University of Groningen

Credit composition and the severity of post-crisis recessions

Bezemer, Dirk; Zhang, Lu

Published in:
Journal of Financial Stability

DOI:
[10.1016/j.jfs.2019.05.010](https://doi.org/10.1016/j.jfs.2019.05.010)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2019

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Bezemer, D., & Zhang, L. (2019). Credit composition and the severity of post-crisis recessions. *Journal of Financial Stability*, 42, 52-66. <https://doi.org/10.1016/j.jfs.2019.05.010>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Credit composition and the severity of post-crisis recessions[☆]Dirk Bezemer^{a,*}, Lu Zhang^b^a Faculty of Economics and Business, University of Groningen, 9747 AE Groningen, The Netherlands^b CPB Netherlands Bureau for Economic Policy Analysis, Bezuidenhoutseweg 30, 2594 AV Den Haag, The Netherlands

ARTICLE INFO

Article history:

Available online 24 May 2019

JEL classification:

C11
C15
E01
O47

Keywords:

Change in credit composition
Mortgages
Leverage
Crisis
Recession

ABSTRACT

Unsustainable credit growth leads to financial stability risks, with real repercussions. But what is unsustainable? In this paper we suggest that the balance between the growth in mortgage credit and business credit is a key factor in post-crisis macroeconomic vulnerability. The sample-average rise in credit composition (the share of household mortgage credit in total credit) in 51 economies in the five years before the 2007 global financial crisis is associated with a 2.1% average growth loss in the five years after the crisis. This finding is robust for total-credit growth and for post-crisis fiscal and monetary policy responses. Delving into the channels, we find that larger changes in credit composition before the crisis are linked to less efficient capital reallocation and larger investment cutbacks afterwards.

© 2019 Elsevier B.V. All rights reserved.

1. Introduction

The allocation of bank credit between business debt and household mortgages, the 'private credit composition',¹ has shifted dramatically in recent years. In this paper we explore how the change in credit composition – rather than only the rise in total credit or the increase in household mortgage debt – has deepened post-crisis stagnations.

This finding adds fresh insight into the well-known truth that countries with more private leverage before the 2007 crisis experi-

enced deeper and more prolonged recessions afterwards. Growth in mortgage credit has been particularly associated with more damaging real outcomes. While business credit has been broadly stable as a share of GDP in many economies, mortgage credit has expanded rapidly. Jordà et al. (2014) find an increase from 30% to 60% in household mortgage credit as a share of GDP since 1900 in a sample of seventeen countries, with most of that increase since the 1970s. The expansion of household credit increases the probability of crisis and the severity of post-crisis recessions (Jappelli et al., 2008; Barba and Pivetti, 2009; Obstfeld and Rogoff, 2009; Büyükkarabacak and Valev, 2010; Rose and Spiegel, 2011; Frankel and Saravelos, 2012; Sutherland et al., 2012; IMF, 2012). Historically, Jordà et al. (2014) find this effect of mortgages in seventeen of the countries analysed from 1870. In microeconomic studies, Dynan (2012) and Mian and Sufi (2009) report that more leveraged US homeowners have experienced larger declines in spending since 2007.

In this paper we aim to contribute to our understanding of the different consequences of household mortgage and business credit on post-crisis stagnation. We study the links between the change in the composition of total credit and the severity of the post-crisis recession in data for 51 economies. We trace bank lending to non-financial business, to non-bank financial business, and to households as consumer debt and mortgage lending. We find that the sample-average rise in credit composition (the share of household mortgage credit of total credit) in the five years before the crisis is associated with a 2.1% average growth loss in the five years after

[☆] We thank Anna Samarina for her help organizing the data. We gratefully acknowledge the financial support received from the Equilibrio Foundation and the Institute for New Economic Thinking (grant INO11-00053). For the helpful remarks which improved earlier versions of this paper, we thank anonymous referees, participants at the 2017 Financial Services Indices, Liquidity and Economic Activity conference at the Bank of England and research seminars at the University of Stirling and Bonn University. Any remaining errors or omissions are ours.

* Corresponding author.

E-mail addresses: d.j.bezemer@rug.nl (D. Bezemer), l.zhang@cpb.nl (L. Zhang).

¹ The definition of credit composition in the present paper should not be confused with credit composition as used in Bertay et al. (2017), which is about the investment/consumption balance. The share of household mortgage credit in all bank credit is not a measure of the investment/consumption balance, since household mortgages do not primarily finance consumption but residential and other investment, which is investment in an asset, not consumption. Credit composition in the present paper is an empirical proxy of the balance between bank finance supporting real estate asset markets and bank finance supporting activity.

Fig. 1. Credit composition. (a) Credit intermediation index in the US. (b) Credit composition in 14 advanced economies. Sources: Fig. (a) is taken from Greenwood and Scharfstein (2013); Fig. (b) is taken from Bezemer et al. (2016).

the crisis. A Bayesian model-averaging analysis supports the model specification. Our findings are robust to including a range of control variables and across subsamples. They are also robust to taking into account post-crisis fiscal and monetary policy responses. Delving into the channels, we find that larger changes in pre-crisis credit composition are linked to less efficient capital reallocation and larger investment cutbacks after the crisis.

The next section discusses the channels from the change in credit composition to recession severity. In Section 3, we describe data, measures and empirical models. Section 4 presents the main empirical results. In sections 5 and 6, we explore additional robustness analyses and channels. Section 7 concludes with a summary, a reflection on this study's limitations, and avenues for future research.

2. Why study credit composition?

Differentiating between non-financial business credit and home mortgages is important because of their different impacts on growth and stability. This is not a new finding in this paper, but motivates its contribution. The contribution of this paper is to suggest that it is not only the growth in total credit or the growth in mortgages which explains rising private leverage and the severity of post-crisis recessions. It is the balance between the growth rates of mortgages and other credit (primarily, to non-financial business) which matters. In this paper we will therefore relate this change in credit composition to several measures for post-crisis recession severity. In this section we first motivate the focus on credit composition.

2.1. Credit composition, income growth and private leverage

Fig. 1(a) shows the development of household credit and corporate credit over time for the US. based on Greenwood and Scharfstein (2013), and Fig. 1(b) shows the development of four different types of credit for a balanced sample of 14 economies based on the data used in the present paper. Business (or corporate) credit has increased only moderately over the last decades as a share of GDP. This contrasts with the steep increase in mortgage debt as a share of GDP.

The implications for income growth of an expansion of household credit – mostly, residential mortgages – are a priori ambiguous. Jappelli and Pagano (1994) argue that alleviating credit constraints on households reduces the savings rate, with negative repercussions for economic growth. In principle, this could be

counterbalanced by household mortgages supporting construction activity, through durable goods spending associated with housing transactions, and via wealth effects on consumption as house prices are rising.²

However, these positive effects appear to be too small to balance the negative effects. In panel data analysis, Beck et al. (2012) and Bezemer et al. (2016) find negative growth coefficients for household credit, but not for business credit. Mian et al. (2017) predict that an increase in the household debt to GDP ratio leads to lower GDP growth in the medium term for an unbalanced panel of 30 countries from 1960 to 2012. Drehmann et al. (2017) study household debt in seventeen economies, and link its expansion to lower future output growth. The theoretical arguments together with these findings suggest, as illustrated in Fig. 1, that the change in credit composition away from business credit and towards mortgage credit has implied an increase in debt growth relative to income growth, pushing up private leverage.

In contrast, theory suggests that business credit enlarges the productive capacity and productivity of the economy and improves its capital allocation, thereby fostering long-term income growth (Levine, 2005). Empirically, Xu (2000) finds that business investment is the channel from financial development to output growth, rather than household spending. Since business borrowing supports income formation as well as debt growth, a rise in private leverage on the macro level is therefore not a necessary outcome of more business borrowing, as Figure 1 also illustrates. Higher leverage is not even a necessary outcome of an increase in mortgage debt, provided sufficient growth in business debt (generating income growth) also occurred. For credit growth to have an effect on leverage, it is the balance between these two types of debt growth which matters. This suggests that a change in credit composition resulting from less growth in business credit than in mortgage credit will lead to rising private leverage, with implications for stability and post-crisis resilience, as we now discuss.

2.2. From pre-crisis leverage to post-crisis recessions

It is uncontroversial that rising pre-crisis private leverage leads to more severe post-crisis recessions. Credit growth prior to the 2008 crisis is linked to recession duration, the severity of income loss following the crisis, the change in average growth after the

² Carroll et al. (2011) estimate the immediate (next-quarter) marginal propensity to consume from a \$1 change in US housing wealth at about 2 cents and the final long-term consumption effect at around 9 cents.

crisis (Claessens et al., 2010), and with larger falls in output, consumption and domestic demand in the period 2008–2009 (Lane and Milesi-Ferretti, 2011). Cecchetti et al. (2011) report that a growing private sector credit-to-GDP ratio is associated with the post-crisis cumulative GDP gap, measured as real GDP growth in 2008–2009 which is not explained by the first principal component of GDP growth. Berkmen et al. (2012) find that the growth of private credit relative to GDP is associated with smaller output growth in 2009 compared to pre-crisis forecasts for that year. Jordà et al. (2013) examine excess credit, defined as the rate of change in the ratio of bank loans to GDP in deviation from its mean, calculated from the previous trough to the subsequent peak. Studying fourteen advanced economies from 1870, they find that due to a one standard deviation of the change in excess credit, the 5-year post-peak recovery path is lower on average by 2% after financial crises. A number of other studies link rising pre-crisis leverage to post-crisis GDP loss (Rose and Spiegel, 2011; Feldkircher, 2014; IMF, 2016; André, 2016; Lombardi et al., 2017).

The theoretical channels include a lagged debt servicing effect of credit booms, as Juselius and Drehmann (2015) and Drehmann et al. (2017) emphasize, which results in larger peak-to-trough GDP losses. Bordo et al. (2017) find that market analyst forecasts tend to be too optimistic during booms. This suggests an expectational bias resulting in over-borrowing. In support, Mian et al. (2017) find that in a credit boom, credit flows toward riskier borrowers (Bahadir and Gumus, 2016).

The damaging post-crisis effects of credit booms often run through household debt and house prices: Justiniano et al. (2015) and Favara and Imbs (2015) show that credit supply shocks drive house prices. Since housing wealth is a driver of consumption, this implies an amplification of growth in a credit boom and a contractionary effect due to housing wealth post-crisis. Also debt levels play a role. In microeconomic studies, Dynan (2012) and Mian and Sufi (2009) report that more leveraged US homeowners have experienced larger declines in spending since 2007. Mian et al. (2017) provide evidence for a consumption-driven growth slowdown due to a hangover of household debt, evidenced in external balance reversal driven by a fall in imports.

Taken together, the literature shows that business credit tends to support income growth, but expansion of household mortgages does this much less. Therefore, private debt relative to income (private leverage) rises when home mortgage credit expands more than business credit growth. Rising private leverage, in turn, increases the probability of a financial crisis and worsens its consequences in terms of output loss, often via channels related to house prices and household debt. It follows that the relative growth rates of home mortgages and business credit – jointly reflected in the change in credit composition – drive the change in private leverage. In turn, these arguments suggest that change in credit composition (rather than only total-credit growth or even home mortgage growth) is a determinant of post-crisis recessions.

3. Data and methodology

3.1. Data

Our dataset covers 51 advanced and emerging countries in the period 2003 to 2012.³ The choice of the country sample is constrained by the availability of data on disaggregated credit. We use a recently collected dataset on four categories of domestic bank credit, namely household mortgages, household consumption credit, credit to non-financial business and credit to financial

business. Household mortgages and credit to non-financial business are the two principal categories. This dataset was collected from the consolidated balance sheets of monetary financial institutions reported by central banks. We refer to Bezemer et al. (2017) for an extensive description of this dataset. We complemented this dataset with additional data collected from various sources reported in Table A.1 in Appendix A.

3.2. Variable construction

We adopt a measure for the severity of post-crisis recession proposed by Agnello and Nerlich (2012), which is cumulative cost. This measure accounts for recession depth and duration simultaneously. The severity of a recessionary phase can be thought of as the area under a triangle, with depth as its height and duration as its base. We define depth as the change of quarterly real GDP from peak to trough during the period 2007–2012, and duration as the number of quarters from peak to trough during the same period. Peaks and respectively troughs are defined as quarters in which real GDP exceeds or is less than GDP in both the preceding and the following quarter. Cumulative cost is then computed as the product of depth and duration divided by two.

This is the most inclusive of the four measures employed in this paper. Two others are the components of cumulative cost, namely depth and duration. The fourth measure we use is growth loss, defined as the GDP growth forecast for 2009 taken from the April 2008 IMF World Economic Outlook, minus actual 2009 GDP growth.⁴ Accordingly, growth loss takes larger positive values for larger growth shortfalls relative to the forecast. This measure takes account of the growth determinants included in the projection which are independent of the crisis event. We thus take into account the endogeneity of declining growth. Any remaining growth decline is a relatively clean measure of the crisis effect, net of country-specific drivers.

We measure the change in credit composition as the average percentage point annual change in the share of household mortgages in total credit.⁵ As noted, this measure reflects the growth of mortgage credit relative to other credit (predominantly business credit). Fig. 2 plots the positive relationship between change in credit composition and the cumulative cost of recession for the economies in our sample.

The list of potential control variables is long. With only a limited number of observations, the model uncertainty issue is pertinent. To address this issue, we first screened eleven papers that study the determinants of post-crisis recession severity and found that – as shown in Table A.1 – among the 28 significant determinants in these studies, nine are significantly correlated to recession severity in more than two studies. These nine factors constitute domestic and external risk factors that impact recession severity. We include these risk factors at year-2007 values (except pre-crisis growth as 3-year averages during 2005–2007) as control variables which

⁴ We experimented with alternative measures for recession severity used in the literature. We used the growth rate in 2009, the average growth rate over 2008–2009 (Berkmen et al., 2012; Rose and Spiegel, 2011), the deviation of the average growth of 2008–2009 from the April 2008 forecast, and the number of quarters of negative growth until 2012Q4 and until 2015Q4 (Claessens et al., 2010; Ólafsson and Pétursson, 2010). The latter is to account for the fact that some countries experienced ‘double dips’. These exercises give qualitatively similar results to the analysis presented below. The results are available upon request.

⁵ Note that this underestimates the total amount of household loans, part of which are held on the balance sheets of non-banks such as special-purpose vehicles and pension funds. Data on these loan assets outside licensed banks are not available consistently across different countries. Alternatively, household mortgage loans could be observed on the liability side of household balance sheets. We investigated this possibility but again found that these data are not available for enough countries and years.

³ Extending the data till 2015 does not affect our results as all countries in our sample experienced the dip in output before 2012.

Fig. 2. Cumulative cost vs. change in credit composition.

affect post-crisis recession severity. The description of the variables, their data sources and descriptive statistics are presented in Appendix B.

Among the domestic factors, total-credit growth appears to be the most robust determinant of post-crisis recession severity, consistent with most of the studies cited above. The per capita income level is another robust variable, reflecting that the crisis originated in advanced economies. Pre-crisis growth during 2005–2007 takes into account business cycle fluctuations, as faster-growing countries tended to slow down more. Lastly, countries with more leveraged and less regulated domestic financial systems are found to experience larger output declines after the crisis.

In addition to domestic risk factors, external factors play an important role in the transmission of crisis and recession to a wide range of countries, especially emerging countries. Domestic credit growth and current account deficits have become increasingly correlated since the 1980s (Jordà et al., 2011). Mendoza and Terrones (2012) and Bahadir and Gumus (2016) show that growth in household mortgage credit and increasing external imbalances have typically jointly developed in emerging economies. Larger current account deficits lead to the buildup of external vulnerabilities and tend to disrupt post-crisis recovery via capital flow reversals. Open financial markets, measured by the sum of financial assets and liabilities to GDP, may also lead to contagion with global financial stress. Emerging economies which heavily relied on foreign credit were hit hard during the crisis, as foreign banks pulled back funds and curtailed credit. As the recession has caused a slowdown in advanced countries' demand, the spillover effects are larger for countries with stronger trade linkages to advanced countries. Economies that are more open to trade, and those have pegged exchange rate regimes appear to have been affected more strongly by the crisis.

Despite this systematic approach to selecting control variables, it is still possible that we miss important determinants of recession severity. One example is perhaps credit risk. Credit risk associated with mortgages has been growing substantially before the crisis. Dell'Ariccia et al. (2012) demonstrates that a relaxation of lending standards, triggered by an increased demand for loans, contributed to the boom and the U.S. subprime mortgage crisis. To the extent that this occurred unevenly over countries, this constitutes another explanation for the variation in recession severity. Unfortunately, data on credit risk that are cross-country consistent are not readily available for our sample. Constructing this is an avenue worth pursuing in future research.⁶

3.3. Empirical strategy

As illustrated in Fig. 2, there is substantial variation in post-crisis recession severity. We examine how the change in credit composition and additional control variables may explain the observed variation. The baseline model specification is the following:

$$Y_i = \alpha + \beta CC_i + \gamma Z_i + \epsilon_i, i = 1, \dots, N \quad (1)$$

where Y_i is post-crisis recession severity (cumulative cost, depth, duration and growth loss) of country i ; CC is our main variable of interest: change in credit composition; Z is the matrix of control variables discussed above; and ϵ_i is a white noise error term with mean 0. Correlation analysis (available on request) suggests that some explanatory variables are highly correlated with each other. For example, GDP per capita is strongly positively correlated with financial openness (0.7). For this reason, we will not include all control variables in one model. We estimate Eq. (1) using ordinary least square (OLS) regressions. These regressions include one or two variables of interest at a time in addition to change in credit composition.

In addition to the OLS regressions, we conduct a Bayesian model averaging (BMA) exercise, following Feldkircher (2014) and Babecky et al. (2013). BMA allows us to consider all potential regressors simultaneously and examine whether the association between each regressor and recession severity is robust to including additional controls in all the possible ways that those additional controls can be added. We use the version of BMA introduced by Magnus et al. (2010).⁷ This method has the advantage of accommodating two subsets of explanatory variables. The key regressors are the explanatory variables that are always included in the model. The auxiliary regressors are additional explanatory variables to be included in the model or left out. When there are K auxiliary regressors, the number of possible models to be estimated is 2^K . This flexibility of the BMA framework is particularly useful in our context as theory is not sufficiently explicit regarding whether change in credit composition should be included in the 'true' regressions of recession severity and how important it is relative to other determinants. To do so, we treat change in credit composition and all other variables as auxiliary regressors. We assess the robustness of each variable by its associated posterior inclusion probability (PIP). A PIP is defined as the sum of the posterior model probabilities of all models that include this regressor. Higher PIP values reflects higher explanatory power of the regressor across models.

4. Empirical results

4.1. Main results

We start the analysis by looking at the relationships between change in credit composition and other determinants of post-crisis recession severity for the cross-section of 51 economies in Tables 1–4, respectively.

Table 1 reports the OLS results using cumulative cost as the dependent variable. We begin by only including pre-crisis change in credit composition in column (1). The coefficient is positive and significant at one percent level, suggesting that countries with higher pre-crisis change in credit composition experience larger recession costs post-crisis. We add total-credit growth in column (2), which appears a robust determinant of post-crisis recession. We further add two additional variables in column (3). GDP per capita reflects that the recession is predominantly a high-income country phenomenon. Pre-crisis growth controls somewhat, albeit imperfectly,

⁶ We thank an anonymous referee for the suggestion.

⁷ The Stata implementation of the BMA was subsequently developed by De Luca and Magnus (2011). We refer to this paper for technical details.

Table 1

The change in credit composition and cumulative cost of recessions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Change in credit composition	3.892*** (1.287)	3.846*** (1.269)	3.743** (1.439)	2.566** (1.248)	3.406** (1.545)	3.798** (1.507)	3.860** (1.652)
Total-credit growth		0.443*** (0.144)	0.483*** (0.167)	0.193 (0.225)	0.325* (0.165)	0.558*** (0.204)	0.431*** (0.167)
GDP per capita			−0.707 (1.605)	0.192 (1.965)	−1.131 (1.638)	−0.947 (1.996)	−0.429 (1.791)
Pre-crisis growth			−0.273 (0.693)	−0.108 (0.717)	−0.193 (0.669)	−0.677 (0.826)	−0.384 (0.746)
Current account				−0.393 (0.239)			
Leverage					0.043* (0.025)		
Trade openness						0.027 (0.024)	
Financial openness						−0.763 (2.065)	
Deregulation							−0.930 (1.346)
Exchange rate regime							−2.147 (1.361)
Constant	8.102*** (1.279)	6.226*** (1.388)	14.226 (17.516)	6.265 (20.479)	13.571 (16.463)	19.639 (17.975)	25.141 (20.462)
Observations	51	51	51	51	51	51	51
R-squared	0.169	0.233	0.237	0.292	0.266	0.253	0.279

The dependent variable is the cumulative cost of post-2007 recession, defined as recession depth multiplied by recession duration, divided by two. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors are in parentheses.

* $p < 0.1$.** $p < 0.05$.*** $p < 0.01$.**Table 2**

The change in credit composition and recession depth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Change in credit composition	3.869*** (1.158)	3.850*** (1.167)	3.382*** (0.993)	2.603** (1.208)	3.055*** (0.995)	3.625*** (1.127)	3.060*** (1.082)
Total-credit growth		0.184 (0.169)	0.239 (0.205)	0.047 (0.264)	0.086 (0.195)	0.317 (0.246)	0.194 (0.205)
GDP per capita			−0.961 (2.280)	−0.366 (2.633)	−1.373 (2.300)	−1.797 (2.746)	−1.207 (2.319)
Pre-crisis growth			0.397 (0.837)	0.507 (0.903)	0.475 (0.801)	−0.174 (1.068)	0.452 (0.851)
Current account				−0.260 (0.182)			
Leverage					0.042** (0.021)		
Trade openness						0.034 (0.026)	
Financial openness						−0.023 (2.140)	
Deregulation							0.721 (0.891)
Exchange rate regime							−0.847 (1.041)
Constant	8.558*** (1.183)	7.778*** (1.476)	15.106 (25.284)	9.834 (28.581)	14.470 (24.455)	21.839 (24.800)	12.809 (26.810)
Observations	51	51	51	51	51	51	51
R-squared	0.228	0.243	0.270	0.303	0.308	0.325	0.284

The dependent variable is recession depth, defined as the peak-to trough fall in real GDP over 2007–2012. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors in parentheses.

* $p < 0.1$.** $p < 0.05$.*** $p < 0.01$.

for business cycle effects. We find that the coefficient of change in credit composition always remains positive and significant.

A next control variable is the current account in column (4). The significance of the change in credit composition coefficient remains, though the size decreases by about one third. The total-

credit growth coefficient is no longer significant. This suggests that worsening external balances are an important channel through which private debt growth translates into recession severity, in line with [Büyükkarabacak and Valev \(2010\)](#) and [Bahadır and Gumus \(2016\)](#). We note that the effect of change in credit composition is

Table 3

The change in credit composition and recession duration.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Change in credit composition	0.555 (0.354)	0.526 (0.349)	0.625 (0.431)	0.534 (0.458)	0.574 (0.458)	0.602 (0.496)	0.738* (0.399)
Total-credit growth		0.284*** (0.091)	0.320*** (0.079)	0.298*** (0.097)	0.296*** (0.096)	0.348*** (0.074)	0.292*** (0.069)
GDP per capita			−0.636 (0.500)	−0.566 (0.562)	−0.700 (0.546)	−0.588 (0.761)	−0.429 (0.594)
Pre-crisis growth			−0.695** (0.319)	−0.682** (0.312)	−0.682** (0.316)	−0.810** (0.362)	−0.772** (0.322)
Current account				−0.030 (0.085)			
Leverage					0.007 (0.010)		
Trade openness						0.009 (0.009)	
Financial openness						−0.466 (0.991)	
Deregulation							−0.680 (0.431)
Exchange rate regime							−1.278* (0.580)
Constant	6.686*** (0.622)	5.483*** (0.682)	14.750** (5.719)	14.136** (6.024)	14.650** (5.773)	16.512** (6.602)	22.014*** (7.583)
Observations	51	51	51	51	51	51	51
R-squared	0.020	0.173	0.254	0.256	0.258	0.261	0.350

The dependent variable is recession duration, defined as the number of quarters from GDP peak to GDP trough after 2007. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors in parentheses.

* $p < 0.1$.** $p < 0.05$.*** $p < 0.01$.**Table 4**

The change in credit composition and growth loss.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Change in credit composition	1.173* (0.600)	1.162* (0.586)	1.137** (0.470)	0.829* (0.505)	1.026** (0.447)	1.073** (0.462)	0.902* (0.451)
Total-credit growth		0.099 (0.071)	0.034 (0.066)	−0.041 (0.072)	−0.017 (0.069)	0.071 (0.080)	−0.002 (0.056)
GDP per capita			1.140** (0.480)	1.375*** (0.479)	1.001** (0.479)	1.310** (0.608)	0.972** (0.463)
Pre-crisis growth			0.890*** (0.262)	0.933*** (0.234)	0.916*** (0.256)	0.768** (0.327)	0.924*** (0.257)
Current account				−0.103 (0.064)			
Leverage					0.014* (0.007)		
Trade openness						0.010 (0.012)	
Financial openness						−0.748 (0.951)	
Deregulation							0.486** (0.225)
Exchange rate regime							−0.762** (0.364)
Constant	5.814*** (0.482)	5.395*** (0.539)	−9.579* (5.201)	−11.661** (4.917)	−9.793* (5.132)	−7.497 (5.233)	−10.657* (5.672)
Observations	51	51	51	51	51	51	51
R-squared	0.135	0.162	0.369	0.402	0.397	0.383	0.427

The dependent variable is growth loss during the recession, defined as the 2008 IMF forecast for 2009 output growth minus actual output growth in 2009. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors are in parentheses.

* $p < 0.1$.** $p < 0.05$.*** $p < 0.01$.

not fully absorbed into this channel. The role of the current account is analyzed in more detail in Section 5.⁸ We then add the leverage ratio in column (5), trade and financial openness in column (6) and deregulation and the exchange rate regime in column (7). Includ-

ing these variables does not change the sign or significance of the coefficient of change in credit composition.

In all, the results of [Table 1](#) suggest that pre-crisis change in credit composition is significantly correlated with post-crisis recession costs, independently of the effect of total-credit growth. This is the key result, and a finding which is new to the literature as far as we have been able to determine. We emphasize that, although we

⁸ We thank an anonymous referee for suggesting this extension.

introduced a time lag between pre-crisis change in credit composition and post-crisis recession cost, a causal interpretation of this finding is open to debate. However, below we will see this result confirmed using the growth loss measure based on IMF forecasts, which goes furthest in accounting for endogeneity concerns.

We continue in Tables 2 and 3 with the analysis of recession depth and recession duration separately. We find that pre-crisis change in credit composition is a robust covariate of post-crisis recession depth in columns (1)–(7) in Table 2. The results are quantitatively similar to those reported in Table 1. We find no significant relationship between change in credit composition and recession duration (Table 3), suggesting that the strong correlation of change in credit composition and cumulative cost is driven by recession depth rather than duration.

With respect to the economic impact, the main specification of column (3) in Table 2 suggests that a one per cent annual change in credit composition before the crisis is associated with a 3.38 per cent greater recession depth. As ‘depth’ averages 11% in this sample, the effect of the average change in credit composition (0.63 percentage point) is sizeable: it would add 2.13 percentage points of GDP growth loss to the annual output contraction over 2008–2012.

It is noteworthy that total-credit growth does not appear to be a significant determinant of recession depth once the change in credit composition is controlled for (Table 2). This is different from most of the literature (Claessens et al., 2010; Berkmen et al., 2012), and may be due to the fact that we include only credit growth in the five years preceding the crisis. However, we find a robust positive relation between total-credit growth and recession duration in Table 3.

The fourth recession indicator we use is growth loss, a measure of ‘forecast error’. Here we make it more difficult to find a significant relationship between change in credit composition and recession severity, since any country-specific drivers of recession which are also correlated to change in credit composition are presumably included in the forecast. Any remaining difference between forecast and realization is more likely due to the crisis.

The results in Table 4 show that growth loss is significantly correlated to the pre-crisis change in credit composition, again with no role for total-credit growth. Other domestic factors, such as GDP per capita, pre-crisis growth and to a lesser extent leverage, are also important in explaining growth loss after the crisis.

The current account balance in column (4) enters with an insignificant coefficient, but it reduces the magnitude and significance of the coefficient on change in credit composition. This suggests that change in credit composition and current account are linked; their correlation coefficient is 0.5. Recent studies (e.g. Mian et al., 2017) show that an increase in household credit tends to increase net imports, especially in emerging economies. We interpret the current account variable as proxying for one mechanism by which change in credit composition may have affected growth loss after the crisis, in terms of raising vulnerability to a shift in external conditions. We find some evidence in column (7) that countries with less regulated financial markets and more flexible exchange rate regimes suffer less growth loss post-crisis.

Since the growth loss measure goes furthest in addressing the endogeneity problem in the context of a cross-sectional framework, we consider these findings to yield the strongest evidence so far on causation from pre-crisis change in credit composition to deeper post-crisis recession severity.

4.2. Should change in credit composition be part of the model?

We report the BMA outcomes in terms of posterior inclusion probabilities (PIP) in Table 5. High PIP values indicate that the regressor has a large explanatory power, irrespective of which other explanatory variables are included. On the basis of the PIP values, change in credit composition is among the most robust determi-

Table 5

BMA results: posterior inclusion probabilities (PIP).

	Cumulative cost	Depth	Duration	Growth loss
Change in credit composition	0.37	0.76	0.11	0.49
Total-credit growth	0.14	0.15	0.31	0.13
GDP per capita	0.1	0.21	0.11	0.51
Pre-crisis growth	0.1	0.12	0.35	0.95
Current account	0.88	0.73	0.34	0.37
Leverage	0.26	0.28	0.21	0.3
Trade openness	0.27	0.69	0.15	0.17
Financial openness	0.12	0.16	0.12	0.14
Deregulation	0.11	0.11	0.11	0.34
Exchange rate regime	0.28	0.1	0.68	0.33

nants of the recession indicators except for duration. Other robust regressors are current account, pre-crisis growth, and to a lesser extent, GDP per capita and trade openness. In some cases, the BMA results throw a different light on the determinants of post-crisis recession severity than the OLS estimations do. However, for change in credit composition, both OLS and BMA outcomes send the same message. The change in credit composition should be part of any model of cumulative cost, recession depth and growth loss.

5. Exploring robustness

We conduct an extensive sensitivity analysis to test the robustness of the results. For reasons of space, in the tables which follow we report parsimonious models with total-credit growth, GDP per capita and pre-crisis growth variables. We checked that the results of the full models including all control variables are qualitatively identical.

5.1. Does change in credit composition proxy for the level of credit or growth of mortgages?

One concern is that change in credit composition might be a proxy for the pre-crisis level of credit (financial development) or the pre-crisis growth of mortgages relative to GDP.⁹ Table 6 reports the estimation results including the level of credit and growth of mortgages, respectively.¹⁰ Their coefficients enter significantly in some models, with the sign changing over recession indicators. Notably, the total-credit growth coefficients reported in columns (1)–(4) are now much larger and significant. More importantly, the coefficients of change in credit composition are quantitatively similar to those reported before. All in all, these results do not suggest that change in credit composition inadvertently picks up the variation in some other dimension of financial development.

5.2. The role of fiscal and monetary policies

It is plausible that recession severity was also affected by post-crisis fiscal and monetary policies, and this might partly be picked up by change in credit composition. The results including post-crisis changes in fiscal and monetary policy are therefore reported in Table 7. Fiscal policy is proxied by the overall fiscal balance (% GDP) and government spending (% GDP), whereas monetary policy is proxied by the short-term interest rate.¹¹ We find that

⁹ We thank an anonymous referee for suggesting this exploration.

¹⁰ We find modest correlations between change in credit composition and the level of credit (–0.28) and growth of mortgages (0.29). Multicollinearity is not a major concern here. However, the level of total credit and growth of mortgages are highly correlated with a correlation coefficient of 0.65. We therefore add them separately in the regression analysis.

¹¹ Another measure we used for fiscal policy is primary balance (%GDP). The results are almost identical to those using overall balance. In addition, we experimented

Table 6

Credit levels, credit growth and mortgage growth.

	(1) Cumulative cost	(2)	(3) Depth	(4)	(5) Duration	(6)	(7) Growth loss	(8)
Change in credit composition	3.513** (1.367)	4.405*** (1.562)	3.068*** (0.978)	4.589*** (1.221)	0.741 (0.445)	0.304 (0.457)	1.045** (0.470)	1.324** (0.503)
Credit growth	0.860*** (0.280)	0.915** (0.416)	0.756*** (0.278)	1.026* (0.521)	0.130 (0.130)	0.111 (0.106)	0.186 (0.120)	0.156 (0.177)
GDP per capita	0.248 (1.736)	−0.778 (1.512)	0.346 (2.207)	−1.092 (2.071)	−1.117* (0.590)	−0.601 (0.457)	1.523*** (0.537)	1.120** (0.479)
Pre-crisis growth	−0.543 (0.785)	−0.567 (0.738)	0.028 (0.917)	−0.138 (0.894)	−0.559* (0.323)	−0.552 (0.334)	0.781*** (0.265)	0.807*** (0.270)
Level of total credit	−0.056 (0.035)		−0.077** (0.030)		0.028* (0.017)		−0.023* (0.013)	
Mortgage credit growth		−1.203 (0.775)		−2.192** (0.993)		0.582** (0.247)		−0.339 (0.314)
Constant	10.218 (17.510)	16.099 (16.712)	9.617 (24.666)	18.517 (23.393)	16.771*** (5.627)	13.844** (5.257)	−11.187** (5.129)	−9.051* (5.227)
Observations	51	51	51	51	51	51	51	51
R-squared	0.266	0.257	0.345	0.361	0.298	0.282	0.410	0.383

The dependent variable is the cumulative cost of post-2007 recession, defined as recession depth multiplied by recession duration, divided by two. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors are in parentheses.

* $p < 0.1$.** $p < 0.05$.*** $p < 0.01$.**Table 7**

Controlling for fiscal and monetary policy changes.

	(1) Cumulative cost	(2)	(3) Depth	(4)	(5) Duration	(6)	(7) Growth loss	(8)
Change in credit composition	2.839* (1.485)	2.994* (1.615)	1.713** (0.846)	1.796** (0.841)	0.952* (0.489)	0.999* (0.496)	1.062* (0.541)	1.078* (0.537)
Total-credit growth	0.289 (0.210)	0.272* (0.139)	−0.146 (0.154)	−0.129 (0.132)	0.396*** (0.082)	0.390*** (0.062)	0.009 (0.068)	0.018 (0.070)
GDP per capita	0.488 (1.108)	1.105 (1.024)	1.967* (1.142)	2.181** (1.022)	−1.254** (0.591)	−1.061* (0.598)	1.430** (0.621)	1.447** (0.563)
Pre-crisis growth	−0.195 (0.981)	0.361 (0.735)	1.244** (0.611)	1.526*** (0.496)	−1.032** (0.431)	−0.862** (0.394)	0.945*** (0.323)	0.997*** (0.298)
Post-crisis fiscal balance change	2.922 (3.411)		−0.164 (1.752)		0.963 (1.065)		−0.410 (0.642)	
Post-crisis fiscal spending change		0.649 (1.502)		2.245** (0.943)		0.114 (0.581)		0.855 (0.551)
Post-crisis interest rate change	−4.361** (1.867)	−4.650*** (1.298)	−8.323*** (1.361)	−7.959*** (1.067)	1.667** (0.650)	1.557* (0.656)	−0.446 (0.564)	−0.261 (0.614)
Constant	1.320 (15.058)	−9.062 (12.085)	−21.484 (13.207)	−25.774** (11.459)	23.498*** (7.607)	20.288*** (7.315)	−13.124* (7.193)	−13.688** (6.369)
Observations	48	48	48	48	48	48	48	48
R-squared	0.336	0.306	0.558	0.591	0.325	0.305	0.348	0.371

The dependent variable is the cumulative cost of post-2007 recession, defined as recession depth multiplied by recession duration, divided by two. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors are in parentheses.

* $p < 0.1$.** $p < 0.05$.*** $p < 0.01$.

neither post-crisis changes in fiscal balance nor government spending enter with significant coefficients, except in one model. A post-crisis decline in interest rate is associated with more severe recessions as measured by all indicators except growth loss, which does most to take endogeneity into account. Therefore, the result is best interpreted not as a causal relation but as the correlation between recession severity and monetary policy responses. Central banks with worse recessions in their economies implemented larger interest rate cuts over 2008–2012. Nevertheless, the coefficients of change in credit composition remain quantitatively similar for all recession severity measures. In all, our results do not appear

to be driven by the conduct of fiscal and monetary policies after the crisis.

5.3. Subsample stability

A next robustness check is to explore potential asymmetric effects of positive and negative changes in credit composition. Existing studies ([Mian and Sufi, 2009, 2014](#)) argue that *increasing* household leverage in particular before the crisis leads to spending cuts when house prices fall afterwards. Hence in a mixed sample with both positive and negative changes, the recessionary effects of rising mortgage shares might be understated. [Table 8](#) focuses on a subsample of 38 countries that experienced positive changes in credit composition, in other words, rising mortgage shares over 2003 to 2007. We find that the coefficients for cumulative cost, depth and growth loss are all about twice as large as in the 51

with alternative measures of fiscal and monetary policies, either by including the post-crisis levels or the difference between post-crisis and pre-crisis levels. The results (available upon request) are robust to these alternative measures.

Table 8
Increasing mortgage credit shares only.

	(1) Cumulative cost	(2) Depth	(3) Duration	(4) Growth loss
Change in credit composition	7.480*** (2.496)	7.364*** (2.027)	0.867 (0.703)	2.152** (0.794)
Total-credit growth	0.660*** (0.193)	0.476** (0.193)	0.281** (0.117)	0.046 (0.098)
GDP per capita	−1.338 (1.550)	−1.697 (2.421)	−0.738 (0.688)	1.342** (0.498)
Pre-crisis growth	−0.909 (0.851)	−0.328 (1.062)	−0.785* (0.437)	0.920*** (0.281)
Constant	17.544 (16.941)	19.464 (26.682)	15.883* (8.137)	−13.139** (5.229)
Observations	38	38	38	38
R-squared	0.361	0.487	0.161	0.505

The dependent variable is the cumulative cost of post-2007 recession, defined as recession depth multiplied by recession duration, divided by two. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors are in parentheses.

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

country sample. The coefficient of duration is still insignificant. These results suggest, in line with the literature, that it is specifically change in credit composition that reflects a rise in mortgage shares which is harmful post-crisis.

We also explore whether the effect of change in credit composition on post-crisis recession severity is more pronounced in advanced countries, since the 2007 crisis was primarily an advanced-country phenomenon ([Claessens et al., 2010](#); [Didier et al., 2012](#); [IMF, 2012](#)). We interact change in credit composition with the advanced country dummy and report the results in [Table 9](#). The results for cumulative cost, depth and growth loss are not significantly different between advanced and emerging countries. Interestingly, the results for duration are larger in advanced economies compared to emerging economies. Our findings are consistent with [Didier et al. \(2012\)](#), who show that emerging economies' GDP bounced back faster after the crisis and argue that this is due to that emerging countries were able to pursue counter-cyclical policies in softening the impact of the crisis.

5.4. External imbalances and wholesale funding

As noted, several studies show that external imbalances constitute an important external risk factor in explaining recession severity of emerging countries ([Lane and Milesi-Ferretti, 2011](#); [Feldkircher, 2014](#)). We check whether this is the case in our sample. [Table 10](#) reports the results. We include a dummy variable which takes value 1 if a country is above the median current account balance in 2007 and 0 otherwise and an interaction effect that captures the differential effects between the advanced and emerging economies.¹² The results are presented in columns (1)–(4) of [Table 10](#). The coefficient for current account dummy is significant and negative for all recession indicators except duration. This finding is in line with the BMA results reported earlier, where the PIP values for current account balances are large. In addition, we find that advanced economies suffer less (in terms of cumulative cost, depth and growth loss) than emerging economies from weaker current account positions. This is consistent with the idea that some emerging countries imported recession.¹³ However,

advanced economies with weaker current accounts suffer more in terms of duration than emerging economies. Since the coefficients on change in credit composition are still significant (albeit somewhat weakened), there is no evidence that current account effects completely absorb the effect of the change in credit composition.

Another possibility we explore in [Table 10](#) is that the effect of the change in credit composition varies with external positions. We explore this in columns (5)–(8). Changes in credit composition fueled by capital inflows, typically leading to more house price growth and more consumption, are expected to cause more severe post-crisis recessions than changes in credit composition in economies with strong current accounts ([Mendoza and Terrones, 2012](#)). The coefficients on the interaction term support this. In economies with below-median current accounts, change in credit composition is associated with higher cumulative costs and deeper recessions than in economies with above-median current accounts. However, different from earlier models, in column (8) change in credit composition is no longer significantly associated with growth loss. In fact, only pre-crisis income levels and growth rates carry significant coefficients here. This suggests that change in credit composition is not fully exogenous to current account balances. This is consistent with earlier work by [Samarina and Bezemer \(2016\)](#) which showed that capital inflows are associated with changes in credit composition. Nevertheless, the results in columns (1)–(4) suggest that the effects of the change in credit composition on cumulative cost, recession depth and growth loss are not absorbed by the effects of current account balances.

Following [Berkmen et al. \(2012\)](#), we also test if more wholesale funding, which increases financial contagion risks, made the recessionary effects of the change in credit composition more acute. We measure wholesale funding by the leverage ratio of the bank system, which is defined as the loan-to-deposit ratio. We construct a dummy variable which takes value 1 if a country is above the median loan-to-deposit ratio and 0 otherwise, and interact the dummy variable with change in credit composition.¹⁴ [Table 11](#) reports the results. Consistent with the literature, we find that the change in credit composition is associated with deeper post-crisis recessions and more growth loss in economies with bank systems that rely more on wholesale funding.

¹² A continuous current account measure is highly correlated with the change in credit composition, as also noted by [Jordà et al. \(2011\)](#) and [Mendoza and Terrones \(2012\)](#).

¹³ We thank an anonymous referee for this suggestion.

¹⁴ A continuous loan/deposit ratio turned out to be multicollinear with change in credit composition.

Table 9

Differences between advanced and emerging countries.

	(1) Cumulative cost	(2) Depth	(3) Duration	(4) Growth loss
Change in credit composition	4.296** (1.749)	7.214*** (2.319)	−0.403 (0.526)	1.018 (0.660)
Change in credit composition * Advanced	−0.114 (2.716)	−4.116 (2.928)	1.275* (0.702)	0.506 (0.921)
Total-credit growth	0.692** (0.258)	0.365* (0.210)	0.356** (0.141)	0.086 (0.110)
Advanced	−4.093 (5.399)	−4.678 (6.446)	−0.501 (1.882)	−2.309 (2.272)
GDP per capita	0.409 (2.309)	1.385 (3.079)	−0.794 (0.821)	1.749** (0.847)
Pre-crisis growth	−0.381 (0.727)	0.469 (0.780)	−0.760** (0.339)	0.869** (0.251)
Constant	6.100 (21.297)	−5.232 (28.743)	16.984** (8.121)	−14.003* (7.023)
Observations	51	51	51	51
R-squared	0.259	0.374	0.209	0.396

The dependent variable is the cumulative cost of post-2007 recession, defined as recession depth multiplied by recession duration, divided by two. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors are in parentheses.

* $p < 0.1$.** $p < 0.05$.*** $p < 0.01$.**Table 10**

The role of current account positions.

	(1) Cum. cost	(2) Depth	(3) Duration	(4) Growth loss	(5) Cum. cost	(6) Depth	(7) Duration	(8) Growth loss
Change in credit composition	2.715* (1.377)	2.406** (0.921)	0.552 (0.609)	1.033** (0.495)	4.121** (1.815)	3.963*** (1.434)	0.655 (0.606)	0.898 (0.665)
CA	−14.264*** (4.041)	−20.887*** (4.828)	1.386 (1.880)	−3.668** (1.598)	−4.877* (2.718)	−3.624 (2.454)	−1.267 (1.318)	−1.454 (1.045)
CA*Advanced	11.183* (5.978)	22.747*** (5.848)	−4.354* (2.393)	3.404* (1.841)				
Change in credit composition * CA					−4.757* (2.392)	−4.788* (2.821)	−0.950 (0.958)	0.056 (1.174)
Total-credit growth	0.358** (0.169)	0.227 (0.185)	0.244** (0.100)	0.016 (0.067)	0.271* (0.160)	0.064 (0.190)	0.269*** (0.088)	−0.008 (0.070)
GDP per capita	−0.691 (2.194)	−1.617 (2.842)	0.001 (0.798)	1.432 (0.870)	−0.833 (1.291)	−1.127 (2.071)	−0.652 (0.558)	1.187** (0.441)
Pre-crisis growth	−0.083 (0.607)	0.555 (0.629)	−0.640** (0.291)	0.942*** (0.246)	−0.521 (0.675)	0.115 (0.900)	−0.736** (0.334)	0.932** (0.284)
Advanced	−6.371 (4.379)	−11.698*** (3.383)	1.007 (2.307)	−2.818 (2.048)				
Constant	22.063 (21.120)	32.173 (28.818)	8.810 (7.767)	−9.846 (7.589)	19.992 (14.048)	20.530 (23.216)	15.988** (6.345)	−9.201* (4.770)
Observations	51	51	51	51	51	51	51	51
R-squared	0.344	0.583	0.314	0.439	0.335	0.377	0.284	0.393

The dependent variable is the cumulative cost of post-2007 recession, defined as recession depth multiplied by recession duration, divided by two. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors are in parentheses.

* $p < 0.1$.** $p < 0.05$.*** $p < 0.01$.

Taken together, these robustness explorations confirm that change in credit composition appears to be a dominant factor in explaining the severity of post-crisis recessions across advanced and emerging countries; in emerging countries, the effect is linked to external imbalances.

6. Exploring channels

What are the channels from the pre-crisis change in credit composition to the severity of post-crisis stagnation? The literature suggests that faster credit growth may affect consumption, investment and government expenditures. Of the private GDP components, a negative wealth effect of household debt could constrain household consumption. In this case, investment financed by bank lending falls post-crisis because of reduced investment

opportunities and lower demand for loans, or because banks which accumulated larger mortgage portfolios before the crisis have weaker balance sheets. This is what [Zhang et al. \(2017\)](#) demonstrate for British bank balance sheet data.

In [Table 12](#) we explore both consumption and investment effects. We regress post-crisis growth in investment, household consumption and government consumption on change in credit composition and control variables. We do this both for post-crisis consumption and investment in 2009 (columns (1)–(3)) and across 2008 to 2009 (columns (4)–(6)).

Pre-crisis change in credit composition correlates significantly negatively to both post-crisis investment growth and government consumption, but not to household consumption. It is striking that the negative coefficient is twice as large for 2009 compared to 2008–2009. This may reflect the strong post-2009 fiscal responses.

Table 11
Conditions: bank system leverage.

	(1) Cumulative cost	(2) Depth	(3) Duration	(4) Growth loss
Change in credit composition	2.389 (2.010)	1.472 (1.087)	0.498 (0.601)	0.195 (0.379)
Change in credit composition * leverage dummy	3.065 (2.225)	4.406* (2.352)	0.173 (0.928)	2.204** (0.839)
Total-credit Growth	0.645** (0.277)	0.363 (0.236)	0.340** (0.141)	0.045 (0.101)
Leverage dummy	0.133 (4.057)	0.737 (3.016)	−0.453 (1.444)	−0.072 (1.200)
GDP per capita	−1.031 (1.431)	−1.311 (1.921)	−0.615 (0.541)	1.096** (0.497)
Pre-crisis growth	−0.668 (0.655)	−0.068 (0.850)	−0.744** (0.357)	0.689* (0.257)
Constant	18.501 (14.861)	19.559 (21.546)	15.088** (6.145)	−8.394 (5.297)
Observations	51	51	51	51
R-squared	0.283	0.397	0.189	0.507

The dependent variable is the cumulative cost of post-2007 recession, defined as recession depth multiplied by recession duration, divided by two. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors are in parentheses.

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

Table 12
Credit composition effects on consumption and investment.

	(1) Growth 09 in ...	(2)	(3)	(4) Growth 08–09 in ...	(5)	(6)
	Investment	Government consumption	Household consumption	Investment	Government consumption	Household consumption
Change in credit composition	−3.777*** (1.390)	−1.241*** (0.433)	−1.174 (0.744)	−3.230*** (1.079)	−0.732** (0.309)	−0.647 (0.578)
Total-credit growth	−0.525* (0.306)	−0.071 (0.075)	−0.195** (0.084)	−0.442* (0.240)	−0.006 (0.055)	−0.212** (0.095)
GDP per capita	−4.120*** (1.521)	−1.632** (0.678)	−0.353 (0.953)	−4.120*** (1.052)	−1.176** (0.506)	−0.944* (0.476)
Pre-crisis growth	−1.682* (0.919)	−0.048 (0.243)	−0.469 (0.428)	−0.481 (0.731)	0.062 (0.200)	−0.019 (0.285)
Constant	35.783** (15.791)	20.191*** (7.309)	5.041 (10.866)	39.207*** (12.034)	14.723*** (5.405)	10.801* (5.662)
Observations	51	51	50	51	51	50
R-squared	0.361	0.281	0.239	0.454	0.256	0.330

The dependent variable is the cumulative cost of post-2007 recession, defined as recession depth multiplied by recession duration, divided by two. Definitions and descriptive statistics of all variables are in [Appendix B](#). Robust standard errors are in parentheses.

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

The results suggest that these responses reduced government consumption more in economies where there had been larger changes in credit composition.¹⁵

More challenging, we also attempt to uncover evidence of the qualitative dimension of the investment channel. Even beyond falling investment levels, changes in credit composition can also have a capital allocation effect, worsening post-crisis recessions. If banks with larger mortgage portfolios reduce lending which finances high-value added investment more than other lending, then the ability of investment to generate value-added falls as a result. This is motivated by the work of [Cecchetti and Kharroubi \(2013\)](#). They find that during a credit boom, banks reduce credit to

¹⁵ We also explored the impact of house prices as a possible channel. We found that if included jointly with mortgage credit growth, house price growth is strongly significant for recession depth and growth losses, but not for cumulative cost and duration. The coefficient for change in credit composition remains significant for recession depth, but not for growth loss and cumulative costs, nor duration (as previously). Full results are available on request. We thank an anonymous referee for suggesting this exploration.

R&D intensive firms more than to other firms. This hurts innovation and thus value-added growth. In addition to this effect during a credit boom, banks may continue to allocate capital sub-optimally post-crisis, due to balance sheet weaknesses connected to mortgage lending ([Zhang et al., 2017](#)).

We explore this issue by asking whether economies with banking systems which experienced more changes in credit composition, also curtailed credit such that it hurt investments which yield higher added value more than other investments. In these economies, the fall in the elasticity of value-added with respect to investment in 2008–2009 compared to the pre-boom level would be larger than in other economies.

We use industry-level data for sixteen countries during the period 1990–2012¹⁶ to analyse this. While the limited data avail-

¹⁶ This dataset, retrieved from the OECD, covers 23 manufacturing industries in Austria, Belgium, the Czech Republic, Germany, Denmark, Finland, France, Greece, Italy, Luxembourg, the Netherlands, Norway, Portugal, Slovakia, Slovenia and Sweden.

Fig. 3. Nonfin. business credit growth and investment efficiency.

ability strongly reduces our number of observations, it does allow us to gain some insight into the capital allocation effect.

As in Wurgler (2000), we computed the elasticity of value-added with respect to investment as the coefficient of a regression of industry value-added on industry investment, for 23 manufacturing industries in each country in our sample for which UNIDO data are available. Elasticity estimates were then computed from regressions of the form $\ln \frac{I_{ict}}{I_{ict-1}} = \alpha_c + \eta_c \ln \frac{V_{ict}}{V_{ict-1}} + \varepsilon_{ict}$, where i indexes industry, c denotes country, and t indexes year.

Since misallocation may occur both in the credit boom before the crisis and in the stagnation that followed the crisis, we performed the analysis pre-boom (all years in the sample from 1990 to 2002) and post-crisis (2008–2009), and computed the difference in coefficient estimates. We chose the years to be consistent with the 2003 to 2007 period over which we measured the change in credit composition in the earlier analyses in this paper. If the change in this elasticity from pre-2003 to post-2007 is more negative (or less positive) in economies where the 2003 to 2007 change in credit composition was larger, then this is consistent with the change in credit composition reducing the efficiency of investment. In Fig. (3) we plot the change in the estimated elasticities of value-added with respect to investment (one observation for each of sixteen countries in the industry-level sample), against change in credit composition. We observe a significant negative correlation, though with substantial scatter around the trend line.

In sum, in this section we found evidence that channels from the change in credit composition to post-crisis recession severity include reductions in government consumption and in investment, and reductions in the quality of capital allocation, in terms of the value-added benefits that it yields.

7. Conclusion and discussion

Countries with faster credit growth before the 2007 crisis experienced deeper and more prolonged recessions. In this paper we aim to take our understanding of the determinants of post-crisis recession severity one step further. It is not just the growth but the composition of credit which matters. We investigate the role of change in credit composition (rising shares of mortgage credit in total credit) before the crisis in explaining the severity of recessions which followed the crisis. Based on disaggregated bank credit data over 2003–2012 for 51 economies, we find robustly positive correlations between the change in credit composition and the cumulative cost, depth and growth loss of post-crisis stagnations. The growth loss measure goes furthest in accounting for endogeneity concerns, supporting a causal interpretation. The growth loss

results also suggest that the change in credit composition is not exogenous to external balances.

The results add to our understanding of the drivers of post-crisis recession severity. In a horse race setup, change in credit composition trumps total-credit growth in explaining recession severity. The positive relationship between change in credit composition and recession severity is robust to including a range of control variables. A Bayesian model-averaging analysis suggests that change in credit composition should be part of the model explaining post-2007 recessions. The results are stronger in sub-samples with positive changes in credit composition (i.e. rising mortgage shares) and in banking systems that rely more on wholesale funding. The effect on recession duration is smaller in emerging economies, in which GDP bounced back faster. Each of these findings throws light on the conditions in which change in credit composition may harm stability.

Additional analysis suggests that investment and government consumption are channels from the change in credit composition to post-crisis recession severity. Both the level of investment and, more cautiously, the quality of capital allocation appear to play a role in explaining the key finding in this paper.

A clear limitation of the analysis is the cross-sectional nature of the data, and the relatively short time span. Many countries experienced significant changes in credit composition in the late 1990s and early 2000s. This could conceivably yield growth gains by stimulating consumption, before its costs growth after a crisis. A more balanced assessment of the costs and benefits of change in credit composition over time would be desirable, but this requires longer-term panel data. Expanding the data back in time would appear a worthwhile extension.

A promising direction in which research can be extended is towards the use of micro-data. With matched bank-household and bank-firm data, the responses of consumption and investment to change in credit composition can be observed at the individual level. This would yield additional insights into the variation in the strength of this connection, and conditions such as household wealth and incomes and bank funding, which govern the responses of change in credit composition. Following studies which utilize matched micro-data to analyse shocks to housing markets (Gan, 2007; Jimenez et al., 2014), a similar approach could be adopted for the study of credit composition in bank loan portfolios.

One policy implication from this research is that changes in credit composition should be tracked. A clearer understanding of the costs of such shifts in the use of debt could help to devise macro-prudential policies, by discouraging changes in credit composition that deepen recessions.

Appendix A. A literature review summary table

Table A.1

Determinants of post-crisis recession.

Variable	Sign	Count
Domestic factors		
Total-credit growth	–	8
GDP per capita	–	7
Leverage	–	5
Pre-crisis growth	–	4
Credit market regulation	–	3
Pegged exchange rate regime	–	3
Fiscal position	+	1
House price appreciation	+	1
Foreign bank ownership		1
Inflation		1
Labour market regulation	+	1
National saving	+	1
Real interest rate	+	1
Output volatility	+	1
Past crisis	–	1
Output correlation	+	1
External factors		
Current account/GDP	–	7
Financial openness	–	3
Trade openness	–	3
External debt	–	3
Short-term debt	–	2
Share of commodity export	+	2
Reserve	+	2
Lending from advanced countries	–	2
Financing via inter. Cap. Markets		1
Public debt	–	1
FDI inflow/GDP		1
Foreign holdings of US equity	+	1

This table is based on the survey of [Cecchetti et al. \(2011\)](#), [Feldkircher \(2014\)](#), [Berkmen et al. \(2012\)](#), [Claessens et al. \(2010\)](#), [Lane and Milesi-Ferretti \(2011\)](#), [Rose and Spiegel \(2011\)](#), [Frankel and Saravelos \(2012\)](#), [Giannone et al. \(2011\)](#), [Ólafsson and Pétursson \(2010\)](#), [Berglof et al. \(2010\)](#) and [Didier et al. \(2012\)](#).

Appendix B. Variable definitions and descriptive statistics

B.1 Dependent variables

Cumulative cost: Following [Agnello and Nerlich \(2012\)](#), our most inclusive variable is a composite measure, depth multiplied by duration and divided by two.

Depth: the change of quarterly real GDP (RGDP) from peak to trough during the period 2007–2012, using the IMF's IFS quarterly real GDP data. For each economy, we define peaks (troughs) as quarters in which real GDP per capita exceeds (is less than) both the preceding and the next quarter.

Duration: the number of quarters from peak to trough.

Growth loss: Forecast GDP growth minus actual growth in 2009. We take the forecast from the IMF's World Economic Outlook published in April 2008, prior to the Lehman collapse. Source: IMF World Economic Outlook (WEO), April 2008.

Growth2009Inv: Gross fixed capital formation growth in 2009. Source: IMF IFS.

Growth2009gov: Government consumption growth in 2009. Source: IMF IFS.

Growth2009con: Private consumption growth in 2009. Source: IMF IFS.

Growth0809Inv: Average gross fixed capital formation growth in 2008 and 2009. Source: IMF IFS.

Growth2009gov: Average government consumption growth in 2008 and 2009. Source: IMF IFS.

Growth2009con: Average private consumption growth in 2008 and 2009. Source: IMF IFS.

B.2 Independent variables

Change in credit composition: The annual average change in the share of mortgages in total credit. Source: own calculation based on [Bezemer et al. \(2017\)](#).

Total-credit growth: The annual average change in total credit to GDP ratio over 2003–2007. Source: own calculation based on [Bezemer et al. \(2017\)](#).

Level of total credit: Credit to GDP ratio. Source: own calculation based on [Bezemer et al. \(2017\)](#).

Mortgage credit growth: The annual average change in mortgage credit to GDP ratio over 2003–2007. Source: own calculation based on [Bezemer et al. \(2017\)](#).

GDP per capita: Real GDP per capita (constant 2005 dollars). Source: World Bank World Development Indicators (WDI).

Pre-crisis growth: The average growth in real GDP per capita over 2003–2007. Source: IMF International Financial Statistics (IFS).

Current account: Current account as a percentage of GDP. Higher numbers indicate surpluses. Source: IFS.

Leverage: The ratio of bank credit to domestic deposits. Source: WDI.

Trade openness: Imports plus exports, divided by GDP. Source: WDI.

Financial openness: External assets and liabilities, divided by GDP. Source: [Lane and Milesi-Ferretti \(2007\)](#).

Credit market deregulation: Credit market deregulation index, which consists of three components: ownership of banks (percentage of deposits held in privately owned banks), extension of credit (share of private sector credit in total bank credit), and presence of interest rate controls/negative interest rates. Each component is scaled from 1 to 10; the credit deregulation index is an average of the three components. Higher values indicate less regulation in credit markets. Source: Fraser Institute's Economic Freedom Indicators.

Exchange rate regime: Exchange rate variability index. Source: [Calvo and Reinhart \(2002\)](#).

Post-crisis fiscal balance change: The average change of fiscal balance over 2008–2012, % GDP. Source: IMF fiscal monitor.

Post-crisis fiscal spending change: The average change of fiscal spending over 2008–2012, % GDP. Source: IMF fiscal monitor.

Post-crisis interest rate change: The average change of short-term interest rate over 2008–2012. Source: IFS.

Table B.1

Table B.1
Descriptive statistics.

Variable	Mean	SD	Min	Max	Obs
Cumulative cost	10.44	11.704	−1.864	63.515	51
Depth	10.883	10.033	−7.293	49.64	51
Duration	7.02	4.823	0	21	51
Growth loss	−6.519	3.958	−20.347	0.48	51
Growth2009Inv	−16.601	−54.238	13.558	13.016	51
Growth2009gov	3.218	−9.453	15.675	4.262	51
Growth2009con	−2.278	−18.633	5.845	−2.278	51
Growth0809Inv	−6.536	−33.658	12.617	9.934	51
Growth0809gov	3.218	−4.801	13.052	2.968	51
Growth0809con	0.258	−12.216	7.873	3.669	51
Change in credit composition	0.58	1.241	−1.974	3.809	51
Total-credit growth	4.3	6.648	−3.239	31.997	51
Level of total credit	90.105	56.396	13.159	241.623	51
Mortgage credit growth	1.407	1.646	−2.265	5.301	51
GDP per capita	9.59	1.239	6.259	11.382	51
Pre-crisis growth	4.875	2.26	1.529	10.861	51
Current account	−1.243	9.498	−27.157	25.751	51
Leverage	120.928	56.206	46.052	306.89	51
Trade openness	109.916	79.127	25.209	398.658	51
Financial openness	5.841	1.079	4.435	10.087	51
Credit market deregulation	9.063	1.301	2	10	51
Exchange rate regime	2.078	1.036	1	4	51
Post-crisis fiscal balance change	−0.37	0.872	−1.98	2.408	48
Post-crisis fiscal spending change	0.385	1.133	−4.964	2.817	48
Post-crisis interest rate change	−0.723	−5.254	0.839	0.833	51

References

- Agnello, L., Nerlich, C., 2012. On the severity of economic downturns: lessons from cross-country evidence. *Econ. Lett.* 117, 149–155.
- André, C., 2016. Household debt in OECD countries: stylised facts and policy issues. In: Technical Report. OECD Working Paper No. 1227.
- Babecky, J., Havranek, T., Mateju, J., Rusnak, M., Smidkova, K., Vasicek, B., 2013. Leading indicators of crisis incidence: evidence from developed countries. *J. Int. Money Finan.* 35, 1–19.
- Bahadir, B., Gumus, I., 2016. Credit decomposition and business cycles in emerging market economies. *J. Int. Econ.* 103, 250–262.
- Barba, A., Pivetti, M., 2009. Rising household debt: its causes and macroeconomic implications – a long-period analysis. *Cambridge J. Econ.* 33, 113–137.
- Beck, T., Büyükkarabacak, B., Rioja, F.K., Valev, N.T., 2012. Who gets the credit? and does it matter? Household vs. firm lending across countries. *B.E. J. Macroecon.* 12, 1–46.
- Berglof, E., Korniyenko, Y., Plekhanov, A., Zettelmeyer, J., 2010. Understanding the crisis in emerging Europe. *Public Policy Rev.* 6, 985–1008.
- Berkmen, S.P., Gelos, G., Rennhack, R., Walsh, J.P., 2012. The global financial crisis: explaining cross-country differences in the output impact. *J. Int. Money Finan.* 31, 42–59.
- Bertay, A.C., Gong, D., Wagner, W., 2017. Securitization and economic activity: the credit composition channel. *J. Finan. Stabil.* 28, 225–239.
- Bezemer, D., Grydaki, M., Zhang, L., 2016. More mortgages, lower growth? *Econ. Inq.* 54, 652–674.
- Bezemer, D., Samarina, A., Zhang, L., 2017. The shift in bank credit allocation: new data and new findings. In: DNB Working Paper No. 559. DNB.
- Bordalo, P., Nicola, G., Andrei, S., 2017. Diagnostic expectations and credit cycles. *J. Finan.* 73, 199–227.
- Büyükkarabacak, B., Valev, N.T., 2010. The role of household and business credit in banking crises. *J. Bank. Finan.* 34, 1247–1256.
- Calvo, G.A., Reinhart, C.M., 2002. Fear of floating. *Q. J. Econ.* 117, 379–408.
- Carroll, C.D., Misuzu, O., Jiri, S., 2011. How large are housing and financial wealth effects? A new approach. *J. Money Credit Bank.* 43, 55–79.
- Cecchetti, S., Kharroubi, E., 2013. Why does financial sector growth crowd out real economic growth. Technical Report. Bank for International Settlements.
- Cecchetti, S., King, M.R., Yetman, J., 2011. Weathering the financial crisis: good policy or good luck? In: BIS Working Papers 351. Bank for International Settlements.
- Claessens, S., Dell'Ariccia, G., Igan, D., Laeven, L., 2010. Cross-country experiences and policy implications from the global financial crisis. *Econ. Policy* 25, 267–293.
- De Luca, G., Magnus, J.R., 2011. Bayesian model averaging and weighted-average least squares: equivariance, stability, and numerical issues. *Stata J.* 11, 518–544.
- Dell'Ariccia, G., Igan, D., Laeven, L., 2012. Credit booms and lending standards: evidence from the subprime mortgage market. *J. Money Credit Bank.* 44, 367–384.
- Didier, T., Hevia, C., Schmukler, S.L., 2012. How resilient and countercyclical were emerging economies during the global financial crisis? *J. Int. Money Finan.* 31, 2052–2077.
- Drehmann, M., Juselius, M., Korinek, A., 2017. Accounting for debt service: the painful legacy of credit booms. In: Technical Report. BIS Working Paper No. 645.
- Dynan, K., 2012. Is a household debt overhang holding back consumption. *Brookings Pap. Econ. Activity* 44, 299–362.
- Favara, G., Imbs, J., 2015. Credit supply and the price of housing. *Am. Econ. Rev.* 105, 958–992.
- Feldkircher, M., 2014. The determinants of vulnerability to the global financial crisis 2008 to 2009: credit growth and other sources of risk. *J. Int. Money Finan.* 43, 19–49.
- Frankel, J., Saravelos, G., 2012. Can leading indicators assess country vulnerability? Evidence from the 2008–09 global financial crisis. *J. Int. Econ.* 87, 216–231.
- Gan, J., 2007. The real effects of asset market bubbles: loan- and firm-level evidence of a lending channel. *Rev. Finan. Stud.* 20, 1941–1973.
- Giannone, D., Lenza, M., Reichlin, L., 2011. Market freedom and the global recession. *IMF Econ. Rev.* 59, 111–135.
- Greenwood, R., Scharfstein, D., 2013. The growth of finance. *J. Econ. Perspect.* 27, 3–28.
- IMF, 2012. Dealing with household debt. In: World Economic Outlook. IMF, pp. 89–124 (Chapter 3).
- IMF, 2016. Debt: use it wisely. In: IMF Fiscal Monitor. IMF, pp. 1–111 (Chapter 1).
- Jappelli, T., Pagano, M., 1994. Saving, growth, and liquidity constraints. *Q. J. Econ.* 109, 83–109.
- Jappelli, T., Pagano, M., di Maggio, M., 2008. Households' Indebtedness and Financial Fragility. In: CSEF Working Papers 208. Centre for Studies in Economics and Finance (CSEF), University of Naples, Italy.
- Jimenez, G., Mian, A.R., Peydro, J.L., Salas, J.S., 2014. The real effects of the bank lending channel. In: SSRN Working Paper. SSRN.
- Jordà, O., Schularick, M., Taylor, A.M., 2011. Financial crises, credit booms, and external imbalances: 140 years of lessons. *IMF Econ. Rev.* 59, 340–378.
- Jordà, O., Schularick, M., Taylor, A.M., 2013. When credit bites back. *J. Money Credit Bank.* 45, 3–28.
- Jordà, O., Schularick, M., Taylor, A.M., 2014. The great mortgaging: housing finance, crises, and business cycles. In: Working Paper 20501. National Bureau of Economic Research.
- Juselius, M., Drehmann, M., 2015. Leverage dynamics and the real burden of debt. In: BIS Working Papers 501. Bank for International Settlements.
- Justiniano, A., Primiceri, G.E., Tambalotti, A., 2015. Credit supply and the housing boom. In: NBER Working Papers 20874. National Bureau of Economic Research, Inc.
- Lane, P.R., Milesi-Ferretti, G.M., 2007. The external wealth of nations mark II: revised and extended estimates of foreign assets and liabilities, 1970–2004. *J. Int. Econ.* 73, 223–250.
- Lane, P.R., Milesi-Ferretti, G.M., 2011. The cross-country incidence of the global crisis. *IMF Econ. Rev.* 59, 77–110.
- Levine, R., 2005. Finance and growth: theory and evidence. In: Aghion, P., Durlauf, S. (Eds.), *Handbook of Economic Growth*, vol. 1. Elsevier, pp. 865–934 (Chapter 12).
- Lombardi, M.J., Mohanty, M., Shim, I., 2017. The real effects of household debt in the short and long run. In: BIS Working Paper No. 607. BIS.
- Magnus, J.R., Powell, O., Pruffer, P., 2010. A comparison of two model averaging techniques with an application to growth empirics. *J. Econometr.* 154, 139–153.

- Mendoza, E., Terrones, M., 2012. An anatomy of credit booms and their demise. In: Working Papers Central Bank of Chile 670. Central Bank of Chile.
- Mian, A., Sufi, A., 2009. The consequences of mortgage credit expansion: evidence from the U.S. mortgage default crisis. *Q. J. Econ.* 124, 1449–1496.
- Mian, A., Sufi, A., 2014. *House of debt*. The university of Chicago press.
- Mian, A., Sufi, A., Verner, E., 2017. Household debt and business cycles worldwide. *Q. J. Econ.* 132, 1755–1817.
- Obstfeld, M., Rogoff, K., 2009. Global imbalances and the financial crisis: products of common causes. *Proceedings, Federal Reserve Bank of San Francisco*, 131–172.
- Ólafsson, T.T., Pétursson, T.G., 2010. Weathering the financial storm: the importance of fundamentals and flexibility. In: *Economics wp51*. Department of Economics, Central Bank of Iceland.
- Rose, A.K., Spiegel, M.M., 2011. Cross-country causes and consequences of the crisis: an update. *Eur. Econ. Rev.* 55, 309–324.
- Samarina, A., Bezemer, D., 2016. Do capital flows change domestic credit allocation? *J. Int. Money Finan.* 62, 98–121.
- Sutherland, D., Hoeller, P., Merola, R., Ziemann, V., 2012. Debt and macroeconomic stability. In: *OECD Economics Department Working Papers 1003*. OECD Publishing.
- Wurgler, J., 2000. Financial markets and the allocation of capital. *J. Finan. Econ.* 58, 187–214.
- Xu, Z., 2000. Financial development, investment, and economic growth. *Econ. Inq.* 38, 331–344.
- Zhang, L., Uluc, A., Bezemer, D., 2017. Did pre-crisis mortgage lending limit post-crisis corporate lending? Evidence from UK bank balance sheets. In: *Bank of England Working Papers No. 651*. Bank of England.