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Capital over the business cycle: renting versus ownership

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Abstract

We find that capital renting makes up one fifth of US capital expenditures, and it increases during downturns. Further, we present cross-country evidence that output losses after financial crises are smaller where renting is more prevalent. To understand these findings, we build a general equilibrium model with borrowing constraints and with the option to rent or buy capital. The countercyclicality of rentals occurs because their supply increases, as renting serves as an additional means of savings when credit markets malfunction. Moreover, demand also shifts towards rentals as they become relatively cheaper. By absorbing excess savings, renting mitigates financial crises.

Key words: Renting, capital, business cycle, financial shocks.

JEL classification: E22, E32, E44, G01, G32.

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Summary

How does the ownership of capital affect the aggregate behaviour of the economy? Does it matter whether firms own or rent production capital such as machinery and equipment, offices and structures? This question has been somewhat ignored by macroeconomists, mainly because in a frictionless world the question of capital ownership becomes irrelevant as firms are indifferent between renting and owning. But in the presence of credit constraints the issue of leasing versus buying may become relevant for firms' investment decisions. The motivation of our paper is to show that the presence of credit constraints makes the question of renting versus owning relevant when attempting to understand the business cycle as well.

The empirical part of the paper reports three sets of evidence on the role of renting. First, we use US firm-level data to show that more financially constrained firms tend to rely more on renting, as indicated by their higher share of renting among capital expenditures. Second, we establish that renting is countercyclical, and we link it to cyclical changes in credit standards. Finally, using cross-country aggregate data, we show that countries with a larger rental sector experience a smaller output loss after financial crises.

The theoretical part of the paper develops a general equilibrium model, where firms' decisions to purchase capital are subject to credit constraints. In contrast, firms' decisions to rent capital are assumed to be unconstrained. The model is used to explain both the observed countercyclicality of rentals and why the presence of rentals mitigates crises. While a stylised model, it is able to match some key dimensions of the US economy.

The intuition behind the countercyclicality of renting is that in a crisis, when the real interest rate falls, the cost of renting (the rental fee) falls by the same magnitude as the real interest rate. By contrast, the cost of owning is reduced by falling interest rates only proportionally to the share that owning is credit financed. This asymmetric impact of the falling real interest rate on the cost of investment choices means that capital renting becomes relatively cheaper, and firms naturally substitute owned capital with rented capital.

Regarding the mitigating impact of renting, in the face of financial distress, the possibility of renting may serve as an extra margin of adjustment for both savers and borrowers. This extra margin serves the purpose of allocating the extra savings that cannot be absorbed by parts of the economy where credit conditions tighten and the capital accumulation process is impeded. This consideration involves not only the choices faced by producing firms, but also the potential suppliers of funds and rented capital.

Without the presence of rentals, equilibrium in the market of loanable funds is restored by further falls in the interest rate, which reduces savers' wealth and slows down economic recovery. With the presence of rentals, some of the extra savings in the economy are absorbed by capital investment which is then rented out for production purposes. Hence the downward pressure on interest rates is mitigated, the wealth of savers is protected and the economic recovery is faster. This general equilibrium mechanism is one of the key theoretical insights of the paper.

The implication is that well-developed rental and leasing markets may effectively offset the impact of malfunctioning credit markets.

1 Introduction

How does the ownership of capital affect the aggregate behaviour of the economy? Does it matter whether firms own or rent production capital such as machinery and equipment, offices and structures? On the one hand, this question has been somewhat ignored by macroeconomists, mainly because in a neoclassical, frictionless world the question of capital ownership becomes irrelevant as firms are indifferent between renting and owning. On the other hand, in the presence of financial constraints or uncertainty, the issue of leasing versus buying is relevant from firms' perspective. The motivation of our paper is to show that the presence of financial constraints alone can make the question of renting versus owning relevant in understanding the business cycle as well.[1]

We report three sets of empirical evidence on the role of renting. First, by replicating and extending earlier findings from the corporate finance literature, based on US firm-level data, we show that more financially constrained firms tend to rely more on renting, as indicated by a higher share of rental expenditure in total capital expenditure. Second, we establish that renting is countercyclical, and we link it to cyclical changes in credit standards.[2] Finally, using cross-country aggregate data, we show that countries with a larger rental sector experience a smaller output loss after financial crises.

To understand these findings, we build a general equilibrium model, along the lines of Kiyotaki and Moore (1997), with two types of agents: a household who saves and an entrepreneur who borrows and produces. Furthermore, we allow for two ways of obtaining capital used in production: rental capital accumulates in the household sector that is not subject

[1]Note that the corporate finance literature prefers the terminology *lease* to *rent*. There are two major types of leases, operating lease and financial lease. The former involves a complete separation of ownership and control, and it is typically referred to as *renting* in economics. Thus, throughout the paper, we focus on operating leases, and use the terms *leasing* and *renting* interchangeably. See more on this in Section 2.

[2]This result is novel and has not been documented in the macro literature yet. The only exception we have recently come across is the independent work of Zhang (2011), who has also documented the evidence on the countercyclical behaviour of renting. Also, this finding can be thought of as the flipside of the results of Covas and Haan (2011) and Jermann and Quadrini (2012) who find that debt financing becomes less important in downturns.

to borrowing constraints, whereas owned capital accumulates in the entrepreneurial sector that is borrowing constrained. Besides supplying rental capital, households also supply credit to entrepreneurs. We show that a standard business cycle shock hitting total factor productivity (TFP) as well as a shock to credit conditions tightening the borrowing constraint can generate a substitution effect between rented and owned capital, leading to the observed countercyclicality of renting.[3] In addition, we show that the possibility of renting mitigates the propagation of aggregate shocks.

The intuition behind the countercyclicality of renting is as follows. In a crisis, when the real interest rate falls, the cost of renting (the rental fee) falls by the same magnitude as the real interest rate. In contrast, the cost of owning is reduced by falling interest rates only proportionally to the share that owning is credit financed. This asymmetric impact of the falling real interest rate on the cost of investment choices means, that capital renting becomes relatively cheaper, and firms naturally substitute owned capital with rented capital.

Further, the intuition behind the mitigating impact of renting is as follows. In the face of financial distress, the possibility of renting may serve as an extra margin of adjustment for both savers and borrowers. This extra margin serves the purpose of allocating the extra savings that cannot be absorbed by parts of the economy where credit conditions tighten and the capital accumulation process is impeded. This consideration involves not only the choices faced by producing firms, but also the potential suppliers of funds and rented capital.

In a real business cycle model of the type we examine, adverse TFP shocks cause recessions. This leads to lower real interest rates which are needed to equilibrate the economy. Without the presence of rentals, equilibrium in the market of loanable funds is restored by further falls in the interest rate, which reduce savers' wealth and demand. But with rentals, some of the extra savings in the economy are absorbed by capital invest-

[3]In this paper, we show that the presence of credit constraints alone can generate the empirical patterns we observe, and do not consider the role of uncertainty and capital adjustment costs. For a partial equilibrium treatment of these factors in shaping renting behaviour, see Gavazza (2010, 2011). Further, recent work by Zhang (2011) uses the joint effects of credit constraints and trading costs with uncertainty to generate countercyclical rentals, also in partial equilibrium.

ment which is then rented out for production purposes. Hence there is less need for interest rates to fall, thereby protecting savers' wealth, and the economic recovery is faster.

Our model is related to two major strands of literature. On the one hand, it builds on the macroeconomics literature with financial frictions (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Bernanke, Gertler and Gilchrist, 1999). More specifically, the theoretical framework is motivated by models with borrowing constraints derived from limited contract enforceability as in Kiyotaki and Moore (1997), Kiyotaki (1998), Krishnamurthy (2003) and Matsuyama (2007), as well as by the related growing literature that studies the relationship between limited enforcement and firms' financing and investment decisions as in Albuquerque and Hopenhayn (2004), Cooley, Marimon and Quadrini (2004), Lorenzoni and Walentin (2007), Caggese (2007) and Rampini and Viswanathan (2010). Our analysis of the impact of financial shocks is inspired by Jermann and Quadrini (2012), who show how unexpected shifts in the borrowing constraint exert large effects on real variables. Iacoviello (2011) and Liu, Wang and Zha (2013) also have a similar line of thinking on exogenous financial shocks. More explicit modelling of financial disruptions and their impact on the macroeconomy can be found in Gertler and Kiyotaki (2010), Gertler and Karadi (2011) and Christiano, Motto and Rostagno (2010).

On the other hand, our paper is related to the finance literature on capital structure. In the neoclassical investment literature, the ownership of productive capital is irrelevant when markets are assumed to be frictionless (Jorgenson, 1967). In these models, capital ownership is indeterminate, and firms are assumed to rent all capital. Miller and Upton (1976) and Myers, Dill and Bautista (1976) are regarded as the first papers to analyze the renting-versus-owning decision in the framework of Modigliani and Miller (1958) with a focus on tax considerations. Our model focuses on other dimensions, such as agency costs associated with the separation of capital ownership and control as well as financing constraints, as in Smith and Wakeman (1985); Krishnan and Moyer (1994); Sharpe and Nguyen (1995); Habib and Johnsen (1999); Eisfeldt and Rampini (2009). A key point we borrow from the literature is related to a major advantage of capital renting, namely, that regaining physical possession of a rented asset in case of bankruptcy is easier than for a secured debt holder to acquire the collateral. As a result, renting may not be subject to financing constraints and it preserves capital.[4]

The rest of the paper is organized as follows: Section 2 presents the three sets of empirical evidence on the prevalence, the dynamics and the impact of renting. Section 3 presents the theoretical model, explains why the rental share is countercyclical in the presence of borrowing frictions, and it compares the business cycle statistics implied by the model to those found in the data. It also shows that the presence of renting could mitigate the adverse effects of aggregate shocks. Section 4 concludes.

2 Empirical Evidence

The aim of this section is to present evidence on the use of renting, its cyclical properties and its impact on the business cycle. In order to specify how we measure renting, we first refer to Eisfeldt and Rampini (2009) from the corporate finance literature. They note that Chapter 11 of the US bankruptcy code clearly distinguishes between capital renting ("true lease" or operating lease) and credit-financed capital purchase, whereby capital is the collateral ("secured lending").[5] As long as the easier repossession of rented capital alleviates problems associated with bankruptcy, capital renting (operating lease) is less subject to borrowing constraints. This is the type of capital renting which we aim to capture below.[6]

[4] In this paper, we do not investigate another potential advantage of renting, namely the flexibility it provides in the face of uncertainty and irreversible capital investments (Dixit and Pindyck, 1994; Abel and Eberly, 1994; Gavazza, 2011).

[5] *"In Chapter 11, the lessee must either assume the lease, which means keeping control of the asset and continuing to make the specified payments, or reject the lease and return the asset. In contrast, the collateral that secures the claim of a secured lender is subject to automatic stay in Chapter 11, which prohibits recovery of or foreclosure on the property. Thus, in bankruptcy it is much easier for a lessor to regain control of an asset than it is for a secured lender to repossess it."* (pp. 1622, Eisfeldt and Rampini, 2009).

[6] In the empirical section of the paper below, we concentrate on the demand for renting (lessee firms). Regarding the supply of rentals (lessor firms), it can come from three basic sources: (1) firms dealing with renting as their main activity, (2) large manufacturers or real estate firms who may offer rentals instead of selling, and (3) "horizontal" renting where a temporarily free capacity is rented out to other firms in the same industry. A good example is the case of airlines (Gavazza, 2010, 2011). Especially for the first two types of rentals, differences in access to credit are likely to play an important role: lessors have usually more access to credit than lessees, and use this advantage to finance

2.1 Firm-level Findings for the US

Our primary data source is Compustat, a widely used company level longitudinal data set containing financial information such as balance sheet and earnings statement items for publicly traded companies. As the largest firms are mostly included, the aggregate cyclical patterns of the economy are well captured (Gabaix, 2011). We use data on the annual financial statements of firms in the United States, which are detailed enough to measure rental as well as other capital expenses. We restrict the focus for the years 1980-2011.[7] Table 3 in the Appendix presents the number of observations by sectors, along with the detailed description of variables and the restrictions applied on the set of firms throughout the whole analysis.

Our rental measure, $rental\,share_{it}$, is defined as rental expenses, $rent_{it}$, as a share of total capital expenditures, for each firm i and year t, following Eisfeldt and Rampini (2009):

$$rental\,share_{it} = \frac{rent_{it}}{rent_{it} + (\delta_{it} + i_{it})K_{it}}. \tag{1}$$

Capital expenditures in the denominator are measured by adding up rental expenses and the imputed user cost of capital $(\delta_{it} + i_{it})K_{it}$, where the depreciation rate, δ_{it}, is calculated from the reported depreciation, interest rates, i_{it}, denote firm-level interest rates on borrowing,[8] and K_{it} is the book value of fixed tangible assets, i.e. owned capital.[9] This rental expenditure share provides a measure for the importance of rented capital used in production.[10]

In order to explore the characteristics of firms that rely more on rent-

the capital goods to be rented out.

[7]Even though the data set starts as early as 1950s, we start our investigation only from 1980, due to widely documented structural changes in the economy discussed in the large literature on the so-called Great Moderation (see McConnell and Perez-Quiros, 2000 and Kim and Nelson, 1999, among others). Also, it helps achieve a reasonable minimum annual sample size of firms (around 4,000).

[8]For firms that do not report their interest payments, we use predicted values from regressions on a quadratic function of capital and time and industry fixed effects.

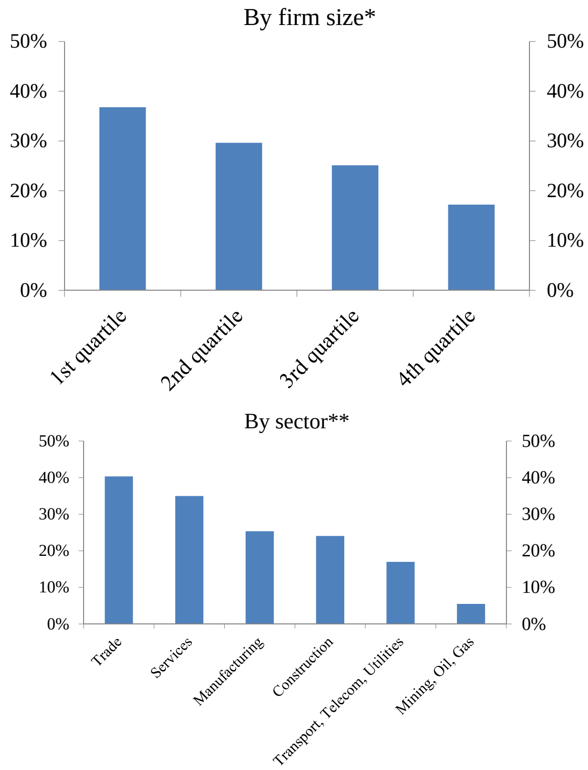
[9]We omit intangible capital due to the inherent problems with its reported book value measure (i.e. not being a comprehensive measure of all intangible investments, the valuation and depreciation are also problematic, etc.).

[10]For robustness, we experiment with a variety of alternative measures (see Sections A.2 and A.4 in the Appendix).

ing when obtaining capital, Figure 1 presents the rental expenditure share along two dimensions: firm size and sector. We confirm the earlier findings

Figure 1: Renting Is More Important among Small and Services Firms

The Share of Rental Expenses in Total Capital Expenditures in the US



*Firm size is measured by fixed tangible assets, and firms are ordered in increasing size (i.e. 1st quartile captures smallest firms). The quartiles are based on the average firm size over years.
** Sectoral classification is based on the Standard Industrial Classification (SIC) system.
Note: rental shares are calculated as the mean of rental shares across firms by size quartiles and sectors and over years 1980-2011.

Source: Compustat, 1980-2011.

of Eisfeldt and Rampini (2009) that for small firms, the rental share is higher (37% in the smallest quartile), but even the largest firms spend a considerable fraction of their capital expenditures on rentals (16% in the largest quartile). In addition, we show that the sectoral dimension is also important: generally, firms related to services rent more (35-40% in trade and services compared to 25% in manufacturing and construction). Heavily capital intensive sectors like transport, telecom, utilities and especially mining, oil and gas, rely less on renting. This finding can partially reflect technological differences: for example, in more capital intensive (production) sectors, it is more likely that capital is firm-specific and hence not easily found on the rental market. However, another key factor is likely to be access to external financing. Small firms with little fixed tangible assets possess less collateral, hence have less access to credit compared to large firms.[11,12]

2.2 Macroeconomic Findings for the US

Based on the micro-level findings presented above, we expect that rentals behave countercyclically. The intuition is the following: in recessions, when financial conditions deteriorate and borrowing constraints tighten, owning capital goods is substituted by other forms of obtaining capital that are less subject to borrowing constraints, such as renting. This subsection presents evidence supporting this hypothesis.[13]

As our main focus now is *aggregate* time-series evidence, we adapt equation (1) in order to appropriately weight observations by firm size and mitigate the effect of firm-level noise. Thus, we arrive at the following aggregate measure:

$$rental\, share_t = \frac{\sum_i rent_{it}}{\sum_i (rent_{it} + (\delta_{it} + i_{it})K_{it})}. \tag{2}$$

Figure 2 describes the evolution of the aggregate rental share for the period 1980-2011.

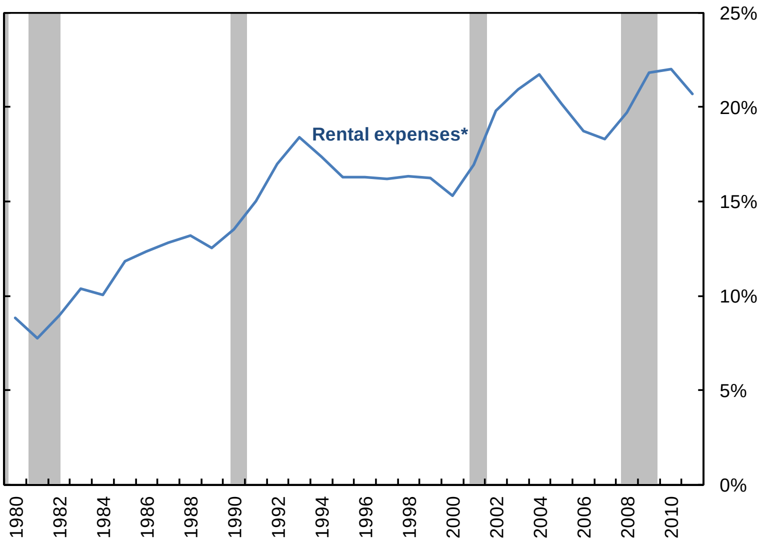
[11]In order to assess whether these factors are indeed jointly present, and what we see is not just an artefact of correlation across size and sector, we ran a regression with firm-size and sectoral fixed effects on the right hand side, and various rental share measures on the left hand side. The result is presented in the Appendix (Table 5), and shows that both fixed effect sets are significant. Hence, there is a separate, complementary role for technological factors, embedded in the sectoral fixed effects, and for financial factors related to collateral size, primarily captured by firm-size fixed effects. Furthermore, the effects of firm size are robust across rental measures.

[12]Note that Eisfeldt and Rampini (2009) (credit constraints) and Rampini and Viswanathan (2010) (exposure to risk) have done extensive work on explaining the choice of renting versus owning in a cross-sectional framework, across heterogeneous firms. In this paper, we focus on how this choice varies systematically over the business cycle.

[13]The countercyclicality of rentals, and the positive relationship between the change in rentals and the tightening of credit conditions have also been found recently and independently in Zhang (2011).

Figure 2: Renting Has Become More Important over the Last Decades

The Share of Rental Expenses in Total Capital Expenditures in the US



* As percentage of total capital expenditures, see equation (2).
Note: Shadings represent recessionary periods.
Sources: Compustat (rental share), firms incorporated in the US; and the National Bureau of Economic Research (recession shadings).

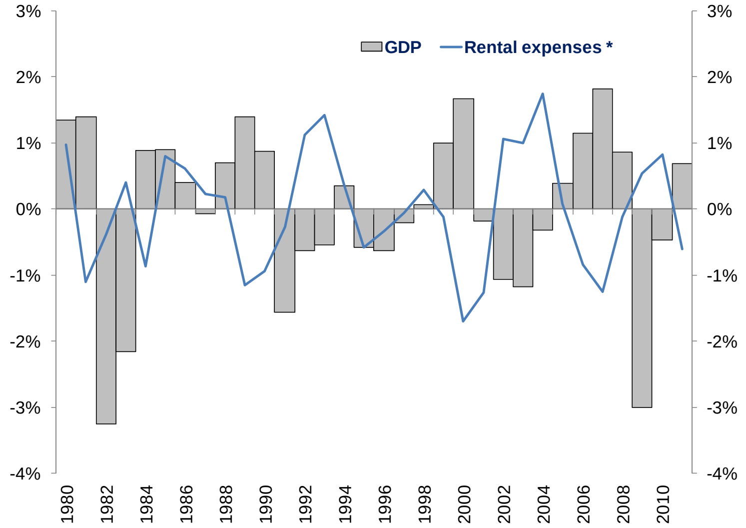
There are two important messages conveyed by the figure. First, the importance of renting has been growing over the last 30 years, and it has become a significant part of total aggregate capital expenditures, accounting for more than 20% of it from less than 10%. Furthermore, the increase in renting is ubiquitous across industries (see Figure 9 in the Appendix).[14] Second, the share of renting is countercyclical: it increases more rapidly during recessions, providing a non-trivial margin of capital adjustment over the cycle.

Focusing more directly on cyclical patterns, Figure 3 compares the cyclical components of real GDP to that of the rental share. It presents a clear pattern of countercyclicality, which has become even more pronounced since the mid-90's. It also shows that capital adjustment on the renting margin is non-negligible, and can fluctuate by as much as 2-3% of total capital expenditures. The robustness of the negative relationship between busi-

[14]Only the most capital intensive *Mining, Oil and Gas* (SIC code 10-14) industry did not show an increase in the share of rental expenditures, pointing to the difficulties in obtaining capital via rentals for such a highly capital intensive activity.

Figure 3: Renting Is Countercyclical

The Cyclical Components of Rentals and GDP in the US



* As percentage of total capital expenditures, see equation (2).
Note: Cyclical components are obtained by applying a Hodrick-Prescott filter (with smoothing parameter 6.25, recommended by Ravn and Uhlig (2002) for annual data) on the rental expenditure share and the log of real GDP.
Sources: Compustat (rental share), firms incorporated in the US, and Bureau of Economic Analysis (GDP).

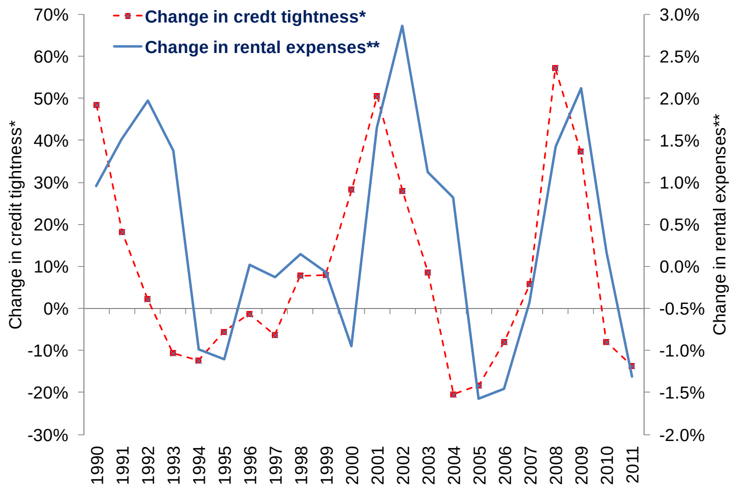
ness cycles and renting is presented in Table 6 of the Appendix where we use a variety of alternative measures on the role of renting to confirm this pattern.

As mentioned in the previous section on cross-sectional firm-level findings, small and services companies with less collateral are likely to face tighter credit constraints and rely more on rentals. In order to understand the countercyclical pattern of rentals, we turn to an aggregate measure of credit tightness.[15] Indeed, as Figure 4 shows, tightening credit standards are associated with an increasing share of renting. As such, aggregate time-series evidence is also consistent with an explanation for rentals based on credit constraints.

[15] Aggregate credit tightness is measured by the Senior Loan Officer Survey of the Board of Governors of the Federal Reserve System.

Figure 4: Renting Increases When Credit Conditions Tighten

The Change in the Rental Share and Credit Tightness in the US



* Measured by the net percentage of respondents indicating a tightening of standards for commercial and industrial loans for large and medium sized firms, from the Senior Loan Officer Survey of the FED.

** Measured by the annual change of the rental share, i.e. rental expenditures as percentage of total capital expenditures in equation 2.

Sources: Compustat (firms incorporated in the US) and Board of Governors of the Federal Reserve System.

2.3 Aggregate Implications of Renting: Cross Country Evidence

In the face of financial distress, the possibility of renting may serve as an extra margin of adjustment for both savers and borrowers. This extra margin allows for the allocation of the extra savings that cannot be absorbed by parts of the economy where credit conditions tighten and the capital accumulation process is impeded. This explanation involves not only the choices faced by producing firms, but also the potential suppliers of funds and rented capital. This general equilibrium mechanism is one of the key insights behind the theoretical model presented in the next section.

A potential macroeconomic implication is that renting may help reduce the impact of financial shocks. Indeed, we find that if the rental sector is larger before a financial crisis hits, the ensuing output loss is generally smaller. Underlying this analysis, we combine three cross-country data sets.

First, for getting proxies on the importance of renting, we use the Structural Analysis (STAN) database of the OECD. This contains annual data on value added and investment by detailed industries, for 27 countries, from 1970 to 2009. The value added of the rental sector will be used as our proxy measure for the importance of renting activity, by country and year.[16]

Second, we use the Systemic Banking Crises Database accompanying the paper by Laeven and Valencia (2012), which identifies the impact of systemic banking crises on subsequent GDP-losses.[17] The third data source is the Financial Structure Dataset (Cihak et al., 2012), which contains various measures of financial development, to be used as control variables. The final combined data set has 20 countries where both financial crises and rental measures are jointly observed. Further descriptions of the data can be found in Section A.1 of the Appendix.

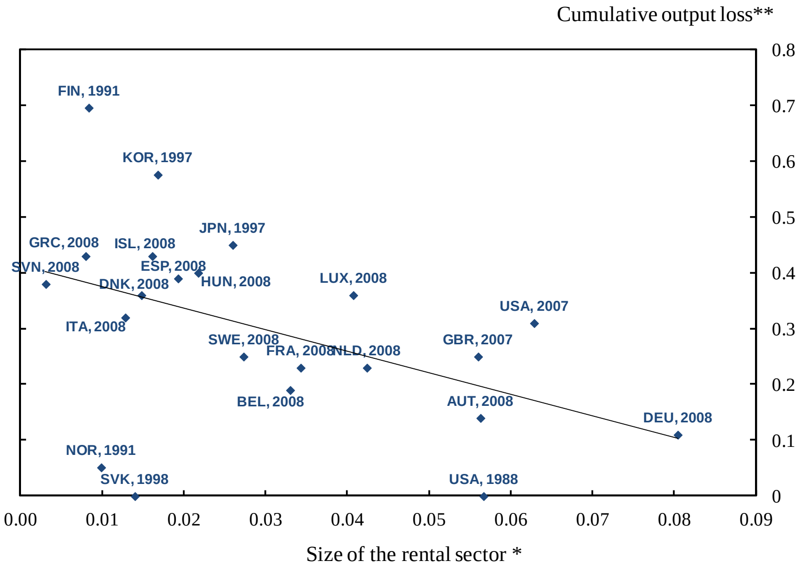
Even though the number of observations is limited, the scatter plot of Figure 5 reveals a clear negative relationship between the cumulative size of the output loss following the outbreak of a crisis and the size of the rental sector in the years preceding it. In order to check for the significance and robustness of this result, the following regressions are estimated with different measures for rentals and various controls for financial development

[16]More specifically, we take the value added of industry 71 in NACE rev1.1 (*Renting of machinery and equipment*) and normalize it by the size of the economy (either by total value added or total investments) to calculate our cross-country rental measure. There is no similar data for the renting of structures and buildings: industry 70 seems to be a candidate but it also contains to a large part the building (not renting) of residential (not corporate) real estate. Note that the primary interest is in productive capital for companies, and structures are less important for them. Thus, looking at machinery and equipment can still provide a good proxy for the overall importance of renting in the economy. Further, also note that Compustat does not have a decent coverage outside the US.

[17]It covers the period 1970-2011 and a large number of countries. According to their data description, "Output losses computed as the cumulative difference between actual and trend real GDP, expressed as a percentage of trend real GDP for the period $[T, T+3]$ where T is the starting year of the crisis. Trend real GDP is computed by applying the HP filter ($\lambda = 100$) to the GDP series over $[T-20, T-1]$." (Laeven and Valencia (2012), Banking crisis database, 2012 version, http://www.luclaeven.com/Data_files/Resolution%20of%20Banking%20Crises%20-%20Database.xlsx)

Figure 5: More Rentals are Associated with Smaller Real Costs of Financial Shocks

Cumulative Output Loss after Financial Crises and the Size of the Rental Sector
1970-2009, 20 countries



* The size of the rental sector is measured by the ratio of value added of the rental sector (industry 71 in NACE Rev 1.1 called *Renting of machinery and equipment without operator and of personal and household goods*) to gross fixed capital formation, as a measure of capital expenditures, at country level. Source: OECD STAN database

** Cumulative output loss is measured, as a ratio of GDP, as the cumulative sum of the differences between actual and trend real GDP over the period [T, T+3], expressed as a percentage of trend real GDP, with T the starting year of the crisis. Source: Laeven and Valencia (2012).

and pre-crisis growth:

$$\widetilde{Y}_{c,t} = \beta_0 + \beta_1 rentals_{c,t-1} + \beta_2 controls_{c,t-1} + \varepsilon_{c,t}, \qquad (3)$$

where $\widetilde{Y}_{c,t}$ denotes the cumulative output loss after a banking crisis in country c in year t, and the size of the rental sector is captured by $rentals_{c,t-1}$. We use four measures for the latter: either Rentals / GDP or Rentals / Investment, averaged either over 2 or 3 years before the crisis, up to the preceding year, $t-1$. If the hypothesized mitigating effect of rentals are true, then we expect $\beta_1 < 0$. Results are summarized in Table 1, and confirm, for all specifications, what the scatter plot shows visually: more rentals seem to be associated with lower real costs of financial shocks.

To give a more causal interpretation to this relationship, in Panel *b* of Table 1 we included a number of controls for factors which may bias this negative relationship. First, one can argue that countries with more developed financial systems can have systematically larger financial meltdowns once a financial crisis breaks out. If the rental sector develops hand-in-hand with the rest of the financial sector, this can bias our β_1 coefficient upwards. If, on the other hand, one takes the view that more developed financial systems reduce the real costs of financial crises (for instance, due to quicker recoveries), then the bias works to the opposite direction, downwards and away from zero, which would warrant the inclusion of controls. Columns (2) through (9) show results when different measures of financial development are included, measured as averages over the years preceding the crises. The negative coefficient of rentals is still significant, and has very similar magnitudes across the various measures. This result allows for a more causal interpretation that rentals mitigate the real impact of financial meltdowns, and also indicates that the general level of financial development does not interfere with this relationship.

As further robustness checks, columns (10) and (11) of Panel *b* of Table 1 include controls for the size of the boom before the crises, measured by average GDP growth in the 5 or 10-year periods preceding the crises. Again, the significant and negative relationship is preserved, with similar magnitudes to previous estimates. In order to get a sense of the scale of the effect, and also to see that the choice of our rental measure does not matter much for the magnitude, standardized beta coefficients are also reported. Their values of around 0.45 mean that, if rentals increase by one standard deviation (0.021), then the output loss decreases by almost half of its standard deviation. This amounts to a substantial, 9% decrease in the cumulative GDP loss after financial crises.

To sum up, we provided firm-level and aggregate evidence that rentals are countercyclical and, that they are used more intensively when access to credit is limited. Moreover, we presented suggestive evidence that renting alleviates the negative impact of credit tightness on economic activity.

Table 1: Renting Reduces the Real Impact of Financial Shocks

Panel a: Output Loss Regressed on Rental Measures

rental measures:	rentals / GDP		rentals / capital expenditures	
	t-2 to *t*-1	*t*-3 to *t*-1	*t*-2 to *t*-1	*t*-3 to *t*-1
rental measure	-16.95**	-18.18**	-3.854**	-4.006**
	(-2.48)	(-2.81)	(-2.52)	(-2.78)
standardized beta coefficient	-0.417**	-0.446**	-0.464**	-0.484**
N	22	22	22	22
R-squared	0.174	0.199	0.215	0.234

Panel b: Output Loss Regressed on Rental Measures and Controls

	rental measure: rentals / GDP (*t*-2 to *t*-1)					
	(1)	(2)	(3)	(4)	(5)	(6)
rental measure	-16.95**	-18.58**	-20.69***	-18.73**	-19.12**	-16.83***
	(-2.48)	(-2.30)	(-2.94)	(-2.77)	(-2.84)	(-3.50)
standardized beta coefficient	-0.417**	-0.439**	-0.515***	-0.461**	-0.470**	-0.438***
control+		0.0421	0.117	0.0411	0.0503*	0.0602
		(1.41)	(1.66)	(1.50)	(1.94)	(0.95)
N	22	20	21	22	22	21
R-squared	0.174	0.189	0.245	0.201	0.213	0.179

	(7)	(8)	(9)	(10)	(11)
rental measure	-15.20**	-19.01***	-16.20**	-18.01**	-14.14*
	(-2.78)	(-5.56)	(-2.53)	(-2.49)	(-2.05)
standardized beta coefficient	-0.396**	-0.648***	-0.474**	-0.475**	-0.405*
control+	0.0113	0.0222	-0.0464	0.690	0.386*
	(0.28)	(1.58)	(-0.21)	(1.36)	(1.96)
N	21	16	17	21	20
R-squared	0.145	0.460	0.219	0.326	0.344

t-statistics in parentheses. * $p<0.1$, ** $p<0.05$, *** $p<0.01$

+List of controls: (1): without control variables; (2): with liquid liabilities / GDP as control; (3): with private credit by deposit money banks and other financial institutions / GDP as control; (4): with bank deposits / GDP as control; (5): with financial system deposits / GDP as control; (6): with stock market capitalization / GDP as control; (7): with stock market total value traded / GDP as control; (8): with private bond market capitalization / GDP as control; (9): with public bond market capitalization / GDP as control; (10): average GDP growth before the crisis (t-5 to t-1) as control; (11): average GDP growth before the crisis (t-10 to t-1) as control.

Note: rental measures use the output (value added) of industry 71 (in NACE Rev 1.1) called *Renting of machinery and equipment without operator and of personal and household goods* in the numerator and either overall GDP or overall gross fixed capital formation (as a measure for capital expenditures) in the denominator. The averages over these ratios are taken for years preceding the crisis, either over two years (t-2 to t-1) or three years (t-3 to t-1). Output loss is measured, as a ratio of GDP, as the cumulative sum of the differences between actual and trend real GDP over the period [t, t+3], expressed as a percentage of trend real GDP, with t the starting year of the crisis.

Sources: rental measures from the OECD STAN database, output loss from Laeven and Valencia (2012), financial development indicators from the September 2012 version of the database by Beck and Demirgüç-Kunt (2009), and GDP growth from the OECD.

3 Model

To conceptualize the intuitive channel suggested by the empirical evidence, we build a simple business cycle model in the spirit of Kiyotaki and Moore (1997) and Kiyotaki (1998). The economy has infinite horizon, is in discrete time, populated by two sectors of risk-averse agents: households and entrepreneurs. Inputs for production consist of capital whose accumulation takes place in both sectors. There are two distinctions between the sectors. First, only the entrepreneur produces, and the household lives off his financial income. Second, the entrepreneur is subject to credit constraints and is less patient than the household. Output is homogeneous, and can be used for either consumption or capital investment by both agents. Both the representative household's and the entrepreneur's utility is a function of the consumption good.

3.1 Households

The representative household has the following utility maximization problem:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \ln C_t^H, \tag{4}$$

where $\beta \in (0,1)$ is the subjective discount factor, and C_t^H denotes the household's consumption at period t. The household is risk-averse, implied by the logarithmic utility function. The household can spend its purchasing power on consuming, C_t^H, buying a one-period riskless discount bond, $\frac{S_t}{R_t}$, and undertaking investment into rented capital, K_t^R. The gross real interest rate is denoted by R_t. The expenditure is financed by reselling the discount bond purchased in the previous period, by acquiring the previous period's rental fee, R_{t-1}^R, after previous period's rental service, K_{t-1}^R, and by reselling the previous period rented capital stock $\left(1-\delta^R\right) K_{t-1}^R$, where $\delta^R \in (0,1)$ denotes the depreciation rate of rentals:

$$C_t^H + \frac{S_t}{R_t} + K_t^R = S_{t-1} + \left(1-\delta^R\right) K_{t-1}^R + R_{t-1}^R K_{t-1}^R. \tag{5}$$

The right hand side of the budget constraint (5) may be defined as the net worth of the household:

$$NW_t^H = S_{t-1} + \left(1 - \delta^R\right) K_{t-1}^R + R_{t-1}^R K_{t-1}^R. \tag{6}$$

Note that the net worth of the household is predetermined at period t. Given that the household has logarithmic utility, consumption at period t is also predetermined, as it is a constant $1 - \beta$ fraction of household net worth. As a result, any shock that hits the economy at the beginning of period t will change only the composition but not the total size of household savings, denoted by HS_t:

$$HS_t = \frac{S_t}{R_t} + K_t^R. \tag{7}$$

If the borrowing constraint for some reason prevents the household from adjusting its savings through the purchase of discount bonds, then savings may adjust through an increase in the price of the discount bond, associated with falling interest rates, or through an absorption by rented capital accumulation.

Regarding the savings decision of the household, the Euler equation yields a no-arbitrage condition between the returns on supplying credit (the net interest rate, $R_t - 1$) and on investing in rental capital (the rental rate R_t^R), adjusted for the depreciation rate of rentals:

$$R_t - 1 = R_t^R - \delta^R. \tag{8}$$

This condition will tightly link changes in the interest rate to changes in the rental fee, and will be a key factor in explaining the countercyclical reaction of rentals to shocks.

As a final note, households in our setup integrate the roles of financial intermediaries (e.g. banks) and those firms who rent out capital (e.g. leasing companies). This simplification is meant to illustrate the effect of having the rental sector less financially constrained than other firms.[18]

[18] There is indeed empirical support for this assumption: leasing companies have significantly lower borrowing costs and higher leverage ratios than other firms, even after controlling for the size of their collateral (i.e. the level of fixed tangible assets). The details of these findings, based on US firms in Compustat, can be found in Tables 7 and

3.2 Entrepreneurs

The representative entrepreneur has a constant-returns-to-scale production technology, that uses capital and labour to produce a homogeneous good Y_t according to

$$Y_t = Z_t K_{t-1}^{\alpha} L_t^{1-\alpha}, \tag{9}$$

where Z_t denotes the technology shock and α is the scale parameter. To simplify the exposition below, we assume that labour is of fixed supply normalized to one, $L_t = \bar{L} = 1$. The technology shock follows a first-order autoregressive process, $\ln Z_t = \rho_z \ln Z_{t-1} + \xi_t^z$, where $\rho_z \in (0,1)$ measures the degree of persistence of the technology shock, and ξ_t^z is a white noise term with a standard deviation of σ_z. Composite capital, K_t, consists of owned capital accumulated by the entrepreneur, K_t^O, and the capital the entrepreneur rents from the household, K_t^R. We assume that there is an imperfect degree of substitutability in production between rented and owned capital:

$$K_t = \left[\omega^{\frac{1}{\epsilon}} \left(K_t^O\right)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\omega)^{\frac{1}{\varepsilon}} \left(K_t^R\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}, \tag{10}$$

where ω and ε capture the share of and the degree of substitution between the two types of capital in the composite. The motivation behind the functional form (10) is both theoretical and empirical. As we show below explicitly, perfect degree of substitutability would lead to a corner solution: depending on the relative cost of the two types of capital, all capital would be either rented or owned. Introducing some degree of complementarity helps eliminate corner solutions and leads to a unique determination of the share of renting in production.

There is also empirical evidence on the imperfect degree of substitution between renting and capital purchases. Given tax considerations, firms will prefer either rentals or debt financed purchases, depending on the tax

8 of the Appendix. As mentioned in footnote 6, some production firms may also rent out to each other, besides leasing companies whose main activity is the supply rental capital. We do not consider this case explicitly, however, to the extent that the differences in lessors and lessees are driven by differences in access to credit, the cyclical drivers of rental supply and demand are captured by the model.

treatment of interest expenses, depreciation and leasing fees.[19] Moreover, certain inherent characteristics of production inputs, especially adjustment costs, make renting more feasible in some cases than in others. For instance, transportation trucks are easily rentable, whereas the production equipment of a factory are more difficult to adjust. Also, more sophisticated machinery can be firm or plant specific, therefore may be harder to find on the rental market.[20]

Equation (10) may be seen as a reduced-form representation to incorporate all these "cross-section" dimensions which may give rise to the imperfect substitutability between rented and owned capital. The structural analysis of these factors is given by the theoretical work of Eisfeldt and Rampini (2009) and Gavazza (2011). We assume that these factors remain relatively stable over the business cycle, and focus on the dynamic role of credit constraints alone.

To introduce financial frictions into our model, we assume that there is a limited contract enforcement problem giving rise to borrowing constraints faced by the entrepreneur, as in Kiyotaki and Moore (1997). There is a limit on the amount of collateralized borrowing, B_t, the entrepreneur can obtain, and only owned capital can be used as collateral:

$$B_t \leq \theta K_t^O. \tag{11}$$

More specifically, the assumption is that only a $\theta < 1$ fraction of owned capital can be recovered in case of bankruptcy. Hence this will be the upper limit of credit the household is willing to give to the entrepreneur.

The maximization problem of the entrepreneur can be written as:

$$\max E_0 \sum_{t=0}^{\infty} \gamma^t \ln C_t^E, \tag{12}$$

where C_t^E denotes entrepreneurial consumption, and $\gamma \in (0,1)$ is the subjective discount factor of the entrepreneur, which is assumed to be smaller than that of the household, $\gamma < \beta$, following the macroeconomics litera-

[19] Miller and Upton (1976); Lewis and Schallheim (1992); Graham, Lemmon and Schallheim (1998).

[20] Indeed, the corporate finance literature has found that renting of structures is more widespread than renting of equipment, see again Eisfeldt and Rampini (2009).

ture on borrowing constraint.[21] This ensures that the borrowing constraint (11) is binding in the steady state, as entrepreneurs always borrow up to the limit, and they do not postpone consumption in order to self-finance production. The maximization problem of the entrepreneur (12) is subject to the technology constraint (9), the borrowing constraint (11), and the following budget constraint:

$$C_t^E + K_t^O + B_{t-1} + R_{t-1}^R K_{t-1}^R = Y_t + \left(1 - \delta^O\right) K_{t-1}^O + \frac{B_t}{R_t}, \tag{13}$$

where equation (13) shows that the entrepreneur uses his income from production, Y_t, and from reselling previous period's depreciated owned capital stock, $\left(1 - \delta^O\right) K_{t-1}^O$, and his borrowings through the issuance of a one-period discount bond, $\frac{B_t}{R_t}$.[22] They use this amount to finance consumption, C_t^E, investment into owned capital, K_t^O, capital renting expenditure, $R_{t-1}^R K_{t-1}^R$, and previous debt obligation, B_{t-1}. We embody the problem of separation of ownership and control, associated with rented capital, by assuming that the owned capital stock depreciates at a slower rate than the rented capital stock, $\delta^O < \delta^R$.[23]

As in the case of the household, the right hand side of the budget constraint (13) can be defined as entrepreneurial net worth:

$$NW_t^E = Y_t + \left(1 - \delta^O\right) K_{t-1}^O - B_{t-1} - R_{t-1}^R K_{t-1}^R, \tag{14}$$

where entrepreneurial net worth at period t is the sum of production and the resale value of previous period's owned capital, net the debt repayment and previous period's rental fee. Note that, contrary to the household, entrepreneurial net worth is *not* predetermined at period t, but is moved

[21]This formulation can be interpreted as firms maximizing the dividend stream, in a way that those payments are to be smoothed over time. Note that risk-aversion is not a necessary assumption for the main qualitative mechanism of the model. However, it allows the model to work better quantitatively and match some of the key business cycle moments in the data.

[22]The depreciation rate of owned capital is $\delta^O \in (0, 1)$.

[23]The difference between δ^O and δ^R can be thought of as a premium associated with the higher monitoring cost of rented capital. This assumption captures the disadvantages of rented capital related to a faster depreciation rate in production and its more costly maintenance. This approach follows the finance literature on leasing. It is also motivated by our empirical evidence on the higher depreciation rate of rented capital (see Tables 7 and 8 of the Appendix).

by unexpected shifts in productivity. Combining the budget constraint (13), the definition of net worth (14), and the borrowing constraint (11), we write the intra-period demand for owned capital as follows:

$$K_t^O = \frac{NW_t^E - C_t^E}{\left(1 - \frac{\theta}{R_t}\right)}, \tag{15}$$

where the demand for owned capital, K_t^O, is an increasing function of entrepreneurial net worth, and a decreasing function of the interest rate. The term in the denominator, $1 - \frac{\theta}{R_t}$, can be interpreted as the down payment fraction required after each piece of owned capital, as $\frac{\theta}{R_t}$ fraction is financed by issuing discount bonds at price $\frac{1}{R_t}$.

Capital demand in optimum is such that the expected value of future marginal products of owned and rented capital, $MPK_{t+1}^O = \frac{\partial Y_{t+1}}{\partial K_t^O}$ and $MPK_{t+1}^R = \frac{\partial Y_{t+1}}{\partial K_t^R}$, equal the respective user costs u_t^O and u_t^R:

$$u_t^O = E_t\left(D_{t,t+1}^E MPK_{t+1}^O\right), \tag{16}$$

$$u_t^R = E_t\left(D_{t,t+1}^E MPK_{t+1}^R\right), \tag{17}$$

where $D_{t,t+1}^E = \gamma\frac{C_t^E}{C_{t+1}^E}$ is the stochastic discount factor of the entrepreneur. The user cost of owned capital u_t^O has three components: $\frac{\theta}{R_t}$ fraction of financing costs are linked to the market interest rate R_t, $1 - \frac{\theta}{R_t}$ fraction is financed from own funds, which have an implicit cost of $1 - D_{t,t+1}^E$, and the loss incurred due to depreciation δ^O :

$$u_t^O = E_t\left\{D_{t,t+1}^E\left(\frac{\theta}{R_t}(R_t - 1)\right) + \left(1 - \frac{\theta}{R_t}\right)(1 - D_{t,t+1}^E) + D_{t,t+1}^E\delta^O\right\}. \tag{18}$$

The term $D_{t,t+1}^E\left(\frac{\theta}{R_t}(R_t - 1)\right)$ captures the discounted value of net interest payment $R_t - 1$ on the credit financed $\frac{\theta}{R_t}$ fraction of capital purchase, due at time $t + 1$. Further, $\left(1 - \frac{\theta}{R_t}\right)(1 - D_{t,t+1}^E)$ captures the net loss related to the down payment, which is the $1 - \frac{\theta}{R_t}$ fraction of financing minus the discounted value of getting it back at time $t + 1$.

Regarding the user cost of rentals, it is simply the rental rate:

$$u_t^R = E_t\left(D_{t,t+1}^E R_t^R\right). \tag{19}$$

Given the one-to-one movement in the interest rate and the rental rate implied by the no-arbitrage condition, equation (8), movements in the interest rate are perfectly matched by movements in the user cost of rented capital. In contrast, movements in the interest rate only affect the user cost of owned capital proportionally to the share that is credit financed, as expressed in equation (18). This asymmetric impact of the interest rate on the user costs changes the relative demand for the two types of capital. For instance, in a downturn when interest rates fall, renting reacts more sensitively to the interest rate decline than owning.[24] This asymmetric response of the user costs will have important consequences on the role of renting as a mitigating factor after negative shocks, which we will spell out later in Section 3.6.

3.3 Equilibrium

In the absence of shocks, the model has a unique stationary equilibrium in which entrepreneurs borrow up to the limit,[25]

$$\theta K_t^O = B_t, \tag{20}$$

and all markets clear. Equilibrium in the goods market implies that total consumption and capital investment equal production:

$$C_t^H + C_t^E + K_t^R - \left(1-\delta^R\right) K_{t-1}^R + K_t^O - \left(1-\delta^O\right) K_{t-1}^O = Y_t, \tag{21}$$

and equilibrium in the bond market results in the stock of financial savings being equal to total debt:

[24] Changes in asset prices, which we do not consider for simplicity, would make this asymmetry even stronger, because an expected asset price decline during a downturn would further drive up the relative user cost of owning.

[25] Similar to Iacoviello (2005), we consider only relatively small movements around the steady state such that the uncertainty effect is dominated by the impatience of the entrepreneurs, hence they will always choose to borrow up to the limit instead of using "buffer stock" savings.

$$S_t = B_t. \tag{22}$$

The competitive equilibrium is an allocation $\{Y_t, C_t^H, C_t^E, K_t, K_t^R, K_t^O, S_t, B_t\}_{t=0}^{\infty}$ together with the sequence of prices $\{R_t, R_t^R\}$ such that the allocation solves the optimization problems for the household and the entrepreneur, and all markets clear. The steady-state and the linearized equilibrium conditions are derived in Appendix B.1 and B.2.

A key point to note is that as the market for loanable funds clears and the borrowing constraint binds, the demand for owned capital is linked to the supply of discount bonds, $\theta K_t^O = B_t = S_t$. This has a direct effect on the composition of household savings (7), which, combined with the binding credit constraint, can be rewritten as:

$$HS_t = \frac{\theta}{R_t} K_t^O + K_t^R. \tag{23}$$

Note that household net worth and household savings HS_t are predetermined, as shown by equation (6), and the demand for owned capital K_t^O depends on the net worth of the entrepreneur, as shown by equation (15). Hence any shock that hits the net worth of the entrepreneur, and thus owned capital demand, has to be accompanied in equilibrium by movements in the real interest rate or by a change in the stock of rented capital. In addition to the asymmetric movements of the user costs discussed in the previous section, this mechanism will also be key when explaining in Section 3.6 the mitigating role of renting during crises.

3.4 The Rental Share in Steady State

The equilibrium conditions imply that the steady-state ratio of rented and owned capital is determined by the steady-state relative marginal products

MPK^R/MPK^O of rented versus owned capital, in the following manner:[26]

$$\frac{K^R}{K^O} = \left(\frac{1-\omega}{\omega}\right)\left(\frac{MPK^R}{MPK^O}\right)^{-\varepsilon}.$$

In turn, the relative marginal product equals the relative user cost u^R/u^O:

$$\begin{aligned}\frac{K^R}{K^O} &= \left(\frac{1-\omega}{\omega}\right)\left(\frac{u^R}{u^O}\right)^{-\varepsilon} \\ &= \left(\frac{1-\omega}{\omega}\right)\left(\frac{\frac{1}{\gamma}-\left(1-\delta^O\right)-\theta\frac{(\beta-\gamma)}{\gamma}}{\frac{1}{\beta}-(1-\delta^R)}\right)^{\varepsilon}.\end{aligned} \tag{24}$$

(See details of the derivation in Section B.1 of the Appendix.) Under realistic parameter values, this steady-state renting-to-owning ratio provides some intuitive results. First, the tighter the borrowing constraint the entrepreneur faces, represented by a lower θ, the less capital will be owned, and the more capital will be rented. Second, the lower the entrepreneur's subjective discount rate γ, the more impatient he becomes and thus prefers rentals to owning. Third, the higher the depreciation rate of rented capital δ^R, the higher its user cost. As a result of the increasing costliness of renting, its share compared to owned capital falls.[27] In the case of perfect substitutability ($\varepsilon = \infty$), equation (24) collapses into a corner solution, where depending on the user costs, all capital will be either rented or

[26]This follows from inverting the relationship below, which simply uses the definition of marginal products implied by the CES specification:

$$\frac{MPK^O}{MPK^R} = \frac{\alpha Z K^{\alpha-(\varepsilon-1)/\varepsilon}\omega^{\frac{1}{\varepsilon}}\left(K^O\right)^{-\frac{1}{\varepsilon}}}{\alpha Z K^{\alpha-(\varepsilon-1)/\varepsilon}\left(1-\omega\right)^{\frac{1}{\varepsilon}}\left(K^R\right)^{-\frac{1}{\varepsilon}}} = \left(\frac{\omega}{1-\omega}\right)^{\frac{1}{\varepsilon}}\left(\frac{K^R}{K^O}\right)^{\frac{1}{\varepsilon}}.$$

[27]Note that our empirical measure (1) is a strictly monotonous function of the expression (24), due to the fixed difference between the rental fee and the interest rate:

$$\begin{aligned}\frac{rent}{rent + capital\, expenditures} &= \frac{R^R K^R}{R^R K^R + (R-1+\delta^O)K^O} = \\ &= \frac{K^R/K^O}{K^R/K^O + \frac{R-1+\delta^O}{R-1+\delta^R}}.\end{aligned}$$

As such, changes in K^R/K^O are also reflected in changes in the observable empirical measure.

owned.

3.5 The Rental Share over the Business Cycle

Having explored the steady-state determinants of the rental share in the previous section, below we explain why the presence of borrowing constraints causes the share of renting to be countercyclical. In order to simplify the analysis for now, we assume perfect foresight, risk neutral entrepreneurs and no depreciation. The key relationship is that the relative marginal product equals the ratio of user costs:

$$\frac{MPK^O_{t+1}}{MPK^R_{t+1}} = \frac{u^O_t}{u^R_t}. \tag{25}$$

The relative marginal products are an inverse function of the relative capital demand K^R_t/K^O_t, and the relative user costs are a function of the interest rate R_t. As the interest rate varies over the business cycle, the relative demand of the two types of capital will change. We will consider the effect of an interest rate change on the relative marginal products, first *without* then *with* borrowing constraints.

In the case of no borrowing constraints, both user costs will equal the net interest rate: $u^O_t = u^R_t = R_t - 1$. In turn, the marginal products will also be equal, thus the relative demand for the two types of capital will be independent of the interest rate:

$$\text{No borrowing constraints:} \qquad \frac{MPK^O_{t+1}}{MPK^R_{t+1}} = 1. \tag{26}$$

Turning to the case when borrowing constraints are present thus the user costs are no longer equal, the impact of the interest rate on the user costs will be different: the fraction θ/R_t of owned capital, financed from borrowing, is affected. In contrast, the fraction $1-\theta/R_t$, financed from own funds, is unchanged. As such, when the interest rate decreases, this will translate to a larger decrease in the rental fee than in the user cost of owned capital. This increases the relative user cost of owned capital hence the relative demand for rentals. Formally, we have the following equilibrium condition between the relative marginal products and user costs:[28]

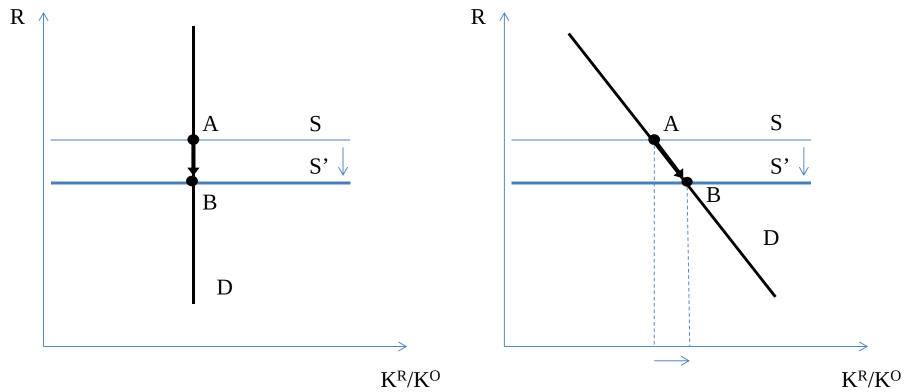
$$\text{Borrowing constraints:} \qquad \frac{MPK^O_{t+1}}{MPK^R_{t+1}} = \frac{\gamma \frac{\theta}{R_t}(R_t - 1) + \left(1 - \frac{\theta}{R_t}\right)(1-\gamma)}{\gamma(R_t - 1)}. \tag{27}$$

The entrepreneur's optimal choice thus determines the relative demand for rentals.

The relative supply is determined by the household's savings decision, i.e. the no-arbitrage condition (8). Since the yield on the two types of investment are equal, the household is indifferent between financing owned capital or supplying rented capital. As the borrowing constraint, in equilibrium, perfectly links the supply of credit and that of owned capital, the relative supply curve between the two types of capital is horizontal.

Figure 6: Relative Demand and Supply for Rented and Owned Capital

(a) Without Borrowing Constraints (b) With Borrowing Constraints



Note: In both panels, the relative supply curve is given by the household's no-arbitrage condition (8). The vertical relative demand curve in panel *a* is given by the relative user costs without borrowing constraints as in equation (26). The downward sloping relative demand curve in panel *b* is given by the relative user costs in the presence of borrowing constraints as in equation (27).

For illustration, Panel *a* of Figure 6 presents the functioning of the capital market, where the rental share is determined in the absence of bor-

[28] As for now, we assume that entrepreneurs are risk neutral, thus their subjective discount factor will be constant $D^E_{t,t+1} = \gamma$. Further, the negative relationship between the interest rate and relative capital demand under realistic parameter values can be easily checked by inverting the relative demand and differentiating it with respect to the interest rate.

rowing frictions. Since the relative demand is independent of the interest rate (vertical demand curve), a negative TFP shock which decreases the marginal product of capital hence the interest rate, would leave the rental share unchanged. This result is no longer true when we introduce imperfections to credit markets (Panel *b*), as the relative demand curve will be downward sloping. A negative TFP shock that reduces the real interest rate thus has an asymmetric effect on the user costs of rented and owned capital, which generates a substitution of owned with rented capital.

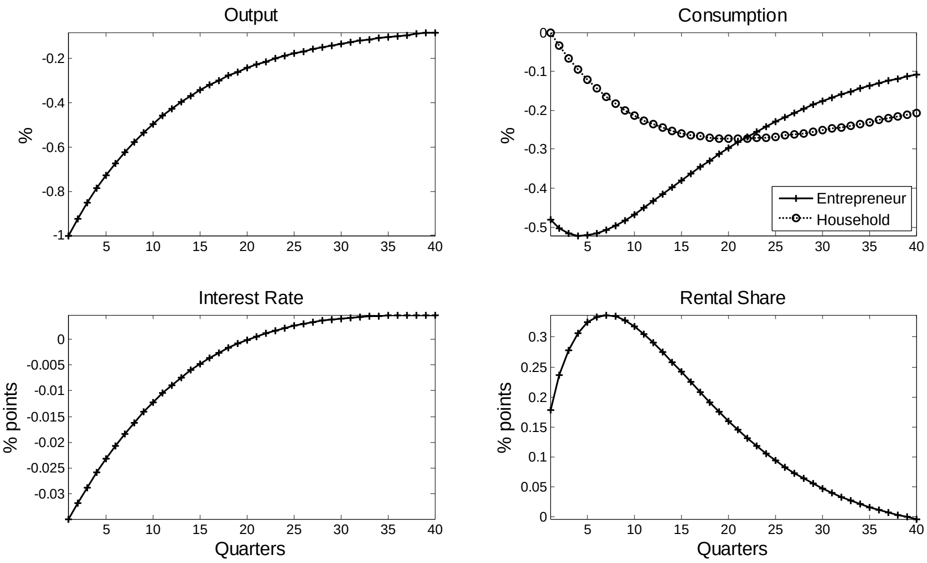
The intuition behind the countercyclical behaviour of the rental share thus can be summarized by the following general equilibrium mechanism: for the entrepreneur, there is a user cost advantage to rentals in case the interest rate decreases. Besides, for the household, renting serves as a means of absorbing the excess savings that cannot easily be absorbed by the financial system through collateralized lending. Also, this mechanism is preserved, and affected only quantitatively, if we take into account the presence of moderate differences in depreciation rates, $\delta^R > \delta^O$, and risk-averse entrepreneurs who smooth consumption.[29]

In order to illustrate the quantitative response of the model economy to a standard downturn, Figure 7 shows the dynamic responses of the key variables following a persistent negative TFP shock. Following the shock, output drops immediately and remains below its steady-state level persistently, whereas the share of renting increases on impact and remains persistently above steady state, along with the fall in the interest rate. Given logarithmic utilities, the consumption responses reflect how the negative shock affects the wealth of the two agents. The wealth of the entrepreneur, who is the net borrower in the economy, falls by more than the wealth of the household, who is the net saver. The equilibrium in the market of loanable funds is restored by falling interest rates and increasing supply of rentals.

As a further check on the quantitative predictions of the model, we compare simulated business cycle moments with the data by conditioning on standard TFP shocks. Table 2 presents some simulation results under

[29]The consumption smoothing motive makes renting even more attractive during a downturn as entrepreneurs then value their own funds more. More specifically, their stochastic discount factor decreases, hence they find the down payment fraction $1 - \frac{\theta}{R_t}$ even more costly to sacrifice.

Figure 7: The Dynamic Effects of a Negative TFP Shock



Note: The vertical axes show percentage or percentage point deviations from the steady-state values in the benchmark model (see label description on the vertical axes). The horizontal axes are in quarters. To produce this graph, the benchmark model used the following parameters: $\alpha = 0.3$, $\beta = 0.9925$, $\gamma = 0.97$, $\delta^R = 0.03$, $\delta^O = 0.02$, $\omega = 0.75$, $\varepsilon = 4.5$, $\theta = 0.6$, $\rho_z = 0.9$, $\sigma_z = 0.01$. The impulse responses are obtained by taking first-order approximation of the model described in the main text. The description of the log-linearized model can be found in Appendix B.2.

standard parametrization. These moments are compared to those observed in the US data. We consider the period 1980-2007, excluding the financial crisis.

In spite of the lack of endogenous labour and the general simplicity of the model, it does reasonably well at matching the second moments of the rental share, while getting close to explaining the dynamics of aggregate consumption, investment and output. More specifically, the annual standard deviation of the rental share in the data is 0.918% points with a correlation coefficients of -0.649. The simulated annual standard deviation is somewhat smaller, 0.802% points, whereas the correlation with output is somewhat larger in absolute terms, -0.917.

Table 2: Business Cycle Statistics at Annual Frequency

Variables	Data (1980-2007)		Model	
	St.dev.	Correlation with output	St.dev.	Correlation with output
Output	1.272	1.000	1.595	1.000
Rental share *	0.918	-0.649	0.802	-0.917
Investment	4.323	0.949	3.934	0.889
Consumption	0.991	0.903	1.241	0.946

* Rental share is taken from Compustat annual data (see equation 2), and is not available at quarterly frequency. Data on real output, investment and consumption are from the Bureau of Economic Analysis, Chained Dollars, HP-filtered logarithms, with a smoothing parameter 6.25 for annual data, as in Ravn and Uhlig (2002). To produce this table, the benchmark model used the following parameters: $\alpha = 0.3$, $\beta = 0.9925$, $\gamma = 0.97$, $\delta^R = 0.03$, $\delta^O = 0.02$, $\omega = 0.75$, $\varepsilon = 4.5$, $\theta = 0.6$, $\rho_z = 0.9$, $\sigma_z = 0.007$. The model moments are obtained by generating 500 simulated datasets, each containing 200 quarters. Annual moments are then obtained by averaging the quarterly observations. The mean over the results from the 500 simulations are presented in Table 2.

3.6 The Role of Renting in Crises

To understand the importance of renting in the presence of borrowing constraints, we ask whether the propagation of shocks is changed by the possibility of renting. In addition to analyzing the effects of TFP shocks, we study the impact of an exogenous shift in the collateral value θ which may be thought of as a proxy for financial shocks or credit crunches. By doing so, we follow Iacoviello (2011), Jermann and Quadrini (2012) and Liu, Wang and Zha (2013), and adopt the following exogenous shock process:

$$\ln \theta_t = (1 - \rho_\theta) \ln \theta + \rho_\theta \ln \theta_{t-1} + \xi_t^\theta,$$

where $\rho_\theta \in (0, 1)$ measures the degree of persistence of the collateral shock, θ is the steady-state value of θ_t, and ξ_t^θ is a white noise term with standard deviation σ_θ. It is helpful to reconsider the household's savings condition (23), as follows:

$$HS_t = \frac{\theta_t}{R_t} \frac{NW_t^E - C_t^E}{\left(1 - \frac{\theta_t}{R_t}\right)} + K_t^R, \tag{28}$$

which suggests that an exogenous fall in the collateral value θ_t would reduce the amount of household savings being intermediated through credit markets for two reasons. First, the entrepreneur's demand for owned capital, described by equation (15), falls because the down payment required to purchase one unit of capital, $1 - \frac{\theta_t}{R_t}$, increases. The falling demand for owned capital would decrease entrepreneurial demand for credit as well. Second, the household's ability to save through credit markets diminishes when the offered collateral – a fraction $\frac{\theta_t}{R_t}$ of owned capital for each unit of loan – falls. Both effects point to the same direction, and without rental markets, they must be accompanied by an immediate and large drop in the interest rate in order to absorb predetermined household savings. A large fall in interest rates will substantially reduce the net worth of the household from the second period onwards, which will impede the future supply of loanable funds hence slowing down economic recovery. The presence of rentals, K_t^R, would mitigate the destruction of household wealth by taking over some of the negative interest rate adjustment when credit markets malfunction, and would channel some of the loanable resources back into production.

This mitigating impact is also present in the face of TFP shocks, however it is much more muted for the following reason. Unlike in the case of a TFP shock where the shock itself was symmetric in hitting the marginal products of the two types of capital equally badly, a collateral shock has a direct impact on the relative user costs of the two types of capital, hence on the relative marginal products:[30]

$$\frac{u_t^O}{u_t^R} = \frac{\gamma \frac{\theta_t}{R_t}(R_t - 1) + \left(1 - \frac{\theta_t}{R_t}\right)(1-\gamma) + \gamma\delta^O}{\gamma(R_t - 1 + \delta^R)}. \tag{29}$$

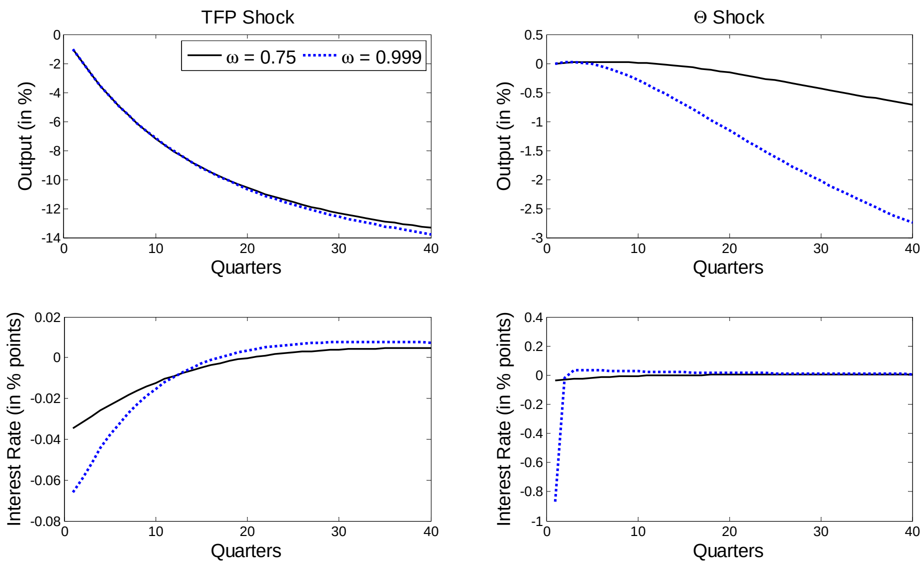
A negative shock to θ_t, which may be seen as a positive shock to down payment requirements $1 - \frac{\theta_t}{R_t}$ for collateralized borrowing, directly increases the user cost of owning because internal funds are more valuable to the entrepreneur than to the market.[31] When a shock to θ_t hits the borrowing constraint and thereby decreases the relative user cost of renting, the financial shock leads to an anti-clockwise rotation in the relative demand curve

[30] For simpler exposition, we again assumed away uncertainty and assume risk neutral entrepreneurs, i.e. their discount factor is fixed at γ.

[31] For this to hold, we need to have $\gamma(R_t - 1) < 1 - \gamma$, which is equivalent to $\gamma < \frac{1}{R_t}$. Note that this inequality captures precisely our assumption that entrepreneurs are more impatient than the market.

in panel *b* of Figure 6. This makes rented capital even cheaper and the rental share even more countercyclical than in response to a TFP shock. Put differently, a financial shock impacts the rental share in two ways. First, as the shock hits the intermediation of credit, there is an excess amount of savings resulting in a fall of the interest rate. This interest rate decline is translated into a relative user cost decline of rentals, similarly to the case of a negative TFP shock. The second, additional impact is through the increase in the required down payment, which directly raises the user cost of owning. One would therefore expect that the possibility of renting has a larger impact on the propagation of a financial shock than on the propagation of a TFP shock.

Figure 8: The Effects of a Negative TFP and Collateral Shock with and without Renting



Notes: The figures represent cumulative impulse responses of output and non-cumulative responses of the interest rate following a 1% shock to TFP, Z_t, and the collateral value, θ_t. The horizontal axes are in quarters. To produce this graph, the benchmark model used the following parameters: $\alpha = 0.3$, $\beta = 0.9925$, $\gamma = 0.97$, $\delta^R = 0.03$, $\delta^O = 0.02$, $\omega = 0.75$ (with renting) or $\omega = 0.999$ (without renting), $\varepsilon = 4.5$, $\theta = 0.6$, $\rho_z = 0.9$, $\sigma_z = 0.01$.

To present this mechanism quantitatively, we compare the impact of negative TFP and collateral shocks in the benchmark model ($\omega = 0.75$) to a hypothetical world where the role of renting in production is marginal

(ω = 0.999) in composite capital (10). Figure 8 shows the cumulative and non-cumulative impulse responses of output and interest rate, respectively. Following a one standard deviation shock to TFP, the responses are marginally lower in the model with the possibility of renting. As argued above, renting serves as an absorber of excess savings, hence the interest rate does not have to fall as much as in the case without renting in order to clear the market of loanable funds. However, the difference is not substantial as the advantage of renting – an absorber of excess savings – is partly off-set by a negative efficiency effect related to its higher depreciation rate compared that of owned capital.

As predicted above, the difference is considerably bigger for a collateral shock, in which case renting substantially mitigates the impact of the crisis. The mitigation is larger because the very nature of a negative θ shock makes renting cheaper, as it directly reduces its user cost relative to owned capital as implied by equation (29). In addition, a collateral shock hits directly the market of loanable funds, thereby triggering a sharper increase in excess savings, in which case the interest rate must fall abruptly in order to clear the bond market. The presence of renting mitigates as it serves as an absorber of excess savings. This result is in line with the empirical evidence presented in Section 2.3, where we showed that the cumulative output loss after financial crises is systematically lower in countries relying more on capital renting.

4 Conclusion

This paper has provided empirical evidence on the countercyclicality of the rental share over the business cycle and on the mitigating role of renting during financial distress. It has presented a dynamic stochastic general equilibrium model with borrowing constraints, which provided an explanation based on borrowing constraints for the countercyclical behaviour and the mitigating impact of rentals during crises. Despite its simplicity, the model performed reasonably well at matching some of the key business cycle moments in the data. The model has shown that the possibility of renting can be powerful, during a downturn, in absorbing some of the economic resources that cannot be absorbed by malfunctioning credit markets.

The focus of the paper has been the aggregate study of the countercyclicality of renting, and the implications of firm-heterogeneity are left for future research. The roles of adjustment costs, irreversibility constraints and uncertainty in affecting renting may be subject to further analysis too.

As a conclusion, we would like to point at two possible implications of this paper. First, our results suggest that it may be important for macroeconomic modellers to distinguish between owned and rented capital. The majority of DSGE models used by policy makers and academics do not make such a distinction, whereas our empirical and theoretical results suggest that the owning-versus-renting choice is a relevant issue. Second, as our results show that the possibility of renting could alleviate problems associated with borrowing constraints and mitigate the adverse impacts of financial shocks, they highlight a potential macroeconomic benefit of having well-developed rental and leasing markets in place, especially in times of tight credit conditions.

Appendix

A Empirical Appendix

A.1 Data Description

The detailed description of variables, with the Compustat variable name in parentheses (Source: Compustat Users's Guide):

- rental expenses (*xrent*): This item represents all costs charged to operations for rental, lease, or hire of space and/or equipment.[32]
- property, plant and equipment (*ppent*): This item represents the cost, less accumulated depreciation, of tangible fixed property used in the production of revenue.
- depreciation and amortization (*dp*): This item represents non-cash charges for obsolescence of and wear and tear on property, allocation of the current portion of capitalized expenditures, and depletion charges.
- amortization of intangibles (*am*): This item represents a non-cash charge for the systematic write-off of the cost of intangible assets over the period for which there is an economic benefit.
- capital expenditures (*capx*): This item represents cash outflow or the funds used for additions to the company's property, plant and equipment, excluding amounts arising from acquisitions, reported in the Statement of Cash Flows.
- average short-term borrowings rate (*bastr*): This item represents the approximate weighted average interest rate for aggregate short-term borrowings for the reporting year. This item is not available for banks or utility companies.

[32] This item excludes so-called *capital leases*, which are accounted for among owned assets on the book. This is justified on the grounds that capital leases are closer to collateralized lending than to real rentals because ownership is essentially acquired by the lessee. The rental expense measure captures only *operating leases*, which do not imply a transfer of ownership to the lessee, hence the lessor bears all the risks of ownership. For more details, see Table 1 of Eisfeldt and Rampini (2009).

- employment (*emp*): This item represents the number of company workers as reported to shareholders. This is reported by some firms as an average number of employees and by some as the number of employees at year-end. No attempt has been made to differentiate between these bases of reporting. If both are given, the year-end figure is used.

- sales (*sales*): This item represents an industry segment's gross sales (the amount of actual billings to customers for regular sales completed during the period) reduced by cash discounts, trade discounts, and returned sales and allowances for which credit is given to customers.

The number of observations, broken down by SIC (Standard Industrial Classification) sectors, are shown in Table 3. Companies in the following sectors are omitted from the analysis: public sector (SIC codes equal 9000 and above), the financial sector (SIC codes starting with 6) as they are the providers of credit hence not considered credit constrained, and agriculture (SIC codes smaller than 1000) as they are less synchronized with the business cycle and also have very few firms in Compustat. Industries whose primary activity is to rent out capital are also excluded, unless indicated otherwise (e.g. Tables 7 and 8): lessors of railroad and real property (6517, 6519), real estate agents (6531), automotive rental and leasing (7510-7519), miscellaneous equipment rental (7350-7359), computer rentals (7377).

Table 3: Number of Observations Broken down by Industries

	Firm-year observations	Firms
Manufacturing	112,883	9,452
Transport, Telecom. and Utilities	32,146	2,554
Trade	28,460	2,586
Services	45,705	4,637
Mining, Oil and Gas	24,935	2,728
Construction	3,246	302
Renting or lessor industries	2,279	233
Total	249,654	22,492

Renting or lessor industries are the following (SIC 4-digit industry codes in parentheses): Lessors of railroad and real property (6517, 6519), real estate agents (6531), automotive rental and leasing (7510-7519), miscellaneous equipment rental (7350-7359), computer rentals (7377).
Source: Compustat, annual financial statements for US companies, 1980-2011.

External data on real GDP (chain-weighted real GDP in billions of chained 2005 dollars) and GDP deflator to deflate sales in Compustat (Implicit Price Deflators for Gross Domestic Product) is taken from the National Income and Product Account Tables of the Bureau of Economic Analysis (as of 11 July 2012).

The data set, used for analyzing the role of the rental sector, is compiled by merging three cross-country data sets (see Section 2). Descriptives of that data are shown in Table 4.

Table 4: Descriptives of the Data Used for Analyzing the Role of the Rental Sector during Financial Crises

	output loss	rentals / GDP	rentals / capital expenditures	private credit by deposit money banks and other financial institutions / GDP	bank deposits / GDP	financial system deposits / GDP
mean	0.285	0.007	0.030	1.110	0.876	0.889
std. dev.	0.183	0.004	0.021	0.458	0.711	0.704
minimum	0.000	0.001	0.003	0.425	0.296	0.296
maximum	0.696	0.019	0.080	1.916	3.737	3.737
N	23	22	22	23	24	24

	stock market capitalization / GDP	stock market total value traded / GDP	private bond market capitalization / GDP	public bond market capitalization / GDP	liquid liabilities / GDP
mean	0.828	0.828	0.651	0.396	0.958
std. dev.	0.557	0.802	0.824	0.220	0.738
minimum	0.087	0.005	0.025	0.110	0.368
maximum	2.078	2.211	3.502	0.812	3.778
N	21	22	17	18	22

Note: rental measures use the output (value added) of industry 71 (in NACE Rev 1.1) called Renting of machinery and equipment without operator and of personal and household goods in the numerator, and either overall GDP or overall gross fixed capital formation (as a measure for capital expenditures) in the denominator. The averages over these ratios are taken for years preceding the crisis, either over two years (t-2 to t-1) or three years (t-3 to t-1). Output loss is measured, as a ratio of GDP, as the cumulative sum of the differences between actual and trend real GDP over the period [t, t+3], expressed as a percentage of trend real GDP, with t the starting year of the crisis. Source: rental measures from the OECD STAN database, output loss from financial crises from Laeven and Valencia (2012), financial development indicators from Cihak et al. (2012), and GDP growth from OECD.

A.2 The Importance of Renting at the Firm Level

Table 5: Small Firms Rely More on Renting

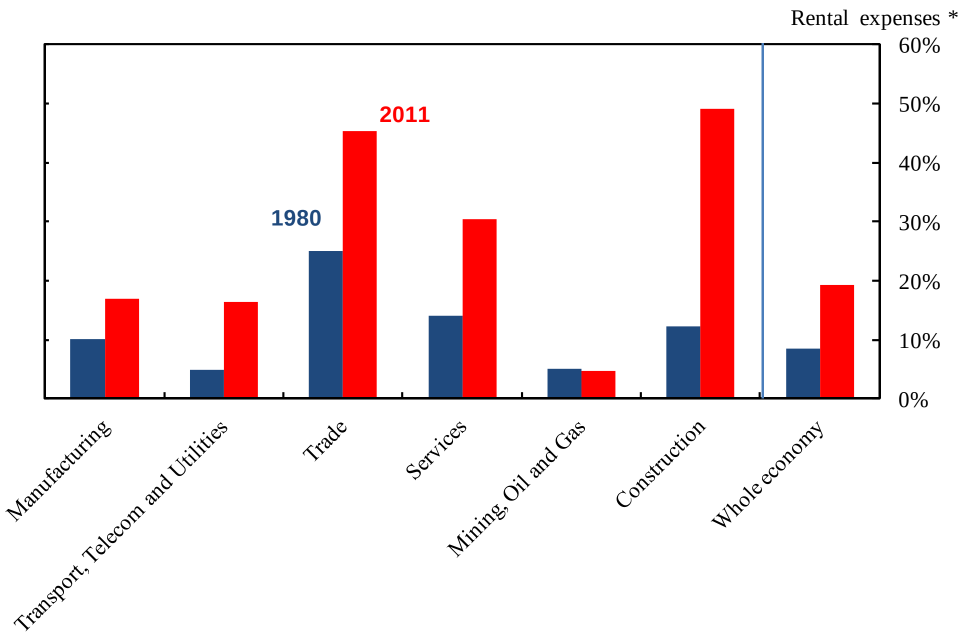
The Effect of Sectoral Affiliation and Firm Size on Renting

	(1)	(2)	(3)
Base effect	0.335***	0.422***	0.632***
	(88.37)	(95.47)	(4.37)
Sectors			
Transport, Telecom and Utilities	-0.036***	-0.051***	0.087
	(-7.94)	(-9.56)	(0.89)
Wholesale and Retail Trade	0.161***	0.138***	-0.219***
	(32.05)	(25.46)	(-3.82)
Services	0.085***	0.076***	-0.191***
	(22.22)	(17.49)	(-2.79)
Mining, Oil and Gas	-0.177***	-0.205***	-0.128**
	(-51.56)	(-42.19)	(-2.39)
Construction	-0.012	0.004	-0.256***
	(-0.84)	(0.25)	(-3.95)
Firm size quartiles			
2	-0.069***	-0.086***	-0.345***
	(-15.40)	(-16.54)	(-2.92)
3	-0.112***	-0.143***	-0.482***
	(-25.56)	(-28.43)	(-4.15)
4	-0.168***	-0.209***	-0.523***
	(-38.73)	(-41.77)	(-4.38)
N	17,598	17,563	17,436
R-sq	0.255	0.241	0.003
Overall mean	0.266	0.327	0.142

t-statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
Note: Left hand side variables are firm-level rental share measures, averaged over time, for each firm.
(1) Baseline measure: $rental\, share^{(1)}_{it} = \frac{rent_{it}}{rent_{it}+(\delta_{it}+i_{it})K_{it}}$
(2) Direct measure for capital expenditures in the denominator: $rental\, share^{(2)}_{it} = \frac{rent_{it}}{rent_{it}+capital\, expenditures_{it}}$
(3) Sales in denominator: $rental\, share^{(3)}_{it} = \frac{rent_{it}}{sales_{it}}$
The base effect is the combination of the left out categories for each dimension, that is manufacturing firms in the smallest firm size quartile. Firm size is measured by fixed tangible assets. Sectoral classifications are based on the Standard Industrial Classification (SIC).

A.3 The Importance of Renting by Sectors and over Time

Figure 9: Renting Has Increased in Nearly All Sectors



*Rental expenses are measured by the rental expenditure share, defined in equation 2, for the years 1980 and 2011, by SIC 1-digit sectors.
Source: Compustat, annual financial statements, 1980-2011.

A.4 Robustness Checks on the countercyclicality of Renting

Table 6: The Robustness of countercyclicality between Renting and Output (1980-2011)

Correlation Coefficients between Several Rental and Output Measures

Output measures		Measures of rental expenses (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total GDP, *in period*	*t-1*	-0.481	-0.515	-0.49	-0.491	0.229	0.154	-0.075	0.223	-0.482
	t	-0.507	-0.631	-0.337	-0.339	-0.081	-0.111	-0.641	-0.54	-0.496
	t+1	0.066	0.148	0.205	0.217	-0.546	-0.538	-0.097	-0.518	0.058
Compustat sales, *in period*	*t-1*	-0.394	-0.417	-0.473	-0.489	0.336	0.227	0.128	0.38	-0.399
	t	-0.629	-0.778	-0.49	-0.547	0.131	0.123	-0.864	-0.456	-0.614
	t+1	-0.156	0.113	-0.048	-0.03	-0.479	-0.503	-0.256	-0.655	-0.163

Definition of rental expense measures:
(1) Benchmark, aggregate measure (equation 2)
(2) Directly observed *Capital expenditures* in denominator, instead of using the implied cost of capital
(3) Benchmark, firm-level mean of equation (1)
(4) Benchmark, firm-level median of equation (1)
(5) Mean of firm-level rental expenses (i.e. only numerator of rental share)
(6) Median of firm-level rental expenses (i.e. only numerator of rental share)
(7) Sales in denominator
(8) Employment in denominator
(9) Balanced sample
Note: Each measure is HP-filtered (with smoothing parameter 6.25) before calculating the correlations.
Source: Compustat (rental expense measures and sales), Bureau of Economic Analysis (GDP and GDP deflator)

To show the robustness of this negative relationship between output and renting, Table 6 presents correlations between the cyclical components of a number of rental and output measures. It confirms that the contemporaneous correlations are robustly negative with respect to both output measures, and for most measures, they tend to be stronger than either lagging or leading correlations. Also, the countercyclicality of rental expenses does not hinge upon the type of capital expenditure measure we use for the denominator (compare measures 1 and 2). Nor it is driven by compositional and firm-size changes throughout the sample (compare measures 1, 3, 4 and 9). Note that measures (5) and (6), which lend the weakest support to countercyclicality, measure the mean and the median of log rental expenditures, without normalizing it with any firm size measure. Also, they do not control for an important factor which is pushing their correlation towards zero, namely the price of rentals (the rental fee). What we can observe for each company is only the nominal *rental expenditure,* which is the product of the rental fee and the amount of rented capital:

$$rent = R^R K^R,$$

where R^R is the rental fee and K^R is the amount of rented capital. This is why it is important to relate rental expenses to total capital expenditures and look at the rental expenditure share: doing so will automatically control for price changes of capital goods, and more generally the changes in the cost of capital (i.e. interest rates and depreciation rates). This has also been the practice in the finance literature when measuring the degree of leasing activity by firms (Eisfeldt and Rampini, 2009, and Rampini and Viswanathan, 2013).[33] Nevertheless, we include two other measures that are normalized with a different firm-size measure than total capital expenditures: sales and employment (columns 7 and 8). The countercyclicality is still preserved.

A.5 Differences between Lessors and the Rest of the Economy

In order to see the extent to which differentiating between lessors and the rest of the economy is justified when considering their financial constraints, this subsection compares the observed leverage ratios and borrowing rates (i.e. interest rates on borrowings) of the two sectors, controlling for the level of collateral (tangible capital). Larger leverage ratios and lower borrowing rates are taken as an indication that lessors are less constrained hence are more capable of accumulating capital and rent it out, compared to the average non-lessor firm. Furthermore, the portfolio of the tangible assets on their balance sheets - which are essentially the ones being rented

[33] Of course, if the rental fee does not closely follow the cost of capital over the cycle, then such a normalization may not take out all cyclical variation due to changes in the rental fee. Although it is difficult to obtain relatively long time-series data on rental rates of capital goods, in order to check their co-movement empirically, theory predicts that a constant "markup" on the rental fee (in order to compensate for additional depreciation of rented capital goods due to moral hazard) results in a perfect correlation between the cost of capital and the rental rate. Also, as we assume that the relative price of rented to owned capital goods are equal, we leave out considerations related to relative price changes.

out - should show higher depreciation due to the more wear and tear stemming from moral hazard on the side of the lessees (firms who rent those capital goods). Tables 7 and 8 show that indeed there are statistically and economically significant differences between lessors and the rest of the economy, at the firm and aggregate levels, respectively.

Table 7: Comparing Lessor Companies with the Rest: Firm-level Results

Panel a: Firm-level Regressions

	Leverage ratio		Borrowing rate (%)		Depreciation rate	
	(1)	(2)	(3)	(4)	(5)	(6)
Lessor industries+	0.0688***	0.0659***	-0.489***	-0.402***	0.0246***	0.0276***
	(3.44)	(3.33)	(-3.18)	(-2.75)	(4.54)	(6.02)
k		-0.0359***		-0.266***		-0.0255***
		(-24.58)		(-24.62)		(-75.24)
k^2		0.00453***		0.000333		0.00167***
		-23.67		(0.24)		(37.54)
Year fixed effects	yes	yes	yes	yes	yes	yes
N	23891	23891	23891	23891	23891	23891
R-squared	0.004	0.029	0.679	0.711	0.028	0.300

t statistics in parentheses * p<0.1, ** p<0.05, *** p<0.01
k measures the log of fixed tangible assets and is meant to be a proxy for the size of the collateral the firm can use when drawing on external funds.
+Lessor industries indicate a dummy variable for those firms whose industrial classification is in one of the following industries (SIC 4-digit industry codes in parentheses): Lessors of railroad and real property (6517, 6519), real estate agents (6531), automotive rental and leasing (7510-7519), miscellaneous equipment rental (7350-7359), computer rental (7377).

Panel b: Descriptive Statistics

	mean	percentiles			N
		10th	50th	90th	
Leverage	0.59	0.29	0.57	0.85	23891
Borrowing rate (in %)	10.82	6.00	10.40	16.60	23891
Depreciation rate	0.14	0.06	0.12	0.24	23891

Source: Compustat, US incorporated, publicly traded firms' annual statements, for the period 1980-2011. Only those firms are included where the leverage ratio, the borrowing rate and the depreciation rates are jointly available.

Table 8: Comparing Lessor Companies with the Rest: Aggregate Results

	Leverage ratio	Borrowing rate (%)	Borrowing rate, weighted (%)	Depreciation rate
Lessor companies	0.77	5.23	2.15	0.12
Rest of the economy	0.62	5.54	2.35	0.09
Difference	0.15	-0.31	-0.19	0.03

Note: annual averages of aggregate measures over the years 1980-2011. Aggregate measures are computed by summing numerators and denominators of ratios (leverage ratio and depreciation rates), and a simple cross-sectional average is taken in case of the borrowing rates or weighted by fixed tangible assets (Borrowing rate, weighted). Depreciation rate is measured by the ratio of depreciation of tangible assets to fixed tangible assets. Leverage is measured by the ratio of total liabilities to total assets. Source: Compustat, US companies' annual statements, for the period 1980-2011.

B Theoretical Appendix

B.1 Steady state of the Model

This section provides an analytic description of the steady state of the model described in Section 3. The steady-state values are denoted by $\bar{\cdot}$. The level of owned capital:

$$\overline{K}^O = \left(\frac{\frac{1}{\gamma} - \left(1 - \delta^O\right) - \frac{\theta}{\gamma}\left(\beta - \gamma\right)}{\alpha \left(\omega^{\frac{1}{\varepsilon}} + (1-\omega)^{\frac{1}{\varepsilon}} \left(\frac{\frac{1}{\gamma} - (1-\delta^O) - \frac{\theta}{\gamma}(\beta-\gamma)}{\frac{1}{\beta} - (1-\delta^R)} \right)^{\varepsilon - 1} \left(\frac{1-\omega}{\omega} \right)^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\epsilon}{\epsilon-1}\alpha - 1} \omega^{\frac{1}{\varepsilon}}} \right)^{\frac{1}{\alpha-1}} \tag{30}$$

The level of rented capital:

$$\overline{K}^R = \left(\frac{A}{\alpha E^k \omega^{\frac{1}{\varepsilon}}} \right)^{\frac{\varepsilon}{k\varepsilon - k - 1}} (D)^{\varepsilon} \left(\frac{1-\omega}{\omega} \right) \tag{31}$$

where $A = \frac{1}{\gamma} - \left(1 - \delta^O\right) - \frac{\theta}{\gamma}\left(\beta - \gamma\right)$, $D = \frac{\frac{1}{\gamma} - \left(1-\delta^O\right) - \frac{\theta}{\gamma}(\beta-\gamma)}{\frac{1}{\beta} - (1-\delta^R)}$, $E = \omega^{\frac{1}{\varepsilon}} + (1-\omega)^{\frac{1}{\varepsilon}} (D)^{\varepsilon-1} \left(\frac{1-\omega}{\omega}\right)^{\frac{\varepsilon-1}{\varepsilon}}$, $k = \frac{\varepsilon}{\varepsilon - 1}\left(\alpha - (\varepsilon - 1)/\varepsilon\right)$

The level of composite capital used in production:

$$\overline{K} = \left[\omega^{\frac{1}{\varepsilon}} \left(\frac{A}{\alpha E^k \omega^{\frac{1}{\varepsilon}}}\right)^{\frac{\varepsilon-1}{k\varepsilon-k-1}} + (1-\omega)^{\frac{1}{\varepsilon}} \left(\frac{A}{\alpha E^k \omega^{\frac{1}{\varepsilon}}}\right)^{\frac{\varepsilon-1}{k\varepsilon-k-1}} (D)^{\varepsilon-1} \left(\frac{1-\omega}{\omega}\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}} \tag{32}$$

The level of household consumption:

$$\overline{C} = \left[\left(\frac{A}{\alpha E^k \omega^{\frac{1}{\varepsilon}}}\right)^{\frac{\varepsilon}{k\varepsilon-k-1}} \left(\theta\beta + (D)^{\varepsilon} \frac{1-\omega}{\omega}\right)\right] (\frac{1}{\beta} - 1) \tag{33}$$

The level of production:

$$\overline{Y} = \left[\omega^{\frac{1}{\varepsilon}} \left(\frac{A}{\alpha C^k \omega^{\frac{1}{\varepsilon}}}\right)^{\frac{\varepsilon-1}{k\varepsilon-k-1}} + (1-\omega)^{\frac{1}{\varepsilon}} \left(\frac{A}{\alpha C^k \omega^{\frac{1}{\varepsilon}}}\right)^{\frac{\varepsilon-1}{k\varepsilon-k-1}} (D)^{\varepsilon-1} \left(\frac{1-\omega}{\omega}\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\alpha\frac{\varepsilon}{\varepsilon-1}} \tag{34}$$

The level of borrowings and savings:

$$\overline{B} = \overline{S} = \theta\beta \left(\frac{A}{\alpha E^k \omega^{\frac{1}{\varepsilon}}}\right)^{\frac{\varepsilon}{k\varepsilon-k-1}} \tag{35}$$

B.2 Optimality Conditions

This section presents the optimality conditions of the the household and the entrepreneur, as explained in Section 3.

$$\frac{1}{R_t} = \beta E_t \frac{C_t^H}{C_{t+1}^H} \tag{36}$$

$$\frac{1}{1 + R_t^R - \delta^R} = \beta E_t \frac{C_t^H}{C_{t+1}^H} \tag{37}$$

$$\frac{1}{R_t} - \psi_t = \gamma E_t \frac{C_t^E}{C_{t+1}^E}, \tag{38}$$

where ψ_t is the shadow price of the borrowing constraint (11).

$$\gamma E_t \left\{\frac{C_t^E}{C_{t+1}^E} \left[\alpha Z_{t+1} K_t^{\alpha-(\varepsilon-1)/\varepsilon} \omega^{\frac{1}{\varepsilon}} \left(K_t^O\right)^{-\frac{1}{\varepsilon}}\right]\right\} = 1 - \gamma E_t \left\{\frac{C_t^E}{C_{t+1}^E} \left(1 - \delta^O\right)\right\} - \theta\psi_t \tag{39}$$

$$\gamma E_t \left\{ \frac{C_t^E}{C_{t+1}^E} \left[\alpha Z_{t+1} K_t^{\alpha-(\varepsilon-1)/\varepsilon} (1-\omega)^{\frac{1}{\varepsilon}} \left(K_t^R\right)^{-\frac{1}{\varepsilon}} \right] \right\} = \gamma E_t \left\{ \frac{C_t^E}{C_{t+1}^E} R_t^R \right\} \quad (40)$$

B.3 Parameter values

The quarterly parameter values are presented in Table 9. Following Iacoviello and Neri (2010), the discount rates of the household and the entrepreneur are $\beta = 0.9925$ and $\gamma = 0.97$, respectively. Capital's coefficient in production is set at $\alpha = 0.3$. The share of renting in composite capital is $\omega = 0.75$, which is calibrated to match the steady-state value of rental share suggested by the model with the value (around 25%) observed in the data. The degree of elasticity ε is calibrated to match the observed volatility of the rental share. The depreciation rate of owned capital is set lower, $\delta^O = 0.02$, than that of rented capital, $\delta^R = 0.03$. These values are based on our firm-level data set. The tightness of the borrowing constraint is $\theta = 0.6$, which gives a steady-state ratio of debt over quarterly GDP equal to around 3.7, similar to Jermann and Quadrini (2012). The persistence of the technology shock is fairly standard, $\rho_z = 0.9$, and the persistence of the collateral shock is set at $\rho_\theta = 0.9$, based on Iacoviello (2011).

Table 9: Parameter values of the quarterly benchmark model

Description	**Parameter**	**Value**
Preferences: Discount factors		
Patient household	β	0.9925
Impatient entrepreneur	γ	0.97
Technology parameters		
Capital's coefficient in production	α	0.3
Share of renting in composite capital	ω	0.75
Elasticity of substitution between the two types of capital	ε	4.5
Depreciation rate of rented capital	δ^R	0.02
Depreciation rate of owned capital	δ^O	0.03
Tightness of the borrowing constraint	θ	0.6
Persistence of the technology shock	ρ_z	0.9
Persistence of the financial shock	ρ_θ	0.9

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