

A Global House Of Debt Effect? Mortgages and Post-Crisis Recessions In Fifty Economies[☆]

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Abstract

The composition of private debt matters to the severity of post-2007 recessions. Using new data on four types of bank credit over 2000-2012 for 51 economies in OLS and Bayesian averaging models, we find that changes in the share of household mortgage credit in total credit before the crisis are significantly associated with recession depth and growth loss after the 2007 crisis. This finding is robust to a wide range of control variables and to the different responses across advanced and emerging economies. The evidence also suggests that mortgage growth combined with increasing bank leverage was particularly damaging to output growth. We discuss policy implications and future research.

Keywords: private credit, mortgages, crisis, output loss

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1. Introduction

Countries with more private debt before the 2007 crisis experienced deeper and more prolonged recessions (Lane and Milesi-Ferretti, 2011; Rose and Spiegel, 2011; Claessens et al., 2010; Feldkircher, 2014). 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 level, but the composition of debt that matters. We explore arguments and evidence that it was growth in mortgage credit, not just debt in general, which created vulnerability to the crisis shock.

We then present newly collected data on 51 economies tracing bank lending to nonfinancial business, to nonbank financial business, and to households as consumer debt and mortgage lending. We find that changes in the share of household mortgage credit have a significant effect on recession severity after the 2007 crisis, more than total credit growth. The inclusion of household mortgage credit shares in the model

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is confirmed in a Bayesian model averaging analysis. The evidence also suggests that mortgage credit growth combined with increasing bank leverage was particularly damaging to post crisis output growth. We draw the key conclusion that “distinction between debts according to purpose, however difficult to carry out” (Schumpeter, 1939, p. 148) may help understand when growth of bank credit helps, hinders and hurts the economy.

This distinction matters especially since household mortgage debt rose to unprecedented levels in recent decades. Jordà et al. (2014) find an increase from 30% to 60% in household mortgage credit as share of GDP since 1900 in a sample of 17 countries, with most of that increase since the 1970s. In a companion paper, we show the increase for a balanced panel of 14 countries from 1990 to 2012, from 20% to 50%. A dramatic example is the Netherlands, where household mortgage debt quintupled from 20% of GDP in 1990 to 101% in 2009. In the same years, bank credit to nonfinancial business increased from 43% to 63% of GDP (Bezemer et al., 2015). The allocation of bank debt has shifted dramatically.

This suggests that we need to rethink the role of bank lending: banks often act more like ‘real-estate funds’ (Jordà et al., 2014) than as funders of entrepreneurial activity. A distinction in the use of financial resources already featured in work by Keynes (1936), Schumpeter (1939) and Minsky (1978). But with a few exceptions, the distinction was largely lost in the empirical credit-growth literature to date, where ‘credit’ is tacitly interpreted as credit to the nonfinancial business sector, supporting production of goods and services. In reality, most of the recent growth in credit has been in support of already produced real estate assets, as Jordà et al. (2014) note, not in support of production of goods and services. James Tobin in his 1984 Hirsch Memorial Lecture ‘On the Efficiency of the Financial System’ already disparaged that “we are throwing more and more of our resources, including the cream of our youth, into financial activities remote from the production of goods and services”. The data suggest that this has become more relevant since then.

If only for this reason, the growth effectiveness of credit is likely to have declined with the rise of mortgage lending in total credit. In support, a small but expanding literature shows that debt held by households (typically, as mortgage debt) does indeed create less income growth for the same debt growth. Xu (2000) find that business investment is the channel from financial development to output growth, rather than household spending. Jappelli and Pagano (1994) model household credit leading to lower private savings and so slower economic growth. Beck et al. (2012) find negative growth coefficients for household credit. Bezemer et al. (2015) show that credit flows to households (most of which is mortgages, in most economies) has negligible income growth effects.

Such growth of debt with little growth of income undermines the ability to service debt from income. Even though debt growth may temporarily stabilize the economy, this ‘stability is destabilizing’ (Minsky, 1978). For instance, Grydaki and Bezemer (2013) and Bezemer and Grydaki (2014) analyse how mortgage debt created both stability and fragility in the U.S. Great Moderation. A number of recent cross-country

studies find positive effects of the expansion of household credit on crisis probability (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). In addition to an effect on *probability* of crisis, there is also an effect on the *severity* of post-crisis recession, which is the subject of this paper. Dynan (2012) and Mian and Sufi (2009) report that more leveraged U.S. homeowners experienced larger declines in spending after 2007– a finding which is the theme of their book ‘House of Debt’ (Mian and Sufi, 2014). Jordà et al. (2014) find a historical ‘House of Debt’ effect for 17 countries analyzed since 1870. We extend the ‘House of Debt’ hypothesis to a contemporary global sample of 51 economies, and show the role of household mortgage debt in deepening recession after a crisis.

In the next section we review the emerging literature on this topic, focusing on the channels from household leverage to post-crisis recession severity, and on the challenge of model selection in analyzing these channels. In sections 3 and 4 we present and explore the data, present the empirical analysis and discuss the results. Section 5 concludes with a summary, a reflection on this study’s limitations and avenues for future research, and policy implications.

2. Private Credit and Post-Crisis Recessions: Channels, Covariates and Model Selection Challenges

2.1. Theoretical Channels

A number of channels from household mortgage debt to crisis severity can be motivated from the recent empirical literature. Claessens et al. (2010) finds that three factors - house price appreciation, bank credit growth prior to the crisis, and size of the current account deficit - caused longer and more severe economic slowdowns after the 2007 crisis. It is significant that household mortgage credit is a driver of each of these factors. It causes a larger rise in house prices (Favara and Imbs, 2015); it leads to weaker external balances, as Büyükkarabacak and Krause (2009) show; and it is strongly associated with growth of the bank-credit-to-GDP ratio, unlike credit to nonfinancial business. Most of the increase in the ratio of private debt to GDP is due to household mortgage debt, as Jordà et al. (2014) and Bezemer et al. (2015) show.

Another channel from household mortgage credit to the severity of post-crisis recession is through vulnerabilities in bank business models specifically linked to mortgage markets. Claessens et al. (2010) find that mortgage debt increases a Financial Stress Index (FSI), which summarizes seven financial market variables (banking sector beta, the spread between T-Bill and Eurodollar futures contracts, the inverted term spread, stock market return and return volatility, sovereign debt spread, and exchange market volatility). The ratio of private credit to GDP, house price appreciation and more sizeable mortgage debt are all associated with greater increases in financial stress. Thus, financial vulnerabilities are another channel for the output effect of credit composition that is the focus of our paper.

Related to this, several papers point to securitization as part of the originate-to-distribute model of lending and to softening of loan standards, amplified by low policy rates (Jiminez et al., 2014; Purnanandam, 2011; Maddaloni, 2011). At the eve of the 2007 crisis, each of these factors had become especially important in mortgage markets, more so than in other credit markets. One result was that mortgage lending expanded beyond the domestic deposit base, with wholesale funding and securitization closing this mortgage deposit funding gap. This led to increased bank balance sheet vulnerabilities to international financial markets. Deteriorating underwriting standards also triggered the exceptional rise in mortgage defaults from 2007 (Mayer et al., 2009). Taken together, this suggests a specific vulnerability: high levels of mortgage credit combined with a deposit funding gap. We will test this in the empirical analysis.

Another factor in understanding the macroeconomic impact is the sheer volume of mortgage debt, compared to other types of bank debt. In most countries, the stock of mortgage debt is only surpassed by the stock of nonfinancial business debt; in a few countries (e.g. The Netherlands and Spain), it is even the largest debt category. It is vastly larger than unsecured consumer bank debt. Household mortgage debt is also held in much more widespread ownership than nonfinancial business debt. Both these factors - volume and wide distribution - amplify debt overhang effects, unlike unsecured consumer debt and unlike the possible debt overhang effect of nonfinancial business debt.

While household mortgage credit has so far not been considered as a determinant of post-crisis recession severity (with the exception of Jordà et al., 2014), a string of recent papers test other determinants. To organize our review of the literature, we summarize the findings of eleven recent cross-country regression studies in the table in Appendix A. Here we discuss measurement methods and key findings.

2.2. Literature Review

A wide variety of variables is used to measure recession depth and severity. First, Lane and Milesi-Ferretti (2011) look at the fall in output, consumption and domestic demand in 2008-2009. Significant correlates include the pre-crisis level of development, increases in the ratio of private credit to GDP, current account deficits, and openness to trade.

Second, Berkmen et al. (2012) take output growth in 2009 compared to pre-crisis forecasts for that year. Below we will follow this approach, since it filters out drivers of recession severity which are unrelated to the crisis. Berkmen et al. (2012) find that much of the variation in this measure is explained by a limited number of financial variables: the degree of leverage in domestic financial systems (as measured by the credit-to-deposit ratio), credit growth, and short-term debt.

Third, Cecchetti et al. (2011) study the post-crisis cumulative GDP gap, measured as real GDP growth in 2008-2009 that is not explained by the first principal component of GDP growth in a sample of 46 economies over 1988-2010. Variables correlated to this measure include lower banking sector capitalization, current account deficits, low foreign exchange reserves and again, and a growing private sector credit-to-GDP

ratio.

Fourth, Claessens et al. (2010) study recession duration, the severity of income loss following the crisis, and the change in average growth, comparing the 2003-2007 years to 2008-2009. As noted, their finding is that house price appreciation, credit growth prior to the crisis, and size of the current account deficit are significant predictors for longer, more severe, and more adverse aggregate economic slowdowns. The lesson we take away from these studies is that recession severity has several dimensions. In our empirical work below we will therefore define post-crisis recession in four ways: by duration, depth, growth loss, and cumulative cost.

The literature (e.g. Claessens et al., 2010) also indicates that post-2007 recessions last longer in richer countries, reflecting the advanced-economy nature of this crisis. Relatedly, Didier et al. (2012) show that while emerging economies suffered growth collapses (relative to the pre-crisis levels) comparable to those experienced by developed economies, they converged more quickly to their pre-crisis growth trend. IMF (2012) analyzes advanced economies over the past three decades, and finds that housing busts and recessions preceded by larger run-ups in household debt tend to be more severe. We will therefore include the advanced/emerging economy distinction in our analysis.

Another lesson from the literature review is that the list of potential determinants of post-crisis recession severity is long. With a limited number of observations, the model selection problem is pertinent. We approach this challenge in two ways. First, we screened eleven recent papers on post-crisis recession severity and found that - as shown in Table A.1 - among the 30 significant determinants in these studies, 9 are significantly correlated to recession severity in more than one paper. They are: pre-crisis real GDP growth (the average annual real output growth rate over 2005-2007), real GDP per capita, the current account balance, trade openness (the sum of exports and imports), financial openness (the sum of financial assets and liabilities), credit market deregulation (the Fraser Institute index), the exchange rate regime (an index which reflects degree of floating) and the bank leverage ratio (the ratio of domestic bank loans to domestic deposits), potentially an indicator of balance sheet vulnerabilities. Definitions and sources of these variables are given in Appendix B. We will include year-2007 values of these variables in our analysis.

A second way we approach the challenge of model selection with many potential variables is to follow Feldkircher (2014) and Babecky et al. (2013) and conduct a Bayesian model averaging exercise. In this way, we also test the robustness of including household mortgage credit in a model explaining recession severity after the crisis.

Zooming in specifically on the household credit literature, we found that Beck et al. (2014) and Beck et al. (2012) study the impact of credit on growth, with a differentiation according to household credit and firm credit. This is much like the early analysis in Werner (1997), who tests the different growth effects of mortgages and business credit for Japan in the 1980s and 1990s, and generalizes this approach in Werner (2012). The present paper is different in that we use panel data (Beck et al. (2012) use a cross-section and

Werner (1997) time series) and we study shares of different credit types in total credit as measures for credit composition. Beck et al. (2014) contrast the value-added share of the financial sector, as proxy for size, to the credit-to-GDP-ratio, as proxy for intermediation activities.

Two other related papers are Büyükkarabacak and Valev (2010) who focus on the impact of (consumer and mortgage) household debt on crisis probability, but not crisis severity; and Jordà et al. (2014) who do test crisis severity effects of mortgage credit since 1870. Our paper differs from theirs in that we use a larger and more recent sample and that we focus specifically on the latest crisis.

In sum, we build on the literature by measuring post-crisis recession along several dimensions; by including all control variables in the analysis which are repeatedly found to be significant in the literature; and by validating inclusion of credit composition (the share of mortgage credit in total credit) in a Bayesian model averaging analysis. In comparison to the literature, our value added is in the new data, with greater country coverage and a new focus on household mortgage credit. In the next section we explore trends in the data.

3. Data and Measures

3.1. Data

The analysis we conduct below is based on data on 51 advanced and emerging countries, with annual observations ranging between 2003-2005 and the end of the sample in 2012. The choice of the country sample is constrained by the availability of data on disaggregated credit categories. Data for each country comes from the consolidated balance sheets of monetary financial institutions in the country's central bank statistical resources. On the asset side of the consolidated balance sheet, loans to non-banks are reported as mortgages to households, household consumption credit, credit to nonfinancial business, and credit to financial business (insurance companies, pension funds, and other non-bank financial firms). This constitutes the source for our data.¹ We compiled the data in one common format, only including those data which are publicly available.

To our knowledge, no data with similar coverage and detail have been collected and reported before. A related data set is reported in Beck et al. (2012), which covers 85 countries and ends in 2005, and which does not distinguish between household mortgages and household consumer credit. Another is BIS (2013), which covers 40 countries to 2011 but does not differentiate bank credit and other credit. The data used in this paper are an extended version of the data set introduced and described in Bezemer et al. (2015), which uses data on fewer countries, for longer time spans. We refer to this paper for an extensive description and for sources.

¹For some countries bank lending to government is also reported, which is usually small; we did not include this.

We find that in this sample, bank lending as unsecured consumer credit and as credit to non-bank financials are relatively small credit categories, comprising respectively 15% and 10% of all bank credit in 2007. This compares to bank credit to nonfinancial business which in 2007 is 47% of all bank credit, and household mortgage loans held by banks which amounts to 30% in 2007.² Also, most of the change in credit composition is due to the growth of household mortgage loans, especially in advanced economies (which comprise 37 of the 51 economies in our sample). Here the average annual percentage points change over 2003-2007 in the share of household mortgages in total credit is 0.62, almost precisely balanced by an 0.67 average annual decline in the share of non-financial business credit. Combined with theoretical arguments for the special role of household mortgage credit reviewed above, these empirics motivate our choice to capture the dynamics of credit composition by the change in the share of household mortgage credit in total credit.

3.2. *Measuring recessions*

We measure the *cumulative costs* of recessions by their depth (the change of quarterly real GDP from peak to trough; Feldkircher (2014)) times their duration (the number of quarters from peak to trough during the period 2007-2012). We define peaks (troughs) as quarters in which real GDP exceeds (is less than) GDP in both the preceding and the following quarter. The underlying idea is that the severity of each recessionary phase can be thought of as the area under a triangle, with depth as its height and duration as its base. Thus, severity captures two dimensions of how bad a recession is (cf. Agnello and Nerlich, 2012). We consider it the most inclusive of the various measures we employ in this study. We will also study correlates of duration and depth separately.

A 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 growth³. Thus, growth loss takes larger positive values for larger growth shortfalls relative to the forecast. This measure takes account of growth determinants which are independent of the crisis event, which are included in the projection. In this way we take the endogeneity of declining growth into account, as Cecchetti et al. (2011) and Berkmen et al. (2012) emphasize. Any remaining growth decline is a relatively clean measure of the crisis effect net of country-specific drivers of growth.

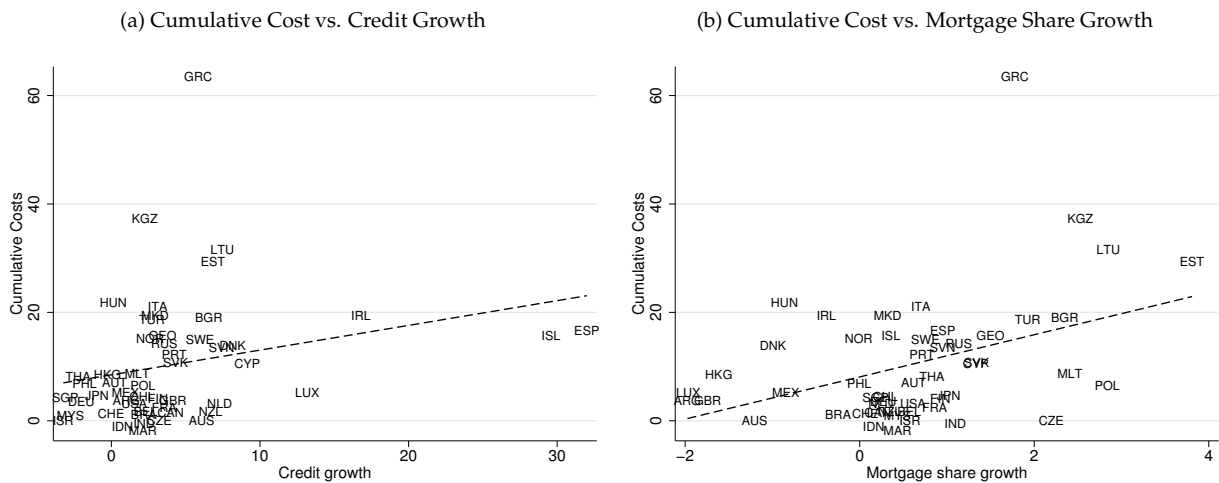
²Note that this underestimated the total amount of household loans, part of which are held on the balance sheets of non-banks such as special-purpose vehicles. Data on these loan assets outside licensed banks are not cross-country available in a consistent manner. Alternatively, household mortgage loans could be observed on the liability side of household balance sheets. We investigated this possibility but found that also these data are not available for enough countries and years.

³We experimented with alternative specifications of these recession measures. We used the growth rate in 2009, the average growth rate of 2008-2009, the deviation of the average growth of 2008-2009 from the forecast in April 2008, and the number of quarters with negative growth until 2012Q4 (so as to account for the fact that some countries experienced "double dips"). These exercises give qualitatively similar results to the analysis presented below

4. Empirical Analysis

The central point of this paper is that the recessionary impact of the 2007 crisis may be due to the composition of credit growth, rather than only to credit growth itself. Figure (1a) shows the growth in total credit scaled by GDP over 2003-2007 in the run-up to the crisis, plotted against the cumulative cost of recessions. The graph shows that the credit-to-GDP ratio increased by 20% on average, with very large increases in some countries. The correlation with cumulative costs is clearly positive, confirming a stylized fact from the literature. Figure (1b) plots the 2003-2007 change in the share of household mortgages in total credit against cumulative costs. In 11 of the 51 countries in our sample, total credit increased faster than household mortgage credit. But in the other countries, the mortgage share in credit increased, often very significantly. The correlation with recession costs is positive, especially in the majority of countries where household mortgage credit shares increased.

Figure 1: Credit composition and cumulative costs of recessions: scatter plots



Note: The cumulative costs are defined as the product of the depth and the duration divided by 2, following Agnello and Nerlich (2012).

In Table 1 we investigate this more rigorously. For the cross-section of 51 economies, we report OLS estimation results of the change in the mortgage credit share regressed on the cumulative costs (depth times duration) of post-crisis recessions. In column (1) we begin with including the credit variable most commonly used in the literature: growth in the credit-to-GDP ratio. In line with the literature, countries with more private credit suffered more recession costs. In columns (2) to (7) we add the change in the share of household mortgages in total credit over 2003-2007. The coefficient is always positive and significant. We observe that explained variation quadruples when adding growth in the mortgage share.

We add control variables in columns (4), (5) and (6). The first pair is income growth and income level in

the years before the crisis. This reflects that the recession was a high-income country phenomenon, and that high mortgage credit levels are more common in high-income countries. Accounting for these correlates, the coefficient on the change in mortgage credit share does not change. A next control is the current account. The total credit growth coefficient is mostly significant, but not when including the current account. This also reduces the size of the coefficient on mortgage share growth, by about one third. This finding 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); but also that the effect of mortgage share growth is not absorbed into this channel.

We further add financial and monetary indicators: credit market regulation, the exchange rate regime, and trade and financial openness. Like income level and growth, these do not change the sign, size or significance of credit or mortgage share growth. It appears that pre-crisis credit composition is correlated to post-crisis recession costs, independently from the effect of total credit growth. This is the key result in this paper, and a finding which is new in the literature, to our knowledge. We emphasize that, although we introduced a time lag between pre-crisis credit composition and post-crisis recession costs, a causal interpretation of this finding is open to debate. However, below we will see this result confirmed using the growth loss measure, which goes furthest in accounting for endogeneity concerns.

We continue in Table 2 and Table 3 with analysis of recession depth and recession duration. The results for depth are much the same as those for cumulative costs, except that the credit growth coefficient is never significant. 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 growth in the 5 years preceding the crisis. The finding suggests that the correlation of total credit growth with cumulative cost is driven by recession duration rather than recession depth.

We also note that the column (2) result, with only total credit growth and mortgage credit share change as independents, suggests that a one per cent annual increase in the household mortgage credit share before the crisis is associated with a 3.85 per cent larger depth. Noting that 'depth' averages 11% in this sample, the effect of the average increase in the household mortgage credit share (.63 percentage point) is sizeable: it would add 2.4 percentage points of GDP loss to the annual output contraction over 2007-2012.

The fourth recession indicator we study is the 'growth loss' due to the recession. As in Berkmen et al. (2012), this is defined as the difference between the IMF forecast for output growth for 2009 issued in 2008, and actual output growth in 2009. Here we make it harder for rising mortgage credit shares to correlate to recessions, since any country-specific drivers of growth and recession which are also correlated to mortgage shares are presumably included in the forecast. Any remaining difference between forecast and realization is more likely due to the crisis.

Table 1: Credit composition and cumulative costs of recessions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Credit growth	0.456*** (0.145)	0.443*** (0.144)	0.483*** (0.167)	0.193 (0.225)	0.325* (0.165)	0.558*** (0.204)	0.431** (0.167)
Mortgage share growth		3.846*** (1.269)	3.743** (1.439)	2.566** (1.248)	3.406** (1.545)	3.798** (1.507)	3.860** (1.652)
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	8.477*** (1.605)	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	0.067	0.233	0.237	0.292	0.266	0.253	0.279

The dependent variable is the cumulative costs of post-2007 recession, defined as recession depth multiplied by recession duration, divided by 2. Definitions and descriptive statistics of all variables are in Appendix B. Robust standard errors are in parentheses,*** p<0.01, ** p<0.05, * p<0.1.

Table 2: Credit composition and recession depth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Credit growth	0.198 (0.156)	0.184 (0.169)	0.239 (0.205)	0.047 (0.264)	0.086 (0.195)	0.317 (0.246)	0.194 (0.205)
Mortgage share growth		3.850*** (1.167)	3.382*** (0.993)	2.603** (1.208)	3.055*** (0.995)	3.625*** (1.127)	3.060*** (1.082)
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	10.032*** (1.634)	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	0.017	0.243	0.270	0.303	0.308	0.325	0.284
R-squared	0.015	0.249	0.442	0.462	0.480	0.483	0.326

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<0.01, ** p<0.05, * p<0.1.

Table 3: Credit composition and recession duration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Credit growth	0.286*** (0.094)	0.284*** (0.091)	0.320*** (0.079)	0.298*** (0.097)	0.296*** (0.096)	0.348*** (0.074)	0.292*** (0.069)
Mortgage share growth		0.526 (0.349)	0.625 (0.431)	0.534 (0.458)	0.574 (0.458)	0.602 (0.496)	0.738* (0.399)
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	5.791*** (0.705)	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	0.155	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. Robust standard errors in parentheses,*** p<0.01, ** p<0.05, * p<0.1.

We find that also growth loss is in all but one specifications significantly correlated to the pre-crisis change in the mortgage credit share, again with no role for total credit growth (table 4). The exception is again the specification including the pre-crisis current account. This suggests that the harmful effect of mortgage credit credit runs through excessive import dependence pre-crisis. Since the growth loss measure goes furthest in addressing the endogeneity problem in the context of a cross section framework, we consider these findings to yield the strongest (though still far from complete) evidence on causation from rising pre-crisis mortgage credit shares to deeper post-crisis recessions.

Table 4: Credit composition and growth loss

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Credit growth	-0.103 (0.068)	-0.099 (0.071)	-0.034 (0.066)	0.041 (0.072)	0.017 (0.069)	-0.071 (0.080)	0.002 (0.056)
Mortgage share growth		1.162* (0.586)	1.137** (0.470)	0.829 (0.505)	1.026** (0.447)	1.073** (0.462)	0.902* (0.451)
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	-6.075*** (0.559)	-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	0.030	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<0.01, ** p<0.05, * p<0.1.

4.1. Should mortgage credit shares be part of the model?

Given the large number of candidate explanatory variables, in this section we explore model selection issues. We consider all the potential regressors simultaneously. OLS techniques cannot handle this task due to the limited number of observations relative to the number of parameters to be estimated. We apply

Bayesian Model Averaging (BMA) to address this issue (cf. Giannone et al. (2011) and Feldkircher (2014)). The rationale for BMA is to consider the results for models including all possible combinations of the regressors – that is, 2^K models where K is the number of regressors – and then to average the results. In our case, $K = 10$ and the number of models we estimate is 1,024.

We report BMA outcomes in terms of posterior inclusion probabilities (PIP) in Table 5. A PIP is defined as the sum of the posterior model probabilities in each model in which the regressor appears. High PIP values indicate that the regressor has a strong explanatory power, irrespective of which other explanatory variables are included. On the basis of the PIP values, mortgage share growth is among the most robust determinants of all recession indicators. For each of the dependents, its PIP value is in the top three. The other robust regressor is the current account and (to a lesser extent) trade openness and income levels and growth. For these variables, the BMA results throw a different light on the determinations of post-crisis recessions than do the OLS estimations. But for mortgage credit share growth, both OLS and BMA outcomes send the same message. The change in mortgage credit shares should be part of any model of recession depth, duration, growth loss and cumulative costs.

Table 5: BMA Results: posterior inclusion probabilities (PIP)

	Duration	Depth	CumulativeCost	Growth loss
Credit/GDP change	0.13	0.12	0.12	0.12
mortgage debt share change	0.33	0.71	0.38	0.46
GDP per capita	0.99	0.21	0.1	0.5
mean GDP growth 0507	0.09	0.12	0.1	0.95
Current account balance	0.82	0.75	0.88	0.39
leverage, 2007	0.13	0.29	0.26	0.31
trade openness	0.11	0.71	0.28	0.17
financial openness	0.11	0.16	0.1	0.14
credit market deregulation	0.1	0.11	0.11	0.35
Exchange rate regime	0.23	0.1	0.27	0.32

5. Exploring Conditions and Robustness

5.1. Sub-sample Analysis

We now explore a number of robustness issues. For reasons of space, in the tables that follow we report parsimonious models with only credit and income variables. We checked that the results of the full models, including all control variables in previous tables, are qualitatively identical. In Table 6 we focus on those countries where the household mortgage credit share increased over 2003-2007, which it did in 39 of the 51 countries. This explores potential asymmetric effects of mortgage share increases compared to decreases. Other studies (Mian and Sufi, 2009, 2014) argue that especially *increasing* household leverage pre-crisis

leads to spending cuts when house prices fall post-crisis. There is no a priori reason why the post-crisis growth benefits of *decreasing* household leverage pre-crisis would match the growth costs of increasing household leverage. Hence, in a mixed sample with both increasing and decreasing mortgage credit shares in total credit, the growth costs of rising mortgage shares might be understated.

We find indeed that focusing on the 39 countries with rising pre-crisis mortgage shares, the coefficients for cumulative costs, depth and growth loss are all roughly twice as large as in the mixed sample of 51 countries. The coefficient on duration is still insignificant. These results suggest, in line with the literature, that it is specifically a *rise* in household credit which is harmful post-crisis. This reinforces the key message of this paper.

Table 6: The effects of increasing mortgage shares

	(1)	(2)	(3)	(4)
	CumulativeCost	Duration	Depth	Growth loss
Credit growth	0.469*** (0.137)	0.340*** (0.085)	0.220 (0.193)	0.015 (0.054)
Mortgage share growth	7.604*** (2.535)	0.828 (0.724)	7.530*** (2.082)	2.173*** (0.795)
GDP per capita	-1.108 (1.542)	-0.810 (0.701)	-1.391 (2.404)	1.379*** (0.494)
Pre-crisis growth	-0.788 (0.804)	-0.822* (0.428)	-0.166 (1.030)	0.940*** (0.282)
Constant	15.134 (16.732)	16.632* (8.222)	16.243 (26.499)	-13.531** (5.202)
Observations	39	39	39	39
R-squared	0.352	0.267	0.459	0.504

Robust standard errors are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.2. Alternative Dependent Variables

We explore alternative dependent variables in Table 7. In columns (1) and (2) we use the actual growth rate of 2008 and average growth over 2008-2009, respectively. In Column (3) we use the forecast error, averaged over 2008 and 2009 rather than only for 2009. In Column (4) we apply the number of quarters it takes for the real GDP to return to the pre-crisis peak. In columns (5) and (6) we use the number of quarters with negative growth. Column (6) takes into account the possibility of a "double dip" by extending the number of quarters with negative growth to 2012. For all recession measures except duration, mortgage share growth enters with a significantly positive coefficient.

Table 7: Alternative Dependent Variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Growth09	Growth0809	Growth loss 0809	length	nrquarter	nrquarterall
Credit growth	-0.065 (0.057)	-0.046 (0.040)	0.072 (0.132)	0.294*** (0.083)	0.098*** (0.033)	0.227*** (0.053)
Mortgage share growth	-1.201** (0.500)	-0.713* (0.393)	2.238** (0.906)	1.271** (0.566)	0.771** (0.361)	0.812* (0.424)
GDP per capita	-2.080*** (0.497)	-1.697*** (0.315)	2.244** (0.967)	1.305** (0.531)	1.173*** (0.225)	1.003*** (0.352)
Pre-crisis growth	-0.412 (0.259)	-0.141 (0.181)	1.798*** (0.525)	-0.399 (0.287)	-0.059 (0.123)	-0.599*** (0.189)
Constant	19.841*** (5.479)	17.092*** (3.673)	-18.769* (10.426)	0.385 (5.964)	-7.224*** (2.315)	-1.696 (4.011)
Observations	51	51	51	51	51	50
R-squared	0.395	0.480	0.371	0.365	0.372	0.455

Robust standard errors are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.3. Exploring conditions for mortgage shares to deepen recessions

All in all, the effect of increasing mortgage credit shares on post-crisis recession depth and its growth loss (but not duration) appear fairly robust. We now turn to the conditions under which this occurred. As discussed, one suggestion from the literature is that it was especially in economies where banking systems relied on wholesale funding, with high loan/deposit ratios, that the financial crisis led to deep and long recessions (Berkmen et al., 2012). Another is that the crisis was an advanced-country phenomenon, especially its duration.

In Table 8 we run regressions on the depth, costs and duration of recessions in countries with high and low loan/deposit ratios.⁴ We construct a dummy variable which takes the value of 1 if a county has a highly leveraged banking system and 0 otherwise. We find that pre-crisis mortgage share growth is associated with deeper post-crisis recessions and more growth loss for high-leverage countries relative to low-leverage countries. The difference amounts to 2.4 percentage point in GDP growth loss.

In Table 9 we observe that the effects of mortgage share growth on recession duration and growth loss were larger in advanced compared to emerging countries. The result on duration is different from earlier findings, and shows that mortgage share growth did lengthen recessions, but not in emerging economies. This is consistent with Berkmen et al. (2012) who shows that emerging economies GDP bounced back faster after 2008.

⁴A continuous loan/deposit ratio turned out to be multicollinear with mortgage credit shares.

Table 8: Conditions: Financial System leverage

	(1)	(2)	(3)	(4)
	Cumulative cost	Duration	Depth	Growth loss
Credit growth	0.421** (0.197)	0.333*** (0.087)	0.136 (0.222)	-0.004 (0.070)
Mortgage share growth	2.429 (2.027)	0.502 (0.603)	1.509 (1.097)	0.203 (0.389)
Leverage (1=high, 0=low)	0.438 (3.995)	-0.937 (1.372)	1.435 (3.037)	0.040 (1.211)
Mortgage share growth * Leverage	2.970 (2.331)	0.451 (0.886)	4.089* (2.387)	2.158** (0.847)
GDP per capita	-0.692 (1.480)	-0.569 (0.526)	-0.995 (1.925)	1.168** (0.489)
Pre-crisis growth	-0.481 (0.635)	-0.753** (0.348)	0.134 (0.832)	0.732*** (0.252)
Constant	14.804 (15.242)	14.718** (5.964)	16.001 (21.578)	-9.192* (5.192)
Observations	51	51	51	51
R-squared	0.267	0.260	0.363	0.498

Robust standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Conditions: advanced countries

	(1)	(2)	(3)	(4)
	Cumulative cost	Duration	Depth	Growth loss
Credit growth	0.481** (0.193)	0.319*** (0.070)	0.239 (0.197)	0.034 (0.064)
Mortgage share growth	3.673*** (1.133)	0.145 (0.420)	4.504*** (1.257)	1.620*** (0.529)
Advanced (1=advanced, 0=other)	-5.328 (4.981)	-1.105 (1.772)	-6.170 (6.040)	-1.950 (2.246)
Mortgage share growth * Advanced	3.169 (5.530)	2.751* (1.470)	-1.744 (2.884)	1.130* (0.627)
GDP per capita	1.102 (2.845)	-0.300 (0.736)	1.236 (3.752)	1.845** (0.881)
Pre-crisis growth	0.117 (0.854)	-0.403 (0.300)	0.304 (1.074)	0.802*** (0.250)
Constant	-1.793 (27.755)	10.679 (7.268)	-1.510 (37.136)	-14.624* (7.320)
Observations	51	51	51	51
R-squared	0.263	0.334	0.298	0.404

Robust standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

6. Summary, Discussion and Conclusion

Countries with more private debt before the 2007 crisis experienced deeper and more prolonged recessions (Lane and Milesi-Ferretti, 2011; Rose and Spiegel, 2011; Claessens et al., 2010; Feldkircher, 2014). 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 level, but the composition of debt that matters. We investigated the role of rising shares of household mortgage credit in total credit pre-crisis in the depth, duration, cumulative costs and growth loss of the recessions that followed the Great Financial Crisis of 2007. A survey of the literature suggests a large numbers of determinants of these recession attributes, but this paper is the first to consider changes in the composition of credit, rather than total credit growth. We present new data on four types of bank credit over 2000-2012 for 51 economies. We find that the pre-crisis correlation of the composition of private debt with the depth, cumulative costs and growth loss of post-crisis recessions are all robustly positive. Since the growth loss measure goes furthest in accounting for endogeneity concerns, the results can be causally interpreted with some confidence.

The results add to our understanding of drivers of recession severity. The correlation of pre-crisis change in credit composition to depth and growth loss of recessions clearly trumps the coefficient of pre-crisis total credit growth. We find that this effect is robust to a range of control variables. Also, Bayesian model averaging analysis suggests that household mortgage credit shares should be part of any model explaining the characteristics of post-2007 recessions. This prompts a rethink of the role of private leverage in deepening recessions. Apparently, it is specifically *mortgage-related* growth in leverage which worsens recessions. In contrast, recession duration appears driven by total credit growth.

A clear limitation of the analysis is the cross-section nature of the data, and the relatively short time span. Many countries experienced mortgage credit booms in the late 1990s and early 2000s. Mortgage credit booms may yield growth gains, before they cost growth after a crisis. A more balanced assessment of their costs and benefits over time would be desirable, but this requires longer-term panel data. Since data limitations prevent us from exploring their impact on subsequent performance over time, expanding the data back in time appears a fruitful extension. Unfortunately, such data are not yet publicly made available by central banks in a manner that is cross-country consistent.

Another direction in which the research can be extended is towards micro data. With matched bank-household and bank-firm data, the response of consumption and investment to high mortgage debts can be observed on the individual level, as in Mian and Sufi (2009, 2014) for the US. This will yield additional insights into the variation in the strength of this connection, and conditions such as household wealth and incomes, and bank funding that govern the response of income to mortgage debt. There are some studies which utilize matched micro data to analyze shocks to housing markets (Gan, 2007; Jiminez et al., 2014). A similar approach could be taken to the study of mortgage credit shares in bank lending portfolios.

A clear policy implication from this research is that the growth of mortgage credit should be watched with suspicion. While this is a statement after the fact when it concerns the 2007 crisis, financial history shows that mortgage-connected crises occur regularly. Over-borrowing in real estate markets is among the most common causes of domestic financial crisis. A clearer understanding of the costs of such lending booms may help to devise policies to restrict mortgage lending to constructive levels, and to prevent high levels of mortgage lending from causing deeper recessions than would otherwise occur.

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Appendix A: A Literature Review Summary Table

Table A.1: Literature Review

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	Sign	Cunt	Cecchetti2011	Feldkircher2014	Berkmen2012	Claessens2010	Lane 2011	Rose2011	Frankel2012	Giannone2011	Olafsson2010	Berglöf2010	Didier2012
Dependent Variables													
Forecast error		3			+			+	+		+	+	
Actual growth (08-09)		4					+	+				+	
Actual growth		5				+		+				+	+
minus pre-crisis growth													
Duration(negat. growth)						+					+		
Independent Variables		2									*		
Trade Channel											*		
Trade openness	-	3			**	**						**	**
Share of commodity export	+	2			**							**	
Financial Channel											*	*	*
Financial openness	-	3									*	*	*
FDI intlow/GDP											*	*	*
Vulnerability		1									*	*	*
Leverage		5	**		**					**	**	**	**
Change in Credit/GDP	-	8		**	**	**	**	**	*	**	**	**	**
Lending from advanced countries	-	2		**	*				**	**	**	**	**
Financing via inter. Cap. Markets	-	1					**	*	**	**	**	**	*
Current account/GDP	-	7	**			*	**	**	**	**	*	**	*
External debt	-	3						**	**	**	*	**	*
Public debt	-	1						**	**	**	*	**	*
Short-term debt	-	2			**			**	**	**	*	**	*
Fiscal position	-	1			**			**	**	**	*	**	*
House price appreciation	+	1			**	**		**	**	**	*	**	*
Foreign bank ownership	+	1						**	**	**	*	**	*
Country Characteristics		1						*	**	**	**	**	**
Inflation		1						**	**	**	**	**	**
Log of GDP per capita	-	7				*	**	*	**	**	**	**	**
country-group dummies								*	**	**	**	**	**
Pegged exchange rate regime	-	2			**			**	**	**	**	**	**
Credit market regulation	-	3			*			**	**	**	**	**	**
Labour market regulation	+	1						**	**	**	**	**	**
Real effective exchange rate appreciation								**	**	**	**	**	**
Political instability/corruption		2						**	**	**	**	**	*
Reserve	+	4		**				**	**	**	**	**	*
Pre-crisis growth	-	4		**				**	**	**	**	**	*
National saving	+	1						**	**	**	**	**	*
Real interest rate	+	1						**	**	**	**	**	*
Output volatility	+	1						**	**	**	**	**	*
Past crisis	-	1						**	**	**	**	**	*
Output correlation		1						**	**	**	**	**	*
Foreign holdings of US equity		1	**					**	**	**	**	**	*

Note: **significant across specifications; *significant in some specifications; Cecchetti2011 refers to Cecchetti et al. (2011); Feldkircher2014 refers to Feldkircher (2014); Berkmen2012 refers to Berkmen et al. (2012); Claessens2010 refers to Claessens et al. (2010); Lane2011 refers to Lane and Milesi-Ferretti (2011); Rose2011 refers to Rose and Spiegel (2011); Frankel2012 refers to Frankel and Saravelos (2012); Giannone2011 refers to Giannone et al. (2011); Olafsson2010 refers to Olafsson and Petursson (2010); Berglöf2010 refers to Berglöf et al. (2010); Didier2012 refers to Didier et al. (2012).

Appendix B: Variable Definitions and Descriptive Statistics

Dependent variables

Cumulative Cost: Following Agnello and Nerlich (2012), our most inclusive variable is a composite measure, depth multiplied by duration and divided by 2.

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.

Growth2009: Real GDP per capita growth in 2009. Source: IMF IFS.

Growth0809: Average real GDP per capita growth in 2008 and 2009. Source: IMF IFS.

Growth loss 0809: Forecast GDP growth minus actual growth in 2008 and 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.

Length: The number of quarters the economy's real GDP was below its pre-crisis peak. Source: Own calculation based on IMF IFS.

Nrquarter: The number of quarters that a country posted a negative growth rate.

Nrquarterall: The number of quarters that a country posted a negative growth rate till 2012Q4 (so as to account for the fact that some countries experienced "double dips").

Independent variables

Credit growth: The annual average change in total credit to GDP ratio over 2003-2007. Source: own calculation based on Bezemer et al. (2014).

Mortgage share growth: The annual average change in the share of mortgages in total credit. Source: own calculation based on Bezemer et al. (2014).

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 deposits. Source: WDI.

Trade openness: Imports plus exports, divided by GDP.

Financial openness: External assets and liabilities, divided by GDP.

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).

Table A.2: Descriptive Statistics

Variable	Mean	Min	Max	Sd	Obs
<i>Cumulative cost</i>	10.44	11.704	-1.864	63.515	51
<i>Depth</i>	10.883	10.033	-7.293	49.64	51
<i>Duration</i>	7.02	4.823	0	21	51
<i>Growth loss</i>	-6.519	3.958	-20.347	0.48	51
<i>Growth2009</i>	-3.113	4.121	-14.847	8.48	51
<i>Growth0809</i>	-0.497	2.95	-9.125	6.186	51
<i>Growth loss 0809</i>	-13.164	7.911	-41.694	1.06	51
<i>Length</i>	12.98	5.457	2	21	51
<i>Nrquarter</i>	4.627	2.993	0	18	51
<i>Nrquarterall</i>	6.431	4.173	0	18	51
<i>Credit growth</i>	4.3	6.648	-3.239	31.997	51
<i>Mortgage share growth</i>	0.601	1.238	-1.974	3.809	51
<i>GDP per capita</i>	9.59	1.239	6.259	11.382	51
<i>Pre-crisis growth</i>	4.875	2.26	1.529	10.861	51
<i>Current account</i>	-1.243	9.498	-27.157	25.751	51
<i>Leverage</i>	120.928	56.206	46.052	306.89	51
<i>Trade openness</i>	109.916	79.127	25.209	398.658	51
<i>Financial openness</i>	5.841	1.079	4.435	10.087	51
<i>Credit market deregulation</i>	9.063	1.301	2	10	51
<i>Exchange rate regime</i>	2.078	1.036	1	4	51