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FINANCIAL FRICTIONS AND FIRM DYNAMICS

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ABSTRACT

Firm entry dynamics are an integral part of the propagation of financial shocks to the real economy. A VAR documents that adverse financial shocks in the U.S. postwar period are associated with a fall in new firm creation and a fall in firm equity values. We propose a DSGE model with endogenous firm entry and financial frictions that is able to explain these facts. The model is novel in giving firms a choice of financing up-front entry costs through a combination of debt as well as equity, so that financial shocks directly impact the financing of firm entry. The model is also novel in making use of the asset pricing implications of the firm entry condition to explain the equity price response to a financial shock. The model indicates that free entry of new firms limits the ability of incumbent firms to respond to negative financial shocks through endogenous capital restructuring. Also, allowing the number of firms to fall after an adverse financial shock is a useful margin of macroeconomic adjustment, reducing the overall impact of the shock on aggregate output. This is because the remaining firms become financially stronger and better able to withstand a financial shock.

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1. Introduction

Recent events have spurred interest in the financial sector as a source of business cycle fluctuations.[1] As is well known, if firms rely upon financing for current production costs, shocks to the ability to secure such financing can lead to fluctuations in production. Less well known is the fact that in addition to a fall in production, the recent financial crisis also has been characterized by a dramatic fall in the rate of new firm creation: the quarterly rate of establishment births in the U.S. fell 22.5% from June 2007 to its low point in June 2009.[2] This paper argues that the fall in firm entry is central to understanding how financial shocks are transmitted to the real economy. We also demonstrate that firm entry is fundamental to understanding other key phenomena associated with the recent financial crisis, such as equity price fluctuations and capital restructuring between equity and debt financing.[3]

While firm entry dynamics have been shown previously to be important for understanding business cycle dynamics, we argue this is especially true in the case of financial shocks which can affect the financing of firm entry.[4] For example, while it is common to model the need for external financing to cover current production costs, this ignores what is probably the greatest need for external financing of a firm, its initial startup costs. The greatest impacts of financial market shocks may be felt in the

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[1]See especially Jermann and Quadrini (2012) and Monacelli, Quadrini and Trigari (2011). See also examples in Arellano, Bai and Kehoe (2012), Asturias, Hur, Kehoe and Ruhl (2012), Barseghyan and DiCecio (2011), Bah and Fang (2012), Shourideh and Zetlin-Jones (2012).
[2] Source: author calculations based on quarterly establishment birth statistics of the Business Employment Dynamics report of the U.S. Bureau of Labor Statistics.
[3]Jermann and Quadrini (2012) showed that capital restructuring was an important aspect of the recent financial crisis. We show that the benefits of capital restructuring are significantly diminished in the presence of free entry.
[4]Bilbiie, Ghironi and Melitz (2012) demonstrate that the sluggish response of firm entry and creation generates an important propagation mechanism for changes in aggregate productivity, and explains stylized facts such as the procyclicality of firm entry and profits but countercycality of markups (with translog preferences). Bilbiie, Ghironi and Melitz (2008) study the role of firm entry and product creation in the transmission of monetary policy. Bergin and Corsetti (2008) find that firm entry amplifies the real effects of monetary policy, and monetary policy rules that offset the uncertainty of productivity shocks can raise the mean level of entry and welfare.

inability of potential firms to acquire financing for their startup costs, leading to large effects on the number of firms.

The paper begins by documenting some new facts regarding the dynamic relationship of firm entry and equity prices after a financial shock. The fall in firm creation observed in the recent crisis is not atypical; using a vector-autoregression on U.S. postwar data, we find that an adverse financial shock in U.S. postwar data leads to a fall in new firm creation. We also find that the financial shock is associated with a fall in equity prices. The fall in entry occurs with a lag of several quarters before becoming significant, while the impact on equity price applies to the short run and dies away once the fall in firm entry becomes substantial.

In constructing a DSGE model to explain this pattern in entry and equity prices, we find that two features are key. Key to replicating the observed magnitude of the fall in firm entry is a novel specification that firm entry is partly financed by debt as well as equity, so that when an adverse financial shock raises the cost of borrowing, this also raises the cost of issuing debt in order to pay the entry cost. The financial shock also lowers entry by lowering the expected discounted stream of profits a firm can expect to earn if it enters, but we find that this channel is not sufficient to generate a large fall in entry in response to a transitory financial shock. Specifying that entry costs are financed in part by debt is novel in the firm dynamics literature, in which firms are assumed to finance their sunk setup costs by issuing equity, if the issue of financing is addressed at all. Nonetheless, there is strong empirical support for a significant role for debt financing of firm entry relative to equity (see Robb and Robinson (2013) and Chen, Miao and Wang (2010)). In particular we specify that firms have an endogenous choice of capital structure between debt and equity financing, which applies both to incumbents and new entrants. This specification allows us also to discuss how financial shocks affect the choice of capital structure, and how firm entry influences this choice.

To explain the positive co-movement of equity price with firm entry after an adverse financial shock, we make use of the novel observation that the firm entry condition has features of an asset pricing equation. Free entry requires that firm value, which equals the discounted stream of expected future profits, be equal to the sunk cost of entry. By introducing a congestion externality in the entry process, making sunk entry cost a positive function of firm entry, the model immediately implies that equity price of the marginal firm commoves positively with firm entry. The congestion externality makes it optimal to spread the process of new firm entry over multiple periods, akin to the familiar convex adjustment costs in a model with physical capital.

Our model of firm entry provides new insights into the economic adjustment to an adverse financial shock. Under endogenous firm entry, the impact of a negative financial shock is split between both a fall in profits (and hence equity price) and a fall in the number of firms. As an adverse financial shock begins to lower firm profits, fewer potential firms find it attractive to enter the market, which means that each existing firm gets a larger share of aggregate profits. The fall in entry thus buffers the fall in firm equity price relative to a case where there is only one representative firm. Given that the tightness of the financial constraint depends on the collateral value of the firm equity, the fact that equity price is less adversely affected than in the case of no entry means that the financial shock has less bite on borrowing for production. This suggests that allowing the number of firms to fall after an adverse financial shock may be a useful margin of macroeconomic adjustment, reducing the overall effect on aggregate output. Simulation of the calibrated model indicates that the impact on output of a negative financial shock is reduced by 60% under completely free firm entry compared to a benchmark case with a dampened fall in entry.[5]

A further implication of the free entry condition is that it greatly restricts the benefits of capital restructuring by incumbent firms. Recent literature posits that firms can minimize the impact of a financial shock that reduces the collateral value of firm equity by postponing current dividend payments to the future, thus raising equity price by raising the discounted stream of future dividends. However, under free entry, an increase in average future firm dividends induces new firms to enter, which compete with incumbent firms and appropriate market share and profits. We show that in a standard simple entry condition, where a constant sunk cost must equal firm value, any postponement of dividends by incumbents leads to sufficient new firm entry that there is no effect on expected future profits of the incumbent firms, and hence no rise in incumbent firm equity value. The benefits of capital restructuring by an incumbent firm are fully neutralized.

The model's specification of the financial friction is related to recent work on capital restructuring, most notably Jermann and Quadrini (2012). But we know of no paper that studies the financing of firm entry in this context, or studies the interactions between firm entry and capital restructuring that we document. Monacelli, Quadrini and Trigari (2011) study a very different model of entry and financial friction, shaped by strategic considerations in a labor market game, rather than the capital restructuring in our model. Macnamara (2012) studies the importance of financial frictions for entry over the business cycle. We differ in allowing an endogenous and time-varying choice between equity and bond financing (capital restructuring), which is a source for our results. In addition, in our model financial shocks affect firm entry

[5] This finding does not contradict claims that a fall in firm entry can also have harmful effects, such as if new firms are disproportionately responsible for new job creation, as found in Foster et al (2012). Our model focuses on the implications of entry for the financial constraint and abstracts from heterogeneity between new and incumbent firms.

by affecting the cost of financing startup costs rather than just through affecting production and expected future profits. This allows financial shocks of the standard type to have large effects on firm entry levels in our model. The importance of capital restructuring in amplifying real impacts of financial shocks is also observed in Gomes and Schmid (2014). But different from their focus on the role of risk premia as a channel connecting debt, equity markets and macroeconomic aggregates, we emphasize the positive co-movement of firm entry and stock market value in response to financial shocks.

The remainder of this paper is structured as follows. Section 2 documents new stylized facts. Section 3 introduces the DSGE model, and section 4 provides some analytical results and intuition. Section 5 presents simulation results. Section 6 concludes.

2. Empirical evidence

We use a vector autoregression to estimate the dynamic response of firm entry and stock prices to financial shocks in the U.S. economy. The number of new incorporations is used as the measure of firm entry, and is obtained from Economagic.[6] The S&P500 index, which covers 75% of US equities, is used as a proxy of stock prices. We estimate a 6-variable VAR model at quarterly frequency from 1963:1 to 1996:3, with variables in the following order: the logarithm of industrial production, logarithm of CPI, non-borrowed reserves ratio, 3-month interbank lending rate, logarithm of new incorporations, and logarithm of S&P500 index. Using a Cholesky decomposition on the reduced-form residuals, we impose the

[6] We do not use the establishment births data series of the BLS noted in the introduction because that data series only begins in 1994 and covers only two recessions, so it is less suitable for time series analysis.

restriction that firm numbers and stock prices can respond contemporaneously to production, CPI, nonborrowed reserves ratio, and lending rate, but not vice versa.

We represent an exogenous financial shock as an innovation to the lending rate orthogonal to the other macroeconomic variables, including the nonborrowed reserves ratio. The latter variables are included to help disentangle the effects on the lending rate due to monetary policy from the effects of an exogenous financial shock.

Fig. 1 reports the baseline results. It shows that firm numbers respond negatively and persistently to a credit tightening shock. However, the responses of firm numbers to the financial shock requires 6 quarters before becoming significant, and the negative effect lasts 12 quarters. The maximal drop of 0.4% occurs 8 quarters after the shock. In contrast, stock prices respond instantly to a credit tightening shock. The negative responses of stock prices last for around 4 quarters, and the maximal drop is 1.4% at the 4^{th} quarter.

We conclude that financial shocks do have negative effects on firm entry and equity prices, but that the effect on equity prices is short-lived while that on entry emerges around the time that the effect on equity prices disappears. Our model provides a theoretical explanation for this pattern of findings.

3. Model

We specify a dynamic stochastic general equilibrium model that features a financing constraint and firm entry, where financing of entry costs is affected by financial market shocks. Our model's specification of the financial market draws on features of Jermann and Quadrini (2012), including a financial constraint that is subject to direct stochastic shocks as a source of business cycle fluctuations, and the ability of firms to alter their equity issue over time through dividend payouts.[7]

The model considers a closed economy with four different types of agents: (1) a perfectly competitive final goods sector that combines all available intermediate goods with a CES aggregator, (2) a monopolistically competitive intermediate goods sector with endogenous firm entry, (3) a representative investor who finances new and existing intermediate firms through equity purchase, and (4) a representative worker who supplies labor to the intermediate firms and purchases bonds from these firms.

The final goods are consumed by the investor and the worker. As in Perri and Quadrini (2012), we assume that the investor is less patient than the worker; that is, the investor has a larger discounting factor than the worker. Because firms are owned by the investor, the higher discounting of investor implies that in equilibrium firms borrow from the worker. The investor's only income is from the equity investment in the intermediate firms, while the worker finances his consumption through wage payments and bond investment in the intermediate firms.

The intermediate goods producers are monopolistically competitive, and each of these firms produces a distinct variety. They hire labor from the worker and issue equities and corporate bonds, which are purchased by the investor and the worker, respectively. To finance production, they must also borrow an intra-period loan. Because the borrowers may default on their loan repayment, their borrowing is subject to an enforcement constraint.

New firms are free to enter the intermediate goods market subject to a one-time sunk investment, and entrants can finance this startup investment with a mix of debt and equity financing. Our model of firm entry differs somewhat from the most common specification, as found in Bilbiie et al. (2012), in that firms are permitted to

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[7]These features distinguish the modeling of the financial friction from the more standard specification in Kiyotaki and Moore (1997).

begin production immediately in the period of production. This specification is required to make firm entry consistent with the specification of the financial constraint, which is a function of the choice of debt for the current period.

3.1 Final goods sector

The final goods sector is perfectly competitive. The production of final goods (Y_t) is a CES aggregate of all $\tilde{n}_t$ existing varieties ($y_{i,t}$), $Y_t = N_t \left[\int_0^{\tilde{n}_t} y_{i,t}^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}$, where $N_t \equiv \tilde{n}_t^{\gamma - \frac{\sigma}{\sigma-1}}$ characterizes the love for variety, σ is the substitution elasticity among varieties.

The demand for individual variety and the corresponding price indices are thus given by:

$$y_{i,t} = N_t^{\sigma-1} \left(\frac{p_{i,t}}{P_t} \right)^{-\sigma} Y_t = \tilde{n}_t^{-\gamma} Y_t \tag{1}$$

$$P_t = \frac{1}{N_t} \left(\int_0^{\tilde{n}_t} p_{i,t}^{1-\sigma} di \right)^{\frac{1}{1-\sigma}} = \tilde{n}_t^{1-\gamma} p_{it} \tag{2}$$

3.2 Production, enforcement constraint, and endogenous entry

Following Jermann and Quardrini (2009, 2012), we assume that firms use equity (stock share denoted by s_t) and debt (denoted by b_t) to finance production. Debt is preferred to equity because borrowers (firm owners) discount the future more heavily than lenders (workers). That is, $\beta_I < \beta$.[8] Here, β_I and β represent the discount

[8]This assumption is critical for the results. As Arellano, Bai and Kehoe (2012) stated, "the financial frictions, by themselves, make internal finance through retained earnings more attractive than external finance. Absent some other force, firms build up their savings and circumvent these frictions." In the

factor of investors (firm owners) and the household workers, respectively. When borrowers discount the future more heavily than lenders, the cost of external financing (through bond issuance) is lower than the cost of internal funds (through equity issuance). This assumption ensures that the borrowing constraint is not irrelevant.

The timeline of the economy is shown in Table 1. Each period starts with two aggregate state variables: the technology shock (A_t), and the financial shock (ξ_t). We will describe the financial shocks (ξ_t) in more detail in the next section. At the beginning of each period, the economy consists of n_{t-1} incumbent firms, each of which has a matured debt repayment b_{t-1}. There are also ne_t new entrants who enter the market, hire labor and produce as the existing incumbents, except that these new entrants do not have a matured debt repayment from last period. The final goods are constructed over the $\left(n_{t-1}+ne_t\right)$ varieties. That is, $\tilde{n}_t \equiv n_{t-1}+ne_t$.

Then, the incumbents and the new entrants hire labor, issue corporate bonds and stocks and produce goods, workers supply labor and make consumption and bond investment decision over the $\tilde{n}_t$ varieties, investors purchase goods for consumption as well as corporate equities of the $\tilde{n}_t$ varieties, and goods and labor markets clear.

At the end of each period after all markets have cleared, there is an exogenous death shock which applies to all incumbents and new entrants, and which occurs with a probability of λ. Because death shock occurs at the end of each period, only n_t firms remain in the market after the death shock:

$$n_t = (1-\lambda)\left(n_{t-1}+ne_t\right). \tag{3}$$

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paper we follow Kiyotaki and Moore (1997), assuming impatient entrepreneurs than workers which makes firm borrow externally through bond issuance. A detailed analysis for the importance of heterogeneous agents can be found in Quadrini (2011).

3.2.1 Enforcement constraint

The labor market requires that firms must make factor payments to the worker at the beginning of the period before the realization of revenue. Thus, following Quadrini (2012), and Jerman and Quadrini (2009, 2012), we assume that in addition to the intertemporal debt, b_t as described above, firms borrow an intra-period loan at the amount of $w_t l_{it}$. The intra-period loan is repaid at the end of the period and there is no interest. As firms may default on their debt repayments, their borrowing ability is restricted by an enforcement constraint:

$$\xi_t E_t(m_{t+1} V_{i,t+1}) \geq w_t l_{i,t} \tag{4}$$

where $m_{t+1} = \beta_I (1-\lambda) \frac{U_{CI,t+1}}{U_{CI,t}}$ is the discount factor as the firms are essentially owned by the investor through equity purchases, and $E_t(m_{t+1} V_{i,t+1})$ is the firm's end-of-period equity value. We assume that the dividend from current period can be easily diverted, and thus only the end-of-period firm value can be used as collateral and resold.

This enforcement constraint says that the lenders are willing to lend only if the liquidation value in case of default is at least sufficient to cover the loaned amount. Here, the lenders can only liquidate the firms' end-of-period value $E_t(m_{t+1} V_{i,t+1})$, but suffer a liquidation loss ($\xi_t < 1$). The stochastic innovation ξ_t is a "financing shock," which captures the countrywide "liquidity" of firm assets. When market credit conditions worsen, lenders might have a low probability of finding a buyer, or might possess low bargaining power in liquidating the firm's remaining assets. Consequently, lenders impose tighter constraints on firm borrowing when liquidity dries up or when firm assets have low liquidity.

3.2.2 Firm production and pricing

Each incumbent produces a unique variety, requiring only one factor, labor:

$$y_{i,t} = A_t l_{i,t}, \tag{5}$$

where A_t is the aggregate productivity common to all firms, and $l_{i,t}$ is the input of labor by firm i.

Firm dividends are given by:

$$d_{i,t} = \pi_{i,t} - \left(b_{it-1} - \frac{b_{it}}{R_t} \right), \tag{6}$$

where $\pi_{i,t} = \frac{p_{i,t}}{P_t} y_{i,t} - w_t l_{i,t}$ defines the operation profit from firm production. The value function of the firm, representing the beginning of period value before dividends are paid, is thus,

$$v_{i,t}\left(b_{it-1}\right) = \max_{p_{i,t}, b_{it}} \{ d_{i,t} + E_t (m_{t+1} v_{i,t+1}\left(b_{it}\right)) \}. \tag{7}$$

The last term in brackets is the end of period firm value, which is our measure of equity price: $q_t = E_t (m_{t+1} v_{i,t+1}\left(b_{it}\right))$. Firm i chooses a price level, which in turn determines its production and labor demand, as well as its issue of debt during the period. These choices maximize its firm value, (Eq. 7), subject to the profit equation, (Eq. 6), the enforcement constraint, (Eq. 4), and the demand for individual variety (Eq. 1). The optimization implies the following pricing rules and the multiplier associated with the enforcement constraint:

$$\frac{p_{i,t}}{P_t} = \frac{\sigma}{\sigma - 1} \frac{W_t}{A_t} \left(1 + \mu_t\right) \tag{8}$$

$$\mu_t = \frac{\frac{1}{R_t} - E_t m_{t+1}}{\xi_t E_t m_{t+1}} \tag{9}$$

where μ_t is the Lagrange multiplier associated with the enforcement constraint. The presence of the enforcement constraint adds a wedge term, $(1+\mu_t)$, to a typical pricing rule, as shown in Eq. (8). This wedge term represents the credit channel introduced by the financing constraint.

Eq. (9) shows that, first, a worsening financing condition (a fall in ξ_t) is associated with a rising μ_t, which implies a rising goods price according to Eq. (8), holding all else constant. Second, in steady state, it is always the case that $\mu > 0$, as in steady state $\frac{1}{R} = \beta(1-\lambda)$, $m = \beta_I(1-\lambda)$, and $\beta > \beta_I$ since the investor is less patient than the worker. As a result, the firm always prefers bond financing from the worker to equity financing from the investor in steady state.

3.2.3 Firm entry

A new entrant makes several decisions: whether to enter, how much debt to issue, and the decision of what price to set, which directly implies the level of production and labor demand. As noted in Table 1, we assume that all these decisions take place in the same period, rather than using the more common specification that the entry decision is made in the period before production begins.[9] We use this specification of entry in order to be fully consistent with the specification of the enforcement constraint (4) above. Because this enforcement constraint is the function of end of

[9]If firms made the entry decision at the end of the period prior to production, they would have no incentive to use equity financing of the entry cost. The equity price of new firms would be different from that of incumbent firms, complicating the computing of the equity price index. Our specification allows us to retain the usual assumption in the firm dynamics literature that the end of period firm value is the same for new firms and incumbents.

period firm value, in order for new entrants to make the same financing decision and have the same end of period value as incumbents, entry and financing decision must take place during the same period. While this entry specification is chosen to facilitate theoretical consistency of the model, it does not significantly affect the model results. We also solved a model with the more conventional specification of entry at the end of the period preceding production, and impulse response are almost identical to our benchmark case. See Appendix 1 for the list of equilibrium conditions for this alternative model.[10]

Begin by specifying the value function of the new entrant:

$$V_{it}^{new} = d_{it}^{new} + E_t\left(m_{t+1}V_{it+1}\left(b_{it}^{new}\right)\right) \tag{10}$$

This represents the beginning of period value of a new entrant, and it is the same as for the incumbent in Eq. (7), except that the new entrant begins the period with zero debt. As in Monacelli et al (2011), we assume that the proceeds from initial debt issues are paid out as dividends to firm owners, so that $d_{it}^{new} = \pi_{it}^{new} + \frac{b_{it}^{new}}{R_t}$. This differs from an incumbent firm just in that there was already a matured debt payment for the incumbent, so $d_{i,t} = \pi_{i,t} - \left(b_{it-1} - \frac{b_{it}}{R_t}\right)$.

New firms enter up to the point that the value of a new entrant equals the cost of entry (K_t^E), implying the entry condition:

$$K_t^E = \pi_{it}^{new} + \frac{b_{it}^{new}}{R_t} + E_t\left(m_{t+1}V_{it+1}\left(b_{it}^{new}\right)\right). \tag{11}$$

One interpretation of this equation is that new entrants have a special issue of equity to investors at the beginning of the period to pay the full sunk cost, the value of which

[10]The main difference is that we need to impose exogenously that new entrants are required as a separate constraint to use the same mix of debt and equity financing as incumbent firm, without solving for this portfolio as an endogenous decision of the new firm.

is equal to K_t^E. During the period, new entrants pay dividends that include the value of their initial bond issue. By the end of the period, these special new entrant dividends have been paid out, and the end of period equity price is the same as for incumbent firms. In the investor budget constraint, the sum of initial debt issue and profits of new entrants cancel out, as the equity price investors pay at the beginning of the period reflects these certain dividends, and they occur in the same period as the equity purchase.

An equivalent and perhaps more insightful interpretation of the entry condition makes use of the fact that the sunk cost of entry is paid at the same period as production and profits are generated and bonds issued. In this perspective, the new entrant can draw on its bond issues as well as current period profits to pay for its entry costs. With debt issue used to pay for sunk costs, there is no special equity issue at the beginning of the period or special dividend payment for new firms. Either equation is consistent with the specification of entry condition (Eq. 11). The latter interpretation highlights that new entrants have multiple sources of financing for firm entry, including equity, debt, and retained earnings.

While our model does not include investment in physical capital in the most typical sense, the sunk entry cost, K_t^E, representing setup investment including plant and equipment, functions as a type of capital. In addition, while our enforcement constraint (4) differs from the published version of Jermann and Quadrini (2012) by using end of period firm value rather than physical capital as collateral, it closely resembles the constraint of Jermann and Quadrini if the entry condition is substituted in, replacing end of period firm value with the sunk entry cost K_t^E: $\xi_t E_t(K_t^E - \pi_{it}^{new} - \frac{b_{it}^{new}}{R_t}) \geq w_t l_{i,t}$.

We now turn to the financing and pricing/production decision of the new firm. Just as for the incumbent, the new firm maximizes the beginning of period firm value (Eq. 10, in this case) subject to the profit equation, (Eq. 6), the enforcement constraint, (Eq. 4), and the demand for individual variety (Eq. 1). The only difference in the problem of a new firm from that of an incumbent lies in Eq. (6) for the fact that a new firm enters the period with no debt. Because the enforcement constraint here is not affected by the initial bond position, the first order conditions are the same as for an incumbent (Eqs. 8 and 9), and we can conclude that the choice variables of the new firm are the same as for the incumbent: $b_{it}^{new} = b_{it}$, $p_{it}^{new} = p_{it}$. From Eqs. (1), (5) and (6), we then have that $y_{it}^{new} = y_{it}$, $l_{it}^{new} = l_{it}$, and $\pi_{it}^{new} = \pi_{it}$. In other words, the incumbents and new entrants are identical except that the new entrants don't have matured debt repayments from last period but the incumbents do.

3.2.4 Sunk cost specification

We follow Bergin and Lin (2012) and Lewis (2009), allowing for the possibility of a congestion externality associated with firm entry[11]:

$$K_t^E = \bar{K}^E \left(\frac{ne_t}{ne_{t-1}} \right)^{\tau}. \tag{12}$$

Here, $\bar{K}^E$ is the steady state level of sunk entry costs, and ne_t describes the number of new entrants who compete with each other. This functional specification of entry costs has been motivated in terms of an imperfectly elastic supply of a factor

[11]Our functional specification of entry costs more closely resembles that in Lewis (2009) in specifying the rise in entry cost as a function of the number of new entrants, motivated in terms of an imperfectly elastic supply of a factor specific to product entry such as advertising. Bergin and Lin (2012) also allows for the possibility of a congestion externality in entry but specifying the rise in entry cost as a function of total number of active firms. Their specification is in line with Berentsen and Waller (2009), which was motivated using a matching externality found in Rocheteau and Wright (2005) and common in monetary search models.

specific to product entry such as advertising.

3.3 Worker preferences and optimization

The representative worker derives utility from consuming the basket of goods ($C_{w,t}$), and disutility from labor supply (L_t) in each period, and maximizes expected lifetime utility,

$$\max\ E_0 \sum_{t=0}^{\infty} \beta^t U(C_{w,t}, L_t), \qquad with \qquad U(C_{w,t}, L_t) = \frac{C_{w,t}^{1-\rho}}{1-\rho} - \kappa L_t,$$

where $\rho > 0$ is worker's degree of risk aversion, $\beta \in (0,1)$ is the subjective discount factor, and κ is the relative utility weight of labor.

The worker derives income by providing labor services (L_t) at the real wage rate (w_t), and receiving financial income from holding corporate bonds of the n_{t-1} existing firms (b_{t-1}). The worker then purchases consumption ($C_{w,t}$), and updates its corporate bond investment to the $(n_{t-1} + ne_t)$ firms with a price at $\frac{1}{R_t}$.

The period budget constraint may thus be written as:

$$C_{w,t} + \frac{(n_{t-1} + ne_t) b_t}{R_t} \leq w_t \mathrm{L}_t + n_{t-1} b_{t-1}.$$

From the constraint, we see that the worker receives financial income from the n_{t-1} surviving incumbents, but purchases corporate bonds from both the surviving incumbents (n_{t-1}) and the new entrants (ne_t).

The worker maximizes his expected lifetime utility subject to the budget constraint, implying the following first-order conditions:

$$U_{C_{w,t}} w_t + U_{L,t} = 0 \tag{13}$$

$$\beta(1-\lambda) E_t \left[U_{C_{w,t+1}} R_t \right] = U_{C_{w,t}} \tag{14}$$

where Eq. (13) is the labor-consumption tradeoff condition, and Eq. (14) is the Euler equation for holding corporate bond.

3.4 Investor preferences and optimization

The representative investor derives utility from consuming the basket of goods ($C_{I,t}$) in each period, and maximizes his expected lifetime utility:

$$\max\ E_0 \sum_{t=0}^{\infty} \beta_I^t U(C_{I,t}), \quad with \quad U(C_{I,t}) = \frac{C_{I,t}^{1-\rho_I}}{1-\rho_I},$$

where $\rho_I > 0$ is the investor's degree of risk aversion, and $\beta_I \in (0,1)$ is the subjective discount factor.

The representative investor purchases equities from the intermediate firms. He doesn't supply labor, but receives income from equity trading. The period budget constraint may thus be written as:

$$C_{I,t} + \left(n_{t-1} + ne_t\right) q_t s_t \le n_{t-1} s_{t-1} \left(q_t + d_t\right) \tag{15}$$

where q_t is the stock price and d_t is the dividend, both in units of final goods. As noted for the worker's financing investment, the investor receives financial income from the surviving incumbents (n_{t-1}), but makes financing investment to both the survivors (n_{t-1}) and the new entrants (ne_t).

The optimization implies the following first-order conditions:

$$\beta_I \left(1-\lambda\right) E_t \left[U_{C_{I,t+1}} \left(q_{t+1} + d_{t+1}\right)\right] = U_{C_{I,t}} q_t \tag{16}$$

where Eq. (16) is the Euler equation for holding corporate shares. Because the investor is less patient than the worker, in steady state bond financing is always cheaper than equity financing.

3.5 Equilibrium

Shocks are common to all firms; thus, this study solves the symmetric equilibrium in which firms behave identically. In other words, $z_t(i) = z_t$ for an endogenous variable z, independent of firm i.

As both incumbents and new entrants hire the same amount of labor in production, the market clearing condition for labor is thus given by:

$$L_t = \left(n_{t-1} + ne_t\right) l_t . \tag{17}$$

Because final goods are consumed by the investor ($C_{I,t}$), the worker ($C_{w,t}$), and the new entrants paying entry costs (K_t^E), the market clearing for the final goods are:

$$Y_t = C_{w,t} + C_{I,t} + ne_t K_t^E . \tag{18}$$

The technology and financing shocks are log-normally distributed as follows:

$$\log A_t - \log \bar{A} = \rho_A (\log A_{t-1} - \log \bar{A}) + \varepsilon_{A,t} \tag{19}$$

$$\log \xi_t - \log \bar{\xi} = \rho_\xi (\log \xi_{t-1} - \log \bar{\xi}) + \varepsilon_{\xi,t} \tag{20}$$

where $\varepsilon_{A,t}$ and $\varepsilon_{\xi,t}$ are technology and financing innovations, respectively, which are i.i.d. random variables with homoscedastic variances.

Equilibrium is a sequence of the following 18 endogenous variables: $C_{w,t}$, w_t, L_t, R_t, y_{it}, p_{it}/P_t, ne_t, d_t, q_t, V_t, b_{it}, l_{it}, μ_t, V_t^{new}, n_t, $C_{I,t}$, Y_t, K_t^E. The 18 equilibrium conditions are as follows: First, price indices and demands for individual varieties (1-2). Second, equations from intermediate goods sector: dynamics of firm varieties (3); conditions for incumbents including firm enforcement constraint (4), production function, firm profit and value function, and firm first order conditions (5-9); conditions for new entrants: new entrant's total firm value (10); entry conditions (11);

entry cost specification (12). Third, worker optimization conditions: labor-consumption tradeoff (13) and Euler equations for bond holding (14); investor optimization conditions: the budget constraint (15), and the Euler equation for stock holding (16). Last, market clearing conditions for labor (17), and for final goods (18). The full equilibrium conditions are listed in Appendix 1.

4 Analytical results and intuition

In this section we highlight how introducing a free entry condition transforms the analysis and implications of capital restructuring, relative to standard models with a fixed number of firms.

4.1 Equity price implications

First, consider how the entry condition constrains the behavior of equity prices. It is instructive to begin analysis with a simplified version of firm entry, of the type standard in the recent firm dynamics literature, before extending the analysis to the somewhat more elaborate entry condition in our model. Suppose that the entry cost is constant, that is, $\tau = 0$ in Eq. (2), and it must be paid at the end of the period prior to production (rather than at the beginning of the period of production). Suppose new entrants only have access to equity financing, and entry investment is in units of final goods.[12] The entry condition is simple in this standard case: $q_t = K^E$. This condition implies that the equity prices in the economy are invariant to any shock and have no

[12] A common alternative in the literature is to specify entry costs in units of labor. This case would imply that the equity price commoves with the wage. We do not see evidence in support of this prediction, so we use goods units for our benchmark case. Simulation results for a model specifying entry costs in labor units are available from the authors upon request. It tends to predict entry is countercyclical in our model, which is counterfactual: the fall in output induced by an adverse shock tends to lower wages and hence entry costs, encouraging more entry.

volatility, which is clearly a very strong and counterfactual prediction of these standard firm entry models.

Next, allow the entry cost to change over time as a function of new entrants as specified in our model above. The entry condition then becomes: $q_t = \bar{K}^E \left(\frac{ne_t}{ne_{t-1}} \right)^{\tau}$.

This entry condition links the equity price to new entry in a way that allows the equity price to move, and implies positive co-movement with new entry. For example, when an adverse financial shock leads to a drop in firm entry, it will also lead to a fall in the value of firms. The greater the value of parameter τ, the greater will be the effect of a shock on equity prices relative to firm entry. This model feature will be helpful later in capturing the empirical regularity that an adverse financial shock lowers both equity prices and new entry.

The full entry condition used in our model allows also for bond financing of the entry cost, so that part of the equity price can be replaced by bond issues. The inclusion of bonds in the entry condition provides a useful channel by which a rise in the cost of bond financing reduces new entry. A rise in the cost of debt financing will increase the effective entry cost, discouraging new firm entry. Given that new firm choices will be the same as those for incumbents, the entry condition (Eq.11) can be written:

$$q_t = \bar{K}^E \left(\frac{ne_t}{ne_{t-1}} \right)^{\tau} - \pi_t - \frac{b_t}{R_t}.$$

This entry condition allows for a richer relationship between equity prices and firm entry than does a standard model of firm dynamics. Model simulations to follow will show the contribution of each of these entry financing features to the dynamics of firm entry and equity prices.

4.2 Implications for capital restructuring

The entry condition provides a useful shortcut to seeing the workings of capital restructuring. For simplicity, consider the case with $\tau = 0$, where the entry condition may be rewritten: $q_t = \overline{K}^E - \frac{b_t}{R_t} - \pi_t$. This entry condition is useful because it summarizes an inverse relationship between the debt issue of a firm b_t/R_t and its equity value, q_t (holding constant current period profits). Jermann and Quadrini (2012) also feature such an inverse relationship, which is useful to a firm as a tool to relax its financial constraint, the tightness of which falls when equity value rises: a firm that lowers its debt issues and dividends in period t by $1/R_t$ units, can raise dividends in period $t+1$ by one unit, for a given level of current profits, as specified by the budget constraints for periods t and $t+1$. The entry condition provides an alternative shortcut to demonstrating this relationship, because the equity price is pinned down by the marginal value of a new entrant.

A further lesson is that free entry is seen to impose a restriction on the ability of firms to use capital restructuring to relax their financing constraint. It is no longer possible for incumbent firms to raise their equity value by postponing current dividends to the future. While it is still true that the equity price of a firm equals the expected present discounted value of the firm’s future dividends, future firm sales and profits are endogenous and will always adjust so that equity price satisfies the entry condition. If the representative incumbent firm lowers current dividend payments, this will raise total dividend payments for the economy in the future. But it will induce a rise in new entrants to compete with incumbents over sales and profits. The rise in entry will be sufficient that the level of profits of an individual firm will not rise, making capital restructuring less effective in relaxing the financing constraint.

5 Quantitative analysis

To analyze the full response path of firm entry, equity prices and other key macroeconomic variables in response to financing shocks, we log-linearize the system of 18 equilibrium conditions around the unique deterministic steady state. We calibrate parameters and numerically solve the log-linearized model for the dynamic responses to exogenous shocks using the method of generalized Schur decomposition.

5.1 Parameter values

Calibrations of financial shocks are taken from Jermann and Quadrini (2012). A period is identified as a quarter, and the persistence and standard deviation of financing shocks are set at $\rho_\xi = 0.97$ and $\sigma_\xi = 0.0098$, respectively; the technology counterparts are set at $\rho_A = 0.95$ and $\sigma_A = 0.0045$. The means of technology and financing shocks are set at $\bar{A} = 1$ without loss of generality and $\bar{\xi} = 0.16$ as calibrated in Jermann and Quadrini (2012), respectively.[13]

In addition, we set $\beta = 0.995$ and $\beta_I = 0.985$ to capture an annual bond return of 2% and an annual stock return of 6%. The exogenous death shock probability is set at $\lambda = 0.02$ to match the 8% annual job destruction rate in the U.S. data as documented in the literature (for instance, in Bernard et al. (2010)). The elasticity of substitution across varieties is set at $\sigma = 6$ to deliver a 20% markup of price over marginal cost (Rotemberg and Woodford, 1992). The risk aversion of the worker and the investor are set respectively at $\rho = 2$ (Arellano, Bai and Kehoe,

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[13] The mean value of financial variable, $\bar{\xi} = 0.16$ in our model, produces a steady state ratio of debt over GDP which matches the data. In the data, the average ratio of bond outstandings for the non-financial business sector based on data from the SIFMA over the period 1984-2010 (http://www.sifma.org/research/statistics.aspx) to business GDP (from National Income and Product Accounts, http://research.stlouisfed.org/fred2/data/GDPCA.txt) is 1.5. In our benchmark model, the steady state ratio of debt over GDP is around 1.6.

2012) and $\rho_I = 1$ (Bilbiie, Ghironi and Melitz, 2012) to capture a relatively riskier investor than worker.

The sunk entry cost does not affect any impulse response. Therefore, we follow Bilbiie, Ghironi and Melitz (2012) to set $\bar{K}^E = 1$. Following their paper, we also set the weight of the disutility of labor in the period utility function, $\kappa = 1$. Though the choice of κ affects the steady state value of each variable, it does not affect the relative magnitude of these variables, and thus has no effect on the quantitative results. Finally, following Bergin and Corsetti (2008), we set the consumer's love for variety at $\gamma = \frac{\sigma}{\sigma - 1}$.

Table 2 lists the parameters in the benchmark setting. The entry adjustment cost parameter τ is calibrated at 2.2 to match the standard deviation of new incorporations in the model to that in the data, as reported in Table 3.

5.2 Impulse responses

The impulse responses for the benchmark specification and calibration are reported in Fig. 2.[14] An adverse financial shock leads to a fall in new entrants that builds over 5 quarters to a substantial amount (1.7%). This pattern matches well the empirical impulse response of new incorporations. The change in new entrants implies a gradual but persistent fall in the total number of firms. The equity price falls on impact, but then improves over time. The improvement in equity price reflects the persistent fall in number of firms, as it raises the expected level of profit per firm. Output and employment also fall after the adverse financial shock, as should be expected.

[14] Impulse responses are very similar in the alternative specification with entry at the end of the preceding period. See Appendix Fig. 1.

Next, we study the role of time-varying sunk costs, by comparing to a case with a constant sunk cost where $\tau = 0$. Fig. 3 shows that the impact effect on equity price is close to zero. Recall from the analytical section above that the co-movement of equity price and firm entry depends upon a time-varying sunk cost of entry. The degree to which the sunk cost falls in response to a fall in firm entry dictates the degree to which the impact of the financial shock is diverted from firm entry to firm equity price.

Further, the specification of the entry cost has large consequences for the transmission of the financial shock to the real economy. Comparing Figs. 2 and 3, the impact effect on output is 60% larger in the case of a time-varying entry cost ($\tau = 2.2$) compared to the case of constant entry cost ($\tau = 0$), and the overall standard deviation of output is 35% higher, as shown in Table 4a. Under a constant sunk cost, less of the adverse financial shock is passed on to a fall in equity prices and more passed on to a fall in firm entry, and the smaller drop in equity prices reduces the tightening of the financial constraint due to the shock. In other words, when there is a reduction in the number of firms, the remaining firms have a stronger financial position, as a given level of aggregate profits is split among a smaller number of firms, and a rise in the level of expected future profit per firm raises equity price of a given firm.

Next we show how the fact that firm entry is partly financed by bond issue provides a channel by which an adverse financial shock reduces firm entry. Fig 4 shows responses for a case where firm entry is financed purely by equity issue and current profit, and not by bond issue. This version of the model sets $b_{it}=0$ and suspends the optimal financing decision (Eq. 9). We also must re-calibrate the parameter τ to 1.6 to maintain the standard deviation of ne equal to that in the data (2.2% as shown in Table 4b).

Fig. 4 shows that the shock now leads to a rise in new entry rather than fall. This is despite the fact that the adverse shock still lowers the level of output and employment among incumbent firms. This result reflects the findings of related papers, such as Macnamara (2012), who find it necessary to add in a separate type of financial shock in order to make entry fall. However, we find that that we can match the empirical finding of a fall in entry by introducing bond financing of firm entry. This specification also differentiates us from the recent firm entry literature, which has either not addressed the issue of how sunk costs are financed, or assumed financing by equity issues alone (Bilbiie, Ghironi and Melitz (2012), Bergin and Corsetti (2008)).

The overall conclusion is that an adverse supply shock raises the effective cost of firm entry by forcing a shift in the financing from cheaper debt to more expensive equity issues. This rise in the cost of financing firm entry lowers the amount of new firms entering the market. The equity price of firms also drops, depending on whether firm entry falls more or less than aggregate profits, which determines whether the ratio of profits per firm falls. In other words, the impact of the financial shock is split between a fall in firm entry and a fall in equity prices. Surprisingly, the greater the share of impact on entry, and hence the smaller the impact on equity prices, the smaller is the impact of the financial shock on aggregate output. Intuition can be found in the fact that the fall in entry means that the surviving firms are financially healthier, and better able to withstand the tightening borrowing conditions created by the shock.

6. Conclusions

This paper studies how firm entry responds to financial shocks, and how it propagates these shocks to the real economy. First, we document empirically that financial shocks in the U.S. are associated with a fall in firm entry. In particular an adverse financial shock leads to a fall in new firm creation with a lag, and the effect on equity prices in the short run dies out once firm entry responds. Second, a DSGE model that combines firm dynamics with endogenous capital restructuring can explain these facts. Firms finance a time-varying sunk cost of entry by a mix of debt and equity issues, which responds to shocks that tighten a borrowing constraint. A key implication of the model is that when firm entry drops in response to a financial shock, the surviving firms have greater equity value, which helps relax the financial constraint for the aggregate economy. This suggests that net exit of firms is a useful market response to financial shocks. These findings underscore the conclusion that how a financial shock propagates through the real economy depends fundamentally upon how it affects firm dynamics.

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7. Appendix 1: Equilibrium Conditions In Two Economies

	Benchmark Economy: New Entrants Entry Simultaneously With Production	Economy 2: New Entrants EntryOne Period Ahead Of Production
Demand and CPI	$y_{i,t} = A_t^{\sigma-1}\left(\frac{p_{i,t}}{P_t}\right)^{-\sigma} Y_t = \tilde{n}_t^{-\gamma} Y_t$ (1) $P_t = \frac{1}{A_t}\left(\int_0^{\tilde{n}_t} p_{i,t}^{1-\sigma} di\right)^{\frac{1}{1-\sigma}} = \tilde{n}_t^{1-\gamma} p_{it}$ (2) $\tilde{n}_t \equiv n_{t-1} + ne_t$	**Same** $\tilde{n}_t = (1-\lambda) n_{t-1}$
Firm Dynamics	$n_t = (1-\lambda)(n_{t-1} + ne_t)$ (3)	$n_t = (1-\lambda) n_{t-1} + ne_t$
Enforcement Constraint	$\xi_t E_t(m_{t+1} V_{i,t+1}) \geq w_t l_{i,t}$ (4)	**same**
Incumbents	$y_{i,t} = A_t l_{i,t}$ (5) $d_{i,t} = \frac{p_{i,t}}{P_t} y_{i,t} - w_t l_{i,t} - \left(b_{it-1} - \frac{b_{it}}{R_t}\right)$ (6) $v_{i,t}(b_{it-1}) = \max_{p_{i,t}, b_{it}}\{d_{i,t} + E_t(m_{t+1} v_{i,t+1}(b_{it}))\}$ (7)	**same**

	$$\frac{p_{i,t}}{P_t}=\frac{\sigma}{\sigma-1}\frac{W_t}{A_t}(1+\mu_t) \quad (8)$$ $$\mu_t=\frac{\frac{1}{R_t}-E_t m_{t+1}}{\xi_t E_t m_{t+1}} \quad (9)$$	
New Entrants	$$V_{it}^{new}=d_{it}^{new}+E_t\left(m_{t+1}V_{it+1}\left(b_{it}^{new}\right)\right) \quad (10)$$ $$d_{it}^{new}=\pi_{it}^{new}+\frac{b_{it}}{R_t}$$ $$K_t^E=\pi_{it}^{new}+\frac{b_{it}^{new}}{R_t}+E_t\left(m_{t+1}V_{it+1}\left(b_{it}^{new}\right)\right) \quad (11)$$ $$K_t^E=\bar{K}^E\left(\frac{ne_t}{ne_{t-1}}\right)^{\tau} \quad (12)$$	**same** $$d_{it}^{e}=\frac{b_{it+1}}{R_t}$$ $$K_t^E=\frac{b_{it}^{new}}{R_t}+E_t\left(m_{t+1}V_{it+1}\left(b_{it}^{new}\right)\right)$$ **same**
Worker	$$U_{C_w,t}w_t+U_{L,t}=0 \quad (13)$$ $$\beta(1-\lambda)E_t\left[U_{C_w,t+1}R_t\right]=U_{C_w,t} \quad (14)$$	**same**
Investor	$$C_{It}+(n_{t-1}+ne_t)q_t s_t\le n_{t-1}s_{t-1}(q_t+d_t) \quad (15)$$	**same**

	$\beta_I(1-\lambda)E_t\left[U_{cI,t+1}\left(q_{t+1}+d_{t+1}\right)\right]=U_{cI,t}q_t$ (16)	
Market Clearing	$L_t=\left(n_{t-1}+ne_t\right)l_t$ (17) $Y_t=C_{wt}+C_{It}+ne_tK_t^E$ (18)	$L_t=(1-\lambda)n_{t-1}l_t$ **same**

Table 1 Timeline

<table>
<tr><th>Beginning of t</th><th>Before death shock</th><th>Death shock[15]</th><th>Beginning of t+1</th></tr>
<tr><td rowspan="4">(1) Exogenous shocks realize: A_t, ξ_t
(2) n_{t-1} producing firms;
(3) Five state variables: $n_{t-1}, s_{t-1}\ b_{t-1}, A_t, \xi_t$</td><td>$n_{t-1}$ Incumbents: (1) wage payments made through intra-period loan; (2) financing choice and revenue realization</td><td rowspan="4">Both incumbents (n_{t-1}) and new entrants (n_{et}) surviving with a probability of $1-\lambda$</td><td rowspan="4">state variables: $n_t, b_t, A_{t+1}, \xi_{t+1}$
$n_t=(1-\lambda)(n_{t-1}+n_{et})$</td></tr>
<tr><td>n_{et} New Entrants: (1) bond and equity issuance to finance entry; (2) Labor hiring, production, profit distributed to investor</td></tr>
<tr><td>Worker: Consumption and bond investment</td></tr>
<tr><td>Investor: Consumption and equity investment</td></tr>
</table>

[15]Here, we follow Monacelli, Quadrinni, and Trigari (2011) to specify that the death shock is realized at the end of a period, and a firm hit by a death shock exits from the economy. This assumption of timing is standard in literature, for instance, in Bilbiie, Ghironi and Melitz (2012).

Table 2. Parameterization.

Description	
Parameters calibrated from literature	
Worker Relative risk aversion	$\rho = 2$
Investor Relative risk aversion	$\rho_I = 1$
Worker discount factor	$\beta = 0.995$
Investor discount factor	$\beta_I = 0.985$
Substitution elasticity across varieties	$\sigma = 6$
Probability of death shock	$\lambda = 0.02$
Entry costs	$K^E = 1$
Love for variety	$\gamma = \sigma/(\sigma - 1)$
Congestion Externality in Entry	$\tau = 2.2$
Parameters related to shocks	
Technology parameter	$\bar{A} = 1$
Enforcement parameter	$\bar{\xi} = 0.16$
Standard deviation: technology shock	$\sigma_A = 0.0045$
Standard deviation: financing shock	$\sigma_\xi = 0.0098$
Persistence: technology shock	$\rho_A = 0.95$
Persistence: financing shock	$\rho_\xi = 0.97$

Table 3 Description Statistics (quarterly data): in log levels, HP filtered data. (C_X, X: variables)

	Log of Labor Productivity	Log of Industrial Production	Log of Real Wage	Log of CPI	Log of New Firm Number	Log of S&P500
Mean	9.80E-14	1.01E-13	1.81E-13	6.02E-14	1.39E-13	9.42E-14
Std. Dev.	0.011119	0.014659	0.008913	0.006436	0.022045	0.083265

Table 4a. Calibration of Tau in the Economy with Both Equity Plus Bonds

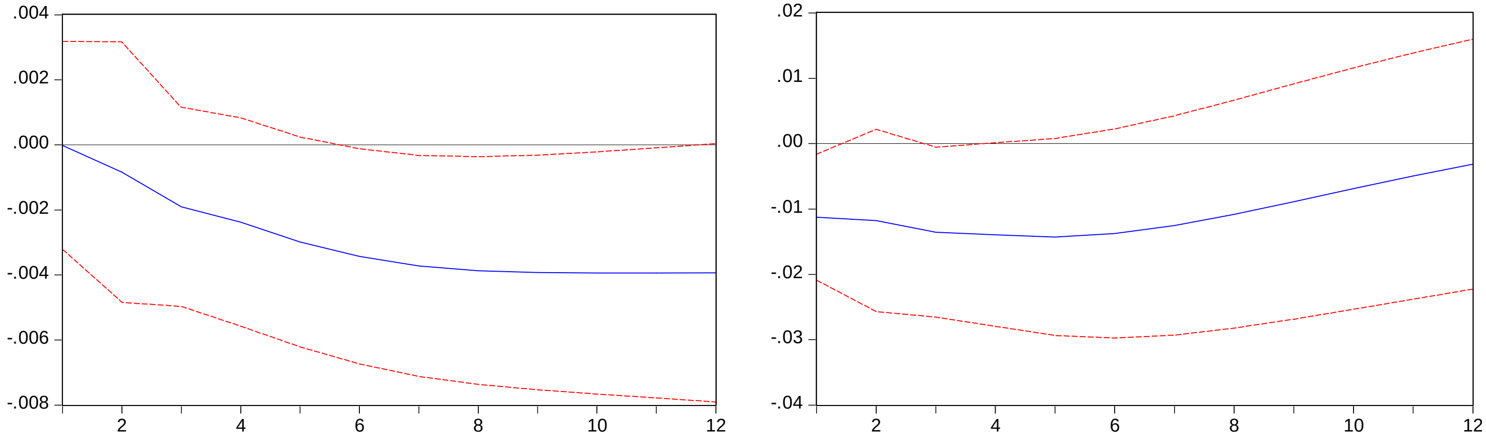
	$\tau = 0$	$\tau = 1.5$	$\underline{\tau = 2.2}$
	STD.DEV	STD.DEV	STD.DEV
ne	0.0678	0.0289	**0.0228**
qi	0.0058	0.0252	0.0279
Y	0.0108	0.0137	0.0146

Table 4b. Calibration of Tau in the Economy with Equity Only

	$\tau = 0$	$\tau = 1.5$	$\underline{\tau = 1.6}$
	STD.DEV	STD.DEV	STD.DEV
ne	0.0805	0.0234	**0.022**
qi	0.0018	0.0087	0.0087
Y	0.0068	0.0065	0.0065

Fig. 1. Impulse Responses to Innovation in Interbank Rate

(a) log of new firms (b) log of stock price index



Note: Impulse responses generated from a 6-variable VAR model at quarterly frequency from 1963:1 to 1996:3, with variables in the following order: the logarithm of industrial production, logarithm of CPI, non-borrowed reserves ratio, 3-month interbank lending rate, logarithm of new incorporations, and logarithm of S&P500 index.

Fig. 2 Impulse Responses to a Negative Financing Shock in Benchmark Calibration of Model ($\tau = 2.2$)

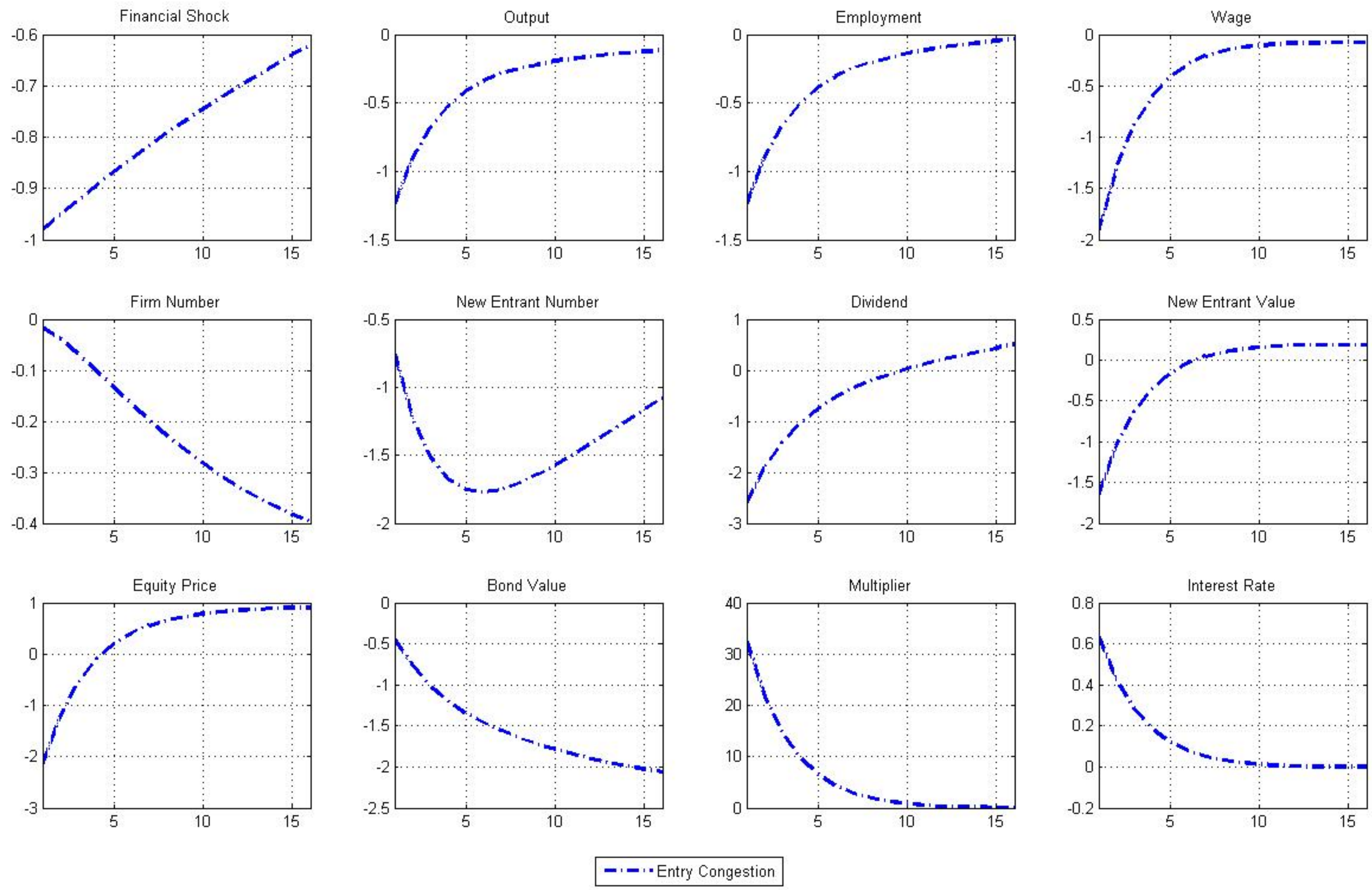


Fig. 3 Impulse Responses to a Negative Financing Shock in Case with Constant Sunk Entry Cost ($\tau = 0$)

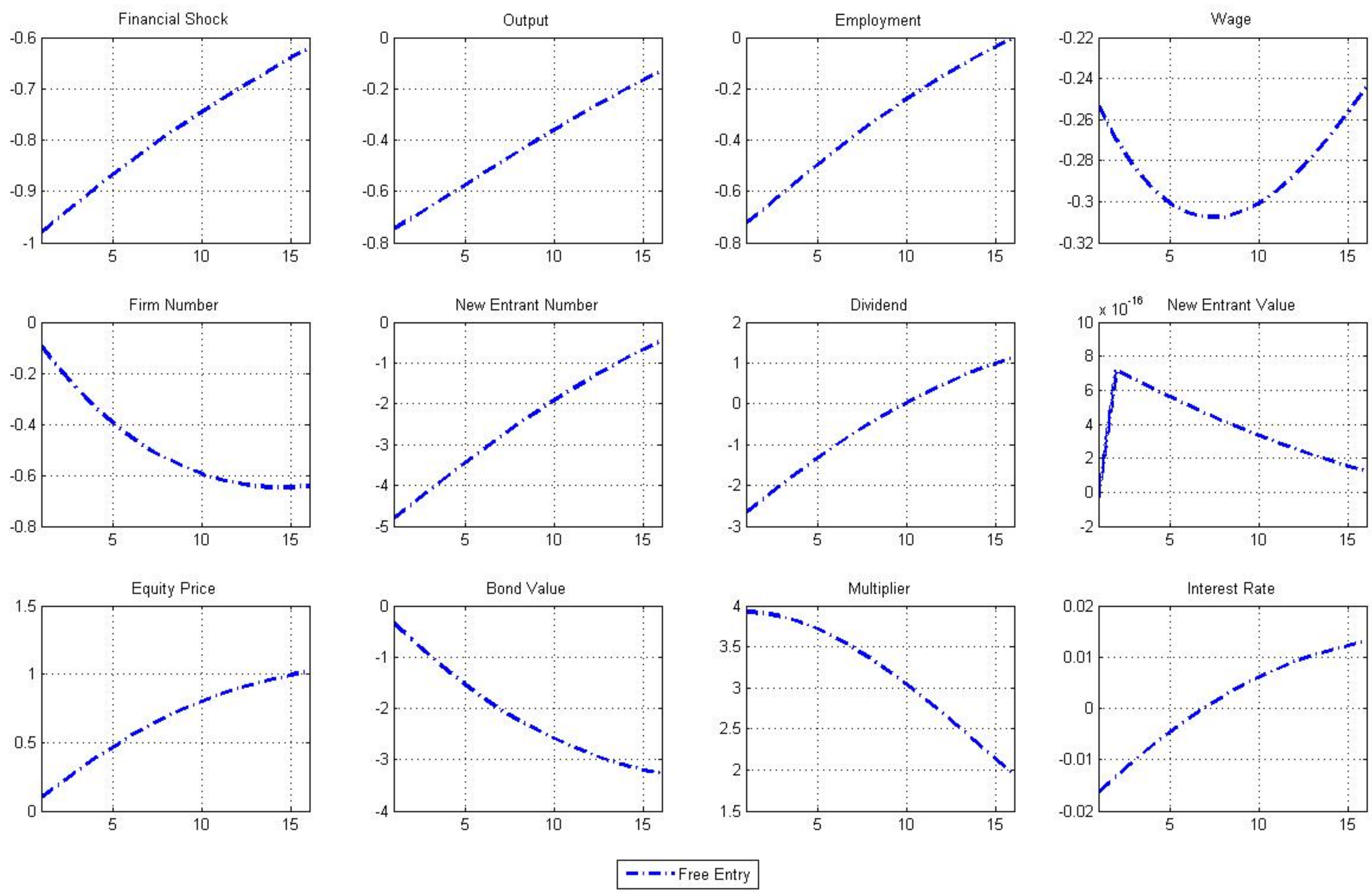
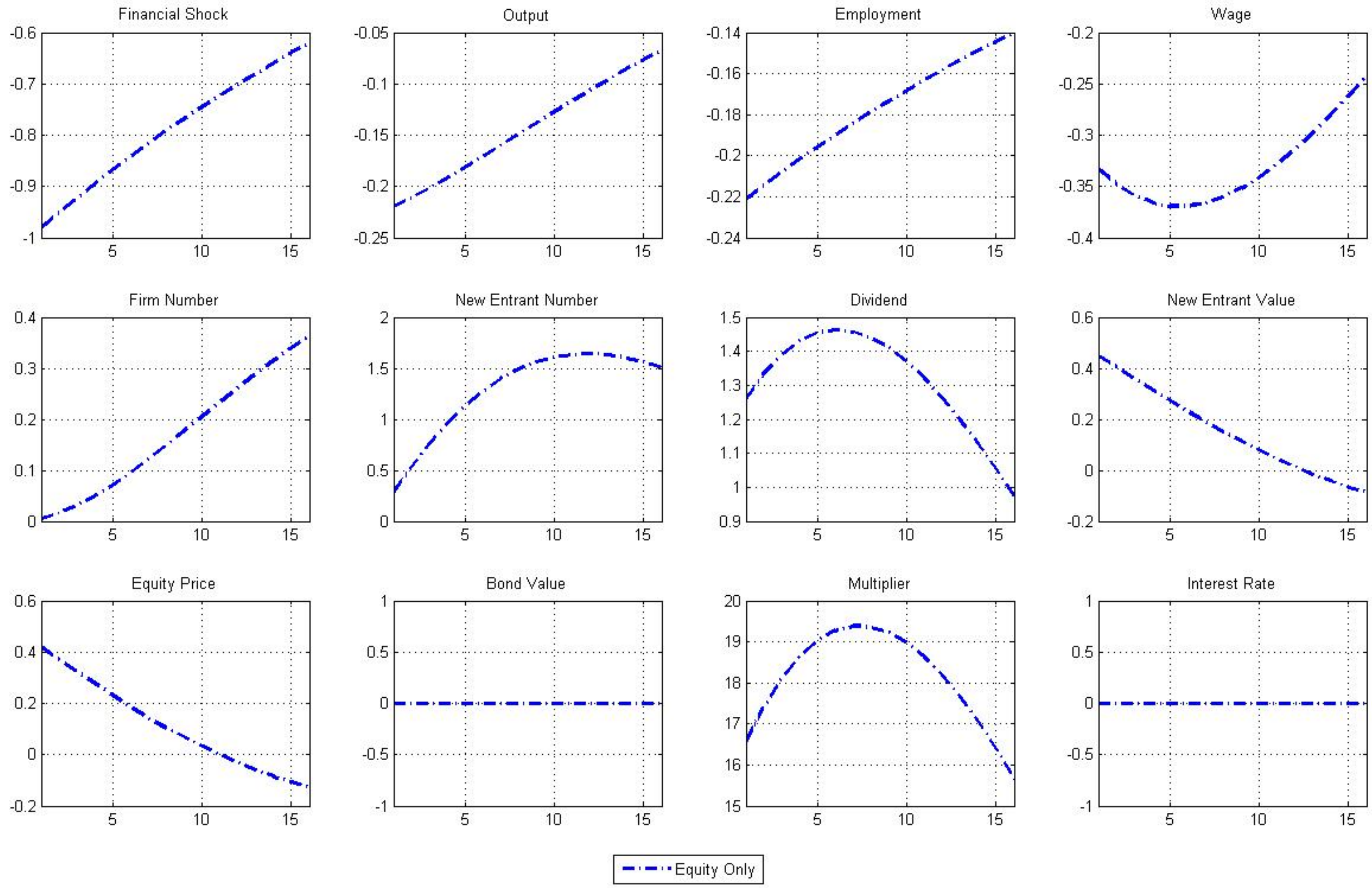


Fig. 4 Impulse Responses to a Negative Financing Shock in Case of Model with Equity Financing of Entry ($\tau = 1.6$)



Appendix Fig. 1 Impulse Responses to a Negative Financing Shock for Appendix Model with Entry in Preceding Period ($\tau = 2.5$)