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Potential output in Latin America: a standard approach for the 1950-2002 period

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Abstract

Potential output estimates are becoming increasingly important in policy design in Latin America (ECLAC, 2002) and the objective of this paper is to make a methodological contribution to this field of work. For a proper evaluation of the macroeconomic situation in a certain point in time it is important to have an idea of the level of potential output. For monetary policy decisions it is important to know what the level of potential output is compared to the effective output. In an era in which inflation targeting has become widespread in Latin America it has become increasingly important to estimate potential output. In projections of economic growth the output gap can be a very important input.

Estimates of potential output are of course only one of many indicators to be used in macroeconomic policy evaluation. In most developed countries an array of measures about the economic cycle are used among which the most important are measures of capacity use, delivery lags and the NAIRU (non-accelerating inflationary rate of unemployment) and direct measures of inflation. In the evaluation of the macroeconomic situation additional elements that might affect the economy (terms of trade, external situation) must be taken into consideration the whole complex environment of the economy internal and external.

The work on economic growth has experienced a rapid expansion in the last few decades. Interesting new ideas have been developed and older somewhat forgotten ones have come to the focus of attention again. The growth performance of nations shows a great variety in results and these differences can be explained, among other causes, by differences in accumulation of production factors and multi factor productivity on one level and institutional factors and the international context on an other.

In the context of these new approaches in the analysis of economic growth concepts like "catching-up" and potential growth are becoming increasingly important. In estimating potential output two approaches can be distinguished. In the first one a variety of statistical detrending techniques are applied, in our case using the Hodrick-Prescott filter, and in the second approach the output gap is estimated on the basis of structural relationships. The Hodrick-Prescott filter defines a "trend" output. The second part on production functions indicate more towards a concept of production frontier or the maximum possible production given certain factors. The paper estimates potential output in a group of nine countries in Latin America: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru and Venezuela. These countries cover around 80% of the Latin American territory and about 90% of its GDP. A new aspect of our estimates is that they introduce the concept of structural change in the production function.

I. Introduction

The theory and empirics of economic growth experienced a fast expansion in the last decades. Interesting new ideas have been developed and older somewhat forgotten ones have come to the focus of attention again. The discussion of the new growth theory, initiated by articles of Romer (1986), Lucas (1988) and Barro (1986) concentrated on the analysis of technical progress and convergence. Growth theory also benefited from the expansion of long run databases, which improved the possibilities of empirically testing the different hypothesis (Maddison, 1995 and Summers and Heston, 1989).

In Latin America, the new developments in economic growth theory have gone hand in hand with one of the worst crisis of the last 50 years. Many countries embarked upon an ambitious programme of economic reforms. The discussion on economic policy in Latin America has been dominated by the so-called “Washington consensus” and the approaches of trade liberalization and privatization after decades of strong state intervention and protection of domestic markets.

However, the recent economic performance of several Latin American countries, especially the high volatility of economic growth, related to economic crises in Asia and Russia, has cast some doubt about this new development model. Especially in developing countries the effects of these economic crises seems to throw the countries far off the economic frontier causing big output losses (CEPAL, 2002). In general, for a proper evaluation of the macroeconomic situation it is important to have an idea of the level of potential output of the economy. The level of potential output as compared to real output is very relevant for economic policy purposes.

Especially in an era in which inflation targeting has become widespread in Latin America it is increasingly important to estimate potential output. Policy design because inflation targeting makes it more important to have an idea of when the economy is reaching full potential which may give rise to inflationary pressures. Potential output is generally defined as the maximum output an economy can sustain without generating a rise in inflation.

A correct estimate of potential output is an important macroeconomic policy tool, which might reduce the volatility of the economy and output losses, and would therefore have positive effects on poverty reduction and would benefit investment and economic growth. Ideally, one of the important results of potential growth estimation exercises is to expand our knowledge about the causes of economic growth performance in the Latin American countries.

It should be clear that estimates of potential output are only one of the indicators to be used in macroeconomic policy evaluation. In most developing countries an additional array of measures about the economic cycle are used in macroeconomic analysis among which the most important are measures of capacity use, delivery lags and the NAIRU (non-accelerating inflationary rate of unemployment) and of course direct measures of inflation.

Output gaps are basically estimated for two purposes (de Brouwer, 1998). The first is to provide information about the excess capacity in the economy at a particular point in time. From the perspective of monetary policy, the output gap over the forecast horizon is of most interest. The second purpose is to use a time series of the output gap in econometric modeling exercises. One of the most common uses of estimates of potential output is in macroeconomic models used for forecasting and policy analysis.

In this paper we will try to answer some questions related with the above. Specifically, we will try to advance on the following: Is it possible to estimate potential output meaningfully in Latin America given the fact of high volatily of economic growth in Latin America? Many authors stress the fact that potential output is a non-observable phenomenon which difficultates its estimation.

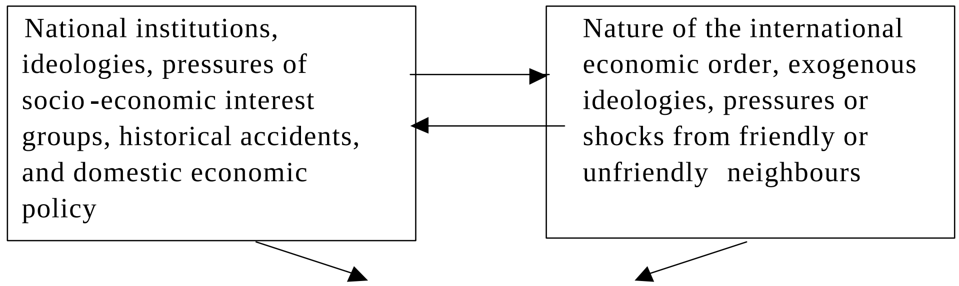
At a more general level and in a longer time perspective, the analysis of the causes of (potential) economic growth has been explained distinguishing between proximate and ultimate causes, as shown in Table 1 (Maddison, 1991).

At a first level, represented in the production function of Table 1, we find proximate and measurable influences defined as those areas of causality where measures and models have been developed by economists, econometricians and statisticians. Here the relative importance of different influences can be more readily assessed. At this level one can derive significant insights from comparative macroeconomic growth accounts.

The second level includes causes of a more ultimate character, that is, qualitative and institutional influences which are more difficult to measure. They include the role of institutions, ideologies, pressures of socio-economic interest groups, historical accidents, and economic policy at the national level. The also involve consideration of the international economic order, foreign ideologies or shocks originating in friendly or unfriendly neighbors.

Graph 1

PROXIMATE AND ULTIMATE ELEMENTS EXPLAINING ECONOMIC PERFORMANCE



$$\frac{Y}{P} = f\left\{\frac{(N'\,L'\,K')\,E + A}{P}\right\}$$

Y = gross domestic product.
P = population.
N' = natural resources augmented by technical progress.
L' = human capital, i.e. labour input augmented by investment in education and training.
K' = stocks of physical capital augmented by technical progress.
E = efficiency of resource allocation.
A = net flow of goods, services, production factors, and technology from abroad.

Source: Maddison (1991).

Hofman (2000) stresses the fact that the proximate causes are not independent of the ultimate causes of growth. To a rather significant degree, proximate causes are dimensions through which ultimate causes can be seen to operate. At the proximate level, the interaction between capital accumulation and technological progress is an example of this interdependence. At the ultimate level, there exists interaction between the institutional framework of a society and the implementation of economic policy. An example of interdependence between the ultimate and proximate levels is the relationship between technological progress and the institutional context. The concept of potential output used in this article is almost completely in the sphere of proximate analysis. It is clear however that may of the elements indicated in the ultimate causes of economic performance will have an important effect on the long term potential growth of an economy.

An additional important issue, which however lies outside the range of this article, is the correct timing of the adjustment on the basis of potential and real output measures. It is important to indicate that for the evaluation of the short term macroeconomic situation the economic authorities need to know the level of potential GDP as compared to real output and not as much about the growth rates of real and potential output. An economy can grow at a rate well above its potential growth if the real output is far below its potential.

II. Methodology

Potential output estimations have a long tradition in the economic science and go back as far as Adam Smith[1]. The development of production functions (Young, Cobb-Douglas, Tinbergen) and growth theories (Harrod-Domar and Solow) in the twentieth century made potential growth and capacity utilization studies possible and they became widespread in the literature. The Keynesian revolution and Europe's post-war reconstruction planning were also important in the development of tools as potential growth estimation. Recently, the new growth theories and advances in econometrics have started up a new brand of potential growth studies.

Basically, two approaches can be distinguished. In the first one a variety of statistical detrending techniques are applied and in the second approach the output gap is estimated on the basis of structural relationships. It is important to distinguish between the different approaches mentioned. Some of them define a "trend" output, this is especially the case with the Hodrick Prescott filter. Others indicate more towards a concept of production frontier or the maximum possible production given certain factors. Among the methodologies most applied (see Cerra and Chaman Saxena, 2000) are the application of filters such as e.g. the Hodrick-Prescott filter, the unobserved components methods which uses information from observed variables to estimate unobserved variables such as potential output and the NAIRU, vector autoregression (VAR) approaches which use information from both demand and supply side in the estimation of permanent and temporary effects of economic growth and demand-side models which estimate the output gap directly from measures of slack in the economy such as for example the unemployment rate.

1 Smith (1776) uses the term idleness and describes the relationship between capital and industry in the chapter on the accumulation of capital of productive and unproductive labour.

Another much applied technique is the estimation of potential GDP on the assumption that GDP peaks of the past represent an approximation of the historical potential output path. Finally, potential output measures are obtained through the econometric estimation of a production function (Cobb-Douglas, CES etc.) using factor inputs, basically capital, labour and sometimes land. The estimated factor coefficients and the multi factor productivity estimate are used in the projection of an estimated growth path.

In this paper a standard methodology is used to estimate potential output in Latin America over a longer period of time, 1950-2002. We have opted for this relatively simple standard methodology because our objective is to obtain estimates of potential output:

- Over a relatively long period of time, 1950-2002.
- Using a methodology that makes comparisons between countries possible.

1. Estimating trends

We present for each country, estimates of trend GDP based on the Hodrick-Prescott filter, a popular methodology, used by many institutions such as the OECD. The Hodrick-Prescott (1997) methodology is a smoothing method that is widely used among macroeconomists to obtain an estimate of the long-term trend component of a series. The method was first used in a working paper (circulated in the early 1980's and published in 1997) by Hodrick and Prescott to analyse post-war U.S. business cycles.

Technically, the Hodrick-Prescott (HP) filter is a two-sided linear filter that computes smoothed series by minimizing its variance, subject to a penalty that constrains the second difference. In formal terms, the HP filter of a series x_t is a series x_t^{HP} resulting from the optimization of the following expression:

$$(1)\, Min \quad \sum_{t=1}^{T} (x_t - x_t{}^{HP})^2 \quad + \quad l \sum_{t=2}^{T-1} \left[(x_{t+1}{}^{HP} - x_t{}^{HP}) - (x_t{}^{HP} - x_{t-1}{}^{HP}) \right]^2$$

Where l is the smoothing parameter, which penalizes changes in x_t^{HP}. Changing this parameter affect how responsive potential output is to movements in actual output. As the smoothing factor approaches infinity, the loss function is minimised by penalising changes in potential growth, which is done by making potential output growth constant (i.e. a linear trend growth rate). As the smoothing factor approaches zero, the loss function is minimised by eliminating the difference between actual and potential output, which is done by making potential output equal to actual output.

The advantage of the Hodrick-Prescott filter is that it renders the output gap stationary over a wide range of smoothing values and it allows the trend to change over time. But it also has the disadvantage that the selection of the smoothing weight is arbitrary and that this matters to the estimate (De Brouwer, 1998).

A problem common to most estimates of potential output is that they change as new data observations come to hand. This also happens to the Hodrick- Prescott filter since it contains leads and lags of output in the loss function. The end-point problem implies that estimates of the gap at the end of the sample may be subject to substantial revision as new data come to hand, the period which is of most interest to policy makers (De Brouwer, 1998, Ffrench-Davis and Tapia, 2002).

It is seen that, while filtering strongly affects autocorrelations, it has little effect on cross correlations. It is argued that the criticism that HP filtering induces a spurious cycle in the series is unwarranted. The filter, however, presents two serious drawbacks: First, poor performance at the end periods, due to the size of the revisions in preliminary estimators, and, second, the amount of noise in the cyclical signal, which seriously disturbs its interpretation.

2. Estimating production functions

2.1 Some methodological problems

The basic framework to estimate a production function is the typical Cobb-Douglas function with capital and labor as factors and constant returns to scale (see equation (2)). However, even under this simplified model, estimating production functions for countries is not straightforward. There are at least two significant empirical problems, caused by the limited availability of the necessary information to develop accurate estimations and the and the inflexibility of traditional empirical approaches.

(2) $Y = AK_t^a L_t^{1-a}$

2.1.1. Lack of relevant information

The relevant information to calculate potential output from equation (2) is frequently more than the available figures. Specially, if there is high under-utilization of factors. Indeed, by definition, a production function is an efficient technical relationship between the level of output and the quantity of inputs to produce it. This means that observations of inefficient relationships, with idle capacity and underused inputs, are not part of the production function. Since in our sample of Latin American countries it is common to face an environment of high real volatility and high unemployment of factors, this shortcoming is very relevant.

In order to deal with this problem the usual strategy consists of an estimate of the parameters of a productive function with the actual GDP in the left side of the equation, and with the used inputs in the right side of the equation. Equation (3), derived from equation (2), shows this step, where small caps denote the use of natural logarithms and the supra-index ***e*** means employed. The error term is represented by e . Then, the potential GDP (y^*) is given by a projection of the output using the inputs at their potential level (k^* and l^*) and the estimated parameters from equation (3): $\hat{a}$ and $\hat{a}$.

(3) $y_t = a + ak_t^e + (1-a)l_t^e + e_t$

(4) $y_t^* = \hat{a} + \hat{a}k_t^* + (1-\hat{a})l_t^*$

However, this strategy imposes the problem of estimating k_t^e for equation (3) and then the problem of estimating l_t^* for equation (4). In the case of k_t^e, there is little availability of information about its evolution since in most countries there are not surveys about the use of physical capacity. A common assumption to deal with this problem is to use the so-called Okun-Law, which establishes a direct relationship between the use of labor and capital. While this approach is useful to "clean" estimates of TFP from under-utilization of factors, it may create a bias in cases of asymmetric supply shocks, changes in technology or relative factor prices.

In the case of l_t^*, it is difficult to determine the level of full use of employment (or supplementary, the natural rate of unemployment), because it is a non-observed variable. One interesting approach is to calculate the NAIRU, linking the concept of natural rate of unemployment with the price stability, but this requires information-consuming and rather complicated procedures.

In our case, the problem of data availability is particularly severe because in our sample even labor unemployment rates are not reliable indicators. Indeed, the level of effective employment (L) is frequently estimated from unemployment rates (U) and labor force (LF) estimates; that is to say $L = U \cdot LF$. For unemployment rates, in most Latin American countries there have been a number of methodological changes, which challenge the comparability through the sample. In addition, the coverage of the figures is heterogeneous: in some cases, statistics include only urban areas, or main cities or the capital city; consequently, unemployment rates are not necessarily representative of the aggregate (under) use of labor. Finally, informal sectors are huge in the region (around 45% of the urban employment, according to ILO estimates for 2001), which tends to bias the measurement of productive employment.

Regarding labor force figures, it should be recalled that these depend on participation rates, which are highly sensitive to the business cycle.

2.1.2. Fixed parameters

A second problem in empirical work on potential output arises because the basic framework to estimate production functions assumes that there is one fixed function, with constant parameters. That assumption can be realistic in the short-run but is rather "heroic" in the long-run. In our case, the sample includes 53 years of history, which is a very long period, and a period including important economic and technological changes. As a result, the use of a constant production function is a serious constraint.

The traditional approach assumes that technological changes are embedded in the total factor productivity. Although this interpretation can be intuitive and is widely accepted, it imposes serious problems in estimating potential output. On the one hand, TPF estimates are residual in nature; therefore they are essentially a measure of what we do not know about the evolution of real output (our ignorance). Consequently, any mistake in the estimation of the production function (omitted factors, functional form, etc.) is "cleaned" by the existence of the TFP factor. Naturally, the reliability of using this component is limited. In addition, since we do not know they nature it is impossible to project their future behavior. On the other hand, it is very difficult to separate the components of the TFP between transitory (i.e. the business cycle, which is not relevant for the production function) and permanent (technological changes, relevant in the estimation of the production function).

2.2. A standard approach

In order to deal with the mentioned typical empirical difficulties, we use a very simple methodology based on: first, the introduction of structural change variables in order to account for technological changes, and second, a depuration of the sample, by excluding observation that are not part of the production function.

2.2.1. Including structural change

In order to estimate (2) we restricted the model in equation (5), with the (log of) output per worker and the (log of) stock of capital per worker represented by $yl_t = y_t - l_t$ and $kl_t = k_t - l_t$, respectively. Our hypothesis is that the parameter a is not fixed but variable. In this exercise, we assume that the technological change depends on the composition of global output, as shown by equation (6), where g_t^i is the share of the value-added of the sector $i \in I$ (set of productive sectors, in our case agriculture, mining, manufactures and services) in total output.

$$(5) \quad yl_t = a + a_t kl_t + e_t$$

$$(6) \quad a_t = b_0 + \sum_I b^i g_t^i ,$$

replacing (6) in (5) yields the equation (7)

$$(7) \quad yl_t = a + b_0 (kl_t) + \sum_I b^i g_t^i (kl_t) + e_t$$

Since the composition of total output can also be sensitive to the business cycle, we used smoothed series of sectoral shares (for simplicity we used the HP filter, ë=1000, in spite of its shortcomings) in order to avoid endogeneity in the estimation of equation (7).

2.2.2. The elimination process

To estimate (7) we must correct for the underutilization of factors. Here, we use the fact that observations with idle capacity are not on the production function. Then we eliminate some of the observations to get closer to the concept of productive frontier. Using this procedure, we estimate (8), an equation that takes into account only fully used inputs and output located on the productive frontier.

$$(8) \quad yl_t^* = a + b_0 (kl_t^*) + \sum_I b^i g_t^i (kl_t^*) + e_t$$

The elimination of observations is a process that can be developed in a number of ways. The process is equivalent to the selection of economic peaks and the elimination of the rest of the points. Then the question is how to select the peaks. One approach in cases of good information is to use a set of criteria (unemployment rates, external deficit, inflation rate, etc.) in order to choose the points of higher use of capacity. In our sample, this kind of procedure is to risky since we do not have reliable and comparable information.

As in Ffrench-Davis (2003), we eliminated observations based on a automatic procedure: first step is estimation of our model (8), using as a criterion the observations where $e_t < 0$. Then we need information about potential use of inputs. In the case of physical capital, we use updated estimates of Hofman (2000). In the case of labor, we assume that full employment is equivalent to the level of the labor force, $L^* = LF$, measured according demographic principles by the Latin American Center of Demography of ECLAC, which ensures comparability across the sample.

The chosen method to eliminate observations can play a key role in final results and, consequently should be selected carefully. Moreover, there is a technical trade-off that we should keep in mind: while the quality of the sample improves (in the sense that we are eliminating observations that do not belong to the productive frontier), the degrees of freedom diminish. Since we are working with a small sample (53 observations), the latter problem can be serious.

The main advantage of the criterion used here is its simplicity and its automatic character. The main disadvantage is that this method assumes that all non-eliminated observations are in the production function, which is a gross simplification. Thus, if some the remaining observations are significantly below the production function, then there will be an underestimation of the output gap.

III. Results

In the Annex to this paper we will present the graphs for each country specifically with a short description of the results. It is important to indicate that, although our objective is to present a common methodology, potential output estimation needs analysis on a country-by-country basis to avoid a to mechanical estimation procedure. This is especially the case in Latin America where data are relatively weak and output is volatile.

The results between the two techniques are, as expected, quite different. The smoothing technique of the Hodrick-Prescott filter produces very small output gaps over the longer cycle, although at the end of the cycle (2002) bigger output differences can be noted. In the production function approach, using the Cobb-Douglas, shows much higher levels of under utilization of production factors and the resulting output gap.

Here it is difficult to distinguish between the two effects applied. The first effect, correction for underutilization of factors, results from the eliminating of observations of the production frontier in a way similar to estimation of a production function on the basis of peaks. The second effect, using the composition of global output, distinguishing between agriculture, mining, manufactures and services, assumes that the technological changes are related to the structural changes that can be observed in the Latin American economies.

Tables 1 and 2 present the results with the Hodrick-Prescott filter and from our production function approach. Table 1 based upon the application of the Hodrick-Prescott filter shows very small output gaps for the 1950-2002 period. For the whole period the average is cero and for the year 2002 a gap of 2.5% is estimated.

Table 1

LATIN AMERICA: OUTPUT GAPS FROM TREND GDP

(percentage of trend GDP)

	1950-72	1973-80	1981-89	1990-2002	1950-2002	2002
Argentina	0.1	-2.2	1.4	-0.7	-0.2	10.8
Bolivia	0.4	-3.6	2.9	-0.9	-0.1	1.3
Brazil	0.8	-4.1	0.2	0.8	-0.1	-0.2
Chile	-0.7	0.6	2.2	-1.4	-0.2	3.6
Colombia	0.2	-1.6	1.1	-0.4	0.0	2.0
Costa Rica	0.3	-3.5	2.6	-0.3	-0.1	3.0
Mexico	0.2	-0.2	-0.2	-0.4	-0.1	0.7
Peru	0.2	-0.9	-2.6	1.5	-0.1	0.3
Venezuela	0.3	-3.2	2.9	-2.0	-0.3	1.2
Latin America (9)	**0.4**	**-2.0**	**0.5**	**0.2**	**0.0**	**2.7**
Simple average	**0.2**	**-2.1**	**1.2**	**-0.4**	**-0.1**	**2.5**

Source: Authors' calculations using HP filter (100).

The results are different for output estimated on the basis of the production function approach. Here an average gap of 3.5% is estimated for Latin America as a whole in the 1950-2002 period. In 2002 the output is estimated between 6 and 7% depending on the application of a weighted or simple average, see Table 2.

Table 2

LATIN AMERICA: OUTPUT GAPS FROM POTENTIAL GDP

(percentage of potential GDP)

	1950-72	1973-80	1981-89	1990-2002	1950-2002	2002
Argentina	3.1	-1.6	8.2	6.0	4.0	14.3
Bolivia	3.0	0.2	10.4	1.4	3.5	0.9
Brazil	4.4	-1.0	5.0	1.9	3.1	-2.3
Chile	1.5	7.5	8.7	2.2	3.8	4.3
Colombia	1.8	0.5	4.7	3.1	2.4	10.2
Costa Rica	3.1	-0.8	12.7	5.3	4.7	0.4
Mexico	4.2	3.3	3.2	1.9	3.4	8.6
Peru	2.7	0.8	4.8	6.1	3.6	3.7
Venezuela	1.7	0.5	7.4	5.6	3.5	23.6
Latin America (9)	**3.6**	**0.8**	**5.2**	**3.0**	**3.3**	**6.2**
Simple average	**2.8**	**1.1**	**7.2**	**3.7**	**3.5**	**7.1**

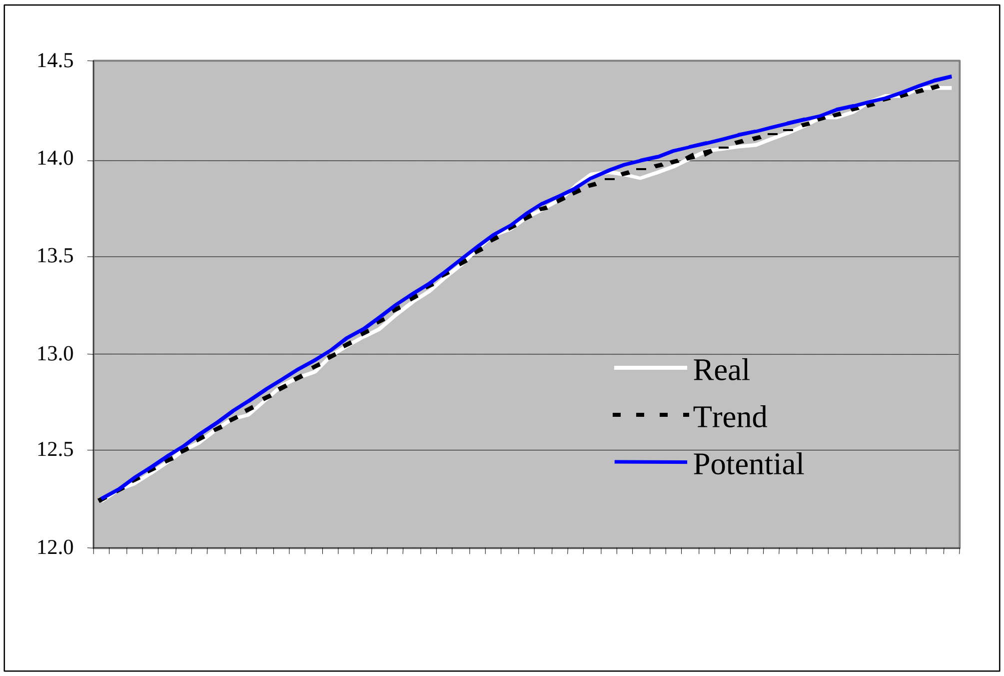
Source: Authors' calculations.

Graph 2 shows the 1950-2002 estimates of real, trend and potential GDP for the Latin America aggregate. The difference between the statistical detrending technique and the production function approach is clear. Trend GDP follows very closely real GDP. Output gaps with respect to potential GDP can be observed, as expected especially in the 1980s. In 2002 the graph shows an output gap of 2.5%.

Graph 2

LATIN AMERICA: REAL, TREND AND POTENTIAL GDP, 1950-2002

(log scale)



All our results must be taken with caution, especially in particular points in time. This paper is a first attempt to obtain estimates of potential output in Latin America for long period using the same method for each country. We are conscious that additional research on the particular features of each country can improve the quality and reliability of the results.

IV. Conclusions

Potential output estimates are an increasingly important element in economic policy decisions as well as for economic projections purposes. In this paper two methods, of the whole array of potential output measures available, have been used to make estimates of potential output in Latin America. We have used the standard Hodrick-Prescott filter to make a first estimate of potential output. Second, within the production function approach we have made a modified estimation in which sectoral approach and a new way of approaching the production frontier are used.

Our results indicate that the Hodrick- Prescott filter stays very close to the real output and may underestimate the potential output. The end of cycle bias of this filter limits its use for projection purposes. The standard production function approach identified in this paper is only a first step in the direction of more complete potential output estimates in Latin America in a comparative perspective. Building on the efforts of some Latin American countries in applying potential output estimates systematically in their policy analysis and the work done at ECLAC (CEPAL, 2002 and Escaith, 2003) this paper attempts to make a first contribution to the objective of offering alternative methods of potential output estimation for the Latin America countries.

The difference of around 3 to 4 percentage points between the Hodrick Prescott filter and the production function approach applied in this paper are a clear indication of the different results both methods generate. At the end-year of analysis in 2002, the Hodrick Prescott filter estimates an output gap of somewhat over 2 percent of GDP while the production function approach comes to an estimate of between 6 and 7 %. For future research it would be important to see what other techniques could be applied and to evaluate their usefulness in the case of Latin America. Our future research will be oriented towards the identification of the needs in the Latin American countries with respect to this kind of research.

References

CEPAL (2002), *Globalización y desarrollo,* LC/G.2157(SES.29/3), Santiago de Chile, april.

Cerra, Valerie and Sweta Chaman Saxena (2000), 'Alternative Methods of Estimating Potential Output and the Output Gap - An Application to Sweden', *IMF Working Paper*, No. 00/59, European I Department, March.

De Brouwer, Gordon (1988), 'Estimating Output Gaps', *Research Discussion Paper*, No.9809, Economic Research Department, Reserve Bank of Australia, August.

De Masi, Paula R. (1997), 'IMF Estimates of Potential Output: Theory and Practice', *IMF Working Paper*, No. 97/177, Research Department, December.

Escaith, Hubert (2003), Estudios estadísticos y prospectivos N°23, *Tendencias y extrapolación en América Latina y el Caribe*, noviembre.

Ffrench-Davis, Ricardo (2003), Entre el neoliberalismo y el crecimiento con equidad: tres décadas de política económica en Chile, Tercera Edición, J.C. Sáez Editor, Santiago.

Ffrench-Davis, Ricardo and Heriberto Tapia (2002), "Nota sobre la estimación del PIB potencial del Ministerio de Hacienda, mimeo CEPAL", agosto.

Hodrick, R. and E. Prescott (1997), 'Post-War US Business Cycles: An Empirical Investigation', *Journal of Money, Credit and Banking*, 29 (1).

Hofman, André A. (2001), 'Long-run economic development in Latin America in a comparative perspective: Proximate and ultimate causes', *Serie macroeconomía de desarrollo No.8*, Economic Development Division, ECLAC, Santiago.

Hofman, André A. (2000), *The Economic Development of Latin America in the Twentieth Century*, Edward Elgar, Aldershot.

Kaiser, Regina and Agustín Maravall (1999), 'Estimation of the Business Cycle: a Modified Hodrick-Prescott Filter', *Spanish Economic Review*, No.1(2).

Maddison, Angus (1991), Dynamic Forces in Capitalist Development – A Long-run Comparative View, OUP, Oxford.

Marfán, Manuel and Patricio Artiagoitía (1989), 'Estimación del PGB potencial, Chile 1960-1988', Colección estudios CIEPLAN, No.27, Diciembre, Santiago.

Meloni, Osvaldo (1999), "Crecimiento Potencial y Productividad en la Argentina, 1980-1997", Ministerio de Economía y Obras y Servicios Públicos, Secretaría de Programación Económica y Regional, Argentina.

Morandé, Felipe G. and Rodrigo Vergara (eds.) (1997*), Análisis empírico del crecimiento en Chile,* Centro de Estudios Públicos / Programa de Postgrado en Economía ILADES/Georgetown University, Santiago.

Phillips, A.W. (1958), 'The relation between unemployment and the rate of change in money wage rates in the United Kingdom, 1862-1957', *Economica*, No.25(100).

Smith, Adam (1776), *An Inquiry into the Nature and Causes of the Wealth of Nations*, edited by Edwin Cannan, 1994 Modern Library Edition, New York.

Annexes

A1. Country cases

Introduction

In this annex we present the results with respect to the Hodrick-Prescott filter and the production function approach. For each of the countries a graph with the estimate of real GDP, potential GDP and the Hodrick-Prescott filter estimate is presented and we also give a short description of the cycle of each country compared with the output gap resulting from both methodologies.

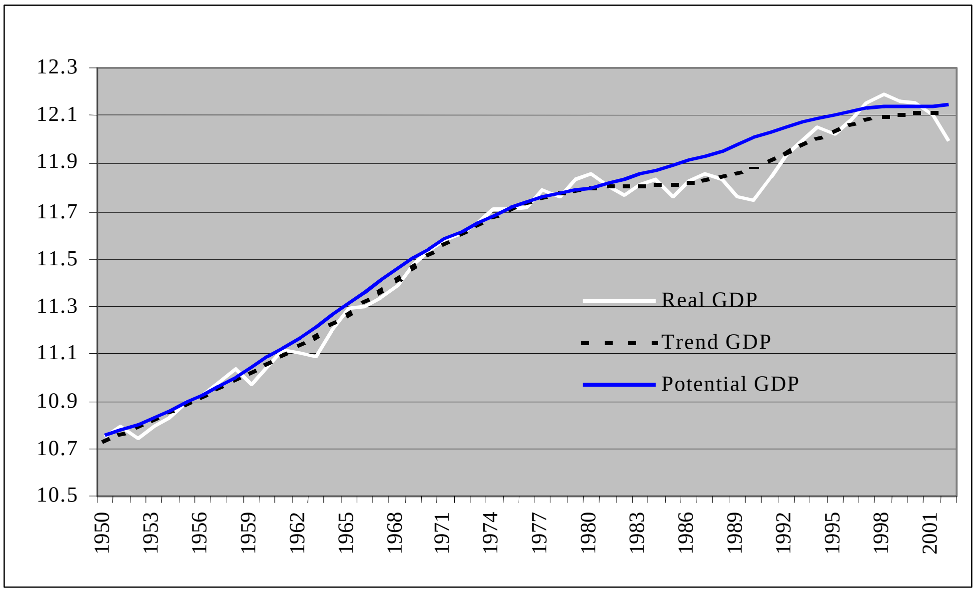
Argentina

In our sample Argentina is one of the countries with the lowest overall growth rates, the 1950-2002 GDP growth rate amounted to 2.4%. Growth was relatively smooth from 1950 to the middle seventies, since then growth has been erratic and on average very slow. Especially the 1980-1990 period has been very bad with a negative growth rate. In terms of potential growth the Hodrick Prescott filter shows some overheating at the end of the 70s and 90s. Potential output stagnates at the end of the 90s. The average output gap for the 1950-2002 period, using the production function approach was 4% of GDP. In 2002 the output gap was 14.3% as a result of the severe economic crisis.

Graph A1

ARGENTINA: REAL, TREND AND POTENTIAL GDP, 1950-2002

(log scale)



Source: Author's data base.

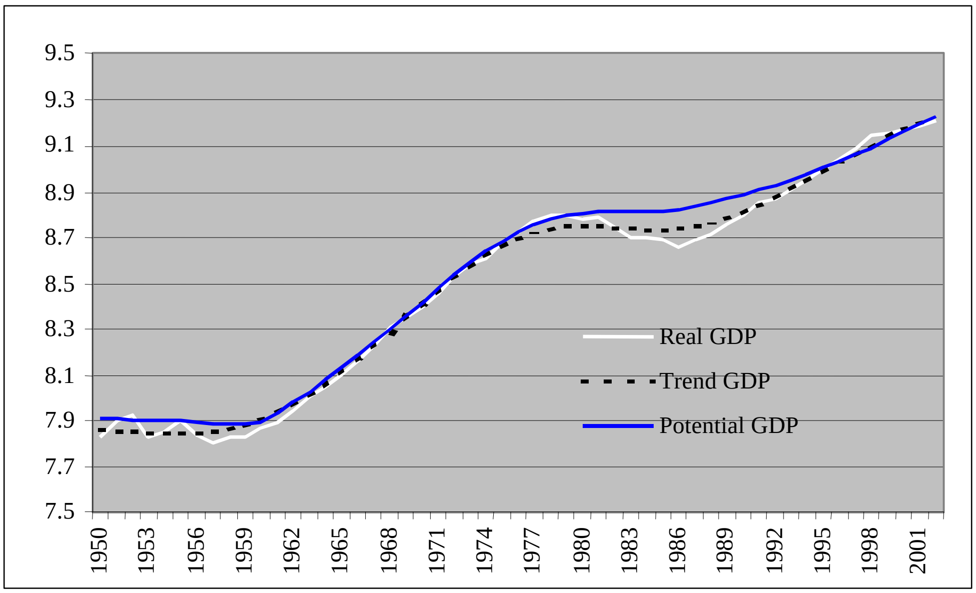
Bolivia

Bolivia growth experience in the post-war period is rather singular. From 1950 to the early 1960s the country stagnated but then started to grow, Bolivia's expansion came to an end at the end of the 1970s and the country experienced a very severe recession until the mid 80s. Bolivia suffered exteme economic instability in the mid 1980s – including an episode of hiperinflation in 1985 – but the economy started to recuperate in the 1990s. Economic growth has been reasonably strong since then and from the middle 1990s potential output, the Hodrick Prescott filter and real output grow simultaneously.. The average output gap for the 1950-2002 period, using the production function approach was 3.5% of GDP (with the Hodrick Prescott filter –0.1%).

Graph A2

BOLIVIA: REAL, TREND AND POTENTIAL GDP, 1950-2002

(log scale)



Source: Author's data base.

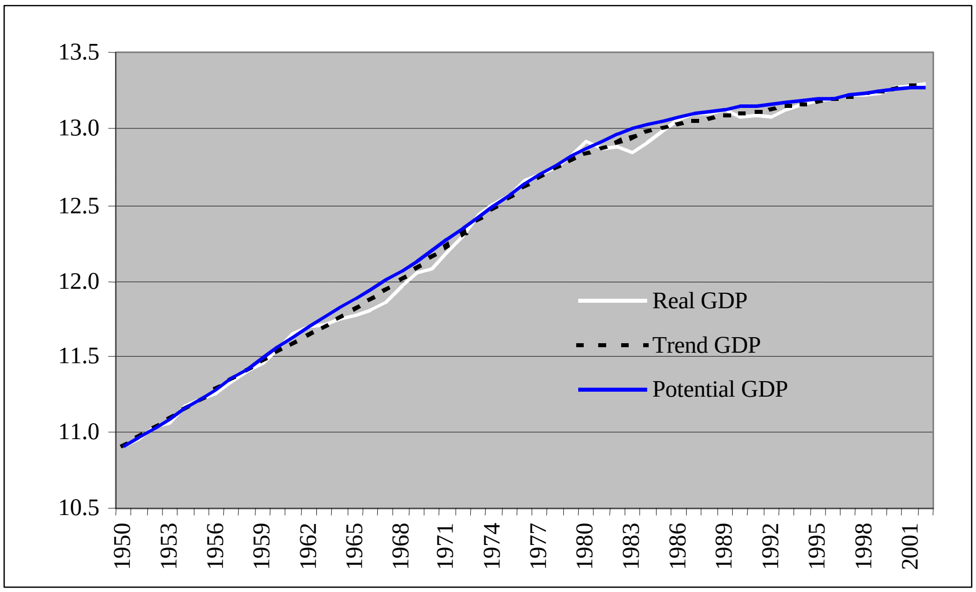
Brazil

Brazil experienced very fast growth from the early 50s until the beginnings of the 1980s. The potential output measure shows overheating of the brazilian economy in almost the whole 1970s and also in the case of the Hodrick Prescott filter real GDP is above the curve. The results for Brazil are somewhat surprising. For future research this result has to be analysed in detail as it does not seem reazonable to have such a long period of real growth above the potential frontier. From 1980 onwards the brazilian economy entered on a slower growth pace experiencing also two recessions. The average output gap for the 1950-2002 period, using the production function approach was 3.1% of GDP.

Graph A3

BRAZIL: REAL, TREND AND POTENTIAL GDP, 1950-2002

(log scale)



Source: Author’s data base.

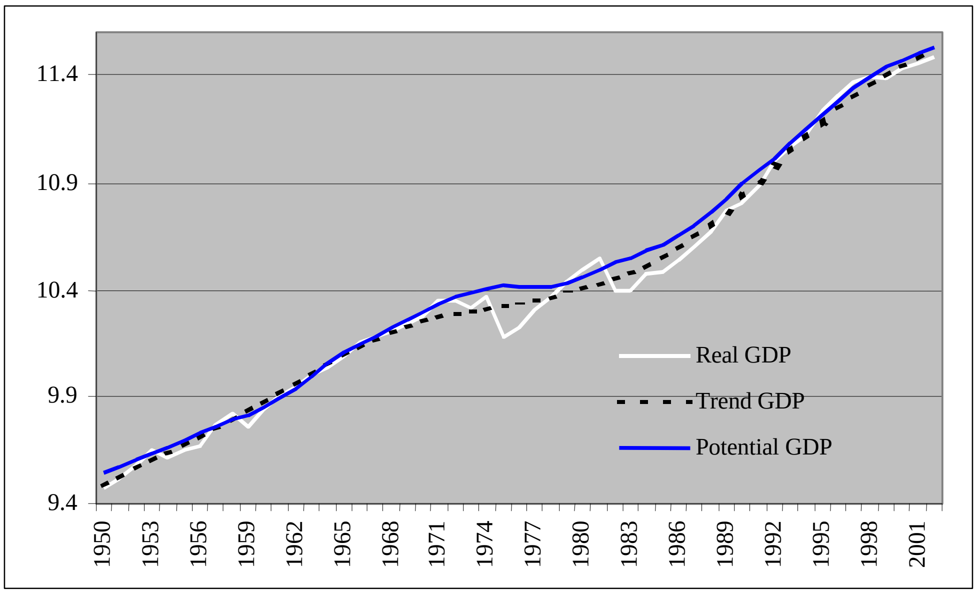
Chile

Chile is the country with one of the longest period of implementation of reforms. From 1975 onwards, after the military coup of 1973, a vast reform program was implemented. Chile experienced at the beginning of the 1980s a very deep crisis. The crisis period from 1970 to 1984 is rather long and the period of 1976 to 1981 was characterised by rather strong economic growth but overall growth in 1970-1984 is low (1.4%). From 1984 onwards the Chilean economy started growing rapidly and in 1987 the former peak level was reached. Average annual economic growth of the Chilean economy in the post-war period (1950-2002) was close to 4%. It is interesting to note that exactly the same annual growth was found in the 1950-1970 and the 1970-2002 subperiods. Potential output shows a similar pace until the mid 1980s in Chile and afterwards potential output accelerated rather sharply. The average output gap for the 1950-2002 period, using the production function approach was 3.8% of GDP.

Graph A4

CHILE: REAL, TREND AND POTENTIAL GDP, 1950-2002

(log scale)

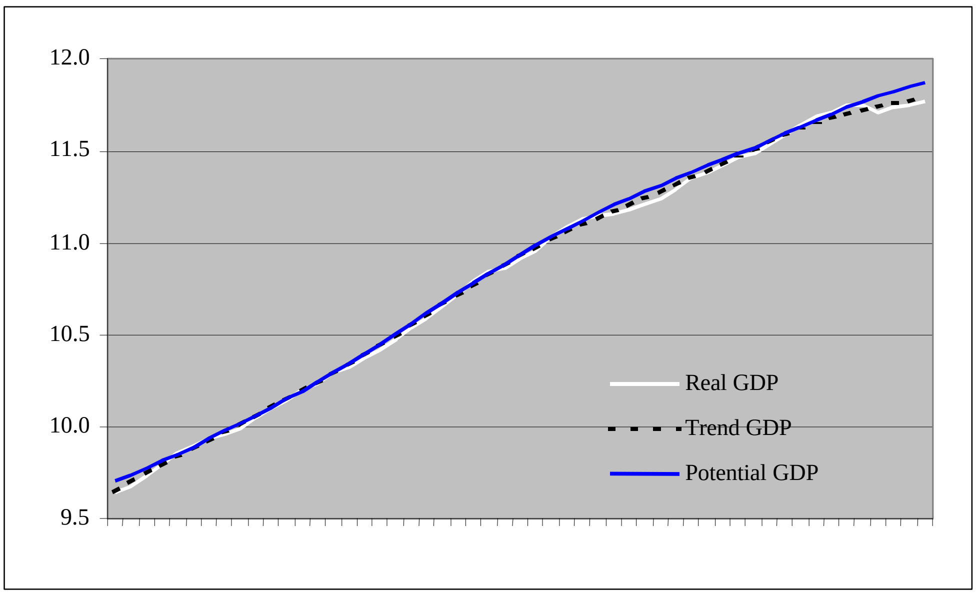


Source: Author's data base.

Colombia

In Colombia real growth is almost more stable then potential growth as becomes clear from Graph A5. Only at the end of the 20th century growth stated faltering and the country entered in recession for the first time since the 1930s. Colombia has been historically the Latin America country with the smoothest growth path, without violent crisis, as becomes also clear from Graph 5. The benchmarks elected were 1980 and 1986, resulting in base period of 1950-1980, a "crisis period" from 1980-1986 and a growth period of 1986-1998. Graphical inspection shows no fall in total GDP for the whole 1950-1998 period and therefore no recovery period was identified (as a matter of fact the last fall in Colombia's total GDP occurred in 1931). The average output gap for the 1950-2002 period, using the production function approach was 2.4% of GDP.

Graph A5
COLOMBIA: REAL, TREND AND POTENTIAL GDP, 1950-2002
(log scale)



Source: Author's data base.

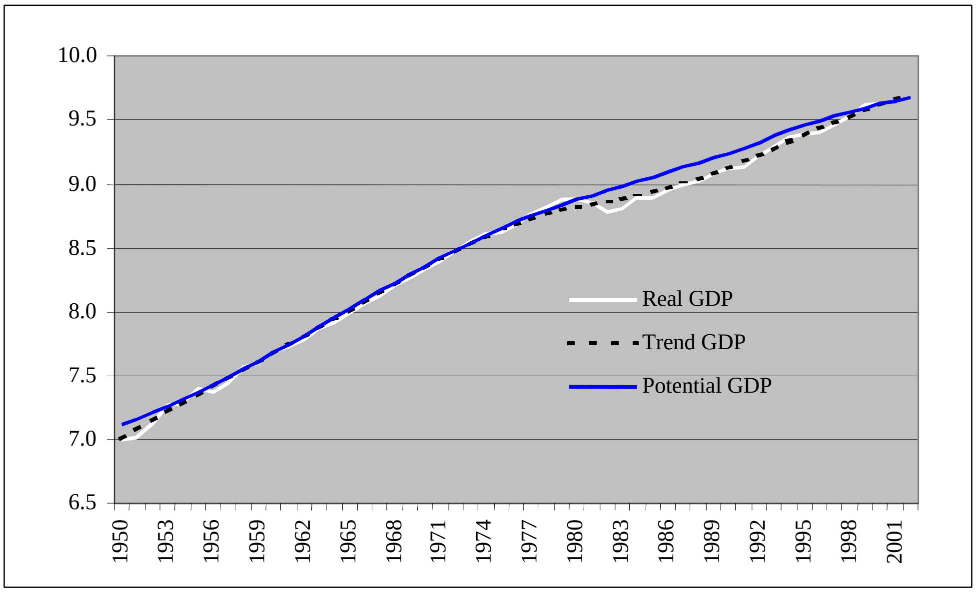
Costa Rica

After some ups and downs in the early 1950s Costa Rica presents a stable growth rate until the 1980s, a recession at the beginning of the 1980s and a recuperation with somewhat unstable growth afterwards at the end of the 1990s our measures of potential output coincide largely with the movement of real outcome. The average output gap for the 1950-2002 period, using the production function approach was a surprisingly high, the highest overal gap of all the countries of our sample, 4.7% of GDP.

Graph A6

COSTA RICA: REAL, TREND AND POTENTIAL GDP, 1950-2002

(log scale)



Source: Author's data base.

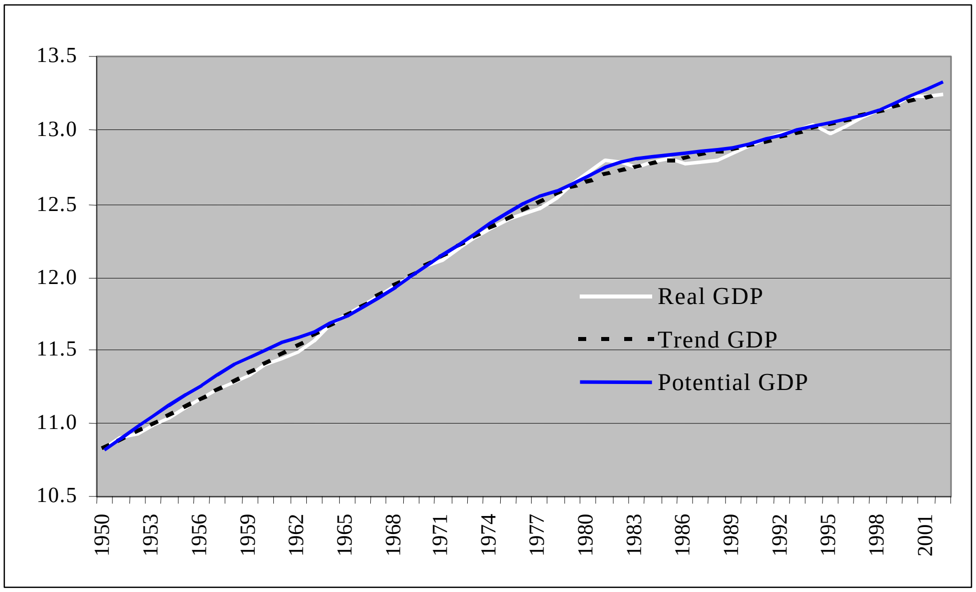
Mexico

As can be observed from Graph A7 the period from 1950-1980 was one of very stable growth in Mexico, as has been extensively documented. However, at the beginning of the 1980s Mexico was not able to meet its international financial obligations and this marked the beginning of one of the worst international financial crisis since the “Great Depression” of the 1930s. From 1986 onwards a new growth period started and in 1989 the previous peak level was reached. The average output gap for the 1950-2002 period, using the production function approach was 3.4% of GDP.

Graph A7

MEXICO: REAL, TREND AND POTENTIAL GDP, 1950-2002

(log scale)

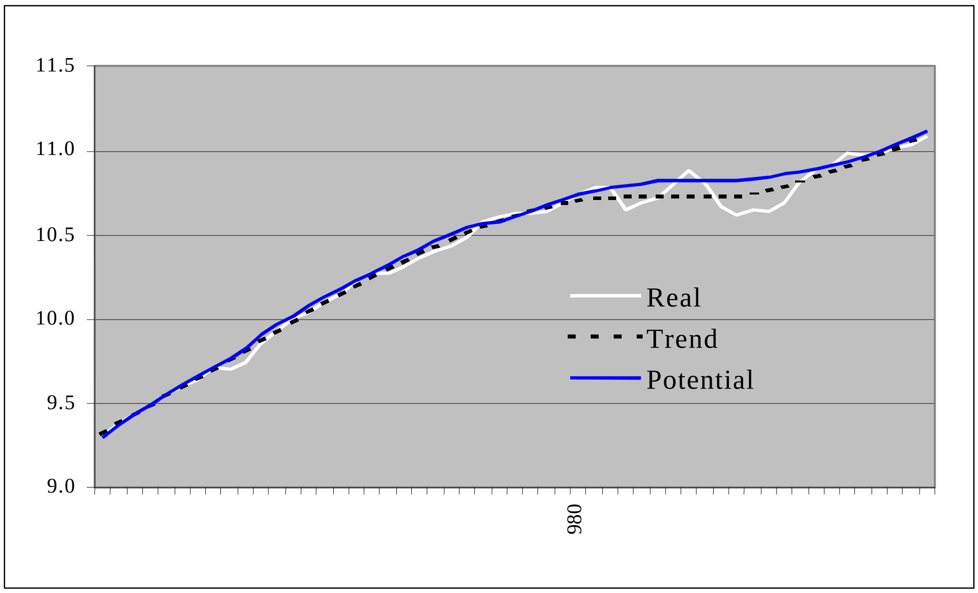


Source: Author’s data base.

Peru

The growth path of Peru was relatively stable, with an exeption at the end of the 1950s, until well into the decade of the 1970s and after a slowdown in the middle 70s the country reached its peak GDP per capita in 1981. Since than growth has been unstable and slow and GDP per capita did not yet recover the peak level of 1981. The country experienced a very severe crisis in 1983 and another one at the end of the 1980s, with output falling from 1988-1990. The average output gap for the 1950-2002 period, using the production function approach was 3.6% of GDP.

Graph A8
PERU: REAL, TREND AND POTENTIAL GDP, 1950-2002
(log scale)

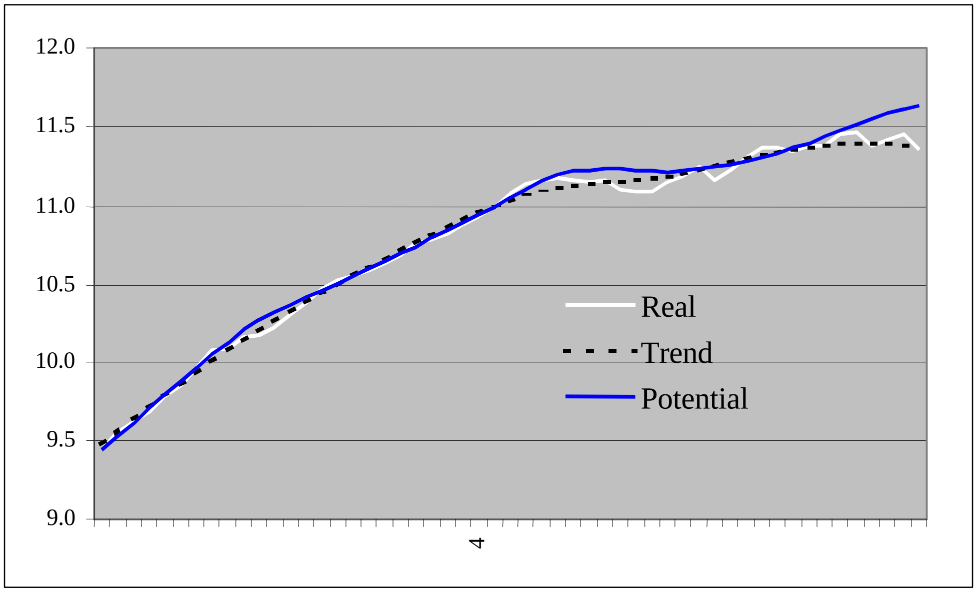


Source: Author's data base.

Venezuela

Graph A9 shows that Venezuela experienced rapid growth until the mid 1970s. However, since then, growth has been slow and volatile and the country has experienced a series of severe crises. Per capita GDP in 2002 is more the 30% below the level of the peak year 1977. The average output gap for the 1950-2002 period, using the production function approach was 3.5% of GDP. The big output gap in 2002 was the result of, as in the case of Argentina, several years of very severe economic crisis.

Graph A9
VENEZUELA: REAL, TREND AND POTENTIAL GDP, 1950-2005
(log scale)



Source: Author's data base.

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