The Colombian Financial Cycle, 1987-2021: What role for post-crisis regulation?

El ciclo financiero colombiano (1987-2021): ¿Qué papel para la regulación post-crisis?

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Abstract

The financial cycle consists of the joint evolution of asset prices and credit aggregates. Its regularity has been abundantly studied for panels of countries which regularly include developed countries and sometimes include less developed or developing countries. This paper employs an innovative methodology to analyze the Colombian financial cycle from time series and bivariate perspectives. First, we characterize expansions and contractions in the stock market and the real exchange rate. These are two distinct asset classes that play an essential role as stores of value in middle-income countries. Our analysis is completed by identifying bull and bear phases in the local-currency credit market. We test the hypothesis that the changes in regulation that originated with the end-of-century crisis in the country impacted the evolution of asset prices and credit aggregates. We find that the amplitude and severity of contraction phases decreased post-reforms, which may signal the success of the new regulation. We find no effect on the behaviour of asset prices and argue that this is to be expected since they were not targeted. Finally, we find that the joint movement of stocks and credit peaks during financial crises and troughs during economic expansions, consistent with findings in the international literature.

Keywords: Colombian financial cycle; colombian stock market; colombian credit growth; non-parametric model; colombian financial history; financial cycle.

JEL classification: C14, E32, E44, G01, N16, N26.

Resumen

El ciclo financiero consiste en la evolución conjunta de los precios de activos y el crecimiento de agregados de crédito. Sus regularidades han sido ampliamente estudiadas para paneles de países que suelen incluir economías desarrolladas y, ocasionalmente, economías en desarrollo o países poco desarrollados. Este artículo implementa una metodología innovadora para analizar el ciclo financiero colombiano desde perspectivas de serie de tiempo y de análisis bivariado. En primer lugar, caracterizamos expansiones y contracciones en el mercado accionario y el tipo de cambio real. Estas dos series representan dos tipos de activos que juegan un papel esencial como reserva de valor en países de ingreso medio. Nuestro análisis se complementa con la identificación de fases de expansión y contracción en el mercado de crédito denominado en moneda local. Contrastamos la hipótesis de que los cambios en la regulación, originados por la crisis finisecular del siglo XX en el país, impactaron la evolución de los precios

de los activos y de los agregados crediticios. Encontramos que la amplitud y severidad de las fases de contracción se redujeron después de las reformas, lo que puede ser indicativo del éxito del proceso regulatorio. No hallamos efecto en el comportamiento de los precios de los activos y argüimos que esto es esperable dado que esta variable no era uno de los objetivos de la nueva regulación. Finalmente, observamos que el movimiento conjunto de los mercados de acciones y de crédito llega a un máximo durante periodos de crisis y toca mínimos en periodos de expansión económica. Esto es consistente con los hallazgos en la literatura internacional.

Palabras clave: ciclo financiero colombiano; mercado accionario colombiano; crecimiento del crédito en Colombia; modelos no paramétricos; historia financiera colombiana; ciclo financiero.

Clasificación JEL: C14, E32, E44, G01, N16, N26.

Introduction

The financial crisis of 2008 confirmed what some researchers, particularly at the Bank for International Settlements (BIS), have been saying from the beginning of this century: central banks and regulators cannot assume a direct correspondence between low inflation and financial stability. This equivalence, which was proposed by Bernanke & Gertler (1999) when presenting the benefits of inflation targeting, has an excessive focus on a single target, induces policymakers both to turn a blind-eye on the accumulation of financial imbalances —undue credit and asset price growth— and to privilege non-financial variables such as expected inflation, output gap and unemployment as inputs for models. This issue is not new, as most of the more sophisticated New Keynesian Dynamic Stochastic General Equilibrium (DSGE) models tend to assign a primary role in reassigning resources to the financial system but omit its ability to create purchasing power through the creation of money (Airaudo *et al*., 2015).

The BIS view hypothesized a financial cycle, composed of the joint behaviour of assets and credit, which accumulates imbalances during periods of excessive growth resulting in financial crises as they unwind (Borio, 2014). Recently, a rich set of literature has evolved to contrast this hypothesis by explaining the sources of synchronization/decoupling of the asset and credit cycles, understanding the role monetary policy and capital flows may play in their evolution and deriving implications for both crisis management and prevention. To do so, researchers use diverse definitions of what constitutes "excessive growth" for

asset prices or credit aggregates and employ both parametric and non-parametric techniques to date phases of expansion and contraction.[1]

Most analyses produce a dummy sequence that takes a value of one for crises or busts and a value of zero for calm periods or booms, depending on the research question. These dummy sequences are subject to criticism for several reasons. First, results vary from study to study as there is a lack of consensus on the way of constructing the indicators and on the conditions a variable has to fulfil to determine whether there is a boom or a bust (Schüler, Hiebert, & Peltonen, 2015). Second, since these sequences are distilled from data with significant variability and other statistical properties such as non-stationarity, many times they do not reflect the breadth and informational content of the underlying series (Pagan & Sossounov, 2003). Finally, Romer & Romer (2015) highlight that a dummy sequence does not allow for drawing distinctions between different kinds of booms and busts but treats all booms (or busts) as formally similar events.

Additionally, crises are rare events that force researchers to pool data to perform more robust statistical inferences. That explains why most studies perform analysis of long and wide panels, including several tens of countries, to find the commonalities in the evolution of credit and asset cycles. However, single country analyses are complicated because of the lack of variability in the dependent variable.

The traditional literature on the topic has reached valuable conclusions for the general evolution of the financial cycle: it has shown that asset booms fueled by excessive credit growth have profound long-run consequences when imbalances unwind (Borio, 2014). It has been demonstrated that recessions that are coupled with the unwinding of imbalances tend to be deeper than those that happen independently (Jordà, Schularick & Taylor 2010, 2011, 2014, 2015; Jordà, Schularick, Taylor & Ward, 2018). It has been shown that, contrary to what was expected, crises have become more pervasive in the last quarter of the twentieth century than ever before (Bordo *et al*., 2001). All these stylized facts are derived from large panels of countries that assume them to be comparable. Due to data availability, the databases employed tend to focus on well-known

1 Authors who follow a parametric approach include Hodrick & Prescott (1997) filter or the Band Pass filter as in Christiano & Fitzgerald (2003). Conversely, those who present a non-parametric approach include Bry & Boschan (1971) and Pagan & Sossounov (2003)

(some would say *over-studied*) developed countries with deep financial markets at the expense of less "popular" developing countries, which, although pertaining to part of the sample, tend to be under-represented.

This motivates a study of Colombia as a small economy that, since the mid-1980s, has made the transition to an open, developing country with a growing bank-based financial system and a noted vulnerability to capital flow reversals and sudden stops (Ocampo, 2015). Major reforms conducted since the early 1990s have set forth an independent central bank and a data-driven inflation targeting regime (Uribe, 2013; Kalmanovitz, 2013). With the end-of-century crisis that began in 1998, the government undertook a series of significant reforms to alter the financial system´s institutional framework, avert the crisis, and change the behaviour of the credit market (Arango, 2006; Badel Florez, 2001). Financial reform has been a pervasive element in Colombia since the early 2000s, reflecting the expected tightening of the financial regulatory cycle after a crisis (Rajan, 2009; Hernandez, 2018; Cunha, 2020). This paper aims to answer whether the behaviour of asset and credit markets, the components of the Colombian financial cycle, changed with the onset of these reforms.

A characterization of the Colombian financial cycle, like the one proposed in this paper, will contribute to the international debate by allowing us to contrast or nuance the findings from larger panels. Additionally, this is a pioneer study in Colombian historiography, where economists and economic historians have focused on asset prices or credit aggregates. To our knowledge, no study addresses the question of their evolution from the financial cycle perspective. Furthermore, our definition of asset prices encompasses a stock market index that acts as a proxy for the securities market and a real exchange rate series, reflecting the fact that investors tend to shift their investments into foreign currency as a safe haven when risk aversion increases.[2] Further research could expand this definition to include real estate prices, which are relevant investments in developing countries. Not including them in this paper has a muted impact as real estate prices are noticeably slower to react to innovations in information than more liquid investments (Agnello & Schuknecht, 2011).

We expect that results from this paper will open new avenues of research for academics to focus on developing countries and for Colombian economic

2 We thank Jose Antonio Ocampo for this keen insight which has the added benefit of increasing the coverage of our asset price variable.

historians. Additionally, we will provide a new database for expansion and contraction phases in stock prices, the real exchange rate and credit aggregates in local currency. This database characterizes each phase by its duration, amplitude and severity, as Harding & Pagan (2002) and Forero-Laverde (2013) have done.

To tackle the identification issues discussed above, we will use the Local Bull Bear Indicator (LBBI) developed by Forero-Laverde (2019) to arrive at stylized facts about the evolution of asset prices and credit aggregates between 1987 and 2021. Furthermore, we will provide dating of expansions and contractions in all phases, allowing for their characterization by three different metrics: duration, amplitude and severity. As argued in Forero-Laverde (2013, 2019), the LBBI methodology is preferred above traditional ones for several reasons: it contains more variability than a comparable dummy sequence; its informational content is closer to the original data; it indicates whether there is a boom or bust and it provides a measure of intensity to establish qualitative differences between diverse types of expansions and contractions.

The contributions of this paper to the financial cycle literature are two-fold. First, we find that there seems to be an impact of changes in the regulatory framework to a more repressive stance as credit bear phases become less severe after reforms. This is not true for asset prices since the duration, amplitude and severity of both expansions and contractions remain statistically the same before and after reforms. This is an exciting result as it shows that the policy targeting credit aggregates did not have unintended consequences on the asset price expansion and contraction process. However, it raises questions about the effect (or lack of effect) that additional reforms and the increase in financial rigidity have had on the accumulation of financial imbalances as proxied by the severity of bull phases in asset prices and credit aggregates. Second, the analysis of time-varying contemporaneous correlation coefficients has shown that, for Colombia, the association between the asset prices and credit aggregates has been volatile during the period. Long-run correlations between real exchange rates and credit turn negative during crisis periods (1998-2011) and peak during recoveries (1991-97; 2014-20). This correlation remains low for long periods and takes long to recover. While this may be counterintuitive, we suggest that it relates to the fact that the US dollar is treated as a safe haven for Colombian investors. Conversely, short-run correlations between stock markets and credit peak during crises (1998-2003; 2007-09, 2014-26), but this regularity is far more volatile and has less momentum than that with the real exchange rate.

The rest of the paper is structured as follows. Section 1 presents a description of the institutional context between 1986 and 2021 and closes with an in-depth explanation of the regulatory changes that occurred with the onset of the end-of-century crisis. Section 2 presents the data and some of its more salient characteristics. Section 3 discusses the Local Bull Bear Indicator methodology and offers a first application of the LBBI methodology to the data for identifying expansions and contractions. Section 4 describes the measures of duration, amplitude and severity and characterizes the phases for the three different time-series. Section 5 performs a bivariate analysis of LBBIs for asset prices and credit growth. Finally, section 6 offers a discussion of results, conclusions and future lines of research. The new databases with the dating of phases for the three-time series are included in the annexes.

1. Financial liberalization (1986-2021)

During the more recent period of Colombian economic history, in the tradition of Southeast Asian nations, the country has looked to openness to reap the benefits of global trade (Kalmanovitz, 2007). This period is characterized by changes to the tax system, an increasing number of institutional investors, a tighter monetary policy stance and a more open foreign sector.

First, a wave of tax reforms started in 1979 with the Tax Relief Law (*Ley de Alivio Tributario*) that favoured capitalization across several industrial companies by making investments in newly public companies tax-deductible. Then, in 1983, in the aftermath of the financial crises that happened in the year before[3], the double taxation of joint-stock companies was eliminated, and the tax burden on dividends was halved. However, double taxation was only fully eliminated by 1986, when the stock market had all but disappeared. In that same year, the tax rate on limited liability and joint-stock companies was equalized. Further reform in 1989 eliminated capital taxes on stocks, and a law in 1990 limited the capital gains tax. The last reform in this wave happened in 1992 when tax incentives were offered to investors in the stock market (Cárdenas & Rojas,

3 The Colombian financial crises started in 1982 and lasted until 1986. It started as the Latin-American debt crises of the 1980s developed although it was neither as protracted nor deep in Colombia. The financial crises came with a deterioration of profitability in the banking sector as well as lower loan quality and increasing delinquencies. The cost of the crisis is estimated in 5% of GDP (Ocampo, 2015).

1996). These measures aimed to achieve a larger, more liquid and dynamic stock market. The success of this plan is discussed in the next subsection.

Second, several regulations were issued during this period to modernize the banking sector. For example, Law 45 of 1990 eliminated restrictions to foreign investment in the financial sector. In addition, it developed a simpler system for mergers, acquisitions and liquidation of financial intermediaries. This law also allowed banks to create subsidiaries that could perform as different businesses such as trust funds, leasing companies, securities trading companies and pension funds. Additionally, in 1995, the Banking Supervisory Bureau (*Superintendencia Bancaria*) issued the Banking Regulation Memorandum (*Circular Básica Contable – Circular Externa 100/1995*) in which it regulated banking activities following the Basel accords of 1988. As these best practices have been updated, the regulation has been extended to cover credit, market, liquidity and operational risks in the banking industry (Ocampo, 2015). Furthermore, in 1996, the Joint Company Supervisory Bureau (*Superintendencia de Sociedades*) issued the Basic Legal Memorandum – External Memorandum 006 (*Circular Básica Jurídica- Circular Externa 006*) – that determined the minimum requirements to file for bankruptcy as well as the conditions for forced liquidation. This memorandum operationalizes Law 222/1995 and has been updated frequently to keep up to date with changes to bankruptcy law in Colombia.

Third, creating a private healthcare and pension system through Law 45 in 1990 and Law 100 in 1993 increased the number of institutional investors and thus the demand for liquid assets. Furthermore, Law 45 allowed for a system of parent companies and subsidiaries that broadened the scope of activities for the financial system (Arango, 2006). Additionally, starting in 1990, stockbrokers could establish and run their stock investment funds. In that same year, the issuance of preferred stocks was allowed, addressing the fear of dilution of the owners of many private companies (Cárdenas & Rojas, 1996). Moreover, Law 35 of 1993 broadened the scope of operations financial intermediaries could undertake by breaking the monopoly on savings that had been given to savings and loans companies (*Compañías de Ahorro y Vivienda - CAV*) and allowed for financial corporations (*Corporaciones Financieras*) and leasing companies (*Compañias de Financiamiento Comercial*) to capture resources form the public (Arango, 2006). These institutional framework changes allowed financial institutions to increase in number from 87 in 1985 to 147 in 1996. However, with the financial crises, institutions troughed at 63 in 2003 (Arango, 2006).

Fourth, most of the investments from these new institutional investors were directed to government bonds issued either in local currency or US dollars (Kalmanovitz, 2007; García Bernal, 2015). This trend, which remains today, occurs because the government crowds out private issuers to capture all available savings in the market. This feature of the Colombian market began with a consistent increase in the size of government since the onset of the new constitution in 1991. Between 1991 and 1999, central government expenditures to GDP increased from 8.9% to 16.9% without an associated increase in tax income. Consequently, government debt increased substantially, and the fiscal deficit reached 6.4% of GDP (Perez-Reyna & Osorio, 2018).

Fifth, before 1991, the exercise of monetary policy by the central bank was done by controlling monetary aggregates and not through interest rates because the backward nature of the financial system did not allow for a good transmission mechanism (Urrutia, 2002). Monetary policy was exercised mainly through the use of marginal reserve requirements that were altered as a function of the monetary policy target. With the constitutional reform of 1991, the Central Bank was given independence in its mandate and started restricting the growth of monetary aggregates to break the depreciation-inflation cycle that characterized the previous period. Law 31 of 1992 developed the constitutional mandate and afforded the central bank the role of managing the exchange rate and becoming a credit and monetary authority and lender of last resort, as well as full independence from the government (Arango, 2006). The reduction of inflation to single digits, which started in 1991, substantially favoured the development of the financial market in terms of mitigating agents' expectations about future price growth (Kalmanovitz, 2007, 2013). Additionally, the constitutional reform released the central bank from its activities as a development bank and granted it full independence, although by 1999, the constitutional court declared that decisions by the central banks had to consider general economic policy (Uribe, 2013; Ocampo, 2015). By 1994, through External Resolution number 14, the central bank altered the use of marginal tax rates definitively to make it more flexible: calculation of marginal reserve requirements would be done on a biweekly basis, and excesses or defects in reserves could be carried over to the next period (García Bernal et al., 2015). Starting in 1999, after the abandonment of the crawling corridor exchange rate regime, an inflation-targeting regime was implemented in Colombia. This policy was of paramount importance for the country´s inflation to decrease after almost two decades of remaining consistently high (Torres, 2008; Kalmanovitz, 2013; Perez-Reyna & Osorio, 2018).

Sixth, during this period, the foreign sector became more open to attract more foreign direct investment (FDI) and benefit from international trade. This was the expected mechanism behind President Cesar Gaviria's (1990-94) program for economic openness (*Apertura Económica*). Law 9 of 1991 eliminated the 49% ceiling of a company's property that could be held by foreigners (Arango, 2006). Foreign direct investment had grown very slowly, averaging 1% per year since the Second World War up until the 1980s. Between 1980 and 1991, it increased rapidly (15% per year up to 3% of GDP in 1986) due to oil exploitations (54%) and mining (27%). After the sovereign debt crises of the 1980s, capital flows towards emerging markets restarted. Still, investors wanting to avoid sovereign risk first directed their attention to privatizations, loans to private companies and finally, portfolio investments in public and private issues (Urrutia, 2002). In the 1990s, the new constitution and the privatization of public companies increased FDI substantially (Kalmanovitz, 2010).

1.1 The financial crisis and an increase in regulation

The emerging-market crises in 1997 and 8 aggressive tax reforms in Colombia during the four years ending in 1999 caused massive capital outflows. At the time, Colombia had a current account deficit of 8% and a fiscal deficit of 5%, making it impossible to refinance the right side of the private and public balance sheets, causing contraction in their activities. As a result, the economic crisis that started in August 1998 and ended in 1999 was the hardest of the 20th century (Kalmanovitz, 2010).[4] The Financial Institutions Guarantee Fund (*Fondo de Garantía de las Instituciones Financieras – Fogafín*), created in 1985, was in charge of reorganizing the financial sector. It restructured and recapitalized public banks, nationalized some private institutions, performed asset purchases and liquidity support operations and financed the capitalization of private institutions. This crisis had an estimated cost of 6.3% of GDP. Its two most relevant effects on the financial system were reducing its size and its increased concentration in a handful of institutions (Ocampo, 2015).

The financial regulatory cycle hypothesis indicates that as crises ensue, there is a loss of faith in the market´s ability to repair economic problems and

4 While a retelling of the crisis well exceeds the scope of this article, Arango (2006), Fogafín (2009) and Perez-Reyna & Osorio (2018) are excellent sources for the interested reader since they offer different perspectives on the evolution of the crisis.

financial imbalances, which leads to an intensification in regulatory initiatives. As financial repression increases and the trend of economic growth returns, trust in the market and its ability to efficiently assign resources to their optimal uses increases, and a trend for deregulation arises until the next crisis (Rajan, 2009; Cunha, 2020). Colombia was no stranger to this cycle, and during the late 1990s, a series of institutional reforms were undertaken in an attempt to cease the financial crisis.

To finance the bailouts during the crisis, in November 1998, the government declared the state of economic emergency through Decree 2336. Additionally, with Decree 2331 that was issued on the same date, the regulator imposed a 2 per 1000 Tobin tax. The levy was increased to 3 per 1000 in 2001 and to 4 per 1000 in 2003, where it remains until the time of this writing (Arango, 2006). That same year, the government enacted Law 454, which focused on the solidarity economy and financial cooperatives. However, because of changes in macroeconomic conditions, the government did not have enough capital to support the increasing level of delinquencies in their loan portfolio (Hernández, 2018). As in most financial crises, the weakest links in the economy are the first to show signs of distress.

The regulatory package to restructure the Colombian economy was wide reaching and implemented rather quickly. In 1999, Law 510 increased regulation and supervision of the financial system by establishing a clear framework for creating financial institutions. After its publication, the system of universal banking was fully implemented such that the only specialized financial institutions that would remain in the country were pension funds, leasing companies and trust funds. That same year, Law 546 forced savings and loans companies (*Corporaciones de Ahorro y Vivienda - CAV*) to become banks over the next three years. This regulation replaced the *Unidad de Poder Adquisitivo Constante – UPAC* with the *Unidad de Valor Real – UVR* (Arango, 2006). The former was a monetary unit, in place for over 25 years, that was originally indexed to inflation and served as a unit of account for most mortgages. As this inflation-linked unit was distorted and its price increased faster than inflation due to political choices of the mid-1990s, a new inflation-linked monetary unit, the UVR, was put in place as a *tabula rasa* on the whole system. With this new unit, all mortgage loans were reliquidated, which in the end represented a bailout destined directly to the homeowners rather than only to financial institutions. Finally, that same year the Pastrana government signed Law 550, which set the rules and regulations for corporate restructuring and reorganization amidst

the crisis. This law aimed to foster economic recovery and facilitate the orderly liquidation of failed businesses. Finally, with Law 617 of 2000, the regulator established a new framework to organize territorial entities (departments, cities and counties) based on their administrative and fiscal capacity in order to arrive at budgetary equilibrium. This established a simple rule by which current expenses needed to be financed by current income that had not been committed in previous fiscal years (Collazos & Romero, 2005).

Regarding risk management policy, the first Basel accord was roughly implemented between 1989 and 1994. By 1996, a regulation on asset and liability management was issued, but its implementation was only required by 1998. By 2000, the Banking Regulation Memorandum (*Circular Basica Contable y Financiera 100*) was expanded to include a chapter on market risk. Since 2002, further expansions of the Memorandum were advanced to include operational risk, liquidity risk, the risk of money laundering and the financing of terrorism. With the issuing of Circular 18 of 2021, the Financial Supervisor instructed all financial institutions to implement an Integrated Risk Management System to provide a global view of credit, market, operational, liquidity, counterparty, warranty, insurance and country risk. It also provides a methodology for aggregating and reporting such risks (Superintendencia Financiera de Colombia, 2021).

Another relevant trend identified during the 1998-2003 period is a high number of privatizations of public financial companies. In 1998 the public sector owned three banks, four financial corporations, two savings and loans companies and two leasing companies. These institutions represented 20.3% of the financial system. Only *Caja Agraria*, which would later become *Banco Agrario*, remained under public ownership (Hernandez, 2018).

The strong wave of post-crisis regulations came to an end with Law 795 of January 2003. It regulated the orderly liquidation of financial institutions and defined minimum capital requirements. It also designed a consumer protection framework as well as rules on transparency. Furthermore, it formalized a Committee to guarantee the correct functioning of the financial system (*Comité de Coordinación para el Seguimiento al Sector Financiero*). This committee comprises the Minister of the Treasury, the Central Bank, the Banking Supervisor, the Director of the National Planning Department (*Departamento Nacional de Planeación – DNP*) and Fogafín and was the predecessor of the current Financial Follow-up Committee (*Comité de Seguimiento Financiero*) (Arango, 2006; Hernández, 2018). That same year, a new institutional arrangement implemented an explicit fiscal rule. This policy constrains fiscal policy

over the following decade and implements a debt ceiling. Both components of the fiscal rule have been useful in guaranteeing public finance stability (Perez-Reyna & Osorio, 2018). The fiscal rule was suspended during 2020 and 2021 due to the COVID-19 pandemic but was reinstated for 2022 (Salazar Sierra, 2021).

The years since the financial crisis have been characterized by a deepening of the financial sector and an increase in the size and number of the institutions that partake in it. However, high concentration in a few institutions is still a relevant policy issue. Strong regulation after the crisis and increased supervisory responsibilities on the Banking Supervisor (now Financial Supervisor – *Superintendencia Financiera*) has been responsible for the relative stability of the Colombian financial sector during the last two decades. As a result, since the early 2000s, the country has had an orthodox economic policy and robust financial regulation (Hernandez, 2018).

Following Hernandez (2018), additional regulation changes took place during the first two decades of the twenty-first century. During 2005, the Banking Supervisor (*Superintendencia Bancaria*) and the Securities Market Supervisor (*Superintendencia del Mercado de Valores*) were merged into a single supervisory unit: the Financial Supervisor (*Superintendencia Financiera*). This idea of an integrated supervisor for all the financial sectors has become a widespread practice in OECD countries. During that same year, countercyclical capital buffers were implemented for commercial loans. Furthermore, by 2007 regulation was perfected to include the concept of expected default, and by 2009 the methodology was improved to clarify the mechanisms for accumulation and consumption of provisions.

By 2007-08 the economy started overheating, and credit growth seemed too strong. As a result, a set of measures was adopted to tame credit growth and mitigate economy-wide risk: the central bank increased the overnight rate, marginal bank reserve requirements were put in place, countercyclical capital buffers were required of every institution that granted loans, exposure to derivatives was strongly curtailed and strong and detailed supervision was implemented throughout the country. Some argue that the strong regulatory process that began in 1999 explains why the subprime crisis in developed economies did not have a contagion effect in Colombia (Hernadez, 2018; Ocampo, 2015).

To better control liquidity and credit risk, during 2011 the Financial Supervisor implemented the Liquidity Risk Indicator as a measure that had to be constantly monitored by financial institutions. This indicator was coupled with the definition of high liquidity assets, which could sufficiently increase an

institution's liquidity at a given time. That same year the values of loss given default were changed. By 2012 the implementation of Basel III was beginning to take form. Decree 1771 introduced a new taxonomy for equity, including Common Equity Tier 1 (CET1), Additional Tier 1 (AT1) and Additional Capital (AC). Decrees 1648 of 2014 and 2392 of 2015 further detailed the definition of capital, including hybrid instruments that could be included in AT1 or AC. During 2015, the reporting of stress test results was made compulsory for several financial institutions to control the accumulation of financial imbalances. By the end of that year, three different capital buffers had been implemented: the general regulatory capital buffer from Basel I and II, countercyclical capital buffers and a buffer against excessive credit growth (Hernandez, 2018; Superintendencia Financiera de Colombia, 2021).

A final interesting trend that has taken place during the last decade began with the Great Financial Crisis (GFC) of 2007-09, which forced several international financial institutions to leave emerging markets, leaving space for Colombian financial institutions with a taste for internationalization. As a result, the largest acquisitions performed by Colombian banks occurred in Central America: *Grupo Suramericana* purchased ING Latinamerica Pension Fund for 3.8 billion dollars, *Grupo Aval* purchased BAC for 1.9 billion dollars, and *Bancolombia* purchased HSBC Panama for 2.2 billion. These moves were fostered by an ever-expanding corporate sector in Colombia with growing needs in foreign markets and friendly regulatory environments in the target markets. This expansion was so relevant that by 2017 Congress issued Law 1870, which regulates financial conglomerates and provides a broad definition of a financial conglomerate that allows the regulation of all the different structures that these companies may adopt through time (Hernandez, 2018).

2. Data description

As has been presented in previous sections, this document performs a study of the long-run behaviour of the stock market, credit aggregates and the real exchange rate for the period starting in 1987.[5] We use a monthly market-wide

5 In part 3 we will show that the LBBI methodology employed in this paper to characterize expansions and contractions requires 5 years of historical data to produce the first observation of the indicator. This explains why, even though the first observation in the database starts in January 1982, we only start characterizing the markets in January 1987.

value-weighted stock index expressed in real terms for Colombia as a stock market variable. The time series is a spliced construction that combines a long-run series downloaded from the Global Financial Database from January 1982 until December 2000.[6] From January 2001 until December 2007, we use the IGBC index, and from January 2008 until December 2021, we use the COLCAP Index. Both the IGBC and COLCAP are downloaded from Bloomberg. The final series runs uninterruptedly from January 1982 and December 2021 with 480 observations.

Credit aggregates were obtained from *Banco de la República* in a nominal time series of weekly frequency that runs uninterrupted from January 1982 until December 2021. We use the observation for the last week of each month, constructing a series that runs uninterruptedly for 29 years, including 480 observations[7]. No seasonal corrections were performed. Data are expressed in real terms using the CPI provided by the National Administrative Department of Statistics (*Departamento Administrativo Nacional de Estadística – DANE*).

The monthly real exchange rate from January 1982 until December 2021 is obtained from Banco de la República, which calculates it using the weights for 22 commercial partners for Colombia and deflates it using the monthly CPI. The real exchange rate increases when a consumption basket in Colombia is relatively less expensive than the same basket abroad and decreases when the basket of goods becomes relatively more expensive in Colombia than abroad.

The panels in the following figure include the evolution of the stock market time series in levels of the index (100=31/01/1982), the evolution of net loans to the non-financial sector in billion COP and the real exchange rate in levels.[8]

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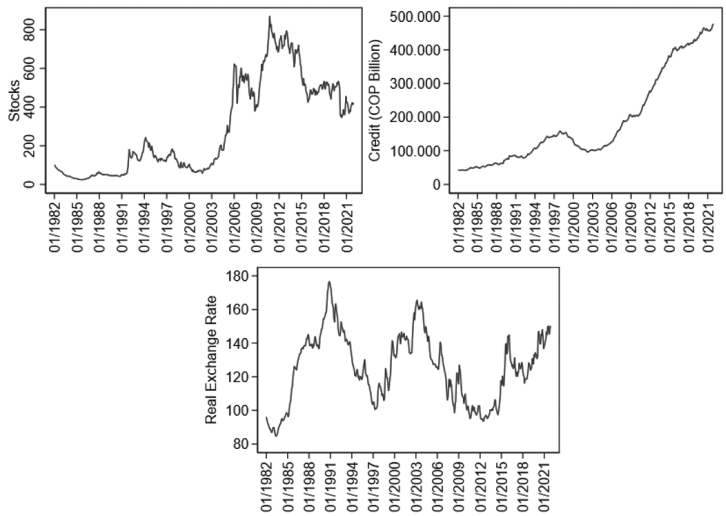
6 The data for the Colombian stock market is found in the series "Colombia IGBC General Index (w/GFD extension)" which has monthly frequency from April 1929 until January 1992 and daily frequency from January 1992 until September 2015. The value of monthly data is recorded by taking the value of the stock market index for the last day of the month. Before the merger of the stock exchanges, the index is built as a weighted average of the available indices for the three different stock exchanges.

7 The time series corresponds to the net value of loans provided by the financial system. It is a very broad time series that reflects the size of loans provided by an ever-evolving financial system. The central bank warns about the diversity of elements that are included, ranging from loans to securitized assets and many other modern products.

8 We treat billions as a million millions or as 10^{12}.

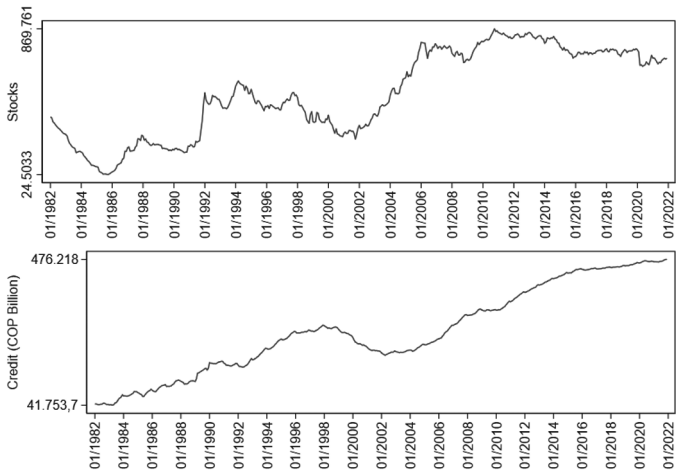
Figure 1: Time series evolution of the stock market, credit and real exchange rate



Source: Global financial data, Banco de la República, author's calculations

The top series may be misleading given that the scale for the y axis is in levels. The following figure shows the time series evolution for stocks and credit using a logarithmic scale to provide better insight. We do not include the real exchange rate because it is unnecessary.

Figure 2: Time series evolution of the stock market and credit in logarithms



Source: Global financial data, Banco de la República, author's calculations

After a first observation of the series, the first natural test to perform is a structural break test. To do so, we run OLS regressions of each variable on a time trend and perform a Wald Test and a cumulative sum test for the stability of the coefficient in each regression (Ploberger & Krämer, 1992; Andrews, 1993; Quandt, 1960). We run the latter both for cumulative and OLS residuals since they have different power depending on whether the break is at the beginning of the end of the series. The null hypothesis is no break in the coefficient in all three cases. However, the following table shows evidence of at least one structural break in each series according to the three tests.

Table 1: Test statistics for structural break tests

			Stocks	Credit	RFX
Expected break date			11/05	12/01	02/92
Wald test		*Statistic*	891,4486	4204,2124	354,8914
		P-Value	0,00	0,00	0,00
Cusum test	*Recursive residuals*	*Statistic*	3,2874	4,0205	4,7489
		P-Value	0,00	0,00	0,00
	OLS residuals	*Statistic*	4,2780	5,3657	3,1657
		P-Value	0,00	0,00	0,00

We find that, for stocks and credit, the structural break seems to happen after the financial crisis and with the onset of additional regulation on the financial system. Conversely, the structural break for the real exchange rate seems to happen with the new constitution, the abandonment of the crawling peg and the adoption of a crawling corridor regime with ever-broadening bands. We take results for stocks and credit as relevant preliminary evidence which favours the hypothesis that the swing in the regulatory pendulum toward financial repression after the end-of-century crises leads to a change in the behaviour of asset prices and credit aggregates.

3. Methodology – the Local Bull Bear Indicator

This section follows the methodology offered by Forero-Laverde (2019), which produces three distinct Local Bull – Bear Indicators (short-run, medium-run, and long-run) based on the structure of the empirical distribution of the underlying data.

For any given series, we construct an n-period linear return matrix R in which rows will represent time and column vectors r_n will hold the return from period *t-n* until *t* where, *n* will only take successive integer values from 1 to 12 months (short-run) and then values of 18, 24, 30, 36, (medium-run) and 42, 48, 54 and 60 months (long-run). By construction, vectors r_n and r_m have different measures since they express *n* and *m* period returns. A solution to keep comparability and thus desirable properties such as additivity across vectors with different values of *n* is to standardize matrix R. By doing so, we generate a new matrix D such that:

$$d_{t,n} = \frac{(r_{t,n} - \mu_n)}{\sigma_n} \tag{1}$$

Where μ_n corresponds to an exponentially weighted moving average for the last 60 observations and σ_n is obtained as the contemporaneous standard deviation after fitting a GARCH(1,1) model. The values obtained from (1) refer to the number of standard deviations σ_n that a given observation $r_{t,n}$ is away from the mean μ_n of vector r_n**.** Since the interpretation of all observations $d_{t,n}$ is the same, vectors d_n and d_m are comparable within D and across different D matrices for different time series. This means that a three-standard-deviation increase in the stock market (D_{stocks}) is comparable to a three-standard-deviation increase in credit aggregates (D_{credit}) and makes this interpretation both pertinent and rich in information.

We obtain a new time series, referred to as a Local Bull Bear Indicator (LBBI), from matrices D.

$$LBBI = \omega' \boldsymbol{D} \tag{2}$$

Where ω is a vector of weights that add to 1. In linear form,

$$BBI_t = \sum_{n=1}^{N} \omega_n \, d_{t,n} \tag{3}$$

The linear combination of vectors through an average can be done since all vectors have been standardized. However, combining short-run and long-run returns may smooth out relevant information. To avoid this issue, we will construct two

LBBIs, a short-run LBBI with returns from one month up to one year and a long-run LBBI with returns from 37 months up to five years.[9]

To tend to the issue of determining the vector of weights (ω), we performed a factor analysis of the matrix D. The idea behind factor analysis is to reduce the dimension of a large dataset (for example, matrix D) which includes a large number of variables *n* into a smaller number *m* of explanatory factors. A regular factor analysis takes the following form (Tsay, 2002):

$$\boldsymbol{D} - \boldsymbol{\mu} = \boldsymbol{\Lambda F} + \epsilon \tag{4}$$

Where Λ is a matrix of factor loadings of dimensions *n*, *m* and F is a matrix of dimension *m, t* that contains orthogonal factors that explain the variability of D. Since we wish to obtain a single BBI for each specification of D of dimension *n*,*t*, in this particular case Λ will be a vector of dimension *n*, *one* and F a vector of dimension *1*,*t*. The factor loadings do not need to add up to 1, so to transform them into weights, we perform the following calculation:

$$\omega_n = \frac{\lambda_n}{\sum_{n=1}^{N} \lambda_n} \tag{5}$$

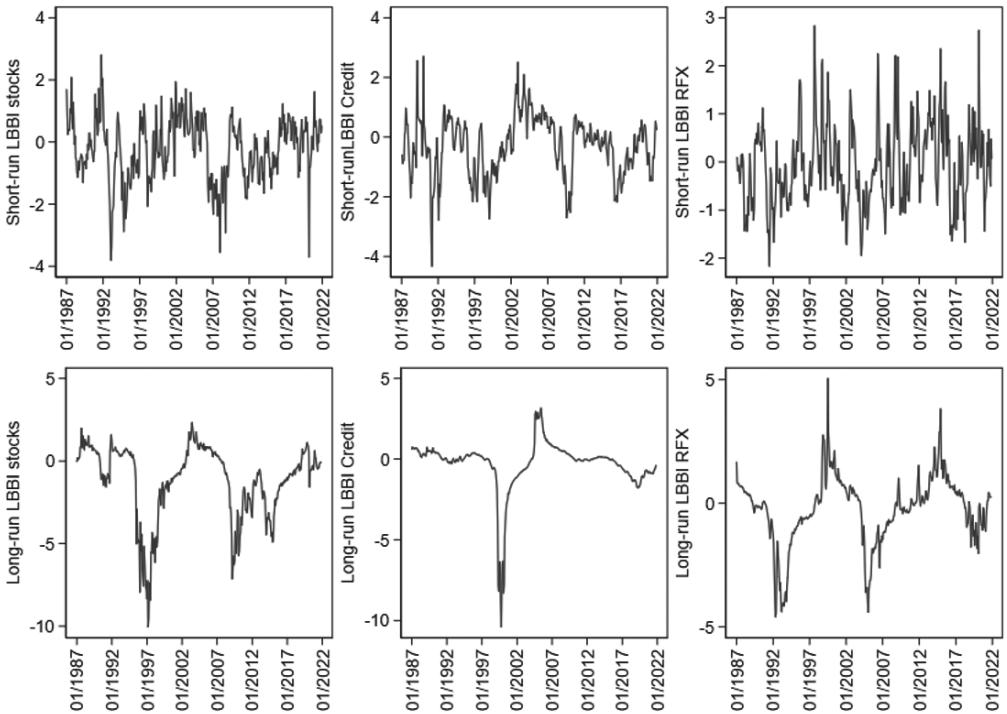
This construction of ω guaranties that it gives each vector d_n a weight directly related to its explanatory power over D. Interestingly, although the different LBBIs may be highly correlated with factor F, this strong correlation need not be positive. In that sense, we prefer BBIs since we know that positive values refer to bull phases and negative values refer to bear phases.

3.1 A first application of the methodology to the data

Using the methodology described above, we calculate the short and long-run Local Bull Bear Indicators for the stock market, credit, and real exchange rate series. We present the evolution of the different time series in the following figure.

9 In unpublished research we have found that the medium-run LBBI, which covers the 13 to 36-month window does not usually provide additional insight once the short and long run LBBIs have been accounted for.

Figure 3: Local Bull Bear Indicators to different time horizons



Source: Global financial data, Banco de la República, author's calculations

To provide further interpretation, the following table presents descriptive statistics for the LBBI series presented in Figure 3.

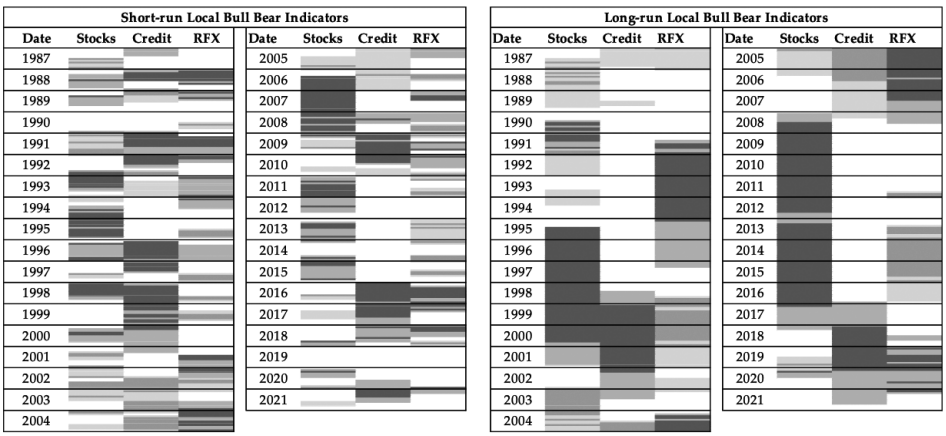
Table 2: Descriptive statistics for LBBIs

	Stocks		**Credit**		Real Exchange Rate	
	Short-run	*Long-run*	*Short-run*	*Long-run*	*Short-run*	*Long-run*
Mean	-0,23	-1,17	-0,31	-0,28	-0,08	-0,24
Min	-3,81	-10,05	-4,33	-10,40	-2,17	-4,59
Max	2,80	2,33	2,70	3,15	2,83	5,05
Range	6,61	12,38	7,03	13,56	5,00	9,64
Std. Dev.	1,00	2,24	0,98	1,54	0,84	1,38
Skewness	-0,46	-1,34	-0,36	-3,07	0,47	-0,63
Obs	420	420	420	420	420	420
Obs < 0	233	262	244	217	236	220
Obs > 0	187	158	176	203	184	200

Several stylized facts can be derived from the results presented in Figure 3 and Table 2. First, the long-run indicator is more volatile. It has a broader range than the short-run indicator for the three different time series under study. In most cases, the range for the long-run indicator is almost double that of its short-run counterpart. This makes sense since the short-run indicator adapts faster to changes in the series and thus presents a narrower range than the more long-run oriented indicator. Secondly, the six series are skewed negatively and with significantly more negative months than positive ones. The most extreme case is the long-run stock market LBBI which has 65% more negative than positive months.

From the figure, we can see it is possible to identify trends, peaks and troughs in all six series. In the following figure, we present a heatmap built from the different LBBIs. We follow a simple colouring rule. If the observation of any given month is between -0.5 and 0.5 standard deviations, the cell for that month remains white. On the other hand, suppose the observation is between -1 and -0.5 standard deviations. In that case, it will be coloured light red, and if it is between 0.5 and 1 standard deviations, it will be coloured light green. Finally, in any case that a given observation is lower than -1 standard deviation or higher than +1, its corresponding cell will be coloured dark red or dark green respectively.

Figure 4: Expansion and contraction phases according to LBBIs



Source: Global financial data, Banco de la República, author's calculations

Figure 4 shows the power of the LBBI methodology as it allows us to identify expansion and contraction phases in time and offers a measure of the intensity of said phases. From the figure, we confirm what had been inferred from the

descriptive statistics. The short-run indicators have values closer to zero, with less intense booms and busts and more phase changes than the long-run indicator, which shows more persistence in phases and allows us to identify longer cycles in the behaviour of asset prices and credit aggregates.

This abundance of information begs further analysis. Consequently, in section 4, we will follow and expand on the methodology presented by Harding & Pagan (2002, 2005) to explore the different bull and bear phases and characterize them by their duration amplitude and severity. We will also explore whether the characteristics of bull or bear phases changed from deregulation (1987-2003) to the period of more stringent regulation (2004-21). Subsequently, in section 5, we will discuss the joint evolution of asset prices and credit aggregates before and after reforms to provide some evidence as to whether regulation changed the behaviour of the Colombian financial cycle.

4. A characterization of bull and bear phases

This section will build a new database of bull and bear phases for the three different time series under study: a stock market index, the total value of loans and the real exchange rate between 1987 and 2021. To do so, we will follow the censoring rule of the turning point algorithm used by Bry & Boschan (1971). Bull (bear) phases will begin on the first month that the LBBI takes a value of 0.5 (-0.5) and remains above (below) for the following months. The end date will occur the last month the LBBI remains above (below) 0.5 (-0.5). A phase must have a minimum duration of 3 months unless the absolute value of the index during the phase is 1.0 or more standard deviations. Furthermore, if two consecutive bull or bear phases are separated by three months or less, and the indicator's sign does not change during the gap months, the two phases are treated as a single phase.

Once we have identified the phases, we will characterize each phase with three different metrics. First, the duration of the phase is the number of months between the start and end date of each phase. Amplitude is the percentage change in the variable's level at the beginning and the end of the phase. To make amplitudes comparable across phases, we express them as compounded annual growth rates (CAGR). We also calculate the average monthly amplitude to avoid the distortions of the compounding process to obtain the CAGR. Finally, the severity of the phase is the accumulated value of the LBBI during the phase. The severity will be positive for bull phases and negative for bear phases. The

measure of severity offers an improvement on the triangular approximation used by Harding & Pagan (2005) to measure the intensity of a phase because their main assumption is that the path from peak to trough or from trough to peak has a constant slope, which is not true, as can be seen in Figure 3.

In the following table, we present a summary of the phases we identified for each of the six LBBIs. The complete database for expansions and contractions can be found in Annex 1.

Table 3: Characterization of phases by time series

			Number of Phases	Average Duration	Average monthly amplitude	Average severity
Stocks	*Short*	*Bull*	14	6,14	6,33%	5,64
		Bear	13	12,46	-3,96%	-15,06
	Long	*Bull*	4	21,5	2,41%	20,91
		Bear	4	58,75	-1,32%	-145,51
Credit	*Short*	*Bull*	6	13	1,86%	11,29
		Bear	9	17,88	-0,18%	-23,06
	Long	*Bull*	3	20	1,12%	25,33
		Bear	2	59,5	-0,22%	-107
Real FX	*Short*	*Bull*	13	5,46	2,51%	6,1
		Bear	14	10,86	-1,29%	-8,92
	Long	*Bull*	4	16,5	0,82%	19,59
		Bear	5	63,6	-0,11%	-55,01

A first regularity observed from the table is that, while long-run indicators have a broader range and larger volatility than short-run indicators, the former present fewer phases than the latter. This is consistent with what we observe in Figure 4, where short-run indicators have more sign changes than long-run ones, thus originating more phases. Conversely, phases for the long run indicators for each series are longer and more severe than the phases identified using the short-run indicator. However, there are no such regularities for the average amplitude.

Furthermore, there is a similar number of phases for stocks and the real exchange rate, the variables we have chosen to proxy for the asset market. Regarding credit, the number of bull or bear phases is lower than for assets, but they are longer and more severe. This is consistent with findings from the Bank for International Settlements and the IMF that indicate that credit variables are more persistent and that altering the stock of credit—the overall leverage level of an economy—is a complex and challenging process.

Still, this paper aims to answer whether changes in the regulatory framework had any kind of impact on the behaviour of asset prices and credit aggregates. To do so, we will break the sample of expansions and contractions in two. First, phases with a starting date before February 2003 are included in the pre-reform group. This date is chosen because Law 795 of 2003 was issued in January, and as argued in section 1, this is the moment where all crises regulation had finished, and its full effects were expected to kick in. Consequently, phases starting on or after February 2003 will be included in the increased regulation period.[10] This break date can be challenged and discussed, but it seems consistent with the break dates identified in section 2 of this document. For example, if we chose November 2005, the break date identified for the stock series, 7 out of 46 phases would change from the post-reform to the pre-reform groups. This, however, would not be caused by any particular piece of regulation; it would be a purely statistical argument. Conversely, if we chose December 2001 for a break date, 3 out of 45 phases would change from the pre-reform to the post-reform group.

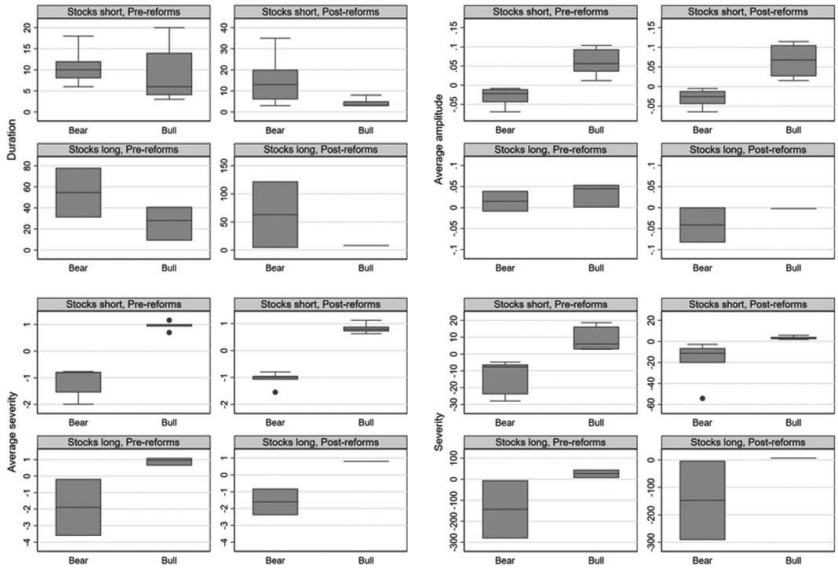
To test whether the regulatory changes may impact the behaviour of bull and bear phases in asset prices and credit aggregates, we will perform comparisons of the duration, amplitude and severity of phases in the pre-reform and post-reform phases groups. We will approach this issue by presenting a compendium of box plots for the duration, average amplitude, severity and average severity by metric, pre- or post-reform grouping and phase for all-time series. The usefulness of boxplots is that they serve as a straightforward way of comparing means across different data groupings.

4.1 Stock market phases

The following figure presents four different panels, which clockwise from the top-left panel include boxplots for the duration of phases, the average monthly amplitude of phases, the accumulated severity, and the average monthly severity.

10 We are careful not to use the term financial repression. While there is an ample literature on the subject, an interesting future line of inquiry is to precisely construct an indicator of financial repression for Colombia to determine whether the break date tested in this paper should be challenged.

Figure 5: Characterization of stock market phases pre- and post-reform



Source: Global financial data, Banco de la República, author's calculations

From the figure, we can infer that there are no significant changes in the structure of stock market phases before and after the reform period. The only salient difference is that the duration of bull phases for the long-run indicator is statistically significantly lower for the post-reform period. All other metrics appear to remain unchanged from one group to the other. This is reasonable since most of the regulation changes described in section 1 were not targeting the stock market or, in general, the securities markets.[11] Rather, these measures were

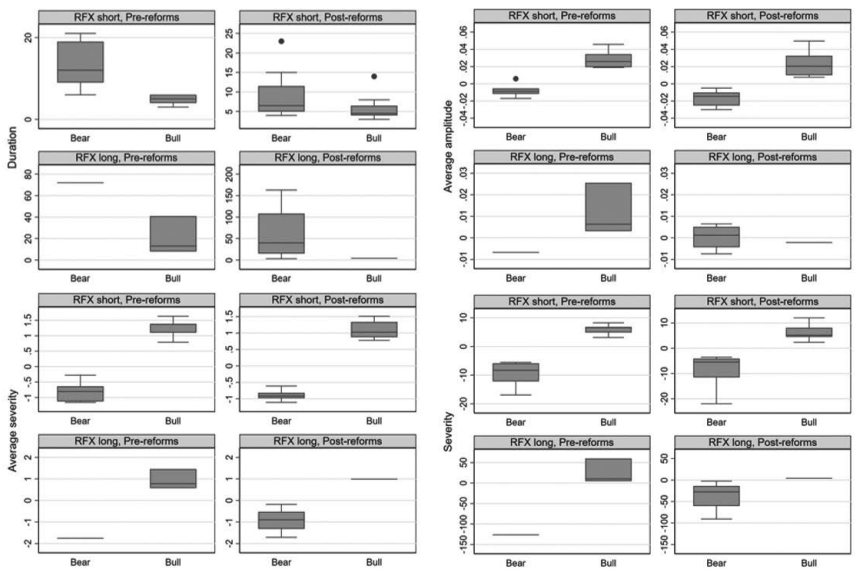
11 Few relevant regulatory changes have impacted the stock market during the period of study. First, a wave of tax reforms that started in 1979 with the Tax Relief Law (*Ley de Alivio Tributario*) which favored capitalization across several industrial companies by making investment in new public companies tax deductible. In 1983, in the aftermath of the financial crises that happened the year before, the double taxation of joint stock companies was eliminated and the tax burden on dividends was halved. However, double taxation was only fully eliminated by 1986, when the stock market had all but disappeared. In that same year the tax rate on limited liability and joint stock companies was equalized. A further reform in 1989 eliminated capital taxes on stocks and a law in 1990 limited the capital gains tax. The last reform in this wave happened in 1992, when tax incentives were offered to those who wanted to invest in the stock market (Cárdenas & Rojas, 1996). All these measures were aimed at achieving a larger, more liquid and dynamic stock market.

directed at credit aggregates and financial institutions as the providers of said credit. Furthermore, Ocampo (2015) indicated that Colombia has a bank-based financial system and the securities market has never been particularly relevant for investors. This is the main reason for us to include the real exchange rate as a second time series to proxy asset prices.

Real exchange rate phases

The following figure presents panels in the same structure as Figure 5 for the different metrics of the phases identified for the short-run and long-run LBBIs of the real exchange rate. This time series was included to proxy for the behaviour of asset prices since, as argued above, many investors will go to the exchange rate market when looking for a safe haven or when trying to hedge country risks.

Figure 6: Characterization of real exchange rate phases pre- and post-reform



Source: Global financial data, Banco de la República, author's calculations

The figure shows no significant changes in phases identified by the short-run LBBI. However, some relevant changes in the phases characterized by the long-run LBBI. Bull phases become shorter, and the average amplitude decreases during the reform period. Regarding contractions, they become less severe and their amplitude, which is negative because of the nature of the phase, moves

closer to zero. These changes suggest that the asset price cycle becomes more moderate in this second period. However, it is challenging to think it is due to the reforms discussed in section 1.

An alternative story that could explain this phenomenon has to do with the abandonment of the crawling corridor in 1999 and the recovery from the Emerging Markets crisis of the late 1990s and early 2000s, which could have negatively impacted terms of trade. Furthermore, the diversification of the export product mix for Colombia, achieved during the first two decades of the 21st century, may explain the improvement of terms of trade during 2012-16. In general, an observation that is confirmed by Figures 1 and 4 is that the real exchange rate seems to improve or recover when the accumulation of imbalances in international markets seems to unwind. Conversely, recovery in international markets and trade seems to coincide with bear phases in the Colombian real exchange rate. This, of course, is very reasonable for an emerging market economy that focuses on exports of traditional, low value-added goods.

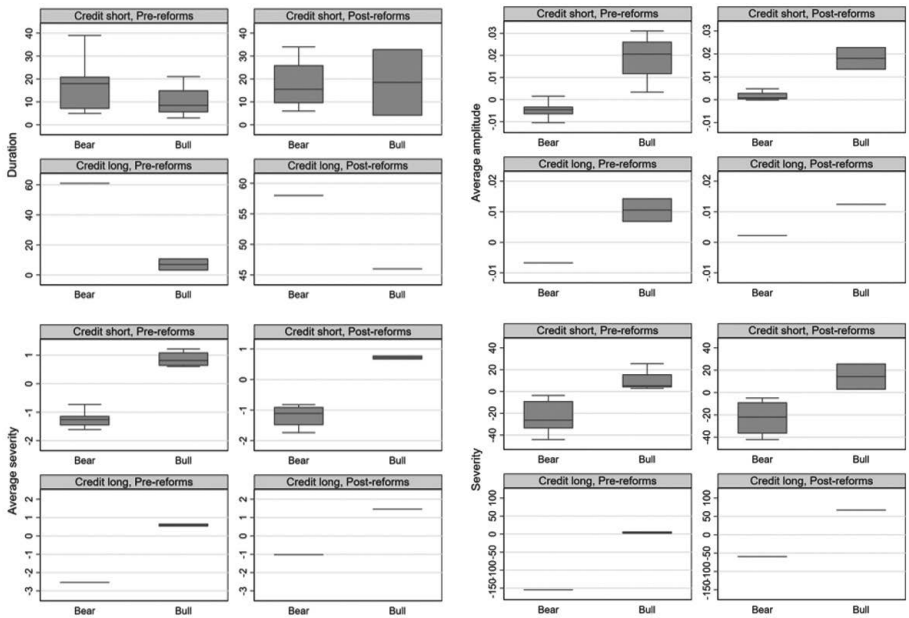
Credit phases

The following figure presents panels in the same structure as Figure 5 and Figure 6 for the different metrics of the phases identified for the short-run and long-run LBBIs for real credit aggregates in domestic currency. The hypothesis suggests that this was precisely the target series for most of the regulations presented and discussed in section 1.

The case of credit aggregates shows that in the short-run indicator, the behaviour of bull phases remains unaltered before and after reforms. Regarding short-run bear phases, the only statistically significant change is an increase in the average amplitude, meaning it becomes less negative during the more stringent regulatory period. The change seems to be what one would expect of regulation: expansions remain unaltered, and contractions seem to be softened.

Regarding the phases identified using the long-run indicator, we find that the duration and severity of expansions are increased in the post-reform period. A possible causal mechanism runs through the risk aversion of agents participating in the market. Usually, stricter regulation on crisis prevention, such as the countercyclical capital buffers and other initiatives discussed in section 1, fosters credit expansions and economic development. King & Levine (1993) and Levine (2005) find a strong link between lower aggregated risk in the economy or better risk pooling and increases in economic growth. This is one of the ways in which finance has been found to foster development (Beck, 2012).

Figure 7: Characterization of credit phases pre- and post-reform



Source: Global financial data, Banco de la República, author's calculations

In what pertain to bear phases as identified by the long-run indicator, we find that said phases are shorter, less severe and have, on average, higher (less negative) average amplitude during the post-reform period. These results, however, are obtained from a single bear phase in the pre-reform period and a single bear phase in the post-reform period. Moreover, they have similar durations (61 months from 06/98 to 06/03 and 58 months from 12/16 to 09/21). However, the earlier phase is much more severe than the more recent one with a total severity of -154,55 standard deviations against -59,45 standard deviations. Finally, the average monthly amplitude shifts from -0,67% for the earlier bear phase to 0,22%. This indicates that during the last bear phase, credit did not actually contract but just grew slower than its usual trend. In conclusion, while results are derived from just one observation in the pre-reform and the post-reform periods, these observations are substantially different. They suggest that, among many possible confounding effects, all the regulation changes could have played a role in altering the structure of bear phases for credit aggregates.

4.2 Summary of results

Results for the differences in the duration, amplitude, and severity of phases in the pre-reform and post-reform periods are summarised in the following table.

Table 4: Summary of changes in the characteristics of bull and bear phases

				Change with reforms
Duration	Stocks	Short	*Bull*	U
			Bear	U
		Long	*Bull*	D
			Bear	U
	RFX	Short	*Bull*	U
			Bear	U
		Long	*Bull*	D
			Bear	U
	Credit	Short	*Bull*	U
			Bear	U
		Long	*Bull*	I
			Bear	D

				Change with reforms
Average Amplitude	Stocks	Short	*Bull*	U
			Bear	U
		Long	*Bull*	U
			Bear	U
	RFX	Short	*Bull*	U
			Bear	U
		Long	*Bull*	D
			Bear	I
	Credit	Short	*Bull*	U
			Bear	I
		Long	*Bull*	U
			Bear	I

				Change with reforms
Average Severity	Stocks	Short	*Bull*	U
			Bear	U
		Long	*Bull*	U
			Bear	U
	RFX	Short	*Bull*	U
			Bear	U
		Long	*Bull*	U
			Bear	D
	Credit	Short	*Bull*	U
			Bear	U
		Long	*Bull*	I
			Bear	D

The table above shows that the characteristics of phases identified by the short-run LBBI remain mostly unchanged between the pre- and post-reform periods. Changes, however, do seem to occur in phases when identified by the long-run LBBIs. For example, the duration of bull phases in asset prices increases during the post-reform period, but their amplitude decreases. This suggests that they become more stable processes during the post-reform period, though establishing a causal link running from the new regulations towards asset prices has proven challenging, particularly when the regulation discussed here was not aimed at asset prices but rather at financial institutions, the governance of the system and the allocation of loans and debt.

Finally, regarding credit, the duration and severity of expansions increased, and the duration and severity of contractions decreased. Additionally, contractions became less negative during the post-reform period. Given that we have identified that the behaviour of asset prices was hardly altered during the period, it is clear that these changes might have been caused by a change in circumstances that did not otherwise affect asset prices. This suggests that it is not an economy-wide policy or a broad-reaching program since these sorts of initiatives would alter the behaviour of both assets and

credit aggregates.[12] Consequently, we suggest that financial regulation may be a good candidate for the cause of these changes as it has been changing at a rapid pace since the end-of-century financial crisis, particularly concerning the governance of the Colombian bank-based system. Most of the changes presented in section 1, particularly in response to the financial crisis, targeted credit aggregates, the disbursements of loans and the hedging of the different sources of risk that impact the financial system at any point in time.

In the following section, we present how the correlation between asset prices and credit aggregates changed during the period.

5. The Colombian financial cycle: A primer

A straightforward approximation of the Colombian financial cycle is to study the rolling-window correlations between an asset price and a credit variable. Correlations can be studied for short-run or long-run LBBIs. Shifts in correlation do not indicate causality but can be interpreted as increases or decreases in co-movement, which may signal the accumulation or unwinding of financial imbalances (Borio & Lowe, 2002, 2004; Jordà, Shularick & Taylor, 2011; Forero-Laverde, 2019).

5.1 Short-run correlations

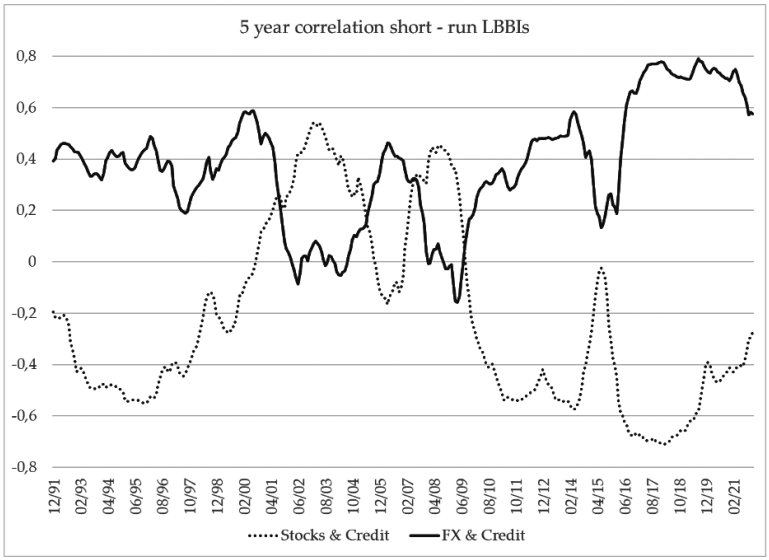
In the following figure, we present the 60-month rolling correlation between the asset price series and the credit series using the short-run LBBI.

The correlation between stocks and credit is far more volatile than between the real exchange rate and credit. This first observation may be explained because the Colombian stock market is particularly small, and prices can be affected by low transactional volumes. Correlations between stocks and credit increase during crises (1997-2003; 2007-09; 2014-16) and decreases during calm periods, consistent with findings in the financial cycle literature. Interestingly, the rolling correlation between exchange rates and credit seems to mirror the correlation between the stock market and credit aggregates. This has to do with the fact that while the Colombian stock market may be perceived as a risky

12 As possible economy-wide policies we suggest changes to the overnight lending rate, institutional changes to the maximum percentage of property a foreigner can hold of a domestic asset, capital controls and many other broad-reaching policies.

investment for periods of economic expansion, the exchange rate market may be perceived as a safe haven for periods of market turmoil. It is noteworthy that the correlation between short-run LBBIs for the real exchange rate and credit aggregates reached its maximum historical value during the period 2017-20. During this time the price of the US dollar increased dramatically, Colombia lost the investment-grade credit rating and credit expanded given the low interest rate that was pervasive for the whole economy.

Figure 8: 60-month rolling correlation between short-run LBBIs



Source: Global financial data, Banco de la República, author's calculations

We perform the Wald test for a structural break with an unknown date on the correlation between credit and the stock market and find it breaks in September 2009 (statistic 820.55, p-value 0.00). This is consistent with the end of the Global Financial Crises and a period of ultra-low interest rates. Abundant liquidity may push credit growth while uncertainty about economic growth keeps stock prices low or even pushes them on a downward trend. Recall that the period starting in 2010 is where the stock market LBBI takes on mostly negative values, signalling a decreasing trend.

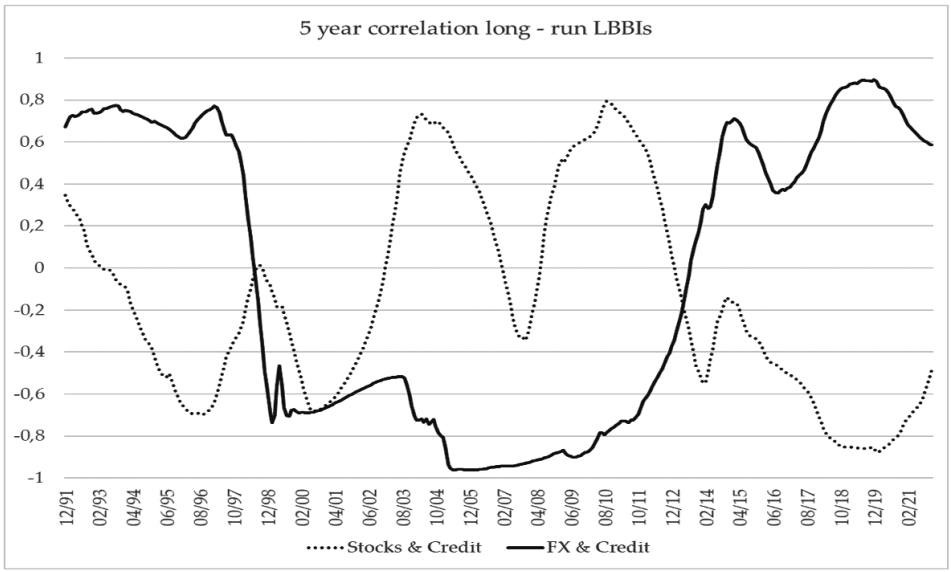
Similarly, we perform the Wald test for a structural break with an unknown date on the correlation between credit and the real exchange rate and find that it

breaks in October 2001 (statistic 561.62, p-value 0.00). This coincides with the end-of-century crisis and the first period of regulatory tightening that would impact the credit market, as we saw in section 4. Furthermore, this break coincides with the beginning of a new exchange rate regime. The central bank allowed for the managed floating of the exchange rate rather than the crawling peg or crawling corridor regimes (Ilzetzki, Reinhart & Rogoff, 2017).

5.2 Long-run correlations

In the following figure, we present the 60-month rolling correlation between each asset price series and the credit series using the long-run LBBI.

Figure 9: 60-month rolling correlation between long-run LBBIs



Source: Global financial data, Banco de la República, author's calculations

Results for the long-run time series are similar to those in the previous subsection. Correlations between the stock market and credit aggregates peak during crises (1997-2001; 2003-05, 2007-09; 104-15). Conversely, correlations between exchange rates and real credit trough during crises remain negative for more than a decade. The lowest values of the series occur from 1998 until 2009 when a slow recovery begins. This is consistent with the idea that heightened risk during the first decade of the 20th century kept people buying dollars while credit

contracted and bringing them back to the country when economic expansion occurred. It is only during periods of economic stability that correlations between both variables tend to increase. In these cases, the joint movement of the real exchange rates and credit aggregates would suggest that economic expansion leads to an expansion of credit and an increase in the exchange rate caused by companies and individuals sending their profits abroad. Still, the joint expansion of credit and exchange rate growth may occur simultaneously but are driven by different phenomena. This interesting point merits further research.

We perform the Wald test for a structural break with an unknown date on the correlation between credit and the stock market and find it breaks in March 2003 (statistic 586.80, p-value 0.00). This is consistent with the end of the regulatory push that took place with the end of century crises. Similarly, we perform the Wald test for a structural break with an unknown date on the correlation between credit and the real exchange rate and find that it breaks on August 2006 (statistic 2099.23, p-value 0.00). The break on this date marks the beginning of increasing correlation between both variables. However, this increasing correlation may not be determined by the changes in the regulatory stance at a given point in time but by the impact that impending economic conditions may have on the relationship between credit and the real exchange rate. The negative relationship started becoming weaker in 2006 and turned positive during 2014, which signals a period where the exchange rate and credit were both increasing simultaneously. As argued earlier, this may have to do with low interest rates and economic recovery in developed economies such as the US and Europe.

To conclude this section, we can argue that the relationship between credit and the stock market is a volatile one that seems to be driven by economic conditions where positive correlations coincide with crises period. Decreasing correlations coincide with calmer periods of economic stability. The story behind the correlation between the exchange rate and credit seems to be the opposite. Correlations decrease during crises because investors and other economic agents use the foreign exchange market to search for a safe haven for their investments. Correlations increase during calmer periods not because of a single driving phenomenon but rather due to an array of economic conditions that may drive each variable independently. These findings warrant further research.

6. Discussion of results and further research

This paper offers a first approach to the Colombian financial cycle and contributes to the broad literature on the subject by presenting a case study for a single country. To attain this goal, we move past the usual identification techniques that require wide and long panels of countries to reach results and use the Local Bull Bear Indicator (Forero-Laverde, 2013, 2019) to identify expansions and contractions in three different variables: a market-wide stock market index expressed in real terms, the real exchange rate and private credit denominated in local currency. The first two series attempt to capture the behaviour of asset prices, while the last variable proxies for the behaviour of credit.

After applying the LBBI methodology to the time series under study, we can identify short and long-run trends for the different variables. Then, we use these series and a turning point algorithm to identify expansion and contraction phases which we characterize by measuring their duration, severity and amplitude. This characterization of asset prices and credit behaviour is a first contribution of this paper to the literature.

With all the information mentioned above, this paper aims to identify whether changes in the country´s regulatory stance regarding credit impacted the behaviour of asset or credit variables either by themselves or jointly. To answer this question in an informative manner, we separate the 1987-2021 period into two distinct phases. The first period between 1987 and 2003 is one of regulatory latitude. Then, with the onset of the end-of-century crisis, regulators start implementing measures to curtail the effects of the financial instability. Then, with the end of the crises and the return of economic stability, a period of stronger regulation begins. This period extends until the time of this writing. Finally, we test whether the defining characteristics of phases – duration, amplitude and severity – change from the less restrictive to the more restrictive period.

Finally, we test whether the joint behaviour of asset and credit variables changes between the first period and the second one. To do so, first, we identify stylized facts on the behaviour of asset price and credit correlations to impending economic conditions. Then we perform structural break tests on correlations to see if they coincide with the changes in the regulatory stance.

As stated in the introduction, we find that changes in the regulatory framework seem to be result in a more repressive stance as credit bear phases become less severe after reforms. This is not true for asset prices since the duration, amplitude and severity of both expansions and contractions remain

statistically the same before and after reforms. This is an interesting result as it shows that the policy targeting credit aggregates did not have unintended consequences on the asset price expansion and contraction process behaviour. However, it raises questions about the effect (or lack of effect) that additional reforms and the increase in financial rigidity have had on the accumulation of financial imbalances as proxied by the severity of bull phases in asset prices and credit aggregates. While the causal mechanism described is logical and seems plausible, this paper is a long way from proving causality or a direct effect of regulation on the behaviour of credit aggregates. It is, of course, an institutional story in which proving definitive causality is extremely complex. However, further research may try to build a financial repression index for Colombia so that better statistical inference techniques may be used to further identify the link. Additionally, the role of the international financial market cannot be discarded. In that sense performing this study after correcting for the effect of international capital markets may be an interesting extension.

Regarding the Colombian financial cycle, the analysis of time-varying contemporaneous correlation coefficients has shown that, for Colombia, the association between the asset prices and credit aggregates has been volatile during the period. Long-run correlations between real exchange rates and credit turn negative during crisis periods (1998-2011) and peaks during recoveries or periods of financial liberalization (1991-97; 2014-20). This correlation remains negative for long periods and takes a long time to recover. While this may be counterintuitive, we suggest it relates to the fact that the US dollar is treated as a safe haven for Colombian investors. To further test this hypothesis, extensions of this paper may try to incorporate the international holdings of Colombian investors and the behaviour of foreign portfolio investments in the country. This extension will relate well with the analysis of the impact of foreign markets on the Colombian financial cycle. Interestingly, this extension could tie into a broad body of literature which argues that there is a global financial cycle that explains about a quarter of the variance of domestic markets (Miranda Agrippino & Rey, 2015; Passari & Rey, 2015; Rey, 2015; Rey, 2016; Forero-Laverde, 2019).

Finally, we find that the four series of correlations have breaks at distinct moments in time. While we try to tie these findings to Colombian economic history, we understand that conclusive evidence needs further research. We offer these findings as a titillating first exploration upon which an extensive research plan could be constructed.

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Annex 1. Phases database

LBBI	Phase	Start	End	Dur	Amplitude		Severity	
					CAGR	*Monthly*	*Phase*	*Monthly*
Stocks Short	Bull	07/87	01/88	7	81,5%	5,0%	7,1	1,0
Stocks Short	Bear	04/88	11/88	8	-18,8%	-1,7%	-6,3	-0,8
Stocks Short	Bear	04/89	09/89	6	-23,1%	-2,2%	-4,8	-0,8
Stocks Short	Bull	12/90	01/92	14	247,2%	10,4%	16,2	1,2
Stocks Short	Bear	10/92	09/93	12	-9,8%	-0,9%	-23,9	-2,0
Stocks Short	Bull	12/93	03/94	4	207,1%	9,3%	2,8	0,7
Stocks Short	Bear	06/94	11/95	18	-35,2%	-3,6%	-27,9	-1,5
Stocks Short	Bear	03/96	12/96	10	-11,9%	-1,1%	-7,7	-0,8
Stocks Short	Bull	08/97	10/97	3	113,5%	6,3%	2,8	0,9
Stocks Short	Bear	01/98	10/98	10	-56,5%	-6,9%	-12,7	-1,3
Stocks Short	Bear	03/00	10/00	8	-41,2%	-4,4%	-6,3	-0,8
Stocks Short	Bull	04/01	08/01	5	15,5%	1,2%	4,8	1,0
Stocks Short	Bull	12/01	07/03	20	53,5%	3,6%	18,7	0,9
Stocks Short	Bull	01/04	03/04	3	263,0%	10,7%	3,4	1,1
Stocks Short	Bull	09/04	11/04	3	295,7%	11,5%	2,4	0,8
Stocks Short	Bull	06/05	01/06	8	245,9%	10,3%	5,8	0,7
Stocks Short	Bear	05/06	03/09	35	-12,8%	-1,1%	-54,2	-1,5
Stocks Short	Bull	05/09	09/09	5	135,2%	7,1%	4,3	0,9
Stocks Short	Bull	08/10	10/10	3	115,4%	6,4%	1,9	0,6
Stocks Short	Bear	02/11	09/12	20	-5,7%	-0,5%	-20,4	-1,0
Stocks Short	Bear	03/13	02/14	12	-19,4%	-1,8%	-11,4	-0,9
Stocks Short	Bear	10/14	11/15	14	-33,0%	-3,3%	-11,1	-0,8
Stocks Short	Bull	08/16	10/16	3	20,8%	1,6%	2,7	0,9
Stocks Short	Bull	05/17	09/17	5	20,2%	1,5%	4,0	0,8
Stocks Short	Bear	10/18	12/18	3	-41,2%	-4,4%	-2,8	-0,9
Stocks Short	Bear	02/20	06/20	6	-53,8%	-6,4%	-6,5	-1,1
Stocks Short	Bull	08/21	10/21	3	56,1%	3,7%	2,1	0,7
Credit Short	Bear	01/87	05/87	5	-5,4%	-0,5%	-3,6	-0,7
Credit Short	Bear	01/88	07/88	7	-7,6%	-0,7%	-8,8	-1,3
Credit Short	Bull	12/88	07/89	8	29,3%	2,1%	4,8	0,6
Credit Short	Bear	12/90	08/92	21	-3,8%	-0,3%	-33,8	-1,6
Credit Short	Bull	10/92	12/92	3	45,1%	3,1%	2,9	1,0
Credit Short	Bull	04/93	12/93	9	26,7%	2,0%	5,9	0,7
Credit Short	Bear	02/96	07/97	18	1,9%	0,2%	-26,3	-1,5
Credit Short	Bear	02/98	04/01	39	-11,8%	-1,0%	-44,1	-1,1
Credit Short	Bull	06/02	02/04	21	4,1%	0,3%	25,5	1,2
Credit Short	Bull	04/04	12/06	33	17,1%	1,3%	26,0	0,8
Credit Short	Bear	02/08	07/08	6	5,9%	0,5%	-4,9	-0,8
Credit Short	Bear	01/09	06/10	18	0,7%	0,1%	-31,3	-1,7
Credit Short	Bull	09/10	12/10	4	31,8%	2,3%	2,6	0,7
Credit Short	Bear	01/16	10/18	34	1,4%	0,1%	-42,1	-1,2
Credit Short	Bear	08/20	08/21	13	-0,1%	0,0%	-12,7	-1,0

LBBI	Phase	Start	End	Dur	Amplitude		Severity	
					CAGR	*Monthly*	*Phase*	*Monthly*
RFX short	Bear	01/88	09/88	9	-6,2%	-0,5%	-10,4	-1,2
RFX short	Bear	01/89	06/89	6	-8,1%	-0,7%	-5,5	-0,9
RFX short	Bull	07/90	10/90	4	36,2%	2,6%	3,2	0,8
RFX short	Bear	03/91	05/92	15	-13,1%	-1,2%	-16,9	-1,1
RFX short	Bear	01/93	07/94	19	-11,8%	-1,0%	-12,2	-0,6
RFX short	Bull	07/95	11/95	5	25,4%	1,9%	6,8	1,4
RFX short	Bear	04/96	12/96	9	-18,5%	-1,7%	-6,2	-0,7
RFX short	Bull	08/97	01/98	6	26,0%	1,9%	8,3	1,4
RFX short	Bull	09/98	11/98	3	73,1%	4,6%	4,9	1,6
RFX short	Bull	05/99	10/99	6	51,0%	3,4%	6,6	1,1
RFX short	Bear	06/01	02/03	21	7,3%	0,6%	-5,9	-0,3
RFX short	Bear	08/03	06/05	23	-11,7%	-1,0%	-22,0	-1,0
RFX short	Bull	04/06	07/06	4	40,8%	2,9%	6,0	1,5
RFX short	Bear	01/07	06/07	6	-29,3%	-2,9%	-6,0	-1,0
RFX short	Bear	02/08	06/08	5	-30,2%	-3,0%	-3,7	-0,7
RFX short	Bull	08/08	03/09	8	32,4%	2,3%	10,1	1,3
RFX short	Bear	06/09	10/09	5	-22,9%	-2,2%	-4,5	-0,9
RFX short	Bear	01/10	08/10	8	-19,2%	-1,8%	-4,9	-0,6
RFX short	Bull	11/10	03/11	5	11,4%	0,9%	4,4	0,9
RFX short	Bull	08/11	12/11	5	14,0%	1,1%	4,5	0,9
RFX short	Bull	02/13	03/14	14	9,5%	0,8%	12,0	0,9
RFX short	Bull	10/14	01/15	4	55,2%	3,7%	5,6	1,4
RFX short	Bull	06/15	09/15	4	81,4%	5,0%	4,6	1,1
RFX short	Bear	03/16	05/17	15	-12,6%	-1,1%	-16,6	-1,1
RFX short	Bear	01/18	07/18	7	-11,4%	-1,0%	-6,5	-0,9
RFX short	Bull	10/18	12/18	3	23,1%	1,7%	2,3	0,8
RFX short	Bear	12/20	03/21	4	-5,8%	-0,5%	-3,6	-0,9
Stocks Long	Bull	07/87	10/89	28	0,5%	0,0%	26,8	1,0
Stocks Long	Bear	06/90	12/92	31	60,4%	3,9%	-5,5	-0,2
Stocks Long	Bull	09/93	05/94	9	90,8%	5,4%	5,7	0,6
Stocks Long	Bear	06/95	11/01	78	-10,7%	-0,9%	-281,5	-3,6
Stocks Long	Bull	12/02	04/06	41	70,9%	4,5%	44,7	1,1
Stocks Long	Bear	02/08	03/18	122	0,3%	0,0%	-291,4	-2,4
Stocks Long	Bull	07/19	02/20	8	-3,1%	-0,3%	6,4	0,8
Stocks Long	Bear	03/20	06/20	4	-63,1%	-8,3%	-3,3	-0,8
Credit Long	Bull	01/87	11/87	11	8,4%	0,7%	7,3	0,7
Credit Long	Bull	07/89	09/89	3	18,9%	1,4%	1,5	0,5
Credit Long	Bear	06/98	06/03	61	-7,8%	-0,7%	-154,6	-2,5
Credit Long	Bull	07/04	04/08	46	16,1%	1,2%	67,2	1,5
Credit Long	Bear	12/16	09/21	58	2,7%	0,2%	-59,5	-1,0
RFX Long	Bull	01/87	01/88	13	3,8%	0,3%	10,1	0,8
RFX Long	Bear	05/91	04/97	72	-7,8%	-0,7%	-126,4	-1,8
RFX Long	Bull	09/98	01/02	41	7,8%	0,6%	59,7	1,5
RFX Long	Bull	07/02	02/03	8	35,9%	2,6%	4,6	0,6
RFX Long	Bear	03/04	07/08	53	-8,5%	-0,7%	-90,8	-1,7
RFX Long	Bull	10/11	01/12	4	-2,6%	-0,2%	4,0	1,0
RFX Long	Bear	05/03	11/16	163	-1,6%	-0,1%	-30,2	-0,2
RFX Long	Bear	07/18	09/18	3	8,0%	0,6%	-2,6	-0,9
RFX Long	Bear	01/19	03/21	27	4,6%	0,4%	-25,1	-0,9