indicators (2014 Update)

*Continued.*

Table A.2. *Continued.*

<b>Variable</b>	<b>Definition</b>	<b>Source</b>
19 <i>goveff</i>	Government Effectiveness Index reflects perceptions of the quality of public services, quality of the civil service and the degree of its independence from political pressures, quality of policy formulation and implementation, and credibility of the government's commitment to such policies on a scale measuring governance performance ranging from approximately -2.5 (weak) to 2.5 (strong)	World Bank's Worldwide Governance Indicators (2014 Update)
20 <i>pflcorri</i>	Corruption Perception Index on a scale measuring corruption ranging from 0 (highest) to 10 (lowest)	CANA Database (v. Jan 2011), by Castellacci and Natera (2011), for pre-2008 data, Transparency International for 2008–2014 data; original source: Transparency International
21 <i>polstab</i>	Political Stability (and Absence of Violence and Terrorism) Index reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically motivated violence and terrorism on a scale measuring governance performance ranging from -2.5 (weak) to 2.5 (strong)	World Bank's Worldwide Governance Indicators (2014 Update)
22 <i>regq</i>	Regulatory Quality Index reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development on a scale measuring governance performance ranging from -2.5 (weak) to 2.5 (strong)	World Bank's Worldwide Governance Indicators (2014 Update)
23 <i>rol</i>	Rule of Law Index reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, particularly the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence on a scale measuring governance performance ranging from -2.5 (weak) to 2.5 (strong)	World Bank's Worldwide Governance Indicators (2014 Update)

*Continued.*



Table A.2. *Continued.*

Variable	Definition	Source
24 <i>voa</i>	Voice and Accountability Index reflects perceptions of the extent to which an economy's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media on a scale measuring governance performance ranging from -2.5 (weak) to 2.5 (strong)	World Bank's Worldwide Governance Indicators (2014 Update)
25 <i>trade</i>	Index of Openness: the sum of exports and imports of goods and services measured as a share of GDP	World Bank's WDI (national accounts data) and OECD's national accounts data
26 <i>rmex</i>	Raw materials as a share of total exports	UN Comtrade Database, SITC Aggregate 2, Revision 1. For Taipei, China, Customs
27 <i>fmex</i>	Fuels and mining products as a share of total exports	Administration of the Ministry of Finance. <a href="https://portal.sw.nat.gov.tw/APGA/GA03E">https://portal.sw.nat.gov.tw/APGA/GA03E</a>
28 <i>rmfmex</i>	Sum of raw materials and fuel and mining products as a share of total exports	
29 <i>kaopen</i>	Kaopen Index measuring capital account openness; normalized to be between 0 (less open) and 1 (more open)	Chinn and Ito (2006)
30 <i>finref</i>	Financial Reform Index measuring financial market liberalization; normalized to be between 0 (less liberalized) and 1 (more liberalized)	Abiad, Detragiache, and Tresselt (2010)
31 <i>peindex</i>	Portfolio Equity Integration Index reflects the sum of the stocks of portfolio equity assets and liabilities as a share of GDP; follows suggestions in Kose et al. (2009)	Updated and extended version of data set constructed by Lane and Milesi-Ferretti (2007)
32 <i>fdiindex</i>	FDI Integration Index reflects the sum of the stocks of FDI assets and liabilities as a share of GDP; follows suggestions in Kose et al. (2009)	
33 <i>integr</i>	Integration Index reflects the sum of total foreign assets and liabilities as a share of GDP; follows suggestions in Kose et al. (2009)	
34 <i>nfagd</i>	Net foreign assets as a share of GDP	

BMA = Bayesian model averaging; EFW = Economic Freedom of the World; FDI = foreign direct investment; GDP = gross domestic product; IFS = International Financial Statistics; OECD = Organisation for Economic Co-operation and Development; PWT = Penn World Tables; RICYT = Red Iberoamericana de Indicadores de Ciencia y Tecnología; R&D = research and development; UN = United Nations; UNESCO = United Nations Educational, Scientific and Cultural Organization; WDI = World Development Indicators.  
 Source: Author's compilation.

Figure A.1. Potential Output Growth Rate Estimates and Actual Output Growth Rates

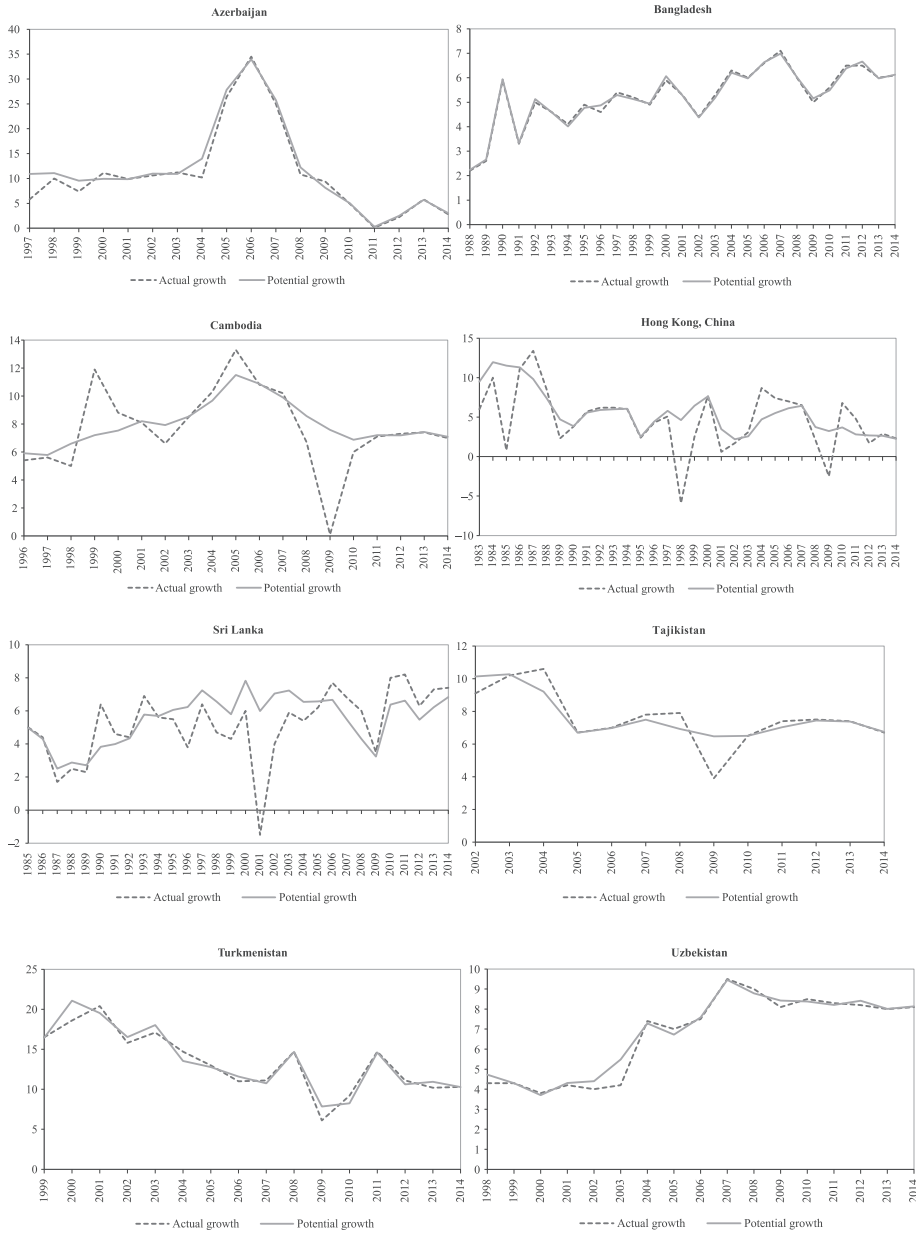
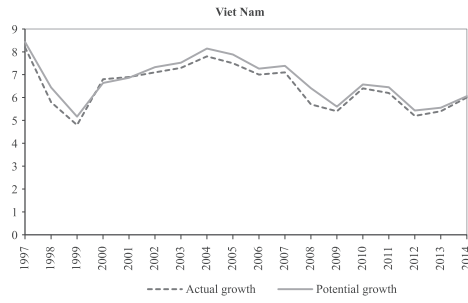


Figure A.1. *Continued.*



Source: Author's calculations.

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