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Limited Participation or Sticky Prices? New Evidence from Firm Entry and Failures

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Abstract

Traditional models of monetary transmission such as sticky price and limited participation abstract from firm creation and destruction. Only a few papers look at the empirical effects of the monetary shock on the firm turnover measures. But what can we learn about monetary transmission by including measures for firm turnover into the theoretical and empirical models? Based on a large scale vector autoregressive (VAR) model for the U.S. economy I show that a contractionary monetary policy shock increases the number of business bankruptcy filings and failures, and decreases the creation of firms and net entry. According to the limited participation model, a contractionary monetary shock leads to a drop in the number of firms. On the contrary the same shock in the sticky price model increases the number of firms. Therefore the empirical findings support more the limited participation type of the monetary transmission.

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Non-technical summary

Two popular approaches of modeling monetary transmission are sticky price and limited participation models. In the New-Keynesian tradition of sticky price models, firms change prices gradually after a monetary shock. When money supply in the economy increases and prices change less than the money supply, then consumption and production increase. As prices converge to the new level, the effect on output disappears.

In the limited participation model of Christiano, Eichenbaum, and Evans (1997), there is no friction on price setting, but instead firms must borrow money from the financial sector and pay out wages before production is sold. This means that traditional marginal cost of production is topped with the interest rate cost. Government injects money into the financial intermediaries and does not give it directly to consumers. When government increases money supply, loan supply increases and the interest rate decreases. Drop in the interest rate makes production cheaper and demand for inputs increases. In a simple version of the model wages increase as much as the interest rate decrease, leaving cost of production for the firms unchanged. People work more and earn higher wages, this brings economic boom.

Recently many authors are interested in the number of firms dynamics over the business cycle. But what can we learn about monetary policy transmission from adding endogenous number of firms into these two models? This paper shows that the empirical evidence of firm creation and bankruptcies gives support to the limited participation type of monetary transmission and not the sticky price approach.

In the data, a monetary expansionary leads to a significant increase in the creation of new firms and to a significant decrease in the number of bankruptcies. For the identification of a monetary policy shock in the vector autoregressive (VAR) model, I adopt a Taylor-rule based recursive scheme of contemporaneous restrictions. I use various measures of entry and failures from 1959 to 2006 for the U.S. and show that the qualitative results are robust to various changes in the model set-up such as inclusion of different variables, sub-periods and identification of neutral and investment specific technology shocks.

In the theoretical part of the paper I augment simple sticky price and limited participation models with exogenous exit and endogenous entry of new firms. Firm creation is labor intensive and the number of firms is determined with the free entry condition. Discounted future profits must equal entry cost. In the limited participation model, after an expansionary monetary shock cost of creating new firms remains unchanged, but profits increase as economy booms and more firms can be created. These results are in accordance with

the empirical results that the monetary expansion leads to an economic boom and to an increase in the firm creation.

In the sticky price model economic boom increases cost of production (wages). As a result creation of firms is more expensive and profit margin decreases because of the rigid prices. The number of firms in the economy decreases after a monetary expansion. If labor supply would be perfectly elastic, and wages fixed, the number of firms would not decrease, but also not increase. This result on the number of firms stands in sharp contrast with the empirical findings, where the number of firms increases. Therefore the empirical evidence supports limited participation type of transmission to the sticky price approach.

Third popular approach of modeling monetary transmission is to assume sticky wages. In this model, and in all the models where wages are more sticky than prices, an expansionary monetary shock leads to an increase in the number of firms. These models require that real wages fall after a monetary expansion. However, this key assumption is not supported by the data. In the empirical part I show that real wages increase after a monetary expansion, and the increase in real wages is strong evidence against sticky wage models.

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1. Introduction

Two popular approaches for understanding monetary transmission are limited participation and sticky price models. These models rarely include firm turnover: entry and exit of firms. What can we learn about monetary transmission by including the number of firm dynamics into these models? What are the empirical effects of monetary shocks on the firm turnover variables?

The empirical results of the paper show that a contractionary monetary shock leads to an increase in the number of business failures and to a decrease in the creation of firms. The sticky price and limited participation models give contradicting predictions about the firm turnover dynamics. According the sticky price model a contractionary monetary policy shock leads to an increase in the number of firms, whereas in the limited participation model the same shock leads to a decrease in the number of firms. Therefore the empirical evidence supports limited participation hypothesis of monetary transmission in comparison to the sticky prices.

I estimate an 11-variable vector autoregressive (VAR) model for the U.S. economy including labor productivity, total hours, GDP deflator, capacity utilization, real wages, consumption, investment, Federal Funds Rate, money velocity, and one-by-one alternative firm turnover measures: firm entry, net entry, business bankruptcy filings, and failures. I adopt the recursive approach in identifying monetary shocks which is based on contemporaneous restrictions. In addition I identify investment specific and neutral technology shocks with long run restrictions in order to minimize problems of mis-specification. The monetary policy results are robust to the use of non-borrowed reserves and the Federal Funds Rate (FFR) in order to identify the shock, inclusion and exclusion of the firm turnover measures from the central bank information set, difference and level stationarity of hours, reduction of the estimation period, etc.

My empirical findings are in line with the previous literature measuring the effects of the monetary policy on the creation of firms. Bergin and Corsetti (2008) use a relatively small scale VAR of monthly data and impose short run restrictions in order to identify the monetary shock. They find that net entry decreases after a contractionary monetary shock when either the FFR or non-borrowed reserves are used in order to identify monetary policy shocks. The firm creation decreases only if non-borrowed reserves are used to identify the monetary shock. Lewis (forthcoming) adopts a sign restriction approach to estimate the effect of the monetary shock to net entry. She finds that net entry decreases only with a significant lag after a contractionary monetary policy shock.

In the theoretical part of the paper I augment two simple models of monetary transmission, a limited participation and a pre-set price model as a simple case of sticky prices, with the endogenous firm creation and exogenous firm destruction dynamics. I assume that creation and operating firms is labor intensive. According to the limited participation model, firms pay wages before production and have to borrow the wage bill from the financial intermediary. A contractionary monetary policy shock decreases the liquidity of the financial intermediaries: bank lending falls and the interest rate increases. The real wage and hours worked decrease because firms can borrow less money to pay for their workers. The marginal cost of production for the firm remains constant because the real wage declines and interest rate increases. Fall in the total production leads to a drop in the creation of firms. In a standard sticky price model, a contractionary monetary shock leads to a drop in demand for the consumer good and consequently to a drop in demand for labor. Therefore labor costs fall equally for production of goods, and for operating and creating firms. Increasing profits per firm lead to higher creation of firms up to the level where the free entry condition is satisfied. These results are the opposite of the predictions of the limited participation model and the empirical results. Some recent models of monetary transmission include the firm turnover dynamics.

In the Bilbiie, Ghironi, and Melitz (2007) model with quadratic adjustment cost of prices, a contractionary monetary policy shock leads to an increase in the number of firms (in their interpretation varieties) when creating firms is labor intensive. Instead, in order to get a decrease in the number of firms, Bilbiie, Ghironi, and Melitz (2007) and Bergin and Corsetti (2008) assume that for the entry cost, new firms buy goods from the existing firms, who sell at pre-set prices. Then monetary contractions decrease entry of firms because of the increase in the real entry cost. However, a decrease in the demand for the output leads to a drop in wages and to an increase in profits for the existing firms. Increasing profits should still lead to an increase in entry in the production sector.

Carried by a similar idea Mancini-Griffoli and Elkhoury (2006) assume that in order to create a firm, entrepreneurs have to buy goods from a specific sector in the economy that ho have to set their prices in advance, whereas the rest of the entrepreneurs set the prices of their goods freely. In such a set-up, a contractionary monetary shock raises the real cost of entry and consequently the creation of firms decreases. A contractionary monetary shock in the sticky wage model leads to a drop in the entry of firms (see Lewis, forthcoming). The sticky wage model also predicts that a monetary contraction increases the real wage. The empirical evidence in this paper shows instead that the real wage decreases.

2. Empirical methodology

I set up the VAR model in order to estimate the effects of the monetary policy shock to the firm turnover measures. I adopt the recursive approach in identifying the monetary shock. In order to reduce the problem of misspecification, I identify in addition two technology shocks: investment specific and neutral technology shocks with the long-run restrictions.

The reduced form VAR is given as:

$$y_t = b_0 + \sum_{i=1}^{p} b_i y_{t-i} + u_t, \tag{1}$$

where y_t is the set of endogenous variables listed in Table 1 in the order as they appear in the model, b_0 represents all the deterministic terms which are used in the estimation including constants, seasonal and impulse dummies, b_i-s are matrices of coefficients, p is the number of lags in the model, and u_t is the error term.

Table 1: Variables used in the benchmark VAR

Notation	Name of the variable
ip	change in logarithm of investment price
lp	change in logarithm of labor productivity
$GDPdef$	change in logarithm of GDP deflator
$capu$	level of capacity utilization
h	logarithm of per capita hours worked (level)
w	logarithm of real labor cost
c	logarithm of consumption share in GDP
i	logarithm of investment share in GDP
ee	change in logarithm of firm demographics measure
FFR	federal funds rate (level)
vel	logarithm of money velocity

I use the Federal Funds Rate (FFR) to measure monetary conditions and the change in the log of the GDP (Gross Domestic Product) deflator as a proxy for inflation. I include the relative price of investment in order to identify an investment specific technology shock and a labor productivity variable in order to identify a neutral technology shock. I add a list of macroeconomic variables in order to reduce a possible omitted variable bias. The additional macroeconomic variables are capacity utilization, hours worked, real unit labor cost (real wages), consumption and investment shares in GDP, and money velocity. For a detailed description of the data see Table 2 in the Appendix.

Several other authors have estimated similar systems of VAR models. For example Altig, Christiano, Eichenbaum, and Linde (2005) use a 10-variable VAR including the relative price of investment, productivity, a GDP deflator, hours, consumption, investment, and several other variables, but do not include a measure of firm dynamics in their system. Ravn and Simonelli (2007) estimate a 12-dimensional VAR adding government expenditures and, specific to their paper, several labor market variables.

The structural VAR is given as:

$$A_0 y_t = B_0 + \sum_{i=1}^{p} B_i y_{t-i} + \epsilon_t \tag{2}$$

where B_i-s are matrices of the structural coefficients, related to b_i-s as follows: $b_i = A_0^{-1} B_i$, ϵ_t are the structural shocks, the variance-covariance matrix $\Sigma_\epsilon = E(\epsilon_t' \epsilon_t)$ is assumed to be diagonal and related to the reduced form shock variance-covariance matrix $\Sigma_u = E(u_t' u_t)$ by the following formula $\Sigma_u = A_0^{-1\prime} \Sigma_\epsilon A_0^{-1}$.

The recursive approach of identifying the monetary policy shocks builds on a Taylor-rule type of argument. A central banker who takes into account the contemporaneous values of the variables in his information set (Ω), then decides on the shock (ζ_t) by setting the interest rate (R_t),

$$R_t = F(\Omega) + \zeta_t. \tag{3}$$

In order to obtain identification, I impose short-run restrictions. The variables in the information set can have a contemporaneous effect on the interest rate, but not vice versa. I estimate the following equation:

$$\begin{aligned} FFR_t = {} & b_0^f + \sum_{i=0}^{p} b_i^{f,ip} ip_{t-i} + \sum_{i=0}^{p} b_i^{f,lp} lp_{t-i} \\ & + \sum_{i=0}^{p} b_i^{f,GDPdef} GDPdef_{t-i} + \sum_{i=0}^{p} b_i^{f,capu} capu_{t-i} + \sum_{i=0}^{p} b_i^{f,h} h_{t-i} \\ & + \sum_{i=0}^{p} b_i^{f,w} w_{t-i} + \sum_{i=0}^{p} b_i^{f,c} c_{t-i} + \sum_{i=0}^{p} b_i^{f,i} i_{t-i} + \sum_{i=0}^{p} b_i^{f,ee} ee_{t-i} \\ & + \sum_{i=1}^{p} b_i^{f,FFR} FFR_{t-i} + \sum_{i=1}^{p} b_i^{f,vel} vel_{t-i} + u_t^f. \end{aligned} \tag{4}$$

All the variables placed before the interest rate can have contemporaneous effects on it, but are assumed not to be affected contemporaneously by it. For example, money velocity, which is the only variable after the interest rate, is contemporaneously influenced by the interest rate, but does not affect the FFR in the same period. I assume that the firm turnover variables enter into the central bank's information set (Ω). The explanatory variables for the interest rate are all the contemporaneous values and lags of the variables placed before it, plus the lags of the interest rate and money velocity.

The recursive identification scheme for the monetary policy is popular in empirical literature, for example it is adopted in the papers by Altig, Christiano, Eichenbaum, and Linde (2005), Boivin, Giannoni, and Mihov (2007), and Ravn and Simonelli (2007). The main alternative is a non-recursive approach proposed by Sims and Zha (2006), but it has been shown to result in very similar impulse responses to the recursive identification scheme. Uhlig (2005) proposes an identification scheme according to which sign restrictions are set on the impulse response functions. The sign restrictions approach challenges some of the empirical results obtained by the short-run restrictions. See Christiano, Eichenbaum, and Evans (1999) for an overview of the main results of the monetary shock and the comparison of various identification approaches.

Bergin and Corsetti (2008) exclude the firm turnover variable from the information set of the central bank. The reason might be the use of monthly data in their estimation. As shown in the robustness analysis section of this paper, the results are not sensitive to different timing.

I base the identification of the investment specific technology shock on the assumption that only the investment specific technology shocks can have a long-run impact on the relative price of investment goods. Therefore, the explanatory variables for the estimated equation on the relative price of investment are the lags of the investment price itself and the lagged values of all other variables differenced once. The use of differenced data implements the zero long-run restrictions, see Shapiro and Watson (1988). The contemporaneous values of the FFR and velocity are not included because of the identification of the monetary shock.

For the permanent neutral technology shock, I assume that only the neutral and investment embodied technology shocks can lead to permanent changes in labor productivity. Therefore all the other variables are differenced once. Again, contemporaneous values of the FFR and money velocity are not included in the set of explanatory variables in order to identify the monetary policy shock.

The embodied technology equation cannot be estimated with the ordinary least squares technique because the contemporaneous value of productivity might be correlated with the residual. Therefore I estimate the equation by IV technique. The instruments are the lagged values of the explanatory variables. The equation neutral technology has the same problem, therefore the equation is estimated with the IV technique using the same instruments as for the equation on the investment price adding the residual from the investment price equation.

After estimating the two technology shocks, I proceed with the estimation of the equations in the order of the variables in Table 1. I estimate all the equations by the recursive IV technique. I include the contemporaneous values of the previous variables in the regression and exploit all the estimated residuals as instruments. Therefore for the estimation of the last equation on money velocity, I include all the other contemporaneous values of the variables in the regression and residuals in the set of instruments.

Many authors consider technology to be the key factors in the macroeconomic fluctuations, including Kydland and Prescott (1982), Altig, Christiano, Eichenbaum, and Linde (2005), Ravn and Simonelli (2007), etc. Several authors adopt the long-run restrictions approach in identifying neutral technology shocks, for example see Gali (1999), Altig, Christiano, Eichenbaum, and Linde (2005), Fisher (2006), and Ravn and Simonelli (2007). Recently Fischer (2006) showed that the neutral technology shock might be mis-specified if the investment technology shock is not identified. Campbell (1998) shows that technology shocks can be important for generating variance in the plant entry and exit dynamics, which is closely related to the business entry and failure variables.

3. Data

The creation of firms (number of new incorporations) and the number of business failures (number of firms failed) are available for the period 1959Q1–1998Q3, and the net entry index (net business formation) can be obtained for the period 1959Q1–1995Q4. This data are collected and calculated by Dun&Bradstreet Inc. available through various sources (see Table 2 in the Appendix). The number of business bankruptcy filings is from the U.S. Court of Bankruptcy. It is used in the estimations for the period 1960Q3–2005Q4. The firm turnover data are presented in log-levels in Figure 1 in the Appendix.

The Dun&Bradstreet database covers around 90% of the enterprises with at least one employee and some without employees. The registration of a company in the Dun&Bradstreet database is voluntary and the registration of the firm can take place some time after the actual start of the business. Therefore the entry data contain noise. The index of the net entry of firms is not available in its aggregate numbers because of the difficulties in counting the number of closing firms. In addition to the abovementioned problems, Armington (2004) discusses several other weaknesses of the firms created and net entry variables.

Up until the year 1984 the number of business failures included only commercial and industrial sectors. In 1984 Dun&Bradstreet extended the coverage and added banks, railroads, real estate, insurance, holding, financial companies, which made the new data directly incomparable. Naples and Arifau (1997) propose an adjustment which makes the post 1984 time-series comparable to the pre 1984 period. According to their results, the number of business failures increased on average about 31% because of the increase in the coverage. For the period 1984–1996, I use the adjusted data. There are no adjusted failure numbers available for the years 1997 and 1998. For these years I subtract the average increase in the coverage of 31%.

In 1978, a new bankruptcy law eased the bankruptcy procedure. The number of failures increased steadily and stabilized at a higher level around 1983. In order to capture the change in the law, a dummy variable is added to the equation of business failures. The number of bankruptcy filings increases at the beginning and decreases at the end of the period, however the inclusion of dummies for different periods does not change the results given the confidence intervals of the estimated results.

Table 3 in the Appendix presents the (augmented) Dickey-Fuller stationarity test results for the firm turnover measures. The variables are not stationary in log-levels, but are stationary in first differences. The results are robust to the number of lags, and the inclusion and exclusion of the trend. The number of business failures has a statistically significant seasonal pattern. Hence for the equation on failures, I include seasonal dummies in the set of explanatory variables. Ravn and Simonelli (2007) show that statistical tests are not robust in determining whether the level of hours is stationary or not. Based on their results, in the robustness analysis I also allow for difference stationarity of hours. For all other series I assume stationarity.

4. Empirical results

This section presents the main empirical results. The benchmark SVAR model has 3 lags. The 68% confidence intervals are centered around the point estimates and based on 1000 bootstrap replications.

Figure 2 in the Appendix illustrates the dynamics of the firm turnover variables in response to a contractionary monetary policy shock — an increase in the interest rate by one standard deviation. The number of business bankruptcy filings and failures increase by 2% starting from the second quarter (see the two upper panels). The effect lasts for more than four years for both of the failure measures. The net entry index decreases by 0.5% after one quarter (see the third panel). The effect is statistically significant up to quarter ten. The entry of firms, presented in the lower panel, decreases by 0.6% and the impact is statistically significant for 11 quarters. The failure rate increases after the contractionary monetary shock, but the results are uninformative about the changes in the entry rate. The failure rate increases because a higher number of firms fail from a smaller number of total firms in the economy (net entry is negative, the entry of firms is lower and the number of failures is higher). Depending on the relative size of firm entry to net entry, the entry rate can either increase or decrease.

All the reactions of the firm turnover measures remain statistically significant also at the 95% confidence level, at least for some quarters. The estimated impulse response functions for the entry of firms and net entry are with a relatively lower confidence level compared to other economic data and to the number of failures. This can be explained by a high level of noise in these the entry variables as explained before.

The result about decrease in the net entry after the contractionary monetary shock is similar to the finding of Bergin and Corsetti (2008). In contrast to my findings, the creation of firms in their model does not react to a contractionary monetary shock when FFR is used to identify monetary shock. In comparison to the results in Lewis (forthcoming), I find that after a contractionary monetary shock, net entry becomes statistically significantly different from zero after one quarter, not after 2 years.

In addition a contractionary monetary shock leads to a hump-shapes decrease in hours, output, consumption, investments, capacity utilization, and velocity of money. The results can be found in Figure 3 in the Appendix for the results of the VAR that includes bankruptcy filings as the firm turnover measure. The investment price, productivity, and inflation react very little. Inflation decreases after a lag of one year. The real wage declines after the contractionary shock. The results on the macroeconomic variables are similar to several previously estimated VAR models, such as Altig, Christiano, Eichenbaum, and Linde (2005), Christiano, Eichenbaum, and Evans (1999), and others.

5. Robustness analysis

In this section I show that the results are robust to various changes in the set-up. As in Bergin and Corsetti (2008), I replace the FFR with the ratio of non-borrowed reserves to total reserves (NBR/TR) in the VAR. A contractionary monetary policy shock is now described by a drop in the NBR/TR ratio. The impact of the shock is smaller for business bankruptcy filings and higher for the other three measures. A standard deviation-sized contractionary monetary shock in the NBR/TR ratio leads to an increase in bankruptcy filings by 2% and business failures by more than 3%. The entry of firms and net entry both decrease by more than 0.6%. The impulse response functions of the firm turnover measures are presented in Figure 4 and all other economic variables in Figure 5 in the Appendix.

Positioning the firm turnover measure after the interest rate, therefore excluding it from the central bank's information set, as it is done in the paper by Bergin and Corsetti (2008), does not change the results much. The contemporaneous effect of the monetary shock is insignificant for the new firms, net entry, and bankruptcy filings, but significant for the failures: a contractionary shock is associated with a small contemporaneous increase in the number of failures. Therefore for the variables Bergin and Corsetti (2008) were concerned with (the entry of firms and net entry), the results are similar.

When two firm turnover measures, the entry of firms and failures are added to the VAR simultaneously, the results again change very little. The entry of firms still decreases by 0.6% and is statistically significant for 12 quarters. The number of failures increases by 2% and lasts for 18 quarters. Differencing hours instead of using it on levels leads to stronger effects for all variables: the entry of firms does not converge in 20 quarters.

Dropping the first 2 or 5 years from the sample does not change the reaction of the firm turnover measures much compared to the baseline: only the failure measure converges quicker than in the benchmark case. However, exclusion of the last 2 or 5 years leads to a stronger and more persistent effect on business bankruptcy filings and the entry of firms, but does not change the results on the business failures and net entry.

Using 8 variables instead of 11 (dropping consumption, investment and the real wage from the initial set-up) makes the effects of the monetary contraction to all firm turnover variables stronger and longer lasting. Using 4 lags instead of 3 leads to a weaker effect on the entry of firms and a stronger effect on bankruptcy filings, leaving the reaction of the other two variables unchanged.

It is impossible to carry out a structural break test related to the change in the bankruptcy law in 1983 because there are two additional important changes that took place around the same time. According to Bernanke and Mihov (1998), the period 1979–1982 is described as a change in the monetary policy regime in the U.S. In addition, around the year 1980, several banking regulations were changed, including the interest rate ceilings for deposits, which might have changed the transmission of shocks in the U.S. economy (Mertens, 2008). For the robustness analysis I drop 20 years of data from the beginning and from the end in order to make the degrees of freedom comparable. The variables are stationary in differences, as was the case for the full period (see Tables 4 and 5 in the Appendix).

Dropping 20 years from the beginning of the sample makes the impulse responses stronger and longer lasting for the case of new firms. Dropping the last 20 years makes the reactions of the business failures, net entry and the entry of firms short — the effect lasts up to 3 quarters. The impact of the shock on bankruptcy filings remains unchanged. As bankruptcy filings data includes the latest period, years from 1999 to 2005, the effects of monetary shocks to firm turnover measures have remained strong. The inclusion of the last 6 years of the data leads to much smoother and stronger impulse responses also for other economic variables.

The use of an unadjusted measure for failures, and the regression without a dummy for the period of high increase in failures does not change the results significantly. There is one more measure available for business failures. The Dun & Bradstreet published a failure rate based on 10000 listed enterprises for the period 1959Q1–1983Q4. The failure rate is stationary only if it is differenced once (see Table 6 in the Appendix). A contractionary monetary shock leads to an increase in the failure rate by 1.5% with the effect lasting for 15 quarters.

6. Limited participation model

In this section I present a simple limited participation model for analyzing the effects of a monetary shock on the number of firms dynamics. In the next section I write down the sticky price model. I keep the two models separate because this allows to pronouce the basic mechanisms at work clearer and keep the models simple.

I adopt the model of Christiano, Eichenbaum, and Evans (1997) and add the endogenous creation and exogenous destruction of firms in the intermediate goods producing sector. The economy consists of a representative consumer, final and intermediate goods producers, financial sector, and a monetary authority.

6.1. Consumer problem

The representative consumer maximizes her lifetime utility derived from consumption and leisure:

$$E_t \sum_{t=0}^{\infty} \beta^t \left(\frac{c_t^{1-\sigma} - 1}{1-\sigma} - \psi_0 ln(n_t) \right), \quad (5)$$

where c_t is real consumption at period t, and n_t denotes the hours spent working. E_t is the expectations operator, $0 < \beta < 1$ is the discount factor, and the weight on the disutility of labor is given by $\psi_0 > 0$. The inverse of elasticity of substitution is denoted by $\sigma > 1$. Together with the logarithmic disutility of labor, it means that the Frisch elasticity of the labor supply is positive. Upper-case letters denote nominal and lower case letters real variables unless it is clear from the context.

She decides on consumption c_t, labor input n_t, money M_t, and deposits H_t. The predetermined variables are cash M_{t-1}, the deposits H_{t-1}, profits from the financial intermediaries $R_t X_t$, and profits from final and intermediate goods firms. The consumer faces following intertemporal budget constraint:

$$M_t - H_t \leq W_t n_t + M_{t-1} - H_{t-1} - P_t c_t + R_t H_{t-1} + R_t X_t + D_t + O_t, \quad (6)$$

where M_t is the nominal money decided at period t to be used for the purchases at $t+1$, H_t is the deposit decided at period t to be given to the financial intermediary in the next period, W_t is the nominal wage, P_t is the price level, R_t is the gross interest rate, $R_t X_t$ are the nominal profits received from the financial intermediary, and the nominal profits from the intermediate and final goods production firms are denoted by D_t and O_t respectively.

In addition the consumer faces a cash-in-advance constraint. For consumption purchases, she can only use the cash left over from one period before ($M_{t-1} - H_{t-1}$) and labor income, so the condition is:

$$P_t c_t \leq W_t n_t + M_{t-1} - H_{t-1}. \quad (7)$$

The optimality conditions are Euler Condition (Equation 8) and optimality condition for labor-leisure choice (Equation 9).

$$E_t \left(\frac{c_{t+2}}{c_{t+1}} \right)^{\sigma} = \beta E_t \frac{R_{t+1}}{\pi_{t+2}} \quad (8)$$

$$\psi_0 c_t^{\sigma} = w_t n_t \quad (9)$$

where $\pi_t = P_t / P_{t-1}$ is one plus the inflation rate and the real wage $w_t = \frac{W_t}{P_t}$.

6.2. Final goods firm

The final goods sector produces consumption goods. It uses a constant elasticity of substitution (CES) aggregator to combine the goods from the intermediate sector:

$$y_t = \left(\int_0^{F_t} y_{i,t}^{1-1/\varepsilon} di \right)^{1/(1-1/\varepsilon)}, \tag{10}$$

where y_t is the output made from intermediate goods, $y_{i,t}$ is the input from the intermediate good producer i at period t, F_t is the number of the intermediate input firms, and $\varepsilon > 1$ is the elasticity of substitution between the intermediate goods.

The final goods firm maximizes profits:

$$O_t = P_t y_t - \int_0^{F_t} P_{i,t} y_{i,t} di, \tag{11}$$

where O_t is the profit of the final goods firm from aggregating the intermediate goods. As there is perfect competition and no entry or exit, it is always equal to zero.

After some rearrangements the first order condition with respect to y_{it} gives the following demand for each of the intermediate goods:

$$y_{i,t} = \left(\frac{P_{i,t}}{P_t} \right)^{-\varepsilon} y_t, \tag{12}$$

where $P_t = \left(\int_0^{F_t} P_{i,t}^{1-\varepsilon} di \right)^{1/(1-\varepsilon)}$ is the price index, with the empirical couterpart of $P_t^{emp} = F_t^{\varepsilon/(1-\varepsilon)} \left(\int_0^{F_t} P_{i,t}^{1-\varepsilon} di \right)^{1/(1-\varepsilon)}$, where $F_t^{\varepsilon/(1-\varepsilon)}$ removes the effects of number of varieties from the price index.

6.3. Intermediate goods firms

The present value ($V_{i,t}$) of an existing intermediate goods producing firm is defined by discounted flow of profits. Writing it in the value form for an existing firm gives the expression:

$$V_{i,t} = D_{i,t} + \beta(1-\delta) E_t \left(\frac{c_{t+1}}{c_{t+2}} \right)^{-\sigma} V_{i,t+1} \tag{13}$$

where $0 < \delta < 1$ is the probability of a death shock to a firm and the future value is discounted with the stochastic discount factor of the consumer.

In each period, a share of the exis ting firms is hit by a death shock. The death shock is realized before the entry decisions are made, so all new firms produce. The aggregate number of existing firms is described by the following equation:

$$F_t = (1 - \delta) F_{t-1} + F_t^N, \tag{14}$$

where F_t^N is the number of newly created firms.

The intermediate goods firms produce with the linear technology:

$$y_{i,t} = l_{i,t}. \tag{15}$$

The market structure is monopolistic competition. The firm takes the demand from the final goods sector as given. They pay wages in advance, and borrow the wage bill from a financial intermediary. The marginal cost of production is equal to the nominal wage times the gross interest rate ($MC_t = R_t W_t$). The intermediate goods firms use a fixed quantity of labor ($\xi^{op} \geq 0$) to operate. The profits are sales minus the costs:

$$D_{i,t} = (P_{i,t} - R_t W_t) y_{i,t} - \xi^{op} R_t W_t \tag{16}$$

In order to maximize profits, take the derivative with respect to the price $P_{i,t}$ and get the pricing rule $P_{i,t} = \frac{\varepsilon}{\varepsilon - 1} R_t W_t$. The firm set the price as a constant mark-up over marginal cost.

The entry of the intermediate goods to the market is free, but every entrant has to pay a one-time fixed cost $\xi^{ent} > 0$ in labor. Hence the free entry condition is written as follows:

$$V_{i,t} = \xi^{ent} R_t W_t. \tag{17}$$

6.4. Financial intermediary

In the limited participation model the intermediate goods firms borrow their wage bill from financial intermediaries: $W_t N_t = H_{t-1} + X_t$. For giving out loans financial intermediaries use deposits H_{t-1} and the money injection of the monetary authority X_t. At the end of each period, financial intermediary pays out its' profits to consumers $R_t X_t = R_t(H_{t-1} + X_t) - R_t H_{t-1}$. Bank gets income from giving out loans, and returns deposits to the consumers with gross interest rate R_t.

6.5. Monetary authority

In the limited participation model, the monetary authority decides on the money injection to the financial intermediary X_t. It is a one-time shock with zero autocorrelation.

6.6. Market clearing conditions and the equilibrium

The aggregate output (Equation 18) is consumed, including the production that is done for creating and operating the firms. Total labor equals total output (Equation 19). This assumption is necessary to avoid any effects from the number of firms to the aggregate consumption, and therefore there is no feedback from the number of firms to the economy. The total profits by firms consists of the aggregate operating profits minus the entry costs paid by the newly created firms (Equation 20).

$$c_t = F_t^{\varepsilon/(1-\varepsilon)} y_t + \int_0^{F_t} \xi^{op} di + \int_0^{F_t^N} \xi^{ent} di \tag{18}$$

$$n_t = c_t \tag{19}$$

$$D_t = \int_0^{F_t} D_{i,t} di - \int_0^{F_t^N} W_t R_t \xi^{ent} di \tag{20}$$

Definition of equilibrium: The equilibrium of the model is the sequence of quantities $\{c_t, n_t, m_{t+1}, h_{t+1}, d_t, d_{i,t}, j_t, F_t, F_t^N\}_{t=0}^{\infty}$, prices $\{P_t, R_t\}_{t=0}^{\infty}$, given the initial conditions $\{m_0, h_0, F_{-1}\}$, and the sequence of government monetary injections $\{X_t\}_{t=0}^{\infty}$, such that consumers maximize their lifetime utility, final and intermediate goods firms are maximizing their profits, financial intermediaries are maximizing their profit, the free entry condition is satisfied, and the markets clear.

7. Model with pre-set prices

In this section I present a simple pre-set prices model as an example of sticky prices. Again I augment the simple model with endogenous entry and exogenous exit of firms in the intermediate goods firms. Creation and destruction of firms in this sector takes place after the shock and the prices are fixed before the monetary shock is realized. The entry is determined by the free entry condition. Fully competitive final goods sector aggregates the goods from intermediate goods sector, there is no entry and exit. Differently from the limited participation model, there is no financial sector.

7.1. Consumer problem

The representative consumer maximizes lifetime utility derived from consumption, leisure, and money balances:

$$E_t \sum_{t=0}^{\infty} \beta^t \left(\frac{c_t^{1-\sigma} - 1}{1-\sigma} - \psi_0 ln(n_t) + \frac{1}{1-\varphi} \left(\frac{M_{t+1}}{P_t} \right)^{1-\varphi} \right), \tag{21}$$

where M_{t+1} is the nominal money transferred to the next period and $0 < \varphi < 1$ is the inverse of elasticity of substitution for money demand. The consumer decides on consumption and work today, and money left for tomorrow. For the pre-set prices model I adopt a money-in-utility approach which is standard in the literature. The utility function implies the neutrality of money, so the sole cause of the real effects is the imposed price stickiness.

The consumer faces the following budget constraint:

$$P_t c_t + B_{t+1} + M_{t+1} = W_t n_t + (1 + i_{t-1}) B_t + M_t + D_t + O_t, \tag{22}$$

where B_t are the bonds at period t. In order to buy consumption good, the consumer can use all the profits received from the firms, money, and bonds: there is no cash-in-advance condition.

In order to maximize consumer utility, take first order conditions with respect to the bonds B_{t+1}, money M_{t+1}, consumption c_t, and labor n_t. There are three optimality conditions for the consumer:

$$E_t \left(\frac{c_{t+1}}{c_t} \right)^{\sigma} = \beta E_t \frac{1 + i_t}{\pi_{t+1}} \tag{23}$$

$$\psi_0 c_t^{\sigma} = w_t n_t \tag{24}$$

$$\left(\frac{M_{t+1}}{P_t} \right)^{-\varphi} = \frac{i_t}{1 + i_t} c_t^{-\sigma}. \tag{25}$$

The Euler Equation (no. 23) determines the optimal consumption path. It is different from the tradeoff in the limited participation model, where the decision was between tomorrow and the day after. Labor-leisure choice Equation 24 is identical to the one in the limited participation model. The money demand is given in Equation 25, which is again different from the limited participation approach, where the money demand was determined by the cash-in-advance constraint.

7.2. Final goods firm

The final goods sector is identical to the limited participation model. The demand for each of the intermediate goods is given by:

$$y_{i,t} = \left(\frac{P_{i,t}}{P_t}\right)^{-\varepsilon} y_t, \tag{26}$$

where P_t is the same as in the limited participation model.

7.3. Intermediate goods firms

In the intermediate goods sector there are three differences compared to the limited participation model. First, the wages are not payed out before production: labor costs do not include the interest rate. Second, the prices must be set one period in advance and the new firms set the same price as all the other firms. Third, according to the consumer problem, the stochastic part of the discount factor for firms includes trade-off between today and tomorrow.

The value of the firm in the intermediate goods sector is given by:

$$V_{i,t} = D_{i,t} + \beta(1-\delta)E_t\left(\frac{c_t}{c_{t+1}}\right)^{-\sigma} V_{i,t+1}, \tag{27}$$

where the stochastic discount factor is taken from the consumer problem, and the profit is given by

$$D_{i,t} = E_{i,t-1}\left((P_{i,t} - W_t)\left(\frac{P_{i,t}}{P_t}\right)^{-\varepsilon} y_t - \xi^{op} W_t\right) \tag{28}$$

The law of motion for the number of firms is described as before by:

$$F_t = (1-\delta)F_{t-1} + F_t^N. \tag{29}$$

The production technology in the intermediate goods sector is again linear:

$$y_{i,t} = l_{i,t}. \tag{30}$$

The nominal marginal cost of production is given by the shadow price of producing an additional unit of output ($MC_t = W_t$). Wages are paid out at the time when the final output is sold.

For maximizing the firms value, take the derivative with respect to $P_{i,t}$ and solve for $P_{i,t}$ to get the condition for optimal pricing, the mark-up over the expected marginal cost:

$$P_{i,t} = \frac{\varepsilon}{\varepsilon - 1} E_{t-1} W_t. \tag{31}$$

The entry to the market of intermediate goods is free, but every entrant has to pay a one-time fixed cost $\xi^{ent}W_t$. The free entry condition is written as follows:

$$V_{i,t} = \xi^{ent}W_t. \tag{32}$$

The crucial assumption in this model in order to have the effects of a monetary policy on the creation of firms is that the firm creation decisions are made during the period in which the nominal rigidities are still binding. Therefore the results also hold when I would assume longer price rigidities and let the firms to enter with a lag.

In the present version of the model, the new firms are not allowed to set different prices from the existing firms. Such a change would complicate the aggregation of the demand without affecting the results much, the extension is left for the future.

7.4. Monetary authority

The monetary authority decides on the injection of money into the economy. There is a one-time shock to money growth g_t^m with zero autocorrelation.

7.5. Market clearing conditions

Again, all the production (Equation 33) is consumed and the total labor equals to the total output (Equation 34). The aggregate profits by the firms are the sum of total operating profits from each firm minus the entry costs (Equation 35).

$$\begin{aligned} c_t &= F_t^{\varepsilon/(1-\varepsilon)} y_t + \int_0^{F_t} \xi^{op} di + \int_0^{F_t^N} \xi^{ent} di && (33) \\ n_t &= c_t && (34) \\ D_t &= \int_0^{F_t} D_{i,t} di - \int_0^{F_t^N} W_t \xi^{ent} di && (35) \end{aligned}$$

Definition of equilibrium: Equilibrium is defined by the sequence of quantities $\{c_t, n_t, b_{t+1}, M_{t+1}, j_t, d_t, d_{i,t}, F_t, F_t^N\}_{t=0}^{\infty}$, prices $\{P_t\}_{t=1}^{\infty}$, given the initial conditions $\{m_0, F_{-1}, P_0\}$, and government money injections, such that consumers maximize their utility, final and intermediate goods firms maximize their profit, the free entry conditions for firms is satisfied, and markets clear.

8. Calibration and results of the two models

I log-linearize the model around the steady state and solve it computationally by using the method of undetermined coefficients proposed by Uhlig (1999).

I follow traditional parameter values in the calibration of the two models for the quarterly frequency (see Table 7 in the Appendix). I set the inverse of the intertemporal elasticity substitution parameter $\sigma = 2$. The probability of the death of a firm is calibrated to 2.5%, which is 10.7% per annum, very close to the actual 11% exit rate per year in the U.S.. I assume that shocks to the economy are small so that there is always positive entry. The discount factor reflects a real interest rate of 4% per year, the elasticity of substitution $(\varepsilon = 17)$ gives a mark-up of 6%, which is standard in the literature, but its only role together with the death probability, operation and entry costs, is to determine the number of firms in the economy. The cost of entry is calibrated to be higher than the operation cost. Steady state yearly inflation in the limited participation model is 2%. The inverse of the elasticity of substitution of money in the middle of the allowed range (between zero and one), and constant in front of the disutility of labor only determines the steady state share of hours worked and does not affect the impulse responses

Figure 6 in the Appendix presents the impulse response functions to a monetary contraction in a limited participation framework. The monetary shock leads to a drop in the funds which the financial intermediary can lend to the intermediate goods producers. This results in lower wages and hours. However, an accompanied increase in the gross interest rate leaves marginal costs for the intermediate goods producers unchanged. As output drops, profits per firm decrease. The lower value of a firm reduces the entry of firms in order to keep the free entry condition satisfied. In the simple limited participation model, a monetary contraction brings an economic expansion from the second period onwards. Nonetheless the number of new firms is decreasing in the first period. By making the limited participation model empirically more plausible for the second period onwards (see Christiano and Eichenbaum, 1992), the decrease in the number of created firms will be stronger. The prediction of the limited participation model is in line with the empirical results on the reaction of the number of firms.

In the pre-set price framework, a contractionary monetary policy shock leads to an increase in the number of firms. The results are presented in Figure 7 in the Appendix. Lower wages lead to an increase in profits and a decrease in the entry cost. The entry of firms increases to the level in which the free entry condition is satisfied. This stands in sharp contrast with the empirical findings about the creation and destruction of firms in the previous section.

The theoretical results depend on the assumption that inverse of the intertemporal elasticity of substitution (σ) is greater than one. The value below one would mean negative Frisch elasticity of labor supply: decrease in wages leads to an increase in the hours worked. In this version of the model, the results are reversed. In the sticky price model, after a contractionary monetary shock wages decrease, hours increase, and number of firms increases. Under the limited participation hypothesis, the number of firms decreases. The empirical evidence in this paper does not find support for this assumption as a contractionary shock leads to a statistically and economically important decrease in the hours worked.

The models are very simple and stylized with the purpose of being clear about the mechanism that drives the results. Because of the simplicity, it also allows to discuss intuitively certain extensions. The results also hold for sticky information type of transmission. The sticky price model where only the firms with low markups change their prices can help to reduce the counterintuitive results of the sticky price approach and lead to no effect of monetary shocks to firm turnover, but cannot deliver reversal of the impact. When one assumes very high menu costs for changing prices, firms could file a bankruptcy instead of lowering prices after a contractionary monetary shock, but then menu costs should also lead to more bankruptcies for expansionary monetary shocks. Therefore the mechanism that causes the firm turnover dynamics must be different from price stickiness.

My empirical results also show that prices do react very little to the shock within a one-year period, whereas output, and firm entry and failures react after two quarters. So if prices do not react, then in order to have increase in the profits at least for some firms, the cost of production has to decrease. When prices are exogenously assumed to be sticky, there is even more need for the costs to decrease.

The simple limited participation model predictions fit well the qualitative empirical results. Monetary contraction leads to an increase in the interest rate, drop in wages, no movement in prices, and increase in firm bankruptcies. The economic contraction that brings drop in the expected profits can explain an increase in failures and a decrease in the creation of firms.

9. Conclusions

Many authors add firm creation and destruction to the traditional dynamic stochastic general equilibrium models. Intuitively the extensive margin plays an important role in propagating shocks, but it is unclear if it constitutes a different propagation mechanism? What does firm turnover influence? These are the questions most of the firm turnover literature tries to answer. This paper takes a different route. Here the question is instead, What can we learn about modeling monetary transmission by introducing firm creation in the models? The answer is that the empirical results about firm creation and destruction reaction after a monetary shock are more in line with the predictions of the limited participation model than those of the sticky prices.

The paper offers extensive empirical evidence that a contractionary monetary policy shock increases failures and decreases entry of firms. This is a robust finding of a VAR model where the monetary shock is identified by using recursiveness assumption based on the Taylor rule type of argument. When the number of firms that file a bankruptcy after an unexpected monetary contraction increases, it is a sign that their expected future profit decreased and restructuring of activity costs more than bankruptcy. This evidence does not necessarily say anything about amplification of shocks in the economy because existing firms could expand their production and possibly increase profits. But the evidence shows that some existing firms do suffer from the shock. The same is true for some of the new firms. Monetary contraction means that fewer firms are created: some of the business ideas are not realized because they are not profitable.

Although standard models of monetary transmission assume away firm creation and destruction, it is straightforward to augment them with firm turnover. I take two alternative approaches, limited participation and sticky price models and augment with endogenous creation and exogenous destruction of firms. The predictions of the two main models of monetary transmission are at odds with each other. According to the sticky price model the number of firms increases after a contractionary monetary policy shock. After the same shock, the limited participation model predicts a decrease in the number of firms in the economy. Therefore the empirical findings about firm turnover support more the limited participation type of monetary transmission compared to the sticky prices.

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Appendix

Table 2: Data Description and Sources

Name	Explanation	Source
Consumption	Consumption of non-durables, services and government expenditures	BEA
Investment	Nominal investment in household consumption of durables and gross private domestic investment	BEA
Investment price	Price of investment relative to consumer prices	For period 1959-1990 from Ravn and Simonelli (2007)
Price of investment	Nominal divided with real investments	BEA
Price of consumption	Nominal divided with real consumption	BEA
Nominal output	Nominal Gross Domestic Product (GDP)	BEA
Real output	Real Gross Domestic Product (GDP)	BEA
GDP deflator	GDP deflator, nominal GDP/ real GDP	BEA
Hours	Gross non-farm business hours (HOANBS)	BEA from Fed. St. Louis
Population	Total population over the age of 16	CPS
Capacity utilization	Index of capacity utilisation in manufacturing	Board of Governors
Nominal wages	Nominal hourly non-farm business compensation	BLS
New incorporations	Number of new enterprises created, mostly employee firms	Dun&Bradstreet, Economagic
Net entry	Index composed by Dun&Bradstreet	Dun&Bradstreet, BEA
Firm failures	Number of firms failed in a quarter	Dun&Bradstreet, Economic Report of the President
Failure rate	Firm failures / listed companies	Dun&Bradstreet, Economic Report of the President
No. of bankruptcies	Number of bankruptcy failings by companies	U.S. Courts of Bankruptcy
FFR	MZM	Fed. St. Louis
NBR/TR	Non- borrowed reserves / Total reserves	Fed. St. Louis
Money stock	Monetary aggregate MZM	Fed. St. Louis

Table 3: Stationarity Analysis of Business Bankruptcy Filings, Failures, Entry of New Firms and Net Entry

	Bankr. Filings		Failures		Net entry		New firms	
Level/Diff	Level	Diff	Level	Diff	Level	Diff	Level	Diff
Trend	y	n	y	n	n	n	n	n
Seas dum	y	n	y	y	n	n	n	n
0	-1.48	-12.00	-1.48	-12.04	-1.33	-9.91	-0.75	-12.65
1	-1.45	-7.98	-1.49	-6.76	-1.65	-7.71	-0.86	-7.41
2	-1.25	-5.70	-1.71	-5.68	-1.66	-6.41	-1.01	-7.17
3	-1.42	-5.22	-1.76	-4.62	-1.62	-5.11	-1.00	-5.72
4	-1.43	-5.01	-1.92	-3.57	-1.86	-4.48	-1.05	-4.99

Note: Constant is included in every regression. The asymptotic critical values for rejecting the hypothesis of unit root on the level of the lagged dependent variable in an (augmented) Dickey-Fuller regressions case without trend are -3.43, -2.86 and -2.58 and with trend -3.96, -3.41 and -3.12 respectively for 1, 5 and 10% critical levels.

Table 4: Stationarity Analysis for Period of First 20 Years Omitted

	Bankr. filings	Failures	Net entry	New firms
Level/Diff	Diff	Diff	Diff	Diff
trend	n	n	n	n
seas dum	y	y	n	y
0	-8.95	-8.49	-5.48	-6.06
1	-4.88	-4.62	-5.44	-4.97
2	-3.78	-3.99	-4.24	-4.57
3	-3.94	-3.82	-3.63	-3.97
4	-3.82	-3.36	-3.25	-2.88

Note: A constant is included in every regression. The asymptotic critical values for the level of the lagged dependent variable in an (augmented) Dickey-Fuller regressions case without trend are -3.43, -2.86 and -2.58 and with trend -3.96, -3.41 and -3.12 respectively for 1, 5 and 10% critical levels.

Table 5: Stationarity Analysis for Period of Last 20 Years Omitted

	Bankr. filings	Failures	Net entry	New firms
Level/Diff	Diff	Diff	Diff	Diff
trend	n	n	n	n
seas dum	y	y	y	n
0	-8.22	-8.77	-8.44	-12.62
1	-6.96	-4.97	-5.13	-6.23
2	-4.94	-4.15	-3.94	-5.65
3	-4.53	-3.23	-3.18	-4.18
4	-4.48	-2.66	-3.03	-3.86

Note: A constant is included in every regression. The asymptotic critical values for the level of the lagged dependent variable in an (augmented) Dickey-Fuller regressions case without trend are -3.43, -2.86 and -2.58 and with trend -3.96, -3.41 and -3.12 respectively for 1, 5 and 10% critical levels.

Table 6: Stationarity Analysis for Failure Rate

	Failure rate	
Level/Diff	Level	Diff
trend	y	y
seas dum	y	y
0	-0.14	-12.70
1	0.76	-7.53
2	0.79	-5.63
3	0.70	-4.00
4	0.06	-2.92

Note: A constant is included in every regression. The asymptotic critical values for the level of the lagged dependent variable in an (augmented) Dickey-Fuller regressions case without trend are -3.43, -2.86 and -2.58 and with trend -3.96, -3.41 and -3.12 respectively for 1, 5 and 10% critical levels.

Table 7: Parameter values

Notation	Value	Name
σ	2	Inverse of intertemporal elasticity of substitution
β	0.99	Discount factor
ψ_0	2	Disutility of labor
ε	17	Elasticity of substitution
δ	0.025	Share of firms hit with death shock
ξ^{ent}	10^{-5}	Units of labor for entry
ξ^{op}	10^{-10}	Units of labor for operation
Specific to the sticky price model		
g_m	1	Size of a shock
φ	.5	Inverse of elasticity of substitution of money
π	1	Inflation in the steady state
Specific to the limited participation model		
π	1.005	Inflation in the steady state

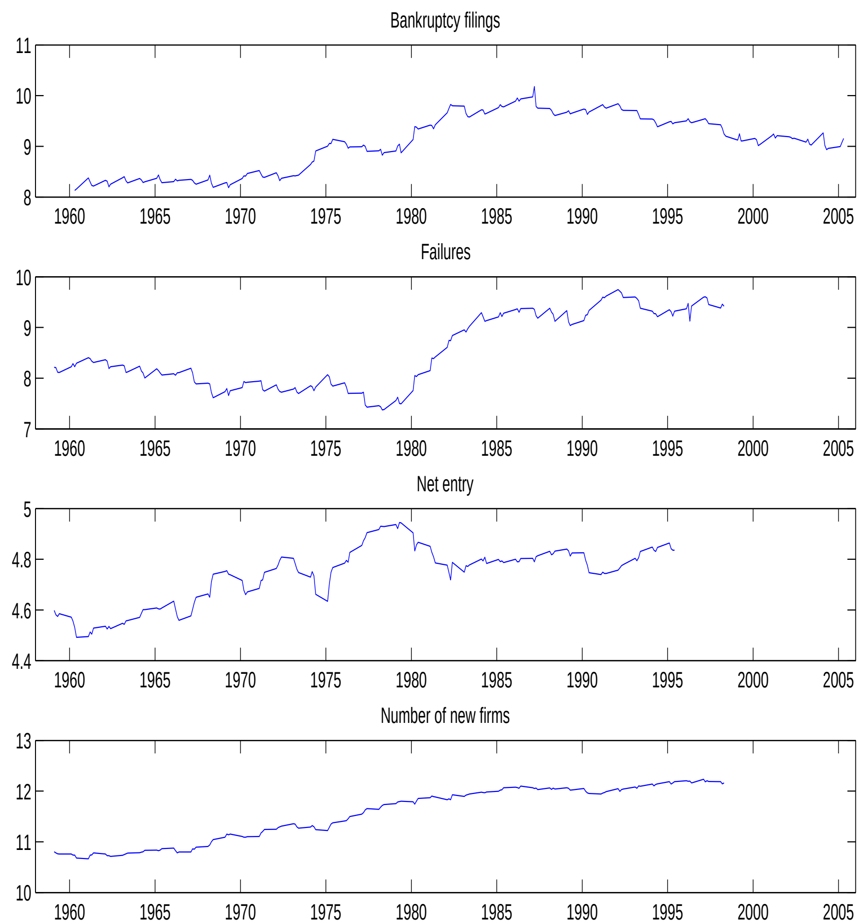

Figure 1: Business Bankruptcy Filings, Failures, Net Entry and New Firms Data in Log Levels

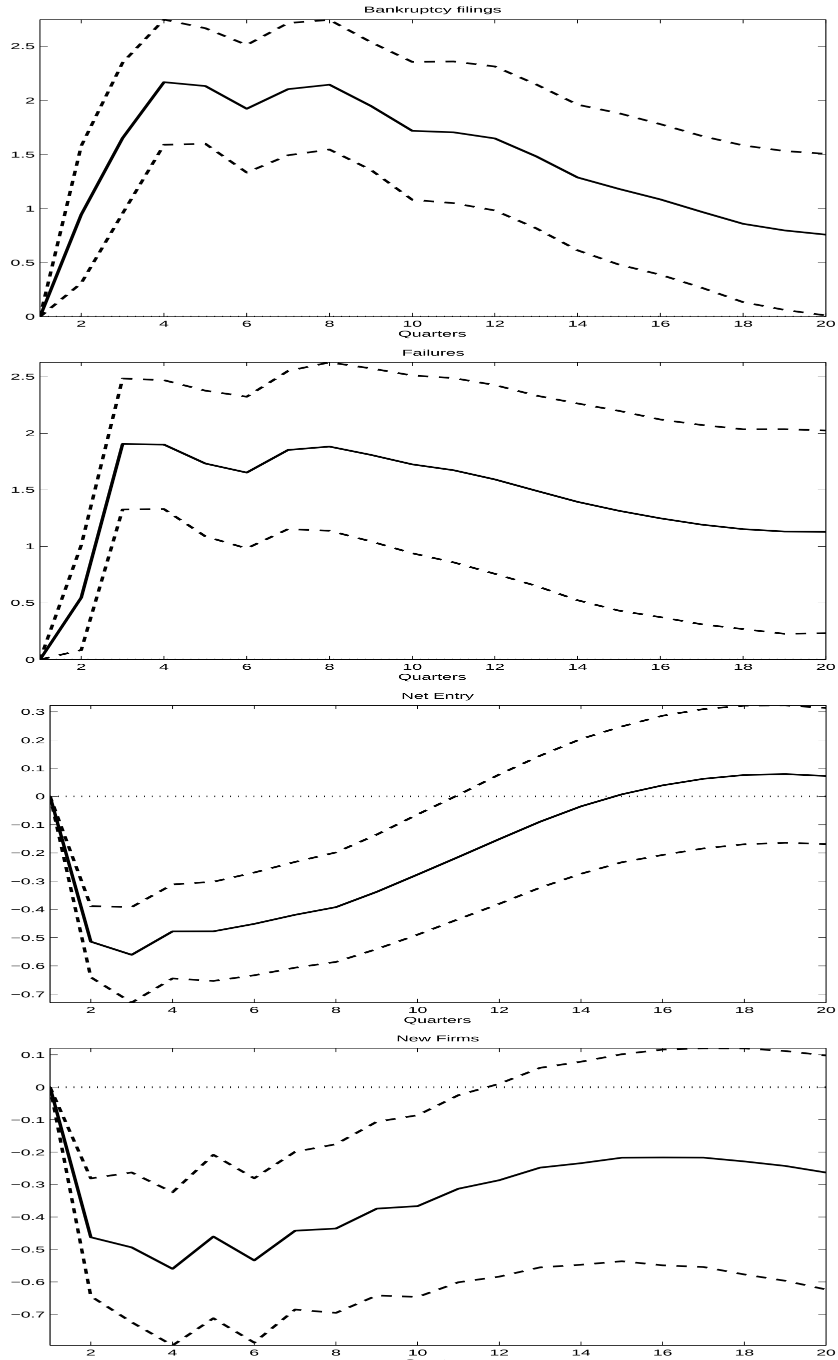

Figure 2: Impulse Response Functions of **Business Bankruptcy Filings, Failures, Net Entry and New Firms** to a Contractionary Monetary Shock, 68% Confidence Intervals around the Point Estimates

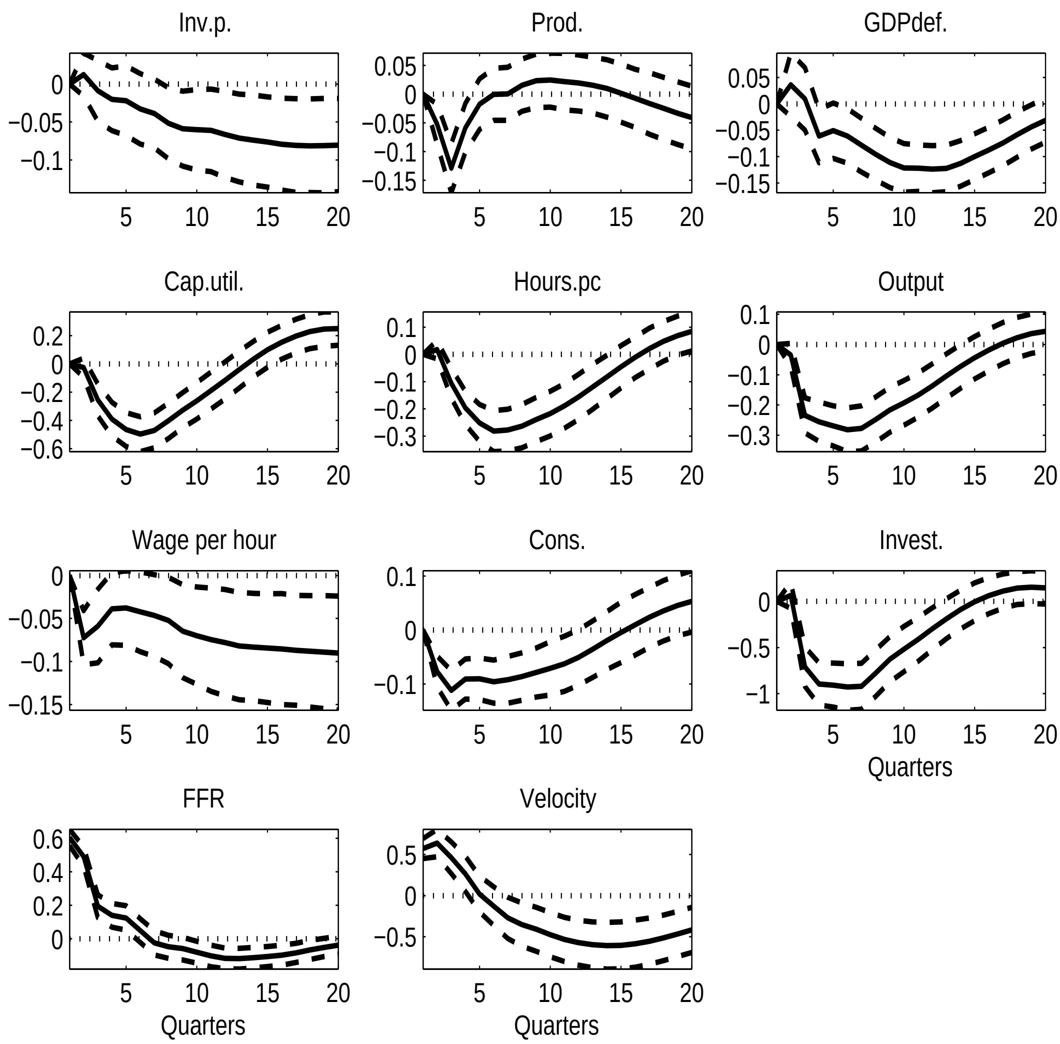

Figure 3: Impulse Response Functions of Macroeconomic Variables to a Contractionary Monetary Shock, SVAR with **Business Bankruptcy Filings** Included, 68% Confidence Intervals around the Point Estimates

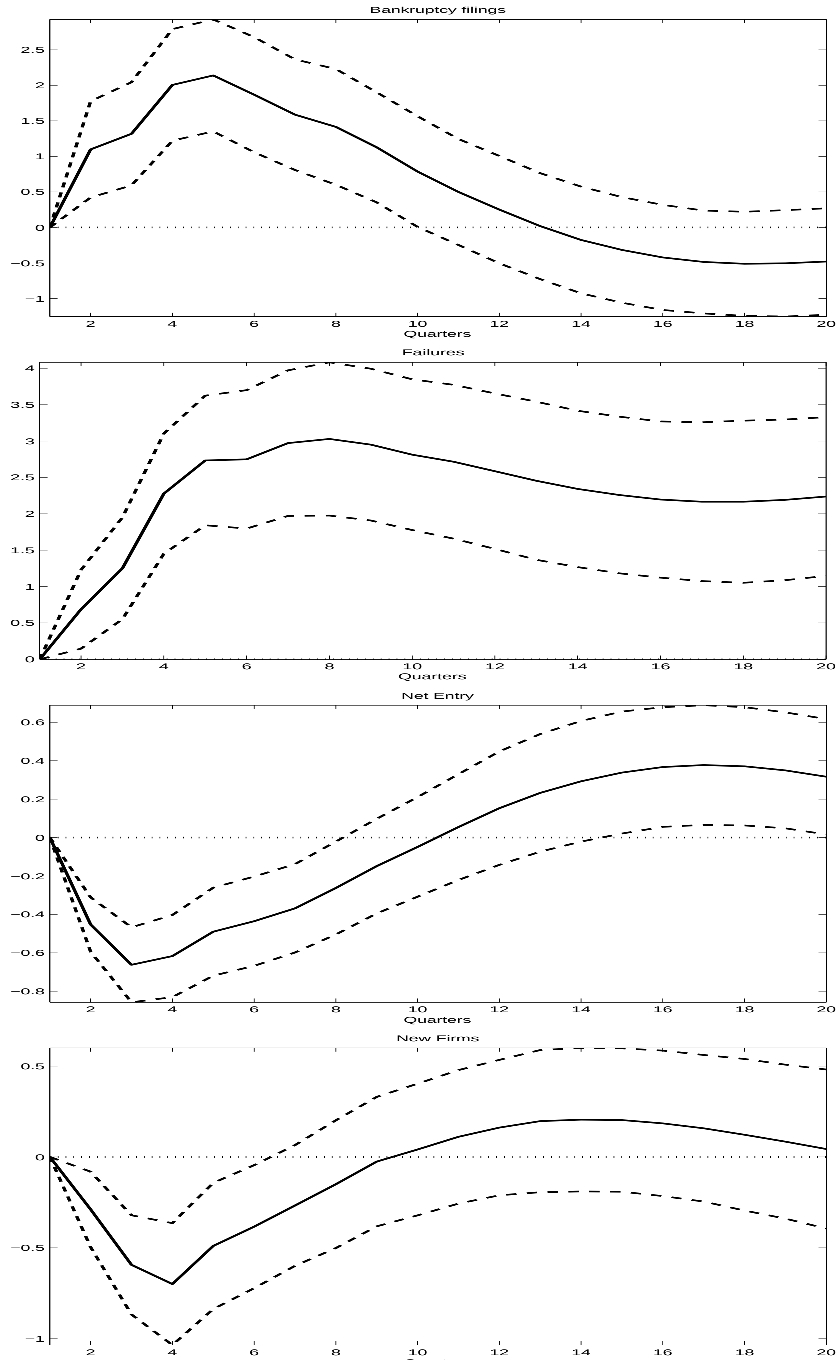

Figure 4: Impulse Response Functions of Business Bankruptcy Filings, Firm Failures, Net Entry and New Firms to a Contractionary Monetary Shock Defined by Change in the NBR/TR ratio, 68% Confidence Intervals around the Point Estimates

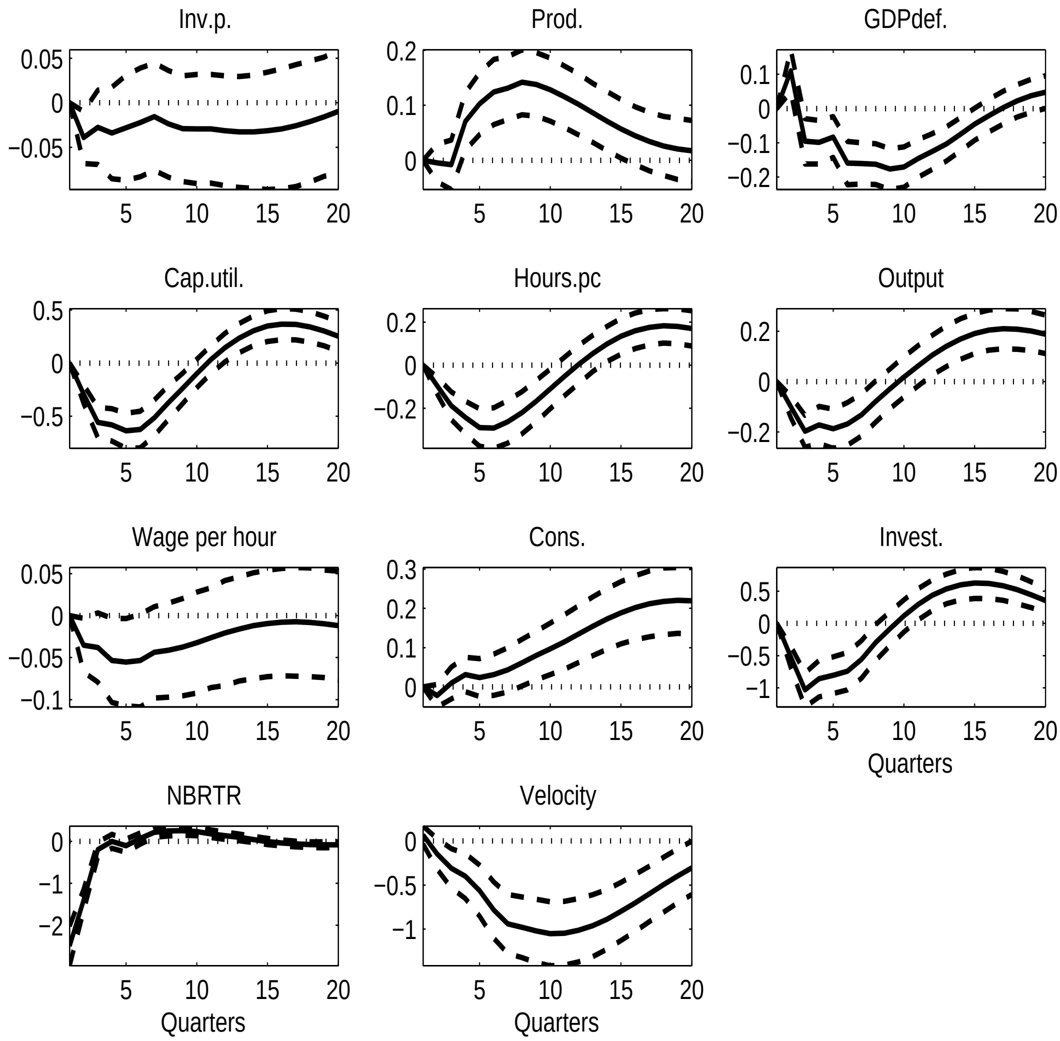

Figure 5: Impulse Response Functions of the Macroeconomic Variables to a Contractionary Monetary Shock Defined by a Drop in the NBR/TR ratio, When Business Bankruptcy Filings are Included, 68% Confidence Intervals around the Point Estimates

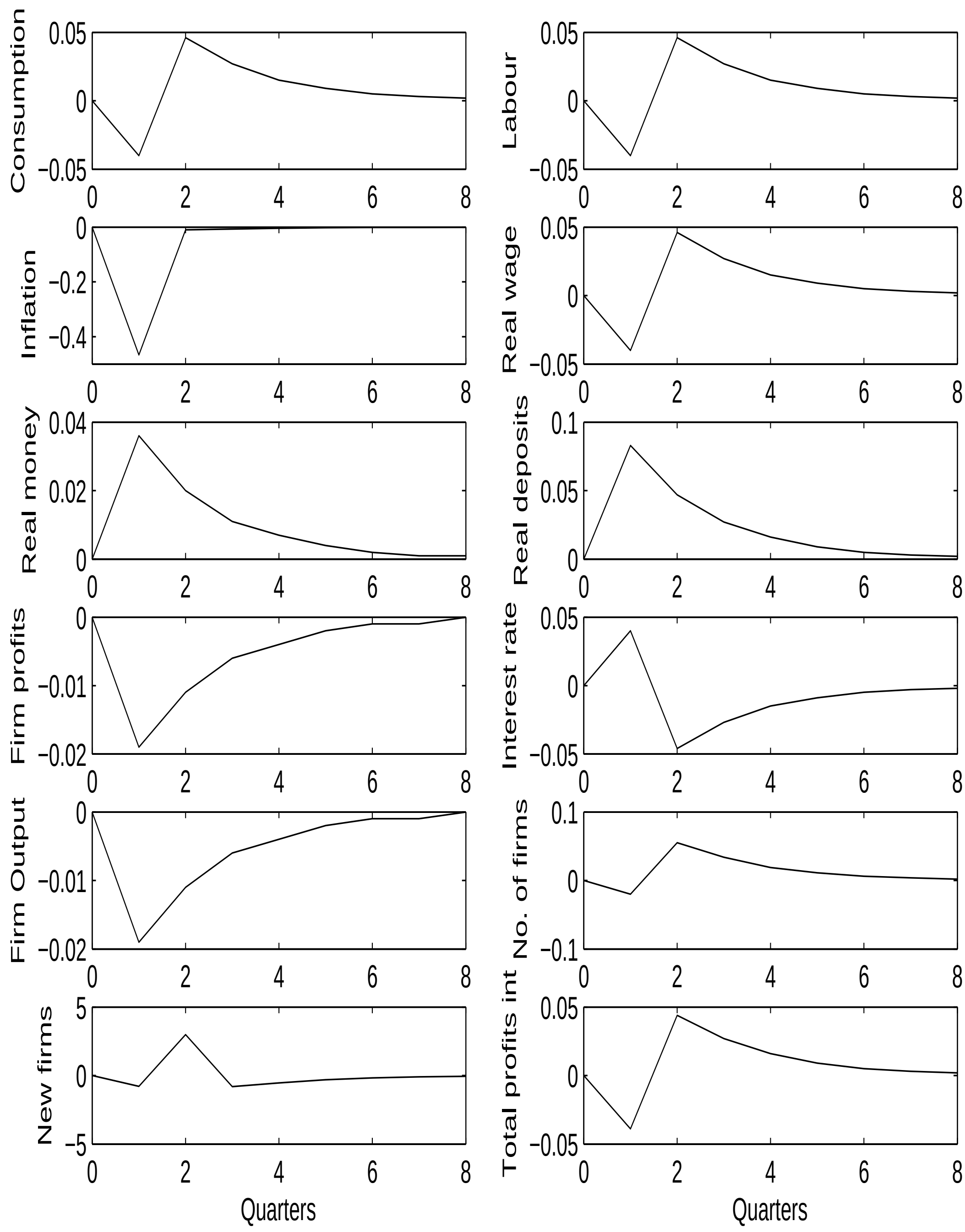

Figure 6: Impulse Response Functions of Economic Variables to a Contractionary Monetary Shock in a Limited Participation Model

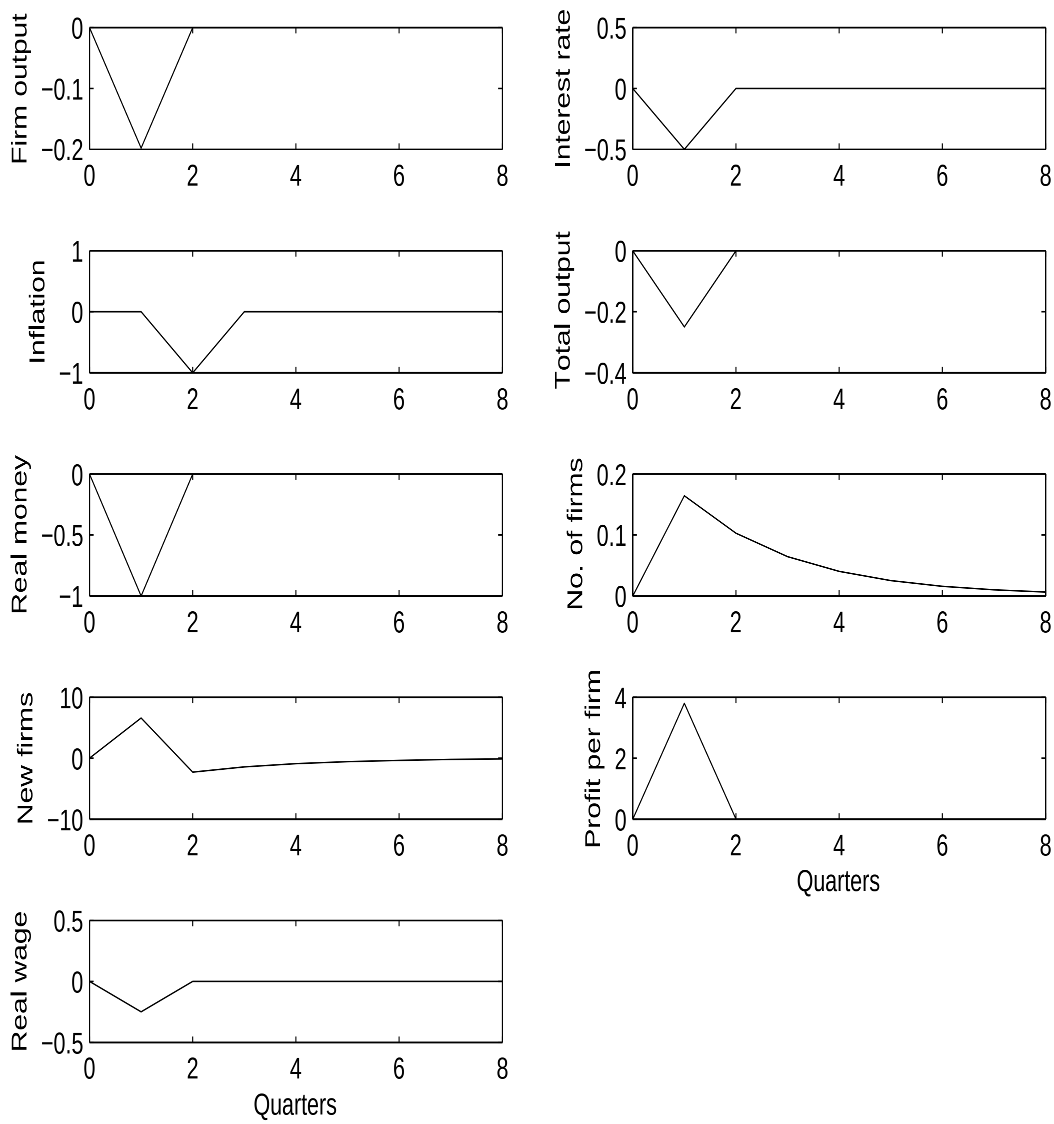

Figure 7: Impulse Response Functions of Economic Variables to a Contractionary Monetary Shock in a Pre-set Price Model

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