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Abstract

Our structural VAR shows that the new business formation in U.S. data has similar positive comovement pattern as common aggregate variables in response to a favorable anticipated shock about technology. However, incorperating firm dynamics into Jaimovich and Rebelo's (Jaimovich and Rebelo, 2009, American Economic Review) model cannot explain our empirical finding. Even worse, the model predicts an aggregate recession instead of a boom. Then, we show that this problem can be resolved with a minor modification by introducing endogenous survival rate of the new entrants.

JEL Classification: E22, E32.

Keywords: Firm Dynamics, Aggregate Comovement, Expectation Driven Business Cycle, News Shocks

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1 Introduction

Recent studies (Beaudry and Portier, 2006; Beaudry and Lucke, 2010; Schmitt-Grohe and Uribe, 2010) find expectation might be the important source for macroeconomic fluctuation. However, the traditional real business cycle model fails to generate the expectation driven business cycle (hereafter EDBC) as defined in Beaudry and Portier (2007). More recently, Jaimovich and Rebelo (2009) (JR for short) establish a full-fledged but concise RBC model with several real rigidities. Their model produces positive comovement of aggregate variables in response to the anticipated shocks about technology, thus explains the EDBC quite well[1]. Yet, their model does not put eyes on the firm dynamics. As the literature (e.g. Jamovich and Floetotto, 2008; Wang and Wen, 2010) document, the net entry in the U.S economy is strongly procyclical and accounts for a large fraction of employment variation. This suggests firm dynamics should also be considered as an important aspect in the EDBC study. To examine how the firm entry, in U.S. economy, responds to news shocks, we construct a four-variable VAR system including TFP, real stock price, real GDP and the new business formation. Based on the identification strategy in Beaudry and Lucke (2010), we find that a positive news shock leads the U.S. economy to experience a boom in stock price, output and firm entry. And the last two series present very similar dynamics: increases in the impact period, then goes up and gets its peak after around 1 year and finally dampens.

To account the above empirical finding, we incorporate endogenous firm entry decision into JR's well established EDBC model. However, the presence of firm dynamics worsens the performance of their model. A favorable news about the future TFP causes a recession instead of a boom. Therefore, the model cannot produce EDBC any more. The main reason is quite intuitive. The higher future technology means producing today is relatively less profitable. With this expectation, the potential firms have incentive to enter the market later. As a result, the total number of incumbent in current period decreases due to the sharp decrement of entry firms. The less labor demand by firms lowers the wage income. As a result, household consumption as a normal goods will go down due to a decrease in wage income. This eventually leads the economy into a recession.[2]

[1] A number of paper success to generate EDBC, e.g. Beaudry and Portier (2004), Christiano et al. (2007), Den Hann and Kaltenbrunner (2007), Gunn and Johri (2010), Karnizova (2010), among others.

[2] This mainly because that the real frictions presented in JR's model make all the aggregate varibles positively comove with each other. Therefore, the decline of consumption causes others like output, investment, hours worked decrease.

The key point to the failure in generating EDBC is that the survival rate of new entrants is assumed to be constant[3]. Since there is no marginal cost of large movement of the entry numbers, the new business formation in the model is extremely volatile. In light of this, we endogenize this rate (denoted as q) as a decreasing function of the entry mass[4]. We show that with this small departure, JR's model with endogenous firm entry is able to explain the positive comovement of common aggregate variables as well as firm entry. The reason here is quite straightforward. Similar to the role of adjustment cost, the decreasing survival rate imposes penalty on the large jump of firm entry. As a result, the number of entrants is relative small comparing to the standard JR model at the period when the news realized. This provides uprising room for the firm value due to the relative small competition effect among the operating firms after the news realized. For those forward looking firms, more will enter the market immediately to capture the higher value when expecting a good economic situation about future. As a result, both firm number and asset price go up when good news hits the economy.

The remainder of the paper is organized as follows. In section 2, we perform structural VAR analysis on a four-variable system to investigate firm dynamics when news shocks hit the U.S. economy. In section 3, we build the model with firm entry based on Jaimovich and Rebelo (2009). Section 4 studies the model's dynamics under the environment with or without endogenous survival rate of the entrants . Section 5 concludes the whole paper.

2 Empirical Evidence from US Data

In this section, based on U.S. macroeconomic data we aim to investigate the dynamic effects of news shocks to firm entry. To identify the news shock, we employ the identification scheme in Beaudry and Lucke (BL for short) (2010). The variables of interest are total factor productivity (TFP) which describe the exogenous process of technology; the stock price (SP) which contains the information about future; the real GDP (Y) captures the macroeconomic condition and

[3]To our knowledge, in the literature, people often assume the failure rate of new entrants are constant or zero, for example, Jaimovich (2007), Bilbiie, Ghironi, and Melitz, (2008).

[4]Our assumption is supported by the empirical finding of decreasing hazard rate $(1 - q)$ in the industrial organization literature. Mata and Portugal (1994) investigate the Portuguese manufacturing data and find the new firm failure varies positively with the extent of entry in the industry; Audretsch, et. al (2000) find the similar pattern using the Netherlands entry data; Hannan et. al (1995) using Belgium, France, Germany and Italy data find that during the mature stage of the industry, the survival rate is negatively affected by the density of entry due to competition effect.

finally the new business formation (Nf) represents the number of firm entry. All the variables are transformed into per capita through the total population of the age from 16 to 64. The appendix gives more details about our data source.

We first range the order of structural shocks so that the first one is surprise technology shock, the second is news shock about TFP, the last two shocks are short-run shocks (e.g demand shock). Specifically, we assume the surprise shock is the only one that has contemporaneous effects on TFP. The news shock, as in BL (2010), has no impact on today's TFP but can change today's stock price[5]. Also this news shock has ability to predict the TFP in long-run, thus the (1,2) element in long-run matrix is not necessary zero. The last two shocks are assumed to be independent with the exogenous TFP process and have no long-run effects on TFP. This means we force the (1,3) (1,4) elements in both impact matrix and long-run matrix to be zero. The above restrictions are enough to identify the news shock[6].

We first estimate a VECM for the four-variable system (TFP, SP, Y, Nf) with four lags[7] and three cointegration vectors[8]. The Figure 1 reports the responses of (TFP, SP, Y, Nf) to one unit positive news shock.

Responses to news shock in the (TFP, SP, Y, Nf) VECM system

Fig. 1. In each panel of this figure, the blue solid line represents the impulse response to one unit news shock. The red dashed lines are 95% bootstrapped confidence interval computed (200 replications) by Hall's percentile interval, see Lutkepohl (2005). All the estimations are conducted in software JMuTi.

From above figure, we observe that a positive news causes TFP initially decrease, but after about 1.5 years, it gradually goes up. Meanwhile, the stock price and output increase

[5] This assumption implies the (1,2) element in impact matrix is zero.

[6] In fact, to fully identify all structural shocks, we still need one additional restriction to distinguish two short-run shocks. Since this restriction does not change the dynamics of news shock, we simply force the (3,4) element in impact matrix to be zero.

[7] Both the Akaike Information Criterion and Final Prediction Error Criterion suggest four lags in level.

[8] Using the Johansen cointegration test , we found that the data do not reject two cointegration relationships at 5-percent level. However, there is only one explicit exogeneous trend—the TFP series in our VECM, a natural assumption on cointegration rank is three, i.e. one common trend. Taking this into account, as in BP (2006), we want to be caustious with the possible misspecification bias, we conservatively choose three cointegration relationships instead of two. In fact, our results are quite robust with the number of cointegration rank.

simultaneously. This pattern is quite similar to that in BL (2010). Most important thing is that the new business formation also experiences a boom after the good news arrival.

3 The Model

3.1 Firms

The economy is characterized by a completely competitive final goods firm and a continuum of intermediate firms. Each intermediate firm produces a differentiated goods. These goods are imperfect substitutes in the production of the final goods. The mass of intermediate goods firm is endogenous determined by the entry and exit of intermediate firms.

3.1.1 Final goods firms

The final goods firms maximize its period-by-period profit function:

$$Y_t - \int_0^{N_t} p_t^i y_t^i di \tag{1}$$

with the technology constraint, which is a CES aggregation of a continuum of intermediate goods indexed by i:

$$Y_t = \left(\int_0^{N_t} \left(y_t^i\right)^\sigma di \right)^{\frac{1}{\sigma}} \tag{2}$$

where y_t^i is the production of the intermediate firm i, N_t is the mass of the intermediate firms, $\sigma \in (0, 1)$ governs the elasticity of substitution across intermediate goods.

The final goods producer's profit maximization yields:

$$y_t^i = \left(p_t^i\right)^{\frac{1}{\sigma - 1}} Y_t \tag{3}$$

and

$$P_t = \left(\int_0^{N_t} \left(p_t^i\right)^{\frac{\sigma}{\sigma-1}} di \right)^{\frac{\sigma-1}{\sigma}} \tag{4}$$

where P_t denote the aggregate price index hereafter normalized to one.

3.1.2 Incumbent Intermediate firms

We first consider a typical incumbent firm. Each intermediate goods, y_t^i, is produced by the firm i using the efficient capital, $u_t^i k_t^i$, and the labor, l_t^i, with the Cobb-Douglas production function:

$$y_t = A_t \left(u_t^i k_t^i\right)^\alpha \left(l_t^i\right)^{1-\alpha}$$

where A_t denotes the aggregate technology, and u_t is a variable rate of capital utilization. The rate of capital utilization determines the intensity of the use of capital, which affect the the rate of capital depreciation. We let $\delta\left(u_t^i\right)$ represent the rate of capital depreciation and assume that depreciation is convex in the rate of utilization: $\delta'(\cdot) > 0$, $\delta''(\cdot) > 0$[9]. The total cost to produce y_t^i can be obtained by:

$$\min r_t u_t^i k_t^i + w_t l_t^i$$

$$s.t. A_t \left(u_t^i k_t^i\right)^{\alpha} \left(l_t^i\right)^{1-\alpha} \geq y_t^i$$

where r_t represents the rental rents per unit of efficient capital; w_t is the real wage; Let ϕ_t^i be the Lagrangian multiplier of the above equation, we then have:

$$r_t = \alpha \phi_t^i \frac{y_t^i}{u_t^i k_t^i}, w_t = (1-\alpha)\,\phi_t^i \frac{y_t^i}{l_t^i}$$

Using the above two equations, we can derive that in the symmetric equilibrium the marginal cost MC_t is:

$$\phi_t = MC_t = \frac{1}{A_t}\left(\frac{w_t}{1-\alpha}\right)^{1-\alpha}\left(\frac{r_t}{\alpha}\right)^{\alpha} \tag{5}$$

Each intermediate firm i maximizes its static period operating profits:

$$\pi_t^i = \left(p_t^i - MC_t\right) y_t^i$$

This yields that optimal price and profit at each period, respectively, are:

$$p_t^i = \frac{MC_t}{\sigma}, \pi_t^i = (1-\sigma)\, p_t^i y_t^i$$

Since the intermediate firms' technology is symmetric with respect to all inputs, thereafter we focus on the symmetric equilibrium: $u_t^i = u_t$, $k_t^i = k_t$, $l_t^i = l_t$, $y_t^i = y_t$, $r_t^i = r_t$, $\phi_t^i = \phi_t = MC_t$, $\pi_t^i = \pi_t$. The representative household provides labor, L_t, and capital, K_t, to firms for production activities. Hence in the symmetric equilibrium the resource constraint in labor and capital market implies: $L_t = N_t l_t$; $K_t = N_t k_t$. In the symmetric equilibrium, the aggregate price index from (4) implies: $p_t = N_t^{\frac{1-\sigma}{\sigma}}$. And the technology of producing the final goods implies: $Y_t = N_t^{\frac{1}{\sigma}} y_t$. Hence, in the symmetric equilibrium, the aggregate final output, the

[9] This assumption is consistent with the assumption in Schmitt-Grohe and Uribe (2007): $\delta(u) = \delta_k + \delta_1 (u-1) + \frac{\delta_2}{2}(u-1)^2$, where δ_k, δ_1, $\delta_2 > 0$.

equilibrium rental rate and wage, and the intermediate firm's operating profit are given by:

$$
\begin{aligned}
Y_t &= A_t N_t^{\frac{1}{\sigma}-1} (u_t K_t)^{\alpha} L_t^{1-\alpha} && (6)\\
w_t &= (1-\alpha)\,\sigma \frac{Y_t}{L_t} && (7)\\
r_t &= \alpha\sigma \frac{Y_t}{u_t K_t} && (8)\\
\pi_t &= (\sigma-1)\, Y_t/N_t && (9)
\end{aligned}
$$

From the market clearing condition, we have:

$$C_t + I_t + n_t f_e = Y_t \tag{10}$$

3.1.3 Potential entrants

In order to enter the market, the potential entrants have to pay f_e units final goods as fixed. After their entry, we assume the startups will become a producing firm with an endogenous probability q_t. As already discussed in the introduction, the empirical literature provides fruitful evidences that survival rate is positively correlated with the industrial density, which definitely varies over time. Take this into account, we naturally assume q_t is a decreasing function of the entry rate $\frac{n_t}{N_{t-1}}$[10]:

$$q_t = q\left(\frac{n_t}{N_{t-1}}\right) \tag{11}$$

with the elasticity $\frac{q' \frac{n}{N}}{q}$ at steady state ranges in $[-1, 0]$. Indeed, the above specification is very similar to Beaudry et al. (2007). In their paper, the success probability q_t is assumed to have a form of $\frac{\eta_t N_{t-1}}{n_t}$, the term $\eta_t N_{t-1}$ indicates the number of vacancy for new birth firms[11]. Slightly different with theirs, we assume the ratio η_t is a concave function[12] of entry rate: $g\left(\frac{n_t}{N_{t-1}}\right)$, with $g' > 0, g'' < 0$. The increasing of $g(\cdot)$ indicates that more new birth firms will produce more vacancy for those new entry. And the concavity of $g(\cdot)$ makes the elasticity $\frac{q' \frac{n}{N}}{q}$ mentioned above be negative and no less than -1.[13]

Each incumbent firm faces a natural death rate δ. Thus only a proportion $1-\delta$ of existing firms would stay in the next period. We also assume the period-t entrants produce at the

[10] Assuming q_t is a decreasing function of either $\frac{n_t}{N_{t-1}}$, $\frac{n_t}{N_t}$ or n_t does not affect our final results.

[11] Beaudry et al. (2007) assume the probability that a startup will become a functioning firm is given by $\min(1, \frac{\eta_t N_{t-1}}{n_t})$. And they only consider the case $n_t \geq \eta_t N_{t-1}$.

[12] Beaudry et al. (2007) assumes η_t is an exogenous shock.

[13] Beaudry's specification implies this elasticity equals to -1.

current period, i.e., there is no time to build[14]. Therefore, the law of motion of the total mass implies[15]:

$$N_t = (1 - \delta_N) N_{t-1} + q_t n_t \tag{12}$$

Finally, the free entry condition implies the potential firms will enter as long as the expected value for the startup is above the cost of entry. Hence, we have

$$f_e = q_t V_t \tag{13}$$

where V_t denotes the present discounted value of expected profits for the incumbent firm, and corresponds to the stock price in the real world. The above equation shows that the entry number n_t is positively correlated to the firm value V_t since $1/q_t$ is increasing in n_t. As a result, more firms will enter the competitive market if their expected value is higher. This point is consistent with the impulse responses reported in our structural VAR exercises in the previous section.

3.2 Households and General Equilibrium

At each period t, the economy is inhabited by a continuum of identical households with mass normalized to one. The representative household has preferences over random stream of consumption, C_t and labor L_t. The representative household maximize the following life-time utility function:

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left(C_t - \psi L_t^{\theta} X_t\right)^{1-\xi} - 1}{1-\xi} \tag{14}$$

where

$$X_t = C_t^{\gamma} X_{t-1}^{1-\gamma} \tag{15}$$

We assume that $0 < \beta < 1$, $\theta > 1$, $\psi > 0$, and $\xi > 0$. The presence of X_t means that preferences is non-time-separable in consumption and labor provided. When $\gamma = 1$, we

[14] The time-to-build assumption does not matters our model's dynamics, except the dynamcis of the total mass N_t at the first period.

[15] It is easy to see that the $q\left(\frac{n}{N}\right)$ plays similar role of the traditional adjustment cost. Since after combining (11) and (12), we can rewrite the law of motion of N_t as

$$N_t = (1-\delta) N_{t-1} + \varphi\left(\frac{n_t}{N_{t-1}}\right) N_{t-1}$$

where $\varphi(.)$ is a concave function.

obtain preferences of the class discussed in King, Plosser and Rebelo (1988) (hereafter KPR). When $\gamma = 0$, we obtain the preferences proposed by Greenwood, Hercowitz and Huffman (1988) (hereafter GHH). In each period, the representative household maximizes his utility (14) subject to the following sequence of budget constraints:

$$C_t + I_t + \int_0^{N_t} V_t^i s_t^i di \leq w_t L_t + r_t u_t K_t + \int_0^{N_t} \pi_t^i s_t^i di + (1 - \delta_N) \int_0^{N_{t-1}} V_t^i s_{t-1}^i di \quad (16)$$

$$K_{t+1} = (1 - \delta_t) K_t + \left(1 - \varphi\left(\frac{I_t}{I_{t-1}}\right)\right) I_t \quad (17)$$

where s_t^i denotes the share of firm i purchased in period t. As in JR (2009), $\varphi'\left(\frac{I_t}{I_{t-1}}\right) I_t$ is the adjustment cost in investment, such that $\varphi(1) = 0$, $\varphi'(1) = 0$, and $\varphi''(1) > 0$. The first-order conditions are:

$$\lambda_t = \left(C_t - \psi L_t^\theta X_t\right)^{-\xi} + \mu_t \gamma C_t^{\gamma-1} X_{t-1}^{1-\gamma} \quad (18)$$

$$\mu_t = \beta E_t\left[(1-\gamma)\mu_{t+1} C_{t+1}^{\gamma} X_t^{-\gamma}\right] - \left(C_t - \psi L_t^\theta X_t\right)^{-\xi}\left(\psi L_t^\theta\right) \quad (19)$$

$$\lambda_t w_t = \left(C_t - \psi L_t^\theta X_t\right)^{-\xi} \psi X_t \theta L_t^{\theta-1} \quad (20)$$

$$\lambda_t r_t = \eta_t \delta_t' \quad (21)$$

$$\lambda_t = \eta_t\left[1 - \varphi\left(\frac{I_t}{I_{t-1}}\right) - \varphi'\left(\frac{I_t}{I_{t-1}}\right)\frac{I_t}{I_{t-1}}\right] + \beta E_t\left[\eta_{t+1}\varphi'\left(\frac{I_{t+1}}{I_t}\right)\left(\frac{I_{t+1}}{I_t}\right)^2\right] \quad (22)$$

$$\eta_t = \beta E_t\left[\eta_{t+1}(1-\delta_{t+1}) + \lambda_{t+1} r_{t+1} u_{t+1}\right] \quad (23)$$

$$V_t = \pi_t + \beta(1-\delta_N) E_t\left(\frac{\lambda_{t+1}}{\lambda_t} V_{t+1}\right) \quad (24)$$

where μ_t, λ_t, and η_t are the Lagrangian multipliers associated with (15), (16), and (17), respectively.

Consequently, the symmetric equilibrium of our model is defined as follows. Given the stochastic process of external shock, A_t, an equilibrium is characterized by a collection of 16 equations, listed in table A1 in the Appendix, such that: (a) household optimally choose his consumption, labor supply, investment and the firm's share; (b) both final firms and intermediate firms maximize their profits; (c) both goods market and labor market clear.

4 Calibration and Results

4.1 Parameters

Table 1: Calibrated Parameters

Parameter	Value	Description
β	0.985	Subjective discount factor
ξ	1	Intertemporal elasticity of substitution
θ	1.4	Corresponds to an elasticity of labor supply of 3.3 when preferences take the GHH form
γ	0.01	the extent of non-time-separable preference in consumption and labor 0 means GHH, 1 means KPR
φ''	1.3	Second derivative of investment adjustment cost function
$\delta''(u)u/\delta'(u)$	0.15	Elasticity of $\delta\prime(u)$ at steady state
α	0.36	Capital share in production
σ	1/1.2	Corresponds to 20% markup.
δ_k	0.025	Steady-state depreciation rate of capital
δ_N	0.025	Exogenous firm exit rate
q	0.975	Steady-state survival rate of startups
f_e	0.12	Fixed entry cost
$\frac{q'\frac{n}{N}}{q}$	-0.5	Elasticity of survival rate at steady state

Table 1 presents the values assigned to the calibrated parameters. For those parameters also present in JR model, we just set the same value. In particular, the time unit corresponds to one quarter. The discount factor, β, is calibrated at 0.985, which implies a steady state annual real interest rate of 6%. The value of intertemporal elasticity of substitution, ξ, is set to be 1 corresponding to logarithmic utility. γ is set to 0.01, so that the preference is close to GHH specification. θ is chosen to be 1.4 implies the elasticity of labor supply is 2.5 when the preference takes the GHH form. On the production side, the share of capital is set to $\alpha = 0.36$, as commonly used in the literature. The steady-state capital depreciation rate is calibrated to $\delta_k = 0.025$, which corresponds to a 10% annual depreciation rate found in the data. We choose the second derivative of the adjustment-cost functions evaluated at the steady state, $\varphi''(1)$, to equal 1.3. For the elasticity of $\delta'(u)$ evaluated in the steady state, we set it to 0.15.

Now we calibrate those parameters absent in JR's model. For the elasticity of substitution across individual intermediate goods $\frac{1}{1-\sigma}$, we set it to be 6, implying $\sigma = 1/1.2$ and the steady state markup is 20%. The natural death rate of firms, δ_N, is set to be 0.025, which implies a 10% annual rate of exogenous exit in our model. This is consistent with the empirical result that the annual job destruction rate in the U.S. is about 10%. Survival rate for new entrants at steady state, q, is set to $1-\delta_N$. In order to make the startups not too many, we set the initial fixed cost, f_e, to 0.12, which has no effect on our results regarding impulse responses.[16] Finally, we set the elasticity of survival rate at steady state, $\frac{q' \frac{n}{N}}{q}$, to be -0.5. Our robustness check shows the results hold in a quite wide range.

4.2 Dynamics: Exogenous vs. Endogenous Survival Rate

In this subsection, we study how the economy responds to a news shock about future TFP when the survival rate is either constant or endogenous. As JR (2009), the timing of the news shock we consider is as follows. At time zero the economy is in the steady state. At time one, unanticipated news arrives. Agents learn that there will be a 1 percent permanent increase in A_t beginning four periods later, in period five.

Impulse responses with constant survival rate q_t

Figure. 2. Dynamic impulse responses to an anticipated shock about future's TFP. The news arrives at period 1 and is realized in period 5.

Impulse responses with endogenous survival rate q_t

Figure. 3. Dynamic impulse responses to an anticipated shock about future's TFP. The news arrives at period 1 and is realized in period 5.

Fig.2 and 3 depict the response of the two models to this news. The dashed lines in Fig.2 clearly illustrate the difficulties in generating positive comovement in JR model with constant survival rate for new entrants. In the first period, the aggregate variables including output, consumption, total investment[17], hours worked and entry numbers decrease under the steady state. Thus, a good news leads the economy into a recession which departs with the empirical findings. As the constant survival rate imposes no extra cost for large movement of entry

[16] It is easy to show that the steady state share of initial entry cost in output equals to $\frac{\delta_N(1-\sigma)q}{1-\beta(1-\delta_N)}$. And according to our calibration, this share equals to 10.25%.

[17] The total investment consists of the physical capital I_t and the entry cost $n_t f_e$.

number, the potential firms have incentive to enter the industry at the news realized period. As shown by the dashed line, the entry number decreases sharply in the first period which induces less labor demand and thus lowers the wage income. Therefore, the consumption of households goes down and thus traps the economy into a recession since the JR specifications (variable capacity utilization, investment adjustment, preference with lower income effect) make the other aggregate variables positively comove with each other. Also note that, in this case the asset price (V_t) is constant according to the free entry condition.

Solid lines in Fig.3 show the responses of the model with endogenous survival rate for new entrants. In sharp contrast, output, consumption, total investment, hours worked and entry number all increase in response to the same news. In particular, the path of entry number is much smoother than the previous case. As the endogenous survival rate induces extra cost for new entrants, to prevent the sharp change of the entry rate, it is optimal for those potential firms to enter the industry in advance when receiving the good news. As a result, the aggregate economy experiences a boom instead of a recession. Another thing worth noting is that the model also predicts the increasing asset price. According to the free entry condition, it is easy to see that the asset price is positively correlated to the inverse of survival rate which is increasing in the entry rate. Thus, the asset price rises in response to the good news. This fact is consistent with the empirical evidence. Moreover, after robustness check, we find the above results hold in a wide range of $\frac{q' \frac{n}{N}}{q}$, say $-1 \sim -0.12$.

5 Conclusion

In the literature, firm dynamics is well believed to be an important mechanism to understand business cycle. But its role in explaining EDBC is still unknown. By incorporating endogenous firm entry problem into Jaimovich and Rebelo's well established EDBC model, we find their model generates a recession rather than a boom in response to good news shocks. This is mainly because there is no cost for large movement of firm entry, and thus when the good news hits the economy, potential firms tend to enter the industry later. After endogenizing the survival rate of new entry firms, we show that the decreasing success probability for startups with respect to the entry mass smooths the firm dynamics. And with this small modification, our model can generate the positive comovement of the main macroeconomic indicators including consumption, investment, output, labor, entry mass and asset price.

References

1. Audretsch, D.B., Houweling, P., Thurik A.R., 2000. Firm Survival in the Netherlands. Review of Industrial Organization 16, 1–11.

2. Beaudry, P., Collard, F., Portier, F., 2009. Gold Rush Fever in Business Cycles. Working paper w12710, NBER.

3. Beaudry, P., Lucke, B., 2010. Letting Different Views about Business Cycles Compete. NBER Macroeconomics Annual 2009 24, 413–455.

4. Beaudry, P., Portier, F., 2006. Stock Prices, News, and Economic Fluctuations. American Economic Review 96(4), 1293–1307.

5. Beaudry, P., Portier, F., 2007. When Can Changes in Expectations Cause Business Cycle Fluctuations in Neo-Classical Settings? Journal of Economic Theory 135(1), 458–477.

6. Bilbiie, F., Ghironi, F.,. Melitz, M.J., 2008. Endogenous Entry, Product Variety, and Business Cycles. NBER Macroeconomics Annual 2007 22, 299–353.

7. Christiano, L.J., Ilut, C., Motto, R., Massimo, R., 2006. Monetary Policy and Stock Market Boom-Bust Cycles. Northwestern University.

8. Den Hanan, W.,J., Kaltenbrunner, G., 2009. Anticipated Growth and Business Cycles in Matching Models. Journal of Monetary Economics 56, 309–327.

9. Greenwood, J., Hercowitz, Z., Krusell, P., 2000. The Role of Investment-Specific Technological Change in the Business Cycle. European Economic Review 44, 91–115.

10. Gunn, C.M., Johri, A., 2011. News and Knowledge Capital. Review of Economic Dynamics 14, 92–101.

11. Hannan, M.T., Carroll, G.R., Dundon, E.A., and Torres, J.C., 1995. Organizational Evolution in a Multinational Context: Entries of Automobile Manufacturers in Belgium, Britain, France, Germany, and Italy. American Sociological Review 60(4), 509–528.

12. Jaimovich, N., 2007. Firm Dynamics and Markup Variations: Implications for Multiple Equilibria and Endogenous Economic Fluctuations. Journal of Economic Theory 137(1), 300–325.

13. Jaimovich, N., and Rebelo, R., 2009. Can News about the Future Drive the Business Cycle? American Economic Review 99(4), 1097–1118.

14. Karnizova, L., 2010. The spirit of capitalism and expectation-driven business cycles. Journal of Monetary Economics 57(6), 739–756.

15. Lutkepohl, H., 2005. New Introduction to Multiple Time Series Analysis, Springer-Verlag, Berlin.

16. Mata J., Portugal, P., 1994. Life Durtion of New Firms. Journal of Industrial Economics 42(3), 227–245.

17. Uribe, M., Schmitt-Grohe S., 2008. What's News in Business Cycles. Working Paper.

18. Wang, P.F., Wen Y., 2010. Understanding The Effects of Technology Shocks. Review of Economic Dynamics, forthcoming.

Appendix

A: Data Description

All the data are quarterly frequency, from 1948Q1—2009Q4.

TFP : total factor productivity , adjusted by capital utilization, download from Fernald's website.

SP : real stock price, download from Shiller's website.

Y : real GDP series from St. Louis FED economic database

Nf : the number of new business incorporations[18]. Since the series is discontinued (up to 1994-Q4) as a result of a reprogramming of resources at BEA, we extend this series to 2009-Q4 by using the BLS' establishment birth and death data.

The SP, Y, Nf series are transformed in per capita terms by dividing them by the population age 15 to 64.

B: Dynamic System for Our Full Model

Table A.1 Dynamic System for Our Full Model

$Y_t = A_t N_t^{\frac{1}{\sigma}-1} \left(u_t K_t\right)^{\alpha} L_t^{1-\alpha}$
$w_t = (1-\alpha)\,\sigma \frac{Y_t}{L_t}$
$r_t = \alpha\sigma \frac{Y_t}{u_t K_t}$
$\pi_t = (1-\sigma)\, Y_t / N_t$
$V_t = \pi_t + \beta\,(1-\delta_N)\, E_t \left(\frac{\lambda_{t+1}}{\lambda_t} V_{t+1}\right)$
$f_e = q_t V_t$
$N_t = (1-\delta_N)\, N_{t-1} + q_t n_t$
$X_t = C_t^{\gamma} X_{t-1}^{1-\gamma}$
$\lambda_t = \left(C_t - \psi L_t^{\theta} X_t\right)^{-\xi} + \mu_t \gamma C_t^{\gamma-1} X_{t-1}^{1-\gamma}$
$\mu_t = \beta E_t \left[(1-\gamma)\,\mu_{t+1} C_{t+1}^{\gamma} X_t^{-\gamma}\right] - \left(C_t - \psi L_t^{\theta} X_t\right)^{-\xi} \left(\psi L_t^{\theta}\right)$
$\lambda_t w_t = \left(C_t - \psi L_t^{\theta} X_t\right)^{-\xi} \psi X_t \theta L_t^{\theta-1}$
$\lambda_t r_t = \eta_t \delta_t'$
$\lambda_t = \eta_t \left[1 - \varphi\left(\frac{I_t}{I_{t-1}}\right) - \varphi'\left(\frac{I_t}{I_{t-1}}\right)\frac{I_t}{I_{t-1}}\right] + \beta E_t \left[\eta_{t+1}\varphi'\left(\frac{I_{t+1}}{I_t}\right)\left(\frac{I_{t+1}}{I_t}\right)^2\right]$
$\eta_t = \beta E_t \left[\eta_{t+1}\left(1-\delta_{t+1}\right) + \lambda_{t+1} r_{t+1} u_{t+1}\right]$
$K_{t+1} = (1-\delta_t)\, K_t + \left(1 - \varphi\left(\frac{I_t}{I_{t-1}}\right)\right) I_t$
$Y_t = C_t + I_t + n_t f_e$

[18] This series is reported by the Business Cycle Indicators Branch, Business Outlook Division (BE-52), Bureau of Economic Analysis, U.S. Department of Commerce. The can be download from the website: http://www.bls.gov/bdm/