Financial Development and Macroeconomic Stability

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VERY PRELIMINARY AND INCOMPLETE

Abstract

In this paper we study a model with financial markets frictions to address three questions. First, does the increasing credit capacity of borrowers during periods of economic expansions create the conditions for sharper and deeper recessions? Second, does the macroeconomic scale of a downturn decrease as the efficiency of the financial system improves? Third, does the macroeconomic expansion differs from a macroeconomic downturn (asymmetry).

We show that financial market frictions do create the conditions for greater macroeconomic instability. This is especially pronounced in downturns (asymmetry). Financial development has two consequences: On the one hand it enables firms to take on more debt, making the economy more vulnerable to shocks. On the other, it increases the accessability to alternative sources of funding and allows for greater flexibility of investment. If the financing flexibility dominates the increase in leverage, financial development improves macroeconomic stability. This is the pattern observed in the post-war experience of the U.S. economy.

1 Introduction

Periods of macroeconomic expansions are often associated with asset price and credit booms. The expansion in the volume of credit raises concerns about the stability of the system once the expansionary period turns to an end. At that point, the borrowers' need to restructure the financial position may trigger a drastic cut in investments. The result would be a deeper recession than in the case in which the financial position of borrowers had not changed during the expansion. These concerns motivate the demand of policies (including monetary measures) contrasting the excessive expansion of credit during economic booms.

This view, although widespread in the policy debate, is not always supported by a solid theoretical foundation. There are several questions that remain to be answered in the theoretical literature. First, does the increasing credit capacity of borrowers during periods of economic expansions create the conditions for sharper and deeper recessions? Second, does the macroeconomic scale of a downturn decrease as the efficiency of the financial system improves? Third, does the macroeconomic expansion differs from a macroeconomic downturn (asymmetry). Fourth, what does this imply for policies? Should the policy maker, including the monetary authority, try to contrast the expansion of credit during booms?

In this paper we try to answer the first three questions. We study a model in which firms finance investments with equity and debt. Contracts are not fully enforceable and the ability to borrow is limited by a non-default constraint. The important feature of the model is that the non-default condition is endogenous and depends on the current conditions of the economy. Consequently, the ability to borrow changes during periods of economic expansions and contractions. We contrast an economy in which debt is the only feasible contract with an economy in which the firm can also sign optimal state-contingent contracts. In the debt-only economy, the credit limit is determined by the incentive of the lender to repay the debt (enforcement). Differently from Kiyotaki & Moore (1997), the debt limit is not determined by the market price of land or capital, but by the expected lifetime profitability of the firm. Because the entrepreneur looses the ability to run the firm after default (due to exclusion from financial markets), the incentive to repay is determined by the loss of future profits after the exclusion. This economy is compared to an economy in which optimal state-contingent contracts are also feasible.

We show that the presence of financial market frictions and the inability to sign optimal contracts create the conditions for greater macroeconomic instability. During periods of economic expansion, the non-default constraint is relaxed and firms take on more debt. When the economy changes its curse, the subsequent contraction in credit capacity requires firms to restructure their financial position. In the short-run this can be done only by drastically cutting investments.

A second finding is that the *over-reaction* to a downturn increases with the enforcement of debt contracts. Although this result may appear counter-intuitive at first, it has a simple intuition. When debt contracts are more enforceable, firms are able to take on more debt. The higher leverage then implies that the debt restructuring, after a downturn, must also be higher. As a result, the macroeconomic consequences of a negative shock are more severe. However, we also show that the sensitivity of the economy to a shock decreases with the ability of the firm to use other sources of financing, that is, financial contracts whose repayment is linked to the performance of the firm. In particular, if firms were able to use state-contingent optimal contracts, the *over-reaction* to a downturn would disappear.

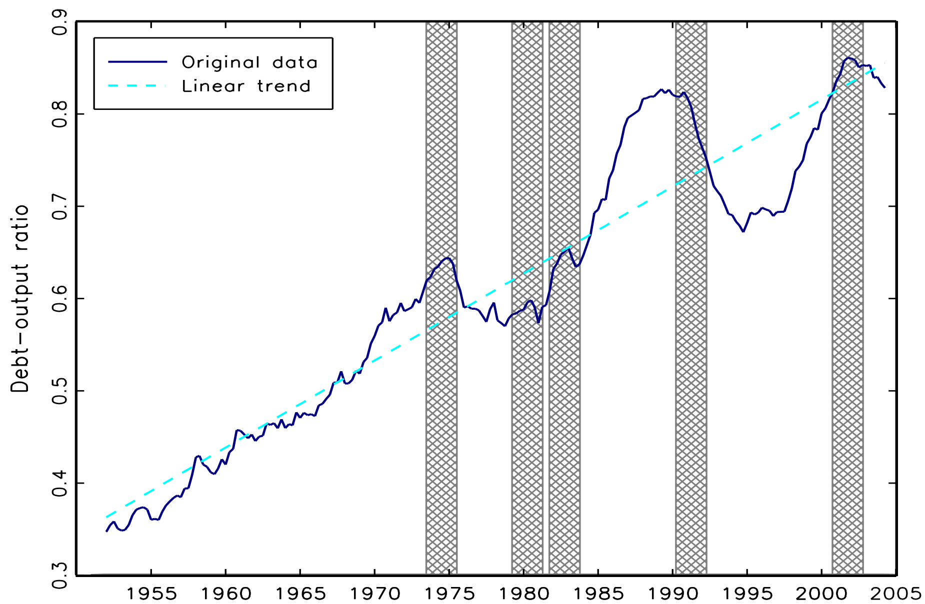
More developed financial systems are characterized by greater enforcement of contracts—in particular, debt contracts—and greater access to alternative sources of funding. While the first may increase the sensitivity of the firm investment to asset price shocks, the second allows for greater financing flexibility and reduces the volatility of investments. Because the second effect is more likely to dominate the first, we have that more sophisticated financial systems are likely to display greater macroeconomic stability.

The third finding is that the macroeconomic responses of the economy to positive and negative shocks are highly asymmetric: while negative shocks lead the economy to sharp downfall, positive shocks induce more gradual expansions. The magnitude of the asymmetry also depends on the extent to which firms can use alternative sources of financing. In the extreme case in which all firms can use optimal contracts, there is no asymmetric responses to shocks. The business cycle asymmetry seems to characterize the business cycle properties of the US economy as we show in the next section.

2 Real and financial cycles in the U.S.

Figure 1 plots the credit market liabilities, as a fraction of output, in the nonfarm business sector. This variable—constructed using data from the Flow of Funds—includes only liabilities that are directly related to credit markets. It does not include, for instance, tax liabilities. We refer to this variable as outstanding debt. The shaded areas outline five of the major recessions experienced by the U.S. economy during the last three decades.

Figure 1: Debt as fraction of output in the nonfarm business sector.



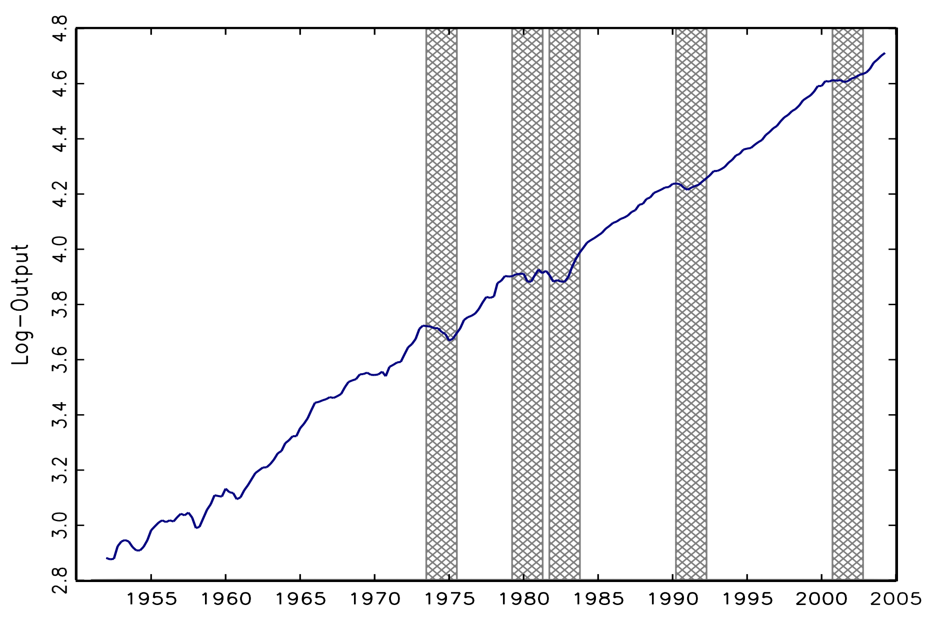
There are two important patterns to emphasize. The first is that the outstanding debt of nonfarm business companies shows an upward trend during the last 50 years. In the early fifties this ratio was only 35 percent while today it is about 85 percent. The second pattern is the increasing volatility of debt. While the debt-output ratio grew at a relatively stable rate during the fifties and sixties, in the last three decades it displayed large oscillations around the same trend, with three major picks: 1975, 1991, 2001.

Each of the three picks coincide with a major recession. After the recession, the debt exposure declines drastically. During this period (last three decades of the sample) there are other two major recessions: at the end of the 1970s and at the beginning of the 1980s. These two recessions, however, took place when the debt exposure was already low, relative to the trend, which may explain why they generated only a small drop in outstanding debt.

The cyclical pattern shown in Figure 1 suggests that recessions lead firms to restructure their financial exposure and the magnitude of the restructuring is particularly severe when the debt exposure is high. However, despite the largest debt restructuring observed in the last two decades, the negative impact on output is relatively small as shown in the next figure.

Figure 2 plots the real nonfarm business output. Each of the five major recessions, outlined by the shaded areas, are preceded by high phases of growth and are characterized by sharp output fall. The output fall is quickly followed by subsequent output expansions. In general, expansionary phases are relatively smoother and longer than recessions. The asymmetric pattern of the business cycle has been emphasized in several empirical studies but there is not an established and well-accepted explanation for this pattern.

Figure 2: Nonfarm business output. Log-value.



Another important pattern shown by Figure 2 is that output volatility has decreased substantially in the last 20 years. Also this fact has received considerable attention in business cycle studies but there is no agrement about the sources of the lower volatility.

We summarize the stylized facts shown by Figures 1 and 2 as follows:

1. *Greater debt exposure.* Business leverage shows an upward trend during the last fifty years.

2. *More volatile leverage.* Business leverage has become more volatile during the last two decades with large medium-term cycles. The leverage seems to pick right before or in the middle of major recessions.

3. *Business cycle asymmetries.* Downturns are characterized by sharp recessions followed by rapid recoveries, while booms are more gradual and long-lasting.

4. *Smaller cycles.* Business cycle fluctuations have been substantially smaller during the last two decades.

In the next section we study a theoretical model with financial market frictions to investigate the extent to which the stylized facts emphasized above are driven by the evolution of the financial system.

3 Model

There is a continuum of entrepreneurs of total mass 1 with lifetime utility:

$$E_0 \sum_{t=0}^{\infty} \beta^t c_t$$

where c_t is consumption and β the intertemporal discount factor.

Entrepreneurs run the production technology $y = f(z_t, k_t) \equiv z_t^{1-\theta} k_t^{\theta}$, where k_t is capital and z_t is the economy-wide level of technology. The variable z_t grows stochastically at rate g. For simplicity we assume that g can take two values, g^L and g^H, with $g^L < g^H$, and follows a first order Markov chain with transition probability:

$$P(g'/g) = \begin{bmatrix} p & 1-p \\ 1-p & p \end{bmatrix}$$

There are no idiosyncratic shocks and the only source of uncertainty comes from z_t, which is the same for all firms. Therefore, there is a *representative* firm in the economy. Capital depreciates at rate δ. For convenience we denote by $F(z_t, k_t) = (1-\delta)k_t + f(z_t, k_t)$ the output plus non-depreciated capital.

Capital is financed with equity and debt. The market interest rate, denoted by r, satisfies $r < 1/\beta - 1$. This condition guarantees that the equities accumulated by firms are bounded. Define e_t the firm's net worth before paying dividends, b_t the debt, and d_t the dividends. The input of capital is $k_t = e_t + b_t - d_t$. Dividends cannot be negative, which implies that the only way to raise equities is by reinvesting profits. The next period net worth, before paying dividends, is $e_{t+1} = F(z_t, k_t) - (1+r)b_t$.

Financial (debt) contracts are not fully enforceable. We assume that, once the entrepreneur has received the loan, he or she can repudiate the debt and appropriate a fraction ϕ of the capital. After default, however, the entrepreneur looses the ability to run the firm. Therefore, the value of defaulting is ϕk_t. The value of the firm for the entrepreneur is the expected discounted value of dividends, that is:

$$V_t(e_t) \equiv E_t \sum_{j=0}^{\infty} \beta^j d_{t+j}$$

Limited enforceability imposes the constraint:

$$\beta E_t V_{t+1}(e_{t+1}) \geq \phi k_t$$

that is, the value of the firm for the entrepreneur cannot be smaller than the value of defaulting. This imposes a limit on the amount of resources that the firm can borrow. The important feature of the model is that the borrowing limit is endogenous and depends on the valuation of the firm. More specifically, when this value increases, the firm is able to take more debt, for a given input of capital. The opposite holds true when the valuation of the firm decreases.

We close the model by assuming that there is a mass m of risk neutral agents with endowment income w and lifetime utility:

$$E_0 \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right) c_t$$

The risk neutrality assumption, coupled with the condition $r < 1/\beta - 1$, implies that in equilibrium the interest rate is constant and equal to r.

4 Firm's valuation, stochastic trend and recursive problem

The value of the firm for an entrepreneur with equity e_t is:

$$V_t(e_t) = E_t \sum_{j=0}^{\infty} \beta^j \Big(e_{t+j} + b_{t+j} - k_{t+j}\Big)$$

The growth in the aggregate level of technology z_t allows the economy to experience unbounded growth with fluctuations around the stochastic trend $A_t = \prod_{j=1}^{t}(1+g_j)$. We will detrend all variables by the factor A_{t-1}, that is, the compounded growth up to $t-1$. Rearranging and dividing the above expression by A_{t-1}, the (detrended) market value of the firm is:

$$V(e_t, g_t) = E_t \sum_{j=0}^{\infty} \beta^j \left(\prod_{s=1}^{j-1}(1+g_{t+s})\right) \Big(e_{t+j} + b_{t+j} - k_{t+j}\Big) \tag{1}$$

where now all the variables are detrended.

Although the detrended payments do not display unbounded growth, the detrended value of the firm depends on the expected future growth rates: if the economy is expected to grow faster, future payments will also grow at a higher rate. This increases the value of the firm today as shown in (1).

We can now write the maximization problem of the firm recursively, where all variables are detrended. The firm chooses d, b, k and e' to maximize:

$$V(e,g) = \max_{d,b,k,e'} \Big\{ d + \beta(1+g)EV(e',g') \Big\} \tag{2}$$

subject to:

$$F(g,k) - (1+r)b - (1+g)e' = 0$$
$$e + b - k - d = 0$$
$$\beta(1+g)EV(e',g') - \phi k \geq 0$$
$$d \geq 0$$

Notice that we have replaced the variable z with the variable g in the production function. In fact, after dividing the production function by A_{t-1}, the variable z_t becomes a constant multiplied by $1+g_t$.

The first order and envelope conditions can be written as:

$$F_k(g,k) = (1+r)\left[1 + \frac{\phi\mu}{1+\gamma}\right] \tag{3}$$

$$\beta(1+r)EV_{e'}(e',g') = \frac{1+\gamma}{1+\mu} \tag{4}$$

$$V_e(e,z) = 1+\gamma \tag{5}$$

where μ is the Lagrange multiplier for the non-default constraint and γ is the Lagrange multiplier for the non-negativity of dividends. See the appendix for the detailed derivation of these conditions.

5 Dynamic Properties

To illustrate some of the basic properties of the model, it will be convenient to consider the simple case in which the economy is affected by un unexpected and permanent shock to the growth rate of z. Suppose that the economy is in a steady state equilibrium with a non-stochastic growth rate $\bar{g} = (g^L + g^H)/2$. At time t the growth rate switches unexpectedly and permanently to either g^L or g^H. After the shift there is no uncertainty because the change is permanent.

Property 1 *The no-default constraint is always binding.*

This property can be shown as follows. First we observe that at least of the two constraints (non-default and non-negativity of dividends) must be binding. If neither of the two constraints are binding, $\mu_3 = \mu_4 = 0$. Then (5) implies that $V_e(e,g) = 1$ and $V_e(e',g') = 1$ and (4) implies $\beta(1+r) = 1$. But this cannot be because we have imposed $\beta(1+r) < 1$.

Given this result, we only need to show that if the constraint on the dividends is binding, the non-default constraint must also be binding. Combining equations (4)-(5) we get:

$$\beta(1+r)(1+\mu) = \frac{V_e(e,g)}{V_e(e',g')}$$

Because the firm pays no dividends in the current period, the next period equity will be higher, that is, $e' > e$. This implies that $V_e(e',g')$ cannot be larger than $V_e(e,g)$ or equivalently that $V_e(e,g)/V_e(e',g') \geq 1$. The above condition then implies that $\mu > 0$, that is, the no-default constraint is binding.

The result that the non-default constraint is always binding has a simple intuition. The entrepreneur would like to reduce e' over time by paying out as much dividends as possible and finance capital with debt. The no-default constraint, however, will prevent the entrepreneur from excessive borrowing. This result does not necessarily old when future values of g are stochastic. In general, however, it will hold if β is sufficiently small and g highly persistent.

Property 2 *The response of (detrended) capital is asymmetric. It does not change after a permanent shift to* g^H *(acceleration) but it temporarily falls after a permanent shift to* g^L *(slow down).*

To show this let's compare the case of a productivity slow down and the case of a productivity acceleration.

Stock market boom: Suppose that there is a permanent acceleration in productivity. From equation (1) we can see that this leads to an increase in the detrended value of the firm. If the firm does not distribute any dividends, the non-default constraint is not binding. But we have seen above that this constraint is always binding. Therefore, the firm distribute must distribute some dividends and $\gamma = 0$. Then constraint (3) becomes:

$$F_k(g,k) = (1+r)(1+\phi\mu) \tag{6}$$

This is also the optimality condition before the shock because in the steady state the firm pays dividends and $\gamma = 0$. What is left to show is that μ is the same before and after the shift in productivity growth. Because the firm was paying dividends before the shock, $\gamma = \gamma' = 0$. This implies $V_e(e,g) = V_e(e',g') = 1$. Condition (4) then implies that $\mu = 1/\beta(1+r) - 1$. After the shock the firm also pays dividends in the current and future periods. Therefore, condition (4) also implies that $\mu = 1/\beta(1+r) - 1$. Returning to condition (6) we can then see that the input of capital does not change after the shock. The firms uses the extra credit to pay out more dividends, not to expand production.

Stock market crash: Let's consider now the case of a productivity slow down. From equation (1) we can see that this leads to a fall in the detrended value of the firm. If the no-default constraint was binding (which must be the case given the property discussed above), then b and k must decrease as long as the cut in dividends is not sufficient to maintain the same input of capital. This will be the case if the fall in the value of the firm is large. To see this, consider the no-default constraint:

$$\beta(1+g)EV(e', g') \geq \phi k$$

By reducing the debt and the input of capital, both terms in the left-hand-side and in the right-hand-side decrease. However, it can be shown that the derivative of the left-hand-side term with respect to b is greater than 1 while the derivative of the right-hand-side term is 1. To see this, notice that $V_e = 1 + \gamma \geq 1$ and $\partial e'/\partial b > 1$ given the concavity of the production function. Therefore, the reduction in the debt will insure that the no-default constraint is satisfied.

To summarize, there is an important asymmetry in the response of the economy to large changes in asset prices. After an asset price drop, the firm cannot reduce the dividends below zero and must cut investment. After an asset price boom, instead, the firm simply replaces equity with debt (by distributing more dividends). But this creates the conditions for more severe consequences of future stock market crashes.

5.1 Higher enforceability leads to more instability

Within this framework, the development of the financial system is captured by the degree of contract enforceability, formalized in the parameter ϕ. Lower is the value of ϕ and greater is the debt capacity of the firm. As a result, firms will take on more debt and in equilibrium they are more leveraged. This is shown in Figure 3, which plots the continuation value of the firm and the default value, for a given input of capital. As we decrease ϕ, the default value decreases and the firm equities (after dividends) are lower.

Although a higher degree of contract enforceability may increase efficiency on average, it also increases the vulnerability of the system after a productivity slow down. From the enforcement constraint we can see that the sensitivity of investment to a stock market drop is larger for lower values of ϕ. In fact, assuming that the enforcement constraint is binding, the input

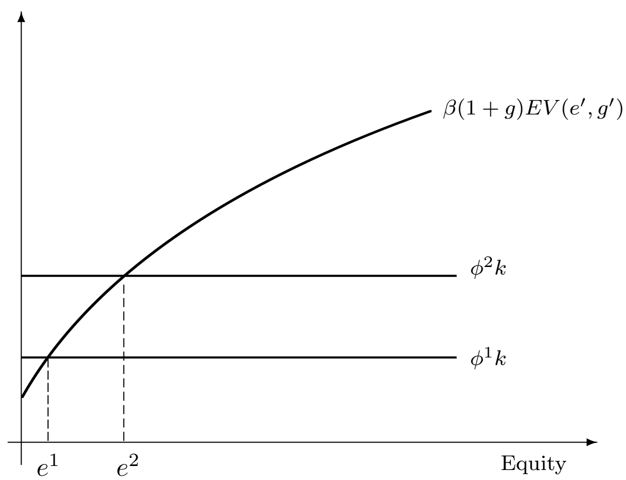


Figure 3: Choice of equity for different values of ϕ, keeping constant the optimal capital k.

of capital can be written as:

$$k = \left(\frac{1}{\phi}\right) \cdot \beta(1+g)EV(e', g')$$

The term $1/\theta$ acts as a multiplier for the drop in investment induced by a large negative change in the value of the firm. Therefore, higher is the degree of contract enforceability (low values of ϕ) and greater is the vulnerability of the economy to an asset price fall. Intuitively, higher is the debt capacity, and larger is the absolute drop in borrowing after a negative drop in the value of the firm that is necessary to avoid default.

6 Numerical example

We now show the properties of the model emphasized in the previous sections with a numerical example. Assuming that a period is a quarter, we assign the following parameter values: $r = 0.0015$, $\beta = 0.975$, $\theta = 0.95$, $\delta = 0.02$, $\phi = 1$. To simplify the example, we assume that the transition probability p is very close to 1. This implies that changes in growth rates are exceptional events. Therefore, the agent's problem is well approximated by assuming that they expect that the growth rate remains constant at the current level.

Suppose that the level of technology z has been growing at 1 percent per quarter for a long period of time and the economy is in a steady state equilibrium. Starting from this equilibrium, the growth rate unexpectedly slows down permanently to 0.0075 per quarter. The dynamics of output is plotted in the top panel of Figure 4. The figure also reports the dynamics for the economy in which contracts are fully enforceable. As can be seen from the figure, the slow down generates a large fall in output. This is in contrast to the case in which contracts are fully enforceable. In this case production slows down but there is no drop in absolute value. This pattern is in sharp contrast to the case in which there is an unexpected acceleration in the growth rate of z. In this case the output dynamics does not change if contracts are fully enforceable or there is limited enforceability.

The bottom panel of Figure 4 compares the output dynamics after a growth slow down for economies that differ in the degree of contract enforceability. The dashed line is for the baseline economy in which $\phi = 1$. The continuous line is for the economy in which $\phi = 0.5$. In this second economy entrepreneurs have a lower incentive to default, and therefore, contracts are more enforceable. As can be seen from the figure, more enforceability implies a more severe drop in output after a slow down. This shows that greater enforceability of contracts leads to greater macroeconomic instability. The numerical example also shows that the output response could be quantitatively very sensitive to ϕ.

7 Conclusion

Financial development has two consequences for the financial policy of the firm. On the one hand, it enables the firm to take on more debt and makes the economy more vulnerable to shocks. On the other, it increases the accessability to alternative sources of funding, in addition to debt, which increases the investment flexibility of the firm. If the second effect dominates, the development of the financial system leads to greater business leverages but also smaller investment and macroeconomic volatility (thanks to the greater financial flexibility of firms). This seems consistent with the post-war experience of the U.S. economy showing an increasing business leverage but a lower macroeconomic volatility.

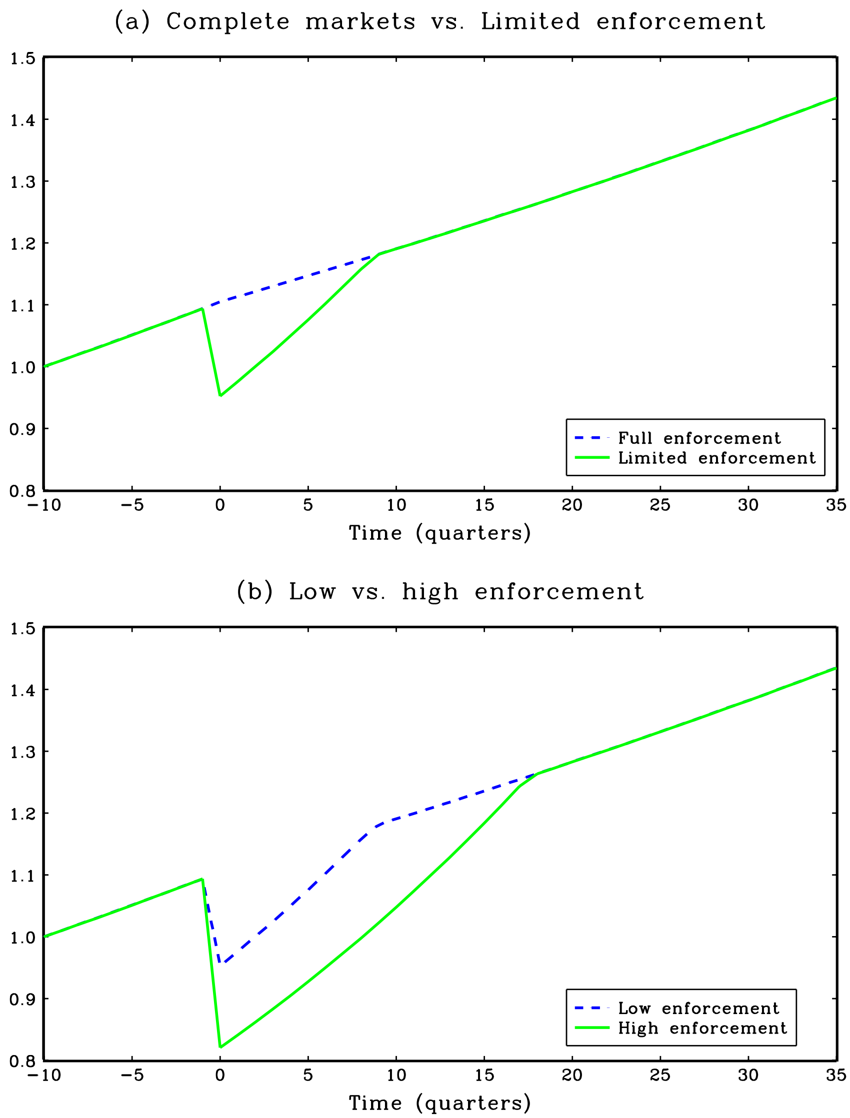


Figure 4: Output dynamics after a slow down in growth.

Appendix: First order conditions

Consider the optimization problem (2) and let λ_1, λ_2, μ and γ be the Lagrange multipliers attached to the four constraints. Taking derivatives of the Lagrangian we get:

$$\begin{aligned}
d: &\quad 1 - \lambda_2 + \gamma = 0 \\
b: &\quad -\lambda_1(1+r) + \lambda_2 = 0 \\
k: &\quad \lambda_1 F_k(g,k) - \lambda_2 - \phi\mu = 0 \\
e': &\quad (1+\mu)\beta E V_{e'}(e',g') - \lambda_1 = 0
\end{aligned}$$

The envelope condition is:

$$V_e(e,g) \quad = \quad \lambda_2$$

Using the second condition to substitute λ_2 we can rewrite the first order and envelope conditions as:

$$\begin{aligned}
&1 + \gamma - \lambda_1(1+r) = 0 \\
&\lambda_1 F_k(g,k) - \lambda_1(1+r) - \phi\mu = 0 \\
&(1+\mu)\beta E V_e(e',g') - \lambda_1 = 0 \\
&V_e(e,g) = \lambda_1(1+r)
\end{aligned}$$

Using the first condition to eliminate λ_1 we get conditions (3)-(5).

References

Kiyotaki, N. & Moore, J. H. (1997). Credit cycles. *Journal of Political Economy*, *105*(2), 211–48.