Securitization of Mortgage Debt, Asset Prices and International Risk Sharing[1]

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Abstract

We explore the impact of mortgage securitization on the international diversification of macroeconomic risk. By making mortgage-related risks internationally tradeable, securitization contributes considerably to better international consumption risk sharing: we find that countries with the most highly developed markets for securitized mortgage debt have consumption responses to a typical idiosyncratic business cycle shock that are 20-30 percent less volatile than those experienced by countries that do not allow for mortgage securitization. Our results are based on quarterly data from a panel of 16 industrialized countries and cover the sample period 1971-2008Q1. They are robust to a range of controls for other aspects of financial globalization, international differences in the structure of housing markets and the financial system etc. Against the backdrop of the subprime crisis, these findings inevitably raise the question whether securitization could not just facilitate risk sharing in tranquil times but that it actually fails to provide international insurance in severe crisis periods. Indeed, we find that international risk sharing decreases in global asset price downturns and increases in booms. But we do not find evidence that countries with more developed securitization markets are systematically more exposed to these fluctuations in the extent to which risk can be shared across national boundaries.

KEYWORDS: FINANCIAL GLOBALIZATION, INTERNATIONAL RISK SHARING, HOME BIAS, SECURITIZATION, MORTGAGE MARKETS, ASSET PRICES, INTERNATIONAL BUSINESS CYCLES

JEL CLASSIFICATION: F 36, F37, F 41, G15, G21

1 Introduction

The securitization of mortage-related debt has played a major role in the emergence and proliferation of the current financial crisis (see Brunnermeier (2008) for a detailed account). Understandably, this has led to widespread scepticism with respect to the usefulness of such instruments for an efficient allocation of macroeconomic risk. From the current experience it seems obvious that the repackaging of mortgage debt in mortgage backed securities (MBS) can have enormous aggregate costs, but to date no empirical account of the macroeconomic benefits of these instruments exists.

In this paper we contribute to filling this gap by exploring the impact that the increasing use of mortgage securitization has had on the international diversification of macroeconomic risk. From a theoretical point of view, one may expect that the impact of mortgage securitization could be large. Mortgage markets are internationally far less integrated than say equity or bond markets. Residential real estate is largely domestically financed in most economies, making fluctuations in the value of housing and the quality of mortgage debt a major background risk from the perspective of an individual country. That the idiosyncratic component of such risks is likely to be significant is illustrated in figure (1), which plots the international correlation of stock markets agains that of residential housing prices: housing prices generally have much lower international correlations, implying the fluctuations in the value of residential real estate (or of the debt collateralized on it) are a significant idiosyncratic risk from the perspective of the individual economy. Securitization can help diversify such risks internationally because it makes mortgage-debt internationally tradeable.

Our evidence strongly supports this theoretical conjecture: we find that over the last 20 years, the increasing securitization of mortgage debt has

contributed considerably to better international consumption risk sharing. The effect is large: the countries with the most highly developed markets for mortgage backed securities have consumption volatilities in response to a typical idiosyncratic business cycle shock that are 20-30 percent lower than experienced by countries that do not allow for securitization. These results are robust to a range of controls for other aspects of financial globalization, international differences in the structure of housing markets and the financial system etc.

If securitization carries benefits in terms of better international risk sharing, this inevitably raises the question whether the costs inflicted by a major downturn such as the current one could not still outweigh the potential welfare benefits of better international risk sharing by an order of magnitude. Securitization may well facilitate risk sharing in tranquil times, but it might actually make things worse in a crisis. We attempt to provide a quantitative impression of this trade-off by asking to what extent international risk sharing is dependent on the state of global asset markets. Indeed, we find that international risk sharing increases in asset price booms and decreases in recessions. At least based on previous episodes, we do not find evidence that the ability to share risk across national boundaries is generally more dependent on global asset market conditions in countries with high levels of securitization than in countries where no secondary markets for mortgage-debt exist. Our (macroeconomic) data set covers the period from 1971 to the first quarter of 2008. Hence, it includes the onset of the current turmoil but does not yet cover the further unfolding of events, including the demise of Fannie Mae and Freddie Mac or the aftermath of the bankruptcy of Lehman Brothers. The judgement on the role of securitization for international transmission and risk sharing in the current crisis is necessarily bound

to remain out for now and we therefore do not attempt to say anything on it here. We note, however, that recent events are certainly in line with the view that securitization has contributed to turning this crisis into the first *globalized* real estate bust. The fact that the costs of the crisis are spread internationally – for better or worse – indicates that markets for securitized mortgage credit *do* seem to provide international risk sharing.

Our paper stands in the tradition of an empirical literature on international consumption risk sharing, building on Sørensen and Yosha (1998) and Crucini (1999). A number of papers in this branch of the literature have recently come to document a positive impact of financial globalization on international risk sharing (see Imbs (2006), Sørensen (2007), Artis and Hoffmann (2008 a,b). Our paper is also closely related to work on deregulation and risk sharing, specifically to Demyanik et al (2007) who have investigated the impact of banking deregulation on interstate risk sharing in the US.

Very few papers have recognized the possibility that the extent of risk sharing might vary over the economic cycle or with asset prices. We explore this possibility here. In this respect we build on Hoffmann and Shcherbakova (2008) and Lustig and van Nieuwerburgh (2005, 2006). Hoffmann and Shcherbakova (2008) show that interstate risk sharing in the U.S. increases in booms and decreases in recessions. This cyclical dependence has, however, been mitigated as a consequence of the liberalization of interstate banking markets during the 1980s. Here we adapt the empirical framework of this previous study to explore the role that asset prices play for risk sharing among countries. Another closely related paper is Lustig and van Nieuwerburgh (2006) who explore the role of time variation in collateral availability for interstate risk sharing.

The paper is now structured as follows. In the next section, we present

our empirical framework. Section three presents our data set. Section four presents the bulk of our empirical results. Section five summarizes and concludes.

2 International Risk Sharing and the securitization of mortgage debt

We measure consumption risk sharing through panel regressions of the form

$$\Delta \log \frac{C_t^k}{C_t^*} = \beta_U \left[\Delta \log \frac{GDP_t^k}{GDP_t^*} \right] + \varepsilon_t^k \tag{1}$$

where C_t^k is per capita consumption in country k in period t, GDP_t^k is the country's output per head and the asterisk denotes the international per capita average of the respective variable. In such a regression, we can think of the estimate of β_u as measuring the amount of uninsured idiosyncratic output risk.

Regressions such as (1) by now have some tradition in both the microeconometric as well as in the macro literature. Mace (1991), Cochrane (1991) and Townsend (1994) were the first to suggest regressions similar to (1) on household level data as a test of the null of complete markets. In a world with complete markets, growth in marginal utility should be equated across regions, so that in all states of nature:

$$\frac{u'(C_{t+1}^k(s))}{u'(C_t^k(s))} = \lambda(s) \tag{2}$$

where s indexes the state of nature and λ is the growth rate in the shadow price of consumption. A key implication of (2) is that if risk is efficiently allocated, marginal utility growth should be independent of country-specific

variables. To the extent that we can associate changes in marginal utility with consumption growth, consumption growth should therefore be independent of a country's business cycle risks - regressions of the form (1) should yield a coefficient of zero. More recently, Asdrubali, Sørensen and Yosha (1996) and Sørensen and Yosha (1998) have argued that the estimate of β_U may be more generally informative: even if the null of complete financial markets is rejected, β_U still is a measure of market incompleteness. In panel regressions, β_U is regularly between 0 and unity, so that $1-\beta_U$ can straightforwardly be interpreted as the share of the average country's idiosyncratic business cycle risk that gets laid off in financial markets, whereas β_U is the portion of non-diversified idiosyncratic risk faced by the average country.

Early estimates of β_U based on international data typically were in the range between 0.7 and 0.8. Estimates based on more recent data are typically considerably lower,reflecting the effect of financial globalization on international risk sharing (see Sørensen et al (2007), Artis and Hoffmann (2008)).

In this paper, we wish to explore to what extent β_U varies across countries depending on whether and to which degree securitization of mortgage related debt is used. Our basic tool will be panel regressions in which we parametrize the coefficient β_U as a linear function of securitization and of other country- and time-varying controls.so that

$$\beta_U^k(t) = \beta_0 + \mathbf{z}_t^{k\prime}\boldsymbol{\beta}_z \tag{3}$$

where $\mathbf{z}_t^k$ is a vector containing time-varying and country-specific characteristics. We partition $\mathbf{z}_t^k$ into aggregate ($\mathbf{x}_t'$) and (time-invariant) country-specific characteristics, v^k. In addition, we also allow for some characteristics to vary by country and time, $\mathbf{y}_t'^k$, so that $\mathbf{z}_t^{k\prime} = \left[\mathbf{x}_t', \mathbf{v}'^k, \mathbf{y}_t'^k\right]$.

We then specificy a panel risk sharing regression of the form

$$\Delta\widetilde{c}_t^k = \beta_u^k(t)\Delta\widetilde{gdp}_t^k + \alpha + \delta^k + \tau_t + \varepsilon_t^k$$

where δ^k is a country-fixed effect and τ_t a common time effect. Here, and in the remainder of the paper, we use lower-case letters to denote logarithms, so that $\widetilde{\Delta c}_t^k = \Delta \log\left[C_t^k/C_t^*\right]$. Plugging (3) into this regression specification and controlling for first-order partial effects we obtain an estimable relation which is

$$\Delta\widetilde{c}_t^k = \beta_0\Delta\widetilde{gdp}_t^k + \mathbf{z}_t^{k\prime}\boldsymbol{\beta}_z\Delta\widetilde{gdp}_t^k + \mathbf{y}_t^{k\prime}\boldsymbol{\gamma} + \alpha + \delta^k + \tau_t + \varepsilon_t^k \tag{4}$$

Note that in this specification we will not generally need to include all the uninteracted terms $\mathbf{z}_t^k$. The reason for this is that the time-variation in aggregate variables will be captured through the panel time-specific effects. Equally, as long as the country-specific characteristics are assumed to be time-invariant, these will be fully captured by the country fixed-effects. Hence, the specification above will only include the first-order terms only for $\mathbf{y}_t^k$, characteristics (such as our indicator of securitization) that vary across countries and time.

In our baseline specifiation, the vector $\mathbf{z}_t^k$ will include a qualitative measure that indicates to what extent mortgage securitization can actually be used in country k in year t. We abbreviate this measure with SEC_t^k so that the baseline regression we estimate is

$$\Delta\widetilde{c}_t^k = \beta_0\Delta\widetilde{gdp}_t^k + \beta_1 SEC_t^k \times \Delta\widetilde{gdp}_t^k + \gamma_1 SEC_t^k + \alpha + \delta^k + \tau_t + \varepsilon_t^k \tag{5}$$

We enrich this specification as we go along with a range of controls

for financial globalization, other characteristics of the financial system and the housing market etc. In addition, we conduct a number of simulation and sample split exercises. Our result is quite clear cut: β_1 is significantly negative – the securitization of mortgage debt seems to be associated with better international risk sharing. Before presenting these results, we describe our data set.

3 Data

Our sample comprises the following countries with the sample period in parentheses: Australia (1971Q1-2008Q1), Belgium (1980Q1 – 2008Q1), Canada (1971Q1 – 2008Q1), Denmark (1977Q1 – 2008Q1), Finland ((1971Q1-2008Q1), France (1971Q1-2008Q1), Germany (1971Q1-2008Q1), Italy (1971Q1-2008Q1), Japan (1971Q1-2008Q1), Netherlands (1977Q1 – 2008Q1), Norway (1971Q1-2008Q1), Spain (1971Q1-2008Q1), Sweden (1980Q1 – 2008Q1), Switzerland (1971Q1-2008Q1), United Kingdom (1971Q1-2008Q1), United States (1971Q1-2008Q1).

We obtain quarterly, real consumption p.c. and real GDP p.c. from the IMF's Financial Statistics. Consumption and GDP are deflated with the respective countries' CPI and population figures. International consumption and GDP are calculated by normalizing price indices of all countries to 100 in 1998Q4 and translating GDP of each country in 1998Q4 dollar values as in Sørensen, et al. (2007).

Since long time series of data on the actual degree of securitization are not available, we use a qualitative indicator of securitization that we abbreviate with SEC_t^k. We codify SEC_t^k based on the information on the use of mortgage backed securities from Tsatsaronis and Zhu (2004) and date the start of mortgage securitisation based on information from the OECD

(Girouard and Blöndal, 2001), the ECB (ECB, 2003) and national sources. Before the introduction of securitization, we assign a value of zero to SEC_t^k. From the date when securitization was introduced onwards, SEC_t^k is assigned a positive value between zero and unity, depending on the degree to which securitization is allowed. Specifically, SEC_t^k is unity for all countries that have a liquid secondary market of mortgage backed securities (MBS). These countries are Australia (1995), Canada (1987), the Netherlands (1996), Spain (1992), the United Kingdom (1987) and the US (1971). The year in which securitization was allowed de jure is given in parentheses. As Tsatsaronis and Zhu (2004) note, there are countries that do not have a liquid secondary market for MBS but nonetheless allow a limited degree of securitization e.g. in the form of "Pfandbriefe" (a special form of covered bonds) as in Germany, Switzerland or Sweden. For these countries we assign a value of 0.33 to SEC_t^k: Finland (1989), France (1991), Germany (1971), Sweden (1971), Switzerland (1971). Again the de iure starting date in our sample of these means of mortgage securitization is given in parentheses.[1] Since Germany and Switzerland use Pfandbriefe as a means of mortgage securitization since the late 19th century, we set SEC_t^k to 0.33 right from the beginnig of the sample (1971).

In the course of our analysis, we will check whether our securitization indicator could not just pick up other characteristics of national mortgage markets and of the financial system more generally. Specifically, we look at how mortgage interest rates are set (fixed vs. flexible), the possibility for mortgage equity withdrawal, the maximum loan-to-value ratio and the valuation method used (historical property valuation vs. market value method).

[1] We experimented with various values from 0.1. to 0.5 to qualitatively account for this mezzanine form of mortgage securitization. None of our results depends on the particular choice of value.

For all these mortgage market characteristics we construct dummies, assigning the values provided in table 2 of Tsatsaronis & Zhu (2004) to the countries in our sample.

An additional robustness check we will perform is to assess the importance of the increase in cross-holdings of foreign assets for our results. We employ the Lane and Milesi-Ferreti (2003, 2007) dataset for this exercise and calculate their measures of financial integration based on gross foreign asset and liability positions: $gfa_t^k = \frac{(FA_t^k + FL_t^k)}{GDP_t^k}$ with FA_t^k gross foreign assets of country i at time t and FL_t^k gross foreign liabilities of country i at time t. as well as a purely equity-based measure: $geq_t^k = \frac{(PEQA_t^k + PEQL_t^k + FDIA_t^k + FDIL_t^k}{GDP_t^k}$ with $PEQA_t^k (PEQL_t^k)$ the stock of portfolio equity assets and $FDIA_t^k (FDIL_t^k)$ the stock of direct investment assets (liabilities). Annual data from 1970 to 2004 is obtained from Philip Lane's website. We calculate quarterly estimates by linear interpolation of year to year growth rates. As an alternative to the linear interpolation we also calculate quarterly values using our measure of global asset market conditions as a scaling factor for the interpolated trend in gfa and geq.

As measure of swings of global asset prices, we consider short-run variations of the U.S. consumption-wealth ratio that we approximate using Lettau's and Ludvigson's (2001) *cay*, the residual of a cointegrating relationship between consumption, asset wealth and labor income for the US. Lettau and Ludvigson show that *cay* is an excellent indicator of asset price cycles in US data. Nitschka (2007) extends this result by showing that *cay* explains a large share of the variation in asset prices in a cross-section of industrialised economies. We therefore use *cay* as an indicator of global asset market conditions. The data is freely available on Martin Lettau's website: http://faculty.haas.berkeley.edu/lettau/data/cay_q_07Q4.txt

4 Results

Table 1 displays the results from our baseline risk sharing regression:

$$\Delta\widehat{c}_t^k = \beta_0 \Delta\widetilde{gdp}_t^k + \beta_1 SEC_t^k \times \Delta\widetilde{gdp}_t^k + \gamma_1 SEC_t^k + \alpha + \delta^k + \tau_t + \varepsilon_t^k \quad (6)$$

As mortgage backed securities emerged in the middle of the 1980s, we first report the results for the sample period from the first quarter of 1985 to the first quarter of 2008 in panel A of table 1. Robust t-statistics appear below the estimates in parenthesis.

Taken alone, the estimate of β_0 in panel A would suggest that about 79% of international consumption risk remains uninsured in the time period from 1985Q1 to 2008Q1. However, the impact of securitization on risk sharing as mirrored in the β_1 coefficient is not negligible. Securitization improves risk sharing. The coefficient β_1 is negative, significant and the effect is large: for the sample period from 1985 to 2008 the estimate of β_1 implies that the countries with the most liquid markets for securitized mortgage debt achieved 35 percentage points more consumption risk sharing than countries in which securitization of mortgage debt is not allowed.

Panel B of table 1 shows the corresponding estimates for the time period from 1995Q1 - 2008Q1. In that time period almost all of the countries under study introduced some form of mortgage payments securitization. Our main conclusion does not only remain unaltered but is even more pronounced. Securitization seems to have an even stronger repercussion on international consumption risk sharing.

A sceptic might argue that we put a lot and maybe too much emphasis on the equity price surge in the late 1990s as well as the house price upswing in recent years. Panel C reports our basline regression estimates for the

time period from 1985Q1 to 1996Q4 thus ignoring the global asset price movements in the past decade. The estimate of β_0 remains almost unaltered. Not surprisingly, the effect of securitization on international risk sharing is weaker as $\beta_1 = -0.23$. But still this estimate is significant.

The story that table 1 tells is suggestive of a beneficial impact of the securitization of mortgage related risks on international risk sharing. The subsample analysis shows that this effect is most pronounced in recent years consistent with the view that securitization really took off in the 1990s. Figure 2 displays the amount of home mortgages outstanding used to back securities in the U.S. This data is from the Federal Reserve's *Flow of Funds* Accounts and covers the period from 1985Q1 to 2008Q1. It underscores that securitization gained importance during the 1990s with a clear upward trend and explosive growth starting around 2004.[2] However, even if we negelect the past decade, securitization of mortgage related risks still has a significant beneficial impact on international risk sharing.

Our findings inevitably raise the question if securitization could not be associated with other time-invariant country-characteristics, such as e.g. a more market based financial system, which would itself lead to more international risk sharing. We address this concern by sorting the 16 countries under study into four bins according to their level of securitization as indicated by SEC_t^k. We repeat this sorting procedure every quarter for the time period from 1985Q1 to 2008Q1 such that we obtain four synthetic panels groups for low, middle-low, middle-high and high securitization country samples. Then we run the risk sharing regression

[2] While we do not have comparable data for most other countries, for those we do (such as e.g. Australia), similar trends are discernible.

$$\Delta\widetilde{c}_t^k = \beta_U \Delta\widetilde{gdp}_t^k + \alpha + \delta^k + \tau_t + \varepsilon_t^k \tag{7}$$

for the first quartile of countries (low securitization) and the fourth quartile (high securitization). Table 2 summarizes our results. About 68% of consumption growth risks of the low securitization group remain uninsured while the high securitization group countries leave on average 55% of consumption growth not shared. Countries that have the opportunity to share their mortgage risks internationally via financial markets reduce the exposure of consumption to idiosyncratic output shocks by 20% $((0.68 - 0.55)/0.68)$ compared to countries that do not allow for mortgage backed securities. Note that in our procedure observations on idiosyncratic consumption and GDP growth change panel group affiliation as countries change their relative degree of securitization. Therefore, these results strongly indicate hat the effect of securitization on risk sharing that we pick up here is systematic and not likely to be incidentally related to other, unobserved (or uncontrolled) country-characteristics.

Taken together our main findings suggest that the securitization of mortgage related risks considerably improves international risk sharing. In the remainder of this paper we assess the robustness of this conclusion further.

4.1 Securitization and international financial integration

Securitization of mortgage related debt seems to improve international risk sharing, which suggests that it is an important aspect of financial globalization. However, this could just be another facet of the secular growth in international gross asset holdings that we have seen since the early/mid 1990s (see Lane and Milesi-Ferretti (2003, 2007)). Sørensen et al. (2007) and Artis and Hoffmann (2008) document that the increase in cross-border

asset holdings is echoed in improved international consumption risk sharing. Since the increase in gross foreign asset holdings worldwide coincides with the period at which securitization has been introduced in various countries in our sample, our securitization indicator could just pick up this trend in financial globalization . Not so: we parameterize risk sharing as a function of a financial globalization trend

$$\beta_U^k(t) = \beta_0 + \beta_1 SEC_t^k + \beta_2 gfa_t + \beta_3 gfa_t \times SEC_t^k + \beta_4 t \qquad (8)$$

where t denotes a time trend and $gfa_t = \sum_{k=1}^{16} \frac{(FA_t^k + FL_t^k)}{GDP_t^k}$ summarizes the average gross foreign asset positions of the countries under study relative to GDP and with FA_{kt} (FL_{kt}) denotes gross foreign assets (liabilities) of country k at time t . Lane and Milesi-Ferretti (2001,2003,2007) propose gfa_t as a measure of the trend in financial integration. As data of foreign asset positions is only available until the end of 2004 we have to restrict our sample period to 1985Q1 - 2004Q4. Quarterly estimates of gross foreign assets are obtained through linear interpolation. Table 2 summarizes the results. None of our results changes if we use a purely equity-based measure of financial integration, $geq_t = \sum_{i=1}^{16} \frac{(PEQA_t^k + PEQL_t^k + FDIA_t^k + FDIL_t^k}{GDP_t^k}$ and/or calculate quarterly estimates that are not based on linear interpolation but rely on movements in global asset prices. These results are not reported but available upon request.

The first line of table 2 gives our basic risk sharing regression for that time period, now also taking account of a linear time trend interacted with GDP growth. The estimates show that our securitization dummy does not reflect a simple time trend. The coefficient of the securitization dummy is negative, statistically significant and in the range of values obtained for our

full sample period.

We corroborate this finding even if, in addition, we consider the trend in financial integration. The second line of table 2 displays the corresponding estimates. Financial integration seems to be helpful in improving consumption risk sharing as is mirrored in the negative β_2. It is not significant at the 95 percent but 90 percent confidence level thus supporting Sørensen et al. (2007) and Artis and Hofmann (2008). In addition, the coefficient of SEC_t^k remains virtually unaltered. Securitization improves international risk sharing. More importantly, this result is independent of the increase in financial integration as measured by gross foreign asset holdings.

For the sake of completeness, the third line of table 2 gives the risk sharing coefficient estimates when we consider all three variables jointly while the forth line reports estimates when the interaction of financial integration and securitization is considered. We see some quantitative but no qualitative differences compared to the previous exercises. Both financial integration and securitization of mortgage related risks reduce the amount of unshared idiosyncratic consumption growth risk, but these effects are independent of each other. We do not report estimates of γ_1 as they are insiginificant in all regression exercises.

4.2 Securitization and other characteristics mortgage finance markets

The structure of mortgage markets differs across countries in many respects. The degree to which securitization is possible is just one of them. Tsatsaronis and Zhu (2004) distinguish between three different groups of OECD countries based on differences in the following dimensions: *i)* the extent to which securitisation of mortgage payments is used, *ii)* the flexibility of

mortgage interest rate agreements, *iii)* the valuation method employed to determine the mortgage lending volume, *iv)* the maximum loan-to-value ratio and *v)* the use of mortgage equity withdrawal. A couple of countries that have liquid secondary mortgage backed security markets also allow for mortgage equity withdrawal. On the other hand, countries that do not allow the securitization of mortgage payments also forbid the use of mortgage equity withdrawal etc. Hence, our securitization dummy could reflect one of the other distinguishing features of national mortgage finance markets.

To alleviate concerns in this respect we take data on mortgage rates (flexible vs. fixed), mortgage equity withdrawal (allowed and used vs. not allowed or nor used), maximum loan to valuation ratio and valuation method (historical prices vs. market valuation) from table 2 in Tsatsaronis and Zhu (2004) to construct qualitative measures for all of these different characteristics of mortgage finance systems just as for securitization.[3] We then parameterize

$$\beta_U(t) = \beta_0 + \beta_1 SEC_t^k + \beta_2 X_t^k + \beta_3 t \tag{9}$$

with X_t^k representing one of the qualitative measures of the other mortgage market characteristis such as flexibility of mortgage interest rates (MR), mortgage equity withdrawal (MEW), loan to valuation ratio (LTV) and valuation method (VM). We use the full sample period from 1985Q1 to 2008Q1.

Table 4 reports if these different mortgage market characteristics influence risk sharing when considered on their own (in each case the first of the two lines) and, specifically, if the other characteristics drive out the impact

[3]Unfortunately, we do not have exact information about the time at which e.g. mortgage equity withdrawal has been allowed in the various countries, such that we have to assume that the differences across countries with regard to the profile of mortgage finance systems prevailed for the whole sample period.

of securitization on international risk sharing (the second line respectively). The results are easily summarized:none of the individual mortgage market characteristics other than securitization is statistically significant. The coefficients are all positive meaning that e.g. more mortgage equity withdrawal is, if anything, associated with less risk sharing. Securitization seems to be special in this respect.

The second lines in the panels labelled MR, MEW, LTV and VM report the estimates for the case when SEC_t^k is also included. Most of the other mortgage market features now seem to statistically significantly influence consumption risk sharing, though it may be hard to interpret these coefficients intuitively. However, securitization is always still significant, the coefficient estimate negative and almost unaltered when compared to the previous regressions where SEC_t^k was the only variable interacted with GDP growth.

The bottom line of the results reported in table 4 is clear: our finding that securitization increases international risk sharing does not seem to be influenced by controls for other characteristics of mortgage markets.

4.3 Monte Carlo Simulation

Our results that securitization of mortgage debt increases international risk sharing appears robust to a range of controls for financial globalization, differences in the financial system. However, it is always conceivable that we have neglected other developments that could have affected international risk sharing over the sample period and that our measure of securitization indicator just picks up the cumulative impact of these developments. This could be a concern in particular because, for lack of alternative data, our securitization indicator is necessarily a *qualitative* one. We therefore conduct

a Monte Carlo exercise in which we demonstrate that both the precise timing and the extent to which securitization was allowed matter for our results. In the setup of our experiment, we follow Hoffmann and Shcherbakova (2008) and randomly assign securitization indicators to countries. Specifically, for all 16 countries we draw from the empirical distribution of SEC_t^k to generate a "placebo" measure of the timing and degree of securitization, $SEC_t^{P,k}$. We repeat this procedure 1000 times. For each draw, we then perform two checks: first, we run the regression

$$\Delta\widetilde{c}_t^k = \beta_0 \Delta\widetilde{gdp}_t^k + \beta_1^P SEC_t^{P,k} \times \Delta\widetilde{gdp}_t^k + \gamma_1 SEC_t^{P,k} + \alpha + \delta^k + \tau_t + \varepsilon_t^k \quad (10)$$

to check in how many cases β_1^P would be negative and more significant than the actual SEC_t^k. Second, we consider both the placebo and the actual securitization indicator jointly and report in how many cases their regression coefficients are individually negative and significant, i.e.

$$\Delta\widetilde{c}_t^k = \beta_0 \Delta\widetilde{gdp}_t^k + \beta_1^P SEC_t^{P,k} \times \Delta\widetilde{gdp}_t^k + \beta_2 SEC_t^k \times \Delta\widetilde{gdp}_t^k + \alpha + \delta^k + \tau_t + \varepsilon_t^k \quad (11)$$

Panel A of table 5 presents the results when we ask about the significance of the placebo indicator. We see that the coefficient of the placebo securitization measure is negative and more significant than the actual measure in no more than about 1.9% of all cases if taken alone.

Panel B of table 5 displays that when both placebo and actual securitization measure are considered jointly, the placebo measure turns out to be individually negatively significant in roughly 4 percent of all draws while the actual securutization measure is significant in 95 percent of all cases. These Monte Carlo simulations thus underscore that our results are not the outcome of pure chance: the extent and the timing at which securitization of

mortgage debt has been introduced is crucial in order to identify the impact of securitization on international consumption risk sharing. In view of these results it appears highly unlikely that other developments that broadly unfolded in the same way as the use of mortgage securitization can account for the significance of our main results.

4.4 Securitization, global asset price cycles and international risk sharing

The notion we have attempted to convey in our analysis is that securitization of mortgage related risks reduces an economy's exposure (in terms of consumption) to idiosyncratic business cycle shocks. *Prima facie*, this message seems to be disconnected from the current crisis in international financial markets. Policymakers worldwide worry if and to what extent the current swings in global asset prices feed back on the real economy. Furthermore, the trigger of the current crisis were losses on securities that were backed by mortgages to U.S. households with poor or no credit rating.

We make the following remarks: increased international risk sharing inevitably increases the relative importance of global shocks for the volatility of consumption. In fact, the view that securitization of mortgage debt has contributed to turning a national real estate boom into what is the first globalized housing bust is not at all inconsistent with our findings here. For better or for worse it suggests that securitization *does* help to share the costs of the crisis internationally.

More immediately relevant for our analysis here is however the possibility that the extent to which international risk sharing is possible could itself be subject to variation over time. If securitization facilitates international risk pooling mainly in tranquil periods but risk sharing becomes

all but impossible in periods of severe global turbulence, then the potential macroeconomic benefits from securitization could be much smaller than is suggested by our previous results.

We address this concern by asking to what extent risk sharing varies as a function of global asset market conditions. We focus on asset prices as indicator of global asset market conditions. The role of asset price fluctuations in driving leverage and liquidity in the recent years (and their role on accelerating the deleveraging process in the current crisis) has been stressed by Adrian and Shin (2008). Lustig and van Nieuwerburgh (2006) point at the importance of real estate prices in explaining collateral availability and the extent of risk sharing among US regions. Hoffmann and Shcherbakova (2008) highlight the importance of stock price movements for risk sharing among U.S. regions. Risk sharing increases in times of high asset prices and decreases in times of low asset prices. Employing the risk sharing regression with interaction terms as we do in this paper, their stand-in for high/low asset prices is the residual of the U.S. consumption-wealth ratio, *cay*, which is a powerful predictor of expected returns on the U.S. stock market (Lettau and Ludvigson (2001)). Nitschka (2007) shows that U.S. *cay* can also be used as a forecasting variable of the G7 stock market returns. We repeat this forecasting exercise for stock market excess returns of the countries in our sample and confirm the predictive power of *cay*: a temporarily high consumption-wealth ratio predicts high future stock market returns.(results not reported but available upon request).

We therefore use *cay* as proxy for global asset price movements and parameterize the risk sharing coefficient $\beta_U(t)$ as

$$\beta_U^k(t) = \beta_0 + \beta_1 cay_t + \beta_2 SEC_t^k + \beta_3 cay_t \times SEC_t^k + \beta_4 t$$

adding one of the terms on the right hand side at a time. Table 6 summarizes the results.

First, we ask if we find dependence of international risk sharing on movements in global asset prices. The answer to this question is yes if we consider the interaction of cay_t with GDP growth on its own. The coefficient $\beta_1$is statistically significant and positive, i.e. high cay_t (low asset prices) are associated with less risk sharing. We thus corroborate one of the results in Hoffmann and Shcherbakova (2008) in an international context. Figure 3 further illustrates this result. Here we plot cay_t (dashed line) against the sequence of coefficients $\beta_U(t)$ (solid line) obtained from the cross-sectional regressions

$$\Delta\widetilde{c}_t^k = \beta_U(t)\Delta\widetilde{gdp}_t^k + \tau_t + \varepsilon_t^k$$

where τ_t is the time t specific constant. Since $\beta_U(t)$ is very noisy, we take a smoothed version using an HP-filter with smoothness parameter $\lambda = 6.25$. As is apparent, uninsured consumption risk and cay_t move together for most of the sample period (a correlation of 0.46): international risk sharing tends to be high when global asst prices are high and vice versa.

Next we additionally consider the interaction of our securitization dummy with idiosyncratic GDP growth. These estimates, reported in the second line of table 6, convey a clear message. Even if we take account of global asset price fluctuations, securitization of mortgage debt still increases international risk sharing significantly and the order of magnitude of the coefficient on SEC_t^k remains unchanged.

The third line of table 6 provides estimates when we also take account of a possible interaction between asset price movements and securitization. This specification explicitly allows the sensitivity of risk sharing to global asset market conditions to depend on whether a country has a developed

market for securitized mortgage debt. There is no evidence for this. If anything, securitization would seem to lower the dependence of a country's ability to share risk to global asset market conditions – though insignificant, the coefficient β_3 is negative. Note also that the coefficient on *cay* alone, β_1, now also becomes insignificant. The relation between global asset price movements as echoed in cay_t and international risk sharing essentially breaks down if we also take account of a time trend. In all cases, the securitization coefficient alone, β_2, is virtually unchanged. We conclude from this exercise that international risk sharing *does* seem to depend on global asset market conditions, increasing in asset price booms and markedly decreasing in downturns. But we do not find that countries with more developed markets for securitization are systematically more or less exposed to this phenomenon.

5 Conclusions

The securitization of mortgage related debt improves international risk sharing because it makes the idiosyncratic risks associated with this debt internationally tradeable. The effect is large: for countries with the most developed secondary markets for mortgage-related debt the volatility of consumption conditional on an idiosyncratic business cycle shocks is betwen 20 and 30 percentage points lower than for countries in which such markets do not exist. We find that this result is robust to a range of controls for other aspects of financial globalization and that it is independent of international diffferences in financial systems, other systematic differences in housing and mortgage markets etc.

Against the backdrop of the current crisis our findings raise the question whether securitization could not just help pooling risks in tranquil times,

leaving the possibility that international risk sharing all but dries up in busts. Indeed we find that the extent to which international risk sharing is possible *does* depend on global asset market conditions: risk sharing increases during asset price booms and decreases sharply in busts. However, even taking account of the most recent downturn (our sample ends in the first quarter of 2008), we do not find evidence that countries with highly developed markets for securitized mortgage debt are necessarily *more* exposed to the global asset price cycle. These findings are consistent with recent events: they underscore that securitization of mortgage debt was crucial in turning the US subprime crisis into what may well be the first globalized real estate bust.

6 Tables

Table1: Securitization and international risk sharing

Panel A: 1985Q1 - 2008Q1		
β_0	β_1	γ_1
0.79	−0.35	0.00
(32.30)	(−4.70)	(0.04)
Panel B: 1995Q1 - 2008Q1		
β_0	β_1	γ_1
0.80	−0.58	−0.00
(23.38)	(−6.01)	(−0.00)
Panel C: 1985Q1 - 1996Q4		
β_0	β_1	γ_1
0.81	−0.23	−0.00
(26.08)	(−2.22)	(−0.00)

Notes: This table displays the results from our baseline risk sharing regression: $\Delta\widetilde{c}_t^k = \beta_0 \Delta\widetilde{gdp}_t^k + \beta_1 SEC_t^k \times \Delta\widetilde{gdp}_t^k + \gamma_1 SEC_t^k + \alpha + \delta^k + \tau_t + \varepsilon_t^k$ where $\Delta\widetilde{c}_t^k$ denotes idiosyncratic consumption growth, $\Delta\widetilde{gdp}_t^k$ idiosyncratic GDP growth and SEC_t^k is a qualitative measure that indicates when and to what extent country k has introduced the securitization of mortgage payments. Robust t-statistics are in parentheses below the estimates.

Table 2: Risk sharing among groups of countries

Low securitization	High securitization
β_U	β_U
0.68	0.55
(26.53)	(10.62)

Notes: This table provides results when we sort the 16 countries under study into four bins according to their level of securitization indicated by 1, 0.33 and 0 values used in the construction of SEC_t^k. We repeat this sorting procedure every quarter for the time period from 1985Q1 to 2008Q1 such that we obtain artificially generated low, middle-low, middle-high and high securitization country samples. We then run $\Delta\widetilde{c}_t^k = \beta_U \Delta\widetilde{gdp}_t^k + \alpha + \delta^k + \tau_t + \varepsilon_t^k$ for the first quartile (low securitization) and fourth quartile (high securitization). Robust t-statistics are in parentheses below the estimates.

Table 3: Trend in financial integration and securitization

sample period: 1985Q1 - 2004Q4				
β_0	β_1	β_2	β_3	β_4
0.79	−0.33			−0.00
(16.35)	(−2.43)			(−1.10)
0.79	−0.33	−0.10		
(16.35)	(−2.39)	(−−1.86)		
0.80	−0.38	−0.13		0.00
(16.92)	(−2.68)	(−2.15)		(0.82)
0.81	−0.36	−0.43	−0.41	0.01
(17.47)	(−2.68)	(−2.18)	(−1.81)	(2.28)

Notes: This table presents results from the regression: $\Delta\widetilde{c}_t^k = \beta_U^k(t)\Delta\widetilde{gdp}_t^k + \alpha + \delta^k + \tau_t + \varepsilon_t^k$ with the parameterization

$$\beta_U^k(t) = \beta_0 + \beta_1 SEC_t^k + \beta_2 gfa_t + \beta_3 gfa_t \times SEC_t^k + \beta_4 t$$

where $gfa_t = \sum_{i=1}^{16} \frac{(FA_{it}+FL_{it})}{GDP_{it}}$ with FA_{it} gross foreign assets of country i at time t and FL_{it} gross foreign liabilities of country i at time t. It thus summarizes the gross foreign asset positions of the countries under study relative to GDP. Robust t-statistics appear in parentheses below the estimates. The sample period runs from 1985Q1 to 2004Q4.

Table 4: Securitization and other mortgage market profiles

	sample period: 1985Q1 - 2008Q1			
	β_0	β_1	β_2	β_3
MR	0.67		0.06	
	(19.41)		(1.30)	
	0.72	−0.34	0.09	−0.00
	(19.72)	(−4.42)	(1.85)	(−2.45)
MEW	0.64		0.08	
	(13.82)		(1.67)	
	0.68	−0.33	0.21	−0.00
	(14.24)	(−4.35)	(2.21)	(−2.65)
LTV	0.61		0.13	
	(9.69)		(1.63)	
	0.64	−0.34	0.17	−0.00
	(10.21)	(−4.47)	(2.27)	(−2.51)
VM	0.49		0.25	
	(3.45)		(1.64)	
	0.47	−0.34	0.35	−0.00
	(3.47)	(−4.48)	(2.28)	(−2.50)

Notes: This table presents results from the regression: $\Delta\widetilde{c}_t^k = \beta_U \Delta\widetilde{gdp}_t^k + \alpha + \delta^k + \tau_t + \varepsilon_t^k$ with the parameterization

$$\beta_U(t) = \beta_0 \Delta\widetilde{gdp}_t^k + \beta_1 SEC_t^k \times \Delta\widetilde{gdp}_t^k + \beta_2 X_t^k \times \Delta\widetilde{gdp}_t^k + \beta_3 t \times \Delta\widetilde{gdp}_t^k$$

with X_t^k representing one of the dummys of the other mortgage market characteristis such as flexibility of mortgage interest rates (MR), mortgage equity withdrawal (MEW), loan to valuation ratio (LTV) and valuation method (VM). Robust t-statistics appear in parentheses below the estimates. The sample period runs from 1985Q1 to 2008Q1.

Table 5: Monte Carlo Simulations

Panel A: $\beta_U(t) = \beta_0 \Delta\widetilde{gdp}_t^k + \beta_1^P SEC_t^{P,k} \times \Delta\widetilde{gdp}_t^k + \gamma_1 SEC_t^{P,k}$		
β_0	β_1^P	γ_1
100%	1.9%	0%
Panel B: $\beta_U(t) = \beta_0 \Delta\widetilde{gdp}_t^k + \beta_1^P SEC_t^{P,k} \times \Delta\widetilde{gdp}_t^k + \beta_2 SEC_t^k \times \Delta\widetilde{gdp}_t^k$		
β_0	β_1^P	β_2
100%	4.1%	95%

Notes: This table provides evidence from a Monte Carlo experiment in which we randomly assign the values that indicate the degree of securitization to each country. We draw from the empirical distribution of SEC_t^k and repeat this procedure 1000 times to generate a "placebo" measure of the timing and degree of securitization, $SEC_t^{P,k}$. First, we run

$$\Delta\widetilde{c}_t^k = \beta_0 \Delta\widetilde{gdp}_t^k + \beta_1^P SEC_t^{P,k} \times \Delta\widetilde{gdp}_t^k + \gamma_1 SEC_t^{P,k} + \alpha + \delta^k + \tau_t + \varepsilon_t^k$$

to check in how many cases β_1^P would be negative and more significant as the actual SEC_t^k. Second, we regard both the placebo and the actual securitization dummy jointly and report in how many cases their regression coefficients are individually negative and significant, i.e.

$$\Delta\widetilde{c}_t^k = \beta_0 \Delta\widetilde{gdp}_t^k + \beta_1^P SEC_t^{P,k} \times \Delta\widetilde{gdp}_t^k + \beta_2 SEC_t^k \times \Delta\widetilde{gdp}_t^k + \alpha + \delta^k + \tau_t + \varepsilon_t^k$$

Panel A gives the percentage of cases in which we find significant estimates of the first exercise, panel B provides the results for the second exercise.

Table 6: Risk sharing, cay and securitisation

sample period:1985Q1 - 2008Q1				
β_0	β_1	β_2	β_3	β_4
0.70	2.56			
(20.73)	(2.53)			
0.77	2.38	−0.35		
(21.36)	(2.17)	(−4.63)		
0.77	2.34	−0.35	0.18	
(20.73)	(1.52)	(−4.51)	(0.04)	
0.77	1.24	−0.32	−0.03	−0.00
(20.53)	(0.74)	(−4.13)	(−0.13)	(−1.57)

Notes: Table 6 reports our panel regression estimates (t-statistics appear in parenthesis below the estimates) for (1) with the specification

$$\beta_U(t) = \beta_{0t}^k + \beta_1 cay_t + \beta_2 SEC_t^k + \beta_3 cay_t \times SEC_t^k + \beta_4 t$$

where "t" denotes a time trend, SEC_t^k is a dummy that indicates when and qualitatively to what extent countries in our sample allowed the securitisation of mortgages. The variable cay_t is the residual from the cointegration relation between consumption, asset wealth and labour income in the U.S. freely available on Martin Lettau's website. Our panel regression estimates are obtained for the time period from 1985Q1 - 2008Q1. Robust t-statistics appear below the estimates in parenthesis.

7 Figures

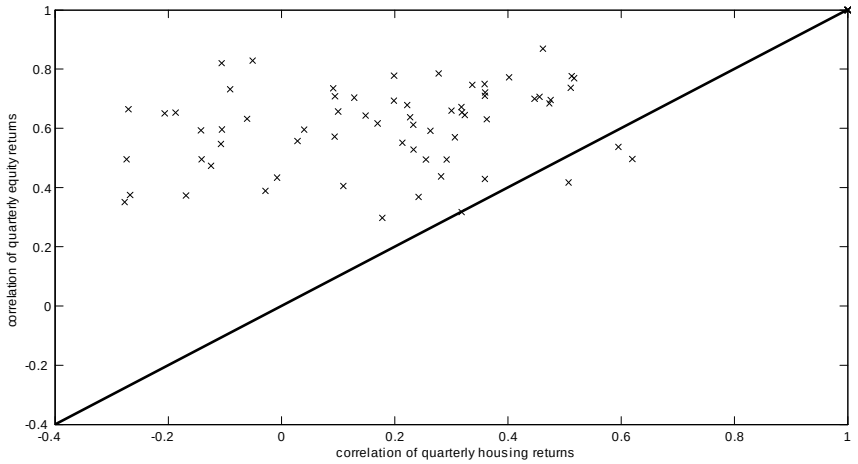

Figure 1: Pairwise correlations of quarterly equity vs. housing returns for the 16 OECD countries under study

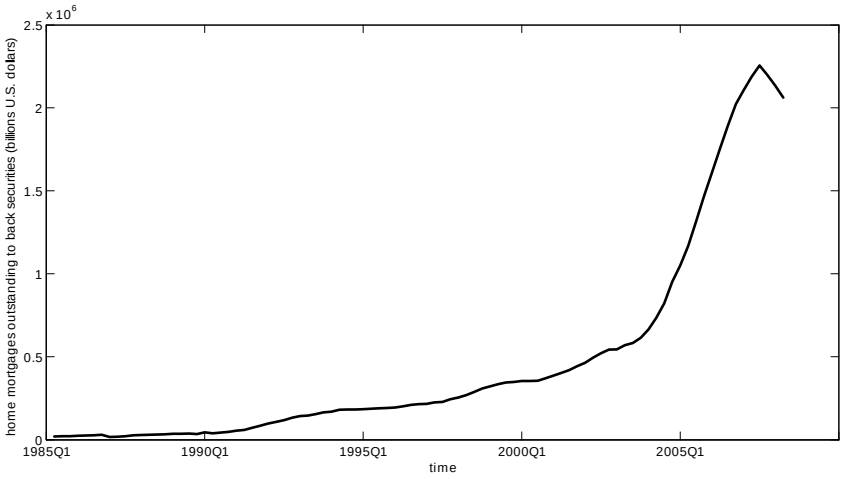

Figure 2: Amount of home mortgages outstanding used to back securities in the U.S. in billions of dollar for the time period from 1985Q1 to 2008Q1.

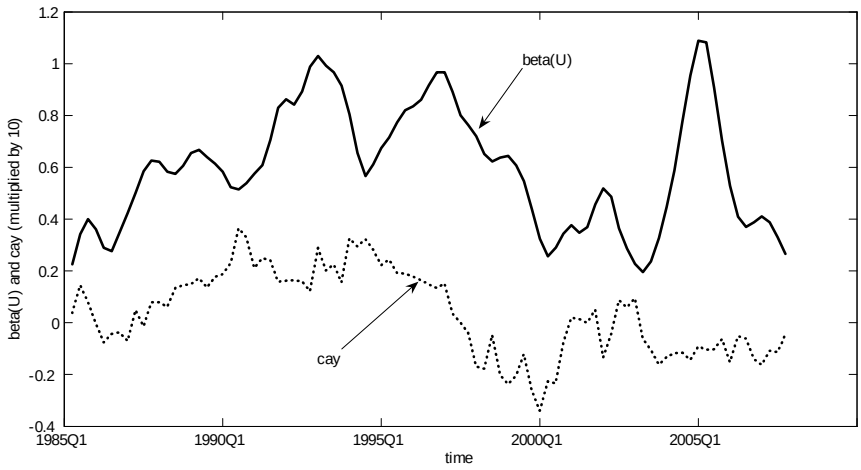

Figure 3: U.S. cay (multiplied by 10) vs. coefficient of uninsured consumption risk over time. This coefficient is obtained from a sequence of cross-sectional risk sharing regressions.

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