Economic Watch
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Economic Analysis

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Stagflation in Chile: More a myth than a reality

- **Periods of stagflation in Chile coincide with major supply shocks and weakness in macroeconomic institutions,** and are characterised by slumps in the terms of trade and/or significant drops in total factor productivity. We would have to go back to the early 1970s and 1980s to find periods of stagflation.

- **The credibility given to the current inflation-targeting scheme has enabled a secular reduction of the likelihood and frequency of stagflation episodes.**

- **Our analysis suggests that both the current state of the economy and its prospects for the next two years cannot be identified as stagflation.** However, a mild rise in the likelihood of a scenario of persistent sub-potential growth, and above-target inflation, is observed. The likelihood of a scenario of persistent sub-potential growth, and above-target inflation, has risen from 3% in late 2011 to 9% in 1Q 2014.

- **The evolution of the current situation into stagflation by further persistence of low growth and high inflation would require supply and demand shocks arising from steady rises in energy costs, a significant drop in the terms of trade and/or declines in total factor productivity.** However, current macroeconomic institutional structures prevent the consolidation of a divergent pattern between inflation and activity. In simple terms, either the economy grows below potential and inflation recedes significantly, or trend growth recovers without mitigating price dynamics.

- **A tax reform that would materially deviate from the fiscal rule** (which we presently do not expect the current administration to adopt) **could also make the recent episode of low growth and significant price rises more persistent.**

Introduction

We have observed sub-potential growth and above-target inflation in Chile since early 2014. **This has raised concerns that we might be entering a process of stagflation.** Within this context, our goal in the following sections is to determine the degree to which the likelihood of a stagflation scenario for Chile is plausible, the evolution of the frequency, magnitude and determinants of stagflation episodes over the last 50 years, and the implications of the probability of such a scenario for the expected management of monetary policy.

Before delving into the details of stagflation episodes observed in Chile, we will review some of the international literature. Several papers that attempt to provide a historical account consistent with the stagflation phenomenon have reached a certain consensus that **observed episodes of stagflation seem to be associated with a supply problem.** The main cause of stagflation would be a strong rise in the costs of production (cost push shocks), particularly energy costs, associated, for example, with a rise in the international oil price or, alternatively, with periods that coincide with low productivity, as variously measured (see Gordon, 1975; Bruno and Sachs, 1985; and Kilian, 2009). Additionally, there are papers that seek to explain the stagflation phenomenon with mechanisms that exist in the determination of wages[1].

Some alternative interpretations posit the possibility of a certain relationship between the materialisation and persistence of observed stagflation episodes (particularly in the US in the early 1970s and early 1980s) and economic policy management. Friedman initially argued that the higher inflation of the early 1970s occurred because interest rates had been kept low for an extended time in past periods, which created an incentive for greater State size and debt.

Current interpretations of US activity cycles have centred on the negative feedback on the economy, presumably caused by monetary (arising from the traditional backward-looking Taylor rule) and a fiscal policy which, upon observing undesirable levels of runaway inflation, decides to raise interest rates aggressively while, in turn, reducing and/or containing public spending. The combination of a supply shock with contractive factors on the side of demand could be counterproductive (particularly as it occurred in the US in the early 1980s), as it exacerbates the supply problem, due to both higher financing costs as well as the effects on aggregate activity and unemployment that arise from *inadequate demand* (Farmer, 2010)[2]. The rest is history: what began as a supply shock ended up becoming a bigger and more persistent problem. However, **US inflation was successfully controlled *ex post*, but at the cost of a persistent period of sub-potential growth and high unemployment.**

The result of these historical observations is precisely what leads to a consensus on the convenience of monetary policy not reacting to supply shocks, and on the need for a fiscal policy that emerges from its procyclical nature. Along these lines, Knotek and Khan (2012) prove that a period of stagflation from monetary policy alone would be probable when the economy faces deviations from the policy rule together with undetermined inflation targets or, as defined by the authors, *drifting inflation targets*. Once the inflation target is fixed, the probability of a stagflation episode from monetary policy alone is essentially eliminated in the model. The authors conclude that **the level of uncertainty over monetary policy actions could indeed contribute to the materialisation of a period of stagflation. This gives rise to the need for appropriate policy rule communication or, alternatively, some level of forward guidance.**

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[1] For a summary of the literature see Berthold and Gründler (2012).

[2] Strictly speaking, Farmer assumes that in the US war period (1950-80) government debt might have been internalised as net household wealth (in addition to that which arises from the value of other assets, such as the stock market), because in a state of war households would not pre-empt future tax increases. He thus assumes low *Ricardianism* in that period, prior to the Great Moderation.

This last point would be key to the likelihood of future stagflation scenarios throughout the world. Along these lines, Taylor (2010) posits that after the *Great Recession*, monetary policy, mainly in the developed countries, would appear to have deviated from the rules that prevailed in the *Great Moderation* period, making them less predictable and more discretionary. Within this context, his recommendation is to get back on track with the rules-based policies that enabled stabilising inflation and output in the decades prior to the sub-prime crisis.

Furthermore, when considering a panel of developed countries, Berthold and Gründler (2012) conclude that although episodes of stagflation occur on a relatively regular basis over the world, the unconditional probability declines over time, while the magnitude of the episodes rises once the stagflation scenario has materialised. They thus highlight that there remains a latent risk of stagflation globally, and that the determinants suggested a rise in the likelihood of such a scenario toward the end of 2010. These determinants are mainly related to the rise in real interest rates and the declines in labour productivity.

In the following section, we propose a simple definition of stagflation, to identify the periods in which Chile experienced this condition. In the subsequent section, we will relax the criteria of this definition of stagflation, to identify a wider set of periods of "low growth and high inflation", to thus empirically assess the likelihood of observing these episodes.

Defining episodes of stagflation in Chile

Before dealing with the likelihood of the statements that attempt to classify Chile's current economic scenario as one of stagflation, we must establish a practical definition of what that phenomenon is taken to mean. We have defined stagflation as *a persistent period of sub-potential growth with a minimum of one standard deviation of potential, and rising consumer inflation above what would be consistent with an explicit (or implicit) target.*

We formalise the definition of a period of stagflation in the following expression:

$$f_t(y_t, \pi_t) = \begin{cases} 1, & \text{if } \begin{aligned} & y_t - \overline{y}_t < 0 & (a) \\ & \wedge \ |y_t - \overline{y}_t| > \sigma_{\overline{y}} & (b) \\ & \wedge \ \pi_t - \overline{\pi}_t > 0 & (c) \\ & \wedge \ \ \Delta\pi_t > 0 & (d) \end{aligned} \\ \\ 0, & \text{for the rest} \end{cases} \qquad (1)$$

We included subscript t to identify all those variables that change over time. Thus, expression (1) gives rise to a general definition to determine a period of stagflation, where y_t is observed growth, $\overline{y}_t$ is potential growth, π_t is observed consumer inflation, $\overline{\pi}_t$ is the inflation target, $\Delta\pi_t$ is the change observed in consumer inflation, and $\sigma_{\overline{y}}$ is the standard deviation of potential growth which, for the time being, we take as a strictly positive constant. For their part, conditions (a), (b), (c) and (d) are the ones that allow us to ensure that our aforementioned stagflation definition is met[3]. It is worth noting that the frequency of these episodes is ultimately sensitive to the assumptions made for the unobservable variables that define the criteria to identify a case of stagflation, particularly growth potential, which also varies over time. Furthermore, if we consider a

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[3] We note that in the case where $\sigma_{\overline{y}} = 0$, condition (b) would be redundant and identical to condition (a). For its part, condition (d) allows rejecting episodes in which inflation is above the target but receding on the margin.

time window that looks farther into the past, the inflation target concept fades, making the definition of an episode of stagflation in previous periods more complex[4].

Chile would appear to have experienced a state of stagflation in three periods over the last 50 years: in the early 1970s, early 1980s and, to a certain extent, in the early 1990s. **However, since the implementation of both the fiscal policy rule (2001) and inflation-targeting schemes for monetary policy (1991), episodes with similar features have not been observed (Figure 1).**

Figure 1
Deviation of GDP versus potential and deviation of CPI versus target (% var. YoY)*
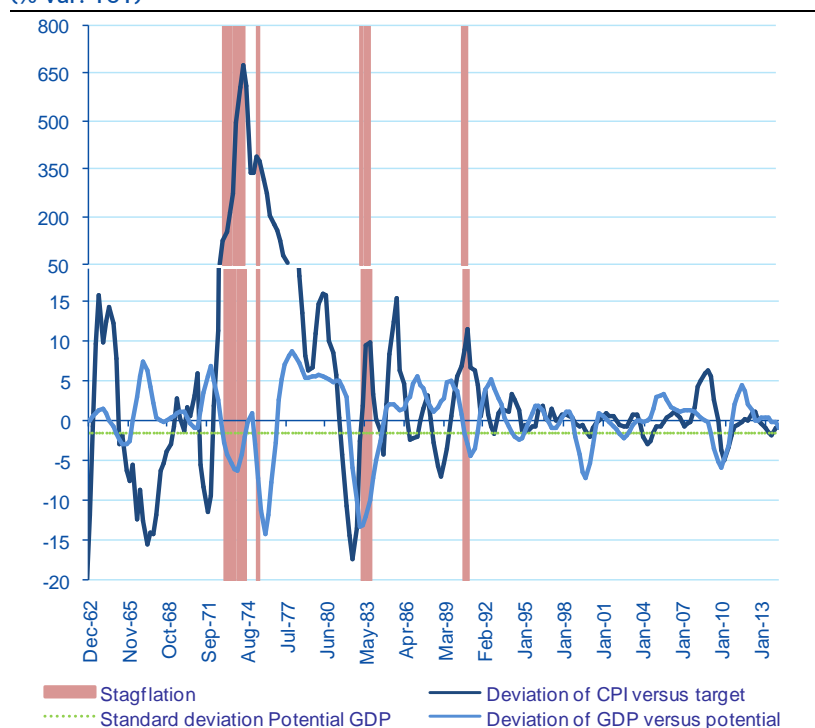
Source: Central Bank of Chile, Budget Office (DIPRES), National Statistics Institute (INE), BBVA Research.
*The annual variation of the moving average for the last four quarters is considered for GDP, to account for the adjective "persistent" in our definition of stagflation. We consider the average annual variation per quarter for CPI inflation.

Institutional progress would appear to have allowed both the frequency and intensity of the stagflation episodes to radically decline over time, in line with the theoretical works on the subject (Knotek and Khan, 2012). The latter is also evidenced by a systematic reduction in the number of consecutive quarters in which episodes identified as stagflation by our algorithm persist (Figure 2).

Said progress notwithstanding, the magnitude of the episodes (understood as deviations of growth versus potential and of inflation versus target) do not reveal a similar pattern (Figure 3), which in turn is consistent with the findings of the international empirical evidence (Berthold and Gründler, 2012).

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[4] For practical purposes, historical inflation averages were considered as implicit targets in those periods where the central bank's institutional arrangement was not yet characterised by an explicit inflation-targeting scheme.

Figure 2
Persistence in episodes of stagflation
(number of consecutive quarters)
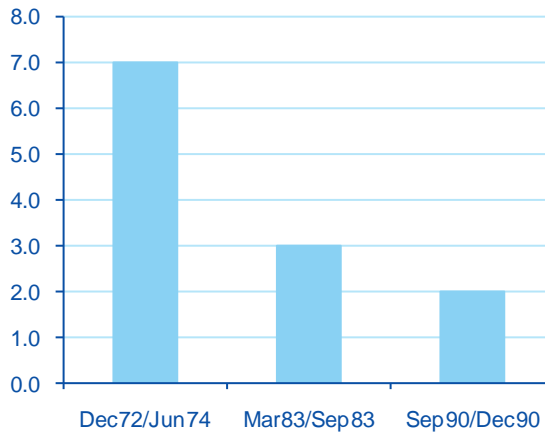
Source: Central Bank of Chile, Budget Office, National Statistics Institute, BBVA Research.
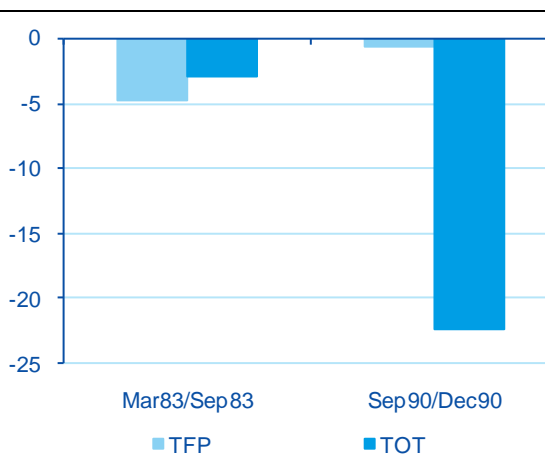
Figure 3
Magnitude of episodes of stagflation
(%, average deviations)*
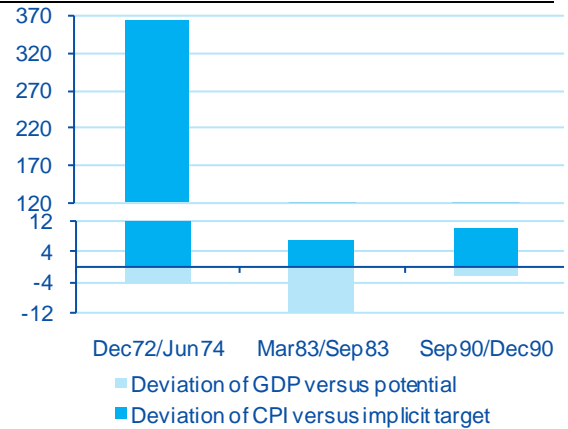
■ Deviation of GDP versus potential
■ Deviation of CPI versus implicit target

Source: Central Bank of Chile, Budget Office, National Statistics Institute, BBVA Research.

We note that said episodes coincide with significant declines in both total factor productivity (TFP) and the terms of trade (TOT), factors that are associated with disruptions in aggregate supply. We see these events coinciding with sharp rises in the international price of oil (equivalent to declines in the terms of trade), which supports the conclusions of the empirical literature on stagflation (Figure 4).

Figure 4
TFP and TOT in episodes of stagflation
(% var. YoY, annual moving average)*

■ TFP   ■ TOT

Source: Central Bank of Chile, Budget Office, National Statistics Institute, BBVA Research.
*Figures refer to the average change in said variables in the periods identified as stagflation.

Figure 5
Expenditure to real GDP and real long-term rates in episodes of stagflation
(%, annual moving average)*

■ G/GDP   ■ R
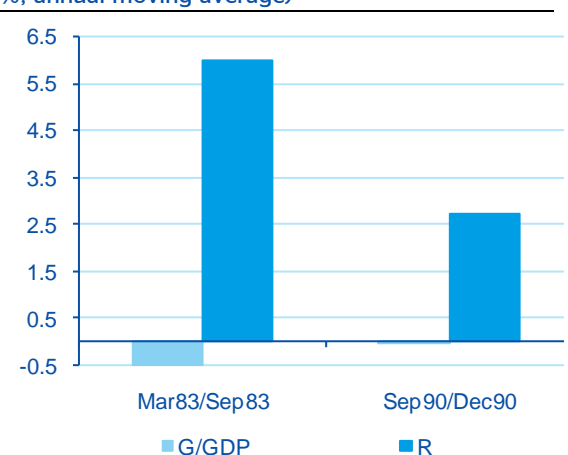
Source: Central Bank of Chile, National Statistics Institute, BBVA Research.
*The case of G/GDP pertains to the difference between the average observed in the period identified as stagflation versus the existent level prior to the start of the episode. The difference between the average level observed in the period identified as stagflation versus a historical average is considered for R.

Lastly, we observe that demand factors would also appear to have a concurrent influence on periods of stagflation. As the literature suggests, these episodes could be exacerbated by a poor co-ordination of monetary and/or fiscal policy. High levels of real long-term interest rates as well as declines in the real level of the expenditure-to-GDP ratio would be variables that would coincide with these episodes (Figure 5).

We thus conclude that there are likely to be very few episodes of stagflation, and that all of these would be characterised by **weak macroeconomic institutionalism.**

In the following section, we will relax the criterion toward one in which growth lies below potential (regardless of the deviation's magnitude) and inflation above the target (regardless of whether or not it is rising), and empirically assess the likelihood of observing said events. **Under this less strict criterion, more periods of "high inflation and low growth" will be observed, which will allow us to determine their likelihood of occurrence by using a simple model.**

Impacts on the likelihood of a sub-potential growth and above-target inflation scenario

We relax the conditions of our definition in expression **(1)** and establish an alternative described by **(1')**. The reason for adopting this less-demanding approach responds to the low frequency of stagflation scenarios observed, and the search for the determinants of "high inflation and low growth."

$$h_t(y_t, \pi_t) = \begin{cases} 1, & if \ y_t - \overline{y}_t < 0 \quad (a') \\ & \wedge \ \pi_t - \overline{\pi}_t > 0 \quad (b') \\ 0, & for \ the \ rest \end{cases} \qquad (1')$$

Our alternative function removes condition **(b)** from expression **(1)** in the previous section, with respect to the requirement for an absolute value of observed deviation of growth versus potential higher than one standard deviation of trend growth. Furthermore, we relax condition **(d)**, which establishes the requirement of rising inflation on the margin.

All of the aforementioned modifications cause function f_t, which describes the frequency of the episodes of stagflation in Chile, to be included in our new algorithm h_t[5]. This is made clearer in Figure 6, which reveals that the episodes we have considered as stagflation are a subset of our alternative algorithm **(1')**, defined by the grey areas as periods of sub-potential growth and above-target inflation.

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[5] Strictly speaking, it is true that $f_t \subseteq h_t$.

Figure 6
Deviation of GDP versus potential and deviation of CPI versus target (% var. YoY)*†
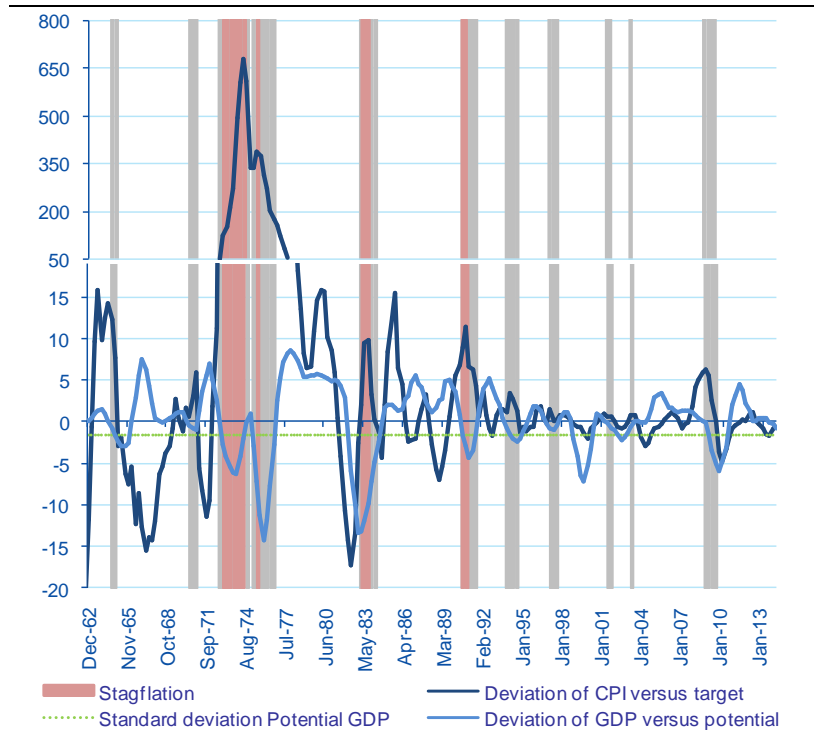
Source: Central Bank of Chile, DIPRES, INE, BBVA Research.
*Grey areas identify episodes of persistent sub-potential growth, and above-target inflation.
†The annual variation of the moving average for the last four quarters is considered for GDP, to account for the adjective "persistent" in our definition. We consider the average annual variation per quarter for CPI.

Table 1 displays the statistical description of the frequencies returned by both algorithms in the full sampling[6]. As we noted in the previous section, a frequency of stagflation episodes of merely 6% is observed. This frequency is found in 22% of the identified periods of persistent sub-potential growth, and above-target inflation[7].

Table 1
Descriptive statistics of h_t and f_t in full sampling

	h_t	f_t
Average	0.22	0.06
Median	0.0	0.0
Standard deviation	0.41	0.24
Sum of observations	45	13
Number of observations	209	209

Source: Central Bank of Chile, Budget Office, National Statistics Institute, BBVA Research.

In short, given the dichotomous nature of our dependent variable, we attempted to replicate the data distribution generated by function h_t with a logit model described in expression (2).

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[6] The full sampling is defined by the quarterly data from Q4 1961 to Q4 2013.
[7] Within this context, periods of stagflation account for 27%=6%/22% of the identified periods of persistent sub-potential growth, and above-target inflation.

$$Prob(h_t = 1|X_t) = \Lambda(\beta X_t + \mu_t) = \frac{1}{1 + \exp[-(\beta X_t + \mu_t)]} \qquad (2)$$

Where X_t is a set of macroeconomic variables commonly used in the literature as determinants of stagflation episodes, while we assume μ_t to be white noise with normal distribution. For its part, β is the vector of parameters to be estimated, associated with the regressors in our specification. Given the limitations in terms of information, we also took a sub-sample of quarterly data from 4Q 1982 to 4Q 2013, a period that includes two of the three episodes identified as stagflation. The statistical description of the dataset used is shown in Table 2.

Table 2
Descriptive statistics for the data sampling used in the model

	h_t	TFP_t	TOT_t	$(G/GDP)_t$	R_t
Average	0.19	0.55	6.47	22.89	7.14
Median	0.00	0.48	1.84	20.82	7.02
Maximum	1.0	7.6	81.0	32.6	14.7
Minimum	0.0	-5.0	-26.7	19.0	3.9
Standard deviation	0.40	2.32	18.76	3.87	2.27
Sum of observations	24.0	68.5	809.0	2,861.9	892.7
Number of observations	125	125	125	125	125

Source: Central Bank of Chile, Budget Office, National Statistics Institute, BBVA Research.

What follows is a description of the regressors that we considered in the model, and the theoretical impact that these variables, in and of themselves, have on the likelihood of a scenario of persistent sub-potential growth, and above-target inflation[8]:

(a) Total Factor Productivity (TFP): A negative shock to TFP reduces the supply of goods and services for each price level, which leads us to expect that reductions (increases) in TFP growth rates increase (reduce) the likelihood of stagflation[9].

(b) Terms of Trade (TOT): a negative shock to TOT and the respective currency depreciation associated therewith increases the cost of imported production inputs, such as oil and capital goods, contracting the supply of goods and services for each price level. However, it is also contractive for aggregate demand, which could end up containing the pressure on the use of domestic resources, and its effect on inflation. In the case of Chile, we should note that reductions (increases) in TOT growth rates increase (reduce) the likelihood of sub-potential growth and above-target inflation[10].

(c) Government Expenditures to GDP ratio (G/GDP): A fiscal imbalance leading to levels of expenditure that are inconsistent with a sustainable borrowing pattern may result in inflation. On the other hand, significant contractions in spending can also exacerbate the impact of a supply shock on activity. In small and open economies, the sign of the parameter with which G/GDP interacts, and the likelihood of an episode of sub-potential growth and above-target inflation, would be contingent upon the degree of *Ricardianism* (or the way in which households and companies

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[8] For the effects of the estimate, it is worth noting that we lagged all the aforementioned variables by one period (quarter), to correct potential endogeneity problems, particularly those in the calculation of the residual TFP series and in the determination of R.
[9] For purposes of estimation, we considered the annual variation of the four-quarter moving average of the TFP index, built based on the methodology defined by the Chilean Committee on Potential GDP.
[10] For purposes of estimation, we considered the annual variation of the four-quarter moving average of the TOT index, obtained from the Central Bank of Chile's database.

pre-empt rises in fiscal spending) and upon the level of credibility given to fiscal rules. We do not rule out that reductions (increases) in this variable may increase (reduce) the likelihood of a scenario of sub-potential growth in the case of Chile, which is characterised by a relatively higher fiscal rule credibility[11].

(d) Real Long-Term Rate (R): Rises in real rates increase the cost of capital use, reducing companies' desired capital stock (lower investment). This contracts the aggregate supply for each price level. Furthermore, it discourages private consumption by making current consumption relatively more expensive. Taylor rule-based inflation-targeting schemes in the management of short-term nominal rates allow us to interpret rises in R as a response to undesired pickups in observed inflation that have implications on medium-term inflation expectations. Reviewing the empirical works that check for this variable, we expect to find that rises (falls) in R increase (reduce) the likelihood of a scenario of sub-potential growth and above-target inflation[12].

The likelihood function returned by equation (2) is used to estimate the model's parameters by maximum likelihood, with the covariance matrix corrected by the GLM. The results of the estimate are shown on Table 3. All variables used are significant at 5%, while the signs of the parameters are consistent with the findings of the literature.

Table 3
Estimate results

Variable	Ratio	Standard error	Statistical t
TFP_t	-0.44	0.112	-3.91
TOT_t	-0.09	0.025	-3.68
$(G/GDP)_t$	-0.17	0.034	-4.93
R_t	0.30	0.091	3.31
Regression standard error	0.336	Akaike criterion	0.722
Residual sum of squares	13.66	Schwarz criterion	0.813
Log likelihood	-41.15		

Source: Central Bank of Chile, Budget Office, National Statistics Institute, BBVA Research.

Furthermore, the model concludes that, according to the identified determinants, **the likelihood of a scenario of persistent sub-potential growth, and above-target inflation increased from 3% in late 2011 to 9% in 1Q14. Even so, that likelihood is quite distant from what we might deem to be consistent with a scenario of stagflation for Chile. The periods that coincide with a scenario of this type in our model would be associated with a conditional likelihood of over 82% (Figure 7).** Under the assumptions of our baseline scenario for the Chilean economy for the 2014-15 period, that conditional likelihood would not exceed 12% (reaching this peak in 1Q15), which is still considerably lower than the conditional likelihood associated with the episodes identified as stagflation (Figure 7).

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[11] For purposes of estimation, we built a quarterly series for the G/GDP ratio in real terms, based on effective government expenditure information reported by the Budget Office and GDP data published by the Central Bank of Chile.
[12] For purposes of estimation, we considered an annual moving average of the banking system's real lending rates for periods of more than three years.

Figure 7
Estimated likelihood of episodes of sub-potential growth and
above-target inflation (%)*†
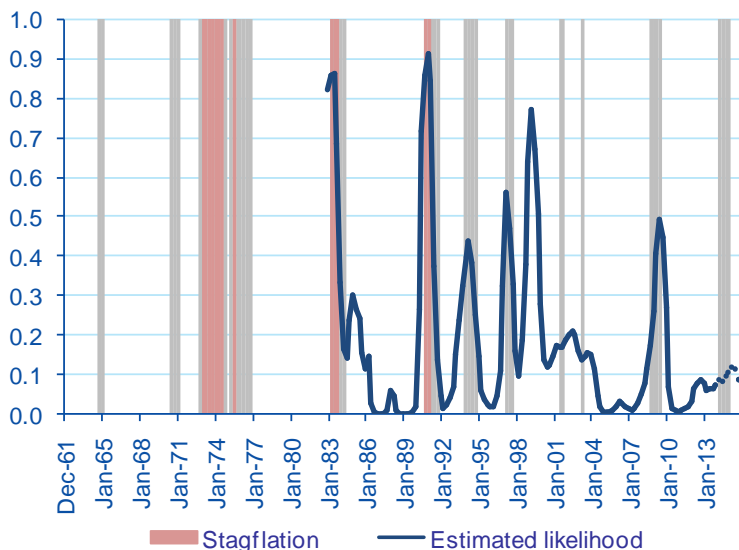
Source: Central Bank of Chile, National Statistics Institute, BBVA Research.
*Dotted line reflects predicted likelihood conditional to our baseline scenario for 2014-15.
†Grey areas identify episodes of sub-potential growth and above-target inflation.

Within this context, the model presents a considerable ability to explain the identified episodes of "high inflation and low growth." Nevertheless, there is just one period, related to the effects of the 1998 Asian crisis, in which the model's estimate of the conditional likelihood was high, approaching what would be deemed as a period of stagflation (the predicted likelihood reached a peak of 77%). For its part, our alternative algorithm does not even interpret it as a combined episode of persistent sub-potential growth, and above-target inflation (grey areas on Figure 7). The reason is that, while activity indeed deviated over one standard deviation of potential GDP (even somewhat higher than that associated with the stagflation of the 1970s), inflation immediately receded to levels below the target (Figure 6). Therefore, we understand the model's predictive limitations and the potential of its returning "false alarms." In this regard, the model's estimated likelihood is solely a reflection of what the determinants indicate.

By breaking down the effects of the regressors on the estimated linear equation, we can find not only the critical value associated with periods identified as "high inflation and low growth" (Figure 8), but also the factors that would explain the slight rise in likelihood. In this regard, we see that the declines of both TOT and TFP explain the rise in likelihood, partially offset by lower real interest rates.

Figure 8
Breakdown of linear regression βX*
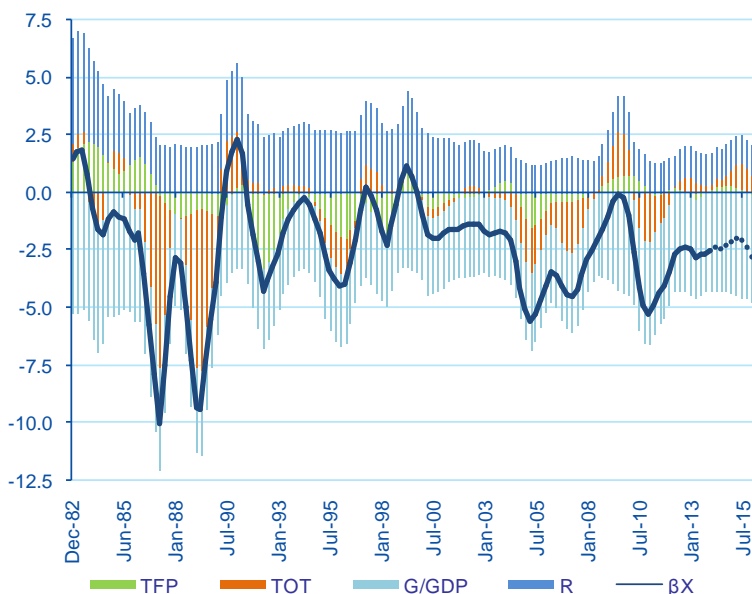
Source: Central Bank of Chile, National Statistics Institute, BBVA Research.
*Dotted blue line reflects predicted factor associated with our baseline scenario for 2014-15.

Only a scenario of intensified falls in TOT and TFP (e.g., from China-related risks and a poor public/private agenda in terms of productivity), in combination with major rises in real interest rates, could bring us closer to a more complex scenario for the domestic economy.

We calculated the marginal effects on the likelihood of a scenario of persistent sub-potential growth, and above-target inflation, by considering a standard deviation for each of the explanatory variables. They are shown on Table 4.

Table 4
Marginal effects on likelihood of h_t

Variable	Standard deviation	Marginal effect
TFP_t	-2.3	+0.07
TOT_t	-18.8	+0.12
$(G/GDP)_t$	-3.9	+0.04
R_t	2.3	+0.05

Source: Central Bank of Chile, Budget Office, National Statistics Institute, BBVA Research.

When analysing the marginal effects, we find that in the case of a negative shock to TOT of 18.8% (all else remaining constant), the likelihood of a scenario of sub-potential growth and above-target inflation would rise by 12pp from the current 9% that the model projects as at 1Q14, that is, a value of 21%. This drop in TOT could be triggered both by a decline in the copper price of a similar magnitude and by a rise of equal proportion in the oil price (or, alternatively, by a combination of both consistent with the fall assumed for the TOT). Taking only the copper price into account, it would have to display a strong decline, from levels of USD3.15/lb to USD2.60/lb. Within this context, the price of the metal would have to fall below our long-term price estimate (USD2.80/lb) on a persistent basis. Alternatively, the price of WTI oil would have to rise from USD105/barrel to around USD125/barrel.

The latter notwithstanding, we have disregarded the marginal effects that arise from policy response, which should make up for the rise in the likelihood of a persistent scenario of "high inflation and low growth" derived from the fall in TOT assumed in this exercise. In effect, within Chile's current institutional framework, both monetary and fiscal policy will display countercyclical effects, warding off a persistent scenario of low growth and high inflation.

Conclusions and policy implications

Based on our analysis, we rule out the contention that the current domestic scenario may be deemed as one of stagflation. Under the current political framework, it should not be surprising to observe above-target inflation and persistent sub-potential growth as a process of adjustment in relative prices. What is more, these scenarios have occurred on a relatively frequent basis (which we identified at around 19% of the time) since Chile's institutional changes and economic policy rules began.

For the current situation to acquire greater persistence and effectively become an episode of stagflation, extremely significant external shocks are required. On an idiosyncratic level, they could be triggered by a public agenda that turns a blind eye to the problems in domestic productivity (associated with the rise in energy costs and the low levels of human capital quality). Lastly, the potential for a tax reform that would materially deviate from the fiscal rule (which we presently do not expect the current administration to adopt) could exacerbate and entrench the current scenario, particularly due to the effects on real interest rates that would arise from an expansion in the size of the State that veers away from the current framework of fiscal policy.

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