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The Neglected Role of the Business Cycle

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Finance and Growth: The neglected Role of the Business Cycle

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Abstract

A canonical cross-country/time-series literature argues that finance, typically measured as private credit, fuels growth. This literature aims to sweep out business cycle effects by averaging the data over five years. We show that growth and credit are positively correlated with output gap measures for five year averaged data. Studies not adequately controlling for this pro-cyclicality overstate the long-run impact of finance. We illustrate the severity of this bias in a careful reassessment of the finance-growth nexus, controlling for business cycles in a panel of 130 developed and developing countries for the period 1965 to 2009. We find robust evidence that once such short-run fluctuations are purged, the impact of credit becomes considerably smaller, and less robust. Further, we present evidence that in recent decades credit became more strongly pro-cyclical and the finance-growth nexus much weaker. This can be explained by financial innovation and too much finance, which are found to harm growth.

Keywords: Finance; Banking; Economic growth; Business cycle; Robustness

JEL: G10; G21; O16; O40

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1. Introduction

In the cross-country/time-series literature on the impact of finance on growth the most commonly applied proxies for financial development are total credit in percent of GDP, bank credit in percent of GDP, and conceptually related measures. From a theoretical perspective one would expect to find a strong positive correlation between these proxies of financial development and growth, as there is a long tradition in economics arguing that credit is pro-cyclical. First, credit demand is pro-cyclical as economic downturns lead to demand shifts, i.e. firms are reluctant to borrow and invest in a period of low aggregate demand and high uncertainty, while the opposite is true for booms (e.g. Keynes, 1936; Bernanke, 1983; Minsky, 1986; Pindyck, 1991; Dixit and Pindyck, 1994; Francois and Lloyd-Ellis, 2003). Second, credit supply is pro-cyclical, as banks are less willing to lend in recessions when bank capital is lower and borrowers have less net worth than in an upturn (e.g. Fisher, 1933; Bernanke and Blinder, 1988; Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Holmstrom and Tirole, 1997). Hence finance itself is important in the propagation of business cycles. There is further a substantial empirical literature linking surges in credit to boom-and-bust cycles.[1]

Thus it is crucial to address the pro-cyclicality of credit in empirical studies on the impact of finance on growth. This should be well known, especially since Beck and Levine (2004) explicitly criticized Rousseau and Wachtel (2000) for not abstracting from "business cycle phenomena" (p. 425) when applying annual data and emphasized "the significance of using sufficiently low-frequency data to abstract from crisis and business cycles" (p. 439). The "by-now-standard approach" (Rousseau and Wachtel, 2011, p. 278) in panel studies to address this issue is to transform annual data into five year non-overlapping periods, which allows one "to

[1] See for example Demirguc-Kunt and Detragiache (1998), Reinhart and Kaminsky, (1999), Mendoza and Terrones (2008), Lane and Milesi-Ferretti (2011), Jordà et al. (2011), Schularick and Taylor (2012), Frankel and Saravelos (2012), Babecký et al. (2013), and Feldkircher (2014).
[2] Studies applying the five-year averaging approach are e.g. De Gregorio and Guidotti (1995), Levine

focus on long-run economic growth" (Beck and Levine, 2004, p. 425).[2]

But it is unclear why five year averaging should successfully purge short-run fluctuations from the data. According to NBER's Business Cycle Dating Committee, the average business cycle in the U.S. from 1960 to 2009 lasted about 6½ years, where the shortest cycle was about 2 years and the longest around 11 years. According to the methodology defined by the German Council of Economic Experts, German business cycles since 1970 even lasted between 6 and 11½ years, whereas the Euro Area Business Cycle Dating Committee finds an average length of the business cycle of 9½ years since the mid-1970s, with a minimum of nearly 4 years and a maximum of more than 1½ decades. Also the output gap measures constructed by the OECD and IMF for several rich countries show business cycles between 2 and up to 15 years of length, which are associated with highly diverse output losses across countries.[3]

Averaging the data over five year periods is therefore unlikely to smooth out cyclical variations in growth and credit for two reasons: First, business cycles last longer than five years on average, and second, as business cycles are not synchronized, their length and severity vary strongly over time and between countries. We therefore agree with Loayza and Ranciere (2006, p. 1054) that "it is not obvious that averaging over fixed-length intervals effectively eliminates business-cycle fluctuations."

We aim to contribute to the existing literature along several dimensions. Fist, we test if five year averaging sweeps out business cycle fluctuations (Section 2). We find

[2] Studies applying the five-year averaging approach are e.g. De Gregorio and Guidotti (1995), Levine et al. (2000), Benhabib and Spiegel (2000), Rousseau and Wachtel (2002 and 2011), Favara (2003), Rioja and Valev (2004), Loayza and Ranciere (2006), Cecchetti and Kharroubi (2012), Arcand et al. (2012), Law et al. (2013), Law and Singh (2014), and Beck et al. (2014).

[3] Own calculations based on the following sources: NBER: http://www.nber.org/cycles/cyclesmain.html [accessed: 2013-06-23]; Euro Area Business Cycle Dating Committee: http://www.cepr.org/data/dating/ [accessed: 2013-06-23]; German Council of Economic Experts Annual Economic Report 2007/2008; OECD Economic Outlook, No. 88; and IMF World Economic Outlook, April 2013.

strong evidence that this is not the case. Second, we show that the inadequate treatment of short-run fluctuations in the econometric standard approach produces biased results and overstates the true effect of finance on long-run growth (Section 2 and 3). Third, we carefully reassess the finance-growth nexus for a panel of 130 countries, and explicitly purge business cycle fluctuations (Section 3). We find evidence that the finance-growth nexus became much weaker in recent decades. This might be explained with the rise of financial innovation and bloated financial systems in many countries, which are found to slow down growth. We conclude in Section 4, where we also mention possible approaches to deal with high frequency fluctuations.

2. Does five year averaging sweep out business cycle fluctuations? A look at the data

To investigate if five year averaging sweeps out business cycles, we construct a data set with annual observations averaged over five years, including information on real GDP per capita, private credit by banks and other financial institutions in percent of GDP, and output-gap measures, a common variable to capture business cycle fluctuations.[4] If high-frequency fluctuations are indeed purged from five year averaged data, the output gap measures should be uncorrelated with growth and private credit.

To construct the output gap we follow Braun and Larrain (2005), and apply the Hodrick-Prescott (HP) filter (Hodrick and Prescott, 1997) with the standard smoothing parameter of λ=100 for annual data. Additionally, we construct further measures using smoothing parameters of λ=25 and λ=50 for the HP filter.[5] Setting λ=100 gives cycles up to one and a half decades (Cotis et al., 2005; Mc Morrow and Roeger, 2001), which is consistent with the discussion on the length of business

[4] See Appendix 1 for data definitions and sources.
[5] λ is calculated as $1600/p^x$, where 1600 is the standard smoothing parameter for quarterly data, p is the number of periods per quarter, and x is 3 and 2, respectively, which gives λ=25 and λ=100. Further we arbitrarily include λ=50 to get a broader variety of results.

cycles in Section 1. We further follow Buch et al. (2005), who prefer the Baxter-King (BK) filter (Baxter and King, 1999) with values for cycle length between 2 and 8 years. Additionally, we allow for cycle length between 2 and 15 years. Our data set is an unbalanced panel of up to 200 countries with annual information for the time period 1965 to 2009. The annual data is averaged over non-overlapping five year periods.[6]

Table 1 shows the pairwise correlation coefficients of growth in per capita GDP and the logarithm of private credit in percent of GDP with the different output gap measures. The output gap measures are consistently positively and statistically significantly correlated with growth *and* private credit. Hence, our first assessment suggests that five year averaging does not sweep out business cycle fluctuations in the data.

Table 1: *Pairwise correlation coefficients of growth in per capita GDP, the logarithm of private credit in percent of GDP, and measures of the output gap, >170 countries, 1965 to 2009, five years averaged data*

		Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.
Growth	Correlation coefficient	0.115***	0.087***	0.067**	0.120***	0.092***
	Significance level	0.000	0.002	0.017	0.000	0.001
	Observations	1317	1317	1317	1317	1317
Private credit	Correlation coefficient	0.077**	0.106***	0.132***	0.154***	0.161***
	Significance level	0.013	0.001	0.000	0.000	0.000
	Observations	1034	1034	1034	1034	1034

Sources: World Bank WDI, AMECO, Cihak et al. (2012), Levine et al. (2000), authors calculations

To interpret this finding, consider the omitted variable bias formula. If the true model is $y_{i,t} = \beta pc_{i,t} + \gamma og_{i,t} + \varepsilon_{i,t}$, where $y_{i,t}$ is growth, $pc_{i,t}$ is private credit, and $og_{i,t}$ the output gap, where the latter is omitted, it states that $\frac{Cov(y_{i,t}, pc_{i,t})}{Var(pc_{i,t})} = \beta + \gamma'\sigma$,

[6] The first period is from 1960 to 1964, the second from 1965 to 1969, and so on. We drop observations if not at least three annual values are available in a five year period. We further drop the first and last five-year period for which GDP per capita is available for every country to address the end-value bias of univariate filter methods (as suggested by Baxter and King, 1999). To reduce the influence of outliers, 1.5 percent of the sample at both tails of growth and the output gap measures are winsorized, where extreme values are substituted by the next values counting inwards from the extremes. Our results, however, do not depend on this.

where β is the true coefficient of private credit, γ is the coefficient of the output gap, and σ is the coefficient from regressions of the output gap on private credit. Table 1 thus suggests that cyclical fluctuations upwardly bias the impact of finance on long-run growth when applying the standard five years averaging method. Given the strong positive correlation of credit and growth in the short-run, the true long-run effect of finance can thus be expected to be smaller than the estimated coefficient when applying the standard approach.

To present further evidence on the pro-cyclicality of private credit in five year averaged data, we proceed by regressing private credit on country and time dummies, country-specific time trends, and, step by step, each of the output gap measures. The specification takes the following form:

$$pc_{i,t} = \beta' X_{i,t} + \delta_i t + \delta_i t^2 + \gamma_t + \eta_i + \varepsilon_{i,t} \text{ for i = 1, ..., N and t = 1, ... T} \qquad (1)$$

$pc_{i,t}$is the logarithm of private credit in percent of GDP, $X_{i,t}$ consists of the output gap. $\delta_i t$ is a country-specific time trend to capture institutional and policy changes in a specific country which influence the development of private credit over time, $\delta_i t^2$ are squared country-specific time trends, and η_i and $\gamma_t$are country- and time fixed effects, respectively. Standard errors are clustered at the panel level to correct for within-group serial correlation and heteroscedasticity (e.g. Bertrand et al., 2004; Cameron et al., 2008). We present four different versions of this specification, with and without country fixed effects, and with and without squared country-specific time trends.

The results are shown in Table 2. The coefficients of the different output gap measures are consistently positively correlated with private credit, and statistically significant in most cases. The R^2 varies between 0.69 and 0.94, suggesting that our specifications are able to explain a high share of the variation of private credit.[7]

[7] We also repeated this analysis for other financial system characteristics. Bank credit to GDP, bank credit to bank deposits, bank assets to GDP, bank assets to bank and central bank assets, and private bond market capitalization to GDP are also strongly pro-cyclical. Public bond market capitalization to GDP is found to be strongly counter-cyclical.

Table 2: *Explaining the logarithm of private credit in percent of GDP, 1965 to 2009, five year averaged data, OLS and fixed effects estimator*

	OLS									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.
Output gap	0.021**	0.021***	0.019***	0.047***	0.034***	0.021**	0.012*	0.010**	0.025*	0.018*
	(0.015)	(0.003)	(0.002)	(0.007)	(0.007)	(0.015)	(0.056)	(0.048)	(0.071)	(0.067)
Country dummies	no	no	no	no	no	no	no	no	no	no
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country specific time trends	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Squared country specific time trends	no	no	no	no	no	yes	yes	yes	yes	yes
R-squared	0.838	0.839	0.840	0.839	0.839	0.839	0.937	0.937	0.937	0.937
Observations	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034
Countries	174	174	174	174	174	174	174	174	174	174
	Fixed effects									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.
Output gap	0.013*	0.012**	0.010**	0.025**	0.018**	0.009	0.009	0.008*	0.018	0.013
	(0.056)	(0.034)	(0.029)	(0.045)	(0.042)	(0.203)	(0.132)	(0.094)	(0.183)	(0.178)
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country specific time trends	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Squared country specific time trends	no	no	no	no	no	yes	yes	yes	yes	yes
R-squared	0.693	0.694	0.694	0.693	0.693	0.831	0.832	0.832	0.832	0.832
Observations	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034
Countries	174	174	174	174	174	174	174	174	174	174

Notes: p-values in parentheses, cluster-robust standard errors. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively.
Sources: World Bank WDI, AMECO, Cihak et al. (2012), Levine et al. (2000), authors' calculations

Overall, the different measures of the output gap are found to be positively and significantly correlated with private credit and growth. Our results suggest that first, five year averaging of data insufficiently purges short-run fluctuations. And second, because of the pro-cyclicality of private credit in the short-run, the coefficient of private credit in studies relying on the five year averaging method might be upwardly biased.

3. Reassessing the finance-growth nexus without and with business cycle controls

To assess the severity of this bias we estimate standard growth regressions (see e.g. Levine et al., 2000; Beck and Levine, 2004; Arcand et al., 2012) and include the output gap as an additional control variable. The specification takes the following form:

$$\Delta y_{i,t} = (1-\alpha) y_{i,t-1} + \beta' X_{i,t} + \eta_i + \gamma_t + \varepsilon_{i,t} \text{ for i = 1, ..., N and t = 2, ... T} \qquad (2)$$

$\Delta y_{i,t}$ is the change in the logarithm of real GDP per capita over a five year period in country i and time period t. $y_{i,t-1}$ is initial GDP at the beginning of each five year period, $X_{i,t}$ is a vector of explanatory variables measured during, or at the start of, the period. It consists of private credit as proxy for financial development, and standard control variables such as average years of schooling, government expenditures to GDP, the inflation rate, and trade openness measured as share of exports and imports to GDP. Depending on the specification, we also include one of the output gap measures as additional regressor. η_i are unobserved country-specific effects, γ_t are period-specific intercepts, and $\varepsilon_{i,t}$ is an idiosyncratic error term.

We apply the system GMM estimator (see Arellano and Bover, 1995; Blundell and Bond, 1998) with the asymptotically more efficient two-step procedure described in Arellano and Bond (1991) and the Windmeijer (2005) finite sample correction. The system GMM estimator seems to be best suited for the task of estimating cross-country growth regressions with persistent variables, a dynamic data generating process, arbitrarily distributed fixed effects, endogenous regressors with only

internal instruments available, and a data set with a small number of time periods and a large cross-sectional dimension (see e.g. Bond et al., 2001). It is also the most commonly applied estimator in the cross-country growth literature.

Table 3: *Growth specification, 1965 to 2009, five year averaged data*

	(1a)	(1b) Output gap, HP λ=25	(1c) Output gap, HP λ=50	(1d) Output gap, HP λ=100	(1e) Output gap, BK 2-8 yrs.	(1f) Output gap, BK 2-15 yrs.
Initial GDP	-0.192	-0.073	0.047	-0.080	-0.276	-0.234
	(0.626)	(0.815)	(0.893)	(0.821)	(0.393)	(0.479)
School	1.283*	1.342**	1.113*	1.224**	1.436**	1.364**
	(0.050)	(0.033)	(0.074)	(0.032)	(0.016)	(0.024)
Inflation	0.116	0.111	0.130	0.142	0.104	0.075
	(0.571)	(0.588)	(0.539)	(0.474)	(0.602)	(0.718)
Government consumption	-2.944***	-2.397***	-2.720***	-2.760***	-2.767***	-2.939***
	(0.000)	(0.002)	(0.001)	(0.000)	(0.001)	(0.000)
Trade openness	2.544***	2.146***	2.053***	2.197***	2.082***	2.023***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Private credit	0.358	0.015	-0.036	0.023	0.141	0.133
	(0.396)	(0.968)	(0.930)	(0.951)	(0.725)	(0.745)
Output gap		0.414***	0.342***	0.210***	0.699***	0.426***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Hansen test (p-value)	0.798	0.983	0.971	0.980	0.982	0.978
Serial cor. test (p-value for 2nd order corr.)	0.575	0.464	0.566	0.619	0.681	0.626
Observations	833	833	833	833	833	833
Countries	132	132	132	132	132	132

Notes: p-values in parentheses, Windmeijer robust standard errors. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively. The regressions include time dummies that are not reported. Instruments limited to two lags. All explanatory variables except output gap in logarithms.
Sources: World Bank WDI, AMECO, OECD, IFS, Cihak et al. (2012), Levine et al. (2000), authors calculations

The Hansen test of overidentifying restrictions and the Arellano-Bond serial correlation test are reported with the regression results. The Hansen tests never reject the null, and thus provide support for the validity of the instruments. All regressions reject the null of no first order autocorrelation, and do not reject the null of no second order autocorrelation.[8] Our data set consists of 132 coutnries over

[8] $y_{i,t-1}$ and years of schooling are treated as pre-determined, the remaining variables as endogenous. In a first assessment, all lags are used as instruments. Probably because of the relatively high time dimension in our sample the Hansen test of overidentifying restrictions is equal to 1.000 in most cases, indicating potential problems with instrument proliferation (Roodman, 2009; Bazzi and Clemens, 2013). Thus we limit the lag-length of the instrumental variables appropriately, typically allowing for two lags. The presented results are very similar if one, two, or three lags are used as instruments. Our central finding also holds if we collapse the instruments (see Footnote 11).

the time period 1965 to 2009.[9] Together with Arcand et al. (2012), our data set hence constitutes the most complete one in the literature so far.

Our findings are presented in Table 3. The first specification, 1a, resembles a standard specification for the maximum sample size. Years of schooling and trade openness are found to increase growth, while government consumption negatively affects growth. The coefficient of private credit is 0.36. Overall these results are extremely similar to the findings of others, especially Arcand et al. (2012), whose covered time and country dimension resembles ours most closely, and who report a virtually identical and also insignificant coefficient for private credit of 0.35 for the time period 1960 to 2010 (Table 4, p. 33).[10]

Specifications 1b to 1f add one output gap measure at a time as additional regressor to the baseline regression. This decreases the coefficient of private credit considerably, on average by more than ⅘. This indicates that specifications following the standard approach are not robust against the inclusion of business cycle controls, and that the estimated impact of finance on growth is smaller if high-frequency variations are purged.[11]

[9] See Appendix 1 for data definitions and sources, and Appendix 2 for summary statistics. The control variables are transformed into logarithms. We follow Arcand et al. (2012) and deal with negative and zero values by applying the inverse hyperbolic sine transformation ($\check{x} = \ln(x + \sqrt{x^2 + 1})$) in the cases of inflation and schooling. To maximize sample size, observations were obtained by interpolation in a few cases, e.g. if government consumption is missing while all other required variables are available. To address the end-value bias of univariate filter techniques we drop the first and last observation for every country, which limits the time period under consideration to 1965 to 2009.

[10] Note that Arcand et al. (2012) explain GDP growth, while we explain GDP per capita growth.

[11] In the text we focus on the system GMM results. But our central finding is robust to different estimation strategies. Appendix 3 presents results applying the difference GMM and OLS estimators. While these alternative estimators yield much lower coefficients of private credit than when estimated with system GMM, we nevertheless consistently find that the coefficient of private credit is reduced further if output gap measures are controlled for. To investigate the topic of too many instruments further (see Footnote 8), we follow the advice of Roodman (2009) and Bazzi and Clemens (2013) and additionally collapse the instruments (see Appendix 4). This reduces the instrument count considerably, resulting in 29 to 37 instruments depending on the specification. This is much lower than the cross-sectional dimension of 132. Collapsing has a noticeable impact on the coefficient (and significance) of private credit, rendering it much smaller. But also in this case we consistently find that the inclusion of output gap measures results in lower coefficients of private credit, thus validating the central findings of this paper.

In none of the specifications presented in Table 3 private credit is found to fuel growth. This goes against conventional wisdom (see e.g. Levine, 2005), and seeks for an explanation. In what follows we investigate several possible lines of explanations.

3.1 Is this result especially driven by rich or poor countries?

Splitting the sample into rich and poor countries, as defined by the World Bank, allows us to test if finance has different growth-impacts in poor compared to rich countries, as well as if our finding that business cycle fluctuations upwardly bias the coefficient of total private credit holds for both groups.

The results are presented in Table 4. Once we split the sample, the effect of finance on growth compared to the full sample seems to decrease in the poor country group, and increase in the rich one. But in both groups, private credit is insignificant. Thus the results do not support the view that developments affecting only one of our country groups explain the insignificant coefficients of private credit in Table 3. However, for both groups of countries we consistently find that the coefficient of private credit is strongly reduced once business cycle effects are controlled for.

3.2 Did the finance-growth nexus become weaker over time?

Rousseau and Wachtel (2011) and Arcand et al. (2012) show that the impact of private credit on growth fell considerably over time. Different theoretical arguments can explain such a diminishing finance-growth nexus. Aghion et al. (2005) present a growth model where countries with developed financial markets grow at the technological frontier, while financial constraints prevent poor countries from taking full advantage of technology transfers. Financial development induces catching-up and leads to a convergence of long-run growth. But our results from Section 3.1 do not seem to favor this explanation.

Table 4: *Growth specification, 1965 to 2009, five year averaged data, high- and upper-middle-income economies and low- and lower-middle-income economies*

High- and upper-middle-income economies

	(2a)	(2b) Output gap, HP λ=25	(2c) Output gap, HP λ=50	(2d) Output gap, HP λ=100	(2e) Output gap, BK 2-8 yrs.	(2f) Output gap, BK 2-15 yrs.
Initial GDP	-1.093***	-0.750*	-1.001**	-0.976**	-0.897**	-1.050**
	(0.003)	(0.090)	(0.044)	(0.048)	(0.029)	(0.018)
School	0.807	1.436*	1.640*	1.693*	1.826**	1.738**
	(0.365)	(0.068)	(0.060)	(0.065)	(0.022)	(0.039)
Inflation	-0.108	-0.309	-0.365	-0.487*	-0.418	-0.348
	(0.629)	(0.275)	(0.187)	(0.098)	(0.200)	(0.220)
Government consumption	-0.164	-0.966	-0.836	-1.042	-1.172	-1.106
	(0.854)	(0.245)	(0.367)	(0.256)	(0.171)	(0.283)
Trade openness	1.281***	1.151**	1.133**	1.162**	1.103**	1.078*
	(0.003)	(0.013)	(0.044)	(0.020)	(0.027)	(0.051)
Private credit	0.643	-0.006	0.093	-0.039	-0.140	0.207
	(0.115)	(0.992)	(0.898)	(0.945)	(0.818)	(0.727)
Output gap		0.430***	0.326***	0.216***	0.542**	0.347*
		(0.003)	(0.000)	(0.001)	(0.024)	(0.063)
Hansen test (p-value)	0.996	1.000	1.000	1.000	1.000	1.000
Serial cor. test (p-value for 2nd order	0.666	0.390	0.526	0.616	0.593	0.659
Observations	484	484	484	484	484	484
Countries	73	73	73	73	73	73

Low- and lower-middle-income economies

	(3a)	(3b) Output gap, HP λ=25	(3c) Output gap, HP λ=50	(3d) Output gap, HP λ=100	(3e) Output gap, BK 2-8 yrs.	(3f) Output gap, BK 2-15 yrs.
Initial GDP	0.043	0.249	0.026	-0.172	-0.045	0.016
	(0.948)	(0.870)	(0.972)	(0.780)	(0.952)	(0.979)
School	0.607	0.436	0.914	0.886	1.139	1.269
	(0.578)	(0.850)	(0.367)	(0.377)	(0.328)	(0.326)
Inflation	0.254	0.066	0.034	0.107	-0.008	-0.055
	(0.534)	(0.937)	(0.921)	(0.791)	(0.980)	(0.877)
Government consumption	-3.991***	-3.064	-2.743**	-3.255***	-3.482***	-3.716***
	(0.000)	(0.380)	(0.016)	(0.003)	(0.004)	(0.003)
Trade openness	2.630**	2.380	2.181*	2.349**	2.735**	2.516**
	(0.038)	(0.290)	(0.061)	(0.014)	(0.033)	(0.018)
Private credit	-0.288	-0.788	-0.809	-0.521	-0.888*	-1.056
	(0.558)	(0.442)	(0.226)	(0.398)	(0.086)	(0.124)
Output gap		0.549**	0.437***	0.313***	1.125***	0.678***
		(0.012)	(0.001)	(0.002)	(0.002)	(0.004)
Hansen test (p-value)	1.000	1.000	1.000	1.000	1.000	1.000
Serial cor. test (p-value for 2nd order	0.969	0.990	0.838	0.781	0.863	0.895
Observations	349	349	349	349	349	349
Countries	59	59	59	59	59	59

Notes: p-values in parentheses, Windmeijer robust standard errors. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively. The regressions include time dummies that are not reported. Instruments limited to one lag. All explainatory variables except output gap in logarithms.
Sources: World Bank WDI, AMECO, OECD, IFS, Cihak et al. (2012), Levine et al. (2000), authors calculations

Table 5: *Growth specification, 1965 to 1999 and 1965 to 1989, five year averaged data*

	1965 to 1999					
	(4a)	(4b) Output gap, HP λ=25	(4c) Output gap, HP λ=50	(4d) Output gap, HP λ=100	(4e) Output gap, BK 2-8 yrs.	(4f) Output gap, BK 2-15 yrs.
Initial GDP	-0.024	0.212	0.182	0.190	0.003	0.038
	(0.955)	(0.564)	(0.655)	(0.610)	(0.994)	(0.946)
School	0.675	0.331	0.472	0.613	0.512	0.472
	(0.355)	(0.636)	(0.524)	(0.392)	(0.446)	(0.669)
Inflation	0.380*	0.347	0.334	0.347	0.283	0.281
	(0.092)	(0.104)	(0.159)	(0.113)	(0.176)	(0.321)
Government consumption	-2.633***	-2.258***	-2.189***	-2.377***	-2.825***	-2.857**
	(0.003)	(0.005)	(0.009)	(0.002)	(0.000)	(0.012)
Trade openness	2.519***	1.861***	1.873***	2.080***	1.935***	1.918**
	(0.001)	(0.004)	(0.004)	(0.000)	(0.002)	(0.030)
Private credit	0.885**	0.465	0.345	0.287	0.512	0.477
	(0.048)	(0.256)	(0.397)	(0.492)	(0.214)	(0.458)
Output gap		0.533***	0.418***	0.264***	0.864***	0.555***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
Hansen test (p-value)	0.616	0.798	0.801	0.842	0.866	0.849
Serial cor. test (p-value for 2nd order corr.)	0.823	0.563	0.788	0.908	0.800	0.776
Observations	582	582	582	582	582	582
Countries	118	118	118	118	118	118

	1965 to 1989					
	(5a)	(5b) Output gap, HP λ=25	(5c) Output gap, HP λ=50	(5d) Output gap, HP λ=100	(5e) Output gap, BK 2-8 yrs.	(5f) Output gap, BK 2-15 yrs.
Initial GDP	-0.196	-0.008	-0.059	0.014	-0.167	-0.107
	(0.718)	(0.987)	(0.911)	(0.982)	(0.741)	(0.830)
School	0.340	0.154	0.099	-0.094	0.161	-0.030
	(0.691)	(0.848)	(0.904)	(0.908)	(0.848)	(0.970)
Inflation	0.359	0.188	0.205	0.219	0.296	0.301
	(0.311)	(0.510)	(0.559)	(0.458)	(0.323)	(0.371)
Government consumption	-2.337*	-2.627***	-2.610**	-2.616**	-2.809**	-2.761**
	(0.081)	(0.002)	(0.018)	(0.034)	(0.020)	(0.016)
Trade openness	2.944***	2.318***	2.206**	2.298**	2.339***	2.193**
	(0.001)	(0.008)	(0.024)	(0.016)	(0.004)	(0.020)
Private credit	1.704***	1.382**	1.490**	1.548**	1.567***	1.573**
	(0.008)	(0.032)	(0.024)	(0.026)	(0.007)	(0.016)
Output gap		0.406***	0.369***	0.273***	0.801***	0.559***
		(0.004)	(0.000)	(0.000)	(0.001)	(0.001)
Hansen test (p-value)	0.621	0.899	0.822	0.848	0.905	0.846
Serial cor. test (p-value for 2nd order corr.)	0.303	0.362	0.468	0.528	0.363	0.376
Observations	367	367	367	367	367	367
Countries	91	91	91	91	91	91

Notes: p-values in parentheses, Windmeijer robust standard errors. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively. The regressions include time dummies that are not reported. Instruments limited to two lags for sample until 1999, no lag-limits for sample until 1989. All explanatory variables except output gap in logarithms.
Sources: World Bank WDI, AMECO, OECD, IFS, Cihak et al. (2012), Levine et al. (2000), authors calculations

Rousseau and Wachtel (2011) link the diminished finance-growth nexus to financial liberalizations and frequent financial crisis since the late 1980's. Hung (2009) argues that unproductive consumption loans can generate such an effect. Dembiermont et al. (2013) show that household lending as a share of total credit tripled in most of the 40 countries in their sample, from around 10 to 20 percent since the 1990s to 30 to 60 percent more recently. Beck et al. (2012) present cross-country evidence that household lending has no growth effect, while firm lending does.

We investigate this issue and present estimates of our model for shorter time periods. Table 5 presents the results when limiting the sample until 1999 and 1989, respectively. Most remarkable are the following three patterns: First, we confirm the result of Rousseau and Wachtel (2011) and Arcand et al. (2012) that including more recent observations yields much lower coefficients for private credit. The coefficient of private credit is 1.70 and highly significant for the sample until 1989 (Specification 5a), only 0.89 and significant for the sample until 1999 (Specification 4a), and become 0.36 and insignificant for the sample until 2009 (Specification 1a). This suggests that significant changes in the financial sector occurred in recent decades.

Second, including an output gap measure reduces the coefficients of credit consistently in all specifications. The impact of this can even change the overall interpretation of the results. For example, while private credit is statistically significant for the sample until 1989, even if we control for business cycle fluctuations, this is no longer the case for the sample until 1999, where private credit becomes indistinguishably different from zero once the output gap is controlled for. Thus, our findings are robust and economically highly relevant for different time periods.

Finally, Table 4 seems to suggest that finance became more pro-cyclical in recent decades. To test this explicitly, we repeat the analysis from Table 2 and explain credit for two sub-periods: 1965 and 1989 and 1990 to 2009 (see Appendix 5a and

b). The output gap measures are indeed much higher for the sup-period 1990 to 2009. Given that financial crisis became much more frequent especially in the 1990ies (e.g. Valencia and Laeven, 2012; Reinhart and Rogoff, 2014), this result might not come entirely as a surprise. But it can also be explained by the increasing short-termism of financial markets participants (e.g. Epstein, 2005; Rappaport, 2011), and the rise of shadow banking and other forms of financial innovation (Gennaioli et al., 2012; Adrian and Shin, 2013). This shows that five year averaging is especially inappropriate to determine the impact of finance on long-run growth in samples including more recent observations.

3.3 Did financial innovation alter the finance-growth nexus?

Next we investigate if the finding of a non-significant growth-effect of finance has to do with financial innovations in recent years. Our data allows us to split total private credit into two components, bank credit and non-bank credit.[12] The latter corresponds to a broad definition of shadow banking as proposed by the FSB (Financial Stability Board, 2011). Because many regulations do not apply for the shadow banking system, it is often linked to high risk-taking and instability, and considered to have played a major role in the recent crisis (e.g. Gorton and Metrick, 2010).

Two caveats should be highlighted here: First, our broad definition of shadow banking might be "too broad for policy analysis" (Claessens et al., 2012), as it also includes activities with economic values like intermediating funds from savers to investors and risk transformation. Second, our data in several important cases, like e.g. the Netherlands or the U.K., is not able to reproduce the figures on non-bank lending from the FSB, published for a small set of countries for single years (see e.g. Financial Stability Board, 2013). This suggests that our data is not reliably capturing non-bank lending for all countries. For these two reasons our results should be interpreted with caution.

[12] Non-bank credit includes pension fund assets, mutual fund assets, insurance company assets, and insurance premiums (see Cihak et al., 2012).

Table 6: *Growth specification, 1965 to 2009, five year averaged data, differentiating between bank and non-bank credit*

	(6a)	(6b) Output gap, HP λ=25	(6c) Output gap, HP λ=50	(6d) Output gap, HP λ=100	(6e) Output gap, BK 2-8 yrs.	(6f) Output gap, BK 2-15 yrs.
Initial GDP	-0.304	-0.233	-0.125	-0.193	-0.302	-0.289
	(0.355)	(0.478)	(0.715)	(0.551)	(0.270)	(0.333)
School	1.181*	1.355**	1.101	1.273*	1.319**	1.264**
	(0.086)	(0.040)	(0.108)	(0.057)	(0.026)	(0.043)
Inflation	0.195	0.176	0.205	0.221	0.126	0.193
	(0.383)	(0.337)	(0.286)	(0.281)	(0.499)	(0.340)
Government consumption	-2.501***	-2.018***	-2.281***	-2.331***	-2.638***	-2.448***
	(0.001)	(0.007)	(0.001)	(0.001)	(0.000)	(0.000)
Trade openness	2.202***	1.878***	1.871***	1.979***	1.926***	1.957***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bank credit	0.809**	0.433	0.386	0.430	0.560	0.545
	(0.016)	(0.238)	(0.327)	(0.239)	(0.120)	(0.135)
Non-bank credit	-0.451**	-0.434**	-0.434**	-0.412**	-0.460**	-0.479**
	(0.032)	(0.030)	(0.033)	(0.039)	(0.025)	(0.013)
Output gap		0.380***	0.313***	0.198***	0.569***	0.363***
		(0.000)	(0.000)	(0.000)	(0.001)	(0.003)
Hansen test (p-value)	0.988	1.000	0.999	1.000	1.000	0.999
Serial cor. test (p-value for 2nd order corr.)	0.711	0.629	0.690	0.754	0.856	0.766
Observations	833	833	833	833	833	833
Countries	132	132	132	132	132	132

Notes: p-values in parentheses, Windmeijer robust standard errors. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively. The regressions include time dummies that are not reported. Instruments limited to two lags. All explanatory variables except output gap in logarithms.
Sources: World Bank WDI, AMECO, OECD, IFS, Cihak et al. (2012), Levine et al. (2000), authors calculations

Table 6 presents our findings. The results of specification 6a suggest that bank credit is statistically significantly causing growth, while non-bank credit reduces growth significantly. The first finding, however, is not robust against the inclusion of the output gap measures (specifications 6b to 6f), which reduces the coefficient of bank credit by ⅓ to ½, and renders it insignificant. The coefficient and significance of non-bank credit seems hardly affected, thus indicating that financial innovation is harming growth.[13]

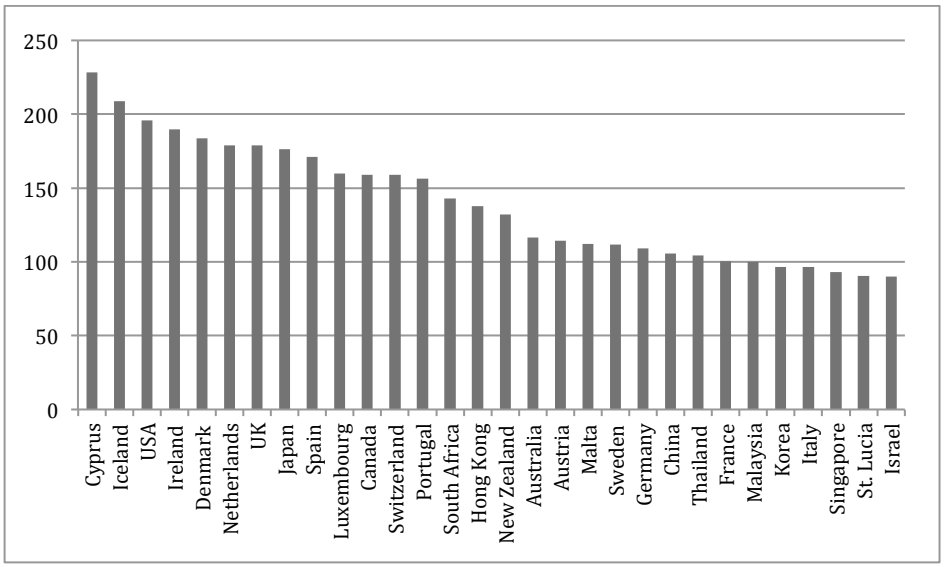
3.4 Does too much finance harm growth?

In an in-depth analysis of some developed countries, Philippon and Reshef (2013, p. 92) conclude that "it is quite difficult to make a clear-cut case that at the margin

[13] Note that it is surprising that non-bank credit seems rather unaffected by the inclusion of the output gap measures in Table 6. One important reason why shadow banking is suspected to increase economic instability is its pro-cyclicality.

reached in high-income economies, the expanding financial sector increases the rate of economic growth."

Figure 1: *Countries where private credit exceeded 90 percent of GDP on average from 2005 to 2009*



Source: Cihak et al. (2012), authors calculations

Masten et al. (2008), based on a sample of European countries, find evidence for significant non-linear effects, with less developed countries gaining more from financial development. Cecchetti et al. (2011), Cecchetti and Kharroubi (2012), Arcand et al. (2012), and Law and Singh (2014) show for panels of developing and developed countries that the finance-growth nexus is non-linear, and that the positive growth-impact of private credit peaks and turns negative after a threshold value. All of them estimate the threshold level of private credit, for different samples and with different estimators, to lie broadly around 90 percent of GDP. This threshold was reached only in the last two decades by a significant amount of mainly developed countries (see Figure 1).[14]

[14] According to Arcand et al. (2012, Figure 3, p. 43), whose data-set resembles ours very closely and who cover significantly more countries over a longer time period than most previous studies, the share of observations in their sample exceeding this 90 percent threshold was around 2 to 5 percent until the mid 1980ies, and then started to rise strongly and steadily to around 10 percent in 1990, above 15 percent in 2000, and more than 30 percent in 2010.

Table 7: *Non-linear growth specification, 1965 to 2009, five year averaged data*

	(7a)	(7b) Output gap, HP λ=25	(7c) Output gap, HP λ=50	(7d) Output gap, HP λ=100	(7e) Output gap, BK 2-8 yrs.	(7f) Output gap, BK 2-15 yrs.
Initial GDP	0.188	0.034	0.043	0.056	-0.142	-0.176
	(0.596)	(0.919)	(0.903)	(0.873)	(0.678)	(0.604)
School	0.623	0.811	0.868	0.983	1.191*	1.210*
	(0.391)	(0.239)	(0.207)	(0.149)	(0.062)	(0.072)
Inflation	0.224	0.073	0.062	0.062	0.051	0.080
	(0.332)	(0.730)	(0.770)	(0.760)	(0.805)	(0.714)
Government consumption	-3.338***	-2.764***	-2.753***	-2.902***	-2.870***	-2.985***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Trade openness	1.981***	1.301***	1.255**	1.407***	1.334***	1.364***
	(0.001)	(0.009)	(0.014)	(0.003)	(0.003)	(0.004)
Private credit	0.032*	0.025	0.019	0.014	0.024	0.026
	(0.067)	(0.127)	(0.273)	(0.425)	(0.161)	(0.147)
Private credit squared	-0.0002*	-0.0001*	-0.0001*	-0.0001*	-0.0001*	-0.0001*
	(0.016)	(0.035)	(0.113)	(0.209)	(0.060)	(0.056)
Output gap		0.513***	0.416***	0.275***	0.797***	0.462***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Hansen test (p-value)	0.294	0.450	0.441	0.481	0.488	0.623
Serial cor. test (p-value for 2nd order corr.)	0.566	0.439	0.614	0.739	0.717	0.663
Observations	833	833	833	833	833	833
Countries	132	132	132	132	132	132
d(growth)/d(credit)=0	93	93	88	80	95	97

Notes: p-values in parentheses, Windmeijer robust standard errors. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively. The regressions include time dummies that are not reported. Instruments limited to one lag. All explanatory variables except output gap, private credit and private credit squared in logarithms.
Sources: World Bank WDI, AMECO, OECD, IFS, Cihak et al. (2012), Levine et al. (2000), authors calculation

We include private credit and private credit squared in levels in the specifications, to test for a non-linear relationship of finance and growth.[15] We present the results of such a non-linear specification for the period 1965 to 2009 in Table 7. In line with Cecchetti et al. (2011), Cecchetti and Kharroubi (2012), Arcand et al. (2012), and Law and Singh (2014), we find that private credit is statistically significant, while private credit squared is negatively significant. The peak value of private credit lies at 93 percent of GDP. But again this finding is not robust against purging business cycle effects. The inclusion of output gap variables narrows the coefficient of private

[15] Because Cecchetti et al. (2011), Cecchetti and Kharroubi (2012), and Law and Singh (2014) do not apply estimation techniques which are able to deal with endogenous variables, they need to assume that finance is exogenous to growth. This is clearly at odds with the theoretical literature cited in the introduction of this paper. We thus follow Arcand et al. (2012) and apply the conventional system GMM estimator to investigate this issue. Note that Law and Singh (2014) apply the estimation approach developed by Kremer et al. (2013). This threshold framework, even though called endogenous threshold model by the authors, does not allow for endogenous regressors other than the lagged dependent variable.

credit (on average by ⅓), as well as private credit squared, leaving the former insignificant. Hence, taken at face value we find that finance does not contribute to growth at all for this period. This confirms our previous finding that omitting business cycle controls might lead to the wrong conclusions.

In Section 3.3 we saw that the impact of non-bank credit seems to differ considerably from bank credit. Thus we again split total private credit into bank credit and non-bank credit, and allow bank credit to have a non-linear effect.[16] The results can be found in Table 8. Bank credit is found to have a significantly positive coefficient, bank credit squared a significantly negative one. Including output gap measures reduces the coefficients of bank credit and bank credit squared considerably, in both cases on average by about ⅓. But this time, we find the results to hold when sweeping out low-frequency variations.

Interestingly, because the output gap measures have about the same effect on bank credit as on bank credit squared, but in opposite directions, the threshold value after which bank credit starts to harm growth remains relatively unaffected by the output gap measures and lies close to 90 percent in all specifications (see bottom line of Table 8). Thus we confirm the finding of the previous literature that an inflated financial system dampens growth. This finding holds when purging short-run fluctuations. However, the result only holds for bank credit, not total private credit.

Finally, the coefficient of non-bank credit consistently shows a negative sign, and is occasionally even close to being statistically significant at the 10 percent level, suggesting that the none-monotone relationship between credit and growth is not the whole explanation for the recently faded finance-growth nexus, but that recent innovations in financial systems also had an adverse effect.

[16] We also tested for a non-linear effect of non-bank credit. In this case, both terms of non-bank credit are highly insignificant.

Table 8: *Non-linear growth specification, 1965 to 2009, five year averaged data, differentiating between bank and non-bank credit*

	(8a)	(8b) Output gap, HP λ=25	(8c) Output gap, HP λ=50	(8d) Output gap, HP λ=100	(8e) Output gap, BK 2-8 yrs.	(8f) Output gap, BK 2-15 yrs.
Initial GDP	-0.008	-0.031	-0.025	-0.050	-0.237	-0.235
	(0.983)	(0.932)	(0.939)	(0.880)	(0.496)	(0.501)
School	0.669	0.725	0.833	0.891	1.182*	1.177*
	(0.357)	(0.364)	(0.246)	(0.216)	(0.063)	(0.088)
Inflation	0.229	0.147	0.115	0.113	0.092	0.061
	(0.305)	(0.470)	(0.555)	(0.599)	(0.612)	(0.729)
Government consumption	-3.021***	-2.654***	-2.679***	-2.811***	-2.616***	-2.663***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Trade openness	1.763***	1.408***	1.357***	1.413***	1.454***	1.415***
	(0.001)	(0.003)	(0.006)	(0.004)	(0.003)	(0.002)
Bank credit	0.062***	0.044***	0.038**	0.040**	0.046**	0.046**
	(0.001)	(0.005)	(0.033)	(0.024)	(0.015)	(0.013)
Bank credit squared	-0.0003***	-0.0002***	-0.0002***	-0.0002***	-0.0002***	-0.0003***
	(0.000)	(0.001)	(0.005)	(0.003)	(0.001)	(0.001)
Non-bank credit	-0.437*	-0.287	-0.301	-0.338	-0.317	-0.347
	(0.052)	(0.142)	(0.129)	(0.116)	(0.152)	(0.108)
Output gap		0.476***	0.377***	0.248***	0.683***	0.417***
		(0.000)	(0.000)	(0.000)	(0.001)	(0.004)
Hansen test (p-value)	0.699	0.857	0.851	0.833	0.850	0.874
Serial cor. test (p-value for 2nd order corr.)	0.640	0.485	0.658	0.777	0.799	0.731
Observations	833	833	833	833	833	833
Countries	132	132	132	132	132	132
d(growth)/d(credit)=0	90	90	87	88	92	91

Notes: p-values in parentheses, Windmeijer robust standard errors. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively. The regressions include time dummies that are not reported. Instruments limited to one lag. All explanatory variables except output gap, private credit and private credit squared in logarithms.
Sources: World Bank WDI, AMECO, OECD, IFS, Cihak et al. (2012), Levine et al. (2000), authors calculation

4. Conclusion

Because of the inherent pro-cyclicality of growth and the most commonly applied proxy for financial development, private credit in percent of GDP, it is crucial to control for business cycle fluctuations in empirical investigations on the impact of finance on growth. The so-called standard approach in the empirical literature attempts to sweep out business cycle fluctuations by averaging data over fixed length intervals of five years. We show that both growth and private credit are highly and positively correlated with various output gap measures for five year averaged data. This suggests that the standard approach of dealing with cyclical

fluctuations is inadequate, and that the impact of finance on long-run growth is overstated in studies which rely on the five-year averaging method.

We demonstrate the relevance of these findings by including measures for the business cycle in growth regressions for a sample of 130 countries over the time period 1965 to 2009. We find that once the short-run correlation of finance and growth is controlled for, the coefficient of private credit consistently becomes significantly smaller. Because of the short-run correlation of growth and credit over the business cycle even in five year averaged data, many findings of the macroeconomic finance-and-growth literature therefore likely overstate the true impact of private credit on long-run growth. The standard empirical approach picks up short-run correlations between credit and growth and biases the results toward the rejection of the null hypothesis.

As five year averaging has become the preferred approach to dealing with business cycle fluctuations in the macroeconomic cross-country/time-series literature more generally, our findings might also be relevant for other topics besides finance in this literature.

There are different ways to tackle this issue. For example, Ndikumana (2005) explains investment as a share of GDP and includes various finance proxies and growth as explanatory variables. Several authors apply cointegration approaches to determine long-run relationships between finance and growth.[17] Arcand et al. (2012) and Bordo and Rousseau (2012) present specifications with data averaged over ten years, which potentially might be more successful in smoothing away business cycles than the five year averaging method. A further possibility would be to determine the length of every business cycle and average accordingly over the whole cycle. Finally, one can follow the approach of this paper and include output gap measures as control variables.

[17] For example Arestis et al. (2001), Favara (2003), Christopoulos and Tsionas (2004), Loayza and Ranciere (2006), Wu et al. (2010), and Bangake and Eggoh (2011).

In our reassessment of the finance-growth nexus we demonstrated that the impact of finance on growth weakened considerably in the last two decades, and that credit became more strongly pro-cyclical in the same period. Hence, considerable changes within the financial sector must have occurred. We present evidence that this can be explained by inflated financial systems and destructive financial innovation, which are found to harm long-run growth. Too much, and laxly regulated finance, therefore, appears to bear considerable risks for economic development.

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Appendix

Appendix 1: *Data description and sources*

Variable	Description and sources
growth	Change in logarithm of real GDP per capita in 2005 U.S. dollars. Source: World Bank World Development Indicators (WDI) 2014, AMECO for Ireland, New Zealand, Switzerland.
private credit	Claims on private sector by deposit money banks and other financial institutions divided by GDP. Source: Cihak et al. (2012) November 2013 version, augmented with data from Levine et al. (2000).
bank credit	Claims on private sector by deposit money banks divided by GDP. Source: Cihak et al. (2012) November 2013 version, augmented with data from Levine et al. (2000).
non-bank credit	Difference between private credit and bank credit.
school	Average years of schooling of males and females above 25 years of age. Source: Barro and Lee (2013), version 1.3.
government	General government final consumption expenditure as a percentage of GDP. Source: WDI, 2014.
openness	Exports plus imports divided by GDP. Source: WDI 2014.
inflation	Annual percent change of the consumer price index. Source: WDI 2014, augmented with OECD and IFS data.
output gap	Cyclical deviation of trend GDP per capita in 2005 U.S. dollars, applying the Hodrick-Prescott or Baxter-King filter . See Section 2 for details. Source: World Bank World Development Indicators (WDI) 2014, AMECO for Ireland, New Zealand, Switzerland.

Appendix 2: *Summary statistics*

	Obs.	Mean	SD	Min	Max
Growth	833	2.026	2.663	-8.608	9.279
Initial GDP	833	8853	12130	144	80925
School	833	5.841	3.131	0.156	13.190
Inflation	833	22.798	127.424	-5.180	2414.346
Government consumption	833	15.508	5.547	4.080	40.591
Trade openness	833	76.522	51.890	8.423	416.246
Private credit	833	42.122	39.117	0.845	228.232
Bank credit	833	38.275	35.414	0.845	208.696
Output gap, HP λ=25	833	-0.036	1.609	-5.689	4.655
Output gap, HP λ=50	833	-0.061	2.082	-7.156	6.013
Output gap, HP λ=100	833	-0.105	2.667	-10.247	7.753
Output gap, BK 2-8 yrs.	833	-0.121	0.949	-3.814	2.776
Output gap, BK 2-15 yrs.	833	-0.160	1.391	-5.568	4.133

Appendix 3: *Growth specification, 1965 to 2009, five year averaged data, difference GMM estimator and OLS*

	Difference GMM					
	(A1a)	(A1b)	(A1c)	(A1d)	(A1e)	(A1f)
		Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.
Initial GDP	-2.921*	-4.245***	-5.234***	-6.833***	-5.705***	-5.770***
	(0.060)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
School	-0.745	-1.978*	-2.535**	-3.640**	-2.720**	-2.774*
	(0.557)	(0.061)	(0.023)	(0.011)	(0.046)	(0.053)
Inflation	-0.753***	-0.982***	-0.882***	-0.791***	-0.900***	-0.901***
	(0.008)	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)
Government consumption	-3.500***	-3.258***	-2.748**	-2.348**	-2.785***	-2.909***
	(0.000)	(0.002)	(0.013)	(0.019)	(0.007)	(0.002)
Trade openness	6.518***	6.232***	6.279***	5.729***	5.506***	5.680***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Private credit	-0.849	-1.655***	-1.874***	-1.947***	-1.625***	-1.699***
	(0.149)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Output gap		0.377***	0.341***	0.286***	0.688***	0.446***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hansen test (p-value)	0.138	0.683	0.625	0.459	0.559	0.606
Serial cor. test (p-value for 2nd order corr.)	0.303	0.369	0.317	0.224	0.455	0.350
Observations	700	700	700	700	700	700
Countries	125	125	125	125	125	125
	OLS					
	(A2a)	(A2b)	(A2c)	(A2d)	(A2e)	(A2f)
		Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.
Initial GDP	-3.720***	-3.979***	-4.044***	-4.107***	-4.319***	-4.275***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
School	-0.726	-0.786	-0.808	-0.831	-0.844	-0.816
	(0.276)	(0.246)	(0.241)	(0.236)	(0.224)	(0.240)
Inflation	-0.338**	-0.361**	-0.356**	-0.352**	-0.359**	-0.359**
	(0.016)	(0.012)	(0.013)	(0.014)	(0.012)	(0.013)
Government consumption	-1.920***	-1.756***	-1.732***	-1.713***	-1.700***	-1.706***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Trade openness	3.546***	3.537***	3.539***	3.541***	3.514***	3.523***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Private credit	-0.103	-0.172	-0.184	-0.195	-0.206	-0.196
	(0.664)	(0.451)	(0.422)	(0.395)	(0.366)	(0.391)
Output gap		0.207***	0.160***	0.127***	0.501***	0.297***
		(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
R squared	0.285	0.306	0.305	0.305	0.323	0.313
Observations	833	833	833	833	833	833
Countries	132	132	132	132	132	132

Notes: p-values in parentheses, Windmeijer robust and cluster-robust standard errors, respectively. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively. Difference GMM: Instruments limited to three lags. OLS: Within transformation to purge fixed effects. The regressions include time dummies that are not reported. All explanatory variables except output gap in logarithms.
Sources: World Bank WDI, AMECO, OECD, IFS, Cihak et al. (2012), Levine et al. (2000), authors calculation

Appendix 4: *Growth specification, 1965 to 2009 and 1965 to 1989, five year averaged data, system GMM estimator with collapsed instruments*

	1965 to 2009					
	(A3a)	(A3b) Output gap, HP λ=25	(A3c) Output gap, HP λ=50	(A3d) Output gap, HP λ=100	(A3e) Output gap, BK 2-8 yrs.	(A3f) Output gap, BK 2-15 yrs.
Initial GDP	-0.030	-1.087*	-1.580**	-1.567**	-1.524***	-1.716***
	(0.965)	(0.067)	(0.014)	(0.035)	(0.004)	(0.003)
School	0.039	2.875**	3.970***	3.886**	4.045***	4.534***
	(0.975)	(0.014)	(0.002)	(0.010)	(0.000)	(0.000)
Inflation	-0.187	-0.503	-0.433	-0.439	-0.848**	-0.829*
	(0.688)	(0.235)	(0.312)	(0.348)	(0.037)	(0.051)
Government consumption	-3.217**	-0.599	0.307	-0.524	0.387	0.863
	(0.042)	(0.685)	(0.858)	(0.789)	(0.775)	(0.555)
Trade openness	7.322***	5.262***	5.038***	5.049***	5.106***	5.285***
	(0.000)	(0.000)	(0.001)	(0.003)	(0.000)	(0.000)
Private credit	0.031	-0.326	-0.603	-0.768	-0.800	-0.892
	(0.961)	(0.563)	(0.324)	(0.286)	(0.148)	(0.122)
Output gap		0.880***	0.854***	0.593***	1.945***	1.416***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hansen test (p-value)	0.142	0.336	0.094	0.002	0.544	0.429
Serial cor. test (p-value for 2nd order corr.)	0.231	0.222	0.683	0.718	0.790	0.618
Observations	833	833	833	833	833	833
Countries	132	132	132	132	132	132

	1965 to 1989					
	(A4a)	(A4b) Output gap, HP λ=25	(A4c) Output gap, HP λ=50	(A4d) Output gap, HP λ=100	(A4e) Output gap, BK 2-8 yrs.	(A4f) Output gap, BK 2-15 yrs.
Initial GDP	0.858	0.746	0.554	0.633	1.090	0.835
	(0.319)	(0.284)	(0.455)	(0.428)	(0.110)	(0.215)
School	-1.863	-1.299	-0.841	-0.994	-1.600	-1.140
	(0.322)	(0.272)	(0.461)	(0.390)	(0.193)	(0.360)
Inflation	1.632	1.055	0.688	0.479	0.834	0.670
	(0.174)	(0.162)	(0.308)	(0.518)	(0.302)	(0.400)
Government consumption	-1.575	-0.720	-0.787	-1.625	-1.670	-1.374
	(0.460)	(0.713)	(0.690)	(0.471)	(0.465)	(0.542)
Trade openness	5.584**	3.819**	3.641**	3.669*	3.696*	3.489*
	(0.016)	(0.037)	(0.042)	(0.062)	(0.076)	(0.095)
Private credit	0.722	0.792	0.479	0.349	0.559	0.528
	(0.653)	(0.597)	(0.728)	(0.809)	(0.732)	(0.737)
Output gap		0.727***	0.709***	0.575***	1.266***	1.008***
		(0.000)	(0.000)	(0.000)	(0.002)	(0.001)
Hansen test (p-value)	0.513	0.614	0.429	0.133	0.520	0.527
Serial cor. test (p-value for 2nd order corr.)	0.072	0.201	0.447	0.782	0.216	0.272
Observations	367	367	367	367	367	367
Countries	91	91	91	91	91	91

Notes: p-values in parentheses, Windmeijer robust standard errors. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively. The regressions include time dummies that are not reported. Instruments limited to three lags and collapsed. All explanatory variables except output gap in logarithms.
Sources: World Bank WDI, AMECO, OECD, IFS, Cihak et al. (2012), Levine et al. (2000), authors calculation

Appendix 5a: *Explaining the logarithm of private credit in percent of GDP, 1965 to 1989, five year averaged data, OLS and fixed effects estimator*

	OLS									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.
Output gap	-0.006	-0.005	-0.004	-0.004	-0.006	-0.006	0.003	0.003	0.005	0.002
	(0.559)	(0.558)	(0.582)	(0.830)	(0.705)	(0.559)	(0.740)	(0.687)	(0.794)	(0.864)
Country dummies	no	no	no	no	no	no	no	no	no	no
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country specific time trends	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Squared country specific time trends	no	no	no	no	no	yes	yes	yes	yes	yes
R-squared	0.877	0.877	0.877	0.877	0.877	0.877	0.964	0.964	0.964	0.964
Observations	444	444	444	444	444	444	444	444	444	444
Countries	113	113	113	113	113	113	113	113	113	113
	Fixed effects									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.
Output gap	0.002	0.003	0.003	0.005	0.002	0.005	0.005	0.005	0.004	0.004
	(0.804)	(0.686)	(0.624)	(0.750)	(0.835)	(0.586)	(0.498)	(0.466)	(0.811)	(0.770)
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country specific time trends	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Squared country specific time trends	no	no	no	no	no	yes	yes	yes	yes	yes
R-squared	0.772	0.772	0.772	0.772	0.772	0.892	0.892	0.892	0.891	0.891
Observations	444	444	444	444	444	444	444	444	444	444
Countries	113	113	113	113	113	113	113	113	113	113

Notes: p-values in parentheses, cluster-robust standard errors. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively.
Sources: World Bank WDI, AMECO, Cihak et al. (2012), Levine et al. (2000), authors' calculations

Appendix 5b: *Explaining the logarithm of private credit in percent of GDP, 1990 to 2009, five year averaged data, OLS and fixed effects estimator*

	OLS									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.
Output gap	0.048***	0.044***	0.036***	0.080**	0.058**	0.048***	0.023**	0.020**	0.040	0.032*
	(0.002)	(0.000)	(0.000)	(0.015)	(0.014)	(0.002)	(0.039)	(0.039)	(0.159)	(0.098)
Country dummies	no	no	no	no	no	no	no	no	no	no
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country specific time trends	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Squared country specific time trends	no	no	no	no	no	yes	yes	yes	yes	yes
R-squared	0.933	0.935	0.936	0.933	0.933	0.933	0.979	0.979	0.978	0.978
Observations	590	590	590	590	590	590	590	590	590	590
Countries	174	174	174	174	174	174	174	174	174	174
	Fixed effects									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.	Output gap, HP λ=25	Output gap, HP λ=50	Output gap, HP λ=100	Output gap, BK 2-8 yrs.	Output gap, BK 2-15 yrs.
Output gap	0.026**	0.023***	0.020***	0.040*	0.032**	0.024	0.022*	0.021*	0.036	0.031
	(0.018)	(0.008)	(0.008)	(0.069)	(0.033)	(0.138)	(0.090)	(0.068)	(0.299)	(0.188)
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country specific time trends	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Squared country specific time trends	no	no	no	no	no	yes	yes	yes	yes	yes
R-squared	0.769	0.771	0.772	0.765	0.767	0.945	0.946	0.947	0.943	0.944
Observations	590	590	590	590	590	590	590	590	590	590
Countries	174	174	174	174	174	174	174	174	174	174

Notes: p-values in parentheses, cluster-robust standard errors. *, **, *** indicate significance at the 10, 5, and 1 percent level, respectively.
Sources: World Bank WDI, AMECO, Cihak et al. (2012), Levine et al. (2000), authors' calculations