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# Expectation driven business cycles with limited enforcement☆

Karl Walentin *,[1]

*Sveriges Riksbank, Research Division, 103 37 Stockholm, Sweden*

## HIGHLIGHTS

- Empirically news shocks yield positive response of macro quantities and stock prices.
- Our model gets the stock price response right.
- First time achieved in real one-sector model with two input factors.
- The key mechanism is financial frictions in the form of limited enforcement.
- Generates additional effect from future productivity on today's investment.

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ABSTRACT

We explore shocks to expected future productivity in a model with limited enforcement of financial contracts. A microfounded collateral constraint implies that good news about future productivity yield an increase in stock prices, available credit and a general economic expansion.



## 1. Introduction

This paper is part of the growing literature following Beaudry and Portier's (2004) work on expectation-driven business cycles. The basic idea is that beliefs about future total factor productivity (TFP) may affect current economic activity. Beaudry and Portier (2006) use structural VARs to document that shocks to expected future TFP, "news shocks", are important drivers of business cycles. Furthermore, they show that news shocks generate a positive response of consumption, investment, hours worked, and stock prices.

We explore the implications of news shocks in a real business cycle model with limited enforcement of financial contracts. Our model generates a positive response of consumption, investment, hours worked, and stock prices to TFP news shocks. The key difference compared to other models is that stock prices increase in response to news. This fundamental characteristic of expectation-driven booms has not previously been obtained in a real one-sector model with two input factors in spite of being pivotal in the empirical work on news shocks. Empirically, Beaudry and Portier (2004, 2006) show that stock prices increase in response to positive news about future TFP, and this result has proven robust to alternative identification approaches (Barsky and Sims, 2011; Forni et al., forthcoming).

The technical contribution to the news shock literature is the analysis of limited enforcement. Our modeling of optimal financial contracts builds closely on Lorenzoni and Walentin (2007). Two effects of introducing limited enforcement in a news shock setting can be distinguished.

First, the *quantity effect* of limited enforcement implies that the funds available to a firm, and thereby its investment, are a function of the value of a "collateral" which depends on the liquidation value of the firm. This introduces a financial channel through which more optimistic expectations increase investment. The notion of

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* Tel.: +46 8 7870491.
*E-mail address:* karl.walentin@riksbank.se.

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this effect goes back to Keynes and Minsky but has not previously been explored in the news shock literature. The quantity effect is not specific to limited enforcement. It is present in any model with financial frictions where the value of the collateral is positively affected by future profits, e.g. in Albuquerque and Hopenhayn (2004) and Bernanke et al. (2000). Empirical evidence of this channel at the firm-level is provided in Chen et al. (2008).

Second, limited enforcement causes a time-varying wedge between marginal $q$ and average $q$, the *price effect*. This wedge reflects the tension between available funds and the future profitability of investment.

Two papers share our focus on aggregate implications of news shocks in settings with constraints on entrepreneurs' financing. Chen and Song (2013) explore the effects of capital reallocation on measured TFP. Kobayashi et al. (2012) study business cycle implications of news shocks in a model with collateral constraints for intra-period financing of four input factors rented on a spot market. In their full model, consumption decreases in anticipation of the TFP increase.

## 2. Model

There are two types of agents: consumers and entrepreneurs, each of unit mass. There are two goods: a perishable consumption good and physical capital. Transformation between the consumption good and capital is subject to adjustment costs. All markets are competitive. The setting is a small open economy. With two exceptions it is a standard RBC model, and in particular it is very similar to Jaimovich and Rebelo (2008). The important exception is limited enforcement of financial contracts. The minor exception is our assumption of habit formation in labor supply. This is similar to the labor adjustment costs used in the news shock models of Jaimovich and Rebelo (2008, 2009).

### 2.1. Setup

*Preferences*. The preferences of a consumer are described by

$$\mathbb{E}\left[\sum_{t=0}^{\infty}\beta^t\left(\frac{C_t^{1-\sigma_C}}{1-\sigma_C}-\varphi_L\frac{(L_t-b_L L_{t-1})^{1+\sigma_L}}{1+\sigma_L}\right)\right].$$

Consumers choose consumption $C$, hours worked $L$, and save in state contingent assets. $\sigma_C$ denotes the inverse intertemporal elasticity of substitution, $b_L$ denotes the degree of habit formation for labor, $\sigma_L$ is the inverse Frisch elasticity and $\varphi_L$ is a scaling parameter.

Entrepreneurs have finite lives. Each period a fraction $\gamma$ of entrepreneurs exits and is replaced by young entrepreneurs. The first period of their life entrepreneurs are endowed with $l_E$ units of labor.

The preferences of entrepreneur $i$, born at date $t$, are described by the utility function $\mathbb{E}_t\left[\sum_{j=0}^{J_i}\beta_E^j C_{i,t+j}^E\right]$, where $J_i$ is the random duration of the entrepreneur's life. Entrepreneurs are more impatient than consumers, $\beta_E < \beta$. Linear utility in consumption for entrepreneurs is assumed to facilitate aggregation. The exposition abstracts from heterogeneity between entrepreneurs from here on.

*Technology*. The production function is Cobb–Douglas in capital and labor: $A_t F(K_t, L_t) = A_t K_t^{\alpha} L_t^{1-\alpha}$. Aggregate productivity follows $\log A_t \equiv a_t = \rho a_{t-1} + \varepsilon_t + \eta_{t-p}$, where $\varepsilon_t$ and $\eta_t$ are i.i.d. shocks. $\eta_t$ is the news shock and is known $p$ periods before it affects TFP. $\varepsilon_t$ is a contemporaneous innovation to TFP. Investment affects capital with a lag, $K_{t+1} = (1-\delta)K_t + I_t$, where $\delta$ is the depreciation rate. Capital adjustment costs take the form $G(I_t, K_t) = \xi(\{I_t - \delta K_t\}/K_t)^2 K_t/2$ resulting in the standard expression for marginal $q$: $q_t^m = 1 + \xi\frac{I_t-\delta K_t}{K_t}$.

*Financial contracts and limited enforcement*. The entrepreneur finances his current and future investment by selling a long-term financial contract. The contract specifies a sequence of state-contingent transfers $\{d_\tau\}_{\tau=t}^{\infty}$, for all the periods in which the entrepreneur is alive. Financial contracts are subject to limited enforcement. Specifically, in each period the entrepreneur can choose to divert funds. He can capture a fraction $(1-\theta)$ of the firm's liquidation value, $v_t$, which is equal to current profits plus the resale value of the capital stock: $v_t = R_t K_t = A_t F(K_t, L_t) - w_t L_t + q_t^m K_t (1-\delta)$. Lorenzoni and Walentin (2007) show that this implies the following no-default condition restricting the liabilities $b_{t+1}$ outstanding at the end of period $t$: $b_{t+1} \le \theta v_{t+1}$. This condition applies separately for each state in $t+1$ and can be interpreted as a "collateral constraint", where the value of the entrepreneur's liabilities is bounded from above by a fraction $\theta$ of the liquidation value of the firm. With small shocks around the steady state it can be shown that the collateral constraint is always binding. This has three key implications: (i) a fixed fraction of the value of the firm is financed by outsiders, (ii) the marginal value of wealth for entrepreneurs, $\phi_t$, exceeds the marginal value of consumption (unity), and (iii) the capital stock is determined by the funds available to entrepreneurs: $K_{t+1} = N_t/\left(q_t^m - \theta\mathbb{E}_t\left[m_{t+1}R_{t+1}\right]\right)$, where $m_{t+1}$ is the consumers' stochastic discount factor and $N_t \equiv v_t - b_t$, represents the difference between the liquidation value of the firm and the value of the claims issued to outsiders.

The aggregate value of $N_t$ is determined by the return to capital and the fact that each period a fraction $\gamma$ of entrepreneurs exits and is replaced by young entrepreneurs with wealth $w_t L_E$: $N_t = (1-\gamma)(1-\theta) R_t K_t + \gamma w_t L_E$.

Combining the above two equations yields the law of motion for capital:

$$K_{t+1} = \frac{(1-\gamma)(1-\theta) R_t K_t + \gamma w_t L_E}{q_t^m - \theta\mathbb{E}_t\left[m_{t+1}R_{t+1}\right]}. \quad (1)$$

The proof of existence of both a deterministic steady state and a recursive competitive equilibrium where the collateral constraint is always binding is provided in Lorenzoni and Walentin (2007).

### 2.2. Asset prices

The ex-dividend value of the firm is simply the sum of all the claims on the firm's future profits: $p_t = W(v_t, b_t) + b_t - d_t$, where $W(v_t, b_t) = \phi_t(v_t - b_t)$ is the net present value of the insider's claims and $b_t$ is the net present value of the outsiders' claims. Recall that the optimal financial contract implies that a fixed fraction $\theta$ of the firm is financed by outsiders, i.e. it takes the form of an equity contract. The equity price is accordingly proportional to the total value of the firm, $p_t$. Normalizing the value of the firm by the total capital invested yields our definition of *average q*: $q_t \equiv p_t/K_{t+1}$.

**Proposition 1.** *Average q is greater than or equal to marginal q, $q_t \ge q_t^m$, with a strict inequality if the collateral constraint is binding.*

**Proof.** Given that $\phi_t \ge 1$ we have

$$p_t = \phi_t(v_t - b_t) + b_t - d_t \ge v_t - d_t = q_t^m k_{t+1}. \quad \blacksquare$$

Absent financial constraints $\phi_t = 1$ and $q_t = q_t^m$. On the other hand, in the presence of financial constraints there is a wedge between the value of the entrepreneur's claims in case of liquidation $(v_t - b_t)$ and the value of the claims he holds to future profits. The fact that $\phi_t > 1$ creates a wedge between $q_t^m$ and $q_t$.

## 3. News shock dynamics

### 3.1. Calibration

We calibrate the model to quarterly frequency. The parameter values are documented in Table 1.