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TCH Bank Conditions Index

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Francisco Covas
+1.202.649.4605
francisco.covas@theclearinghouse.org

INTRODUCTION

This research note provides a description of the methodology used to construct TCH Bank Conditions Index (TCHBCI). The index is a quantitative assessment of the resiliency of the U.S. banking sector and will be used to support a variety of TCH's research initiatives. The index is constructed using a wide range of indicators that are commonly used to characterize the condition of the banking sector.

Following the aftermath of the past global financial crisis, a series of key capital and liquidity regulations have been enacted - Basel III, annual stress tests, GSIB capital surcharge - which have contributed to an increase in banks' capital levels, more liquid balance sheets and a reduction in the degree of connection between financial institutions. Among many other potential uses, the TCHBCI will help researchers to assess the impact of changes in the regulatory landscape on overall bank condition as well as a large variety of banking indicators.

In the first section of the note, we provide an overview of the construction of the TCHBCI that synthetizes data on 23 banking indicators, grouped into six categories: capital, liquidity, risk-appetite, asset quality, interconnectedness and profitability. Each category is comprised of several banking indicators and the choice of the variables included in each category follows a large academic literature on banking crises.

While an index value of 100 is consistent with a maximally resilient banking system, it is probably not the level most conducive of robust economic growth. On the one hand, having extremely safe banks is desirable from a financial stability perspective as vulnerabilities in the banking system amplify and propagate adverse economic and financial shocks, resulting in severe and persistent economic downturns. On the other hand, a banking system that takes no risk will also have an adverse impact on economic growth over the medium and longer term, namely by restraining credit to borrowers that are bank-dependent (e.g., small firms) and via higher lending rates on loans to all types of borrowers.[1]

These factors suggest that there is an optimal level of TCHBCI that balances between these two extreme cases. We find in our analysis that a value of the index of about 60 maximizes the contribution of the TCHBCI in tracking future GDP growth. Currently the TCHBCI is at 77, which is higher than the optimal level indicated by our statistical model, suggesting that banking regulations could be holding-up economic growth somewhat.

METHODOLOGY

The construction of TCH Bank Conditions Index is done in three steps:

» First, the variables that comprise the index are grouped into six categories: capital, liquidity, risk-taking, asset quality, interconnectedness and profitability.

» Second, the index for each category is calculated by taking a simple average across all variables included in that category. Each variable is standardized before calculating the average so that they are in the same units.

1 See "The two-speed economy," Goldman Sachs, April 2015.

» Third, the TCHBCI is constructed by taking a simple average across all the six categories included in the index and then mapping it onto the (0,100) interval corresponding to the percentile of its empirical cumulative distribution function. A value of the index close to 100 corresponds to a banking sector that is the least vulnerable as it has ever been since the start of the analysis. In contrast, a value close to 0 implies that the U.S. banking sector is as vulnerable as it has even been relative to the start of the sample. A value of the index close to 50 indicates that the level of vulnerabilities is in the midpoint of its historical range.

To implement the construction of the index we use all top-tier bank holding companies that filed a Consolidated Financial Statements for Bank Holding Companies (the FR Y-9C form) in any quarter from the first quarter of 1996 to the third quarter of 2016. Table 1 lists all variables included in TCHBCI across all of its six categories, alongside some of the historical values of each series. The choice of indicators is based on the academic literature on banking crises and financial distress.[2]

The first category is capital, which measures the ability of the banking sector to absorb losses. This category is comprised of both risk-based as well as non-risk based capital measures and includes all four regulatory capital ratios included in the U.S. stress tests and it is augmented with a measure of market leverage developed by NYU Stern's Volatility Laboratory model.[3]

The second category includes measures of bank liquidity and maturity transformation, to gauge the banking sector's ability to absorb reductions in the liquidity of its assets or availability of its funding without defaulting or pulling back from the provision of liquidity counterparties. Such resiliency reduces the risk of spillover from the financial sector to the real economy. The measures of liquidity in the banking sector included are a proxy for the share of high-quality liquid assets relative to total assets, the net stable funding ratio, short-term wholesale funding and the maturity gap.

The third category includes measures of bank risk-taking to assess the vulnerability of banks' balance sheets to aggregate shocks. This category includes average risk-weights, defined as the ratio of risk-weighted assets to total assets, the ratio of loans to deposits, the ratio of loans to gross domestic product and changes in lending standards reported in the Federal Reserve's Senior Loan Officer Survey. We included the loans-to-GDP ratio in this category since there is an influential academic literature that demonstrates that credit growth is a powerful predictor of financial crisis.

The fourth category includes measures of asset quality, to evaluate the health of banks' loan books. This category includes net charge-offs, loan loss reserves, the share of non-performing loans, and the adequacy of loan loss reserves.

The fifth category includes measures of interconnectedness among banks, to capture the extent to which a negative shock could lead to fire sale spillovers that arise when a

2 See "An assessment of the long-term economic impact of stronger capital and liquidity requirements," Basel Committee on Banking Supervision, August 2010 and the references therein.

3 See the references listed on a recent TCH blog post available at https://www.theclearinghouse.org/eighteen53-blog/2016/july/ccar-vs-vlab.

TABLE 1: INDICATORS INCLUDED IN TCH BANK CONDITIONS INDEX

INDICATORS	AVERAGE	MINIMUM	MAXIMUM	LATEST VALUE
Capital				
Common equity tier 1 ratio (%)	8.9	5.4	12.3	11.9
Tier 1 capital ratio (%)	10.3	8.0	13.6	13.1
Total capital ratio (%)	13.3	11.3	16.0	15.6
Leverage ratio (%)	7.3	5.6	9.3	9.3
Market leverage ratio under stress (%)	6.9	1.4	11.5	4.8
Liquidity				
High-quality liquid assets ratio (%)	11.6	4.3	22.4	21.9
Maturity gap (years)	4.6	3.1	5.3	5.3
Net stable funding ratio (%)	101.4	86.9	124.2	121
Short-term wholesale funding (%)	38.0	26.5	50.5	26.7
Risk-taking				
Average risk-weighted assets (%)	68.6	59.4	76.1	68.5
Loan to deposit ratio (%)	91.7	76.0	104.3	78.6
Total loans to GDP (%)	-0.1	-2.6	7.1	0.6
Changes in lending standards	6.3	-24.1	83.6	11.6
Asset Quality				
Reserves to loan ratio (%)	1.9	1.2	3.9	1.4
Non-performing loans ratio (%)	2.1	0.8	6.0	1.7
Net-charge-offs (%)	1.0	0.4	3.7	0.5
Reserves to non-performing loan ratio (%)	114.7	57.6	191.6	81.9
Size/Interconnectedness				
Herfindahl index for total assets (index)	5.4	2.5	7.7	6.7
Exposure to financial entities (%)	9.1	5.2	13.3	9.7
Profitability				
Return-on-assets (%)	0.9	-1.4	1.4	1.0
Return-on-equity (%)	10.5	-17.4	19.7	8.3
Net interest margins (%)	3.1	2.3	4.3	2.4
Non-interest income to assets ratio (%)	0.7	0.2	1.0	0.6

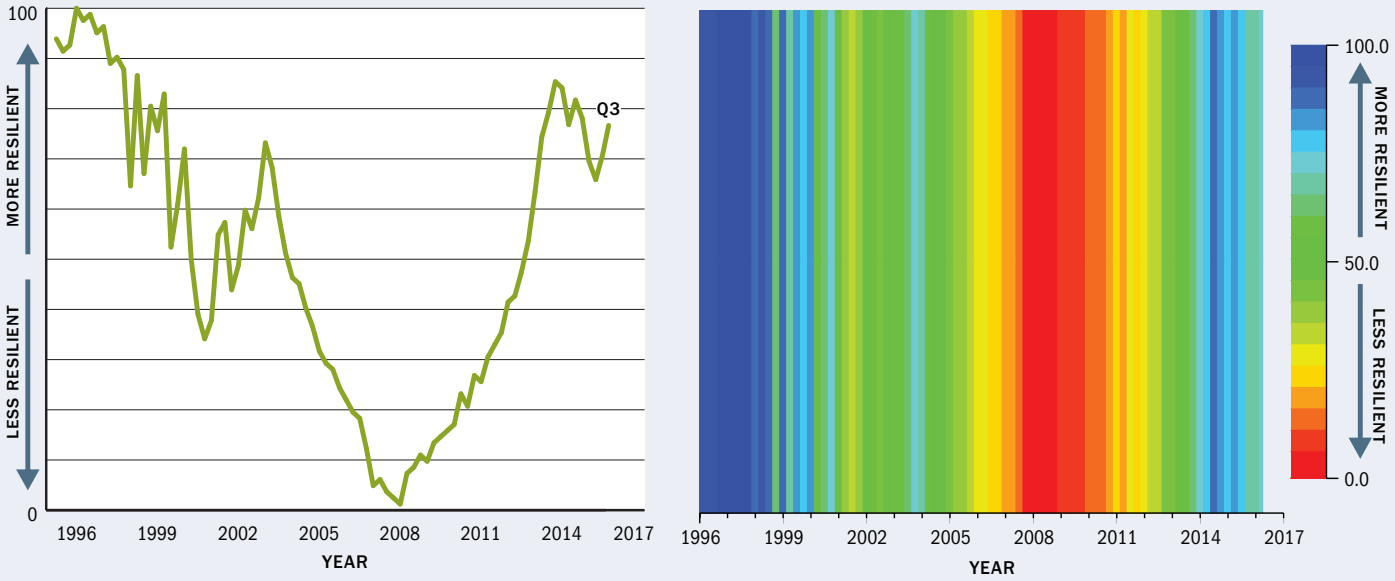
Notes: *Sample period: quarterly data from the first quarter of 1996 and the third quarter of 2016, unless otherwise noted. See online appendix for the definitions of the variables.*

bank has to liquidate assets. If the banking sector is very concentrated, it is more likely that the actions of one large bank generate severe fire sales externalities in financial markets. This category includes a measure of bank concentration—the Herfindahl index for total assets—as well as the ratio of loans made to other depository institutions, repos and federal funds sold to total assets.

Finally, the sixth category provides a gauge on the level of bank profitability. Bank profits are a source of strength, that is banks that are profitable are able to increase retained earnings and better able to withstand adverse shocks. This category includes return-on-assets, return-on-equity, net interest margins and the share of noninterest income in total assets.

Both the aggregate index as well as all the sub-indexes are mapped into the (0,100) interval in order to allow for a straightforward

EXHIBIT 1: TCH BANK CONDITIONS INDEX



comparison of each category over time. Namely, a value of the index close to 100 corresponds to a banking sector that is the least vulnerable as it has ever been since the first quarter of 1996, the first available data point of the index. In contrast, a value close to 0 implies that the U.S. banking sector is as vulnerable as it has even been over the past two decades. Neither of the two extremes is ideal for economic growth. When the level of vulnerabilities is elevated there is a high probability of a banking crisis and thereby a potential large loss in output if the economy is impacted by an adverse economic or financial shock. In contrast, when the level of vulnerabilities is very low credit is being constrained to creditworthy borrowers and lending costs are excessive, which will have an adverse impact on economic growth over the medium and longer term.

RESULTS

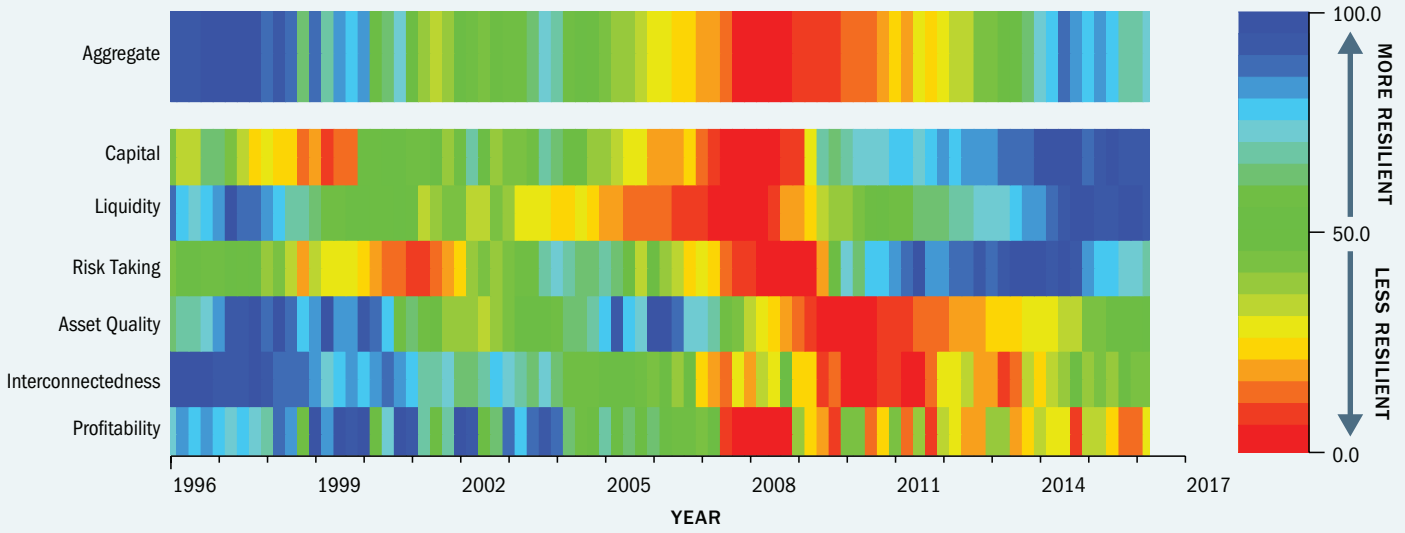
The left panel of Exhibit 1 shows the time-series of TCH Bank Conditions Index since the first quarter of 1996, the first available data point of the index. The index decreased somewhat during the recession in the early 2000s and fell significantly during the 2007-2009 global financial crisis. Note that the decline in the TCHBCI is gradual, and tends to show some signs of vulnerability in the years prior to the start of a financial crisis. In contrast, popular measures of systemic risk such as conditional Value-at-Risk (Adrian and Brunnermeier, 2011) and systemic expected shortfall (Acharya et al, 2011), only started to detect vulnerabilities in the banking system at the onset of the financial crisis. Currently, the index is at a level consistent with a low level of vulnerabilities in the U.S. banking sector, reflecting the significant increase in the capital and liquidity positions of U.S. banks.[4]

The right panel of Exhibit 1 plots the heat map of TCHBCI by assigning a color to each percentile of the index. Values near 100 (more resilient) are show in dark blue, indicating that the banking system is extremely safe, while values near zero (less resilient) are shown in red, indicating the presence of significant vulnerabilities in the banking sector. As pointed out earlier, a banking system that takes no risks will likely have an adverse impact on economic growth over the medium and long term by restraining credit to borrowers that are bank-dependent.

4 Adrian, Tobias and Markus K. Brunnermeier, "CoVaR" American Economic Review, July 2016, 106(7): 1705–1741.

Acharya, Viral, Lasse Pedersen, Thomas Philippon and Matt Richardson, "Measuring Systemic Risk", Forthcoming, Review of Financial Studies.

EXHIBIT 2: TCH BANK CONDITIONS INDEX



Similarly, a banking system that exhibits a high level of vulnerability will amplify and propagate adverse economic and financial shocks.

Exhibit 2 shows the heat map for each of the categories that comprise the aggregate index. As shown to the leftmost part of the chart, in the mid-1990s the large majority of categories of TCHBCI were hovering around the midpoints of their historical ranges, with the exception of the interconnectedness category which showed a very low level of vulnerability. As noted earlier, the aggregate index indicates that the level of vulnerability of the banking sector was quite low in the mid-1990s. Thereafter, the condition of the banking sector remained extremely resilient until the Russian crisis in late summer and early fall of 1998, where the aggregate index dipped to a value slightly above 50. As shown in the heat map chart, the downward spike in TCH's index in 1998 is entirely driven by a sharp fall in the risk-taking category, in particular driven by a tightening in lending standards and an increase in average risk-weights (not shown). Over the next two years, the TCHBCI recovered but only for a brief period until the recession that occurred in the early 2000s. The recession was associated with a deterioration in liquidity and risk-taking in the banking sector. Between 2002 and 2005 the index recovered to levels around the middle of its range. After that, there was a widespread decrease in all categories of the index until the onset of the 2007-2009 global financial crisis. The categories that started showing the most vulnerability were liquidity and capital, respectively. During the past financial crisis, the increase in the vulnerability of the banking sector became widespread across all categories of the overall index.

In the aftermath of the crisis, the TCHBCI shows that the capital and liquidity positions of U.S. banks have improved significantly. Risk-taking has remained at relatively subdued levels and has increased only slightly over the past few years, mostly driven by an increase in risk-weights as a result of changes in regulation. Meanwhile, the level of bank profitability remains well-below the levels observed prior to the past financial crisis and the degree of connectivity among financial institutions has decreased at a moderate pace in the post-financial crisis period.

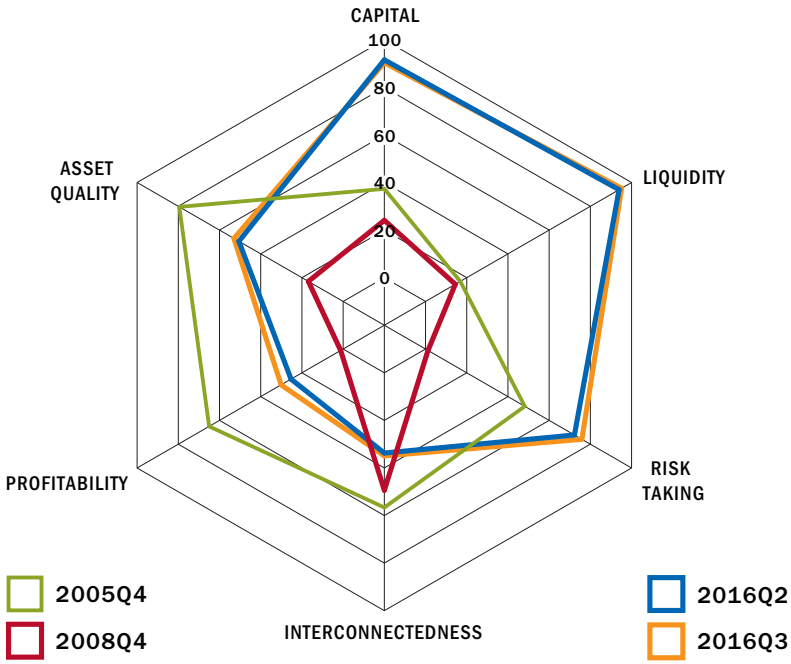
Exhibit 3 describes the behavior of each of the six categories that comprise TCHBCI at 3 different points in time: (i) the end of 2005, (ii) the end of 2008, and (iii) the most recent quarter. Points plotted near the center of the chart indicate a high degree of vulnerability in that category while points plotted near the rim indicate high resiliency. The aggregate index

started to show some decreased resiliance in the banking sector towards the end of 2005 (left panel, Exhibit 1). As shown by the green line in Exhibit 3, capital, liquidity and risk-taking categories had declined to relatively low levels by the end of 2005, significantly before the first signs of the financial crisis were felt in the summer of 2007. As shown by the red line, in the fourth quarter of 2008, the quarter immediately after the failure of Lehman Brothers, almost all categories of the aggregate index were at very low levels. Over the years since the crisis, almost all categories of the index have improved considerably, as shown by the blue line in Exhibit 3, especially the capital and liquidity positions of U.S. banks. These remarkable improvements largely reflect the increase in capital requirements and the more stringent liquidity requirements that are part of Basel III as well as the U.S. stress tests that have continued to curtail the dividend payouts of large banks. TCHBCI has declined a bit in recent quarters driven by increases in risk-taking, due to increases in average risk-weights (Basel III implementation) and weaker profitability (reflecting subdued NIMs and the decline in fee income, not shown).

PREDICTIVE POWER OF TCH'S BANK CONDITIONS INDEX

This section studies the empirical relationship between TCHBCI and the growth rate of real GDP. The objective is to provide an assessment of which values of TCHBCI are most likely to be associated with robust economic growth. As pointed out earlier, values of the index close to 0 or 100 are likely to have a negative impact on economic growth. Specifically, values of TCHBCI close to zero imply that the banking system is too vulnerable and likely to be a source of amplification and propagation of adverse economic and financial shocks. In contrast, values of TCHBCI close to 100 reflect an extremely safe banking sector that is unwilling to take on risk and support robust economic growth.

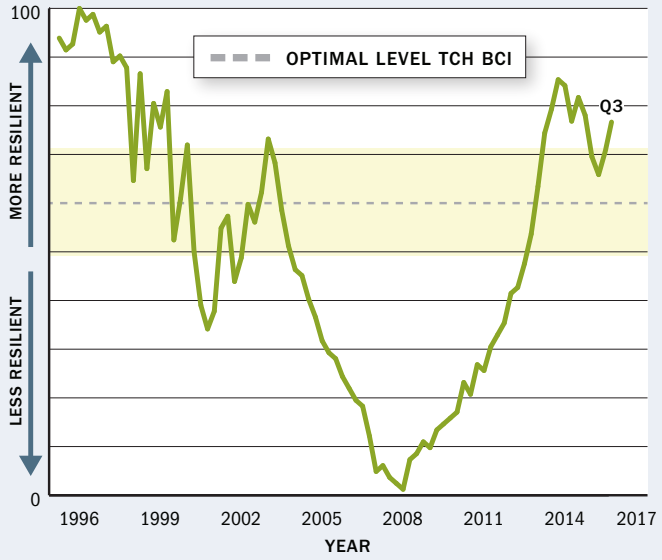
EXHIBIT 3: RADAR PLOT OF TCH BANK CONDITIONS INDEX COMPONENTS



In order to establish a baseline value of TCHBCI that would be most supportive of robust economic growth, we first investigate whether TCHBCI helps track future GDP growth. Next, we study which values of TCHBCI are most supportive of robust economic growth. Our estimate provides a baseline value of the index to evaluate the overall degree of tightness of conditions in the banking sector.

In our empirical specification the dependent variable is the growth rate of real GDP and includes as explanatory variables TCHBI, the squared-value of TCHBCI and Goldman Sach's Financial Conditions Index (GS FCI). The reason we also included GS FCI in our regression was to study if TCHBCI had additional useful information to track future GDP growth besides the one already included in a well-established financial conditions index.

EXHIBIT 4: OPTIMAL LEVEL OF TCH BANK CONDITIONS INDEX



Note: The shaded area denotes the confidence interval of the estimate of the optimal level of TCH BCI, that is the value of the index that maximizes the contribution of TCH BCI in tracking future GDP growth.

In addition, the inclusion of nonlinear terms for the TCHBCI allows us to test whether the impact of the index on GDP growth increases linearly with the level of our banking conditions index, or if there is an inflexion point, beyond which more resiliency in the banking sector dampens economic growth. The results presented in the appendix show that the value of TCHBCI that maximizes its contribution to future GDP growth is about 60 (near the upper end of the green zone in the heat map). Exhibit 4 plots the time-series of TCH Bank Conditions Index, the estimate of the optimal value of the index and the 95 percent confidence interval around the estimate, which varies between 49 and 72. The empirical specification and results are available in the appendix. ■

APPENDIX

To carry out our empirical test to determine the optimal level of TCHBCI that is most conducive of robust economic growth we estimate the following regression model:

$$(y_t - y_{t-4}) = \beta_0 + \sum_{i=1}^{p} \beta_i (y_{t-i} - y_{t-i-4}) + \sum_{i=0}^{q} \gamma_i x_{t-i} + \sum_{i=0}^{q} \varphi_i x_{t-i}^2 + \sum_{i=0}^{r} \delta_i w_{t-i} + \varepsilon_t$$

where y_t denotes the logarithm of real GDP, x_t represents the TCHBCI, w_t is the GS financial conditions index, ε_t is the error term and p, q and r represent the number of lags of each variable included in the right hand size of the regression. The number of lags for each regressor was determined using the Akaike Information Criteria (AIC). To account for the fact that some of the series in the capital and liquidity categories are only available in the fourth quarter of 2001, all regression analysis start after that.

Table 2 shows the estimated coefficients of the model represented in equation (1). The first column reports the regression results of an univariate model for the growth rate of real GDP. The AIC chose a model that exhibits some persistence, in which the growth rate of GDP in the current quarter depends on the past two quarterly values of real GDP. The autoregressive model is stable, since the sum of the autoregressive coefficients is less than 1. The second and third columns show the results by adding TCH's bank conditions index to the model contemporaneously and lagged one quarter, respectively. In both instances, the coefficient for TCHBCI is positive and statistically different from zero at the 5 percent level, implying that higher values of the index are associated with higher growth rates of real GDP. Adding the TCHBCI to the regression

improves the fit of the model as reflected by a lower AIC and slightly higher R-squared. The fourth column shows the regression results when the squared value of TCHBCI is also included in the empirical model. The coefficient on TCHBCI^2 has a negative sign and it is statistically different from zero, suggesting the relationship between the level of TCH bank conditions index and future economic activity is nonlinear. Specifically, the marginal effect of an increase in TCHBCI on future GDP growth is given by $\hat{\gamma_1} + 2\hat{\varphi}_1 x$, which depends on the level of TCHBCI. Solving for the value of TCHBCI that maximizes its contribution to future GDP growth we get it to be $-\hat{\gamma_1}/2\hat{\varphi}_1$ or 57 (near the upper end of the green zone in the heat map). The results presented in column 5 include only the lagged values of real GDP growth and contemporaneous GS FCI (lagged values of the GS FCI were insignificant). Finally, the last column of Table 2 shows that TCHBCI remains an important predictor of real economic activity even after controlling for GS's financial conditions index. The specification estimated in column 6 is superior to the model presented in column 4, as evidenced by the lower AIC and higher R-squared, and the "optimal" value of TCHBCI remains to be around 60.

TABLE 2: PREDICTIVE POWER OF TCH BANK CONDITIONS INDEX

EXPLANATORY VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta^4 y_{t-1}$	1.305***	1.249***	1.253***	1.210***	1.183***	1.085***
	(0.121)	(0.108)	(0.113)	(0.100)	(0.092)	(0.103)
$\Delta^4 y_{t-2}$	-0.486***	-0.479***	-0.499***	-0.501***	-0.455***	-0.470***
	(0.107)	(0.109)	(0.113)	(0.116)	(0.085)	(0.099)
x_t		0.797**				
		(0.368)				
x_{t-1}			0.883**	4.080**		4.159***
			(0.388)	(1.631)		(1.312)
x^2_{t-1}				-3.569**		-3.660***
				(1.657)		(1.320)
w_t					-0.316**	-0.321***
					(0.130)	(0.094)
AIC	2.24	2.21	2.20	2.16	2.15	2.04
R^2	0.82	0.83	0.83	0.85	0.85	0.86

Notes: *Sample period: quarterly data from first quarter of 2001 to third quarter of 2016. The dependent variable in each regression is the fourth quarter change in the logarithm of real GDP. The notation '(t-x)' means that the explanatory variable is lagged 'x' quarters. All specifications include a constant (not reported). The Newey-West robust standard errors are reported in parenthesis. * p-value < 0.10; ** p-value < 0.05; and *** p-value < 0.01.*