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To Create or to Redistribute? That is the Question *

Demetris Koursaros[†], Nektarios Michail[‡], Niki Papadopoulou[§], Christos Savva[¶]

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Abstract

This study attempts to explain low corporate investment in the post-crisis period, which persisted despite aggressive easing of financial conditions. Agents utilize available funding by either investing in new capital creation or by acquiring existing assets (asset redistribution). The former increases total income and employment, while the latter alters the distribution of wealth amongst agents. Theoretical explanations and empirical evidence are provided to support the argument that during recessions investors deem it more profitable and banks find it safer to fund re-purchases of existing assets, rather than create new assets. This trend exacerbates a recession and slows recovery as it deprives entrepreneurs of funding. Furthermore, this scenario provides an explanation of the phenomenon of rising inequality and social harm over the course of a recession. As asset redistribution is predominantly a privilege of the rich, an increase in inequality encourages more income redistribution, thus further exacerbating recessions. Finally, it is demonstrated that macroprudential policies promoting access to finance for new capital investments can discourage asset redistribution and potentially boost recovery.

JEL Classification: *E52; E25; E32; E21*

Keywords: *investment; business cycles; asset redistribution; inequality*

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Contents

1 Introduction

The financial crisis of 2007 was followed by weak recovery not only in the US but also across most developed countries. The deployment of conventional and unconventional monetary policy tools, were only somewhat effective in tackling the crisis, as shown by, for example, Engen et al. (2015) and Chung et al. (2012). It has been particularly puzzling that corporate investment has remained stubbornly low, despite aggressive efforts by central banks to ease financial conditions. Figure 1 shows the evolution of corporate bond yields and bank loan rates. The green solid line corresponds to the weighted-average effective loan rate for commercial and industry loans across US commercial banks. Clearly, the cost of borrowing is experiencing near-record lows for large companies as well as small- and medium-sized enterprises, which traditionally rely more heavily on bank loans. As Gilchrist et al. (2015) state, this is the effect of both conventional and unconventional tools of monetary policy that tend to reduce the borrowing rate for investors. However, investment recovery has remained very weak.

The most common explanation for this phenomenon is that the return on investment in capital formation has been too low during and after the crisis. To shed some light on this, Figure 2 provides a useful interpretation. The blue and red bars correspond to the yields for pre- and post-crisis periods covering 1990 - 2007 and 2010 - 2014 respectively, for various investments in the US. From left to right the numbers represent the return to capital (marginal product of capital), the yields of Baa and Aaa bonds, the yield on government bonds and the return on the stock market. The green line is the percentage change in the yield from the two sub-periods for each asset category. While it is clear that the assets experienced a drop in their yields compared to the pre-crisis period, the return to capital has not deteriorated as much, thus still providing a high return. Banerjee et al. (2015) confirm these findings, stating that the low capital investment cannot be attributed to the low capital returns.

Using a panel of seven OECD countries, Banerjee et al. (2015), Guiso and Parigi (1999) and Bloom et al. (2007) conclude that the driving force for the phenomenon is the increase in risk. The theoretical model proposed in this study builds on a similar premise; risk, and specifically the need to diversify, is what makes asset redistribution desirable in the first place. During a recession, higher risk exposure incentivizes income redistribution. Financial firms tend to attract more credit than entrepreneurs, which prolongs the recession and leads

to a slow recovery. This study therefore demonstrates that it is not the risk per se that hinders growth, but the ability of some financial firms to capitalize on it, which diverts credit in their favor.

This interaction also provides a possible explanation for the rise in income inequality during downturns. In such periods, those who are better off benefit more from income redistribution, while the rest of the economy experiences a slump in revenue and well-being. To illustrate this, Figure 3 plots different percentiles of income distribution in log deviations from the 1967 value for all series. The same data are used as in Heathcote et al. (2009), the Current Population Survey (CPS) for the period 1967-2005. The lower series (red line) is the evolution of income for the 5th percentile of the income distribution (poorer), going up to the 95th percentile (richer). The shaded areas represent periods of recession. The figure agrees with Saez and Zucman (2016) and Piketty (2011), who note that income inequality has been increasing in general, but it is also evident that it tends to increase even further during recessions leading to a pronounced drop in income for the less well-off. The observation that inequality is countercyclical is also reported by other studies using different data series such as Krueger et al. (2009), Heathcote et al. (2009) and Silvia et al. (2012). Further evidence that also support our mechanism come from Semmler and Parker (2017) and Chappe and Semmler (2016), where the authors document that when agents are able to accumulate assets over time the distribution of income may have fat tails, implying that a great portion of total wealth is accumulated by very few individuals.

For this purpose, this paper turns its focus on a newly emerging trend, namely the tendency by investors to divert funds towards the purchase of existing assets rather than the creation of new assets. Funds can be used to create new capital through productive investments in the real economy. Alternatively, the same funds can be utilized to redistribute existing assets that already exist in the economy between agents. Warren Buffet's hedge fund, for example, is a stakeholder in many companies acquired through asset redistribution, especially during downturns and periods of distress. This is an example where an organization that is able to attract funds reacts in a strategic manner by purchasing existing assets. In macroeconomic models, funds are utilized for new capital and/or firm creation but the literature largely ignores the effect of different agents buying assets from each other, as it is presumed that this behavior has minimal effect.[1] This paper analyzes the ways in which

[1] In homogenous agent models, which constitute the dominant specification in macro DSGE models, asset redistribution only has real effects if the agents have varying expectations. Otherwise, asset prices are

the allocation of credit between entrepreneurs and hedge funds affects the real economic environment and suggests appropriate reactions for policymakers. Specifically, this study investigates the way in which incentives to create new wealth, or redistribute existing wealth, changes along the business cycle and how this affects investment in capital formation and other macroeconomic variables.

Using various VARs with US data, this study demonstrates that, in downturns, more funds are directed to the redistribution of assets rather than towards capital formation. The data is quarterly, spanning the period from 1960:Q1 to 2015:Q2 and extracted mainly from the FRED database. This study also reports that, during downturns, financial firms that focus on redistributing assets do better than firms producing final goods and services. During recessions, financial firms suffer a lesser blow to earnings, are forced to lay off less personnel and tend to accumulate more assets.

To investigate these empirical findings, this study proposes a theoretical model, which distinguishes between two different types of agents: Entrepreneurs and hedge funds. Entrepreneurs invest in the production of new goods and services (capital investment) and hedge funds invest in existing assets. These two types of agents compete for credit from banks. The banks validate the profitability and riskiness of such investments and earmark funds to entrepreneurs or hedge funds accordingly. In essence, the model explores the profitability potential of investing in the production of new goods and services, against that of redistributing existing assets. Standard representative agent models are unable to account for such dynamics as they assume that agents are identical and thus redistribution of income or assets has a minimal effect. This study demonstrates that the ability to redistribute assets across different types of agents affects capital investment, prolongs recessions and exacerbates inequality.

The model in this study investigates the behavior of entrepreneurs and hedge funds and how it changes along the business cycle. It demonstrates that during recessions asset redistribution becomes increasingly appealing to all agents. Both banks and hedge funds favor the use of credit for asset reallocation, resulting in entrepreneurs being deprived of credit in times where the economy needs more firms and jobs. Nonetheless, this behavior is still regarded as optimal during a recession; high uncertainty in the economy favors redistribution of existing wealth rather than the creation of additional wealth. New projects and firms start small, their new owners seeking to diversify by sharing part of their risky asset for risk-free cash. In

determined in equilibrium without any trade between agents.

a recession, entrepreneurs are more eager to sell part of the wealth they create to others, in an attempt to hedge their position. This gives the advantage to hedge funds to accumulate even more wealth by purchasing equity from the firm "creators", i.e. the entrepreneurs. In other words, during recessions, a lower return on projects implies a lower return per unit of risk, which renders the projects high risk. Entrepreneurs, having a stronger incentive to diversify, are willing to sell a stake in their firm to hedge funds for cash. Hedge funds seize this opportunity, as they attract credit for this very purpose. This implies that more credit tends to flow towards hedge funds rather than to entrepreneurs. This exacerbates low investment, as whatever limited credit is available, is utilized for repurchases of existing assets.

The mechanism proposed in this paper is also supported by findings from Benhabib et al. (2011) that demonstrate that Capital income risk is very important in generating the heavy tails observed in wealth distributions in many countries. Moreover, Chappe and Semmler (2016) also document that the financial sector contributes significantly to wealth disparities among agents as the ability of agents to accumulate wealth plays a central role.

To address the aforementioned adverse effects on investment incentives, this study shows how a simple policy tool can make it easier for entrepreneurs to secure loans in downturns, a move which could eventually reduce business cycle fluctuations. Specifically, policies that favor access to credit for productive purposes, including macroprudential tools such as procyclical loan-to-value (hereafter LTV) ratios for entrepreneurs, can considerably reduce the severity of recessions. This tool can increase both lending for productive purposes, as well as incentives for asset redistribution in expansions. Moreover, central banks can promote access to finance by providing liquidity to commercial banks to fund loans for productive purposes or earmark specific loan amounts for investment purposes. As a consequence, the policymaker is able to direct funds from asset redistribution to the productive/real sector, thus reviving the economy and avoiding a prolonged recession.

Overall, this study contributes to the literature that focuses on tackling financial crises and boosting growth. Specifically, it seeks to provide an answer to the inertia of investment and capital formation given the increasing liquidity in the financial environment. This provides a different perspective for analyzing recessions, as asset redistribution within the economy has a real effect, unlike models with homogenous agents. To the best of our knowledge, this is the first paper that investigates the interaction between asset redistribution and capital investment, focusing on the inefficient allocation of resources that emerges along the business cycle. In addition, this framework can provide an explanation for the rising income inequality

that occurs during recessions and goes on to elaborate on how such inequality is harmful to the economy.

It is important to note that asset redistribution is not detrimental per se. It is demonstrated in this study that in the case that asset redistribution is conducted with own funds and not through credit, then redistribution does not affect the volatilities in the economy during cycles. Asset redistribution amplifies business cycles only when it competes for credit with the goods producing sector. Therefore, it is the interaction between entrepreneurs, banks and other financial firms (that seek capital gains through asset purchases) that can potentially exacerbate recessions.

The rest of the paper is organized as follows. Section 2 provides certain empirical evidence from VAR models to document the traces of asset redistribution in the data, while Section 3 presents the theoretical model economy. The parametrization of the model is presented in Section 4. Subsequently, Section 5 presents the theoretical rationalization of asset redistribution in a partial equilibrium solution of the model, while Section 6 shows the macroeconomic implications from the general equilibrium solution. In the end, 7 attempts to provide some policy recommendations which potentially can diminish the adverse effect of asset redistribution. Thereafter, Section 8 concludes.

2 Empirical motivation

A structural VAR with a linear trend is estimated using US data, covering the period 1960:Q1-2015:Q4 to motivate this study. It first investigates empirically whether income redistribution is stronger during recessions by estimating a structural VAR using US data. This is an estimation that follows the work of Kilian (2009). The sources and description of each data series employed in this exercise are presented in Table 1. A Choelesky decomposition is used to identify the impulse responses, such that changes in ordering of variables do not have a major effect on the VAR responses, especially for non-monetary shocks, which are harder to identify. For monetary shocks, the exclusion restriction employed in the structure implies that a recessionary interest rate shock impacts the economy with a lag of at least one period.

The impulse responses after a (one standard deviation) shock that increases the federal funds rate are depicted in Figure 4. The sample period ranges from 1960:Q2 to 2015:Q4 and the lag structure is set to four; nonetheless, the results are qualitatively unchanged if fewer lags are employed. Following an increase in the federal funds rate, a recession follows:

real GDP decreases, along with wages and hours, while unemployment increases. Inflation initially increases before turning negative, which is due to the inclusion of pre-Volcker data. Investment in capital goods (fixed capital formation) also decreases significantly. On the other hand, fund shares increase, despite the economy deteriorating. This implies that investment vehicles whose sole purpose is to redistribute existing assets increase their activities. Moreover, the profits of non-financial firms deteriorate while the profits of financial firms initially increase, albeit insignificantly. Employment in finance, compared to employment in the real economy, increases, indicating that the financial sector is in a better shape compared to goods production.

The story remains the same for technology shocks. In Figure 5 the impulse response from a 1 standard deviation increase in labor productivity is documented. Labor productivity is defined as output per hour. A Cholesky ordering is determined, such that the increase in productivity produces an expansion. Some orderings are excluded, specifically when productivity shocks replicate a recession, as theory suggests that productivity improvements are expansionary. In the orderings that simulate expansions, the responses are mostly invariant to changes in the ordering. The lag length is set to one, according to the Akaike, Schwarz and Hannan-Quinn criteria. It is still evident that fund assets, profits by financial firms and the relative change in employment between finance and goods production are all countercyclical.

Figure 6 investigates the effect of an increase in the loan-to-value ratio for hedge funds that increases the amount of loans in the financial sector. More explicitly, it analyses the effect on the economy from easing the credit conditions for the hedge funds. It seems that such a shock puts the economy into a recession. Even with other elements remaining constant, more loans to the financial sector produces a downturn, a result that is robust even when the sample excludes the recent financial crisis. This is in line with the prediction that such a shock is recessionary because the incentive to redistribute existing assets becomes stronger and absorbs a larger share of credit, resulting in the goods-producing sector being deprived of funding.

To explore the way income inequality changes along the business cycle, a second VAR is estimated using annual data. The annual frequency was due to the fact that the Gini coefficients are solely available in annual frequencies from 1961 to 2006. As shown in Figure 7, after an increase in the federal funds rate GDP drops, along with investment in capital. The household income Gini coefficient increases, showing that inequality is on the rise. In addition, the total amount of assets held by the top 1% of the income distribution increases

during a downturn.

3 The model economy

A theoretical model is developed in order to thoroughly examine first asset redistribution in a partial equilibrium solution while subsequently explore the propagation mechanism in the real economy in a dynamic stochastic general equilibrium (DSGE). The model consists of seven types of representative agents: common households, entrepreneurs, hedge fund, banks, the intermediate and final goods-producing firms and the monetary authority.

The common households are the workers in the economy. They sell their labor to entrepreneurs and they consume and deposit part of their income into banks each period. They supply their labor to the intermediate firms and deposit their savings in the banks.[2]

The entrepreneurs are those that create wealth for the whole economy by implementing ideas and producing goods and services as well as jobs. There is a continuum of ideas that can be put into production, although, in order to implement an idea, the entrepreneurs rely on banks for credit to pay for the cost of labor. They search for a bank to obtain a line of credit and when this connection is established, the newly-created firm gets a loan every period in the necessary amount at a gross interest rate. The firms live for at most a period.[3] The line of credit is permanently interrupted in case the firm defaults on its obligations and the entrepreneur must search for another bank to fund its operation in the following period. To secure loans, the entrepreneurs need to provide collateral and the only asset eligible for that is housing, which also provides utility to the owners.

The distinction between entrepreneurs and common households is close in construction to Iacoviello (2005), Andrs and Arce (2012) and Aliaga-Daz and Olivero (2012). Furthermore, the introduction of search and matching frictions in the market for credit closely resembles the work of Liberati (2014), Somers and Weil (2004) and Dong et al. (2016).

The hedge funds are the households that can make a living through their ability to attract funds. The hedge funds do not contribute to the creation of firms, but instead provide a way

[2]Common households cannot get loans as it is assumed loans are only for investments and not for consumption purposes even though this can easily be reformulated.

[3]This avoids a state space that depends on the whole history of asset creation, destruction, purchases and sales.

for entrepreneurs to diversify.[4] [5] The hedge funds is very similar to the entrepreneur. They consume, buy housing and search for credit lines to borrow and invest in assets. A default on an investment is covered by the household even if the bank loses its reputation or suffers loan-monitoring expenditures or legal costs.

A process of redistributing assets from the entrepreneurs to the hedge funds takes place. The model in this section is close to that of Emmons and Schmid (2002) in the sense that it introduces uncertainty. The portfolio of stocks the hedge fund and entrepreneur hold are managed by their respective portfolio manager/financial analyst. Firms are created by entrepreneurs who eventually choose to share the risk of their project due to their need for diversification, a need that is exploited by the hedge funds. In doing so, entrepreneurs sell shares in their firm to the hedge funds. Therefore, the hedge funds which have an active credit line with a bank, simply create a portfolio of selected stocks amongst those that are available and traded each period, resulting in purchasing a share of that periods firm earnings.[6] This provides hedge funds with the option of acquiring a share of the wealth created by the entrepreneurs, simply because they have access to funding. Projects, and thus firms, tend to start small and this is where the incentive to diversify arises. Hedge funds take advantage of the appetite for diversification shown by entrepreneurs and purchase part of the asset.

The large portfolio of assets held allows the fund to fully hedge against idiosyncratic risk, which is the reason entrepreneurs sell part of their share in the first place. Default on the hedge fund investment implies the termination of a credit line which will need to be re-established in the following period. As hedge funds purchase the right to firms' profits for a period, there are no opportunities for them to sell assets. On the other hand, since hedge funds are big enough, they are able to influence prices and decides upon how much stock to hold. In the end, hedge funds are able to affect the real economy due to fending off firm's idiosyncratic risk.[7]

Banks borrow from common households (deposits) and seeks to opens credit lines for both

[4] In reality such transactions tend not to provide services to the economy. Here we assume that all such transactions provide diversification, despite being frequently a result of overconfidence.

[5] The hedge funds and the hedge fund clients are merged into a single entity; however breaking the decision problem to two separate ones makes the model simpler without loss of generality.

[6] The hedge funds do not buy the whole firm as this would entail the need to track the entire history of transactions which makes the model intractable.

[7] Hedge funds may also redistribute wealth to each other but this does not necessarily affect the real economy unless many agents are unable to repay their obligations. As hedge funds are also homogeneous, trade with each other is not likely to have any real effect and is thus omitted from the model.

entrepreneurs and hedge funds. Only entrepreneurs and hedge funds compete for loans and their relative stock of collateral affects the number of loans they can acquire. In addition, the relative probabilities of default on their investments also play a vital role in the distribution of loanable funds to either the entrepreneurs or the hedge funds. For the credit lines that find a match, the bank lends the required amount and charges gross interest. In opening credit lines, banks must bear a cost, that is to say the resources necessary to search for worthy opportunities within the pool of potential borrowers. Upon defaulting, it is assumed that the entrepreneurs pool their incomes and cover the losses. However, banks suffer a penalty with each default, namely, legal or monitoring costs that decrease returns.

Intermediate goods-producing firms are generated and managed by entrepreneurs in order to produce a differentiated product by using the labor effort of a single worker from the common households. The cost of creating a firm can only be funded by loans and are based on idiosyncratic uncertainty.

Final goods-producing firms purchase the product of the intermediate goods-producing firms in order to produce the final consumption good, subject to nominal rigidities.

The deposit rate is set by the central bank via an interest rate rule, leading to a supply of deposits by the households due to the bank balance sheet constraint which determines the demand of loans. The transmission of standard monetary policy is described in Figure 8.

In what follows, a detailed description of the models representative agents is provided.

3.1 Common households

Common households, denoted by "C", are non-ricardian and enter period t with D_{t-1} units of deposits that earn a gross real return R^d_{t-1}. During period t common households purchase consumption C^C_t and decide on their new deposits to the bank D_t. Furthermore, they receive wage income $N_t w_t L_t$ by selling labor to entrepreneurs, where L_t denotes their labor effort, w_t is the wage rate and N_t is number of employed workers.

At the end of period t they also receive dividends T_t from the final goods-producing firms' profits and banks and face a budget constraint, which is defined as follows

$$C^C_t + D_t = N_t w_t L_t + R^d_{t-1} D_{t-1} + T_t. \tag{1}$$

Common households get utility indicated by $U(.)$ from consumption and disutility from

labor indicated by $G(.)$.[8] Furthermore, following Begenau (2015), households hold a preference for liquidity in the form of bank liabilities over consumption similar to the money in the utility specification, which captures the benefits from money-like-securities that service households with liquidity.[9]

Hence, the common household, subject to the budget constraint in equation (1), chooses $\left\{C_t^C, L_t, D_t\right\}$ for all t to maximize its expected lifetime utility function defined as follows

$$\max_{\{C_t^C, L_t, D_t^C\}_{t=0}^{\infty}} E_t \sum_{t=0}^{\infty} \beta_C^t \left\{ U\left(C_t^C\right) - N_t G\left(L_t\right) + \frac{z_c}{1-\alpha_C} \left(\frac{D_t}{C_t^C}\right)^{1-\alpha_C} \right\} \tag{2}$$

where $0 < \beta_C < 1$ is the discount rate, z_c is the utility weight on deposits and α_C governs the curvature of the deposit-to-consumption ratio in the utility function.

By denoting λ_t^C the Lagrange multiplier on the budget constraint, the common household's first-order condition with respect to C_t^C is given by

$$U'\left(C_t^C\right) - z_c \left(\frac{D_t}{C_t^C}\right)^{1-\alpha_C} \frac{1}{C_t^C} = \lambda_t^C \tag{3}$$

for labor hours L_t, which implies that the real wage compensates the workers for the disutility, is given by

$$\frac{G'\left(L_t\right)}{U\left(C_t^C\right)} = w_t \tag{4}$$

and for deposits D_t is given by

$$\lambda_t^C = \beta_C E_t \left(\lambda_{t+1}^C R_t^d\right) + \lambda_t^C z_c \left(\frac{D_t}{C_t^C}\right)^{1-\alpha_C} \frac{1}{D_t}. \tag{5}$$

Substituting for the Lagrange multiplier in equation (5), the Euler equation for deposits is therefore given by

$$1 = \beta_C E_t \left(\frac{U_c\left(C_{t+1}^C\right)}{U_c\left(C_t^C\right)} R_t^d\right) + z_c \left(\frac{D_t}{C_t^C}\right)^{1-\alpha_C} \frac{1}{D_t}. \tag{6}$$

[8] We assume external habit formation for the utility function i.e. $U\left(C_t^C\right) = \log\left(C_t^C - a_c \overline{C_{t-1}^C}\right)$. The past consumption, $\overline{C_{t-1}^C}$, is assumed to be the consumption of other common households.

[9] This assumption is necessary for determinacy in the case deposits are determined by the household.

3.2 Entrepreneurs

Entrepreneurs, denoted by "E", enter period t with an endowment consisting of an asset that lasts for a period. The asset is valued at $V_{i,t}$ and represents profits, is assumed to be normally distributed with mean $\bar{V}_t$ and standard deviation S_t, that is $V_{i,t} \sim N\left(\bar{V}_t, S_t^2\right)$.[10]

During period t, entrepreneurs decide to sell a portion $1 - Q_t^E$ of this asset to hedge funds for cash. The underlying price for the whole asset from the interaction between buyers and entrepreneurs is P_t^I. This enables entrepreneurs to diversify as they end up holding $Q_t^E V_{i,t}$ worth in a risky asset and $\left(1 - Q_t^E\right) P_t^I$ in cash.

It is assumed that entrepreneurs may default if the valuation of their asset is negative. The probability to default is therefore defined as follows

$$p_{d,t}^E \equiv \Pr\left(V_{i,t} \leq 0\right) = \Pr\left(\frac{V_{i,t} - \bar{V}_t}{S_t} \leq -\frac{\bar{V}_t}{S_t}\right) = \Phi\left(-\frac{\bar{V}_t}{S_t}\right) \tag{7}$$

where Φ is the cdf of the standard normal.

At the end of period t, entrepreneurs maximize their expected utility, by choosing the portion of the asset to keep Q_t^E which is defined as follows

$$\Pi_t^E = \max_{\left\{Q_t^E\right\}} E\left\{U^A\left(Q_t^E V_{i,t} + \left(1 - Q_t^E\right) P_t^I\right)\right\}. \tag{8}$$

Based on the assumption that the utility function is CARA and defined as follows

$$U^A(x) = -e^{-\phi x} \tag{9}$$

with x being normally distributed $x \sim N\left(\mu, \sigma^2\right))$ and ϕ being the entrepreneur's risk aversion coefficient, the expected utility can be substituted as follows

$$E\left\{U^A(x)\right\} = e^{-\phi\left(\mu - \frac{\phi}{2}\sigma^2\right)}. \tag{10}$$

Maximizing the above is thus identical to maximizing just $\mu - \frac{\phi}{2}\sigma^2$. This implies that maximizing the objective in equation (8) is identical to maximizing

$$\Pi_t^E = \max_{\left\{Q_t^E\right\}} \left\{Q_t^E \bar{V}_t + \left(1 - Q_t^E\right) P_t^I - \frac{\phi}{2}\left(Q_t^E S_t\right)^2\right\}. \tag{11}$$

[10] The profit may include the revenue, loan repayment and fixed cost.

The corresponding first-order condition for the share of the asset the entrepreneur wishes to keep is therefore the following

$$Q_t^E = \frac{\bar{V}_t - P_t^I}{\phi S_t^2} \tag{12}$$

implying that ceteris paribus, when either uncertainty S_t or ϕ increases, the entrepreneur is willing to keep a smaller portion of the asset. Should the offered price be equal to the average valuation $\bar{V}_t = P_t^I$ then the entrepreneur is fully insured by selling the whole asset to the hedge fund's and thus Q_t^E approaches zero.

Based on the demand for the asset by the entrepreneur in equation (12) and the constraint that the share of the asset that goes to hedge funds Q_t^R is defined as

$$Q_t^R = 1 - Q_t^E \tag{13}$$

it is implied that the hedge fund's inverse demand is defined as follows

$$P_t^I = \bar{V}_t + \phi S_t^2 Q_t^R - \phi S_t^2. \tag{14}$$

In the end, the entrepreneur's average cash flow post-diversification which gives the real value of the entrepreneur's assets is given by

$$\Psi_t^E = \left(Q_t^E\right) \bar{V}_t + (1 - Q_t^E) P_t^I. \tag{15}$$

Entrepreneurs, also at the end of period t choose $\left\{C_t^E\right\}$ to maximize their expected lifetime utility function from consumption

$$\max_{\left\{C_t^E\right\}_{t=0}^{\infty}} E_t \sum_{t=0}^{\infty} \beta^t \left\{U\left(C_t^E\right)\right\}, \tag{16}$$

subject to the constraint imposed by the budget constraint

$$C_t^E = N_t \Psi_t^E. \tag{17}$$

where Ψ_t^E is defined in equation (15).

Over each period, the entrepreneurs have N_t credit lines open and thus N_t operating firms. Therefore, the law of motion for the number of credit lines or firms in the following

period is defined as follows

$$N_{t+1} = \left(1 - p_{d,t}^{E}\right) N_t + \left(\tilde{N}_t - N_t\right) q_t^E \tag{18}$$

where $\tilde{N}_t$ denotes the maximum number of firms that can apply for a credit line which is the number of profitable ideas the entrepreneurs wish to fund which is assumed to be constant. As before, $p_{d,t}^{E}$ is the probability that a firm defaults on its obligations to the bank and the credit line is broken and thus, the following period $p_{d,t}^{E} N_t$ number of credit lines disappear. The entrepreneurs can search for $\tilde{N}_t - N_t$ new credit lines, each one having a probability of q_t^E to find a match with the bank.

3.3 Hedge funds

The hedge funds, denoted by "R", are risk neutral and seek to purchase part of the Entrepreneurs' shares for the capital gain.[11] In doing so, they seek to purchase $Q_t^R \bar{V}_t$ worth of an asset at a cost of $Q_t^R P_t^I$ dollars. To be able to do so, they seek loans from banks at a gross rate $R_t > 1$ with the purpose of making capital gains.

It is assumed that hedge funds may default if the valuation of the borrowed asset is less than the cost incurred to acquire it. Therefore the probability of a hedge fund investment to default is defined as follows

$$p_{d,t}^{R} \equiv \Pr\left(V_{i,t} \leq R_t P_t^I\right) = \Pr\left(\frac{V_{i,t} - \bar{V}_t}{S_t} \leq \frac{R_t P_t^I - \bar{V}_t}{S_t}\right) = \Phi\left(\frac{R_t P_t^I - \bar{V}_t}{S_t}\right). \tag{19}$$

At the end of period t they optimally choose the share of the firm to borrow, Q_t^R, in order to maximize their expected utility function Π_t^R, which is the same as the average cash flow post-diversification Ψ_t^R and defined as follows

$$\Pi_t^R = \Psi_t^R = \max_{\{Q_t^R\}} Q_t^R \left(\bar{V}_t - R_t P_t^I\right) \tag{20}$$

subject to entrepreneurs' demand in equation (14). The first-order condition is therefore the following

$$Q_t^R = \frac{\left(1 - R_t\right) \bar{V}_t + R_t \phi S_t^2}{2 R_t \phi S_t^2} \tag{21}$$

[11] Deviating from this assumption by considering risk averse hedge funds does not alter the results.

implying that an improvement in economic activity, interpreted as higher average valuation of the asset $\bar{V}_t$, reduces the share of the asset purchased by hedge funds as diversification is less necessary.

By plugging equations (21) in (14), the equilibrium price of the firm[12] can be defined as follows

$$P_t^I = \frac{(1+R_t)\,\bar{V}_t - R_t\phi S_t^2}{2R_t} \tag{22}$$

inferring that the probability of default of the hedge funds can be defined as follows

$$p_{d,t}^R = \Phi\left(\frac{(R_t-1)\,\bar{V}_t - R_t\phi S_t^2}{2S_t}\right). \tag{23}$$

An the end of period t, hedge fund maximize utility in a similar way as in the previous section

$$\max_{\{C_t\}_{t=0}^{\infty}} E_t \sum_{t=0}^{\infty} \beta_R^t \left\{U\left(C_t^R\right)\right\} \tag{24}$$

subject to the budget constraint

$$C_t^R = N_t^R \Psi_t^R. \tag{25}$$

where Ψ_t^R is defined in equation (20).

Each period they have N_t^R credit lines open and thus N_t^R operating firms. Therefore, the law of motion for the amount of credit lines or firms in the following period is defined as follows

$$N_{t+1}^R = \left(1 - p_{d,t}^R\right) N_t^R + \left(\tilde{N}_t^R - N_t^R\right) q_t^R \tag{26}$$

where $p_{d,t}^R$ is the probability that a hedge fund client defaults on their obligations to the bank and the credit line is broken and thus, the following period $p_{d,t}^R N_t$ number of credit lines disappear. The hedge fund can search for $\tilde{N}_t^R - N_t^R$ new credit lines, each one having a probability of q_t^R to find a match with the bank. $\tilde{N}_t^R$ is the maximum number of firms they can acquire information for each period and it is assumed to be constant.[13]

[12] In the Appendix B.1 the version with risk averse hedge funds is investigated and demonstrates that the results are even stronger in such an environment.

[13] A version where the maximum amount the entrepreneurs and hedge funds is endogenous affected by LTV ratios and housing accumulation can be provided upon request. The effects of changing collateral values although important, has already been investigated extensively in the literature by Kiyotaki and Moore (1997) and others. The goal of this study is to present the effect of redistribution to the exclusion of other influences, in order to isolate the main argument.

3.4 Banks

The bank uses its deposits D_t to fully allocate to loans, with R_t^d denoting the borrowing rate. For this task, the bank is required first to open credit lines with potential customers, a process which is subject to search frictions. When a match is formulated and a credit line is open, the bank funds any amount required for the customer's project. In the event that the customer defaults on the loan, the line of credit breaks and the customer must return to the state of searching for a new line of credit with a bank. Both entrepreneurs and hedge funds in need of credit search for banks to open a credit line, implying that there are constant returns to scale matching functions which determine the allocation of credit lines to the two parties each period. The bank searches for lines of credit among entrepreneurs and hedge funds. If the total amount of lines of credit is Γ_t, the bank opens s_t^E share of the total for the entrepreneurs and $s_t^R = 1 - s_t^E$ share for the hedge funds. There are two matching functions, with constant returns to scale, one for the entrepreneurial lines of credit and one for the hedge funds.

The matching function that determines the number of credit lines opened for entrepreneurs over each period is

$$M_t^E = A_\Gamma \left(\tilde{N}_t^E - N_t^E\right)^{\alpha_\Gamma} \left(s_t^E \Gamma_t\right)^{1-\alpha_\Gamma} \tag{27}$$

where $\tilde{N}_t - N_t$ is the number of credit lines the entrepreneurs can apply for and $s_t^E \Gamma_t$ the number of lines of credit the bank is offering to entrepreneurs.

The matching function for loans to the hedge funds takes a similar form

$$M_t^R = A_\Gamma \left(\tilde{N}_t^R - N_t^R\right)^{\alpha_\Gamma} \left(\left(1 - s_t^E\right) \Gamma_t\right)^{1-\alpha_\Gamma} \tag{28}$$

where $\tilde{N}_t^R - N_t^R$ is the maximum number of credit lines the hedge fund can apply for and $\left(1 - s_t^E\right) \Gamma_t$ the corresponding number the bank assigns to them.

The probability a line of credit assigned to entrepreneurs to find a match is

$$\rho_t^E = A_\Gamma \left(\frac{\tilde{N}_t - N_t}{s_t^E \Gamma_t}\right)^{\alpha_\Gamma} \tag{29}$$

while the probability a line of credit for the hedge fund clients to find a match is

$$\rho_t^R = A_\Gamma \left(\frac{\tilde{N}_t^R - N_t^R}{s_t^R \Gamma_t} \right)^{\alpha_\Gamma}. \tag{30}$$

Lastly, the probability for an entrepreneur to successfully establish a credit line with the bank is

$$q_t^E = A_\Gamma \left(\frac{s_t^E \Gamma_t}{\tilde{N}_t - N_t} \right)^{1-\alpha_\Gamma} \tag{31}$$

while the probability for the hedge fund to open a credit line with the bank is

$$q_t^R = A_\Gamma \left(\frac{s_t^R \Gamma_t}{\tilde{N}_t^R - N_t^R} \right)^{1-\alpha_\Gamma}. \tag{32}$$

3.4.1 Bank's objective

At the start of the period, the bank is committed to funding firm and hedge fund operations with an existing line of credit. Its decision has to do with the number of new lines of credit to offer Γ_t and the way those lines are going to be allocated to entrepreneurs s_t^E and hedge funds $1 - s_t^E$.

The law of motion for the number of credit lines to entrepreneurs is defined as follows

$$N_{t+1} = \left(1 - p_{d,t}^E\right) N_t + \rho_t^E s_t^E \Gamma_t \tag{33}$$

stating that credit lines in the following period include those for firms that have not defaulted in the previous period, as well as those which are newly created. New credit lines depend on the number of lines the bank allocates for entrepreneurs $s_t^E \Gamma_t$ and the corresponding probability each line to match, ρ_t^E.

Similarly the law of motion for the lines of credit to hedge funds is defined as follows

$$N_{t+1}^R = \left(1 - p_{d,t}^R\right) N_t^R + \rho_t^R \left(1 - s_t^E\right) \Gamma_t. \tag{34}$$

In the end, the balance sheet of the bank is the following

$$N_t r_t K_t + N_t^R Q_t^R P_t^I + \kappa_t^E s_t^E \Gamma_t + \kappa_t^R s_t^R \Gamma_t = D_t + \Omega_t \tag{35}$$

stating that the amount of lending and the cost to post new potential credit lines $\kappa_t^E s_t^E \Gamma_t$ and $\kappa_t^R s_t^R \Gamma_t$ are financed from deposits D_t and initial reserves Ω_t.[14]

Hence, subject to the constraints based on the entrepreneurs and hedge funds law of motions in equations (33) and (34) and the bank's balance sheet in equation (35), the bank seeks to maximize the following objective

$$JB_t = \max_{\left\{\Gamma_t, s_t^E\right\}_{t=0}^{\infty}} N_t \left(R_t^E - p_{d,t}^E R_L^E\right) w_t L_t + N_t^R \left(R_t^R - p_{d,t}^R R_L^R\right) Q_t^R P_t^I - R_t^d D_t + E_t \Lambda_{t,t+1} JB_{t+1} \tag{36}$$

by choosing the number of new lines of credit Γ_t[15] and the way they will be allocated to entrepreneurs s_t^E and where it earns R_t^E minus the losses from default R_L^E that occur to a share $p_{d,t}^E$ of all firms and $R_t^R - p_{d,t}^R R_L^R$ from the N_t^R credit lines maintained with the hedge funds. In the former case the bank earns this return for the N_t credit lines maintained with entrepreneurs and the loan amount to each firm is $w_t L_t$ and the firm is free to ask for any amount as long as a credit line is open. For the latter term, the hedge funds borrow $Q_t^R P_t^I$ amount to purchase firms, where P_t^I is the price offered for the firm and Q_t^R the share of the firm the hedge fund seeks to acquire.

The first-order conditions with respect to Γ_t is

$$R_t^d \left(\kappa_t^E s_t^E + \kappa_t^R s_t^R\right) = s_t^R \rho_t^R E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}^R} + s_t^E \rho_t^E E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}} \tag{37}$$

and with respect to s_t^E is

$$R_t^d \left(\kappa_t^E - \kappa_t^R\right) = \rho_t^E E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}} - \rho_t^R E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}^R}. \tag{38}$$

To interpret the way the allocation of credit lines between entrepreneurs and hedge funds works, without loss of generality it is assumed that the cost of opening credit lines is equal

[14] Both the costs κ_t^E and κ_t^R are assumed to be constant except for the policy recommendation exercise in Section 7.

[15] The case where loans are simply set by depositors, the bank maximises its objective function by choosing only the way they these depositors' determined loans will be allocated to entrepreneurs s_t^E. The derivation of this case is shown in Appendix B.2. As it is also discussed though in Section 6, running the model as in this case provide similar results.

for each type of borrower and $\kappa_t^E = \kappa_t^R$. Therefore, equation (38) implies[16]

$$\rho_t^E E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}} = \rho_t^R E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}^R}. \tag{39}$$

To get the credit line posting conditions, the two envelope conditions are derived by taking derivatives of objective in equation (36) with respect to N_t and N_t^R, as follows

$$\frac{dJB_t}{dN_t} = \left(R_t^E - p_{d,t}^E R_L^E - R_t^d\right) r_t K_t + \left(1 - p_{d,t}^E\right) E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}^E} \tag{40}$$

and

$$\frac{dJB_t}{dN_t^R} = \left(R_t^R - p_{d,t}^R R_L^R - R_t^d\right) Q_t^R P_t^I + \left(1 - p_{d,t}^R\right) E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}^R} \tag{41}$$

By using equation (38) to eliminate $\rho_t^R E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}^R}$ from equation (37), it can be implied that

$$\kappa_t^R R_t^d = \rho_t^R E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}^R} \tag{42}$$

signifying that at the optimal level, the cost of searching for a credit line must be equal to the expected benefit from opening it, which depends on the probability ρ_t^R. Similarly, by using equation (38) to eliminate $\rho_t^E E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}}$ from equation (37) it can be implied that

$$\kappa_t^E R_t^d = \rho_t^E E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}}. \tag{43}$$

By leading equation (40) a period in advance and substituting in equation (42) and the same equation (42) a period in advance, one can get the line of credit creation condition for the entrepreneurs

$$\frac{\kappa_t^E R_t^d}{\rho_t^E} = E_t \Lambda_{t,t+1} \left(R_{t+1}^E - p_{d,t+1}^E R_L^E - R_{t+1}^d\right) r_{t+1} K_{t+1} + E_t \Lambda_{t,t+1} \left(1 - p_{d,t+1}^E\right) E_t \frac{\kappa_{t+1}^E R_{t+1}^d}{\rho_{t+1}^E} \tag{44}$$

Using the same steps, the line of credit creation condition for the hedge fund credit lines is

[16] By using the result from equations (29) and (30), in which ρ_t^E and ρ_t^R are decreasing functions of s_t^E and s_t^R, one can derive that if one sector promises higher return on the marginal credit line than the other, (for example if $\frac{dJB_{t+1}}{dN_{t+1}} > \frac{dJB_{t+1}}{dN_{t+1}^R}$), then the portion of the vacant credit lines s_t^E assigned to entrepreneurs increases while the portion s_t^R going to hedge funds decreases. In other words, as more vacant credit lines are assigned to entrepreneurs, the probability of each one to find a match drops which pushes ρ_t^E downwards (and ρ_t^R upwards) until the equality in equation (39) is restored.

as follows

$$\frac{\kappa_t^R R_t^d}{\rho_t^R} = E_t \Lambda_{t,t+1} \left(R_{t+1}^R - p_{d,t+1}^R R_L^R - R_{t+1}^d \right) r_{t+1} K_{t+1} + E_t \Lambda_{t,t+1} \left(1 - p_{d,t+1}^R \right) E_t \frac{\kappa_{t+1}^R R_{t+1}^d}{\rho_{t+1}^R} \quad (45)$$

Therefore, the profit of the bank in the current period is as follows

$$\tilde{\Omega}_t = N_t \left(R_t^E - p_{d,t}^E R_L^E \right) r_t K_t + N_t^R \left(R_t^R - p_{d,t}^R R_L^R \right) Q_t^R P_t^I - R_t^d D_t \quad (46)$$

In the end the reserves and thus the initial capital in the following period is defined as follows

$$\Omega_{t+1} = (1 - \omega) \tilde{\Omega}_t + (1 - \delta_B) \Omega_t \quad (47)$$

where the bank pays ω fraction of the current earnings as dividends to the owners, while there is also a cost to maintaining bank capital and thus a fraction δ_B of capital/reserves is lost.

3.4.2 Surplus

The interest rate charged by the bank to each type of customer is derived from a Nash bargaining where the underlying rate is the one that splits the surplus from the match to the two parties. In this section, the Bellman equations necessary to derive the surplus from a match is determined, along with the Nash Bargaining problem.

Given the maximization problem in the previous section, the value of a vacant credit line to the bank is

$$V_t^E = -R_t^d \kappa_t^B + \rho_t^E E_t \Lambda_{t,t+1} J_{t+1}^E + \left(1 - \rho_t^E \right) E_t \Lambda_{t,t+1} V_{t+1}^E \quad (48)$$

where $V_t^E = 0$ for every t and the value of an active credit line to the bank is

$$J_t^E = \left(R_t^E - p_{d,t}^E R_L^E - R_t^\Gamma \right) w_t L_t + \left(1 - p_{d,t}^E \right) E_t \Lambda_{t,t+1} J_{t+1}^E \quad (49)$$

where $p_{d,t}^E$ is the probability of default which depends on the state of the economy and is explicitly determined in a following section. Upon default, the bank is still covered (receives R_t^E) but forces the borrower to liquidate the collateral, a move that affects the bank's reputation (or carries legal costs) and results in a constant loss of R_L^E.[17]

[17] The possibility of a bank defaulting is out of the scope of this study and this is why it is assumed the

The value of a vacant credit line to the bank is

$$V_t^R = -R_t^d \kappa_t^B + E_t \Lambda_{t,t+1} \rho_{t+1}^R J_{t+1}^R + \left(1 - \rho_t^R\right) E_t \Lambda_{t,t+1} V_{t+1}^R \tag{50}$$

where $V_t^R = 0$ for every t. The value of an active credit line with a hedge fund to the bank is

$$J_t^R = \left(R_t^R - p_{d,t}^R R_L^R - R_t^d\right) Q_t^R P_t^I + \left(1 - p_{d,t}^R\right) E_t \Lambda_{t,t+1} J_{t+1}^R \tag{51}$$

where $p_{d,t}^R$ is the probability of default for the hedge fund. The probabilities of default for both projects are obviously correlated but the bank cannot account for the correlation of defaults of every pair of assets in the economy and, accordingly, has no reaction. The value of a credit line to entrepreneur is

$$\Xi_t^E = R_t^V - R_t^E w_t L_t + \left(1 - p_{d,t}^E\right) E_t \Lambda_{t,t+1} \Xi_{t+1}^E + p_{d,t}^E E_t \Lambda_{t,t+1} \tilde{\Xi}_{t+1}^E \tag{52}$$

while the value of an entrepreneur's idea seeking a credit line is

$$\tilde{\Xi}_t^E = q_t^E E_t \Lambda_{t,t+1} \Xi_{t+1}^E + \left(1 - q_t^E\right) E_t \Lambda_{t,t+1} \tilde{\Xi}_{t+1}^E. \tag{53}$$

Similarly, the value of a credit line to the hedge fund is

$$\Xi_t^R = Q_t^R \bar{V}_t - R_t^R Q_t^R P_t^I + \left(1 - p_{d,t}^R\right) E_t \Lambda_{t,t+1} \Xi_{t+1}^R + p_{d,t}^E E_t \Lambda_{t,t+1} \tilde{\Xi}_{t+1}^R \tag{54}$$

and the value of searching for a credit line to the hedge fund is

$$\tilde{\Xi}_t^R = q_t^R E_t \Lambda_{t,t+1} \Xi_{t+1}^R + \left(1 - q_t^R\right) E_t \Lambda_{t,t+1} \tilde{\Xi}_{t+1}^R \tag{55}$$

3.4.3 Interest rates

In order for the bank to determine the interest rates charged for loans to entrepreneurs and hedge funds, it solves the usual bargaining problem that splits the surplus from an existing credit line, allocating ζ portion to the entrepreneurs and $1-\zeta$ to the hedge funds. Specifically,

bank is always covered when it lends up to a "utility" or reputation loss. As long as the probability of default varies with time, the results are unchanged.

the bank solves

$$\max_{\{R_t^E\}_{t=0}^{\infty}} \left(\Xi_t^E - \tilde{\Xi}_t^E\right)^{\zeta} \left(J_t^E\right)^{1-\zeta}. \tag{56}$$

The first-order condition is

$$\zeta J_t^E = (1-\zeta)\left(\Xi_t^E - \tilde{\Xi}_t^E\right). \tag{57}$$

By plugging in the above equations (49), (52), (53) and (48), at the equilibrium the gross rate to entrepreneurs is the following

$$R_t^E = (1-\zeta)\frac{R_t^V}{w_t L_t} + \zeta p_{d,t}^E R_L^E + \zeta R_t^d - \zeta \frac{q_t^E}{\rho_t^E}\frac{R_t^d \kappa_t^E}{w_t L_t} \tag{58}$$

stating that the interest rate charged to them increases along with the expected revenue from the firm relative to its cost $\frac{R_t^V}{w_t L_t}$. There is also a risk premium captured by the risk of default $1 - p_{d,t}^E$ and the loss given default R_L^E. Higher deposit rate R_t^d leads to a higher rate charged to entrepreneurs. The last term depends on the market tightness for credit lines. If there are more applications for credit lines than the banks are offering to entrepreneurs, it becomes more likely for a bank to find a match and thus less likely for the bank to have to carry the cost κ_t^E next period. Therefore, the bank charges a lower rate. As the bank needs to pay this cost from deposits, the borrowing rate is also relevant in this last term of equation (58).

For the derivation of the interest rate charged to hedge funds one can use the first-order condition for the Nash-bargaining problem between the bank and the hedge fund in order to get

$$\zeta J_t^R = (1-\zeta)\left(\Xi_t^R - \tilde{\Xi}_t^R\right) \tag{59}$$

and by plugging in equations (51), (54), (55) and (50), one can derive that the gross rate for the hedge funds is as follows

$$R_t^R = (1-\zeta)\frac{V_t}{P_t^I} + \zeta p_{d,t}^R R_L^R + \zeta R_t^d - \zeta \frac{q_t^R}{\rho_t^R}\frac{R_t^d \kappa_t^R}{Q_t^R P_t^I} \tag{60}$$

which has a similar interpretation as in equation (58).

3.5 Intermediate goods-producing firms

There are N_t intermediate firms generated and managed by entrepreneurs, each producing a differentiated product x_{it} and thus the aggregate intermediate good X_t is as follows

$$X_t = A_t^x \left[\int_{N_t} (x_{it})^{\frac{\theta_x - 1}{\theta_x}} di \right]^{\frac{\theta_x}{\theta_x - 1}}. \tag{61}$$

The elasticity of substitution is θ_x and $A_t^x = N_t^{\xi - \frac{1}{\theta_x - 1}}$ is a variety effect.[18] The usual cost minimization problem determines the demand for each good defined as follows

$$x_{it} = (A_t^x)^{\theta_x - 1} \left(\frac{p_{it}^x}{\tilde{P}_t^x} \right)^{-\theta_x} X_t \tag{62}$$

where p_{it}^x is the price of each intermediate firm. The price of the aggregate good is as follows

$$\tilde{P}_t^x = \frac{1}{A_t^x} \left[\int_{N_t} (p_{it}^x)^{1-\theta_x} di \right]^{\frac{1}{1-\theta_x}}. \tag{63}$$

Each firm produces using the labor effort of a single worker L_{it} according to the following production function

$$x_{it} = z_t L_{it} \tag{64}$$

The cost of creating a firm can only be funded by loans and is defined as $w_t L_{it}$, where w_t is the wage of each worker. Furthermore, there is idiosyncratic uncertainty associated with intermediate firms, captured by the random cost φ_i.[19]

Hence, the entrepreneur maximizes the expected profit

$$V_{it} = \max_{\{p_{it}^x\}_{t=0}^{\infty}} \left\{ \frac{p_{it}^x}{P_t} x_{it} - R_t^E w_t L_{it} - \bar{\varphi} \right\} \tag{65}$$

where φ_i is an IID random variable and $\varphi_i \sim N(\bar{\varphi}, S_t^2)$. The maximization is subject to the

[18] When $\xi = \frac{1}{\theta_x - 1}$ the aggregator, equation (61) takes the standard Dixit-Stiglitz form.

[19] The reason we inserted the idiosyncratic uncertainty φ_i as an addition to the profit of the firm is to be able to secure normality for the valuation of the firms as well. Deviating from this assumption does not alter the results, despite complicating the derivations.

demand, in equation (62), and the production function, equation (64). The corresponding first-order condition is therefore as follows

$$P_t^x \frac{p_{it}^x}{\tilde{P}_t^x} = \frac{\theta_x}{\theta_x - 1} \frac{R_t^E w_t}{z_t}. \tag{66}$$

By defining the relative price of the aggregator as

$$P_t^x \equiv \frac{\tilde{P}_t^x}{P_t} \tag{67}$$

and since firms are all *ex ante* identical, then from equation (63) one can get $\frac{p_{it}^x}{\tilde{P}_t^x} = N_t^\xi$ and therefore the aggregate relative price is

$$P_t^x = \frac{\theta_x}{\theta_x - 1} \frac{R_t^E w_t}{z_t N_t^\xi} \tag{68}$$

which shows that the relative price is a markup over marginal cost.

The reservation cost $\hat{\varphi}_t$ is the value of the idiosyncratic shock φ_i such that the profit of the firm is zero and by using equation (68) it can be defined as

$$\hat{\varphi}_t = \frac{P_t^x X_t}{\theta_x N_t} \tag{69}$$

stating that any draw from the distribution of φ_i greater than $\hat{\varphi}_t$ means that the firm makes a loss. Furthermore, the above states that the no default cost $\hat{\varphi}_t$ is higher (i.e. lower chance of default) when the price P_t^x is higher, the demand X_t is higher, the competition N_t lower, and there is a low degree of substitutability θ_x between the goods.

Therefore following some derivations shown in Appendix B.5, the probability of default $p_{d,t}^E$ for entrepreneurs used in equation (49) is thus

$$p_{d,t}^E = \Pr\left(\varphi_i > \hat{\varphi}_t\right) = 1 - F\left(\hat{\varphi}_t\right). \tag{70}$$

while for hedge funds is

$$p_{d,t}^E = \Pr\left(\varphi_i > \hat{\varphi}_t\right). \tag{71}$$

Furthermore, the two reservation values in the above probabilities are as follows

$$\hat{\varphi}_t^R = \hat{\varphi}_t - \frac{\left(1 + R_t^R\right) \bar{V}_t - R_t^R S_t^2 \phi}{2}. \tag{72}$$

From equation (72) the probability of default is greater for the hedge fund as $\hat{\varphi}_t^R < \hat{\varphi}_t$, a result which is expected because it relates both to the probability of default for the firm and for the hedge fund. However, in a recession where the firm valuation $\bar{V}_t$ decreases, equation (72) states that the reservation point $\hat{\varphi}_t^R$ becomes greater relative to $\hat{\varphi}_t$. Therefore, the probability of default $\Pr\left(\varphi_i > \hat{\varphi}_t^R\right)$ for the particular asset the hedge fund invests, decreases relative to the probability of the entrepreneur to default $\Pr\left(\varphi_i > \hat{\varphi}_t\right)$. This is going to direct more funds to the hedge funds by encouraging the bank to provide increased credit lines. To summarize, in a recession, more funds are going to be allocated to hedge funds and thus away from the production of goods and services. It seems more rewarding for investors to redistribute existing wealth than to make the effort to produce more goods and services.

Given the distribution of φ_i, the conditional valuation of the firm given that for all period t variables are observed apart from the idiosyncratic shock, is distributed as $V_{it} \sim N\left(\bar{V}_t, S_t^2\right)$, where the mean $\bar{V}_t$ (after some algebra) is

$$\bar{V}_t = \frac{1 - \tau_t^E}{\theta_x} \frac{P_t^x X_t}{N_t} - \bar{\varphi} \tag{73}$$

while the variance could be constant S_t^2 or countercyclical as evidence by Mele (2007) suggests.

3.6 Final goods-producing firms

The objective of the final goods-producing firms is to maximise profits subject the demand for each firm derived from a cost minimization problem of the household is defined as follows

$$y_{jt} = \left(\frac{p_{jt}}{P_t}\right)^{-\theta} Y_t \tag{74}$$

where the aggregate price level is

$$P_t = \left[\int_0^1 (p_{jt})^{1-\theta} \, dj \right]^{\frac{1}{1-\theta}}. \tag{75}$$

while the aggregate output is

$$Y_t = \left[\int_0^1 (y_{jt})^{\frac{\theta-1}{\theta}} \, dj \right]^{\frac{\theta}{\theta-1}} \tag{76}$$

with θ being the elasticity of substitution.

The production function is as follows

$$y_{jt} = z_t^f X_{it} \tag{77}$$

where z_t^f is productivity and X_{it} the amount of the aggregate intermediate good used by the firm.

The firm also faces nominal rigidities (Calvo pricing), where with probability γ is not able to adjust its price every period.

Therefore, the objective of the firm is to maximise the profits defined as follows

$$\max_{\{p_t\}_{t=0}^{\infty}} \sum_{k=0}^{\infty} \gamma^k E_t Q_{t,t+k} \left[\frac{p_t}{P_{t+k}} y_{t+k}(p_t) - \frac{P_{t+k}^x}{z_t^f} y_{t+k}(p_t) \right]. \tag{78}$$

The first-order condition is

$$(\theta - 1) \Lambda_t^1 = \theta \Lambda_t^2 \tag{79}$$

where

$$\Lambda_t^1 = \left(\frac{p_t}{P_t} \right) \sum_{k=0}^{\infty} \beta^k \gamma^k E_t \lambda_{t+k} \left[\left(\frac{P_t}{P_{t+k}} \right)^{1-\theta} Y_{t+k} \right] \tag{80}$$

and

$$\Lambda_t^2 = \sum_{k=0}^{\infty} \beta^k \gamma^k E_t \lambda_{t+k} \left[\frac{P_{t+k}^x}{z_{t+k}^f} \left(\frac{P_t}{P_{t+k}} \right)^{-\theta} Y_{t+k} \right]. \tag{81}$$

Recursively, the two expressions become

$$\Lambda_t^1 = \left(\frac{p_t^*}{P_t}\right)\lambda_t Y_t + \beta\gamma\left(\frac{p_t^*}{P_t}\right)E_t\left(\frac{P_{t+1}}{p_{t+1}^*}\right)\left(\frac{P_t}{P_{t+1}}\right)^{1-\theta}\Lambda_{t+1}^1 \tag{82}$$

and

$$\Lambda_t^2 = \lambda_t\frac{P_t^x}{z_t^f}Y_t + \beta\gamma E_t\left(\frac{P_t}{P_{t+1}}\right)^{-\theta}\Lambda_{t+1}^2 \tag{83}$$

In the end, the relative price $\frac{p_t^*}{P_t}$ of the price adjusting firms is

$$1 = (1-\gamma)\left(\frac{p_t^*}{P_t}\right)^{1-\theta} + \gamma\left(\frac{P_{t-1}}{P_t}\right)^{1-\theta} \tag{84}$$

3.7 Monetary authority

The central bank uses standard monetary policy via a common interest rate rule to adjust the federal funds rate i_t^{ff}

$$\frac{i_t^{ff}}{i^{ff}} = \left(\frac{i_{t-1}^{ff}}{i^{ff}}\right)^{\rho_m}\left[\left(\frac{P_t}{P_{t-1}}\right)^{g_\pi}\left(\frac{Y_t}{Y}\right)^{g_y}\right]^{1-\rho_m} \tag{85}$$

where the federal funds rate is equal to the deposit rate in equilibrium, i.e. $i_t^{ff} = R_t^d$.

4 Model parametrization

Table 2 presents plausible values for the model's parameters along with their description. It is assumed that the interest rate charged to entrepreneurs and the hedge fund is $R^E = 1.1$ and $R^R = 1.12$. By definition, the probability of a firm to default is lower ($1 - p_d^E < 1 - p_d^R$) than the probability of a hedge fund to do so on an investment in the same firm. Furthermore, it is assumed that the loss upon default for both entrepreneurs and hedge funds is the same ($R_L^E > R_L^R$).

The number of firms N in the steady state is set to one and the number of those firms partially owned by entrepreneurs is $N^R = 0.4$. Usually, transactions classified as wealth redistribution can be much higher, but the redistribution of wealth from one hedge fund to another is ignored as all hedge funds are grouped into one big household for simplicity.

Therefore, no frictions are imposed on the redistribution of assets between the hedge funds.

5 Countercyclical asset redistribution in a partial equilibrium

The following propositions highlight the characteristics of the (primary) market for assets which results in countercyclical asset redistribution. The results are based on a partial equilibrium model which sheds light on the basic mechanism in closed form steady state solution and are also comparable to the empirical evidence of Section 2. The specification of the partial equilibrium model differs from the actual model as it is a 2 period model and thus it is not dynamic. In addition, the agents do not search for credit lines but directly for cash from banks as the partial equilibrium model is not dynamic.

Proposition 1 *According to the hedge fund's objective* [20]

$$\Pi^R = \Psi^R = \max_{\{Q^R\}} Q^R \left(\bar{V} - RP^I\right) \tag{86}$$

and equilibrium conditions [21]

$$Q^R = \frac{(1-R)\,\bar{V} + R\phi S^2}{2R\phi S^2} \tag{87}$$

$$P^I = \frac{(1+R)\,\bar{V} - R\phi S^2}{2R} \tag{88}$$

when the average firm valuation $\bar{V}$ increases, the hedge fund's shares $\frac{dQ^R}{d\bar{V}} < 0$ and the hedge funds' value of fund's profit $\frac{d\Psi^R}{d\bar{V}} < 0$ decrease, while the entrepreneur's post-diversification expected profit increases $\frac{d\Psi^E}{d\bar{V}} < 0$.

The proof of the Proposition 1 is in Appendix A.1. It shows that the number of shares the funds own is countercyclical, which was also documented empirically, specifically, as fund assets in Figures 4 and 5. Moreover, Proposition 1 also states that profits of hedge funds are countercyclical, while profits to entrepreneurs are procyclical, which is again confirmed empirically in the same Figures 4 and 5 (responses of Profit Financial and Profit non-Financial).

[20] Equation (20) in the steady state.
[21] Equations (21) and (22) in the steady state.

In a recession, the average valuation of a firm decreases and since the risk per firm is constant, the expected return per unit of risk decreases. This means that projects available to entrepreneurs are perceived as more risky. For this reason entrepreneurs become willing to offer the same portion of the asset at a lower price as they are more eager to diversify. The hedge funds take advantage of the opportunity and buy a larger share of the asset at a lower price, thus making a capital gain.

This implies that in a recession where each firm's valuation deteriorates, the profit opportunity for the hedge fund increases since the firm owners are more eager to diversify. This closely relates to Warren Buffet's strategy of buying assets with low price-to-book value shares. The hedge fund is better off when dealing with firms in distress, which happens more often during recessions.

Proposition 2 *According to the bank's optimality conditions* [22]

$$V_t^E = V_t^R \tag{89}$$

where

$$V^E = \left(\frac{b^E}{s^E \Gamma}\right)^{\alpha_\Gamma} \left(R - R^d - \Phi\left(-\frac{\bar{V}}{S}\right) R^L\right) \tag{90}$$

and

$$V^R = \left(\frac{b^R}{(1-s^E)\,\Gamma}\right)^{\alpha_\Gamma} \left(R - R^d - \Phi\left(\frac{(R-1)\,\bar{V} - R\phi S^2}{2S}\right) R^L\right) \tag{91}$$

when the average firm valuation $\bar{V}$ increases, the bank's share of credit that is earmarked for entrepreneurs s^E decreases $\frac{ds^E}{d\bar{V}} < 0$ while the bank's share of credit that is earmarked for hedge funds s^R decreases $\frac{ds^R}{d\bar{V}} > 0$.

The proof of the Proposition 2 is in Appendix A.2. The main difference with banks in the benchmark dynamic case is that here the search is for allocating the marginal dollar to fund projects and not to create credit lines to keep the model a two period one. It shows that in a recession ($\bar{V}$ decreases), the probability of default for the entrepreneur increases while the probability of default for the hedge fund decreases. As a result, the bank's return from funding the entrepreneurs is less desirable than the return from allocating the extra dollar to

[22] This involves equating equations (37) to (38) and ignoring time subscripts. Moreover, equations (40) and (41) hold ignoring the following period dynamics and also they represent returns from allocating a dollar to each project and not a credit line.

the hedge fund, inducing the bank to increase the share of earmarked funds to hedge funds, therefore s^E decreases. The above result raises the probability ρ^E of a dollar earmarked for entrepreneurs to match ($\left(\frac{b^E}{s^E\Gamma}\right)^{\alpha_\Gamma}$ increases) while ρ^R decreases until the right hand side of (89) equals the left hand side and the equality is restored. Therefore, more credit flows to hedge funds in a recession than to entrepreneurs.

Figure 9 characterizes the above equilibrium credit line allocation by the banks to entrepreneurs and hedge funds.[23] Initially, the right hand side of equation (89) is graphed as the downward sloping curve V_1^E which is a function of the share of funds s^E that go to entrepreneurs. The upward sloping curve V_1^R is the left hand side of equation (89). The equilibrium is where the two curves intersect, which is initially at E_1. In an expansion, $\bar{V}$ increases and therefore the probability for entrepreneurs to default $\Phi\left(-\frac{\bar{V}}{S}\right)$ decreases as firms become more profitable. Thus the value of the extra dollar loan to entrepreneurs becomes higher which shifts figure V_1^E upwards to V_2^E in Figure 9. On the other hand, as the need for diversification becomes less important to entrepreneurs (risk is unchanged), they sell their shares to hedge funds at a relatively higher price. For the bank the probability of a hedge fund to default $\Phi\left(\frac{(R-1)\bar{V}-R\phi S^2}{2S}\right)$ increases as $R > 1$ as redistribution becomes less rewarding. This shifts figure V_1^E downwards to V_2^E. The new equilibrium is at E_2 where more credit is allocated by the bank to entrepreneurs than to hedge funds. Alternatively, in a recession more funds go to hedge funds at the expense of entrepreneurs.

The incentives for the two types of agents competing for funds are in opposition along the business cycle, as documented by the VAR model as well. While the incentives for nearly all other investments coincide along the business cycle, capital investment and asset redistribution one can move in opposite directions. This observation can be exploited by policymakers to boost growth during a recession.

Lemma 3 *If the hedge funds use their own funds for asset redistribution, then asset redistribution does not amplify business cycles.*

Lemma 3 is very important because it emphasizes that asset redistribution is not necessarily exacerbating recessions. It distorts the dynamics of the economy only if the asset purchases are funded through credit or outside funding. Therefore, the problem is not the

[23] It is the graphical representation of equations (89) to (91) calibrated using common parameter values, which come from the benchmark calibration summarized in Table 2.

asset redistribution per se but the way it takes credit away from entrepreneurs towards financial firms that seek a capital gain. The proof is derived easily from the proof of Proposition 1 by setting $R = 1$ since in this case the hedge funds are not using external funds. It is evident that if they use their own funds the shares they purchase and the change in their profits is constant along the business cycle. Nonetheless, this effect is evident also from equation (21). By setting $R = 1$, $Q_t^R = 1/2$ and thus the share of the firm purchased each period is constant for all time periods and also from equation.

6 Macroeconomic implications

Following the evidence from the VAR estimations reported previously, this section compares them with theoretical model predictions. Specifically, this paper focuses first on the predictions of the model after a shock that eases access to funding for the hedge funds that can also be replicated empirically for comparison. Second, it investigates the predictions of the model for income inequality. Although there is a growing literature that provides empirical evidence for income inequality along the business cycle, this study provides its own empirical experiment that replicates other work and also provides the means to compare the predictions of the model.

Figure 10 displays the responses of a negative productivity shock that decreases z^f. The shock is designed as a 1% decrease in the aggregate productivity z_t^f of each of the final good firms which subsequently follows an AR(1) process. Upon the impact of the productivity shock, firm value in plot(4,4)[24] decreases as each firm becomes less productive. A drop in firm valuation eventually reduces the *ex post* cash flow to entrepreneurs (i.e. the cash flow after selling part of the firm to hedge funds) in plot(5,2) and at the same time the cash flow to the hedge funds increases in plot (5,3), as low valuation allows hedge funds to step in and purchase assets providing diversification to entrepreneurs. This immediately increases the probability of default for entrepreneurs in plot(2,2) and decreases the probability of default for the hedge funds in plot(2,3), a situation that encourages banks to open more credit lines for the hedge funds in plot(3,1), taking away credit from entrepreneurs in plot(2,4). Hence, the number of intermediate firms decreases in plot(1,4), while the number of hedge funds or

[24]Due to the large number of subplots, reference to any specific plot is carried out by referring to the row and column in the figure. For example, plot(i,j), corresponds to the plot on the ith row and j^{th} column of the respective figure.

the number of assets the hedge funds accumulate increases as seen in plot(2,1). Inevitably, output drops more than it would if credit did not favor hedge funds during downturns.

It is also evident that inequality increases in the model as shown in plot(5,4). This result is robust even when entrepreneurs are classified as rich. This is notable, because as inequality increases the rich gain the opportunity to redistribute income that increases fluctuations from potential output, making recessions more severe and prolonging the economy's recovery time. This result implies that there is countercyclical inequality in which it is surging in recessions and decreasing in expansions. As it is the rich who hold most financial assets, while enjoying the capital gains from their purchases, they are also the ones who are less affected by recessions due to their ability to capitalize on asset redistribution. This increases inequality, which comes with many adverse effects, as documented by various authors such as Kumhof et al. (2015).

The above responses are in line with the results obtained from the VAR analysis on US data in Section 2. After a recessionary shock (in productivity or of a monetary nature), both Figures 4 and 5 show that the number of assets accumulated by the funds increases and the profitability of financial firms increases over that of goods-producing firms. The same can be said of employment in the financial sector. In the model, a proxy for employment in the goods-producing sector is the number of intermediate firms plot(1,4). A proxy for employment in finance is the number of firms acquired, plot(2,1), which is also the number of hedge funds and their respective employees in the model. Clearly, the movement of the two resembles the movement of the relative employment in the two sectors in the empirical VARs in Figures 4 and 5.

In another exercise it is demonstrated that the standard deviation S of the idiosyncratic fixed cost of the firms ϕ is important for GDP dynamics. Figure 11 depicts sensitivity of the a negative productivity shock to the effect of a change in uncertainty in the economy. The solid red impulse responses represent the effect of a 1% negative productivity shock when $S = 0.1$ which is the same exercise that generated Figure 10. The dashed blue responses are the ones corresponding to a model with higher uncertainty, $S = 0.3$. More uncertainty makes a stronger case for asset redistribution, as there is a much larger benefit to the hedge funds than in a less uncertain environment. As previously stated, banks favoring hedge funds, effectively depriving credit from entrepreneurs, has the effect of making a recession both more severe and harder to recover from. The effect of uncertainty in the investment response is very important and coincides with the findings in Banerjee et al. (2015). The effect

of asset redistribution is much more severe in a more uncertain environment because even small decreases in the returns from entrepreneurial projects can produce a strong incentive to diversify and shift credit heavily towards redistribution. Therefore, higher uncertainty in the economy makes the problems created by income redistribution more severe as the repercussions of the recession worsen.

Figure 12 investigates the effect of easing the conditions for the hedge funds to obtain credit. The way this is depicted in the model is by a reduction in cost for banks to open credit lines with hedge funds κ_t^R which follows an AR(1) for persistent effects. The ease of access to credit for the hedge funds makes them more attractive to both banks and investors, thus keeping the economy in a recession. Hedge funds attract a higher share of credit, while the production sector struggles to secure the same, causing the production of goods to deteriorate. The theoretical model indeed predicts that easing access to credit for investment companies (hedge funds) pushes the economy into a recession as more credit is diverted to redistributing existing assets instead of creating new ones. The evident in Figure 12 replicates the impulse responses from the empirical VAR after an increase in the loan-to-value ratio for hedge funds in Figure 6.

Figure 13 represents the responses in the model economy after a 1% increase in the federal funds rate [25]. The dynamics are similar to those which preceded, with a similar interpretation. Even though an increase in the federal funds rate puts the economy in a recession the incomes of those that redistribute income rise.[26]

Figures 10 to 13 from the theoretical model demonstrate that income inequality is countercyclical and rises during recessions. The ability of the rich to capitalize on the entrepreneurs' desire to diversify induces a reallocation of existing assets that crowds out investment in capital. The countercyclical inequality, surging in recessions and decreasing in expansions, is not only evident in the model, but also empirically discussed in Silvia et al. (2012) and shown from our VAR on annual US data in Figure 7, which shows that contractionary monetary policy increases the household income Gini coefficient.

[25] Running the model as in the case where depositors set the equilibrium loanable funds in the economy and where banks just define the allocation between entrepreneurs and hedge funds is not much different.

[26] More accurately, for the current deals, the hedge funds are profiting. They could be making a loss on already existing assets though, a feature that is not captured in the model due to tractability issues.

7 Policy recommendations

As already documented in previous sections, easing credit conditions for entrepreneurs can decrease the deviation from potential output in the model. This signifies that supporting and easing credit to entrepreneurs during recessions may provide a way to control the severity of recessions and speed up recovery. For example, suppose the central bank imposes the following rule that determines the cost of opening credit lines to entrepreneurs

$$\frac{\kappa_t^E}{\bar{\kappa}^E} = \left(\frac{Y_t}{\bar{Y}}\right)^{a_m} \tag{92}$$

where $a_m > 0$ and κ_t^E represents the cost for the bank to search for entrepreneurs in order to form credit lines with. The above rule supports the constraint to banks to decrease the cost of credit lines to entrepreneurs as income Y_t drops during a recession. Simulations from such a framework are reported in Figure 14. The graph depicts the responses of a negative 1% productivity shock and the red responses are those reported earlier in the benchmark case. The solid blue lines correspond to the model where κ_t^E evolves according to the rule in equation (92). Clearly, the recession in this case is milder than in the benchmark model. A smaller share of loans is now reaching the hedge funds and a larger portion is reaching entrepreneurs, supporting the creation of intermediate firms which boosts employment. Moreover, the inequality problem is less severe, according to the last two sub- plots.[27]

There are other ways of boosting recovery in practice. Affecting κ_t^E or κ_t^R can represent various strategies in practice. The same effect can be triggered for example by making the LTV ratio for the entrepreneurs procyclical. This brings back a very old tool of monetary policy, in fact, the first tool ever used by central banks to influence the real economy. Before the central bank engaged in open market operations, it used the discount window to inject liquidity in a very specific way. It handed loans to banks to fund "productive" investments, i.e. investments aimed at producing goods or services. Increasing the incentives for banks to fund projects for productive purposes can prevent inequality from distorting the flow of credit. Similar schemes have recently[28] been promoted by the European Investment Bank, in order to "Promote Access to Finance" (PAF), albeit to a limited extent. PAF has proven to

[27] There are two inequality estimates because we classify entrepreneurs as rich in the first case and not rich in the other. Nevertheless, the effect is the same.

[28] See http://www.eib.org/infocentre/publications/all/jeremie-a-new-way-for-using-eu-structural-funds-to-promote-sme-access-to-finance-via-holding-funds.htm.

reduce the effects of inequality caused by the reallocation of funds to asset redistribution, by encouraging credit flow to the production of goods and services instead and, consequently, diminishing the severity of the recession as shown in Figure 14.

Therefore, increasing PAF to encourage loans for wealth creation is strongly recommended. While this plan can be undermined in its effectiveness should there be a decrease in the incentive for entrepreneurship during a recession, it can nevertheless support existing businesses and stave off further deterioration of the economic environment. In addition, it can diminish the incentive for the hedge funds to redistribute wealth, which is an important factor that prolongs the downturns as demonstrated in this paper. If funding to entrepreneurs becomes more easily accessible, the recession becomes less severe and recovery is stimulated.

8 Conclusion

This paper aims to give an explanation and propose a way to confront low investment response following a crisis. In an economy, credit is not only used for investments that have the potential to create new wealth, but it can also be used for redistributing existing wealth. Wealth redistribution tends to be a privilege of the few and the incentive to capitalize on it changes along the business cycle. It is demonstrated in this study that during a recession the incentive to redistribute wealth becomes stronger. As return per unit of risk is lower during a recession, entrepreneurs perceive an increased risk in their business. In their attempt to hedge this risk, they allow hedge funds to profit through acquiring a stake in their assets. Thus, redistribution in a downturn becomes more profitable to investors and also more attractive for the banks, resulting in heavier funding of these type of investments. Moreover, those able to profit from asset accumulation become richer, enabling them to absorb even more credit, leading to a new round of asset redistribution. As entrepreneurs compete for credit with portfolio investors, this leaves entrepreneurs with fewer credit options, forcing them to cut firm creation and production further, deepening the recession.

Moreover, the ability of those with access to funding to profit from capital gains in a recession widens the gap between the rich and the poor, for it is the rich that have access to funding and hold portfolios of assets. This also provides an explanation as to why inequality increases during downturns, which is an empirical observation documented in many studies. This study can also point out certain ways in which rising inequality can be harmful to the economy. As the rich become richer, access to credit enables them to redistribute existing

assets, which increases fluctuations around potential output. The higher the uncertainty in an economy, the more pronounced are the deviations from potential output as income redistribution becomes more responsive in such an environment. Here, there is an incentive for policy makers to intervene appropriately during recessions to boost growth and employment by discouraging asset redistribution.

Specifically, this study proposes that central banks should ease access to credit for goods production and hinder it for asset redistribution during recessions and take the opposite tack during expansions. Practically, this can be achieved by using the discount window to offer liquidity to banks that fund productive investments, which was the first tool to be used by the Federal Reserve to conduct monetary policy. In addition, using macroprudential tools such as LTV ratios and promoting access to finance (PAF) in ways which allow entrepreneurs to secure loans more easily, recessions can become less severe and recovery may be boosted.

This study aims to create a new strand of literature that ultimately aims to find the optimal size of the financial sector that focuses on wealth redistribution. If asset redistribution crowds out productive investments, then regulating the financial sector appropriately might offer rewards in terms of growth. The interaction between capital goods investors and portfolio investors can have real effects and investigating this relationship can aid policymakers in achieving their goals.

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Appendices

A Proof of Propositions

A.1 Proposition 1

From equation (21)

$$\frac{dQ^R}{d\bar{V}} = \frac{1-R}{2R\phi S^2} < 0 \tag{A.1}$$

as $R > 1$ because it is the gross interest rate charged by the bank. Next use equation (21) to differentiate $Q^R\bar{V}$ with respect to $\bar{V}$. That is

$$\frac{dQ^R\bar{V}}{d\bar{V}} = \frac{(1-R)\,\bar{V} + R\phi S^2}{2R\phi S^2} + \frac{(1-R)\,\bar{V}}{2R\phi S^2} = \frac{1}{2} + \frac{(1-R)}{R\phi S^2}\bar{V} \tag{A.2}$$

For P^I to be positive, equation (22) signifies that $(1+R)\,\bar{V} > R\phi S^2$ and thus $\bar{V} > \frac{R\phi S^2}{1+R}$. This suggests that if we substitute $\frac{R\phi S_t^2}{1+R}$ for $\bar{V}$ in the above equation (A.2), it entails that

$$\frac{dQ^R\bar{V}}{d\bar{V}} = \frac{1}{2} + \frac{1-R}{R\phi S^2}\bar{V} > \frac{1}{2} + \frac{(1-R)}{R\phi S^2}\frac{R\phi S^2}{1+R} = \frac{3-R}{2\,(1+R)} > 0 \tag{A.3}$$

For the next result plug in equation (20), equation (21) and (22). This implies that

$$\Psi^R = \frac{(1-R)\,\bar{V} + R\phi S^2}{2R\phi S^2}\left(\frac{(1-R)\,\bar{V} + R\phi S^2}{2}\right) = \frac{\left[(1-R)\,\bar{V} + R\phi S^2\right]^2}{4R\phi S^2} \tag{A.4}$$

Differentiate the above and use equation (21) to get

$$\frac{d\Psi^R}{d\bar{V}} = Q^R\,(1-R) < 0 \tag{A.5}$$

For $\frac{d\Psi^E}{d\bar{V}}$ differentiate equation (15)

$$\frac{d\Psi^E}{d\bar{V}} = 1 - \frac{(R-1)^2}{2\,(R)^2\,\phi S_t^2}\bar{V}_t = 1 - \frac{R-1}{R}\frac{(R-1)\,\bar{V}_t}{2R\phi S_t^2} > 0 \tag{A.6}$$

because for both terms, it is required that $\frac{R-1}{R} < 1$ and $\frac{(R-1)\bar{V}_t}{2R\phi S_t^2} < 1$ for Q^R to be positive as (21) indicates.

A.2 Proposition 2

Since return of the marginal dollar to the Entrepreneurs should equal the return of the marginal dollar to the Hedge funds at the optimum, set equation (90) equal to (90) and rearrange to get

$$\left(\frac{s^E}{1-s^E}\right)^{\alpha_\Gamma}\left(\frac{b^R}{b^E}\right)^{\alpha_\Gamma} = \frac{R - R^d - \Phi\left(-\frac{\bar{V}}{S}\right)R^L}{R^\Gamma - R^d - \Phi\left(\frac{(R-1)\bar{V}-R\phi S^2}{2S}\right)R^L} \tag{A.7}$$

Differentiate the above with respect to $\bar{V}$ given that s^E is an implicit function of $\bar{V}$. That is

$$\begin{aligned} &\left(\frac{b^R}{b^E}\right)^{\alpha_\Gamma}\alpha_\Gamma\left(\frac{1-s^E}{s^E}\right)^{1-\alpha_\Gamma}\frac{1}{(1-s^E)^2}\frac{ds^E}{d\bar{V}} \\ = &\frac{f\left(-\frac{\bar{V}}{S}\right)\frac{R^L}{S}\left(R^\Gamma - R^d - \Phi\left(\frac{(R-1)\bar{V}-R\phi S^2}{2S}\right)R^L\right) + f\left(\frac{(R-1)\bar{V}-R\phi S^2}{2S}\right)\frac{R^L(R-1)}{2S}}{\left[R^\Gamma - R^d - \Phi\left(\frac{(R-1)\bar{V}-R\phi S^2}{2S}\right)R^L\right]^2} \end{aligned} \tag{A.8}$$

where $\frac{d\Phi(x)}{dx} = f(x)$ where $f(.)$ is the pdf of a standard normal. Every single term in the above expression is positive thus $\frac{ds^E}{d\bar{V}} > 0$.

B Additional model derivations

B.1 Risk averse hedge funds

In this section, a version where the hedge funds are risk averse is considered. The utility function is CARA with risk averse parameter ϕ^r. The profit maximization problem for the rate of asset to purchase Q_t^R by hedge funds becomes

$$\max_{\{Q_t^R\}_{t=0}^{\infty}} Q_t^R \left(\bar{V}_t - R_t^R P_t^I\right) - \frac{\phi^r}{2} \left(Q_t^R\right)^2 \frac{S_t^2}{N_t^R} \tag{B.1}$$

The first order condition after substituting P_t^I using equation (14) solved for Q_t^R is

$$Q_t^R = \frac{\left(1 - R_t^R\right) \bar{V}_t + R_t^R \phi S_t^2}{2 R_t^R \phi S_t^2 + \phi^r S_t^2} \tag{B.2}$$

By plugging equation (B.2) in the demand equation (14) to get

$$P_t^I = \left(\frac{\phi^r}{\phi} + 1 + R_t^R\right) \bar{V}_t - \left(R_t^R \phi + \phi^r\right) S_t^2 \tag{B.3}$$

It is evident that Q_t^R is affected by changes in $\bar{V}_t$ the same way as in the risk neutral case ($\phi^r = 0$). However, the price is even more volatile when hedge funds are risk averse by an additional term $\frac{\phi^r}{\phi}$. Therefore, if hedge funds are risk averse they provide insurance at a higher cost and thus the result becomes even stronger.

B.2 Depositors setters of loan portfolio

When loans are set by deposits, the bank solves the same optimization problem in equation (36) with the same constraints, however it optimally only chooses s_t^E and not the aggregate number of credit lines. In other words, the central bank sets the deposit rate, the depositors set the amount of deposits and through equation (35) and the bank simply splits this amount between entrepreneurs and deposits. Therefore, for this solution the necessary condition is

$$R_t^{\Gamma} \left(\kappa_t^E - \kappa_t^R\right) = \rho_t^E E_t \Lambda_{t,t+1} d \frac{JB_{t+1}}{dN_{t+1}} - \rho_t^R E_t \Lambda_{t,t+1} d \frac{JB_{t+1}}{dN_{t+1}^R} \tag{B.4}$$

along with the two envelope conditions

$$\frac{dJB_t}{dN_t} = \left(R_t^E - p_{d,t}^E R_L^E - R_t^\Gamma\right) r_t K_t + \left(1 - p_{d,t}^E\right) E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}} \tag{B.5}$$

and

$$\frac{dJB_t}{dN_t^R} = \left(R_t^R - p_{d,t}^R R_L^R - R_t^\Gamma\right) Q_t^R P_t^I + \left(1 - p_{d,t}^R\right) E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}^R}. \tag{B.6}$$

Following the same procedure as in Section 3.4, the interest rate to entrepreneurs is defined as follows

$$R_t^E = (1-\zeta) \frac{R_t^V}{r_t K_t} + \zeta p_{d,t}^E R_L^E + \zeta R_t^\Gamma - \zeta \frac{q_t^E}{r_t K_t} E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}} \tag{B.7}$$

while the interest rate to hedge funds is

$$R_t^R = (1-\zeta) \frac{V_t}{P_t^I} + \zeta p_{d,t}^R R_L^R + \zeta R_t^\Gamma - \zeta \frac{q_t^R}{Q_t^R P_t^I} E_t \Lambda_{t,t+1} \frac{dJB_{t+1}}{dN_{t+1}^R}. \tag{B.8}$$

B.3 Equilibrium

B.3.1 Entrepreneurs

The net cash flow to the entrepreneurs Ψ_t^E from each firm created is

$$\Psi_t^E = \frac{N_t^R}{N_t} \left[Q_t^E \bar{V}_t + \left(1 - Q_t^E\right) P_t^I\right] + \left(1 - \frac{N_t^R}{N_t}\right) \bar{V}_t. \tag{B.9}$$

where the first term is the return from selling part of the firm to the hedge funds. As hedge funds secure N_t^R credit lines, they randomly choose N_t^R firms each period. Therefore, the probability of a firm to be partly purchased by hedge funds is $\frac{N_t^R}{N_t}$. The second term is the return from the business they fully own.

Bank capital evolves as follows

$$\Omega_{t+1} = (1-\omega) \tilde{\Omega}_t + (1-\delta_B) \Omega_t \tag{B.10}$$

where initial capital and reserves in the following period Ω_{t+1} is the percentage $1-\omega$ of profits

$$\tilde{\Omega}_t = N_t \left(R_t^E - p_{d,t}^E R_L^E\right) r_t K_t + N_t^R \left(R_t^R - p_{d,t}^R R_L^R\right) Q_t^R P_t^I - R_t^d D_t \tag{B.11}$$

which are paid as dividends after deducting the percentage δ_B denoting the cost to maintain

bank capital.

B.3.2 Hedge funds

The value of the investment to the hedge funds is

$$\Psi_t^R = Q_t^R \left(\bar{V}_t - R_t^R P_t^I\right) \tag{B.12}$$

and the number of firms the hedge funds hold a stake in is $N_t^R \leq N_t$.

B.4 Market clearing conditions

The aggregate resource constraint is

$$\begin{aligned} & C^R + C^E + C^C + G + N\bar{\varphi} + \delta_B \Omega + \left(s_t^E \kappa_t^E + s_t^R \kappa_t^R\right) \Gamma_t \\ = \; & Y - \left(1 - \psi^E\right) R_L^E N_t w_t L_t - \left(1 - \psi^R\right) R_L^R N_t^R Q_t^R P_t^I. \end{aligned} \tag{B.13}$$

The amount of housing is fixed and therefore

$$H_t^E + H_t^R = \bar{H}. \tag{B.14}$$

B.5 Default probabilities

If V_{it} is the valuation of the i project, then the breakeven point considered by hedge funds is $V_{it} = R_t^R P_t^I$. Substitute in the price equation (22) to get

$$V_{it} = \frac{\bar{V}_t + R_t^R \bar{V}_t - R_t^R \phi S_t^2}{2}. \tag{B.15}$$

The valuation depends on the idiosyncratic shock (see the intermediate goods-producing firms)

$$V_{it} = \frac{1}{\theta_x - 1} \frac{R_t^E r_t}{N_t^{1+\xi} z_t} X_t - \varphi_i. \tag{B.16}$$

Using equations (B.15) and (B.16) we get the cut-off point which a default occurs for the hedge fund

$$\hat{\varphi}_t^R = \frac{1}{\theta_x - 1} \frac{R_t^E r_t}{z_t N_t^{1+\xi}} X_t - \frac{\bar{V}_t + R_t^R \bar{V}_t - R_t^R \phi S_t^2}{2}. \tag{B.17}$$

Use equation (69) in equation (B.17) above, to get an expression relating the two reservation values

$$\hat{\varphi}_t^R = \hat{\varphi}_t - \frac{\left(1 + R_t^R\right) \bar{V}_t - R_t^R S_t^2 \phi}{2}. \tag{B.18}$$

Therefore $p_{d,t}^i$ where $i \in \{E, R\}$ are the probabilities of default

$$p_{d,t}^R = \Pr\left(\varphi_i > \hat{\varphi}_t^R\right) \tag{B.19}$$

and

$$p_{d,t}^E = \Pr\left(\varphi_i > \hat{\varphi}_t\right). \tag{B.20}$$

Table 1: Sources of data used in the empirical analysis

Variable	**Code**	**Description**
GDP	GDPC1	Real Gross Domestic Product; Billions; Chained 2009 Dollars; Seasonally Adjusted Gross Domestic Product
Inflation	GDPDEF_PCH	Implicit Price Deflator; Change; Seasonally Adjusted
Fedfunds Rate	FEDFUNDS	Effective Federal Funds Rate; Percent; Quarterly;
Investment	USAGFCFQDSMEI	Gross Fixed Capital Formation; Not Seasonally Adjusted
Loans Fin. Sector	FBLSRAQ027S	Financial Business; Total Loans Liability; Level; Millions; Not Seasonally Adjusted
Unemployment	UNRATE	All Employees; Financial Activities; Thousands; Seasonally Adjusted
Empl. Goods	USGOOD	All Employees; Goods Producing Industries; Thousands; Seasonally Adjusted
Empl. Finance	USFIRE	All Employees; Financial Activities; Thousands; Seasonally Adjusted
TFP	OPHNFB	Non-farm Business Sector; Real Output Per Hour Index 2009=100; Seasonally Adjusted
Hours	PRS85006022	Non-farm Business Sector; Average Hours; Change; Annual Rate; Seasonally Adjusted
Profit Financial	A392RC1Q027SBEA	Corporate Profits; Domestic Industries; Financial; Billions; Seasonally Adjusted
Profit Non Financ.	A464RC1Q027SBEA	Non-financial Corporate Business; Profits bef. tax; Billions; Seasonally Adjusted
Fund Assets	Z1/Z1/LM653164205.Q	Mutual Fund Shares; Federal Reserve Board
HH Income Gini	Gini Equiv HH Disp Inc	Heathcote Perri and Violante(2009)
Tot. Assets Rich	Top 1% fin. Assets	http://topincomes.g-mond.parisschoolofeconomics.eu/

Notes: All data come from the *St. Louis FRED* dataset unless otherwise stated.

Table 2: Theoretical model parametrization

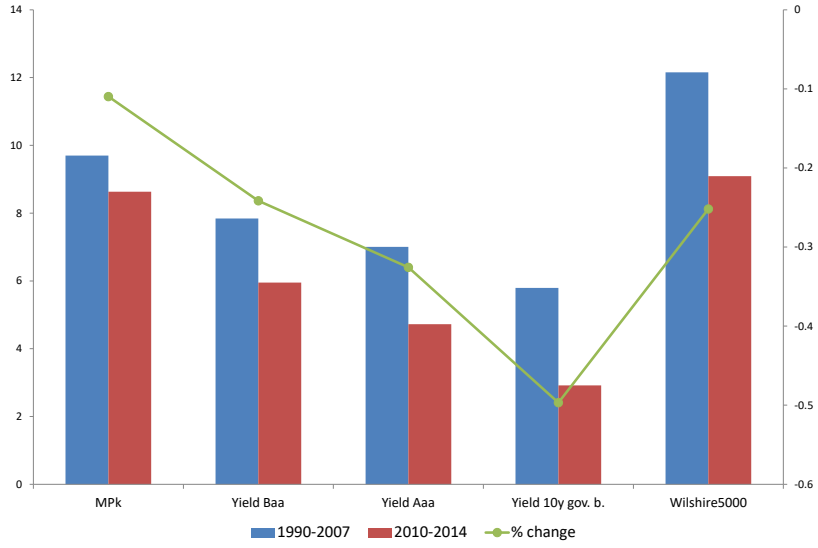
Variable	Value	Description	Variable	Value	Description
N	1	Number of firms	κ^E	0.05	Cost credit line E
N^R	0.4	Firms owned by HF	κ^R	0.001	Cost credit line HF
$1-p_d^E$	0.1	Prob. default E loan	ρ_m	0.85	Interest rate inertia par.
$1-p_d^R$	0.48	Prob default HF loan	γ	0.85	Calvo prob.
R^d	1.05	Gross deposit rate	R_L^E	0.1	Bank loss from E
R^E	1.12	Rate to E	R_L^R	0.1	Bank loss HF
R^R	1.05	Rate to hedge funds	β^C	0.98	discount factor comm.
α_Γ	0.5	Matching function elast.	β	0.7	disc factor E and HF
A_Γ	0.6	Matching function const.	θ	11	Elast. of subst. firms
$\bar{\varphi}$	0	firm fixed cost/revenue	ρ^E	0.6	Prob. bank lends E
S_t	0.1	Standard deviation of φ_i	ρ^R	0.75	Prob. bank lends HF
l	2	Disutility of labor param.	g_y	0	Interest rate rule gdp resp.
θ_x	11	Elasticity of subst. int.firms	g_π	1.1	Interest rate rule infl. resp
q^E	0.6	Prob. E get loan	$\tilde{N}^E$	1.2	Max credit lines E
q^R	0.4	Prob. HF get loan	$\tilde{N}^R$	0.9	Max credit lines HF

Notes: The letter E corresponds to entrepreneurs while HF to hedge fund.

Figure 1: Yields on corporate bonds and bank corporate loan rates

Source: *St. Louis FRED.*

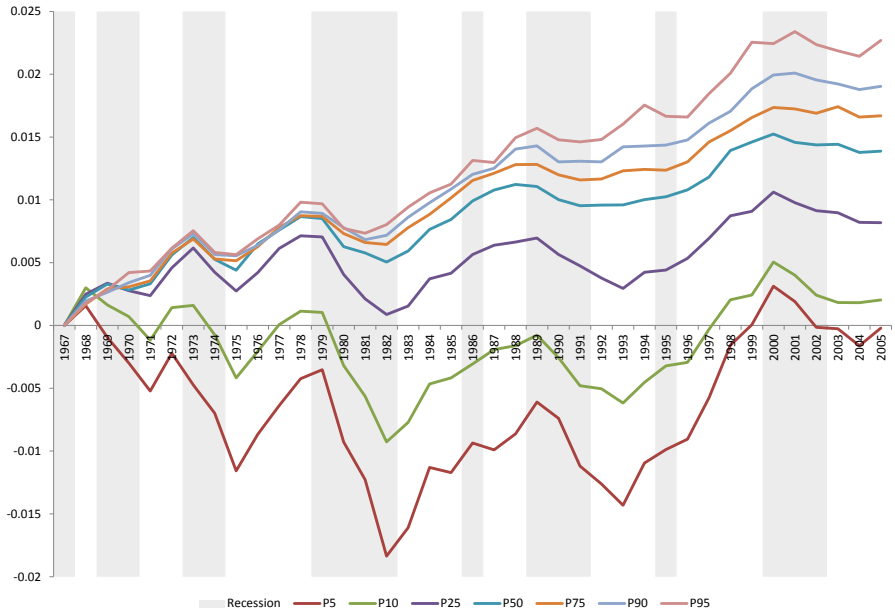
Figure 2: Pre- and post-crisis returns for various types of investments



Source: *St. Louis FRED.*

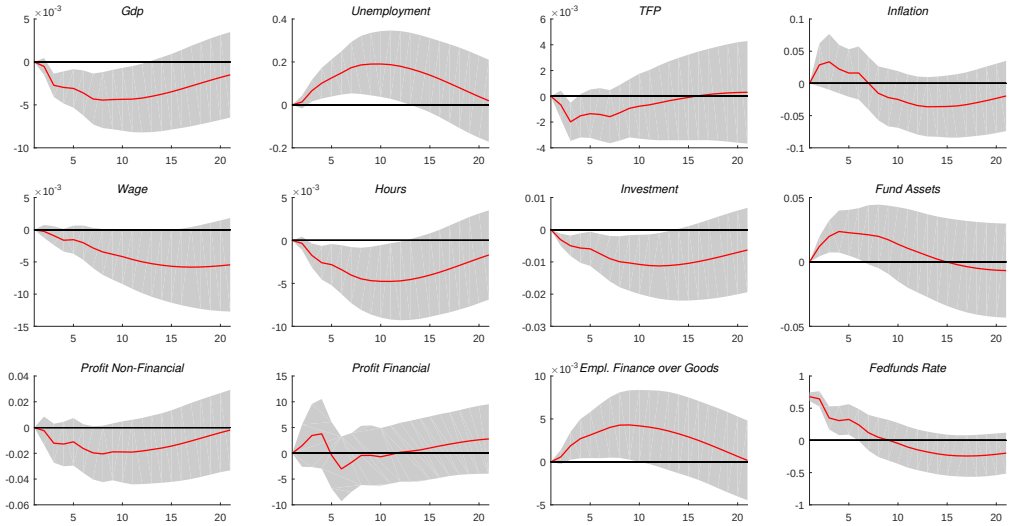
Notes: The returns for various types of investments in the US market for the period before the crisis 1990 - 2007 (blue bars) and the period after the crisis 2010 - 2014 (red bars). Percentage change shown in right axis.

Figure 3: Evolution of income for different percentiles of the income distribution



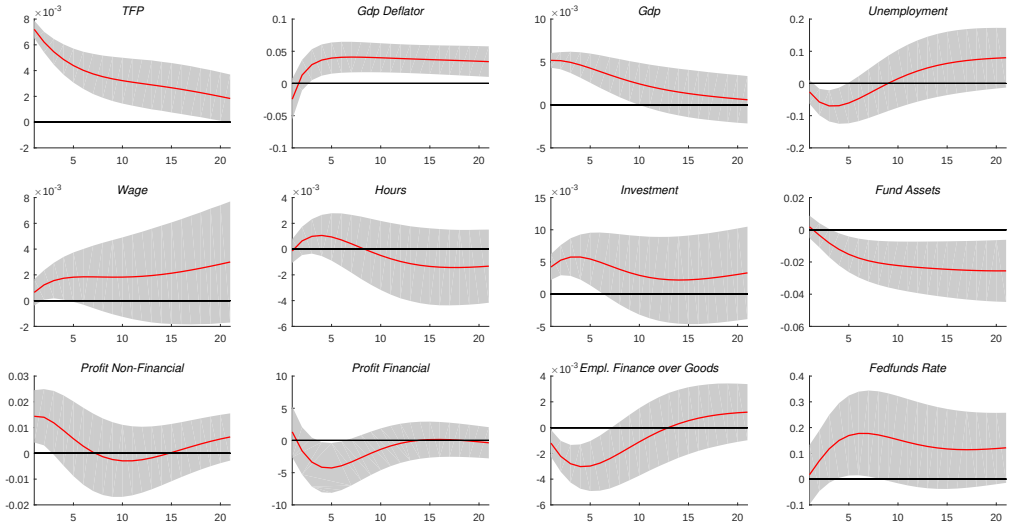
Source: *Current Population Survey.*
Notes: Shaded areas represent periods of recession.

Figure 4: Structural VAR impulse responses of a monetary policy shock



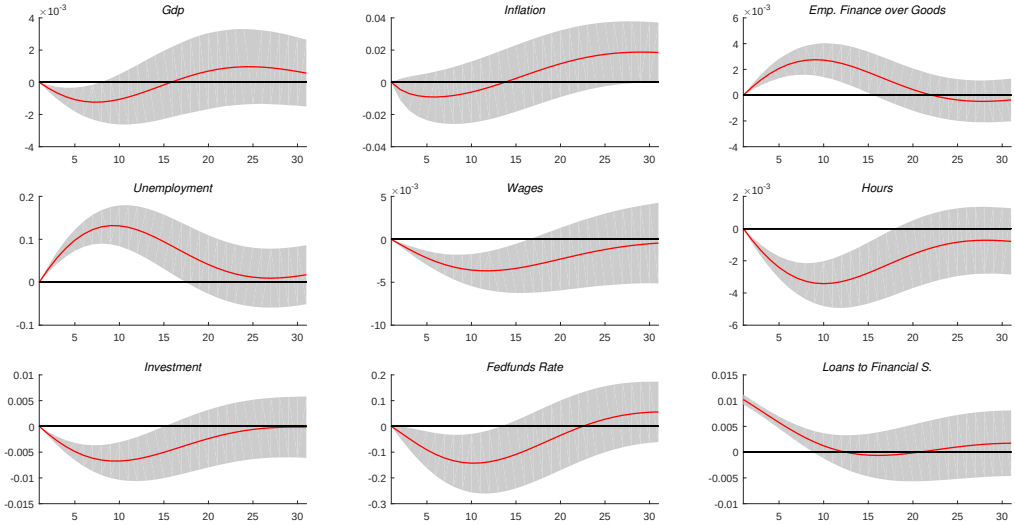
Notes: Impulse responses from a structural VAR on US data from 1960:Q2 to 2015:Q4. The solid red lines are the impulse responses after a 1 standard deviation shock that increases the federal funds rate. All variables except for the federal funds rate respond with a lag. Shaded areas represent 95% confidence intervals.

Figure 5: Structural VAR impulse responses of a productivity shock



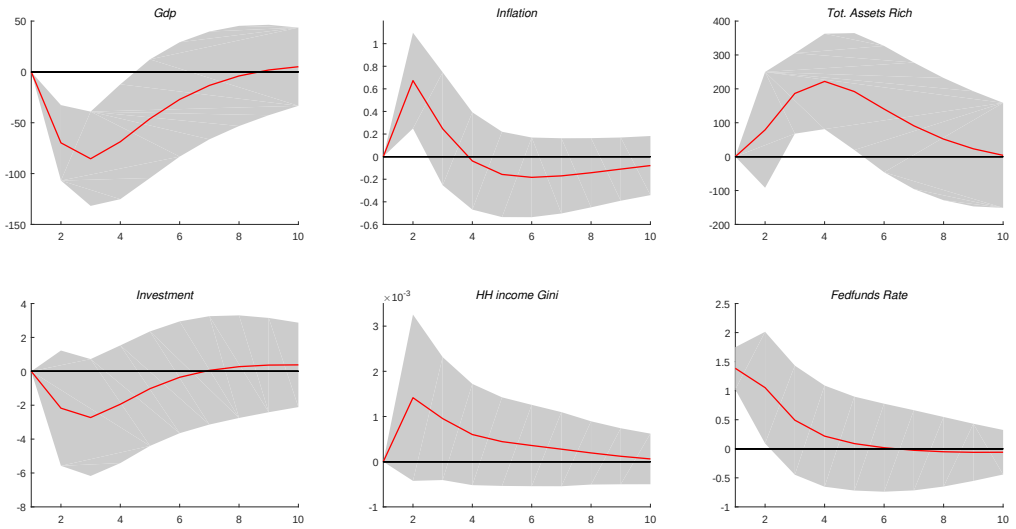
Notes: Impulse responses from a structural VAR on US data from 1960:Q2 to 2015:Q4. The solid red lines are the impulse responses after a 1 standard deviation productivity shock (output over hours). Shaded areas represent 95% confidence intervals.

Figure 6: Structural VAR impulse responses of an increase in loans to the financial sector



Notes: The impulse responses from a structural VAR on US data from 1960:Q2 to 2015:Q4. The solid red lines are the impulse responses after a 1 standard deviation increase on loans to the financial sector. Shaded areas represent 95% confidence intervals.

Figure 7: Structural annual VAR impulse responses of a monetary policy shock



Notes: Impulse responses from a structural VAR on US data from 1961 to 2006, on an annual basis. The solid red lines are the impulse responses after a 1 standard deviation shock that increases the federal funds rate. All variables except for the federal funds rate respond with a lag. Shaded areas represent 95% confidence intervals.

Figure 8: Transmission of monetary policy in a schematic representation

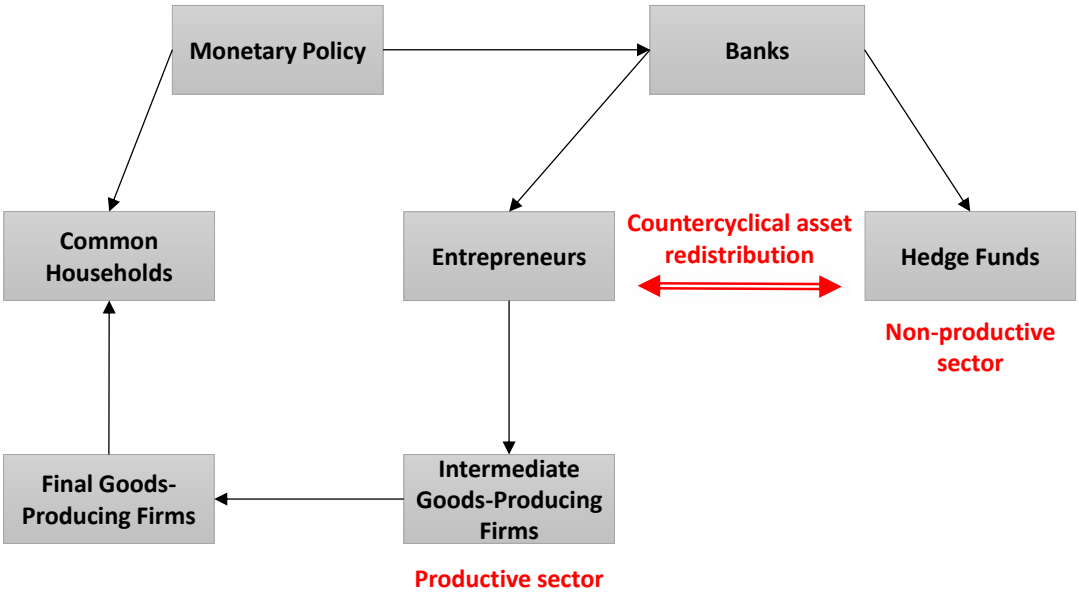
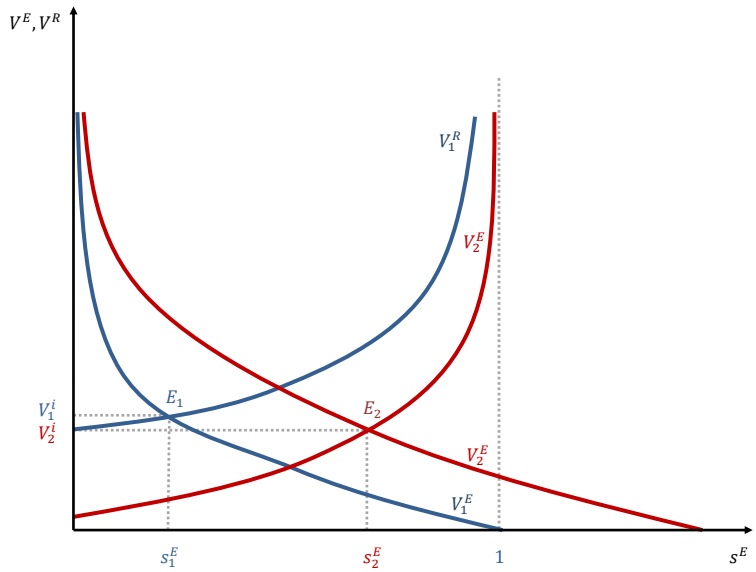
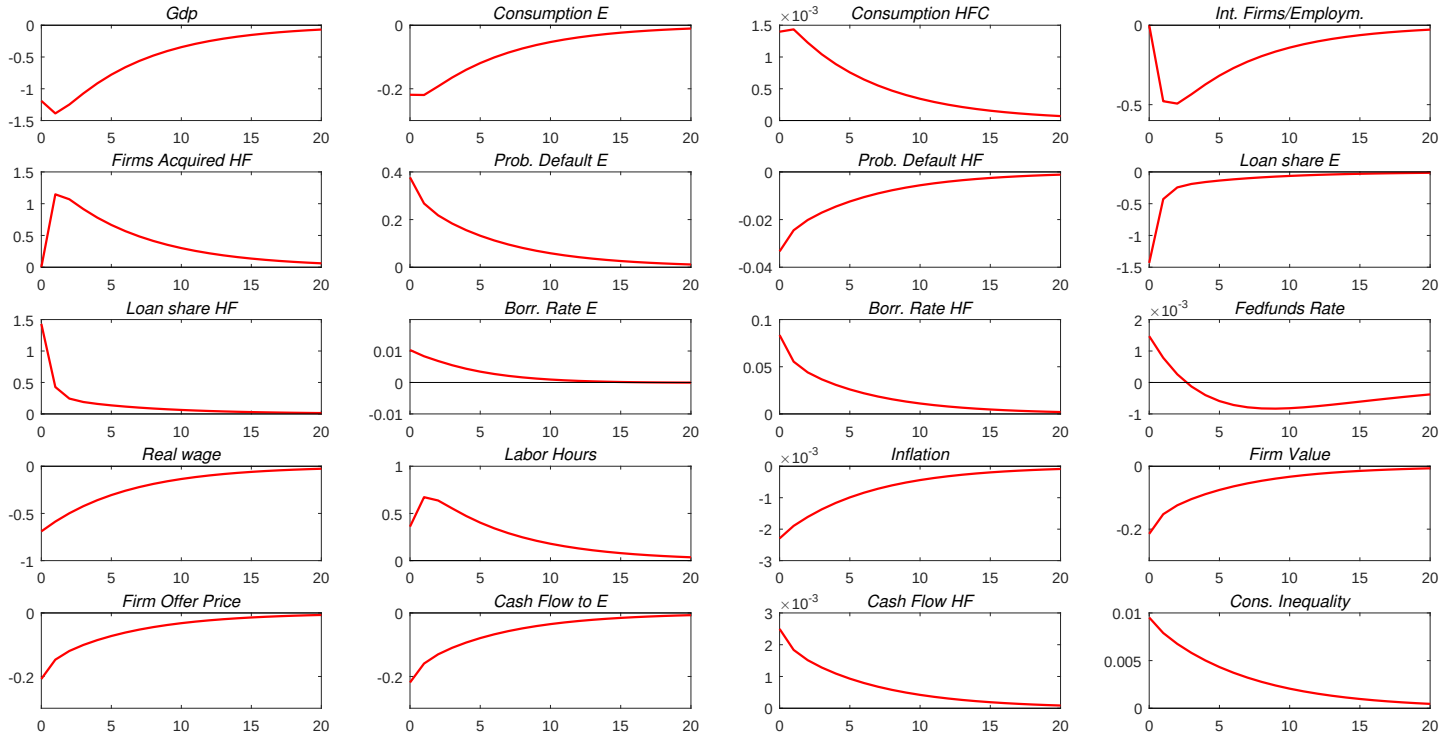


Figure 9: Solution of the partial equilibrium model



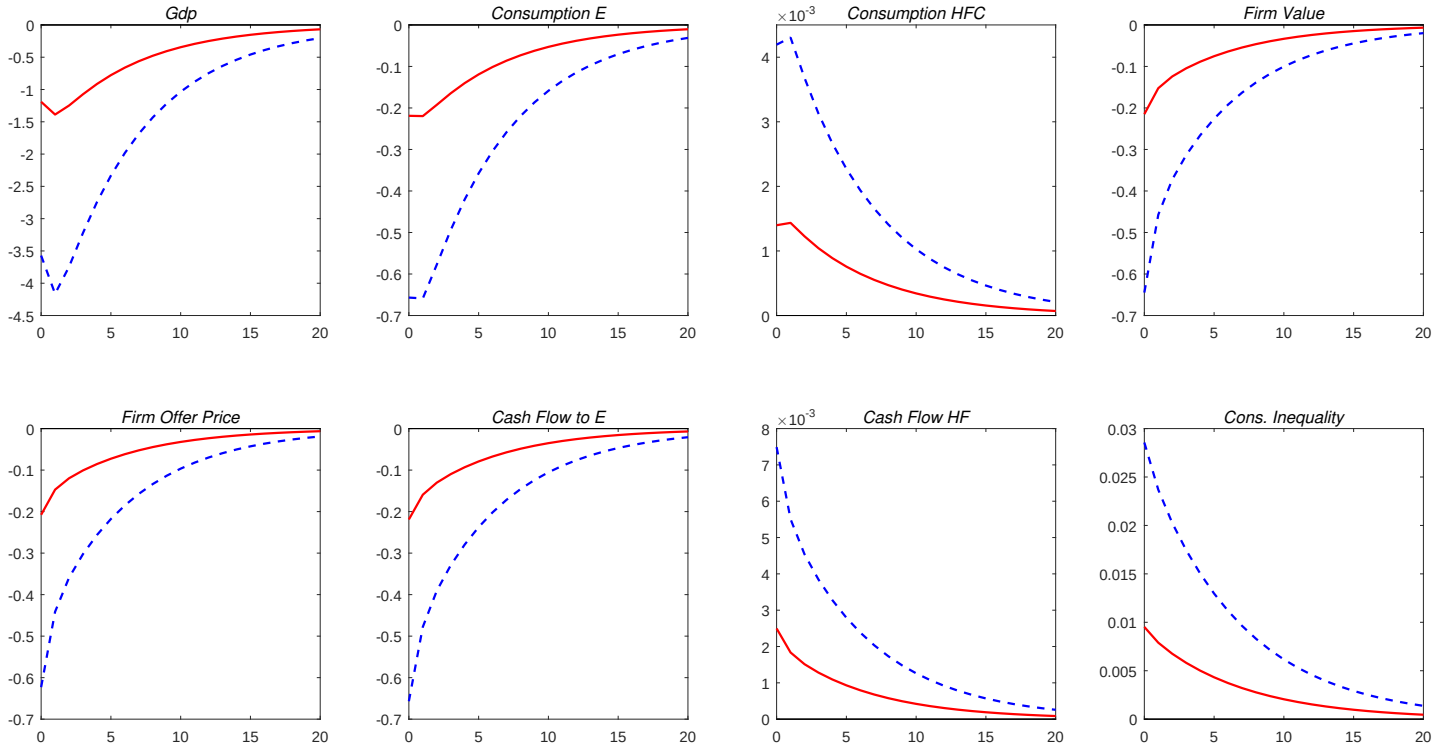
Notes: The horizontal axis depicts the share of lines of credit the bank allocates to the entrepreneurs while the rest is allocated to hedge funds.

Figure 10: Model impulse responses of a productivity shock



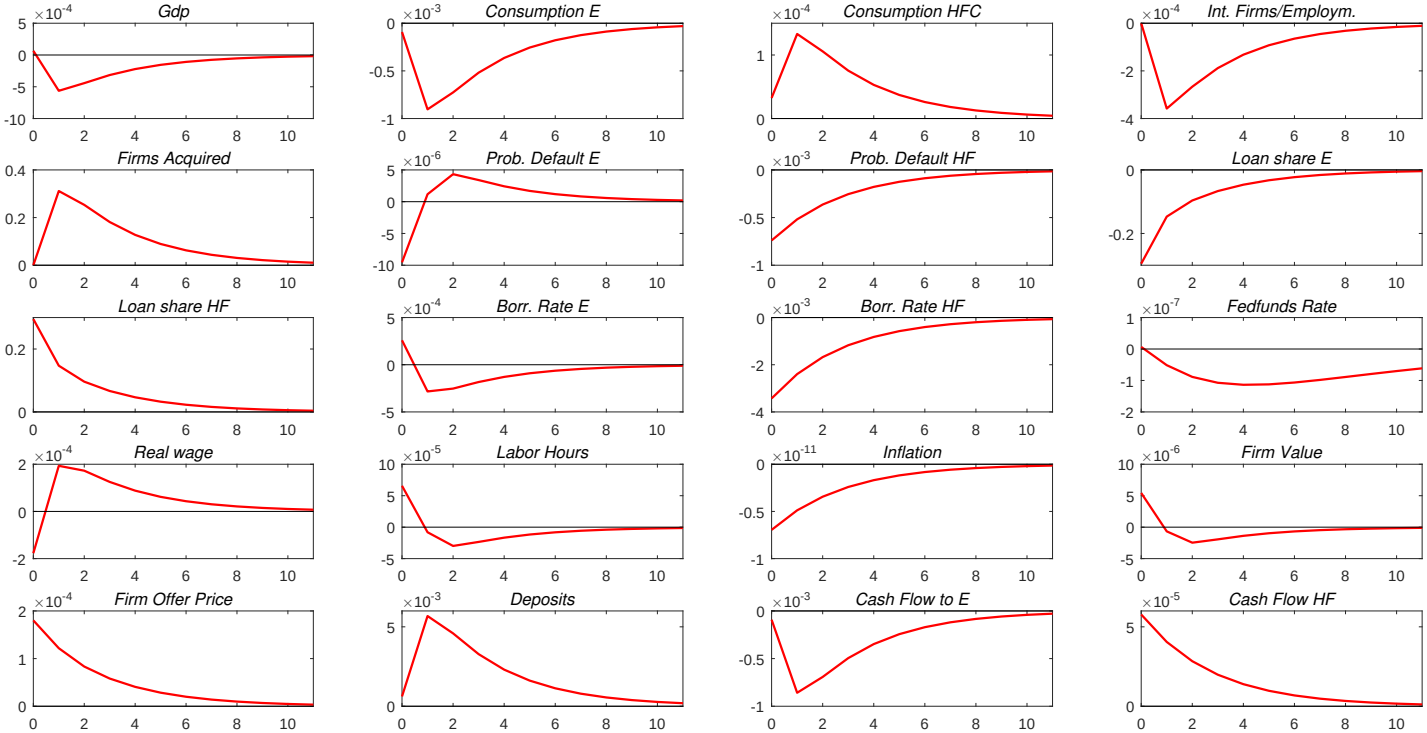
Notes: Negative 1% technology shock that decreases the total factor productivity. The letter E corresponds to entrepreneurs, HFC to the hedge fund clients and HF to hedge funds. In the model, HFC and HF are merged to the representative hedge fund agent.

Figure 11: Model impulse responses of a productivity shock subject to higher uncertainty



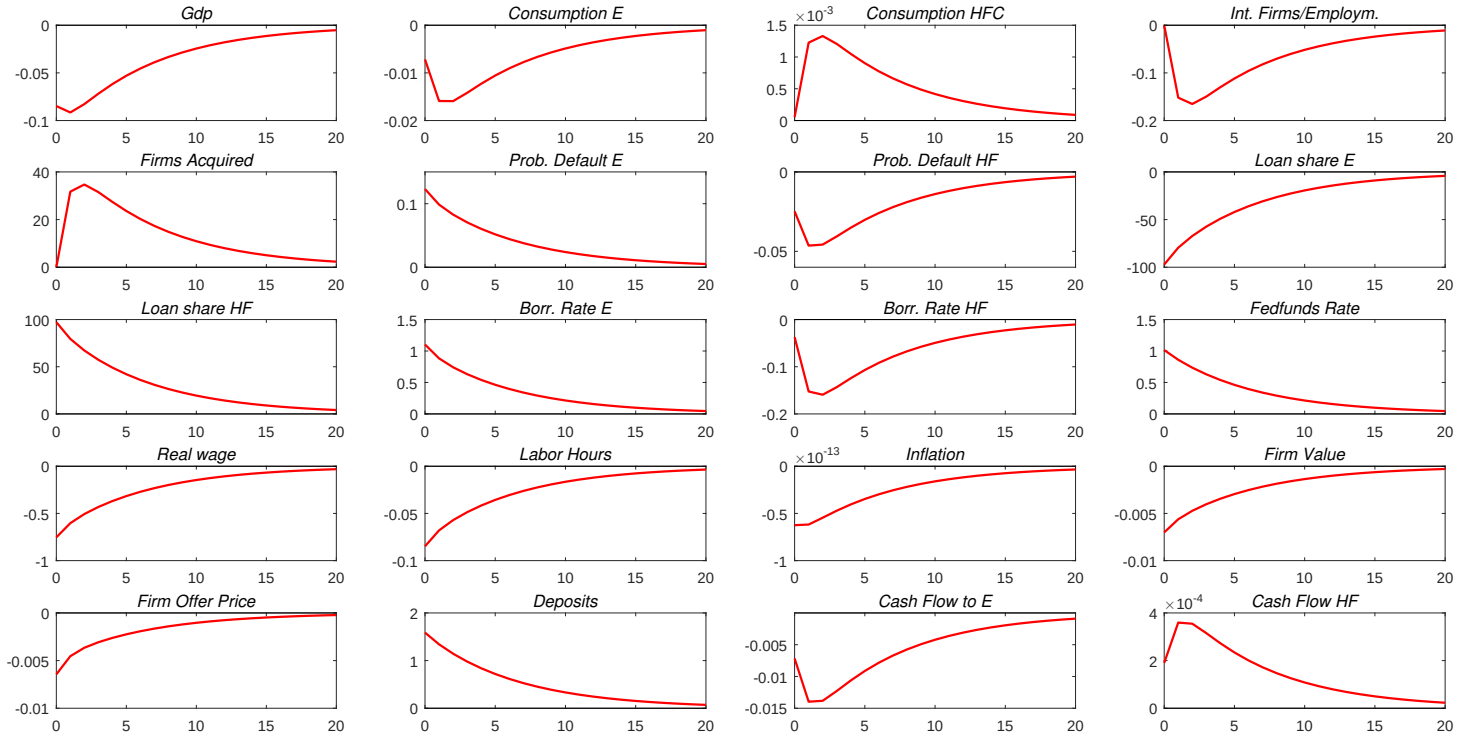
Notes: Negative 1% technology shock that decreases the total factor productivity. The solid red responses correspond to a standard deviation parameter for the idiosyncratic shock equal to 0.1 and the dashed blue responses to a standard deviation of 0.3. The letter E corresponds to entrepreneurs, HFC to the hedge fund clients and HF to hedge funds. In the model, HFC and HF are merged to the representative hedge fund agent.

Figure 12: Model impulse responses of a shock to the hedge funds access to funding



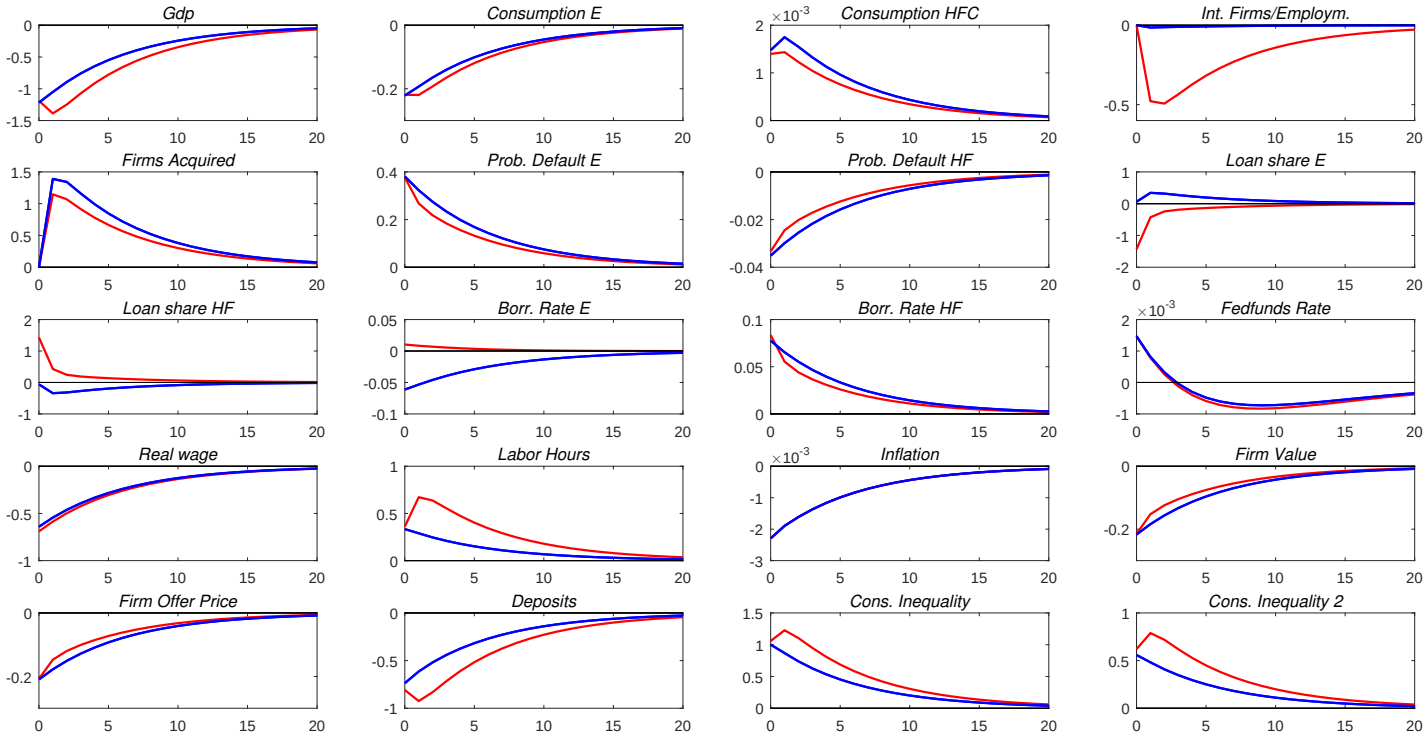
Notes: 1% decrease in $_R$ that makes the access to funding for the hedge funds easier. The letter E corresponds to entrepreneurs, HFC to the hedge fund clients and HF to hedge funds. In the model, HFC and HF are merged to the representative hedge fund agent.

Figure 13: Impulse responses of the benchmark model after a 1% monetary policy shock



Notes: Impulse responses of the benchmark model after a 1% shock that increases the federal funds rate. The letter E corresponds to entrepreneurs, HFC to the hedge fund clients and HF to hedge funds. In the model, HFC and HF are merged to the representative hedge fund agent.

Figure 14: Model impulse responses of a productivity shock subject to the prescript policy rule



Notes: Impulse responses after a 1% negative productivity shock. The red lines correspond to the responses of the benchmark model. The blue lines are the responses from the model with a lower relative cost of opening a credit line with entrepreneurs instead of hedge funds. The letter E corresponds to entrepreneurs, HFC to the hedge fund clients and HF to hedge funds. In the model, HFC and HF are merged to the representative hedge fund agent.