Mind the Gap: Computing Finance-Neutral Output Gaps in Latin-American Economies

Amador-Torres, Juan and Gómez González, Jose and Ojeda-Joya, Jair and Jaulin-Mendez, Oscar and Tenjo-Galarza, Fernando

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Mind the Gap: Computing Finance-Neutral Output Gaps in Latin-American Economies[1]

Juan S. Amador-Torres

Jose E. Gomez-Gonzalez

Jair N. Ojeda-Joya

Oscar F. Jaulin-Mendez

Fernando Tenjo-Galarza[2]

Abstract

We compute a measure of the finance-neutral potential output for Colombia, Chile and Mexico. Our methodology is based on Borio et al (2013, 2014) and incorporates the cycle of credit, house prices and the real exchange rate on the computation of the output gap. The literature on business cycles in emerging market economies, particularly papers focusing on Latin American economies, has highlighted the importance of including shocks to the interest rate in world capital markets together with financial frictions; terms of trade fluctuations; and a procyclical government spending process. Our results show that around the financial crises of the 1990s the finance-neutral output gap behaved differently than the traditional measures observed by policymakers. In particular, gaps are higher before crises and lower after them.

Keywords: Potential output, financial cycle, asset prices, Kalman filter

JEL Classification Codes: E44, E47, E52

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[2] The four first authors work as economists for Banco de la República (Central Bank of Colombia). The last author is General Director of CEMLA. Their emails are, respectively: jamadoto@banrep.gov.co; jgomezgo@banrep.gov.co; jojedajo@banrep.gov.co; ojaulime@banrep.gov.co ; Fernando.tenjo@cemla.org;

1. Introduction

Economics, as well as every day's life, is full of important though unobservable realities. Potential output is the paramount example of this fact. This variable is traditionally defined as the highest level of output that an economy can sustainably achieve (see for instance Okun, 1962; and, Mishkin, 2007).

However, several different sustainability criteria have been proposed and debated over time, and clearly there is no consensus on which is better than the others (see for instance, Smets, 2002; Billmeier, 2004; Cobo, 2005). Unfortunately, potential output estimations depend heavily on the particular assumptions. This fact is challenging for policymakers, as key decisions depend upon the measurement of the output gap. For instance, the sign and level of the output gap is crucial for monetary policy within an inflation targeting environment that follows Taylor-type rules.

It is common practice to include economic information in potential output estimations in order to address the sustainability criterion. This approach has gained favorability because it yields meaningful economic and statistical improvements (Borio et al, 2014).

However, the recent international financial crisis has made evident that financial stability is a key concept for understanding economic sustainability (for example, see Adrian et al, 2012). Ignoring this fact may lead to specification errors and to misleading policy recommendations. In many different episodes, the build-up of financial imbalances in a low-level inflation environment has led to huge posterior output losses (see, for instance, Schularick and Taylor, 2012). Whenever the monetary authority follows a Taylor rule with a traditional output gap estimate, financial imbalances can accumulate leading to potentially harmful macroeconomic outcomes. The best well-known example of such process is the recent international financial crisis that started in 2007-2008.

Many emerging economies experienced deep financial crisis in the late 1990. The Latin American region constitutes an interesting example of the effects of financial imbalances on economic performance during this period of time. These countries experienced pronounced capital-flow cycles that led to credit and asset price booms followed by large sudden stops and financial cycle busts.

Taking into account the episodes of financial distress occurring in Latin American economies during the 1990s, a growing body of literature studying the complex relationships between financial and real variables is developing. A strand of this literature has centered in the dynamic interactions among financial variables, real activity, monetary aggregates and asset prices (for example, Goodhart and Hoffman, 2008). Other strand of the literature deals with the predictive power of financial indicators on economic crises (Ng, 2011).

Recently, much attention has been paid to the interdependence between financial and real business cycles (Borio, 2012; Claessens et al, 2012; Gómez-González et al., 2014, among others). Emphasis has been given to the frequencies at which credit and property prices are related with the business cycle. Drehman et al. (2012) highlight the importance of considering the interdependence between medium-term financial cycles and short-term product cycles.

Following Borio et al (2013, 2014), in this paper we perform estimations of the output gaps that take into account the financial cycle (finance-neutral output gaps) for three major Latin-American economies (Colombia, Chile and Mexico). Studying these countries is important as they all experienced major financial crises during the 1990s and their recoveries lasted about 5 years. Our second contribution is proposing a specific way of applying the methodology by Borio and co-authors to the case of small open and emerging economies. Namely, we incorporate the real exchange rate as a measure of the stance of the external sector. As mentioned above, small open economies, like those we include in our empirical analysis, are vulnerable to external shocks that increase their vulnerability to financial crises and deep economic downturns. As a robustness check, we also include the terms of trade indicator as an alternative measure of external sector innovations.

We use this framework to get new insights on output fluctuations in emerging market countries. There are several important factors that exert influence on business cycles in emerging market economies, including financial cycle aspects. In fact, the greater volatility of emerging market economies can account for the higher vulnerability of these economies to waves of banking failures. Therefore, the characterization of business cycles in emerging market economies needs to take into account financial variables which control for the likelihood of occurrence of a financial crash (Oviedo, 2004). External financial liberalization can also be a source of increased volatility of cycles after real interest rate shocks (Minetti and Peng, 2013).

We compute finance-neutral output gaps by including real asset price growth, real total credit growth and the first difference of the real exchange rate. The two first indicators account for the interplay among financial frictions, credit and collateral value and the third one for the balance of payments behavior. These links are very important. First, asset prices affect the perceived wealth of households that in turn influence credit demand (see Kiyotaki and Moore, 1997). Second, several studies have shown that abnormal credit growth is the main predictor of financial crises (Schularick and Taylor, 2012). Finally, real exchange rate movements is the key adjustment variable behind possible external imbalances in small and open economies. These episodes are able to explain a significant part of their business cycles (Bracke et al, 2008). We also use the terms of trade as an alternative external sector indicator in order to do robustness checks.

Our contribution to the literature is two-fold. Firstly, we estimate finance-neutral output gaps for three Latin-American economies. We did not find any previous estimation usinf this methodology for these countries. Given their peculiarities, we extend the existing literature by including the real exchange rate for accounting for the build-up of external financial imbalances which makes emerging economies more prone to financial crashes. And secondly, we complement the existing literature by showing that taking into account financial factors is a key issue for output gap estimation.

Our results have also interesting policy implications. Policy makers in Latin American economies should consider the stage of the financial cycle while making monetary policy decisions. If financial variables are omitted from the output gap, important financial and/or external sector imbalances that may lead to further recessions can be neglected.

Section 2 presents a brief literature review. Section 3 is a methodological section. Section 4 describes the data used in the empirical analysis and the estimation results. Section 5 performs a robustness check of the initial results. Finally, section 6 concludes.

2. Literature review

The recent international financial crisis has renewed academic interest for studying the interdependence between financial and real variables. A strand of this literature has centered in the dynamic interactions among financial variables, real activity, monetary aggregates and asset prices. For instance, Goodhart and Hoffman (2008) use a sample of 17 industrialized economies for the period 1970 – 2006, and estimate the multidimensional links between money, credit, house prices and economic activity. They find a strong link between house prices and monetary variables post–1985. They also find that the macroeconomic effects of monetary and credit shocks are stronger when house prices are booming.

A few papers have studied these relations from a historical perspective. Schularick and Taylor (2012) evaluate the behavior of financial, monetary and macroeconomic indicators for a set of 14 countries with data starting back in 1870. A key finding of this paper is that exuberant credit growth usually anticipates financial crisis. Similar results have been obtained by Alessi and Detken (2011), Borio and Drehmann (2009) and by Tenjo and López (2010) who construct early warning models of financial crises for alternative groups of countries.

Other strand of the literature deals with the predictive power of financial indicators on economic crises. Ng (2011) uses three alternative financial measures to evaluate their capacity of forecasting business cycles. He finds that only measures related to financial stress have important short-run predictive power. Some recent papers study the interaction

between real and financial cycles. Aikman et al (2011), construct a model of the banking industry where credit cycles emerge as a consequence of coordination failure among banks.

These authors estimate medium-term cycles both for GDP and credit for 12 countries using Schularick and Taylor's (2012) database. They find evidence favoring the existence of financial cycles and their predictive power of banking crises. Additionally, these cycles are found to be different from the business cycle in frequency and amplitude.

Claessens et al (2012) measure the interdependence between business and financial cycles on short-term frequencies for a list of 44 countries over 50 years. They report evidence on strong statistical liaisons between these cycles, for instance, recessions appear to be deeper when they coincide with troughs in financial variables such as asset prices. DBT find similar evidence using fewer developed countries, but separating the cycles in their short and medium-term components. They also find that the medium-term cycle is more volatile than the short-term cycle.

The literature on business cycles in emerging market economies, particularly papers focusing on Latin America, has highlighted the importance of including shocks to the interest rate in world capital markets together with financial frictions; terms of trade fluctuations; and a procyclical government spending process (see, for instance, Fernandez, 2010).

3. Model and empirical specification

The static Hodrick and Prescott (HP) filter can be represented in a state-space form by the following transition and measurement equations, respectively:

$$\Delta y_t^* = \Delta y_{t-1}^* + \varepsilon_{0,t} \qquad (1)$$

$$y_t \ = y_t^* + \varepsilon_{1,t} \qquad (2)$$

Where $y_t = \ln(y_t)$ stands for real GDP and $\varepsilon_{i,t}$ (for $i = 0,1$) is assumed to be a Gaussian independently distributed error term with zero mean and ${\sigma_{i,t}}^2$ variance. For any given state equation such as (1), $\lambda = \frac{{\sigma_{0,t}}^2}{{\sigma_{1,t}}^2}$ is the signal-to-noise ratio, which determines the relative variability of the estimated potential output series. If λ is large, potential output would follow approximately a linear trend, while if it is small, potential output would imitate actual output.

Borio et al (2013, 2014) re-writes the measurement equation (2) to include economic information in the output gap estimates:

$$y_t = y_t^* + \beta\left(y_{t-1} - y_{t-1}^*\right) + \gamma' x_t + \varepsilon_{2,t} \qquad (3)$$

Where x_t is a vector of economic and financial variables and $\varepsilon_{2,t}$ is a Gaussian error term. The scaling factor, λ, is set to maintain the same cyclicality assumed by the standard HP filter provided β is less than 1 in absolute value.

The general state-space representation used in this paper (equations (1) and (3)) use several different variables in x_t that explain the business and financial cycles. If a variable included in x_t explains a certain aspect of the cycle, the potential output would be "neutral" to motions of that particular variable. In spite of a general lack of consensus on its exact definition, some studies have shown that the most parsimonious definition of the financial cycle is in terms of credit and asset prices (Borio, 2012).

Three variables were included in x_t; real asset price growth, real total credit growth and the first difference of the real exchange rate. The two first indicators account for the interplay of financial frictions, credit and collateral value and the third one for the balance of payments behavior. These links are very important. First, asset prices affect the perceived wealth of households that in turn influence credit demand (see Kiyotaki and Moore, 1997). Second, several studies have shown that abnormal credit growth is the main predictor of financial crises (Schularick and Taylor, 2012). Finally, the real exchange rate summarizes possible external imbalances of small and open economies. These imbalances might explain the fluctuations of their business cycles. We also use the terms of trade as an alternative external sector indicator in Section 5.

The model was estimated using a Bayesian approach with Gamma distributed priors for the parameters. The initial values for both the level and variance of the potential output are chosen using the HP estimation. Changing them does not affect the estimation significantly. Following Borio et al (2014), we assume for the autoregressive parameter a prior mean of 0.7 and standard deviation of 0.3. The rest of the coefficients have prior means and standard deviations equal to 0.3. All variables were demeaned using Cesaro's mean.

4. Empirical Analysis

We collected quarterly data on GDP, credit, asset prices (housing and stock prices), and real exchange rate from central banks. All variables are expressed in real terms. Information for Colombia spans the period 1988Q1-2013Q2; for Chile 1991Q1-2013Q; and for Mexico 1980Q4-2013Q2.

Regarding credit, we use a measure of total private credit provided by the financial system. This corresponds to internal credit. In these three countries external debt is almost entirely due to the public sector. Given that in this paper we focus in the behavior of the private sector, we do not include external credit in the output gap estimation.

Table 1 (see appendix) presents results of estimating the following measurement equation for Colombia, Chile and Mexico:

$$y_t = y_t^* + \beta(y_{t-1} - y_{t-1}^*) + \sum_{i=0}^{4} \gamma_i \Delta cr_{t-i} + \sum_{i=0}^{4} \sigma_i \Delta ap_{t-i} + \sum_{i=0}^{4} \delta_i \Delta q_{t-i} + \varepsilon_{2,t} \quad (4)$$

Where Δcr_t represents the annual rate of credit growth, Δap_t stands for the annual growth rate of asset prices and Δq_t is the annual rate of real exchange rate appreciation.[3]

Initial estimations included all regressors contemporaneously and with up to 4 lags as specified in Equation (4). However, using a general to specific approach, Table 1 only reports those coefficients that appeared to be either statistically or economically significant[4].

Several results are noteworthy. First, note that β coefficients are all positive and less than one, indicating that stationarity conditions are met. Second, all other coefficients are also positive which implies that the output gap is positively related to positive growth rates of credit and asset prices as well as to real exchange rate appreciations. Third, the β for Mexico is significantly larger than those for Colombia and Chile, implying that in the former the output gap inertia is more important than in the latter. In other words, the included macro and financial variables are more important in determining the output gap dynamics in Colombia and Chile than in Mexico. Fourth, while in Chile the output gap is explained importantly by contemporaneous credit growth, in Colombia contemporaneous house prices are its most important determinant.

Furthermore, while the inclusion of the exchange rate does not appear to be statistically significant for these set of countries (except for Mexico), its economic significance calls for its inclusion in the financial output gap estimation. In fact, if we drop this variable the output gap changes importantly and becomes less predictive of financial imbalances. Figures 1, 2 and 3 nicely illustrate the results we have just discussed.

Results show that finance-neutral gaps differ substantially from traditional HP gaps. These differences are especially noticeable around financial crises. During times in which the

[3] We use growth rates instead of variables in levels in order to guarantee stationarity. Even though we detrended all variables in levels, this did not led to stationarity.

[4] By economically significant, we refer to a coefficient whose absolute value is larger than 0.001. This value implies that a 1% higher growth rate of the covariate leads to a static effect of 1 basis point on the output gap. The total effect will depend on the dynamics of the system.

financial imbalances responsible of later financial crises are created, finance neutral output gaps are significantly higher than HP gaps. This is the case for the three countries before their financial crises in the 1990s. See Table 2 (Appendix).

This result highlights the fact that when policymakers consider financial variables when calculating the output gap, they can make better assessments of macroeconomic risks and imbalances.

Another interesting feature is that during and right after financial crises, the finance neutral output gap becomes more negative and takes longer to recover than the HP gap. This result shows that finance-neutral output gaps capture better the severity and the persistence of financial crises. This finding goes in line with the results for the US reported by Borio et al (2013, 2014).

Finally, it is important to mention that Colombia's finance neutral gap (in contrast to Chile and Mexico in which both gaps behave similarly) has been positive and higher than the HP gap for the last 8 years, except for a brief episode in 2010 in which this gap shrank to zero. This result can be explained by the long appreciation period of house prices and the real exchange rate. A similar finding for Colombia has been reported in Gomez-González et al (2015), where evidence of recent financial imbalances is documented.

Figure 1. Estimated output gaps for Colombia (1988-2013)

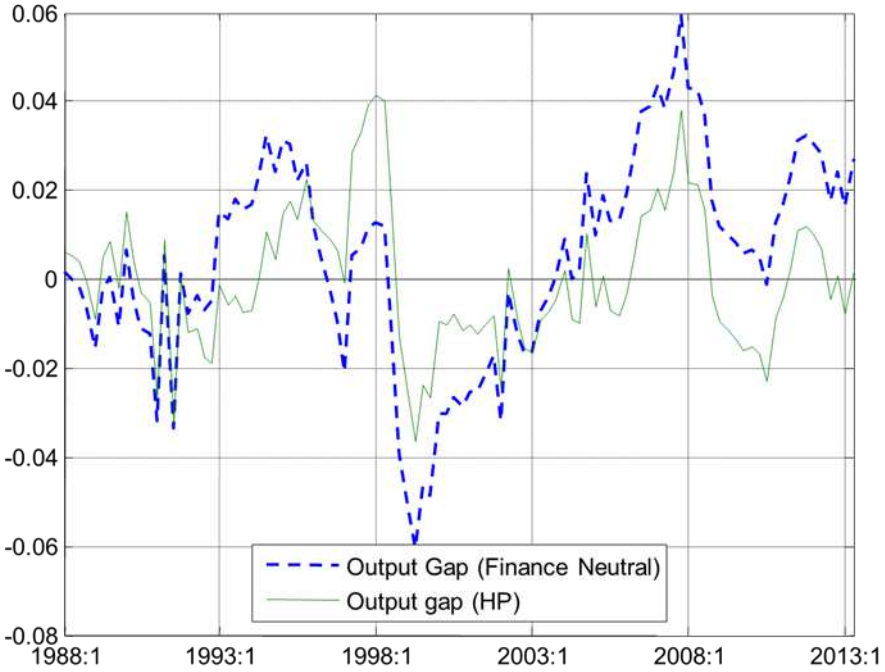


Figure 2. Estimated output gaps for Chile (1991-2013)

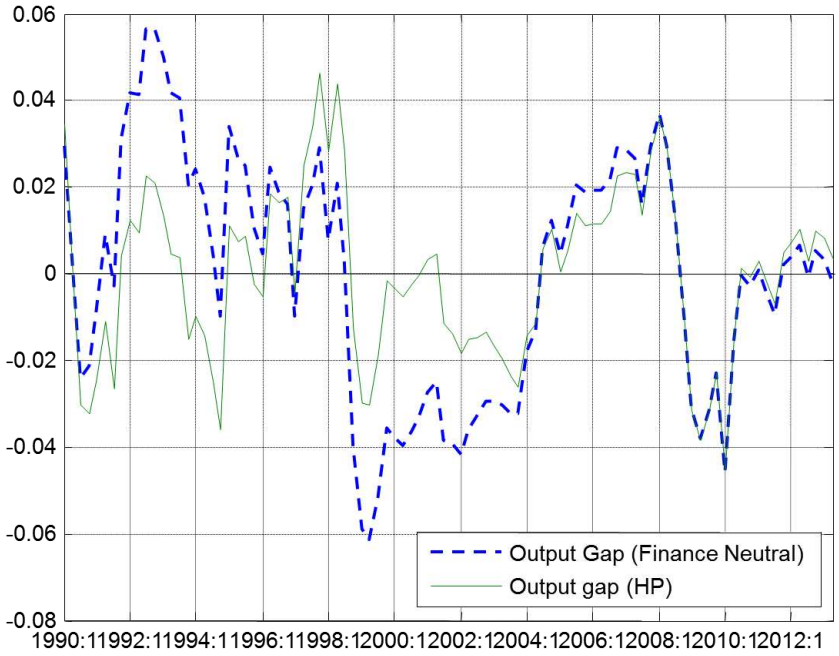
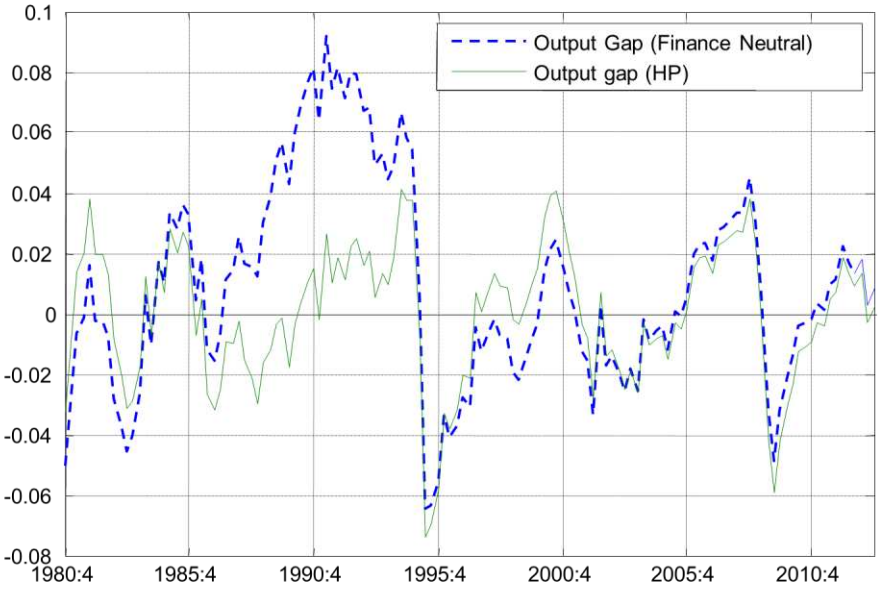


Figure 3. Estimated output gaps for Mexico (1980-2013)



5. Robustness Check

In this section we show alternative estimations of a finance-neutral output gap but now using the terms of trade, instead of the real exchange rate, as the indicator of potential external imbalances in each country. This robustness check is important since it allows studying how sensitive the estimated output gap in each country (Figures 1-3) is to alternative indicators of the external sector.

We use the same methodology described in Sections 3 and 4. Regarding terms of trade, we use the official measure which is computed by the central bank of each country. This index corresponds to the ratio of two price indices: exports and imports. Thus, an increase of the terms of trade corresponds to an improvement of the relative export prices and therefore implies a better trade balance.

Figures 4-6 show the results of this new estimation of the finance-neutral output gap for each country. Similarly to Figures 1-3, the estimated gap is compared with the standard gap obtained with the Hodrick-Prescott (HP) filter.

Figure 4. Alternative estimation of the finance-neutral output gap for Colombia

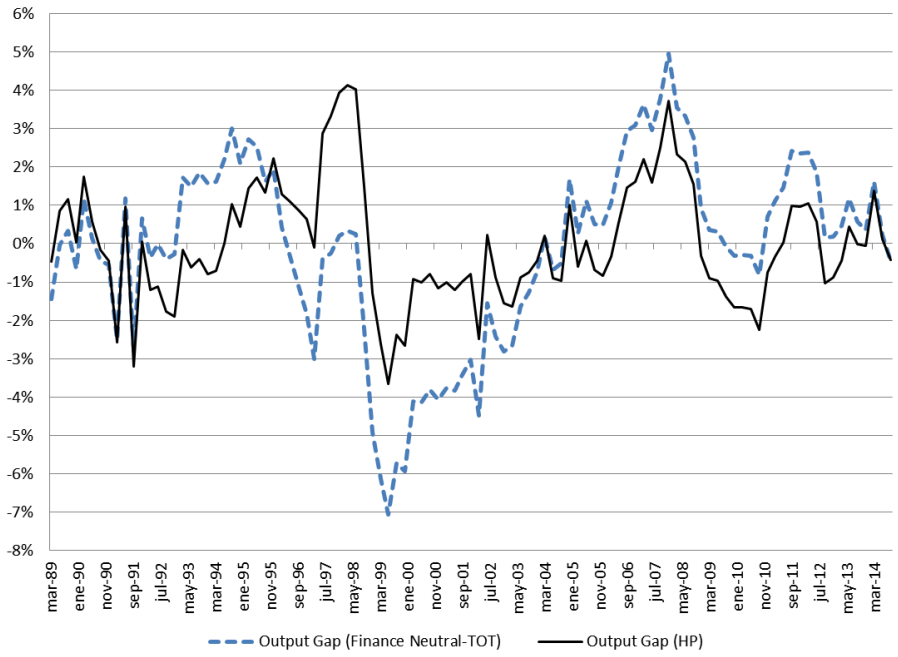


Figure 5. Alternative estimation of the finance-neutral output gap for Chile

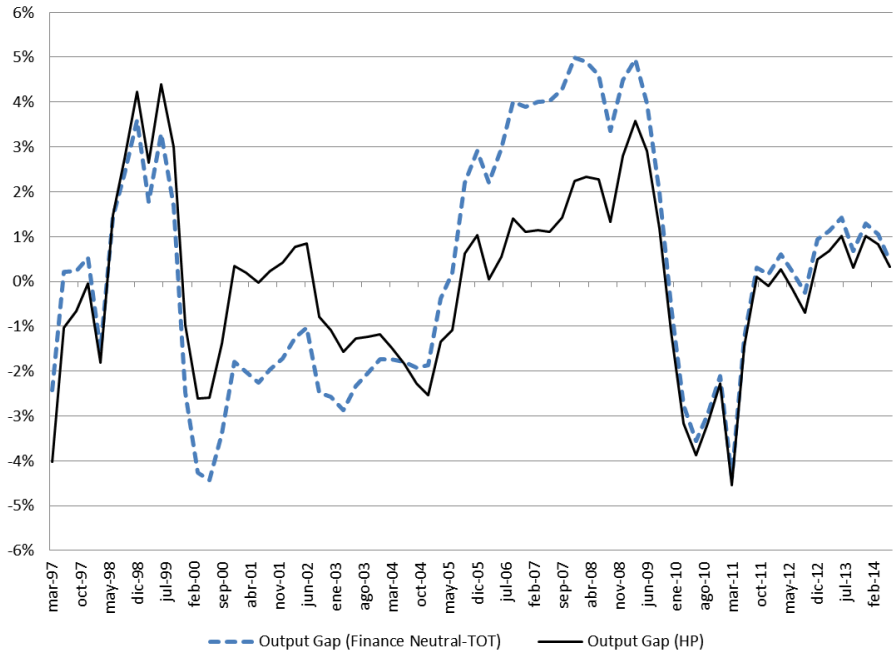
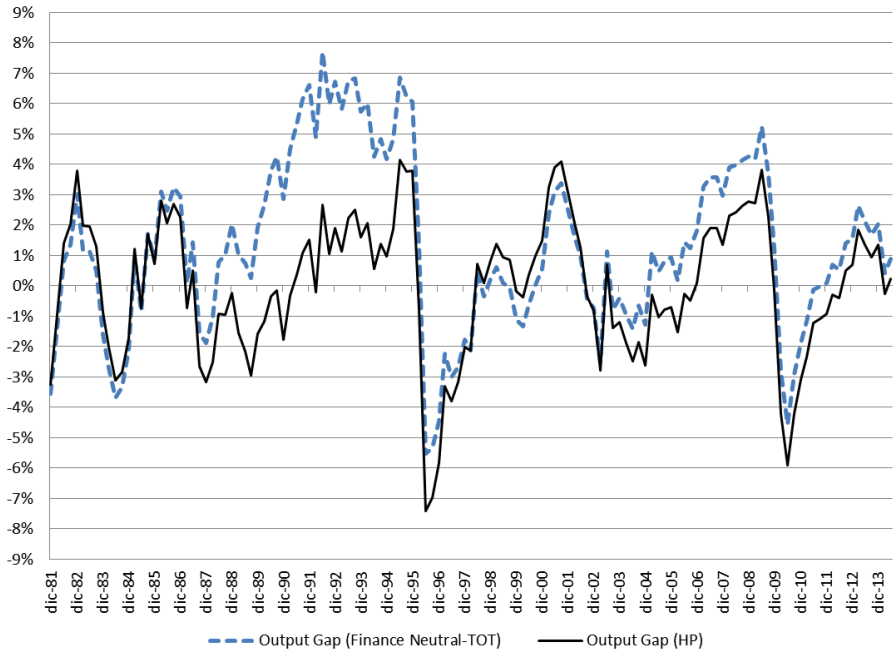


Figure 6. Alternative estimation of the finance-neutral output gap for Mexico



Figures 4 and 6 show that the results for Colombia and Mexico are very similar to those described in Section 4. In the case of Chile, we find a few differences by comparing Figure 5 and 2. First, the output gap computed using the real exchange rate (Figures 2) show a deeper effect of the 1999 crisis than the one computed using terms of trade (Figure 5). On the other hand, the latter gap implies a greater output boom right before the 2008-2009 international financial crisis than the one in Figure 2. Despite these differences, it is clear that all qualitative results remain and therefore the finance-neutral gap estimations are robust to this alternative indicator of external imbalances.

6. Conclusions

It is common practice to include economic information in potential output estimations in order to address the sustainability criterion. This approach has gained favorability because it yields meaningful economic and statistical improvements, (Borio et al, 2014). However, central banks have shown preference for potential output estimates that are consistent with stable inflation. In particular, many consider that a good potential output measure should imply a non-accelerating rate of inflation. Following Phelps (1967) and Friedman (1968), most central banks have implemented similar criteria for output gap measurement.

Following Borio et al (2013, 2014), in this paper we perform estimations of the output gaps that take into account the financial cycle (finance-neutral output gaps) for three major Latin American economies (Colombia, Chile and Mexico). We include the real exchange rate and the terms of trade in order to account for external imbalances, and not only domestic financial frictions, as we deal with three small open economies that are subject to shocks originating abroad. Studying these countries is important as they all experienced major financial crises during the 1990s and their recoveries lasted about 5 years. Several studies have shown that the financial crises of the late 1990s in Latin America are associated with both domestic financial imbalances and external shocks related to the crises in Russia, Asia and Brazil.

Our contribution to the literature is two-fold. Firstly, we estimate finance-neutral output gaps for a set of emerging market economies which have not been studied in the literature. The scarce existing literature focuses in developing and relatively closed economies. Up to our knowledge this paper is the first in studying Latin American economies. Given their peculiarities, we extend the existing literature by including the real exchange rate and the terms of trade for accounting for the build-up of external financial imbalances which makes emerging economies more prone to financial crashes. And secondly, we complement the existing literature by showing that taking into account financial factors in a key issue,

especially during some periods of time. For instance, the 1990s in Latin America, after several processes of financial liberalization occurred in these countries.

Results show that finance-neutral gaps differ substantially from traditional HP gaps. These differences are especially noticeable around financial crises. During times in which the financial imbalances responsible of later financial crises are created, finance neutral output gaps are significantly higher than HP gaps.

Our findings highlight the importance of considering financial variables when assessing the economic slack, as doing so policymakers can better evaluate macroeconomic risks and imbalances.

Our results have also interesting policy implications. Policy makers in Latin American economies should consider the stage of the financial cycle while making monetary policy decisions. If financial variables are omitted from the output gap, important financial and/or external sector imbalances that may lead to further recessions cannot be detected.

Appendix

Table 1: Bayesian Kalman filter estimation of finance-neutral output gaps.

Variable	Colombia	Chile	México
λ	7.59	6.00	7.70
β	0.4109** (0.0509)	0.4137** (0.0678)	0.7606** (0.0509)
γ_0		0.2674** (0.0446)	0.0246** (0.0092)
γ_3	0.0088 (0.0204)		
γ_4	0.0514** (0.0212)	0.0583 (0.0448)	0.0158 (0.0091)
σ_0	0.1145** (0.0194)		
σ_2		0.0228** (0.0052)	
σ_4		0.0046 (0.0053)	
δ_0		0.0194 (0.0219)	0.0402** (0.0078)
δ_1	0.0107 (0.0123)		0.0050 (0.0079)
δ_2		0.0164 (0.0217)	
δ_3		0.0259 (0.0219)	
δ_4	0.0128 (0.0124)		

* Note: Standard errors are presented in parenthesis. * and ** represent significance at the 10 and 5 percent levels, respectively.

Table 2: Average output gaps for selected periods

	Period	Finance neutral	HP
Colombia	1991Q1 - 1995Q4	1.45%	0.00%
	2003Q1 - 2013Q2	1.95%	0.09%
Chile	1990Q2 - 1996Q2	2.14%	-0.37%
	2004Q3 - 2008Q1	2.37%	1.54%
Mexico	1983Q3 - 1995Q4	3.52%	0.06%
	2003Q3 - 2013Q2	0.51%	-0.03%

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