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Statistical Versus Economic Output Gap Measures: Evidence from Mongolia

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Abstract

This paper compares the output gap estimates based on a number of different methods. We take advantage of the unique properties of the Mongolian economy in order to evaluate the different approaches. We find that an economic measure derived from a Blanchard and Quah-type joint model of output and inflation provides a more robust estimate of the output gap than the traditional statistical decompositions.

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I. Introduction

The output gap is a key concept in assessing the economic situation and designing appropriate macroeconomic policies. A positive output gap indicates that aggregate demand exceeds aggregate supply while a negative output gap is associated with recession. Measuring the output gap is not straightforward as it is not directly observed. Furthermore, concerns over data quality and availability complicate the task.

The purpose of this article is to compare different output gap measures and assess their suitability for policymaking. For any economy, a good output gap measure should have good end-point properties and be stable, i.e., it should adequately characterize the current state of the economy and the assessment should not change substantially as new data becomes available. Furthermore, structural changes that are outside policymakers' control should be excluded from output gap measures. In this article we will take advantage of the unique properties of the economy of Mongolia to examine the performance of different output gap measures on these fronts.

Mongolia differs from most other economies in the importance of mineral production in the economy, with mining accounting for about 90 percent of exports, a quarter of government revenue and about a sixth of GDP. Variations in mineral production are outside policymakers' control and are best thought of as affecting potential GDP. Therefore, we will measure the output gap both for overall GDP and nonmineral GDP, i.e., excluding mineral GDP. As movements in mineral GDP should appropriately be captured in the trend and not the cyclical component, a good output gap measure should yield similar results for both GDP measures and we will use this as an additional criterion in evaluating output gap measures for Mongolia.[2]

We compare three commonly used statistical output gap measures: linear detrending; the Hodrick-Prescott (1997) filter with different smoothing parameters; and an asymmetric frequency filter, the Christiano Fitzgerald (2003) filter; with an economic measure: a bivariate Blanchard-Quah decomposition using long-run economic restrictions based on the relationship between inflation and real GDP for Mongolia.[3]

After describing the data, we present the different output gap measures in sections III and IV for overall GDP, while in section V we compare them with the same output gap measures applied to nonmineral GDP. Section VI concludes.

II. Data

Our analysis focuses on quarterly Mongolian real GDP data for 1998Q1 until 2010Q3. The sample is very short compared to the length of time series normally used but it is the longest available time series for Mongolia.[4] It is likely to cover only around three to four business cycles, making the use of more sophisticated methods infeasible.

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[2] The importance of measuring separately the output gap for the natural resource and non-natural resource sectors for commodity exporters is discussed, e.g., in Villafuerte, Lopez-Murphy, and Ossowski (2010) and Magud and Medina (2011). Villafuerte et al. use the non-resource output gap to assess the cyclicality in fiscal policy in nonrenewable resource exporters in Latin America and the Caribbean. Magud and Medina analyze the differences in potential output in the natural-resource (mining, agriculture, and fishing) and non-natural-resource sectors in Chile and the nonlinear contributions to potential growth of the sectors.

[3] For low-income countries and emerging market economies the empirical and policy-oriented literature commonly resort to either the Hodrick-Prescott filter, e.g., Ochirkhuu (2010) for Papua New Guinea; or a battery of output gap measures, e.g., Medina (2010) for Peru; Magud and Medina (2011) for Chile, Faal (2005) for Mexico, and El-Ganainy and Weber (2010) for Armenia.

[4] Real GDP growth has increased sharply after 2010 driven mainly by massive investments to develop a large new mine, resulting in 2012 real GDP being a third higher than 2010 real GDP. Furthermore, the National Statistical Office of Mongolia has revised its methodology to measure quarterly GDP after 2010 Q3 and has also released retroactive revisions back to 2000. Our sample period hence leaves out the large structural changes since 2011 and relies on the old measurements of quarterly GDP with two more years of data.

Figure 1 presents the seasonally adjusted data for real GDP and nonmineral real GDP.[5] Mining plays an important role in the Mongolian economy. However, as mining in Mongolia is very capital- but not labor-intensive and the minerals extracted are almost exclusively exported, the impact on aggregate domestic demand is quite limited. Therefore, we are interested in the differences in the output gaps found by the various measures when applied to total GDP versus nonmineral GDP. A proper output gap measure should be similar for the two data series since the output gap should exclude structural movements. We begin the analysis focusing on total real GDP and then in Section V we compare the results from the different filters for total versus nonmineral real GDP.

III. Univariate Output Gap Measures

A. Linear trend

As a first statistical method to measure the output gap, we estimate the output gap as the deviations of the series from a simple linear trend.[6] The estimated output gap is presented in Figure 2. Based on this method, the output gap appears to be positive at the beginning and ending of the sample and negative over most of the 2001-2006 period.

B. Hodrick and Prescott (HP) filter

The Hodrick and Prescott (1997) filter is probably the most commonly used method to decompose a GDP series into trend and cycle. This filter is a two-sided smoothing method that minimizes both the fluctuations of the cycle and the trend. The filter is conditional on a smoothing parameter, lambda, where the higher the lambda, the smoother the trend. For quarterly data, the standard value for lambda is 1600 based on US GDP data. However, this

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[5] We use the X12-Arima procedure (U. S. Census Bureau) to seasonally adjust the data.

[6] We also tested for structural breaks by applying the Quandt-Andrews unknown breakpoint test to the mean of real GDP but we are unable to reject the null hypothesis that there are no structural breaks.

might not be an appropriate parameter value for developing countries where the trend might be much less smooth (and therefore require a smaller lambda, see discussion in Canova, 1998). The remainder of this analysis will use the HP filter with a smoothing parameter of 40, which appears more appropriate for a developing country.

The advantage of the HP filter is that it is an easy method and widely used. The downsides are the end-sample bias, which calls into question its suitability for forward-looking policy decisions, and the sensitivity to the choice of the smoothing parameter. Furthermore, as discussed in Cogley and Nason (1995), the HP filter can generate spurious cycles when applied to persistent data.

C. Christiano Fitzgerald frequency filter

Band pass filters are designed to eliminate high and low frequency movements in the data using a two-sided symmetric moving average. A two-sided symmetric filter is not appropriate for policy analysis, which is mainly focused on assessing the current state of the economy. Christiano and Fitzgerald (2003) construct a filter that is nonstationary, asymmetric, and depends on the time series properties of the underlying data. Their filter is an approximation to the ideal band pass filter, which is optimal when the underlying raw data follow a random walk.[7] This output gap measure is appealing because it suggests a smaller number of cycles than the HP filter and this appears economically more plausible.

D. Comparison of statistical filters

The most striking difference between the output gaps measured by the different filters is that very few periods are consistently assessed as positive or negative (Figure 2). Only the boom-

[7] Murray (2003), however, shows that similar to HP filters, band pass filters in general may not properly isolate the cycle when applied to series with an integrated trend.

bust cycle in 2007-2009 and a negative gap in late 2005-early 2006 were jointly identified. While the state of the economy at the end of the sample is assessed as a positive output gap by the HP filter, the linear trend and the Christiano-Fitzgerald filter show a closing, but still negative output gap. As the statistical filters do not present a robust output gap measure, additional economic information may help in identifying the appropriate output gap. We turn to this in the next section.

IV. Multivariate Output Gap Measure: The Blanchard-Quah Decomposition

The statistical filters previously discussed rely exclusively on the information provided in a single series to identify the output gap. Blanchard and Quah (1989) go a step further and exploit long-run economic relationships with other macroeconomic variables to identify separate (supply and demand) shocks. They define the output gap as the accumulation of demand shocks. More specifically, in their model of the US they use the unemployment rate in addition to real GDP to identify the underlying shocks. For identification they assume that the two types of disturbances are uncorrelated and neither has a long-run effect on unemployment. Furthermore, they assume that one type of shock has a long-run effect on output (supply shock) while the other type of shock does not (demand shock).

For Mongolia, we use the inflation rate as an additional macroeconomic variable instead of the unemployment rate, the reason being that unemployment data is not very informative due to high informal (un)employment and underemployment. Unit root tests (Augmented Dickey Fuller test and Kwiatkowski, Phillips, Schmidt, and Shin test) confirm that the log of seasonally-adjusted real GDP is integrated of order 1 while the inflation rate is stationary. The inflation data is presented in the first panel of Figure 3.

We estimate a structural VAR for the first difference of the log of seasonally-adjusted real GDP and the quarter-on-quarter seasonally adjusted headline inflation rate imposing Blanchard and Quah's long-run restriction for identification. The lag length selection criteria suggest using 4 lags. The output gap series is then constructed as reflecting only the effect of demand disturbances using the recovered structural demand shocks and the (non-cumulative) Impulse Response Function. The derivation of the output gap requires setting a starting point at which the gap is closed. Following the Bank of Mongolia, we choose to set the output gap equal to zero in the first quarter of 2000.[8]

The second panel of Figure 3 presents our estimates of the Blanchard-Quah output gap for Mongolia. According to these estimates, the output gap was negative for most of the sample with a large boom in 2008 followed by a bust and then a smaller boom at the beginning of 2010 again followed by a bust.

V. Nonmineral GDP

Mineral output and value added in mining do not depend on demand conditions and do not move with the business cycle. For example the volume of copper Mongolia exported (and mined) has remained unchanged throughout the last boom-bust cycle. Variations in mineral production, like the exploitation of a new mine or the reduction of reserves in an existing mine, are better thought of as affecting potential GDP than as driving the business cycle. Furthermore, mining in Mongolia is very capital intensive (mostly foreign capital) and employment is quite limited hence playing a minor role for aggregate domestic demand. Therefore, we will measure the output gap both for overall GDP and nonmineral GDP, i.e., excluding mineral GDP. As movements in mineral GDP should appropriately be captured in the trend and not the cyclical

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[8] This assumption affects the absolute level of the output gap, but not its relative movements.

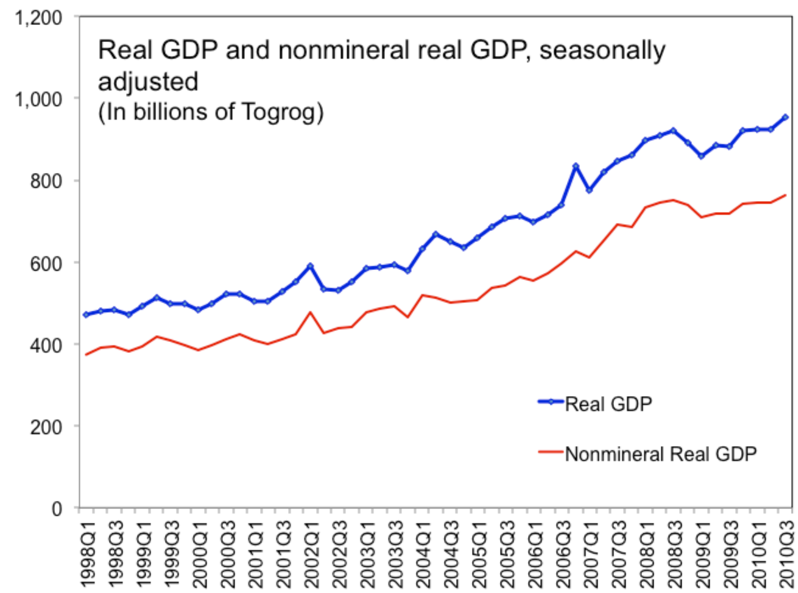
component, a good output gap measure should yield similar results for both GDP measures and we will use this criterion to choose a robust output gap measure for Mongolia.

Indeed, the output gap derived with the HP filter, the Christiano-Fitzgerald filter, a linear trend and the Blanchard-Quah decomposition is broadly the same for nonmineral and overall GDP (see figures 4 and 5). A few differences are that the Christiano-Fitzgerald filter has some differences in the sign of the output gap between 2002 and 2004, the linear trend produces a slightly smoother output gap measure for nonmineral than for overall GDP and for the BQ decomposition the transition from positive to negative output gap for nonmineral GDP once slightly lagged behind. Overall, however, it appears that the BQ decomposition has the smallest difference between the two measures both in terms of magnitude and in terms of missed turning points. Therefore, including the additional economic information in the inflation measure seems to improve upon the simple univariate filters.

VI. Conclusion

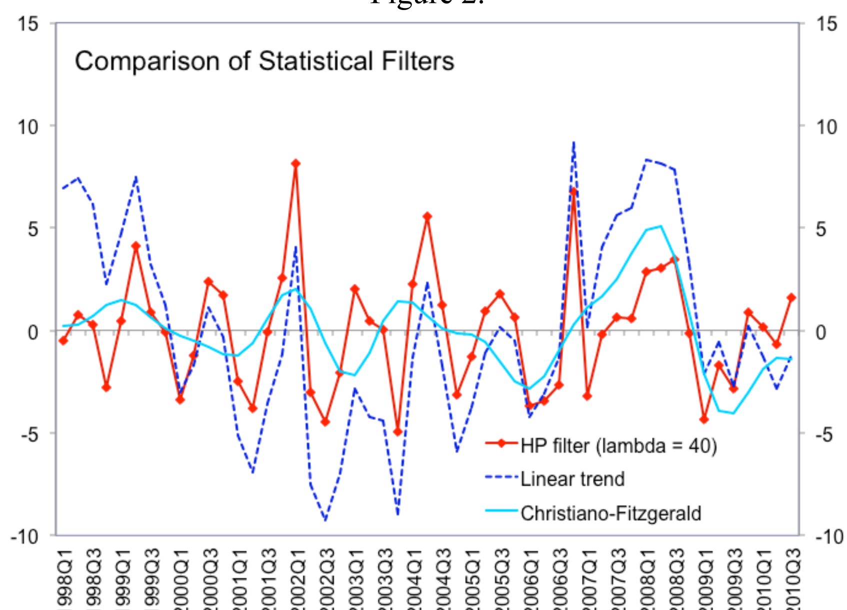
In this article we construct output gap estimates for Mongolia based on a number of different methods. In particular, we compare the estimates from univariate statistical filters to a Blanchard and Quah-type model which includes the additional economic information provided in inflation data from Mongolia. We find that the Blanchard and Quah-type joint model of output and inflation provides a more robust estimate of the output gap for Mongolia than the traditional statistical decompositions. In particular, the results are similar whether we apply the approach to overall real GDP or nonmineral real GDP. This is important for a country like Mongolia where a large sector of the economy, here mining, is not subject to traditional demand pressures and is almost entirely for export purposes. The additional economic information provided through the inflation data helps better identify demand versus supply shocks and therefore is a substantial improvement over univariate statistical filters as a policy-relevant output gap measure.

Figure 1.



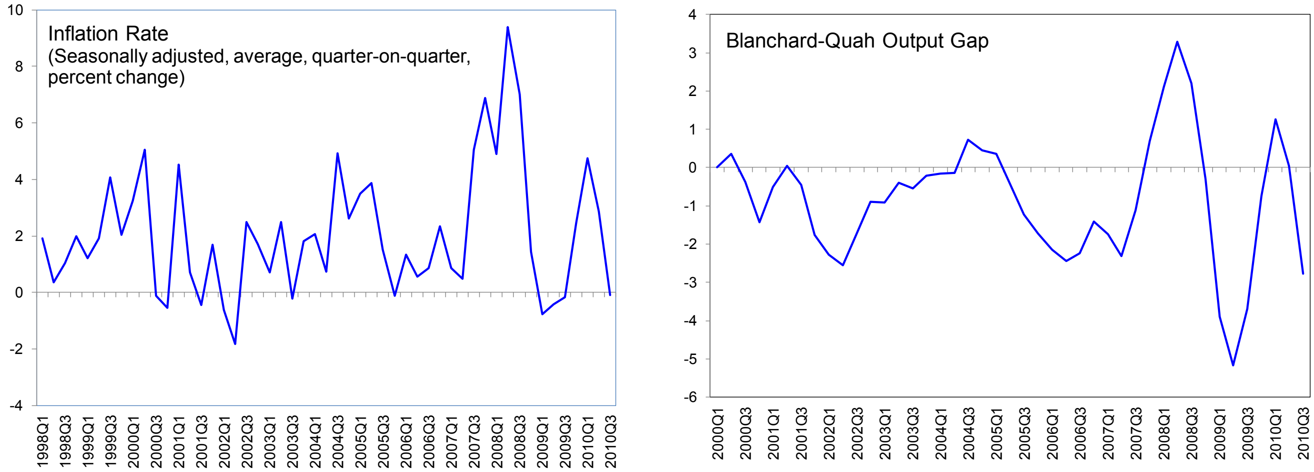
Sources: Mongolian authorities and author estimates.

Figure 2.



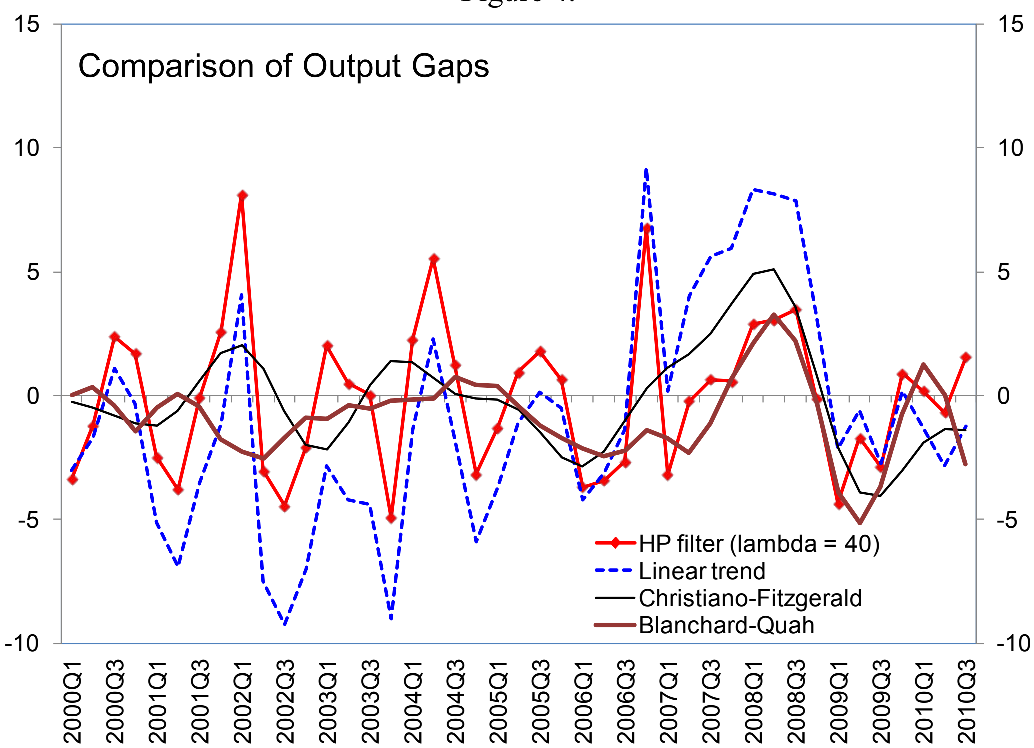
Sources: Mongolian authorities and author estimates.

Figure 3.



Sources: Mongolian authorities and author estimates.

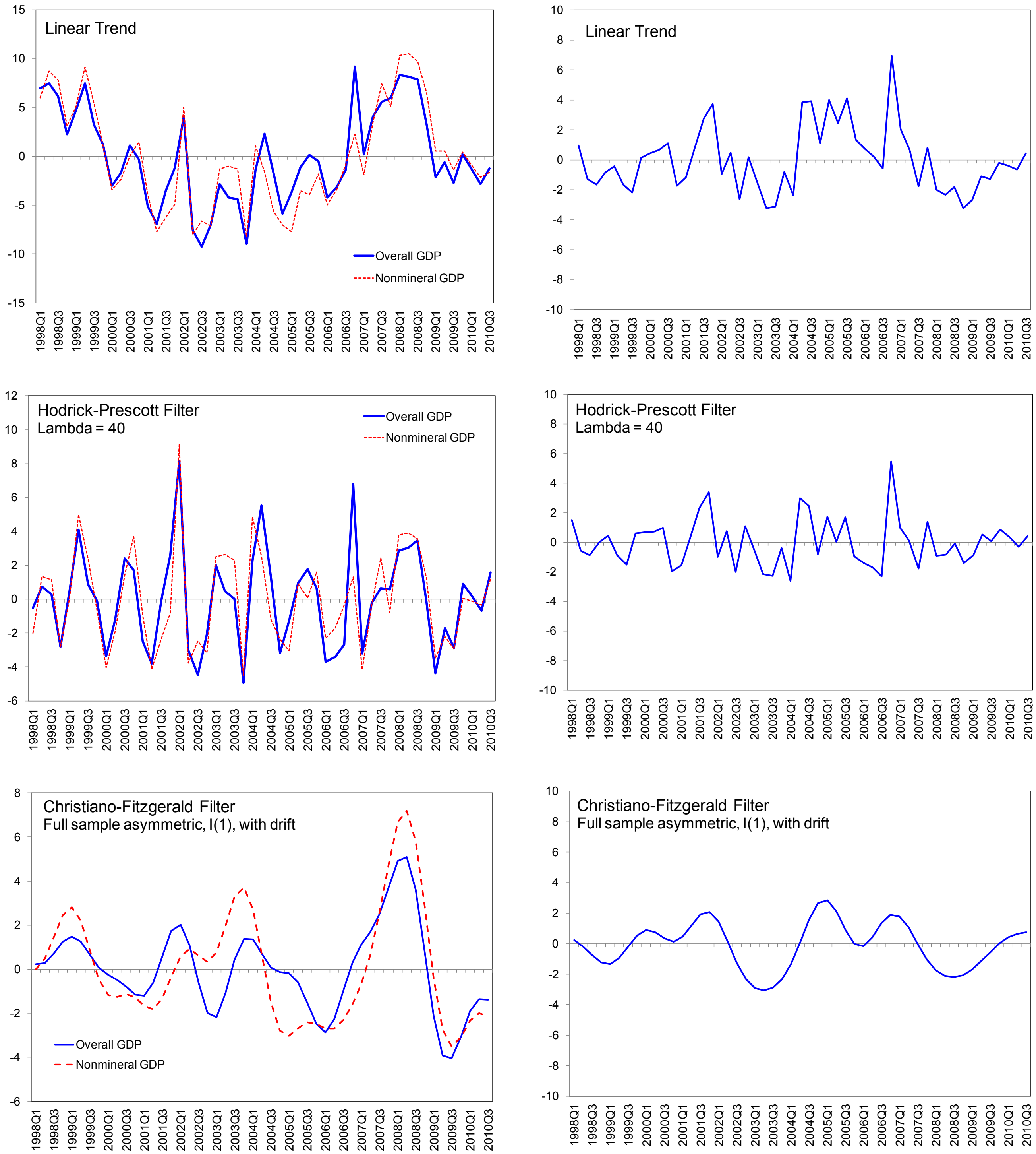
Figure 4.



Sources: Mongolian authorities and author estimates.

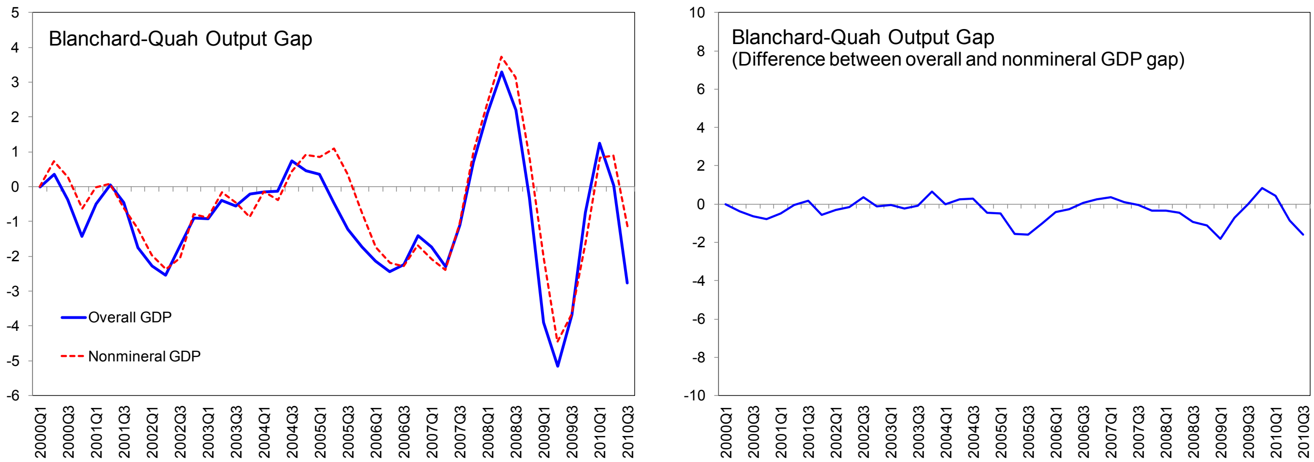
Figure 5a.

Output gap: Overall and nonmineral GDP | **Difference: overall and nonmineral GDP output gap**



Sources: Mongolian authorities and author estimates.

Figure 5b.



Sources: Mongolian authorities and author estimates.

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