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Essays On The Effects Of Oil Price Shocks And Monetary Shocks On Labor Reallocation

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DEDICATION

To my lovely family.

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Chapter 1: Introduction

Asymmetries in economic activity to oil price shocks and monetary shocks have been observed in empirical works and supported by several theoretical papers. However, recent papers by Kilian and Vigfusson (2011b), and Lo and Piger (2005) pointed to some pitfalls and limitations in the estimation methodology previously used to estimate the impact of oil shocks and monetary shocks on economic activity. Other papers have reported a reduction in the effect of positive oil price shocks on the economy since the Great Moderation. In this chapter, we review the debate on the asymmetric effect of oil shocks and monetary shocks on economic activity and emphasize on the contributions that this dissertation offers to the existing literature.

Three theoretical channels explains the asymmetry in the response of oil price shocks on economic activity: The reallocative effect (see Hamilton, 1988; Davis, 1987a; Davis 1987b), the uncertainty effect (see Bernanke, 1983; Pindyck, 1991) and the effect of the Federal Reserve response to unexpected oil price changes (see Bernanke, Gertler and Watson 1997). All these channels operate regardless of the unexpected oil price change. Yet, through these channels of transmission unexpected oil price increases seem to generate strong economic downturn whereas oil price decreases are viewed to only corrects for the downturns generated by unexpected oil price increases and generate mild expansions.

Empirical work by Hamilton (1983), Loungani (1986), Mork (1989) observed that an unanticipated oil price increases generate strong economic downturn, whereas oil price declines generate an insignificant effect on GDP growth. Using slope based test, a significant evidence of nonlinearity in the oil price-macroeconomy relationship was reported by Mork, Olsen, and Mysen (1994), Cuñado and Pérez de Gracia (2003), and Jimenez-Rodriguez and Sanchez (2005).

Yet, Kilian and Vigfusson (2011b) questioned the consensus reached in the early 2000s about the nonlinearities in the effects of oil price shocks on aggregate economic activity. They claim the previous empirical literature used censored vector autoregressive models and show that estimates based on these models could lead to biased and inconsistent estimates. More importantly, Kilian and Vigfusson (2011b) implemented an impulse response function based test of symmetry to evaluate whether the response aggregate economic activity to oil price shocks is asymmetric and found that a linear model provides a very good approximation for the impact of oil price shocks on aggregate economic activity.

Moreover, evidence of asymmetry in the response of aggregate economic activity to positive and negative monetary shocks has been widely reported in the empirical literature (see e.g. Cover, 1992; Kandil, 1995). Several theory works have explained the presence of these asymmetries. Ball and Mankiw (1994) and Senda (2001) theoretical Keynesian models based on price rigidities show that prices are more rigid downward then upward, which implies that contractionary monetary policy primarily generates a reduction in output whereas quantitative easing mainly generates inflation.

On the other hand, the asymmetry in the response of aggregate economic activity to positive and negative monetary shocks does not seem to hold in more recent empirical papers. For instance, papers by Weise (1999) and Lo and Piger (2005) used an extended sample of observations and incorporate models that focus on several forms of asymmetry. They found that changes in monetary policy during recessions have a stronger effect than the changes taken during expansions and find no evidence of asymmetry in the response of economic activity to positive and negative monetary shocks.

Apart from the issue of asymmetry, there seems to be a strong evidence for the reduction in the effects of oil shocks and monetary shocks on economic activity since the Great Moderation. Blanchard and Gali (2010) found that the effect of positive oil price shocks on aggregate employment has reduced since 1984. Barth and Ramey (2002) have found that the role of the cost channel of monetary transmission has been reduced since the start of the Great Moderation, and evidence of a reduction in the effect of monetary shocks over time have been reported by Höppner, Melzer and Neumann, 2008)

In the next three chapters, we make important contributions regarding the asymmetric effect of oil and monetary shocks on economic activity and examine the changes in the impact of these shocks over time. Using an impulse response function based test in the light of Kilian and Vigfusson, we test for the labor reallocative effect – a channel known for generating asymmetries in the response of economic activity to shocks – triggered by oil and monetary shocks. Furthermore, we evaluate whether the allocative channel has been reduced since the start of the Great Moderation.

In Chapter 2, we examine the impact of a unexpected increase in an oil price shock on job creation and job destruction in aggregate manufacturing and industries at the 2-digit and 4-digit SIC code. We found that there are significant costly sectoral labor reallocations triggered by an unanticipated positive oil price shock. We also found that this reallocation process has diminished since the start of the Great Moderation and claim that the reduction of labor reallocation following an oil price shock could have played a role into the dampening effect of oil shocks on the economic activity since the mid-1980s. We also inquire on the asymmetry of job creation (job destruction) to positive and negative oil price shocks. We found almost no evidence of asymmetry for job creation. But evidence of asymmetry was significant for several industries especially following an unexpected large oil price shock.

In Chapter 3, we examine the impact of oil price shocks on regional labor reallocation. Our inquiry directly contributes to the literature interested in regional business cycles fluctuations. Using an impulse response function based test, we find significant evidence of costly labor reallocation across regions. In addition, even though we find differences in the magnitude of the responses of job creation and job destruction across regions, we observe a strong commonality in the response of regional job flows and the response of national job flows to unexpected positive oil price shocks. Finally we inquire on whether the spatial asymmetry to the response of job creation (job destruction) to positive unexpected oil price shocks hold and find no evidence of asymmetry.

In Chapter 4, we study the impact an unexpected increase in the quality spread on sectoral job creation and job destruction. We associate the presence of an allocative process following a positive monetary shock as a negative supply shock that generates asymmetry in the response of aggregate economic activity. We find significant evidence of costly labor reallocation and considerable reallocation effect. In line with Barth and Ramey (2002), our results show that the magnitude of this reallocative effect has been reduced since the Great Moderation.

In Chapter 5, we summarize the contributions, the methods used and the major findings in our research. We also, present limitations and possible extensions for future research.

Chapter 2: The Effects of Oil Price Shocks on Sectoral Job Reallocation[1]

Using quarterly data on manufacturing job creation and job destruction, we estimate a simultaneous equation model that nests both a symmetric and asymmetric response of job flows to oil price shocks We test for a job reallocation effect and find evidence that the allocation channel played a role in the transmission of oil price shocks. Especially for sectors that are energy intensive in consumption (e.g., transportation equipment) or production (e.g., rubber and plastics). We also test for symmetry in the response of job creation (or job destruction) to positive and negative oil price shocks. We find almost no evidence of asymmetry in the response of job flows to positive and negative oil price innovations. Finally, we explore whether the reallocation channel changed during the Great Moderation and discuss evidence of a moderation in the response of job flows since the mid-1980s.

2.1 Introduction

In the last five years, there has been a renewed interest in the question of whether the response of macroeconomic activity to oil price increases and decreases is asymmetric (see, e.g., Kilian and Vigfusson 2011a; Kilian and Vigfusson 2011b; Hamilton 2011). Kilian and Vigfusson (2011b) prove that the methodology commonly used in the empirical literature to assess the possible asymmetry in the response of economic activity to an oil price shock can lead to inconsistent estimates, and can overestimate the magnitude of this effect. They also show that, for a typical (one standard deviation) shock, a symmetric model appears to provide a very good approximation to the response of aggregate economic activity (e.g., U.S. GDP growth) to an innovation in the real price of oil.

[1] **This chapter is co-authored by professor Ana María Herrera.**

Herrera, Lagalo and Wada (2011) find similar results for aggregate industrial production growth when they consider a typical shock. However, they find strong evidence against the hypothesis of symmetric responses at the disaggregate level. Thus, this literature points not only to the importance of re-examining the question of asymmetries at a more disaggregate level, but also to the need of re-evaluating the mechanisms that might be at play in the transmission of oil price shocks to the aggregate economy.

One of the channels through which changes in oil prices are purported to have an asymmetric impact on aggregate output and employment is sectoral reallocation (see, e.g., Davis 1987a; Davis 1987b; Davis and Haltiwanger 2001). In particular, Davis and Haltiwanger (2001, hereafter DH) find that oil price increases bring about flows of job reallocation from declining sectors –i.e., sectors that use oil intensively in production or consumption– to expanding sectors. Such a process of reallocation tends to be slow and costly due to search and matching issues, thus entailing prolonged unemployment spells. Furthermore, DH find that the higher the energy intensity of a particular industry, the stronger the effect an oil price hike has on job reallocation.

Our paper makes four contributions to this literature. First, building on the work by DH and Kilian and Vigfusson (2011b) we estimate a structural model that nests both a symmetric and an asymmetric model of the transmission of oil price shocks to job creation and job destruction. Our model differs from DH in one important aspect. DH include both an oil price index and the absolute value of the oil index as left-hand variables in their near-VAR. In contrast, we include only the oil price change as a dependent variable in our simultaneous equation system, and both the oil price change and a nonlinear transformation of the oil price change as explanatory variables. In this manner, we avoid introducing a bias in the coefficient estimates of the structural model and, hence, in the impulse response functions by including a censored variable as a dependent variable

(see Kilian and Vigfusson 2011b for an in-depth discussion.)

Second, we use an impulse response based test to evaluate whether the response of sectoral job creation and job destruction to oil price increases is symmetric. Implementing such a test is important for two reasons. First, given that job reallocation is defined as the sum of job creation and job destruction, our test of symmetry is equivalent to explicitly testing whether oil price shocks have an effect on job reallocation. In addition, estimates of the impulse response functions are subject to substantial sampling uncertainty, especially when considering a large two standard deviation shock. Thus, it is useful to conduct formal tests of job reallocation such as the impulse response based test described in section 4.1 in order to assess the statistical significance of the allocative channel.

Third, we contribute to the discussion regarding the asymmetry in the response of economic activity to oil price increases and decreases by examining the response of job flows. More specifically, we use an impulse response based test to investigate whether the response of job creation (job destruction) to positive and negative oil price innovations is symmetric.

Fourth, motivated by Edelstein and Kilian (2009) and Blanchard and Galí (2010) who find that the effect of oil price shocks on economic activity during the 2000s have been muted compared to the 1970s, we explore whether a dampening in the response of job reallocation took place since the onset of the Great Moderation. In addition, we investigate whether oil price shocks during the Great Moderation are associated with a more flexible labor market, as measured by larger changes in excess job reallocation.

Our results suggest an economic and statistically significant effect of oil price increases on job reallocation, especially for sectors that are energy intensive in production (e.g., textiles, petroleum and coal, rubber and plastics) or in consumption (e.g., transportation equipment). For most of these sectors, this job reallocation takes the form of a considerable increase in job destruction, and a muted response or no change in job creation for the first year after the shock. Interestingly, statistical evidence of asymmetry is more prevalent for a large (two standard deviation) shock, even though the uncertainty in estimating the response to this shock is higher relative to that involved in estimating the response to a typical (one standard deviation) shock.

Regarding the presence of asymmetry in the response of job creation and destruction to positive and negative oil price shocks, little evidence of asymmetry is found for a typical oil price shock. This suggests that, for the majority of sectors, a linear model provides a good approximation to the response of job reallocation to oil price increases and decreases. However, the responses of both job creation and job destruction in total manufacturing to large positive and negative oil shocks exhibit asymmetry. This is also the case for a number of sectors that are energy intensive in the use of energy in production (e.g., rubber and plastics) or in consumption (e.g. truck trailers).

Finally, estimation results suggest that the allocative channel continued to play a role in the transmission of oil price shocks during the Great Moderation. Yet, the strength of this channel (at least at the aggregate level) appears to have declined in the 2000s. This is evidenced by a decline in the asymmetry of the response of job creation and job destruction to increases in the price of crude oil.

The remainder of the paper is organized as follows. Section 2 briefly reviews data on job flows and oil prices. Section 3 describes the empirical strategy. The responses of job flows to a positive innovation in oil prices are discussed in section 4 and the results of the impulse response based test of job reallocation are reported in section 5. A different question of asymmetry, whether job creation (and destruction) respond symmetrically to positive and negative oil price shocks, is addressed in the following section. Section 7 inquires into the changes in the response of job creation and destruction before and after the Great Moderation. Section 8 concludes.

2.2 Job Flows and Oil Prices

In order to explore the effect of oil price shocks on sectoral reallocation we use the gross job flows data collected by Davis, Haltiwanger and Schuh (1996) in the 1990s and updated on-line in 2009. This database contains quarterly data on total manufacturing and sectoral job flows.[2] Data on total manufacturing span the period between 1972:Q2 and 2005:Q1, whereas data at the 2-digit and 4-digit SIC level cover the period between 1972:Q2 and 1998:Q4. In this paper we use data for twenty 2-digit sectors and four 4-digit industries in the transportation equipment sector. We include the latter industries because we believe additional insight into the effect of oil price shock on job reallocation can be gained by focusing on a number of sectors in the automobile industry, an industry that has been shown to be very responsive to oil price shocks (see e.g., Lee, Ni and Ratti 1995).[3]

As in Davis, Haltiwanger and Schuh (1996), let Z_{est} be the average employment in industry e between time t and $t-1$. Similarly define Z_{St} as the average employment for a set of establishments in industry S. Then, the employment growth rate g_{est} in establishment e of industry S at time t is defined as the change in employment between t and $t-1$ periods divided by Z_{est}. The job creation rate, $POS_{S,t}$, in industry S at time t is given by the sum of employment growth at expanding and entering establishments within industry S, where this sum is divided by the size of the industry in order to express the flow in terms of a rate:

$$POS_{S,t} = \sum_{e \epsilon S^+} \frac{Z_{est}}{Z_{St}} g_{est} \tag{1}$$

[2] We use the X-11 Census method to seasonally adjust the data.

[3] We leave the investigation of the effect of job reallocation on other 4-digit SIC industries for future research due to the large computational time. Replicating the impulse response based test in section 5 for the 244 four-digit industries available in the data set, would take about 5,612 hours using a high performance Grid enabled computing system, which allows us to run 10 or more parallel codes. If we add to this time, the computation time required to replicate the subsample results in section 6, we would end up with nearly 2 years of continous computation.

Similarly, job destruction is given by the sum of employment losses at contracting and exiting establishments, and expressed as a rate:

$$NEG_{S,t} = \sum_{e \epsilon S^-} \frac{Z_{est}}{Z_{St}} |g_{est}| \tag{2}$$

Job creation and job destruction rates are used to compute other measures of job flows. In particular, total job reallocation ($SUM_{S,t}$) inside industry S between quarter $t-1$ and t represents an upper bound on the rate of job reallocation and is defined as

$$SUM_{S,t} = POS_{S,t} + NEG_{S,t}, \tag{3}$$

whereas excess job reallocation ($EXC_{S,t}$) represents job reallocation in excess of the net change in jobs ($NET_{S,t}$) where

$$NET_{S,t} = POS_{S,t} - NEG_{S,t}, \tag{4}$$

and

$$EXC_{S,t} = POS_{S,t} - |NET_{S,t}|\,. \tag{5}$$

Note that $EXC_{S,t}$, which is the amount of job turnover that goes on above and beyond what would be required to attain the observed net change in employment in industry S at time t, constitutes an indicator of the flexibility of the labor market in a particular industry (see Bauer and Lee, 2007 and Micco and Pagés, 2004).

Table 1 summarizes the average quarterly job flows by industry between 1972:Q2 and 1998:Q4; we also include the average flow for total manufacturing over the 1972:Q2-2005:Q1 sample. Note that the variation in job reallocation and excess reallocation rates across industries is driven by differences in both job creation and destruction. In particular, industries with higher job creation also have higher job destruction, which results in higher job reallocation and excess reallocation rates. Furthermore, the fact that excess reallocation tends to be quite large suggests that a considerable proportion of job reallocation is not driven by aggregate shocks. (Recall that in the absence of heterogeneous job creation and destruction patterns across establishments within sectors, excess job reallocation would be zero.) In addition, it is worth noting that reallocation at the interior of the transportation equipment sector, tends to be larger for industries in the automobile sector than for total manufacturing.

With respect to the evolution of job flows over time, Figure 1 suggests a slight decline in the rate of job reallocation (SUM) and excess reallocation (EXC) for total manufacturing, which coincides with a period of increased volatility in real oil prices and the dampening effect of oil price shocks during the Great Moderation (Blanchard and Galí, 2010). Nevertheless, comparing the two EXC columns in Table 2, does not reveal a clear pattern of decline in excess reallocation by industry between the 1972:Q2-1983:Q4 and the 1984:Q1-1998:Q4 periods.[4] Thus, a more in depth analysis is required to inquire into the changes in the response of job flows to oil price shocks before and during the Great Moderation (see section 6).

In this paper, we follow Hamilton (1996, 2003) and Davis and Haltiwanger (2001) by measuring nominal oil prices using the producer price index of crude petroleum. We compute real oil prices (o_t) by deflating the nominal price of oil by the total producer price index. The growth rate of the real oil price is then defined as

$$x_t = \ln(o_t) - \ln(o_{t-1}).$$

Because we are interested in estimating a model that nests both symmetric and asymmetric

[4] See Davis, Faberman and Haltiwanger (2012) for an in-depth analysis of changes in labor flows over time.

responses of job flows to oil price increases and decreases, we use two nonlinear transformations of the natural logarithm of the real oil prices. The first measure is the oil price increase (Mork 1989), which sets all quarterly oil price decreases to zero so that

$$x_t^1 = \max\left\{0, \ln\left(o_t\right) - \ln\left(o_{t-1}\right)\right\}. \tag{6}$$

The second measure is the net oil price increase over the previous 4-quarter maximum (Hamilton, 1996)

$$x_t^4 = \max\left\{0, \ln\left(o_t\right) - \max\left\{0, \ln\left(o_{t-1}\right), ..., \ln\left(o_{t-4}\right)\right\}\right\}. \tag{7}$$

This nonlinear transformation filters out increases in real oil prices that correct for previous declines, and has been purported to be successful in capturing the nonlinear relationship between oil prices and economic activity (Hamilton 1996, 2003; Lee and Ni 2002). Figure 2 illustrates the evolution of the real oil price change (x_t), the oil price increase (x_t^1), and the net oil price increase (x_t^4) over the 1972:Q2-2005:Q1 period. Notice that, as implied by equations (6) and (7), the degree of censoring is higher for the net oil price increase than for the oil price increase.

2.3 Empirical Strategy

To study the effect of oil price shocks on job flows we estimate the following simultaneous equation model

$$x_t = a_{10} + \sum_{i=1}^{p} a_{11,i} x_{t-i} + \sum_{i=1}^{p} a_{12,i} NEG_{S,t-i} + \sum_{i=1}^{p} a_{13,i} POS_{S,t-i} + \varepsilon_{1,t} \quad (8a)$$

$$NEG_{S,t} = a_{20} + \sum_{i=0}^{p} a_{21,i} x_{t-i} + \sum_{i=1}^{p} a_{22,i} NEG_{S,t-i} + \sum_{i=1}^{p} a_{23,i} POS_{S,t-i} + \sum_{i=0}^{p} g_{21,i} x^{\#}_{t-i} + \varepsilon_{2,t} \quad (8b)$$

$$POS_{S,t} = a_{30} + \sum_{i=0}^{p} a_{31,i} x_{t-i} + \sum_{i=0}^{p} a_{32,i} NEG_{S,t-i} + \sum_{i=1}^{p} a_{33,i} POS_{S,t-i} + \sum_{i=0}^{p} g_{31,i} x^{\#}_{t-i} + \varepsilon_{3,t} \quad (8c)$$

where $x^{\#}_t$ refers to any of the two nonlinear transformations of oil prices (x^1_t, x^4_t) defined in section 2, ε_t is a vector of contemporaneously and serially uncorrelated innovations, and $p = 4$. Note that for identification purposes we assume that oil prices do not respond contemporaneously to changes in job destruction or job creation and that job destruction does not respond contemporaneously to changes in job creation.[5] Furthermore, given that we do not impose any exclusion restrictions on the lags of the endogenous variables and that we assume the innovations are orthogonal, the system in (8) can be estimated via OLS equation by equation.

Note that our model specification differs from that in DH in three aspects. First, instead of the rate of growth in the real oil price, DH use an oil price index defined as the real oil price at time t divided by a "weighted average of the real prices in the prior 20 quarters, with weights that sum to one and decline linearly to zero" (DH, pg. 481). We prefer to use the rate of growth in oil prices as it is a closer measure of the quarter to quarter change in the price of crude oil.

Second, DH include both the oil index and the absolute value of the oil index as left-hand

[5] Results not reported herein, but available from the authors upon request, show that ordering job creation before job destruction does not alter the conclusions of our paper. In fact, Pesaran and Shin (1998) show that the generalized impulse response functions –as those computed in this paper– are invariant to the ordering of the variables.

variables in their near-VAR. Instead, in order to avoid the bias induced by including a censored variable as a dependent variable in our simultaneous equation system (see Kilian and Vigfusson 2011b for an in-depth discussion), we include only x_t as a left-hand variable in (8a) and both x_t and $x_t^{\#}$ as explanatory variables in (8b) and (8c).

Third, DH include a macro block before the sectoral block comprised by the job creation and job destruction rates. This macro block contains the oil price index, the absolute change of the oil index, total job creation in the manufacturing sector, total job destruction in the manufacturing sector, and the quality spread (i.e., the difference between the 6-month commercial paper rate and the 6-month Treasury bill rate). Instead, we opt for a more parsimonious model that is better suited for our purpose of explicitly testing for symmetry in the response of job creation and job destruction for a number of reasons: (a) under the assumption that oil prices are predetermined with respect to the sectoral job flows, a parsimonious model consistently estimates the impact of an unexpected increase in oil prices on the variables of interest; (b) the computation time for the impulse response based test (see section 4.1) is considerably diminished by reducing the dimension of the simultaneous equation model; and (c) DH use the block recursive nature of their near-VAR to attain partial identification, such an identification strategy is not possible when calculating the generalized impulse response functions because –as section 4.1 will show– the computation of the latter relies on the recursive nature of (8).

2.4 The Response of Job Flows to an Increase in Real Oil Prices

2.4.1 Computation of the Impulse Response Functions

Because our simultaneous equation model, (8), is nonlinear in x_t, computing the impulse response functions –hereafter $IRFs$– in the usual textbook manner is erroneous (see Gallant, Rossi and Tauchen 1993 and Koop, Pesaran and Potter 1996). In particular, the textbook $IRFs$ may overestimate the effect of an oil price when the variable of interest has been censored, as it is the case with $x_t^{\#}$ (see Kilian and Vigfusson 2011b.) In such framework, the $IRFs$ depend on the history of $x_t^{\#}$ and the magnitude of the shock. Following Koop et al. (1996) and Kilian and Vigfusson (2011b), we compute the $IRFs$ for 13 horizons ($h = 0, 1, \ldots 12$) conditional on the history and the size of the shock in the following manner:

(1) Estimate the model (8) via OLS equation by equation and keep the estimated coefficients (denoted by $\widehat{B}_1$, $\widehat{B}_2$, $\widehat{B}_3$), the standard deviations ($\widehat{s}_1$, $\widehat{s}_2$, $\widehat{s}_3$), and the residuals ($\widehat{\varepsilon}_1$, $\widehat{\varepsilon}_2$, and $\widehat{\varepsilon}_3$) from the three equations.

(2) Given a history $\{x_{t-1}, \ldots, x_{t-p}, NEG_{t-1}, ..., NEG_{t-p}, POS_{t-1}, ...,POS_{t-p}\} = \{X_t, N_t, P_t\} \in \Omega^t$, generate two time paths of x_t such that:

$$\begin{aligned} x_t^1 &= \widehat{B}_1 \left[1, X_t, N_t, P_t\right] + \delta \\ x_t^2 &= \widehat{B}_1 \left[1, X_t, , N_t, P_t\right] + \varepsilon_{1t} \end{aligned} \tag{9}$$

where ε_{1t} is drawn from the empirical distribution of ε_{1t} (i.e., resampled with replacement from the residual $\widehat{\varepsilon}_1$ in (8a)) and δ equals either one or two standard deviations.

(3) The updated information sets, together with the censored variables are given by $\mathcal{I}_t^1 = \{1$, x_t^1, X_t, N_t, P_t, $x_t^{1\#}$, $X_t^{1\#}\}$ and $\mathcal{I}_t^2 = \{1$, x_t^2, X_t, N_t, P_t, $x_t^{2\#}$, $X_t^{2\#}\}$. Given these two histories, two paths for NEG_t are generated as:

$$\begin{aligned} NEG_t^1 &= \widehat{B}_2 \mathcal{I}_t^1 + \varepsilon_{2t} \\ NEG_t^2 &= \widehat{B}_2 \mathcal{I}_t^2 + \varepsilon_{2t} \end{aligned} \tag{10}$$

where ε_{2t} is drawn from the empirical distribution of ε_{2t}. (Notice that the same value is used as ε_{2t} to generate NEG_t^1 and NEG_t^2 as we are interested only in the effect of a shock to oil prices.)

(4) The new updated information sets are given by $\widetilde{\mathcal{I}}_t^1 = \{1,\, x_t^1,\, N_t^1,\, X_t,\, N_t,\, P_t,\, x_t^{1\#},\, X_t^{1\#}\}$ and $\widetilde{\mathcal{I}}_t^2 = \{1,\, x_t^2,\, N_t^2,\, X_t,\, N_t,\, P_t,\, x_t^{2\#},\, X_t^{2\#}\}$. Given these two histories, two paths for POS_t are generated:

$$\begin{aligned} POS_t^1 &= \widehat{B}_3\mathcal{I}_t^1 + \varepsilon_{3t} \\ POS_t^2 &= \widehat{B}_3\mathcal{I}_t^2 + \varepsilon_{3t} \end{aligned}$$

where ε_{3t} is drawn from the empirical distribution of ε_{3t}. (Again, notice that the same value is used as ε_{3t} to generate POS_t^1 and POS_t^2.)

(5) Generate new information sets $\Omega_{t+1,1}^t = \{1,\, x_t^1,\, x_{t-1},\, \ldots,\, x_{t-p+1},\, NEG_t^1,\, NEG_{t-1},\, \ldots,\, NEG_{t-p+1},\, POS_t^1,\, POS_{t-1},\, \ldots,\, POS_{t-p+1}\}$ and $\Omega_{t+1,2}^t = \{1,\, x_t^2,\, x_{t-1},\, \ldots,\, x_{t-p+1},\, NEG_t^2,\, NEG_{t-1},\, \ldots,\, NEG_{t-p+1},\, POS_t^2,\, POS_{t-1},\, \ldots,\, POS_{t-p+1}\}$; the two paths for x_{t+1} are given by

$$\begin{aligned} x_{t+1}^1 &= B_1\Omega_{t+1,1}^t + \varepsilon_{1t+1} \\ x_{t+1}^2 &= B_1\Omega_{t+1,2}^t + \varepsilon_{1t+1}. \end{aligned}$$

Repeat steps (2)-(5) $H+1$ times.

(6) After R repetitions of steps (2)-(5), generate the conditional $IRFs$ as

$$I_{NEG}\left(h, \delta, \Omega^t\right) = \frac{1}{R}\sum_{r=1}^{R} NEG_{t,r}^1 - \frac{1}{R}\sum_{r=1}^{R} NEG_{t,r}^2 \quad \text{for } h = 0, 1, \ldots, H$$

and

$$I_{POS}\left(h,\delta,\Omega^{t}\right)=\frac{1}{R}\sum_{r=1}^{R}POS_{t,r}^{1}-\frac{1}{R}\sum_{r=1}^{R}POS_{t,r}^{2}\ \text{ for } h=0,1,\ldots,H$$

where $I_{NEG}\left(h,\delta,\Omega^{t}\right)\xrightarrow{p}E\left[NEG_{t+h}|\delta,\Omega^{t}\right]-E\left[NEG_{t+h}|\Omega^{t}\right]$ as $R\to\infty$ and $I_{POS}\left(h,\delta,\Omega^{t}\right)\xrightarrow{p}E\left[POS_{t+h}|\delta,\Omega^{t}\right]-E\left[POS_{t+h}|\Omega^{t}\right]$ as $R\to\infty$. In our computation we set $R=10,000$.

(7) The unconditional $IRFs$ are generated by repeating (2) to (6) for all possible Ω^{t}, $t=1:T$ and then taking the mean over all the histories.

$$I_{NEG}\left(h,\delta\right)=\frac{1}{T}\sum_{t=1}^{T}I_{NEG}\left(h,\delta,\Omega^{t}\right)$$

and

$$I_{POS}\left(h,\delta\right)=\frac{1}{T}\sum_{t=1}^{T}I_{POS}\left(h,\delta,\Omega^{t}\right).$$

(8) The variance-covariance matrix for $\left[I_{NEG}\left(h,\delta\right),I_{POS}\left(h,\delta\right)\right]$ is computed as follows. First, given the estimated parameters $\widehat{B}_1$, $\widehat{B}_2$, $\widehat{B}_3$, $\widehat{s}_1$, $\widehat{s}_2$, $\widehat{s}_3$, the residuals, and an arbitrary chosen history Ω^{m}, the system in (8) is used to generate pseudo-series of the same length of our data. Second, for each of the newly generated pseudo-series, (X^{m},N^{m},P^{m}), we repeat steps (1) through (7) to get the unconditional $IRFs$. Finally, for M unconditional $IRFs$, both for NEG and POS , the variance covariance matrix is computed. The matrix has a size of $2\left(H+1\right)\times 2\left(H+1\right)$.

2.4.2 Job Creation, Job Destruction, and Oil Price Shocks

Figures 3a and 3b plot the responses of job creation and job destruction to a positive innovation of one standard deviation in the real oil price (hereafter a typical shock). For ease of comparison, we plot the negative of the response of job destruction. The responses generated using the oil price increase, x_t^1, and the net oil price increase, x_t^4, are plotted in the left and right panels, respectively.

To conserve space, the $IRFs$ for the remaining nine 2-digit SIC industries are reported in the online appendix (see Figures A.1.)

As the top panel of Figure 3 illustrates, the responses of job creation and destruction to a typical shock appear to be asymmetric for total manufacturing. For instance, regardless of the non-linear transformation of oil prices used (i.e., x_t^1 or x_t^4), the response of job destruction is about 34% larger than the response of job creation four quarters after the shock. Moreover, note that the magnitude of the asymmetry appears to increase for the first year after the shock and it declines afterwards. As for the industry level data, Figure 3 also suggests an asymmetry in the response of job creation and destruction to a typical oil price increase, especially for sectors that are energy intensive in production (e.g., textiles, petroleum and coal, rubber and plastics) or in consumption (e.g., transportation equipment). For most sectors, the $IRFs$ illustrate a considerable increase in job destruction and a muted response or no change in job creation for the first year after the shock. Furthermore, the $IRFs$ are qualitatively similar across different nonlinear transformations of oil prices, although the magnitude of the effect on job reallocation tends to be somewhat larger for x_t^4.

Using the computed $IRFs$ for job creation and job destruction, plus the job flows definitions in equations (3)-(5), we calculate the cumulative change in net employment, job reallocation, and excess job reallocation four and eight quarters after a typical shock (see Table 3). Based on the model with x_t^1 our calculations suggest that, on average during the 1973-2005 period, a typical positive innovation in real oil prices lead to a one-year (two-year) cumulative decline of 0.32 (0.51) percentage points in net employment for total manufacturing. The one-year (two-year) cumulative increase in job reallocation equals 0.33 (0.67) percentage points. These numbers imply that the cumulative job flows in and out of manufacturing firms brought about by a typical positive shock to oil prices barely exceeded the net employment change by the end of the first year but were

0.12 percentage points larger by the second year. Interestingly, computations using the 1973-1998 period, which corresponds to the sample period of the disaggregated data, suggest that the magnitude of the allocative effect of oil prices on total manufacturing declined during the 1999-2005 period. Note that the magnitude of the effect on net employment, job reallocation and excess reallocation is larger in the 1973-1998 sample than the 1973-2005 sample, with the effect on excess reallocation being economically significant both a year and two years after the shock. Furthermore, the magnitude of the cumulative effect on job reallocation diverges greatly across sectors. For instance, the two-year cumulative effect ranges between 0.12 (0.03) percentage points for tobacco products and 3.93 (4.67) percentage points for transportation equipment using x_t^1 (x_t^4), respectively.

Consider now the effect of a large positive innovation in the real price of oil. For total manufacturing, regardless of the sample specification (1973-1998 or 1973-2005) and the non-linear transformation of oil prices (x_t^1 or x_t^4), the one-year and two-year cumulative change in labor reallocation and net employment brought about by a large shock is almost more than twice of that generated by a typical shock for most sectors (compare Table 3 and Table 4). Similarly, the magnitude of the labor reallocation generated by a large shock at the industry level is significantly larger than that caused by a typical shock. For instance, using x_t^1, the one-year (two-year) cumulative change in job reallocation after a large shock is 5.46 (8.24) percentage points for transportation equipment, 3.78 (6.22) for lumber, and 2.77 (4.90) for rubber and plastics. The corresponding change for a typical shock is 2.62 (3.93)percentage points for transportation equipment, 2.05 (3.53) percentage points for lumber, and 1.39 (2.36) for rubber and plastic. Note that both a typical and a large oil price shock lead to considerable reallocation activity in transportation equipment. This finding is consistent with work by Bresnahan and Ramey (1993) and Ramey and Vine (2010) who show that oil price shocks have an important negative effect on the automobile sector.

2.4.3 A Closer Look at Motor Vehicles and Trucks

To gain additional insight into the job reallocation process in and out of the transportation equipment sector, we estimate our model and compute the $IRFs$ for four 4-digit SIC industries: motor vehicles and passenger car bodies, truck and bus bodies, motor vehicle parts and accessories, and truck trailers. We focus on these four industries because they belong to the automotive sector, which has been shown to be greatly affected by oil price shocks, and because the average rate of labor reallocation in these industries is higher than in other industries in the transportation equipment sector (e.g., aircraft manufacturing, guided missiles and space vehicles, boats and ships manufacturing and railroad equipment.)

The four bottom panels of Figure 3b depict the $IRFs$ to a typical shock for these 4-digit SIC industries. As can be seen by comparing these panels with the $IRFs$ for total manufacturing and transportation equipment, the magnitude of the job flows in and out of employment tends to be larger for these 4-digit industries than for the aggregates. For instance, a typical oil price shock leads to a 0.02 percentage points reduction of job creation and a 0.57 percentage points increase in job destruction for transportation equipment at a four quarter horizon. The corresponding changes in job creation (job destruction) are 0.54 (1.11) for motor vehicles and passenger car bodies, -0.43 (0.69) for truck and bus bodies, 0.04 (0.58) for motor vehicle parts and accessories, and -0.16 (1.90) for truck trailers.

The last rows of Table 3 show that a typical oil price shock leads to considerable reallocation activity at the interior of the automobile sector. Note that the one-year cumulative change in the job reallocation rate equals 10.59 (12.42) percentage points for motor vehicles and passenger car bodies, 0.41 (0.28) for truck and bus bodies, 2.61 (3.55) for motor vehicle parts and accessories, and 4.66 (5.50) for truck trailers using x_t^1 (x_t^4). The two-year cumulative change in the job reallocation rate equals 13.81 (16.10) percentage points for motor vehicles and passenger car bodies, 1.28 (1.30) for truck and bus bodies, 3.65 (5.20) for motor vehicle parts and accessories, and 8.85 (10.80) for truck trailers using x_t^1 (x_t^4). Furthermore, after two years, excess reallocation, which represents the amount of job turnover that goes on above and beyond what would be required to attain the observed net change in employment, has increased by 8.68 (10.76) percentage points in motor vehicles and passenger car bodies, -0.29 (0.48) in motor vehicles parts and accessories, 1.38 (2.78) in truck trailers, and has declined by 1.83 (2.64) percentage points in truck and bus bodies using x_t^1 (x_t^4).

How much larger is the process of labor reallocation caused by a large oil price shock? Comparing the one-year cumulative change for the two 4-digit sectors with the largest reallocation –motor vehicles and passenger car bodies, and truck trailers– suggests that a doubling in the size of the oil shock leads to about double the amount of labor reallocation (compare Tables 3 and 4). For instance, using $x_t^1(x_t^4)$, the one-year cumulative change in labor reallocation for motor vehicles and passenger car bodies equals 10.59 (12.42) and 24.32 (35.19) percentage points for a typical and a large shock, respectively. The corresponding changes in net employment are -4.75 (-4.73) percentage points for a typical shock and -11.63 (-14.20) percentage points for a large shock whereas the corresponding changes in excess reallocation are 5.84 (7.69) and 12.7 (21) percentage points for a typical and a large shock, respectively.

All in all, the $IRFs$ indicate that oil price shock have a considerable effect on job reallocation. This behavior is evidenced in that the response of job creation and the (negative) of the response of job destruction plotted in Figures 3 and 4 very rarely lie on top of each other. More specifically, our results imply that oil price increases lead to a considerable increase in job destruction and only a moderate change in job creation, especially in industries that are intensive in the use of energy in consumption (e.g., motor vehicles). As a consequence, in these industries, an increase in net employment ensues one to two years after an increase in oil prices.

It is interesting to compare our findings with the analysis in DH. As part of their investigation on the effect of oil price shocks on the creation and destruction of U.S. manufacturing jobs, DH compute impulse response functions based in their estimated near-VAR. Unlike our model, theirs included a macro block, contained a censored measure of oil prices as a left-hand-side variable, and was estimated using data for 1972-1988. Thus, to compare results we re-estimated our simultaneous equations model including the same macro block as DH and using 1972-1988 data.[6] Figure A.3 of the appendix shows a smaller effect of oil price shocks on the creation and destruction of manufacturing jobs than originally estimated in DH. This smaller impact is consistent with Kilian and Vigfusson's (2011b) conclusion that the inclusion of a censored oil price variable in the VAR may lead to overestimating the impact of an oil price shock.

2.5 A Job Reallocation Test

Given the definitions of job reallocation, net employment and excess job reallocation in equations (3)-(5), one may argue that the presence of an asymmetry in the response of job creation and destruction to positive oil price innovations, with the rate of job destruction exceeding the rate of job creation, would explain why an increase in oil prices leads both to a decline in net employment and an increase in excess reallocation (see equations (4) and (5).) Furthermore, such asymmetry (if present) would constitute evidence of a reallocation effect. Hence, consider testing for symmetry in the response of job creation and job destruction to a positive oil price shock of size δ in the following manner. After computing the unconditional impulse response functions for job creation,

[6] Our identification assumptions differ from DH in that we assume recursive ordering of the system. As we mentioned before, given the methodology we use to compute the $IRFs$ we need a model that is fully identified.

$I_{POS}(h,\delta)$, and job destruction, $I_{NEG}(h,\delta)$, described in section 3, compute the test:

$$W = \left(R\widehat{\beta}\right)' \left(R\widehat{\Xi}R'\right)^{-1} \left(R\widehat{\beta}\right) \sim \chi^2_{H+1}$$

where

$$\underset{2(H+1)\times 1}{\widehat{\beta}} = \begin{bmatrix} I_{NEG}(0,\delta) \\ \vdots \\ I_{NEG}(H,\delta) \\ I_{POS}(0,\delta) \\ \vdots \\ I_{NEG}(H,\delta) \end{bmatrix}; \quad \underset{(H+1)\times 2(H+1)}{R} = \begin{bmatrix} 1 & \dots & 0 & 1 & \dots & 0 \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ 0 & \dots & 1 & 0 & \dots & 1 \end{bmatrix};$$

$$\underset{2(H+1)\times 2(H+1)}{\Xi} = E\left[\left(\widehat{\beta}-\beta\right)\left(\widehat{\beta}-\beta\right)'\right].$$

The null hypothesis is that the responses of job creation and destruction to a positive oil price shock of size δ, up to horizon H, are symmetric. That is:

$$H_o : I_{NEG}(h,\delta) + I_{POS}(h,\delta) = 0 \text{ for } h = 0,1,2,...,H.$$

Given the definition of job reallocation in (3), the null here is that oil price increases have no effect on job reallocation. For this reason we will refer to this test of symmetry as a job reallocation test. Furthermore, note that the null hypothesis evaluated in this section differs from that in Kilian and Vigfusson (2011b) –which we will explore in section 5– where the null is that the response of a variable y to a positive oil price shock of size δ and the negative of the response of the same variable y to a negative oil price shock of size $-\delta$, up to horizon H, is symmetric (i.e.,

$H_o : I_y(h,\delta) = -I_y(h,-\delta)$ for $h = 0, 1, 2, ..., H$.)

In our analysis we report the job reallocation test for a one year horizon (4 quarters) for three reasons. First, the job reallocation test for $h = 4$ is a joint test of symmetry for horizons $h = 1, 2, 3, 4$, hence it evaluate whether the sum of response of job creation and destruction to a positive oil price shock was jointly significant from impact until a year after the shock. Second, it has been shown that the effect of oil price shocks on economic activity tends to be largest a year after the shock and dies out progressively afterwards (see e.g.,DH, and Lee and Ni, 2002); thus, it makes sense to evaluate the effect at this horizon. Last but not least, if one was to repeat the impulse response based test over a number of horizons there would be the possibility that any rejection of the null of job reallocation might be simply obtained by chance. Thus, to avoid this data mining problem we focus on the one-year horizon.

Results for the job reallocation test for a typical and a large shock are reported in Table 5. Regardless of the oil price measure, x_t^1 or x_t^4, we fail to reject the null no job reallocation for total manufacturing when we consider a typical shock (see left panel of Table 5). In contrast, we reject the null at a 5% significance level for furniture and fixtures, rubber and plastics, truck trailers, using either x_t^1 or x_t^4. In addition, we reject the null of no job reallocation when we use x_t^4 for lumber and stone, clay and glass.

More widespread evidence of job reallocation is found when we consider a large shock using x_t^4.We reject the null of no reallocation for 10 sectors: textiles, lumber, furniture and fixtures, petroleum and coal, rubber and plastics, stone, clay and glass, electronic and electric equipment, motor vehicles and passenger car bodies, motor vehicle parts and accessories, and truck trailers. Yet, less evidence of asymmetry is found for x_t^1 (see right panel of Table 5). In this case, we reject the null of no job reallocation for furniture and fixtures only.

It is worth comparing the results obtained here with those of reallocation test for a model à la DH where we include a macro block and use their sample (1972-1988). In that case we are unable to reject the null of no job reallocation for all sectors, regardless of the nonlinear transformation of oil prices.

In brief, the $IRFs$ plotted in Figures 3a and 3b suggest the responses of job creation and job destruction to typical positive oil price shocks are asymmetric. In particular, in the face of an oil price increase, the rate at which exiting and contracting establishments shed jobs increases more than the rate at which entering and expanding establishments create jobs. Furthermore, the job reallocation test suggest that this difference is statistically significant for a number of sectors that use energy intensively in production or consumption. Statistical evidence of job reallocation is more prevalent for a large shock, even though the uncertainty in estimating the response to a large shock is higher relative to that of a small shock.

2.6 Asymmetries in the Response to Oil Price Increases and Decreases?

The research question initially addressed by Davis and Haltiwanger (2001) and re-examined in the previous section is the presence (or absence) of asymmetry in the response of job creation and job destruction to positive oil price shocks. This question is crucial in understanding the effect of oil price increases on job flows and, especially, in gauging the role of the allocative channel (via job reallocation) in accounting for the transmission of oil price shocks.

Another aspect that is key in grasping the nature of the relationship between oil prices and the macroeconomy is whether the response of job destruction (and creation) to oil price increases and decreases is symmetric. In other words, do oil price increases lead to the same change in the rate of job destruction (creation) than the change brought about by a decline in oil prices? A negative answer to this question would provide support to the idea that asymmetry in the response of manufacturing job flows to oil price increases and decrease could lead to asymmetries in the response of industrial production (see for instance Herrera, Lagalo and Wada, 2011). To investigate this issue, we implement Kilian and Vigfusson's (2011b) IRF based test to examine the null of symmetry in the response of job creation to oil price increases and decreases, where:

$$H_o : I_{POS}(h, \delta) = -I_{POS}(h, -\delta) \text{ for } h = 0, 1, 2, ..., H.$$

Similarly, for job destruction we test the null

$$H_o : I_{NEG}(h, \delta) = -I_{NEG}(h, -\delta) \text{ for } h = 0, 1, 2, ..., H.$$

For the reasons discussed above, we compute the impulse response function based test for a one-year horizon ($h = 4$ quarters). Table 6 reports the $p - values$ for the IRF based test of symmetry in the response of job creation and job destruction, (left and right panels, respectively) to oil price increases and decreases. Table 6 shows that for a typical shock the null is not rejected at a 5% for both job creation and job destruction for all sectors and regardless of the nonlinear transformation of oil prices.

Test results reported in Table 7 suggests asymmetries are more widespread for a large oil price shock. Note that, when we use x_t^1, we are unable to reject the null of symmetry at for total manufacturing. At the industry level, we reject the null of symmetry in the response of job creation only for tobacco. Interestingly, when we use x_t^4 we are able to reject the null for total manufacturing using the 1972:Q2-2005:Q1 sample. In addition, we find evidence of asymmetries for lumber.

Similarly, we don't find evidence of asymmetry in the response of job destruction for total manufacturing to large shocks. Yet, we find evidence of asymmetry in the response of job destruction to large shocks at the industry level for several sectors (see right panel of Table 7). Using x_t^1, we reject the null of symmetry at a 5% significance level for food and petroleum and coal. Evidence of asymmetry is more prevalent using the net oil price increase x_t^4. In fact, we reject the null for textiles, furniture and fixtures, petroleum and coal products, rubber and plastics, fabricated metals, electronic and electric equipment, and truck trailers.

In brief, our results suggest that for a typical oil price shock, a linear model provides a good approximation to the response of job creation (and job destruction) to positive and negative oil price innovations. Yet, some evidence of asymmetry is found for the response to a large shock. This is clearly the case for total manufacturing, textiles, furniture and fixtures, and petroleum and coal.

2.7 Job Flows and Oil Price Shocks: Before and During the Great Moderation

Recent research into the oil price-macroeconomy relationship has found a muted effect of oil prices on GDP growth.[7] Blanchard and Galí (2010) suggests that increased flexibility in the labor market –more precisely, a decrease in real wage rigidity– partially accounts for the fact that oil prices do not shock in the 2000s as they did in the 1970s. To explore whether the response of job flows to a positive oil price shock has changed since the Great Moderation, we re-estimate our model and compute the $IRFs$ based test for two subsamples: 1972:Q2-1983:Q4 and 1984:Q1-2005:Q1 for total manufacturing, and 1972:Q2-1983:Q4 and 1984:Q1-1998:Q4 for the sectoral data.

[7] See Hooker (2002), Herrera and Pesavento (2007), Edelstein and Kilian (2007) and Blanchard and Gali (2010).

2.7.1 The Response of Job Flows to an Increase in Real Oil Prices

Figures 4a and 4b plot the responses of job creation and job destruction to a typical positive oil shock. Recall that, to facilitate the comparison and to conserve space, we plot the negative of the job destruction rate and we depict the $IRFs$ only for 18 of the industries under study.

Before we proceed to discuss our results two caveats are necessary. First, because the number of observations used to estimate the model in the first sub-sample is small, estimates of the $IRFs$ for this sub-sample are estimate with a low degree of precision precision. Second, while a typical one standard deviation shock corresponds to 0.08% in the first sub-sample, a one standard deviation in the second subsample is equivalent to 0.16%.

Overall, the responses of job creation and job destruction to a typical positive oil price shock appear to be milder since the onset of the Great Moderation. This is especially the case for lumber, furniture and fixtures, petroleum and coal, transportation equipment, motor vehicles and car bodies, motor vehicles and parts and truck trailers, when we use x_t^1 (see Figures 4a and 4b). Yet, for transportation equipment –an industry that accounts for 10% of employment in manufacturing–, the cumulative effect on net employment is larger during the Great Moderation. For instance, compared to the pre-1984 sample, the two year cumulative effect drops from to -2.80 percentage points to -2.15 (see Table 8). At a 4-digit SIC level, large drops in the effect of oil price shocks on the one-year and two-year net employment are evident for motor vehicle parts and passenger car bodies, truck and bus bodies, and motor vehicle parts and accessories. Estimation results not reported herein -but available in the appendix- show very similar results when we use the net oil price increase, x_t^4.[8]

The fact that this decline in the effect on net employment coincided with an increase in the

[8] See Figures A.4a, A.4b, A.5a, A.5b in the on-line appendix as well as Tables A.1 and A.2.

effect on job reallocation and excess reallocation, suggests that increased flexibility in the labor market could have played a role in accounting for the diminished impact of oil price shocks on total manufacturing during the Great Moderation.

As for a large innovation, Table 9 shows a reduction in the impact of oil price shocks on net employment since the start of the Great Moderation. More specifically, we obtain a decline in the two-year cumulative change for total manufacturing for seventeen of the twenty 2-digit SIC industries (i.e., all but printing, rubber and plastics, and transportation equipment), and for three of the 4-digit SIC industries (i.e., all but truck trailers). Although large flows in and out of employment in U.S. manufacturing are evident across subsamples, evidence of increased job reallocation during the Great Moderation is more prevalent for a typical shock than for a large shock. Yet, whether this is indicative of increased flexiblity in the labor market –due possibly to less costly labor reallocation–, or indicative of a stronger mismatch is a question that will be addressed in the following section.

2.7.2 A Test of Job Reallocation

As in the previous section, a caveat is necessary before we proceed to discuss the results of the IRF based test. Little is known regarding the power of this test in samples of the size considered in this section. In particular, the fact that we estimate the $IRFs$ for the first subsample using only 47 observations imply that our coefficients are imprecisely estimated. Therefore, these test results should be interpreted with caution.

Table 10 reports the $p - values$ for the test of job reallocation to a typical (one standard deviation) shock. Clearly the number of rejections declines significantly when we split the sample in two. In particular, for the pre-1984 subsample, we are unable to reject the null of no job reallocation. The only exceptions are petroleum and coal and truck trailers for which we reject the null in the response to a typical shock respectively, when we use x_t^4. Recall that these are two industries that are energy intensive in the use of oil in production (petroleum and coal) or consumption (truck trailers).

The fact that we are able to reject the null of no job reallocation for total manufacturing for the 1984:Q1-1998:Q4 period, regardless of the oil measure and the size of the shock, suggests that the allocative channel played a role in the transmission of oil price shocks since the start of the Great Moderation. Yet, as evidenced by the large $p-value$ for the 1984:Q1-2005:Q1 subsample, the strength of this channel appears to have diminished in the 2000s. As it is the case with the test results for the full sample (see section 5), evidence of job reallocation is more prevalent during the Great Moderation for a large shock than for a typical shock (see Table A.9–12).

2.8 Conclusions

Building on the work by Davis and Haltiwanger (2001) and Kilian and Vigfusson (2011b) we take another look at the effect of oil price shocks on labor reallocation. Using a simultaneous equation model that nests both a symmetric and an asymmetric model of the transmission of oil price shocks to job creation and job destruction, we find some evidence of an asymmetric response of job creation and job destruction to oil price increases. More specifically, following an unexpected oil price hike, firms shed jobs at a faster rate than the rate at which they create jobs thus leading to a drop in net employment and an increase in labor reallocation. Yet, this asymmetry, first uncovered by Davis and Haltiwanger (2001), is statistically significant only for a number of industries that are energy intensive.

Furthermore, splitting the sample in two periods, before and after the Great Moderation, suggests that the magnitude of the asymmetry in response to a typical shock has declined over time. This result is consistent with Blanchard and Galí's (2010) finding that oil prices do not shock in the 2000s as they shocked in the 1970s. Yet, our results suggest the importance of the reallocation effect continued to be considerable for a large oil price shock during the Great Moderation.

Finally, as for the question of asymmetry in the response of job flows to positive and negative oil price innovations, our test results suggest a linear model provides a good approximation to estimating the response to a typical shock.

Table 1. Magnitude of gross job flows by sectors

Sectors	POS	NEG	SUM	NET	EXC
Total manufacturing (1972:Q2-2005:Q1)	5.14	5.47	10.61	-0.34	9.79
Total manufacturing (1972:Q2-1998:Q4)	5.33	5.55	10.88	-0.22	10.08
Food	8.27	8.20	16.47	0.07	15.64
Tobacco	6.04	6.58	12.63	-0.54	9.58
Textiles	3.37	4.01	7.38	-0.65	6.29
Apparel	5.53	6.41	11.95	-0.88	10.44
Lumber	6.22	6.31	12.53	-0.08	10.66
Furniture and fixtures	5.09	5.13	10.22	-0.03	8.70
Paper	3.48	3.57	7.05	-0.09	6.20
Printing	4.63	4.52	9.15	0.11	8.17
Chemicals	3.54	3.78	7.31	-0.24	6.43
Petroleum and coal	3.82	4.24	8.05	-0.42	6.80
Rubber and plastics	5.22	4.99	10.21	0.22	8.72
Leather	4.78	5.93	10.71	-1.15	8.88
Stone, clay and glass	5.18	5.38	10.56	-0.20	9.16
Primary metals	3.47	4.08	7.56	-0.61	5.70
Fabricated metals	5.12	5.31	10.44	-0.19	8.92
Industrial machinery	4.85	5.02	9.87	-0.16	8.15
Electronic and electric equipment	4.66	4.81	9.47	-0.15	7.92
Transportation equipment	5.13	5.37	10.50	-0.24	8.46
Instruments and related products	4.05	4.23	8.28	-0.19	7.02
Miscellaneous manufacturing	6.65	6.85	13.50	-0.19	11.82
Motor vehicles and passenger car bodies	7.45	7.89	15.34	-0.44	9.69
Truck and bus bodies	7.11	6.97	14.08	0.14	10.61
Motor vehicle parts and accessories	4.58	4.75	9.33	-0.17	6.57
Truck trailers	7.47	7.22	14.63	0.19	9.58

Notes: This table reports the average job creation (POS), job destruction (NEG), net employment change (NET), job reallocation (SUM), and excess job reallocation (EXC). Values in table are in percent.

Table 2. Magnitude of gross job flows before and after the Great Moderation

	1972:Q2-1983:Q4					1984:Q1-1998:Q4				
Sectors	POS	NEG	SUM	NET	EXC	POS	NEG	SUM	NET	EXC
Total manufacturing (1973-2005)						4.86	5.25	10.11	-0.39	9.72
Total manufacturing (1973-1998)	5.63	5.88	11.51	-0.24	10.34	5.09	5.30	10.39	-0.21	10.19
Food	9.41	9.53	18.94	-0.11	18.06	7.38	7.16	14.53	0.22	14.31
Tobacco	6.32	6.84	13.16	-0.52	10.75	5.83	6.38	12.21	-0.55	11.66
Textiles	3.60	4.24	7.84	-0.63	6.46	3.18	3.84	7.02	-0.66	6.37
Apparel	5.62	6.36	11.99	-0.74	10.41	5.46	6.45	11.91	-0.99	10.92
Lumber	7.06	7.45	14.51	-0.39	11.91	5.57	5.51	10.98	0.16	10.82
Furniture and fixtures	5.34	5.51	10.84	-0.17	8.76	4.91	4.83	9.74	0.07	9.67
Paper	3.72	3.95	7.67	-0.23	6.54	3.29	3.27	6.56	0.02	6.54
Printing	4.64	4.57	9.21	0.07	8.19	4.62	4.48	9.10	0.14	8.96
Chemicals	3.80	4.14	7.94	-0.34	6.92	3.33	3.50	6.83	-0.16	6.66
Petroleum and coal	3.96	4.46	8.41	-0.50	6.94	3.71	4.06	7.77	-0.36	7.42
Rubber and plastics	5.66	5.60	11.26	0.06	8.90	4.87	4.52	9.39	0.35	9.04
Leather	4.88	5.89	10.77	-1.01	9.15	4.70	5.97	10.67	-1.27	9.40
Stone, clay, and glass	5.48	5.89	11.36	-0.41	9.53	4.95	4.98	9.92	-0.03	9.89
Primary metal	3.74	4.68	8.42	-0.94	5.67	3.26	3.62	6.88	-0.36	6.53
Fabricated metal	5.60	5.97	11.57	-0.36	9.45	4.75	4.80	9.55	-0.05	9.50
Industrial machinery	5.07	5.34	10.41	-0.27	8.23	4.68	4.76	9.44	-0.08	9.36
Electronic and electric equipment	4.98	4.97	9.95	0.00	7.81	4.41	4.67	9.09	-0.26	8.82
Transportation equipment	5.94	6.31	12.25	-0.38	9.32	4.49	4.63	9.12	-0.14	8.99
Instruments and related products	4.48	4.23	8.71	0.25	7.13	3.71	4.23	7.94	-0.53	7.41
Miscellaneous manufacturing	6.92	7.32	14.24	-0.40	12.17	6.44	6.48	12.92	-0.04	12.88
Motor vehicles and passenger car bodies	9.63	10.39	20.03	-0.76	11.79	5.74	5.92	11.66	-0.18	11.48
Truck and bus bodies	8.47	8.52	16.99	-0.50	12.54	6.05	5.76	11.81	0.29	11.52
Motor vehicle parts and accessories	5.30	5.68	10.98	-0.38	6.64	4.01	4.02	8.04	-0.01	8.02
Truck trailers	8.25	8.25	16.50	-0.01	10.28	6.75	6.42	13.17	0.34	12.84

Notes: This table reports the average job creation (POS), job destruction (NEG), net employment change (NET), job reallocation (SUM), and excess job reallocation (EXC). Values in table are in percent.

Table 3. Cumulative change in job flows due to a typical oil price shock

	$x_t^{\#}= x_t^1$						$x_t^{\#}= x_t^4$					
	NET		SUM		EXC		NET		SUM		EXC	
Sectors	4	8	4	8	4	8	4	8	4	8	4	8
Total manufacturing (1972:Q2-2005:Q1)	-0.32	-0.51	0.33	0.67	0.01	0.12	-0.41	-0.89	0.36	0.92	-0.05	0.03
Total manufacturing (1972:Q2-1998:Q4)	-0.71	-0.83	0.85	1.44	0.14	0.51	-0.78	-1.10	0.90	1.72	0.12	0.51
Food	-0.25	-0.38	0.83	1.61	0.18	0.80	-0.33	-0.55	1.00	2.04	0.40	1.21
Tobacco	0.73	0.69	0.14	0.12	-1.27	-1.50	1.16	1.31	-0.03	0.03	-1.84	-2.01
Textiles	-1.08	-0.81	0.73	1.20	-0.35	-0.41	-1.23	-1.07	0.88	1.62	-0.34	-0.19
Apparel	0.06	-0.01	0.47	0.75	-0.22	-0.31	0.04	-0.36	0.52	0.91	-0.25	-0.47
Lumber	-3.28	-3.05	2.05	3.53	-1.23	-0.19	-3.22	-3.11	2.09	3.79	-1.13	0.05
Furniture and fixtures	-1.67	-1.66	1.08	2.01	-0.60	-0.33	-1.78	-2.31	1.09	2.35	-0.70	-0.34
Paper	-0.79	-0.77	0.35	0.74	-0.45	-0.41	-0.89	-1.14	0.48	1.18	-0.40	-0.19
Printing	-0.46	-0.47	0.63	0.75	0.06	0.11	-0.45	-0.62	0.48	0.53	-0.05	-0.19
Chemicals	-0.04	-0.05	0.40	0.68	-0.09	0.05	-0.25	-0.60	0.59	1.22	0.02	0.30
Petroleum and coal	-0.32	-0.44	1.02	1.15	-0.81	-0.83	-0.59	-0.84	1.54	1.86	-0.11	-0.04
Rubber and plastics	-1.75	-1.54	1.39	2.36	-0.36	0.04	-1.97	-1.99	1.60	3.08	-0.37	0.43
Leather	-0.12	-0.42	-0.23	0.12	-1.27	-1.29	0.07	-0.32	-0.29	0.06	-1.68	-1.81
Stone, clay, and glass	-1.85	-2.32	1.15	2.00	-0.70	-0.36	-1.91	-2.53	1.26	2.31	-0.66	-0.29
Primary metal	-0.72	-1.40	0.27	1.17	-0.62	-0.49	-1.00	-2.26	0.63	2.24	-0.37	-0.02
Fabricated metal	-1.38	-1.50	1.17	1.85	-0.22	0.23	-1.47	-1.89	1.28	2.33	-0.19	0.39
Industrial machinery	0.02	-0.48	-0.04	0.10	-0.52	-0.88	-0.23	-1.29	0.17	0.61	-0.46	-1.07
Electronic and electric equipment	-0.92	-1.02	0.65	1.07	-0.27	-0.23	-1.01	-1.47	0.88	1.70	-0.14	-0.04
Transportation equipment	-2.15	-2.37	2.62	3.93	0.47	1.43	-2.19	-2.36	3.01	4.67	0.81	2.22
Instruments and related products	0.19	-0.02	0.17	0.32	-0.50	-0.60	0.31	-0.07	0.38	0.78	-0.33	-0.34
Miscellaneous manufacturing	-0.93	-0.78	1.07	1.34	0.01	0.00	-1.31	-1.53	1.02	1.31	-0.31	-0.60
Motor vehicles and passenger car bodies	-4.75	-4.67	10.59	13.81	5.84	8.68	-4.73	-4.47	12.42	16.10	7.69	10.76
Truck and bus bodies	-2.43	-2.92	0.41	1.28	-2.02	-1.83	-2.96	-3.74	0.28	1.30	-2.68	-2.64
Motor vehicle parts and accessories	-3.18	-2.41	2.61	3.65	-0.56	-0.29	-3.73	-2.74	3.55	5.20	-0.18	0.48
Truck trailers	-5.22	-4.42	4.66	8.85	-0.56	1.38	-5.10	-4.99	5.50	10.80	0.40	2.78

Notes: This table reports the cumulative change (measured in percentage points) in net employment (NET), job reallocation (SUM), and excess reallocation (EXC) due to a positive one standard deviation innovation in the real oil price. Computations are based on 10,000 simulations of model (8).

Table 4. Cumulative change in job flows due to a large oil price shock

	$x_t^{\#} = x_t^1$						$x_t^{\#} = x_t^4$					
	NET		SUM		EXC		NET		SUM		EXC	
Sectors	4	8	4	8	4	8	4	8	4	8	4	8
Total manufacturing (1972:Q2-2005:Q1)	-0.83	-1.28	0.73	1.43	-0.10	0.09	-1.40	-2.41	1.04	2.41	-0.36	-0.03
Total manufacturing (1972:Q2-1998:Q4)	-1.81	-2.14	1.94	3.28	0.14	0.92	-2.46	-3.06	2.38	4.40	-0.08	0.95
Food	-0.67	-0.99	1.47	3.21	-0.37	1.01	-0.95	-1.37	1.91	4.14	0.32	2.08
Tobacco	1.18	1.26	0.48	0.52	-3.84	-4.42	2.38	2.71	-0.09	0.00	-3.48	-3.79
Textiles	-2.33	-1.76	1.30	2.24	-1.03	-1.18	-3.20	-2.53	2.04	3.65	-1.16	-1.13
Apparel	-0.09	-0.47	0.55	1.26	-1.09	-1.39	-0.42	-1.37	0.51	1.41	-2.12	-2.82
Lumber	-7.57	-6.49	3.78	6.22	-3.79	-2.48	-8.69	-7.90	4.36	8.05	-4.33	-1.96
Furniture and fixtures	-4.05	-4.12	2.21	4.38	-1.83	-1.2	-5.17	-6.30	2.22	5.26	-2.94	-2.23
Paper	-1.87	-1.93	0.49	1.32	-1.38	-1.40	-2.38	-2.79	1.11	2.83	-1.27	-0.93
Printing	-1.42	-1.62	1.44	1.80	-0.01	0.10	-1.77	-2.27	0.86	0.97	-0.90	-1.30
Chemicals	0.00	-0.03	0.79	1.56	-0.47	-0.05	-0.94	-1.70	1.42	2.98	-0.41	0.32
Petroleum and coal	-0.70	-0.87	1.90	2.12	-3.59	-3.71	-1.61	-2.14	4.05	4.75	-1.02	-0.96
Rubber and plastics	-4.12	-3.63	2.77	4.90	-1.35	-0.54	-5.75	-5.35	3.77	7.19	-1.98	-0.32
Leather	0.04	-0.47	-1.02	-0.52	-2.94	-3.03	0.53	-0.57	-1.55	-0.78	-4.54	-4.93
Stone, clay and glass	-4.95	-5.84	2.42	4.07	-2.54	-1.97	-5.96	-7.03	3.06	5.44	-2.90	-2.04
Primary metals	-2.32	-3.71	0.74	3.01	-1.73	-0.99	-4.13	-6.70	2.41	6.63	-1.72	-0.21
Fabricated metals	-3.39	-3.61	2.22	3.60	-1.17	-0.31	-4.58	-5.37	3.00	5.54	-1.59	-0.02
Industrial machinery	0.09	-1.31	-0.78	-0.48	-1.97	-3.05	-1.20	-4.02	-0.01	1.28	-2.04	-3.58
Electronic and electric equipment	-2.51	-2.89	1.35	2.47	-1.16	-1.13	-3.23	-4.12	2.27	4.35	-1.12	-0.86
Transportation equipment	-5.43	-6.06	5.46	8.24	0.04	1.81	-6.25	-6.37	7.64	11.62	1.39	4.74
Instruments and related products	-0.21	-1.14	-0.05	0.29	-1.64	-2.24	0.06	-1.16	0.62	1.55	-1.58	-1.97
Miscellaneous manufacturing	-2.13	-1.92	1.62	2.01	-0.57	-0.69	-4.11	-4.69	1.37	2.14	-2.73	-3.39
Motor vehicles and passenger car bodies	-11.63	-11.92	24.32	30.79	12.7	17.9	-14.20	-12.74	35.19	44.05	21.00	28.40
Truck and bus bodies	-5.75	-6.45	-1.50	-0.33	-7.25	-7.38	-8.42	-9.43	-1.48	0.54	-9.91	-9.85
Motor vehicle parts and accessories	-7.13	-5.63	5.28	7.52	-1.84	-1.35	-10.25	-7.14	9.26	13.20	-0.99	-0.16
Truck trailers	-12.60	-11.04	10.55	20.86	-2.05	3.59	-14.22	-12.92	14.99	28.46	0.77	6.06

Notes: This table reports the cumulative change (measured in percentage points) in net employment (NET), job reallocation (SUM), and excess reallocation (EXC) due to a positive one standard deviation innovation in the real oil price. Computations are based on 10,000 simulations of model (8).

Table 5. Job reallocation test

Sectors	Typical oil price shock		Large oil price shock	
	$x_t^{\#}= x_t^1$	$x_t^{\#}= x_t^4$	$x_t^{\#}= x_t^1$	$x_t^{\#}= x_t^4$
Total Manufacturing (1972:Q2-2005:Q1)	0.27	0.40	0.49	0.38
Total Manufacturing (1972:Q2-1998:Q4)	0.34	0.14	0.42	*0.06*
Food	0.81	0.21	0.87	0.35
Tobacco	0.84	0.98	0.71	0.99
Textiles	*0.08*	*0.07*	0.14	**0.01**
Apparel	0.71	0.65	0.83	0.70
Lumber	*0.08*	**0.05**	0.13	**0.02**
Furniture	**0.05**	**0.05**	**0.04**	**0.00**
Paper	0.42	0.32	0.36	0.13
Printing	0.72	0.88	0.65	0.81
Chemicals	0.55	0.22	0.50	0.13
Petroleum and coal	0.40	0.11	*0.09*	**0.01**
Rubber and plastics	**0.04**	**0.01**	*0.07*	**0.00**
Leather	0.49	0.78	0.26	0.85
Stone, clay, and glass	*0.10*	**0.04**	0.17	**0.02**
Primary metal	0.61	0.37	0.53	0.16
Fabricated metal	0.41	0.26	0.60	*0.10*
Industrial machinery	0.80	0.89	0.76	0.73
Electronic and electric equipment	0.53	0.26	0.57	**0.03**
Transportation equipment	0.22	0.12	0.47	*0.09*
Instruments and related products	0.62	0.30	0.68	0.20
Miscellaneous manufacturing	0.32	0.32	0.55	0.34
Motor vehicles and passenger car bodies	0.18	0.13	0.17	**0.02**
Truck and bus bodies	0.66	0.37	0.79	0.32
Motor vehicle parts and accessories	0.11	*0.07*	*0.07*	**0.02**
Truck trailers	**0.05**	**0.01**	*0.06*	**0.00**

Notes: Computations are based on 10,000 simulations of model (8). $p-values$ are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level, respectively.

Table 6. IRF based test of symmetry in the response to a typical oil price shock

	Job creation		Job destruction	
Sectors	$x_t^{\#}=x_t^1$	$x_t^{\#}=x_t^4$	$x_t^{\#}=x_t^1$	$x_t^{\#}=x_t^4$
Total manufacturing (1972:Q2-2005:Q1)	0.71	0.46	0.66	0.61
Total manufacturing (1972:Q2-1998:Q4)	0.67	0.74	0.73	0.73
Food	1.00	0.93	0.27	0.83
Tobacco	0.27	0.89	0.77	0.82
Textiles	0.96	0.95	0.77	0.48
Apparel	0.95	0.79	0.81	0.59
Lumber	0.35	0.54	0.40	0.42
Furniture and fixtures	0.83	0.67	0.30	0.38
Paper	0.78	0.76	0.78	0.72
Printing	0.68	0.75	0.84	0.74
Chemicals	0.64	0.50	0.70	0.46
Petroleum and coal	0.31	0.56	*0.10*	0.23
Rubber and plastics	0.54	0.80	0.69	0.44
Leather	0.44	0.67	0.64	0.97
Stone, clay and glass	0.60	0.72	0.76	0.71
Primary metals	0.77	0.76	0.73	0.71
Fabricated metals	0.75	0.73	0.87	0.54
Industrial machinery	0.94	0.73	0.93	0.81
Electronic and electric equipment	0.81	0.91	0.81	0.41
Transportation equipment	0.36	0.94	0.91	0.88
Instruments and related products	0.53	0.82	0.74	0.58
Miscellaneous manufacturing	0.67	0.72	0.99	0.79
Motor vehicles and passenger car bodies	0.28	0.79	0.66	0.78
Truck and bus bodies	0.89	0.88	0.95	0.72
Motor vehicle parts and accessories	0.43	0.79	0.93	0.78
Truck trailers	0.49	0.86	0.34	0.51

Notes: Computations are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level, respectively.

Table 7: IRF based test of symmetry in the response to a large oil price shock

	Job creation		Job destruction	
Sectors	$x_t^{\#} = x_t^1$	$x_t^{\#} = x_t^4$	$x_t^{\#} = x_t^1$	$x_t^{\#} = x_t^4$
Total manufacturing (1972:Q2-2005:Q1)	0.60	**0.01**	0.52	*0.06*
Total manufacturing (1972:Q2-1998:Q4)	0.42	0.16	0.55	*0.06*
Food	1.00	0.92	**0.04**	0.73
Tobacco	**0.04**	0.80	0.63	0.64
Textiles	0.93	0.78	0.61	**0.00**
Apparel	0.92	0.44	0.69	0.13
Lumber	0.14	**0.05**	0.17	*0.07*
Furniture and fixtures	0.68	*0.09*	*0.07*	**0.00**
Paper	0.54	0.32	0.56	0.17
Printing	0.53	0.38	0.80	0.29
Chemicals	0.45	0.18	0.57	*0.10*
Petroleum and coal	*0.07*	*0.10*	**0.00**	**0.00**
Rubber and plastics	0.23	0.30	0.57	**0.02**
Leather	0.25	0.33	0.40	0.93
Stone, clay and glass	0.34	0.12	0.65	0.24
Primary metals	0.62	0.36	0.60	0.22
Fabricated metals	0.44	0.19	0.79	**0.02**
Industrial machinery	0.90	0.31	0.89	0.60
Electronic and electric equipment	0.72	0.77	0.75	0.02
Transportation equipment	*0.10*	0.87	0.88	0.55
Instruments and related products	0.38	0.55	0.64	0.12
Miscellaneous manufacturing	0.54	0.25	0.98	0.59
Motor vehicles and passenger car bodies	*0.07*	0.37	0.47	0.25
Truck and bus bodies	0.78	0.29	0.92	0.27
Motor vehicle parts and accessories	0.23	0.57	0.88	0.33
Truck trailers	0.41	0.72	0.20	**0.03**

Notes: Computations are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level, respectively.

Table 8. Cumulative change in job flows after a typical oil price shock ($x_t^{\#} = x_t^1$)

	1973-1983						1984-1998					
	NET		SUM		EXC		NET		SUM		EXC	
Sectors	4	8	4	8	4	8	4	8	4	8	4	8
Total manufacturing (1972:Q2-2005:Q1)							-0.44	-0.71	0.40	0.58	-0.04	-0.13
Total manufacturing (1972:Q2-1998:Q4)	-0.07	-0.33	-0.50	-0.54	-1.13	-1.44	-0.69	-0.94	0.95	1.27	0.27	0.33
Food	0.15	-0.03	-1.10	-0.91	-2.12	-2.10	0.08	-0.10	0.77	1.25	0.02	0.29
Tobacco	1.33	1.40	0.07	0.43	-1.36	-2.18	1.30	1.14	0.36	0.51	-2.43	-2.89
Textiles	0.19	0.46	-0.48	-0.48	-1.75	-2.38	-0.88	-0.80	0.87	1.01	0.00	0.05
Apparel	0.10	-0.31	-0.58	-0.48	-1.77	-2.52	0.44	0.67	1.05	1.07	0.53	0.32
Lumber	-2.33	-2.59	-1.39	-1.49	-3.72	-4.45	-1.77	-2.01	1.44	1.61	-0.39	-0.48
Furniture and fixtures	-1.36	-1.37	-0.02	-0.11	-1.81	-2.57	-0.99	-1.03	1.35	1.55	0.36	0.37
Paper	-1.31	-1.35	-0.15	0.85	-1.46	-1.53	-0.14	-0.08	0.05	0.03	-0.38	-0.51
Printing	0.11	0.03	-0.75	-0.89	-1.31	-1.69	-0.28	-0.18	1.02	0.91	0.39	0.15
Chemicals	0.52	0.47	-0.26	0.03	-1.69	-2.28	-0.01	0.06	0.19	0.13	-0.47	-0.69
Petroleum and coal	0.60	1.26	1.10	1.59	-2.03	-2.19	0.33	0.38	0.06	-0.06	-1.29	-1.56
Rubber and plastics	-0.75	-0.47	0.26	0.86	-0.77	-0.79	-1.45	-1.58	1.24	1.34	-0.21	-0.34
Leather	1.33	0.73	-0.74	-0.28	-2.48	-2.66	-0.81	-0.73	0.48	0.84	-0.75	-0.60
Stone, clay and glass	-1.15	-1.78	-0.53	0.05	-1.71	-1.96	-1.16	-1.63	0.91	0.99	-0.28	-0.68
Primary metals	3.93	2.41	-2.23	-2.57	-6.19	-8.04	-0.43	-0.72	-0.12	0.04	-0.91	-1.04
Fabricated metals	-0.75	-1.25	-1.20	-0.82	-2.23	-2.78	-0.21	0.13	0.66	0.51	-0.13	-0.61
Industrial machinery	3.21	2.41	-3.05	-4.49	-6.50	-9.24	-0.14	-0.13	0.37	0.35	0.19	0.07
Electronic and electric equipment	-0.80	-0.64	0.39	0.37	-0.90	-1.14	-0.72	-0.87	0.62	0.78	-0.18	-0.30
Transportation equipment	-0.97	-2.80	1.79	2.62	-0.24	-1.24	-1.57	-2.15	1.90	2.98	0.33	0.83
Instruments and related products	1.92	1.26	-0.63	-0.78	-2.63	-3.55	0.17	0.22	0.18	0.22	-0.07	-0.10
Miscellaneous manufacturing	-0.29	0.03	0.25	0.17	-1.12	-1.65	-0.53	-0.24	1.74	1.34	0.60	-0.09
Motor vehicles and passenger car bodies	-8.92	-7.33	14.16	12.84	5.24	2.10	-1.91	-2.19	3.67	6.37	1.77	3.76
Truck and bus bodies	-6.84	-6.45	-1.34	-0.74	-8.22	-8.69	-0.74	-2.01	1.06	1.90	-1.40	-1.84
Motor vehicle parts and accessories	-5.52	-4.69	3.06	3.98	-2.47	-3.22	-1.43	-1.08	0.90	1.25	-0.53	-0.58
Truck trailers	5.23	0.59	-1.77	1.85	-12.96	-16.46	-5.70	-4.26	4.63	7.49	-1.07	0.34

Notes: This table reports the cumulative change (measured in percentage points) in net employment (NET), job reallocation (SUM), and excess reallocation (EXC) due to a positive one standard deviation innovation in the real oil price. Computations are based on 10,000 simulations of model (8).

Table 9: Cumulative change in job flows after a large oil price shock ($x_t^{\#} = x_t^1$)

	1973-1983						1984-1998					
	NET		SUM		EXC		NET		SUM		EXC	
Sectors	4	8	4	8	4	8	4	8	4	8	4	8
Total manufacturing (1972:Q2-2005:Q1)							-0.91	-1.31	0.80	1.05	-0.11	-0.26
Total manufacturing (1972:Q2-1998:Q4)	-1.37	-2.10	0.21	0.95	-1.16	-1.27	-1.69	-2.14	2.52	3.28	0.73	1.04
Food	-0.49	-1.02	-0.69	0.67	-2.74	-1.91	0.47	0.22	0.94	1.60	-1.78	-1.43
Tobacco	0.43	-0.25	-1.33	-0.86	-2.74	-3.64	2.49	2.18	1.94	2.21	-6.88	-9.14
Textiles	-1.64	-1.37	0.66	2.38	-2.08	-1.60	-1.26	-0.99	1.66	1.63	0.21	-0.16
Apparel	-1.22	-2.02	0.35	2.14	-2.08	-2.27	1.27	1.53	0.92	0.56	-0.45	-1.19
Lumber	-7.21	-6.95	-0.22	1.60	-7.43	-7.17	-4.16	-4.41	2.54	2.72	-2.24	-2.55
Furniture and fixtures	-4.46	-4.41	1.41	3.10	-3.42	-3.80	-2.72	-2.79	2.95	3.35	0.23	0.26
Paper	-3.30	-3.62	0.17	2.18	-3.13	-3.33	-0.35	-0.23	0.15	0.00	-0.64	-1.03
Printing	-0.63	-1.34	-0.26	0.44	-1.63	-1.85	-1.54	-1.73	1.99	1.59	0.09	-0.62
Chemicals	-0.13	-0.79	0.50	1.89	-2.13	-2.65	0.04	0.48	0.33	0.14	-2.13	-2.92
Petroleum and coal	-1.78	-1.88	3.08	4.13	-2.59	-1.96	1.40	1.80	-0.53	-0.95	-5.10	-6.02
Rubber and plastics	-3.43	-2.37	1.51	3.45	-1.92	-1.89	-4.12	-4.20	3.00	3.21	-1.12	-1.43
Leather	0.22	-1.36	-0.06	1.77	-2.73	-2.62	-0.82	-0.01	0.30	0.05	-2.08	-3.14
Stone, clay and glass	-4.64	-6.11	0.81	3.24	-3.82	-3.41	-3.86	-5.20	2.41	2.53	-1.46	-2.66
Primary metals	1.06	-3.84	-0.72	2.51	-3.94	-5.61	-2.32	-2.82	0.95	1.95	-1.95	-1.55
Fabricated metals	-4.23	-5.61	-0.36	1.84	-4.59	-4.81	-1.12	-0.42	1.23	1.05	-1.07	-1.95
Industrial machinery	2.48	-2.19	-3.50	-2.82	-6.25	-10.24	-0.84	-0.64	0.38	0.22	-0.45	-0.98
Electronic and electric equipment	-3.65	-3.92	1.58	2.72	-2.24	-2.24	-2.43	-2.65	2.17	2.84	-0.31	-0.21
Transportation equipment	-3.55	-6.22	4.65	6.09	1.10	-0.13	-4.68	-6.57	5.02	8.09	0.33	1.52
Instruments and related products	1.09	-1.05	0.41	1.53	-2.09	-3.12	-0.43	-0.77	-0.39	-0.52	-1.58	-2.05
Miscellaneous manufacturing	-2.14	-2.52	1.49	3.47	-0.82	-0.43	-1.82	-1.15	3.39	2.61	-0.23	-1.68
Motor vehicles and passenger car bodies	-16.83	-14.49	32.08	30.68	15.25	11.51	-7.15	-9.41	14.51	24.44	5.41	13.07
Truck and bus bodies	-11.78	-10.57	-2.46	-1.39	-14.52	-15.21	-1.82	-4.69	2.22	4.30	-4.73	-5.52
Motor vehicle parts and accessories	-11.48	-8.92	7.85	10.18	-3.63	-6.33	-4.27	-3.22	2.75	4.03	-2.49	-2.36
Truck trailers	-0.41	-8.67	3.34	14.57	-11.9	-14.81	-16.28	-11.42	12.66	20.49	-3.62	-0.64

Notes: This table reports the cumulative change (measured in percentage points) in net employment (NET), job reallocation (SUM), and excess reallocation (EXC) due to a positive one standard deviation innovation in the real oil price. Computations are based on 10,000 simulations of model (8).

Table 10: Job reallocation test for a typical positive oil price shock.

	$x_t^{\#} = x_t^1$		$x_t^{\#} = x_t^4$	
Sectors	1973-1983	1984-1998	1973-1983	1984-1998
Total manufacturing (1972:Q2-2005:Q1)		0.27		0.40
Total manufacturing (1972:Q2-1998:Q4)	0.73	**0.02**	0.81	**0.02**
Food	0.23	0.73	*0.07*	0.24
Tobacco	0.96	0.69	0.77	0.50
Textiles	0.97	0.16	0.59	0.60
Apparel	0.92	0.71	0.35	0.66
Lumber	0.92	0.30	0.81	0.43
Furniture and fixtures	0.41	0.13	1.00	0.15
Paper	0.18	0.95	0.33	0.97
Printing	0.68	0.34	0.69	0.42
Chemicals	0.71	0.85	0.36	0.71
Petroleum and coal	1.00	0.31	*0.10*	0.39
Rubber and plastics	0.38	**0.05**	0.17	*0.09*
Leather	0.88	0.47	0.64	0.70
Stone, clay and glass	0.72	0.39	1.00	0.45
Primary metals	1.00	0.69	1.00	0.64
Fabricated metals	1.00	0.44	0.61	0.61
Industrial machinery	1.00	0.78	1.00	0.81
Electronic and electric equipment	0.70	0.73	0.21	0.49
Transportation equipment	0.69	0.13	0.91	0.12
Instruments and related products	1.00	0.91	0.23	0.88
Miscellaneous manufacturing	0.89	0.15	0.50	0.36
Motor vehicles and passenger car bodies	0.40	0.33	0.40	0.57
Truck and bus bodies	0.62	0.63	0.24	0.44
Motor vehicle parts and accessories	0.74	0.40	0.93	0.20
Truck trailers	*0.08*	**0.00**	**0.03**	**0.05**

Notes: Computations are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Figure 1: Job flows and oil price

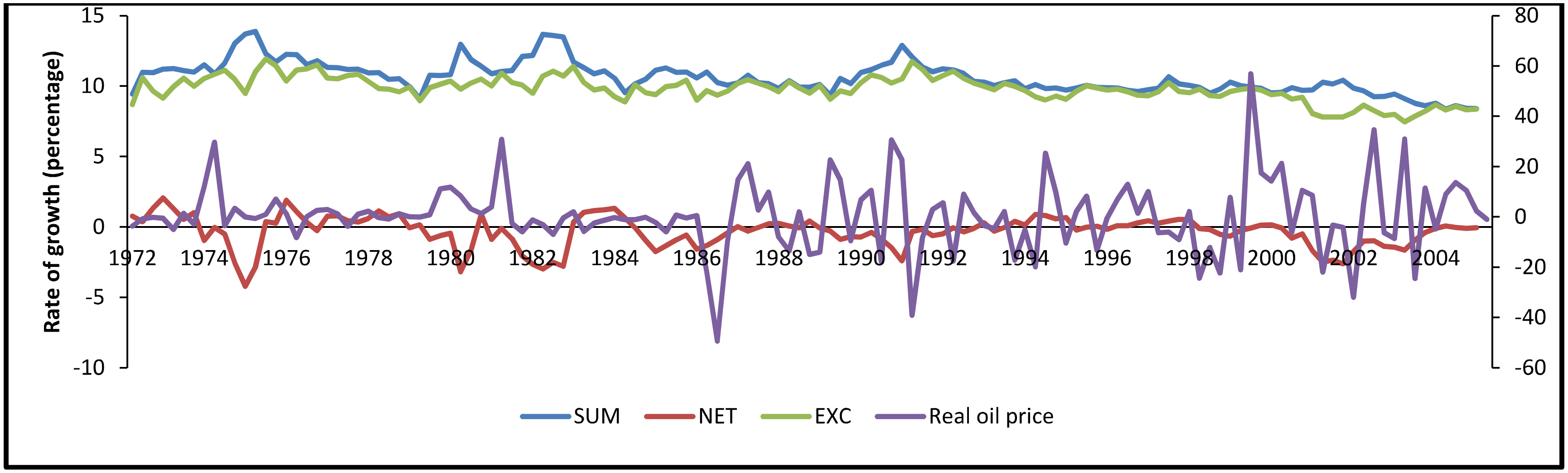


Figure 2: Oil prices and censored oil price measures

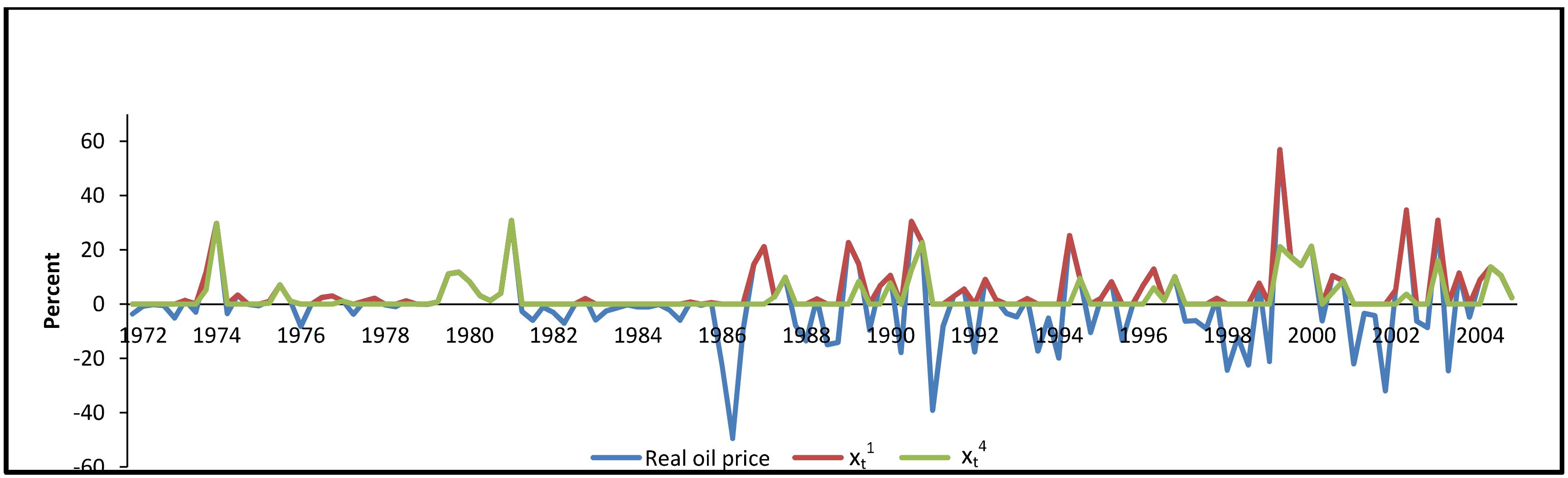


Figure 3a: Job creation and job destruction responses to a positive oil price shock of 1 s.d.

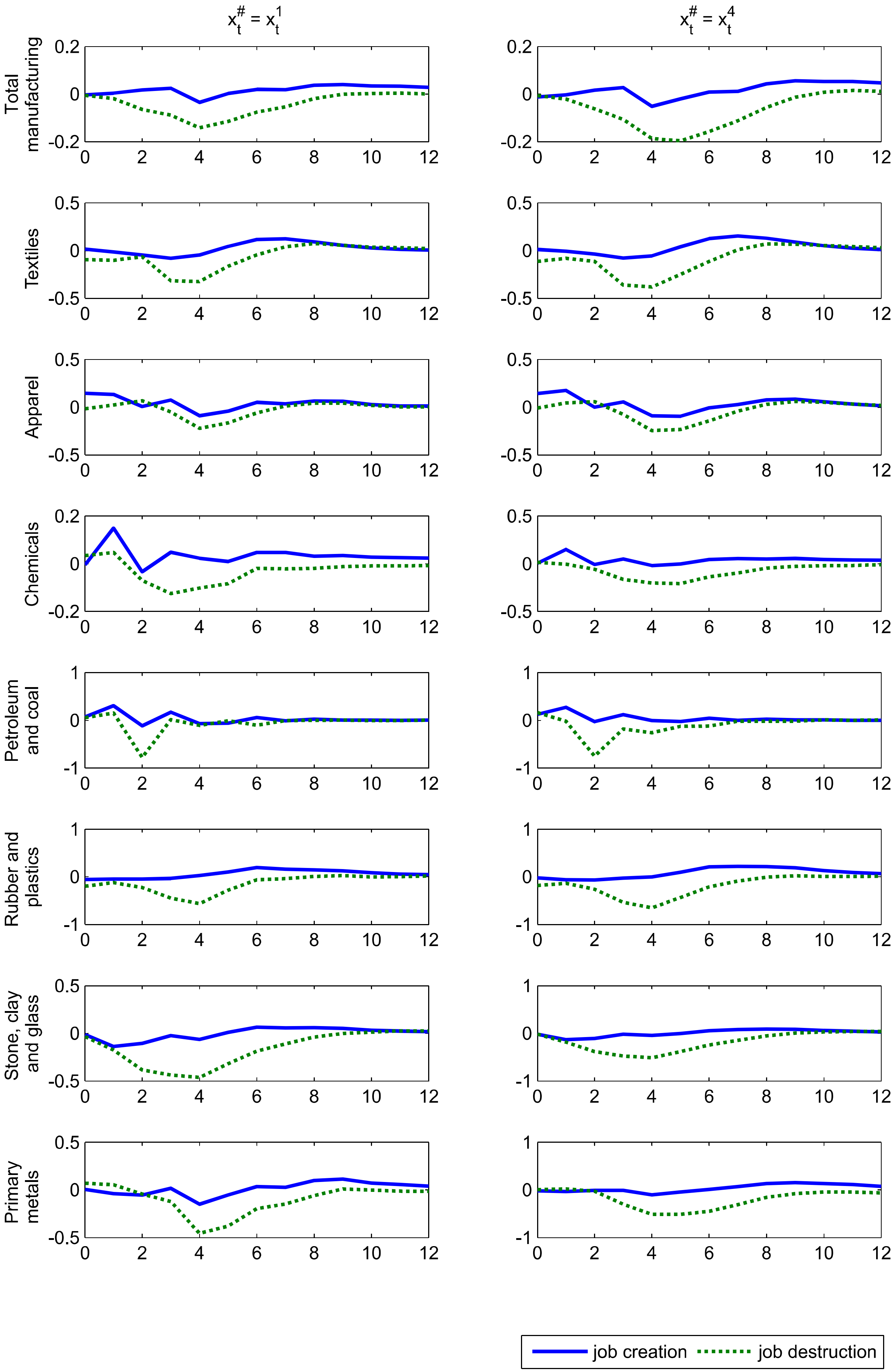


Figure 3b: Job creation and job destruction responses to a positive oil price shock of 1 s.d.

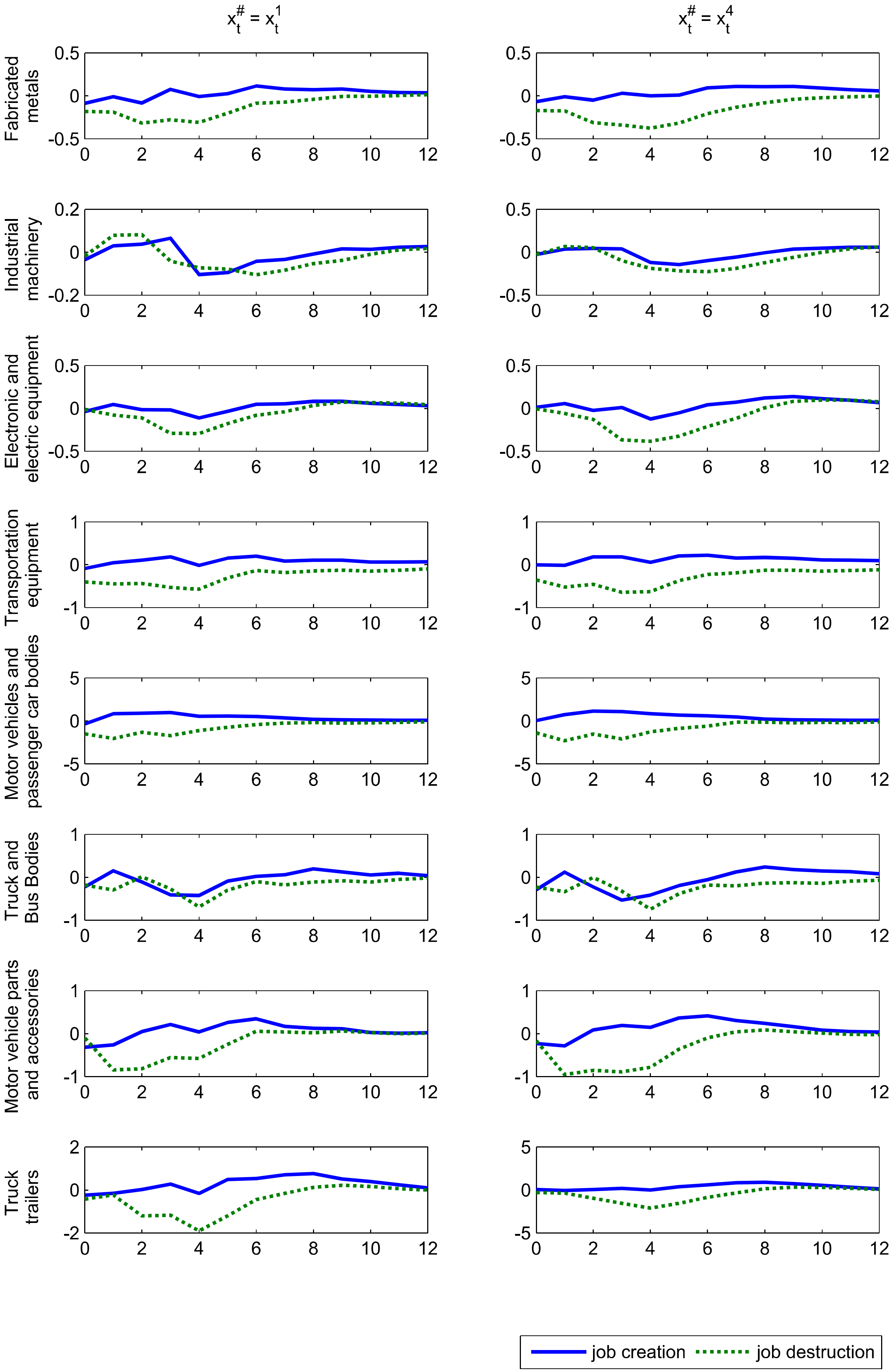


Figure 4a: Job creation and job destruction responses to a positive oil price shock of 1 s.d., using $x_t^{\#} = x_t^1$

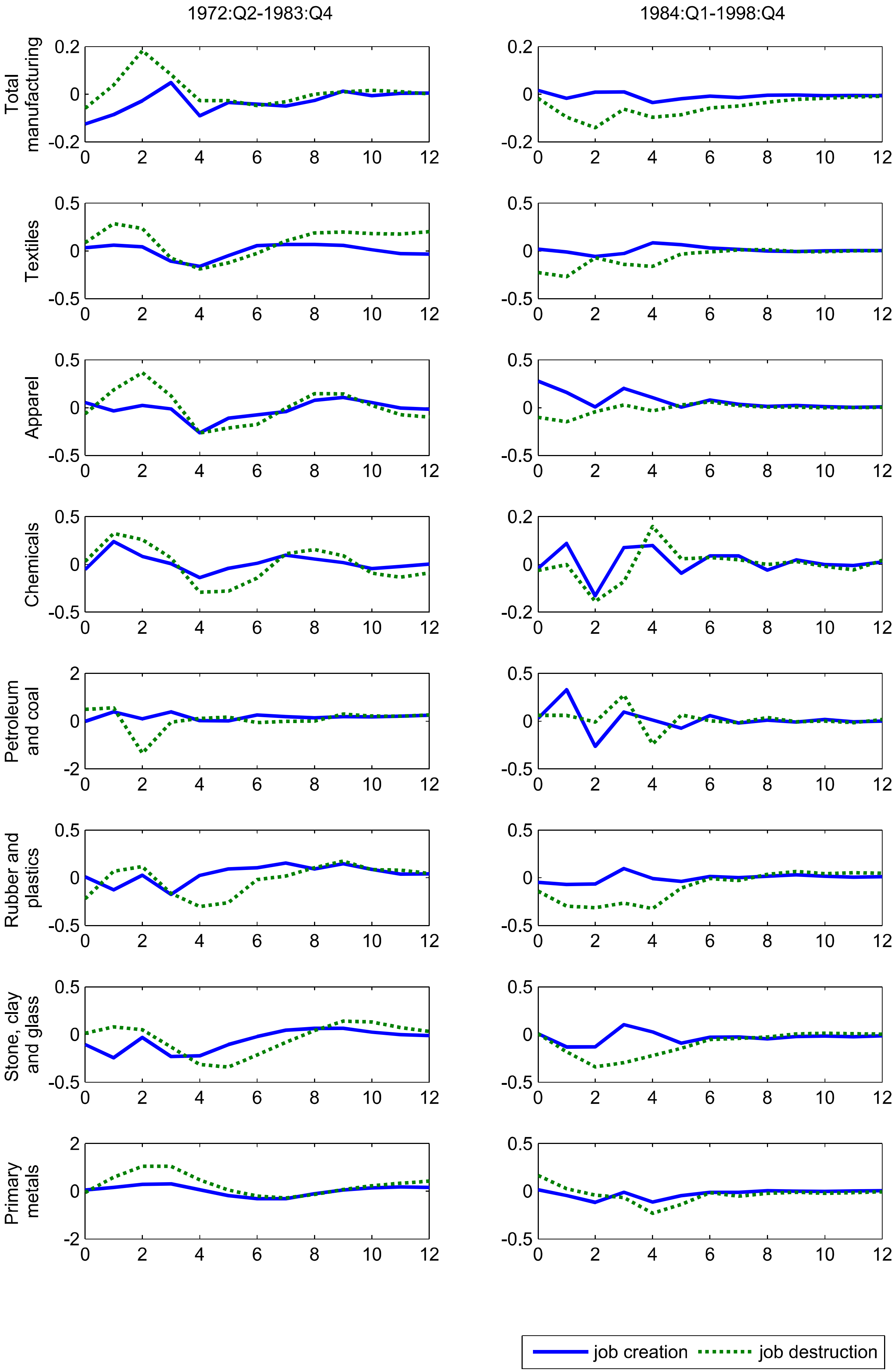
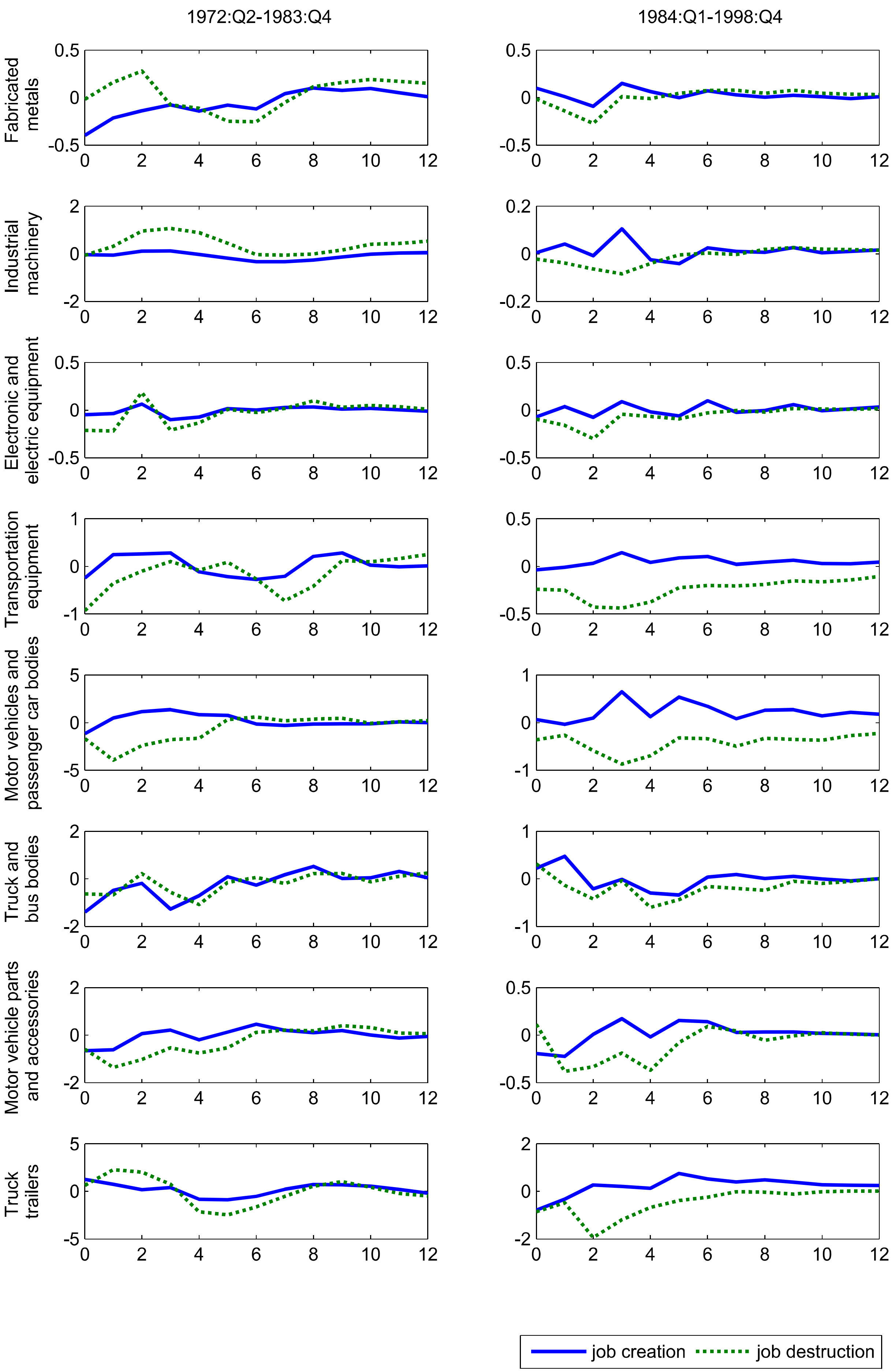


Figure 4b: Job creation and job destruction responses to a positive oil price shock of 1 s.d., using $x_t^{\#} = x_t^1$



Chapter 3: Oil price shocks and Regional Labor Reallocation

This chapter builds on the methods by Kilian and Vigfusson (2011b) to study the impact of oil price shocks on job creation and job destruction in US census regions. We use a structural equation model that nests both symmetric and asymmetric effects associated with an oil price shock. We compute generalized impulse response function and conduct an impulse response function based tests of symmetry to evaluate whether the response of job creation and job destruction to a positive real oil price shock is symmetric. We find evidence of asymmetries and report evidence of regional labor reallocation. Then we contribute to the literature interesting in testing for the spatial asymmetry in the response of employment to positive and negative oil price shocks. We find no evidence of asymmetry for job creation (job destruction) for a typical shock. Yet, symmetry in the response of job destruction is rejected for few regions using large oil price innovations.

3.1 Introduction

Since the work by Hamilton (1983) and Mork (1989) positive oil price shocks have been viewed as a major source of economic fluctuations while negative oil price shocks have been seen to generate mild and insignificant effects. This asymmetric effect in the response of economic activity to oil shocks have been found by Loungani (1986), Davis (1987a,b) and Hooker (1996) and tested using slope based test of nonlinearity by Mork, Olsen, and Mysen (1994), Cuñado and Pérez de Gracia (2003), and Jiménez-Rodríguez and Sánchez (2005).

Recent findings by Kilian and Vigfusson (2011b) – hereafter KV (2011b) – have questioned the consensus that had been reached in the early 2000s about the nonlinearity in the relationship between oil prices and output. They claim that previous empirical papers that rejected the linearity in the relationship between oil prices and the macroeconomy are based on censored VAR models. In their paper, KV(2011b) explicitly demonstrate how these models can lead to biased and inconsistent estimates, which often exaggerate the impact of oil prices on economic activity. They further explain why the textbook orthogonalized impulse response functions (OIRF) – heavily used in the literature in forecasting the nonlinear impact of oil prices – are not informative about the degree of asymmetry in the response to an oil price shock, and emphasize the importance of using generalized impulse response functions (GIRF) introduced by Koop, Pesaran and Potter (1996) when nonlinear transformations of the variable of interest (e.g., oil prices) are included in a simultaneous equations model. In addition, KV (2011b) proposed an impulse response based test to evaluate the statistical significance of the asymmetric responses of output to an oil price shock and conclude that the relationship between oil prices and GDP growth (or consumption and unemployment rate) is well captured by a linear model.

Two channels explain the theoretical rational behind the transmission mechanism of an oil price shock on the economy: Aggregate channels and allocative channels. In addition, each channel is guided by direct and indirect demand side and supply side effects. By direct demand side effects, we refer to the change in purchasing power upon an oil price shock, which leads to a symmetric change in aggregate demand (see Mork, 1994). On the other hand, there are indirect demand side effects that generate asymmetries that amplify output fluctuations due to increases in precautionary saving (see Edelstein and Kilian, 2009) associated with heightened uncertainty (see Bernanke, 1983 and Pindyck, 1991) and a change in the composition of demand (see Ramey and Vine, 2012).

By direct supply side effects, we refer to the change in the cost of production associated with oil price shocks, which leads to a symmetric change in aggregate supply (see Rotemberg and Woodford, 1996). On the other hand, we refer to the deployment of labor and capital across sectors (see Davis 1987a; Davis 1987b; Davis and Haltiwanger, 2001; Hamilton, 1988) as the indirect supply side effects that generate an asymmetric impact on output and employment.

Several papers have attempted to find empirical evidence for the theoretical rational of costly labor reallocation associated with an oil price shock. Davis, Loungani and Mahidhara (1997) found that oil price shocks generate asymmetries in the response of regional unemployment to positive and negative oil price shocks. They use this result as an evidence for the reallocation of labor and claim that both aggregate and allocative channels play a role in transmitting the impact of oil prices. Other studies have focused on sectoral data and reported evidence of sectoral labor reallocation (see Davis and Haltiwanger, 2001; and Chapter 2).

In this paper we make five contributions to the existing literature. First, unlike Davis, Loungani and Mahidhara (1997) we estimate the impact of oil prices on quarterly regional job creation and job destruction instead of regional unemployment. As explained by Davis and Haltiwanger (2001), the use of job flows instead of employment rates data can determine the dominant channel through which oil prices affect the economy. If oil prices operate mainly through aggregate channels, then a positive oil price shock will lead to an increase in job destruction and a symmetric decline in job creation rates, whereas if oil prices operate mainly through allocative channels, then a positive oil price shock will lead to an increase in both job creation and job destruction rates.

Second, we use a structural model building on Kilian and Vigfusson (2011b) methods and following Herrera and Karaki (2012) that nests both symmetric and asymmetric effects associated with the transmission of oil prices to the economy. The previous literature that focused on studying the nonlinearity in the response of economic activity to oil price shocks were often based on censored vector autoregressive models. Work by Kilian and Vigfusson (2011b) has shown that this methodology will most likely lead to biased and inconsistent estimates.

Third, we compute generalized impulse response functions and evaluate the asymmetries in the response of regional job creation and job destruction to a positive oil price shock by implementing a job reallocation test following Herrera and Karaki (2012). Unlike DH (2001) who claim significant sectoral labor reallocation based on their generated orthogonolized impulse response functions, we are aware of the substantial sampling uncertainty that the impulse response functions estimates are subject to especially for a large shock; thus, we conduct a formal test of symmetry to investigate the regional reallocative effect associated with a positive oil price shock.

Fourth, the presence/absence of regional labor reallocation contributes to the literature interested in the disparities and commonality of business cycles across regions (see Hamilton and Owyang, 2012). The costly reallocation of labor across sectors due to search and matching issues is responsible for amplifying output fluctuations (e.g. Davis and Haltiwanger, 2001). In this paper, we investigate whether oil price shocks generate regional reallocation of labor leading to an amplification of output across regions.

Fifth, we contribute to the literature on the nonlinearity in the response of aggregate economic activity to oil price increases and decreases. We test for the symmetry in the response of regional job creation (destruction) to oil price increases and decreases using an impulse response function based test of symmetry.

This paper reports five major findings. First, the computed impulse response functions for the effect of positive oil price shocks on job creation and job destruction reveal important reallocation of labor across regions. Second, we find that an unexpected oil price shock has a negative effect on net employment for all regions including East South Central, a region that groups oil producing states. Third, the observed pattern of strong increases in job destruction and mild changes in job creation four quarters after the shock indicate that even though some regions experience a stronger downturn than others but there seems to be a strong common national component for recessions caused by an unexpected oil price hike. Fourth using an impulse response function based test following the methods used in chapter 2, we find that the observed asymmetries in the response of job creation and job destruction to a positive oil price shock are statistically significant for several regions. This result indicates that the allocative channel played a central role in transmitting the effects of oil price shocks to regional economies. Finally, we use an impulse response function based test in the light of KV (2012b) and find no evidence of asymmetry in the response of job creation (job destruction) to positive and negative typical oil price shocks. This result is in line with Engemann, Owyang and Wall (2012) who find no evidence of asymmetry in the response of payroll employment across states to positive and negative oil price shocks.

The rest of the paper is structured as follows. Section 2 discusses the data on regional job flows and oil prices. We present the model in section 3 and discuss the computation of the generalized impulse response functions. Section 4 explores the empirical findings results. Section 5 conducts an impulse response based test of symmetry inspired by KV (2011b) to assess the statistical significance of the asymmetric responses of job creation and job destruction rates to a positive oil price shock. Finally the oil price job creation (destruction) functional forms are examined in section 6. Section 7 concludes.

3.2 Job Creation, Job Destruction and Oil prices

We use quarterly data on regional job flows in the manufacturing sector from the Gross Job Flows database (1996, 2005) by Davis and Haltiwanger and Shuh -hereafter DHS- to examine the impact of oil prices on regional job creation and job destruction. The data on regional job creation and job destruction spans 1972:Q2 to 1998:Q4.

As defined by DHS, job creation represents the sum of employment gains at expanding and entering establishments and job destruction represents the sum of employment losses at contracting and exiting establishments. Those job flows measures are computed as job creation and job destruction rates, POS_t and NEG_t(see Davis and Haltiwanger, 1996). Furthermore, following Davis and Haltiwanger (1996), we define the net growth rate of employment for an industry j at time t is defined as:

$$NET_{j,t} = POS_{j,t} - NEG_{j,t}, \tag{1}$$

where $POS_{j,t}$ and $NEG_{j,t}$ represent the job creation rate and job destruction rate in industry j at time t or in the aggregate manufacturing sector. Also, the job reallocation rate is defined as the sum of $POS_{j,t}$ and $NEG_{j,t}$.

$$SUM_{j,t} = POS_{j,t} + NEG_{j,t}, \tag{2}$$

As an indicator regarding the flexibility of labor markets DHS define the excess job reallocation rate as:

$$EXC_{j,t} = POS_{j,t} - |NET_{j,t}|\,. \tag{3}$$

To get a better grasp on the labor market flexibility, we also compute the excess job reallocation rate, which measures the amount of reallocation that would have been necessary to offset changes in net employment growth.

Regarding oil price measures, we compute nominal oil prices using the producer price index of crude petroleum following Hooker (1996), Davis and Haltiwanger (2001) and Hamilton (1996, 2003). Then, we obtain real oil prices by deflating the nominal price of oil with the total producer price index (PPI). In our model, we define x_t as the percentage change in the real price of oil and $x_t^{\#}$ as a nonlinear transformation of oil prices. Two different nonlinear transformations of the natural logarithm of the real oil price o_t are used in our analysis.

The first measure is Mork's (1989) oil price increase. This measure was motivated by Mork's (1989) claim that oil price increases lead to significant economic downturn while decreases in oil prices have no effect on economic activity. This nonlinear transformation of oil prices sets the value of $x_t^{\#}$ equal to zero for any period where the oil price change was negative:

$$x_t^1 = \max\left\{0, \ln\left(o_t\right) - \ln\left(o_{t-1}\right)\right\}. \tag{4}$$

The second censored oil price measure used in our analysis is Hamilton net oil price increase measure (Hamilton, 1996). This measure set $x_t^{\#}$ equal to zero for the oil price increases that corrects for the oil price decreases and is defined as:

$$x_t^4 = \max\left\{0, \ln\left(o_t\right) - \max\left\{0, \ln\left(o_{t-1}\right), ..., \ln\left(o_{t-4}\right)\right\}\right\}. \tag{5}$$

As suggested by Hamilton (1996, 2003) this nonlinear transformation of oil prices is known for successfully capturing the nonlinearity in the oil price and aggregate economic activity relationship. In the next section we present our model using the defined notation of the variables in this section.

3.3 Model

To study the effect of oil price shocks on job creation and job destruction we estimate the following structural model:

$$x_t = a_{10} + \sum_{i=1}^{p} a_{11,i} x_{t-i} + \sum_{i=1}^{p} a_{12,i} NEG_{j,t-i} + \sum_{i=1}^{p} a_{13,i} POS_{j,t-i} + \varepsilon_{1,t} \tag{6a}$$

$$NEG_{j,t} = a_{20} + \sum_{i=0}^{p} a_{21,i} x_{t-i} + \sum_{i=1}^{p} a_{22,i} NEG_{j,t-i} + \sum_{i=1}^{p} a_{23,i} POS_{j,t-i} + \sum_{i=0}^{p} g_{21,i} x_{t-i}^{\#} + \varepsilon_{2,t} \tag{6b}$$

$$POS_{j,t} = a_{30} + \sum_{i=0}^{p} a_{31,i} x_{t-i} + \sum_{i=0}^{p} a_{32,i} NEG_{j,t-i} + \sum_{i=1}^{p} a_{33,i} POS_{j,t-i} + \sum_{i=0}^{p} g_{31,i} x_{t-i}^{\#} + \varepsilon_{3,t} \tag{6c}$$

where x_t stands for the percentage change in oil prices, $x_t^{\#}$ refers to any of the two nonlinear transformation of oil prices defined in section 2, $POS_{j,t}$ is the job creation rate in the industry j, $NEG_{j,t}$ is the job destruction rate in industry j, and $\varepsilon_t = [\varepsilon_{1,t}, \varepsilon_{2,t}, \varepsilon_{3,t}]$ is a vector of contemporaneously and serially uncorrelated innovations. We impose the following identification restrictions. Oil prices are assumed to be exogenous and job destruction does not respond contemporaneously to changes in job creation. Our model 6(a)-6(c) can be estimated efficiently by OLS. For the same reasons explained in chapter 2 we use a parsimonious model instead and compute generalized impulse response functions to analyze the impact of a positive oil price shock on job creation and job destruction.

3.4 The Response of Regional job Flows to a positive oil price shock

3.4.1 The Effect of a typical shock

We look at the impact of oil price shocks on job creation and job destruction for the national total manufacturing and for total manufacturing in nine census regions. Figure 5 plots the impulse response functions of job creation and job destruction rates for a typical shock using the two nonlinear transformations of oil prices described in section 2. Note that for ease of comparison, we plot the negative of the response of job destruction. The impulse response functions plotted in Figure 5a-b, suggest that the responses of job creation and destruction to a typical positive real oil price shock is asymmetric for national total manufacturing. The estimated responses of job creation and job destructions are qualitatively similar across different nonlinear transformations of oil prices, as can be seen by comparing the left and right panels of Figure (5a-b). Following a typical positive oil price shock, we observe a strong increase in job destruction and a slight change in job creation. The magnitude of the asymmetry appears to increase for the first year after the shock and it declines afterwards.

This asymmetry in the response of job creation and job destruction in total manufacturing to a typical positive oil price shock is prevalent across different census regions but the degree of asymmetry differs across regions. In the East North Central, East South Central, Mountain and Pacific regions the magnitude of the asymmetries are larger than the one reported for National total manufacturing. For instance, four quarters after the shock, the change in job creation (job destruction) using x_t^1 is -0.01 (0.25) and -0.06 (0.40) for National total manufacturing and total manufacturing in East North Central respectively. Other regions respond similarly to the national level such as New England, Middle Atlantic, South Atlantic and West North Central. The only region that responds almost symmetrically to a positive oil price shock is West North Central a region known for being a composite of agricultural states.

These differences in the responses underline the importance of using disaggregated data while examining the transmission mechanism of oil price shock on job flows. In fact, the observed regional differences in the response of job creation and job destruction indicates that workers in different regions behave differently following a typical positive oil price shock, leading to important differences in the amount of labor reallocation across regions. These differences in labor reallocation lead to important regional output fluctuations (see Davis, Loungani and Mahidhara, 1997; Davis and Haltiwanger, 2001).

To gain insight on the magnitude of the asymmetries and the job reallocation effect associated with a positive oil price shock, table 11 reports the cumulative net employment growth (NET) and job reallocation rate (SUM) defined in section 2. We report the one-year and two-year cumulative effects because the largest effect of oil price shock on the macroeconomy occurs one year after the shock (e.g. Lee and Ni, 2002) and the search and matching issues are usually eliminated two years after the shock.

To make sense of the reallocative effect associated with an oil price shock, we consider the cumulative effect of a typical oil price shock on the job reallocation rate. Table 11 shows that at the national level, the one-year and two-year cumulative reallocation rate are 0.85 (1.44) and 0.90 (1.72) percentage points using

x_t^1 (x_t^4). At the regional level, the one-year and two-year cumulative reallocation rate ranges between 0.48 (0.63) and 1.45 (1.44) percentage points and the two-year cumulative reallocation effects ranges between 0.63 (1.04) and 2.59 (2.80) percentage points for the New England and Pacific regions respectively using x_t^1 (x_t^4).

The magnitudes of the labor reallocation rate across regions are important. We report a two-year cumulative reallocation rate greater than the one for national manufacturing in 3 regions (East North Central, Mountain and Pacific regions) using x_t^1 and 4 regions (East North Central, East South Central, Mountain and Pacific regions) using (x_t^4) report. In addition, the magnitudes of one-year and two-year cumulative reallocation rate across regions are comparable to the magnitudes of the sectoral labor reallocation rate reported for the 2-digit SIC code industries in chapter 2.

We find important regional allocative effects associated with a positive oil price shock. Our results are supportive of Davis, Loungani and Mahidhara (1997) findings that oil price shocks have been the major source of regional fluctuations since 1973.

3.4.2 The Effect of a Large Shock

Kilian and Vigfusson (2011a) argue that one standard deviation shocks account for two third of historical oil shocks and that shocks of two standard deviation (large) size have historically occurred with only a 5% probability. Consequently, they suggest that leaning on large shocks to determine the impact of oil prices on the macroeconomy is inadequate. On the other hand, Hamilton (2011) claims that what one might have in mind when analyzing an “oil shock” is the dramatic consequences of extraordinary events. In this sub-section we report the changes in the cumulative reallocation and net employment growth rates for the aggregate manufacturing at the national level and across 9 census regions following a positive large (two standard deviations) shock.

Figure 6a-b plot the impulse response functions of job creation and job destruction rates for a large shock using Mork (1989) oil price increase measure and Hamilton (1996) net oil price increase measures defined in section 2. The estimated impulse response functions plotted in Figure 6a-b, suggest that the responses of job creation and destruction to a large positive real oil price shock is asymmetric for national and regional total manufacturing. The magnitude of this asymmetry varies across different regions. Yet, the strong increase in job destruction and the mild change in job creation around $h = 4$ for total manufacturing at the national and across regions support Hamilton and Owyang (2012) claim that there is a strong national component for all recessions.

Table 12 shows that the cumulative net employment change is almost three times larger than the net employment change following a typical positive oil price shock for either x_t^1 or x_t^4. The one-year and two-year cumulative net employment growth rate, is almost three times larger regardless of which nonlinear transformation of oil prices is being used (see Table 11 and 12). At the national level, the one-year cumulative change in net employment is -1.81 (-2.46) percentage points and the two-year cumulative change in net employment is -2.14 (3.06) percentage points using x_t^1 (x_t^4). At the regional level, the one-year cumulative change in net employment for total manufacturing is larger than the national level in 3 regions using x_t^1 (East North Central, Mountain and Pacific) and 4 regions using x_t^4 (East North Central, South Atlantic, Mountain and Pacific). The two-year cumulative change in net employment for total manufacturing is larger than the national level in 2 regions using x_t^1 (Mountain, and Pacific) and 4 regions using x_t^4 (New England, West South Central, Mountain and Pacific). For instance, the two-year cumulative net employment change is -1.94 (2.78) and -3.01 (-5.07) in the East North Central and Pacific regions.

Furthermore, Table 12 shows that the cumulative reallocation rate for a large shock is at least twice as large as the reallocation rate for a typical shock for either x_t^1 or x_t^4. At the national level, the one-year cumulative change in job reallocation is 1.94 (3.28) and the two-year cumulative change in net employment is 2.38 (4.40) using x_t^1 (x_t^4). At the regional level, the one-year and the two-year cumulative change in job reallocation for total manufacturing are larger than the one reported for total manufacturing at the national level in 3 regions using x_t^1 (East North Central, Mountain and Pacific) and 3 regions using x_t^4 (East North Central, East South Central and Pacific). For instance the two-year cumulative change in job reallocation is 3.51 (5.61) and 5.52 (6.25) in the East North Central and Pacific regions.

Last but not least, the cumulative two-year excess reallocation rate is larger than the one reported at the national level for total manufacturing for the Pacific region, and for the East North Central, East South Central and Pacific regions using x_t^1 and x_t^4 respectively. For instance, the cumulative two-year excess job reallocation is 0.83 (1.89) for East North Central and 2.22 (1.11) for Pacific regions using x_t^1 (x_t^4).

The differences in the response of net employment growth and reallocation rates across regions indicate that it's inadequate to evaluate the transmission mechanism of oil prices by only focusing on total manufacturing at the national level. Our findings are in line with the results in chapter 2 where we find strong differences in the impact of oil price shocks across industries in the manufacturing sector.

In all regions and regardless of the magnitude of the shock or the nonlinear transformation of oil prices used, we find a decline in the one-year and two-year cumulative net employment change in total manufacturing. Unlike Iledare and Olatubi (2004), who find a decline in unemployment in oil producing states following a positive oil price shock, we find that the change in net employment growth in manufacturing for West South Central – a region that groups major oil producing states (Oklahoma, Arizona, Texas and Louisiana) – is always negative.

Also, we find that along with the strong declines in net employment growth we find important labor reallocation following positive oil price shocks in the East North Central region. This result provides an explanation for the finding by Carlino and Sill (2000) regarding the strong decline in income beyond the national level in the Great Lakes region following a positive oil price shock.

The observed asymmetries in the impulse response functions suggest that oil price shocks trigger costly regional reallocation of labor. In order to investigate the statistical significance of the asymmetries, an impulse response function based test in the light of Kilian and Vigfusson (2011b) is implemented in the following section to evaluate whether the response of job creation and job destruction to a positive real oil price shock is symmetric.

3.5 Impulse response function based test for the response of job flows to a positive oil price shock

As we observe important asymmetries in the response of job creation and job destruction to a positive real oil price shock, which suggests that oil prices operate mainly through allocative channels and that a positive oil price shock triggers costly labor reallocation, KV (2011b) claim that making conclusions based on the estimated impulse responses could be misleading because the difference between the responses may not be statistically significant.

To determine the statistical significance of the asymmetric responses of job creation and job destruction rates to a positive oil shock, we conduct an impulse response function based test in the spirit of KV (2011b) where the null hypothesis is:

$$H_o : I_{NEG}\left(h, \delta\right) + I_{POS}\left(h, \delta\right) = 0 \text{ for } h = 0, 1, 2, ..., H.$$

This impulse response based test is computed in the following manner:

1. We compute the variance-covariance matrix $\left[I_{POS}\left(h, \delta\right), I_{NEG}\left(h, \delta\right)\right]$ as follows. First, given the estimated $\widehat{B_1}$, $\widehat{B_2}$, $\widehat{B_3}$, $\widehat{s_1}$, $\widehat{s_2}$, $\widehat{s_3}$, the residuals and an arbitrary chosen history $\hat{\Omega}^m$, the system in (5) is used to generate pseudo-series of the same length of data. Second, for each of the newly generated pseudo-series, ($\widehat{X}^m$, $\widehat{NEG}^m$, $\widehat{POS}^m$), we repeat steps (i) to (iv) [this numbering is confusing, you should use letters here] used to compute the generalized impulse response functions in section 3 to get the unconditional IRFs. Finally for the M (we set $M = 1000$) unconditional IRFs for both job creation and job destruction, the variance covariance matrix is computed. The matrix has a size of $2(H + 1) \times 2(H + 1)$.

2. Finally the test statistic of symmetry of job creation and job destruction to a positive oil price shock is computed as:

$$W = \left(R\widehat{\beta}\right)' \left(R\widehat{\Xi}R'\right)^{-1} \left(R\widehat{\beta}\right) \sim \chi^2_{H+1}$$

where,

$$
\underset{2(H+1)\times 1}{\widehat{\beta}} = \begin{bmatrix} I_{NEG}(0,\delta) \\ \vdots \\ I_{NEG}(H,\delta) \\ I_{POS}(0,\delta) \\ \vdots \\ I_{NEG}(H,\delta) \end{bmatrix}; \quad \underset{(H+1)\times 2(H+1)}{R} = \begin{bmatrix} 1 & \dots & 0 & 1 & \dots & 0 \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ 0 & \dots & 1 & 0 & \dots & 1 \end{bmatrix};
$$

$$
\underset{2(H+1)\times 2(H+1)}{\Xi} = E\left[\left(\widehat{\beta}-\beta\right)\left(\widehat{\beta}-\beta\right)'\right].
$$

we compute an impulse response function based test to determine the statistical significance of the observed asymmetries in the responses. Tables 13 and 14 report the results for the test of symmetry of the response of job creation and job destruction to a typical deviation (one standard deviation) shock and a large (two standard deviations) shock, respectively. Using x_t^1, symmetry is rejected at the 10% for at least one horizon for 3 regions for a typical oil shock. Asymmetries are statistically significant at the 10% level for the Mountain and Pacific regions and at the 5% for East South Central region. For a large shock, symmetry is rejected only for the East South Central region using x_t^1.

Using x_t^4, or the net oil price increase, a measure claimed to better capture the nature of the nonlinearity (Hamilton 1996, 2003), asymmetries in the response of job creation and job destruction to a positive typical oil price shock are statistically significant at the 5 % level for East North Central, East South Central and Pacific. Furthermore, symmetry is rejected at the 10% level for the South Atlantic and Mountain regions. For a large shock, rejection of symmetry is statistically significant for East North Central, East South Central, Pacific and South Atlantic regions at the 5% level. In addition, symmetry is rejected at the 10% level for the New England and West North Central regions.

Our evidence of significant regional reallocation across regions and lack of evidence of asymmetry in the response of job creation and job destruction to a positive shock for National manufacturing job flows, especially for a typical shock, underline the importance of using disaggregating data by region while analyzing the transmission mechanism of an oil price shock. Our results are in line with Bhattacharya (2003) who found that oil shocks have more pronounced effects at the local level than at the national level.

We find a significant evidence of regional labor reallocation in East North Central, South Atlantic, East South Central and the Pacific regions. These regions have the highest shares of manufacturing employment. For instance, the share of manufacturing employment in East North Central is 24%, 17% for South Atlantic, 12% for the Pacific regions and 8% for East South Central. In addition, these regions are composite of states that a high share of their earnings relies on manufacturing (see Bernat and Repice, 2000). Our findings indicate that the allocative channel of oil price shocks was significant and important during the 1973-1998 period.

3.5.1 Impulse response function based test to the response of job creation (job destruction) to oil price shocks

In the previous section, we computed an impulse response function based test to evaluate the statistical significance of the regional labor reallocation associated with a positive oil price shock. Our interest in that exercise is to assess the importance of the allocative channels in the transmission mechanism of oil price shocks on regional economies. In this section, we test whether the response of job creation (job destruction) to positive and negative oil price shocks is symmetric using Kilian and Vigfusson (2011b) impulse response function based test. Herrera and Karaki (2012) found evidence of asymmetry in the response of sectoral job creation (destruction) in to positive and negative oil price shocks. In this paper, we are interested to see whether there is evidence of asymmetry in the response of regional job creation (destruction) to positive and negative oil price shocks, where the null hypothesis for job creation is:

$$H_o : I_{POS}\left(h, \delta\right) = -I_{POS}\left(h, -\delta\right) for (h = 0, 1, 2, ..., H.)$$

and the null for job destruction is:

$$H_o : I_{NEG}\left(h,\delta\right) = -I_{NEG}\left(h,-\delta\right) for(h = 0, 1, 2, ..., H.)$$

Table 15 and 16 reports the test results for job creation and job destruction based on a typical shock of a 1 standard deviation magnitude. For all regions, we don't find any evidence of asymmetry in the response of job creation (job destruction). Our results are in line with work by Engemann, Owyang and Wall (2012) who found no evidence of asymmetry in the response of employment payroll to positive and negative oil price shocks across states. For a large shock, we also don't find any evidence of asymmetries in job creation across regions (see Table 17). However, symmetry in the response of job destruction to large of positive and negative oil price shocks is rejected for at least one horizon for national manufacturing, South Atlantic, East South Central and West South central (see Table 18).

Our findings indicate that a linear model could provide a good approximation for the effects of a typical oil price shock on regional job creation and job destruction. But for a large shock, we find significant evidence of asymmetry for the response of job destruction to positive and negative oil shocks. This is especially true for the South Atlantic, East South Central and Atlantic regions.

3.6 Conclusion

This paper contributes to the literature on regional business cycles and the channels of transmission for an oil price shock. To overcome the possible bias generated with the inclusion of a censored variable in the model, we use a structural model that nests both symmetric and asymmetric effects associated with oil innovations. The reported generalized impulse response functions show strong asymmetries in the response of job creation and job destruction across regions four quarters following an unexpected oil price hike. In line with Hamilton and Owyang (2012), we find that even though there is a notable disparity in the magnitude of this asymmetry across regions, there seems to be a strong common national component for recessions caused by higher oil prices.

We also find a significantly negative effect on net employment in all regions, following an unanticipated rise in oil prices and large increases in job reallocation rates. These findings indicate that the reallocation process across regions was costly and time consuming.

To evaluate the statistical significance of the observed asymmetries in the impulse response functions, we conduct an impulse response function based test of symmetry following Herrera and Karaki (2012) and KV (2011b). Our results point out that there is a significant regional labor reallocation triggered by an oil price shock. This finding indicates that the allocative channel does play a central role in the transmission mechanism of oil prices into regional economies.

Finally, we contribute to the literature interested in testing for the spatial asymmetry in the response of job flows to positive and negative oil price shocks. We didn't find any evidence of asymmetry for job creation or job destruction, especially for a typical shock, where it seems that a linear model provides a very good approximation for the effects of oil prices.

Table 11: Cumulative net employment, job reallocation, and Excess reallocation to a typical oil shock. Sample: 1972:Q2 - 1998:Q4

	$x_t^{\#} = x^1{}_t$						$x_t^{\#} = x^4{}_t$					
	NET		SUM		EXC		NET		SUM		EXC	
Regions	4	8	4	8	4	8	4	8	4	8	4	8
National	-0.71	-0.83	0.85	1.44	0.14	0.51	-0.78	-1.1	0.9	1.72	0.12	0.51
New England	-0.57	-0.69	0.48	0.63	-0.31	-0.35	-0.64	-1.18	0.63	1.04	-0.36	-0.49
Middle Atlantic	-0.62	-0.63	0.77	1.22	0.15	0.30	-0.67	-1.03	0.86	1.68	0.19	0.55
East North Central	-0.91	-0.82	1.22	1.76	0.31	0.61	-1.10	-1.10	1.48	2.41	0.38	1.03
West North Central	-0.43	-0.54	0.53	0.90	-0.18	-0.06	-0.73	-1.10	0.79	1.69	-0.11	0.30
South Atlantic	-0.68	-0.55	0.52	0.91	-0.16	-0.10	-0.89	-0.95	0.68	1.44	-0.21	0.09
East South Central	-0.46	-0.23	1.02	1.42	0.56	0.66	-0.69	-0.57	1.19	2.00	0.50	0.95
West South Central	-0.31	-0.66	0.54	0.95	0.11	0.17	-0.42	-1.09	0.67	1.27	0.11	0.05
Moutain	-1.25	-2.09	1.36	2.45	-0.22	0.03	-1.06	-1.83	1.21	2.28	-0.29	0.01
Pacific	-1.06	-1.19	1.45	2.59	0.40	1.25	-1.14	-1.83	1.45	2.80	0.31	0.97

Table 12: Cumulative net employment, job reallocation, and Excess reallocation to a large oil shock. Sample: 1972:Q2 - 1998:Q4

	$x_t^{\#} = x^1{}_t$						$x_t^{\#} = x^4{}_t$					
	NET		SUM		EXC		NET		SUM		EXC	
Regions	4	8	4	8	4	8	4	8	4	8	4	8
National	-1.81	-2.14	1.94	3.28	0.14	0.92	-2.46	-3.06	2.38	4.4	-0.08	0.95
New England	-1.55	-2.11	0.71	1.07	-1.08	-1.34	-2.03	-3.55	1.42	2.50	-1.32	-1.76
Middle Atlantic	-1.55	-1.53	1.47	2.52	-0.09	0.30	-2.10	-2.87	1.86	3.87	-0.23	0.67
East North Central	-2.17	-1.94	2.44	3.51	0.27	0.83	-2.99	-2.78	3.54	5.60	0.54	1.89
West North Central	-1.03	-1.27	0.89	1.70	-0.77	-0.55	-2.39	-3.01	2.00	4.19	-0.70	0.45
South Atlantic	-1.68	-1.37	1.07	1.90	-0.61	-0.53	-2.54	-2.34	1.87	3.65	-0.67	0.02
East South Central	-1.22	-0.66	1.91	2.73	0.69	0.83	-2.27	-1.69	2.67	4.47	0.40	1.16
West South Central	-1.08	-1.75	0.97	1.66	-0.12	-0.13	-1.93	-3.39	1.63	2.96	-0.44	-0.57
Moutain	-3.52	-5.28	2.55	4.61	-1.00	-0.70	-3.35	-5.04	2.07	4.21	-1.74	-1.29
Pacific	-2.54	-3.01	2.95	5.52	0.41	2.22	-3.37	-5.07	3.13	6.25	-0.24	1.11

Table 13: IRF Based Test of Symmetry for 1 standard deviation shock (1972:Q2-1998:Q4)

	$x_t^{\#} = {x^1}_t$							$x_t^{\#} = {x^4}_t$						
Regions	0	1	2	3	4	5	6	0	1	2	3	4	5	6
National	0.44	0.45	0.32	0.23	0.34	0.4	0.52	0.49	0.5	0.1	0.09	0.14	0.11	0.16
New England	0.81	0.76	0.90	0.73	0.84	0.89	0.93	0.68	0.73	0.87	0.28	0.41	0.29	0.40
Middle Atlantic	0.26	0.47	0.68	0.61	0.62	0.68	0.70	0.31	0.29	0.48	0.26	0.28	0.25	0.21
East North Central	0.22	0.29	0.38	0.15	0.23	0.23	0.31	*0.10*	0.11	0.16	**0.05**	*0.08*	*0.09*	0.13
West North Central	0.75	0.85	0.69	0.70	0.28	0.20	0.23	0.60	0.63	0.63	0.38	0.23	0.11	*0.10*
South Atlantic	0.89	0.83	0.92	0.12	0.19	0.20	0.27	0.97	0.75	0.90	*0.10*	0.15	0.15	0.22
East South Central	0.16	0.29	0.45	**0.01**	**0.02**	**0.03**	**0.05**	0.10	0.14	0.27	**0.00**	**0.01**	**0.01**	**0.02**
West South Central	0.50	0.71	0.87	0.64	0.77	0.80	0.76	0.45	0.64	0.83	0.35	0.47	0.46	0.55
Moutain	0.52	0.49	0.48	*0.09*	0.16	0.19	0.22	0.91	0.64	0.41	*0.10*	0.13	0.20	0.28
Pacific	0.16	0.23	0.37	*0.07*	0.11	0.16	0.23	0.27	0.30	0.43	**0.04**	**0.05**	*0.08*	0.13

Table 14: IRF Based Test of Symmetry for 2 standard deviation shock (1972:Q2-1998:Q4)

	$x_t^{\#} = {x^1}_t$							$x_t^{\#} = {x^4}_t$						
Regions	0	1	2	3	4	5	6	0	1	2	3	4	5	6
National	0.26	0.43	0.52	0.29	0.42	0.50	0.61	0.32	0.40	0.30	**0.03**	*0.06*	**0.05**	*0.09*
New England	0.99	0.91	0.98	0.94	0.96	0.98	0.99	0.70	0.89	0.97	0.15	0.20	*0.10*	0.16
Middle Atlantic	0.45	0.75	0.90	0.87	0.66	0.77	0.77	0.47	0.67	0.83	0.34	0.24	0.21	0.19
East North Central	0.34	0.58	0.65	0.38	0.50	0.56	0.65	0.19	0.23	0.33	**0.05**	*0.08*	*0.08*	*0.09*
West North Central	0.92	0.99	0.73	0.76	0.47	0.40	0.37	0.57	0.76	0.86	0.22	0.20	*0.10*	0.12
South Atlantic	0.80	0.97	0.99	0.32	0.43	0.51	0.62	0.73	0.90	0.96	**0.04**	*0.08*	*0.07*	0.11
East South Central	0.21	0.45	0.61	**0.05**	*0.06*	*0.10*	0.14	0.17	0.34	0.43	**0.00**	**0.00**	**0.00**	**0.00**
West South Central	0.72	0.89	0.97	0.85	0.93	0.97	0.94	0.52	0.73	0.89	0.24	0.35	0.38	0.43
Moutain	0.51	0.77	0.81	0.39	0.53	0.61	0.66	0.89	0.98	0.57	0.14	0.23	0.31	0.42
Pacific	0.18	0.37	0.54	0.26	0.32	0.42	0.54	0.24	0.43	0.60	**0.01**	**0.02**	**0.03**	**0.05**

Table 15: IRF Based Test of Symmetry for the impact of 1 standard deviation shock on job creation (1972:Q2-1998:Q4)

	$x_t^{\#} = x^1{}_t$							$x_t^{\#} = x^4{}_t$						
Regions	0	1	2	3	4	5	6	0	1	2	3	4	5	6
National	0.41	0.6	0.69	0.67	0.67	0.73	0.83	0.19	0.41	0.61	0.72	0.74	0.81	0.86
New England	0.17	0.39	0.56	0.54	0.63	0.74	0.82	0.83	0.98	0.86	0.90	0.84	0.91	0.91
Middle Atlantic	0.22	0.46	0.59	0.73	0.75	0.75	0.83	0.24	0.51	0.70	0.83	0.89	0.94	0.93
East North Central	0.29	0.57	0.58	0.55	0.68	0.79	0.87	0.42	0.72	0.86	0.94	0.95	0.93	0.97
West North Central	0.41	0.69	0.78	0.82	0.91	0.95	0.97	0.22	0.47	0.45	0.60	0.66	0.71	0.74
South Atlantic	0.66	0.79	0.83	0.92	0.97	0.99	1.00	0.30	0.59	0.78	0.88	0.91	0.88	0.89
East South Central	0.78	0.60	0.80	0.91	0.95	0.98	0.99	0.48	0.66	0.82	0.91	0.96	0.97	0.98
West South Central	0.31	0.55	0.76	0.82	0.89	0.95	0.97	0.20	0.43	0.61	0.66	0.77	0.86	0.87
Moutain	0.44	0.32	0.51	0.59	0.65	0.76	0.84	0.37	0.38	0.56	0.71	0.82	0.90	0.93
Pacific	0.51	0.75	0.90	0.84	0.90	0.95	0.98	0.40	0.70	0.83	0.87	0.84	0.91	0.93

Table 16: IRF Based Test of Symmetry for the impact of 1 standard deviation shock on job destruction (1972:Q2-1998:Q4)

	$x_t^{\#} = x^1{}_t$							$x_t^{\#} = x^4{}_t$						
Regions	0	1	2	3	4	5	6	0	1	2	3	4	5	6
National	0.14	0.27	0.46	0.60	0.73	0.83	0.90	0.25	0.51	0.69	0.62	0.73	0.81	0.86
New England	0.87	0.92	0.98	0.98	0.96	0.98	0.99	0.77	0.79	0.92	0.51	0.54	0.67	0.76
Middle Atlantic	0.80	0.52	0.41	0.53	0.48	0.57	0.65	0.55	0.67	0.83	0.62	0.61	0.73	0.80
East North Central	0.52	0.75	0.87	0.94	0.98	0.99	0.99	0.30	0.58	0.77	0.78	0.85	0.92	0.92
West North Central	0.91	0.63	0.54	0.68	0.77	0.86	0.91	0.33	0.44	0.61	0.58	0.66	0.74	0.70
South Atlantic	0.49	0.54	0.60	0.75	0.86	0.92	0.96	0.17	0.25	0.41	0.36	0.50	0.59	0.67
East South Central	0.44	0.58	0.75	0.85	0.89	0.89	0.93	0.33	0.58	0.66	0.51	0.62	0.72	0.75
West South Central	0.62	0.87	0.96	0.98	0.98	0.99	1.00	0.11	0.20	0.36	0.32	0.43	0.55	0.66
Moutain	0.22	0.44	0.64	0.64	0.73	0.81	0.88	0.80	0.90	0.86	0.72	0.82	0.86	0.92
Pacific	0.27	0.34	0.49	0.55	0.52	0.65	0.75	0.20	0.31	0.50	0.55	0.63	0.75	0.83

Table 17: IRF Based Test of Symmetry for the impact of 2 standard deviation shock on job creation (1972:Q2-1998:Q4)

	$x_t^{\#} = x^1{}_t$							$x_t^{\#} = x^4{}_t$						
Regions	0	1	2	3	4	5	6	0	1	2	3	4	5	6
National	0.34	0.51	0.56	0.49	0.42	0.46	0.58	**0.04**	0.11	0.21	0.25	0.16	0.12	0.14
New England	0.11	0.28	0.42	0.33	0.40	0.50	0.62	0.81	0.97	0.82	0.85	0.70	0.81	0.80
Middle Atlantic	0.18	0.39	0.48	0.62	0.59	0.57	0.65	0.12	0.29	0.48	0.62	0.64	0.76	0.74
East North Central	0.22	0.47	0.42	0.34	0.44	0.56	0.68	0.31	0.59	0.72	0.85	0.81	0.78	0.86
West North Central	0.38	0.66	0.72	0.75	0.86	0.92	0.94	0.15	0.36	0.19	0.32	0.30	0.37	0.32
South Atlantic	0.62	0.74	0.76	0.88	0.94	0.97	0.99	0.18	0.41	0.62	0.72	0.71	0.56	0.48
East South Central	0.75	0.50	0.70	0.84	0.90	0.94	0.97	0.35	0.42	0.55	0.62	0.72	0.80	0.85
West South Central	0.26	0.48	0.69	0.74	0.83	0.90	0.95	*0.10*	0.26	0.40	0.37	0.45	0.57	0.60
Moutain	0.41	0.22	0.38	0.42	0.45	0.57	0.68	0.28	0.19	0.28	0.40	0.49	0.62	0.69
Pacific	0.42	0.65	0.83	0.71	0.79	0.88	0.93	0.24	0.50	0.59	0.62	0.44	0.57	0.63

Table 18: IRF Based Test of Symmetry for the impact of 2 standard deviation shock on job destruction (1972:Q2-1998:Q4)

	$x_t^{\#} = x^1{}_t$							$x_t^{\#} = x^4{}_t$						
Regions	0	1	2	3	4	5	6	0	1	2	3	4	5	6
National	*0.09*	0.16	0.31	0.43	0.55	0.68	0.78	*0.07*	0.19	0.33	**0.05**	*0.06*	*0.10*	0.16
New England	0.87	0.92	0.98	0.98	0.95	0.98	0.99	0.76	0.78	0.91	0.23	0.13	0.18	0.26
Middle Atlantic	0.80	0.50	0.34	0.45	0.32	0.38	0.44	0.49	0.57	0.76	0.32	0.18	0.27	0.37
East North Central	0.50	0.73	0.85	0.93	0.97	0.99	0.99	0.21	0.46	0.66	0.54	0.55	0.63	0.72
West North Central	0.91	0.60	0.44	0.57	0.66	0.77	0.83	0.29	0.43	0.57	0.34	0.29	0.40	0.40
South Atlantic	0.47	0.50	0.52	0.68	0.80	0.89	0.93	*0.09*	0.12	0.20	**0.02**	**0.03**	*0.06*	*0.09*
East South Central	0.40	0.52	0.69	0.80	0.83	0.82	0.88	0.20	0.40	0.39	**0.03**	**0.03**	**0.05**	*0.09*
West South Central	0.60	0.86	0.96	0.97	0.98	0.99	0.99	*0.06*	0.12	0.24	**0.04**	*0.07*	0.12	0.18
Moutain	0.18	0.37	0.56	0.50	0.58	0.67	0.77	0.76	0.86	0.73	0.36	0.48	0.60	0.71
Pacific	0.20	0.24	0.35	0.38	0.28	0.39	0.50	*0.09*	0.12	0.23	0.17	0.15	0.17	0.25

Figure 5a: Job creation and job destruction responses to a positive oil price shock of 1 s.d.

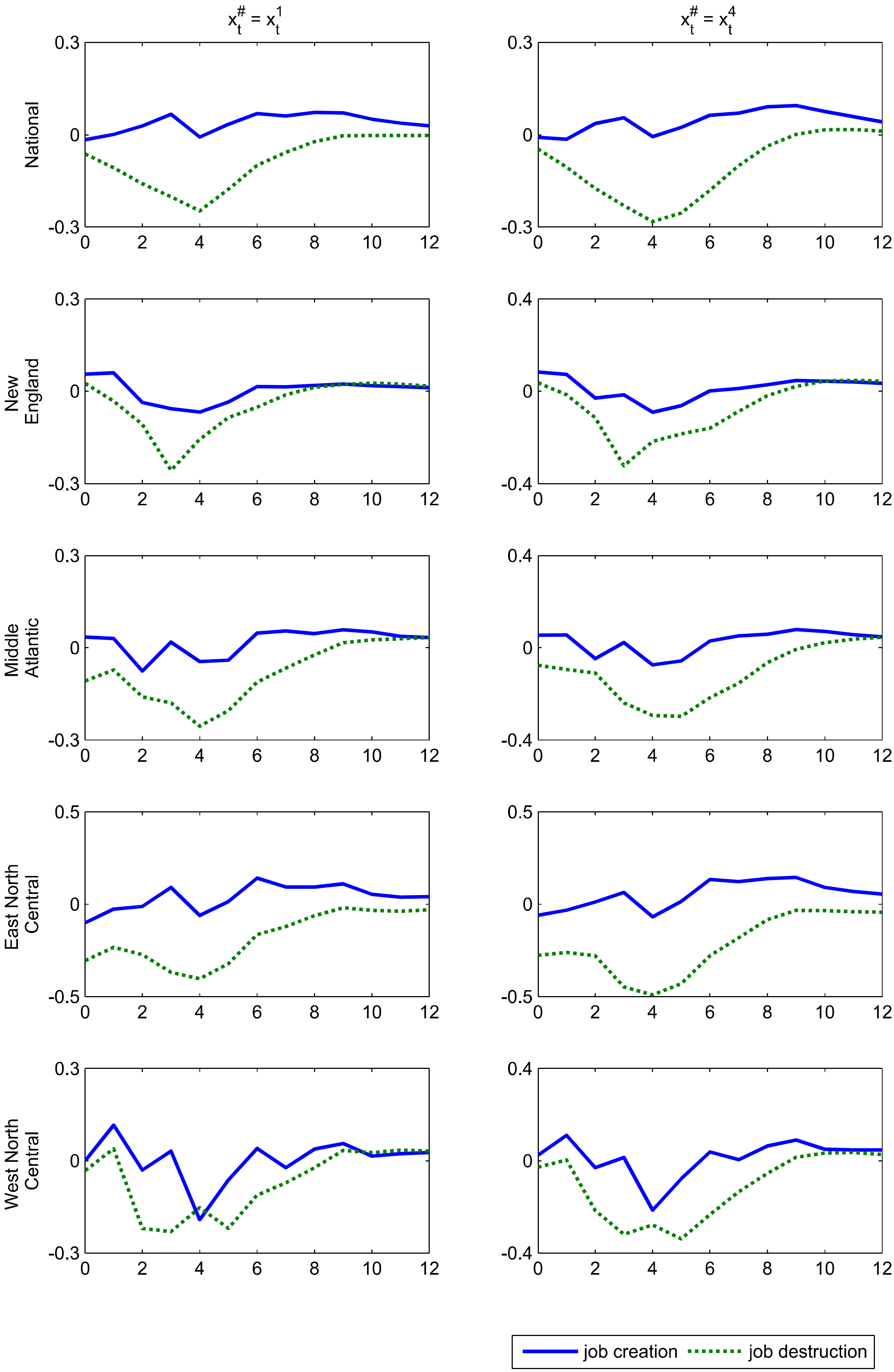


Figure 5b: Job creation and job destruction responses to a positive oil price shock of 1 s.d.

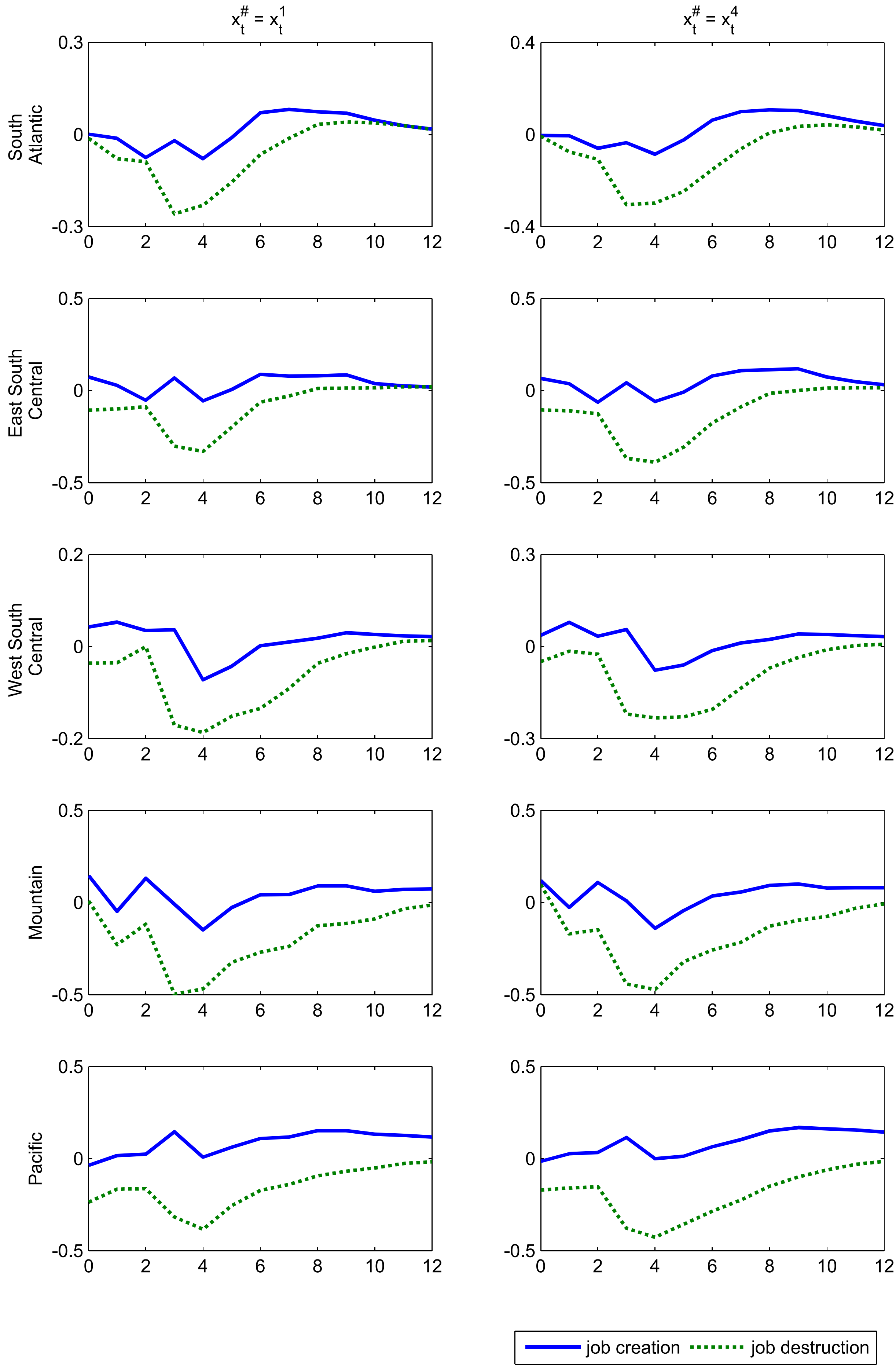


Figure 6a: Job creation and job destruction responses to a positive oil price shock of 2 s.d.

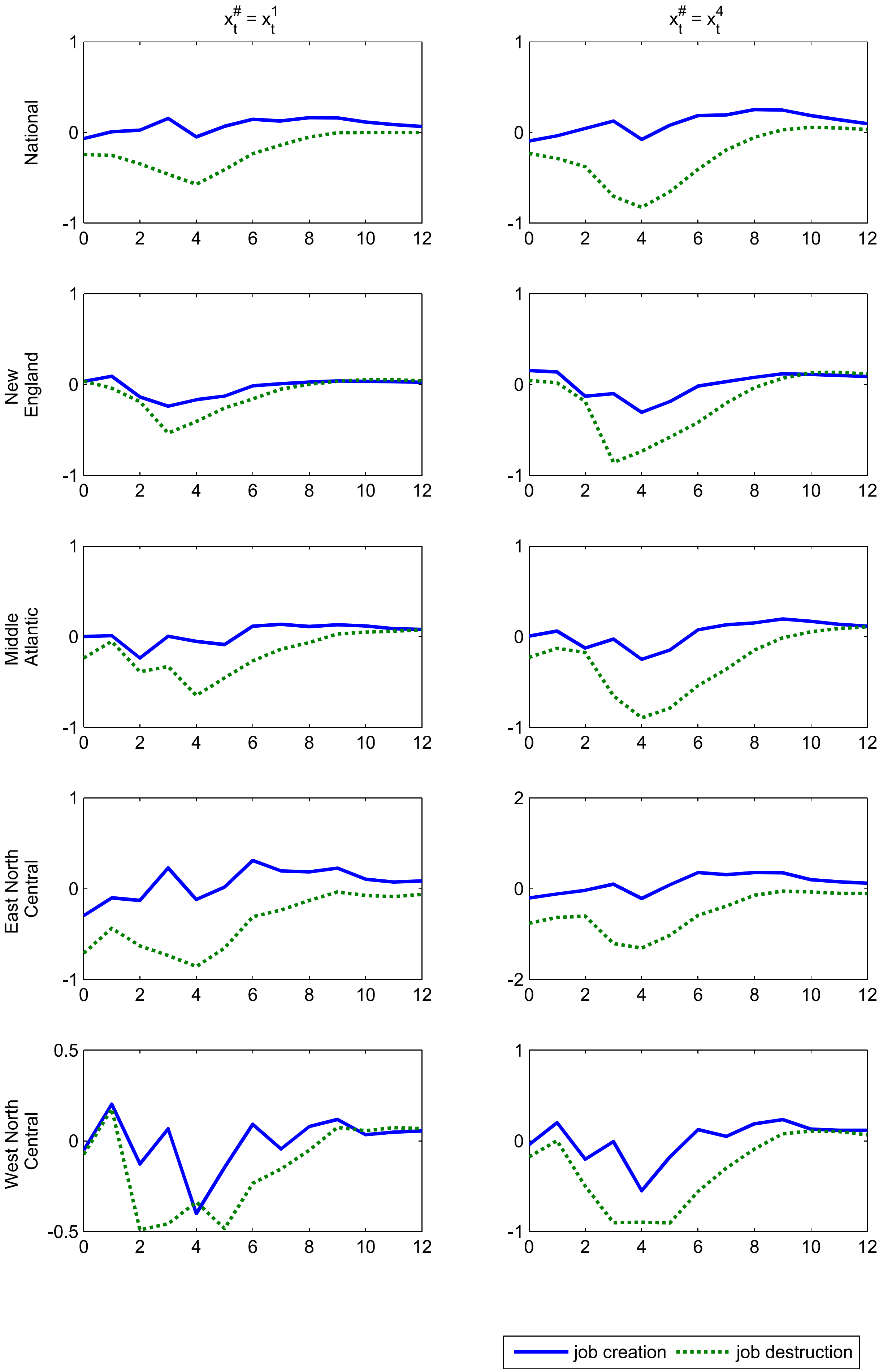
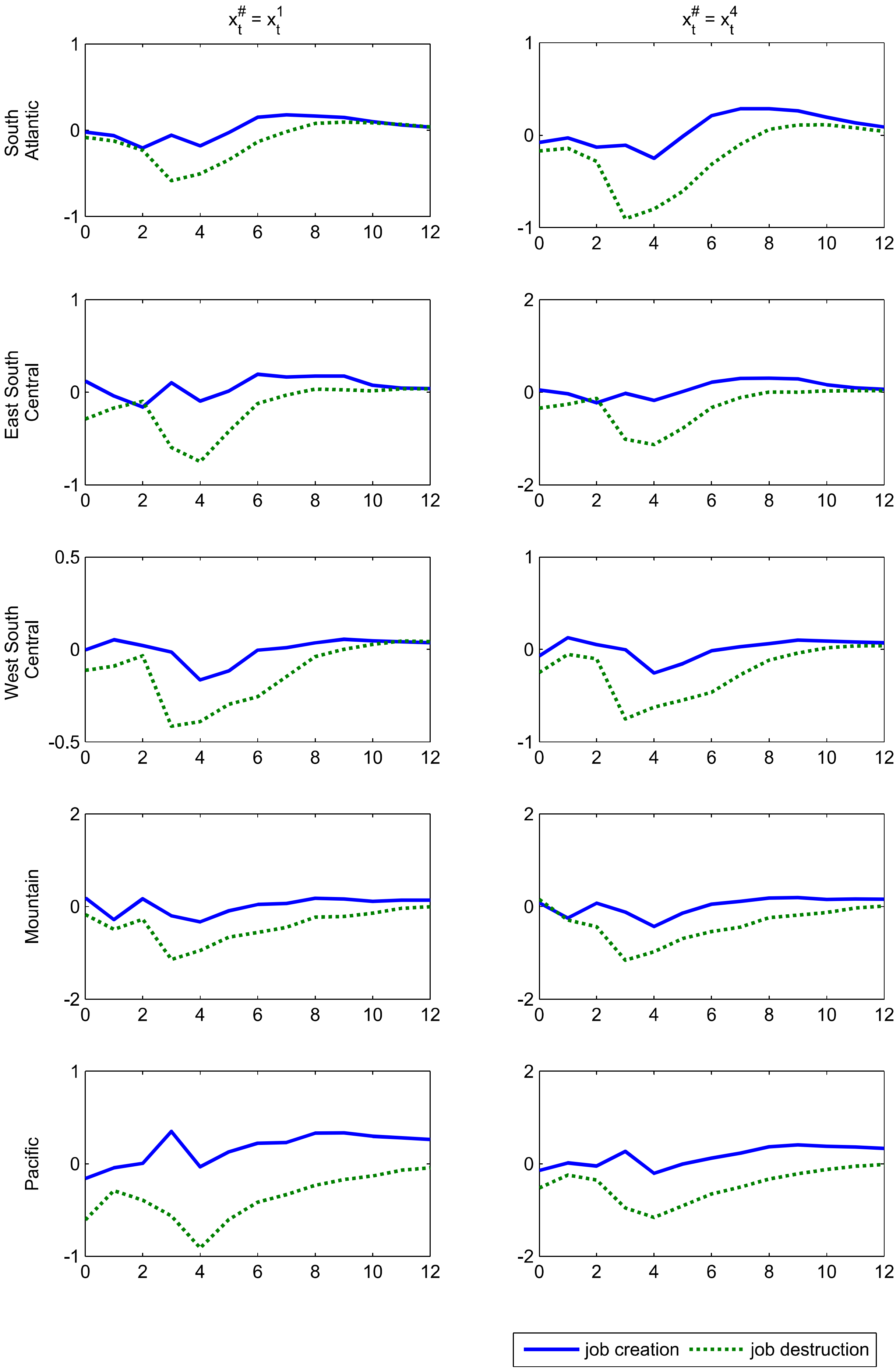


Figure 6b: Job creation and job destruction responses to a positive oil price shock of 2 s.d.



Chapter 4: Monetary shocks, Labor Reallocation and the Great Moderation

This chapter examines the impact of monetary shocks on job creation and job destruction in manufacturing using industry level data. We use a structural VAR following Giordani (2004) model and observe asymmetries in the response of job creation and job destruction to a positive spread shock. Using impulse response function based test, symmetry is rejected for several industries. Our findings indicate that a positive spread shock triggers costly sectoral labor reallocation. Yet, this cost channel of monetary transmission has been weaker since the Great Moderation.

4.1 Introduction

In the past decades, there has been a revived interest in research on the asymmetric effect of monetary policy on aggregate economic activity. Since Johnson (1962) tight monetary policy was viewed to create a sharp economic downturn while quantitative easing failed to stimulate the economy. This policy view was supported by several empirical and theoretical papers.

Cover (1992) regresses US output growth data on positive and negative monetary policy shocks using a quarterly dataset that spans the period of 1950:Q1 to 1986:Q4, and found that the asymmetric effect of contractionary monetary policy and quantitative easing is statistically significant. This result was supported by Morgan (1993), Kandil (1995), Thoma (1994) as well as papers using data on European countries such as Karras (1996). These studies were based on reduced form regime switching autoregressive models where the threshold parameter was based on money supply. Yet, recent papers that uses an extended sample of observations, and implements structural models using different regime switching parameters such as growth rate of real output (see Weise, 1999) or the federal funds rate (see Lo and Piger, 2005) found less or no evidence of asymmetry to positive and negative shocks. Instead, both Weise (1999) and Lo and Piger (2005) found evidence of asymmetry in the state of the business cycle, indicating that monetary policy shocks have greater effects during recessions. This asymmetry was supported by Höppner, Melzer and Neumann (2008) who claim, using a sample from 1962 to 2002, that the impact of monetary policy shocks has been gradually declining over time.

These empirical findings of asymmetry in the effects of positive and negative policy shocks on economic activity were explained by theoretical Keynesian models based on price rigidity, where monetary policy lead to asymmetric effects on the macroeconomy under the assumption that prices are more flexible upward than downward. As a result, quantitative easing leads to little change in output along with increases in prices while contractionary monetary policy leads to a reduction in output and little change in price (see Ball and Mankiw, 1994, Caballero and Engel, 1992). Another channel that seems to foster the asymmetric effects of monetary shocks on output is the changes in how the banking sector responds during crisis. In periods of tight money supply, banks willingness to supply credit for riskier borrowers decreases. This behavior, leads to a reduction in output that is asymmetric to the response of output following an expansionary monetary policy (see Jackman and Sutton, 1982).

Moreover, the reduced effect of monetary shocks over time has been also explained through several monetary policy channels of transmission. One channel that explains this reduced effect is the cost channel presented by Barth and Ramey (2002) – hereafter BR (2002) – who argue that higher interest rates are likely to alter the ability of firms to produce in the short-run by investing in working capital. In their paper, BR (2002) show that the effect of this channel has been reduced since the start of the Great Moderation.

Furthermore, this cost channel presented by Barth and Ramey (2002) has provided explanation on the presence of the price puzzle. They show that contractionary monetary policy generates increases in relative prices and reduction in output for several manufacturing industry. The significance of this cost channel explains that increases in inflation are expected following a contractionary monetary policy.

In this paper, we study the impact of a positive spread shock on manufacturing job creation and job destruction in manufacturing. We hypothesis that the costly labor reallocation triggered by contractionary monetary policy is another supply side effect associated with monetary transmission and argue that the significance of this channel provides additional supportive explanation for the price puzzle. Moreover, investigating the presence (absence) of sectoral labor reallocation following an increase in interest rates provides explanation for the asymmetric (symmetric) effect of positive and negative monetary shocks on the economic activity.

Two papers have examined the impact of monetary shocks on job creation and job destruction in manufacturing. Garibaldi (1997) presents theory and evidence on the asymmetric effect of monetary policy on job flows. Using a matching model, he showed that upon an increase in interest rates there is a strong increase in job destruction and a mild change in job creation. He explains this asymmetry as evidence of costly and time consuming reallocation. In addition, Garibaldi (1997) uses a single equation regression model to verify empirically that manufacturing net employment responds asymmetrically to positive and negative interest rates using data on manufacturing that spans the 1972:Q2-1988:Q4 period.

Using the same sample, Davis and Haltiwanger (2001) have studied the impact of a positive spread shock on job creation and job destruction in manufacturing industries. They found asymmetries in the response of job creation and job destruction roughly 3 quarters after the shock. Yet their model specification makes their results questionable and subject to possible bias and inconsistency due the inclusion of a censored variable as a left hand side variable in their structural near VAR (see chapter 2).

In this paper, we estimate the impact of a positive spread shock on job creation and job destruction for total manufacturing and 2-digit and 4-digit SIC code industries. Our study is disaggregated by industries in manufacturing for several reasons. First, since banks willingness to supply credit to riskier borrowers change during crisis, we expect industries to respond differently to monetary shocks. As a result if monetary shocks generate costly labor reallocation, then analyzing the impact of a spread shock at the aggregate level will conceal these reallocation frictions. In fact, concluding that there is no allocative effect associated with a positive spread shock based on a symmetric response in job creation and job destruction for total manufacturing might be misleading because aggregate manufacturing represents a weighted average of symmetric and possibly asymmetric responses for job flows at the industry level.

In this study, we use a sample that spans the 1972:Q2 to 2005:Q1 period for total manufacturing job flows and 1972:Q2 to 1998:Q4 for jobs flows at the 2-digit and 4-digit industry level. We find asymmetries in the response of job creation and job destruction to a positive monetary shock around a year after the shock. At the 2-digit SIC code industry level, asymmetries are stronger especially in sectors that are energy intensive such as primary metals and transportation equipment. Examining the impact of a positive spread shock on job creation and job destruction rates for industries in the transportation equipment sector, we find stronger asymmetries especially for motor vehicles parts and accessories, and truck trailers.

In order to inspect the statistical significance of the observed asymmetries in the responses of job creation and job destruction to a positive monetary shock, we conduct an impulse response based test of symmetry in the spirit of KV (2011b) and following Herrera and Karaki (2012). We find ample evidence of asymmetries for sectors that are energy intensive such as textiles, furniture and fixtures, primary metals, transportation equipment, motor vehicles parts and accessories, and truck trailers. Our evidence of sectoral labor reallocation triggered by a positive spread shock explains the asymmetries in the response of economic activity to positive and negative monetary shocks. Furthermore, the significant costly sectoral reallocation triggered by a positive spread shock provides another explanation for the supply side effects associated with monetary policy.

Finally, we examine whether the economy's response to a positive monetary shock has changed since the Great Moderation. Following Blanchard and Gali (2010) we split the sample in 1983 and find that monetary shocks had a larger effect on job creation and job destruction rates prior to 1983:Q4 and that the effect of monetary shocks during the Great Moderation was relatively mild. Our results are in line with Barth and Ramey (2002) who found a reduction in the impact of monetary shocks on output since the start of the Great Moderation.

Our results have important implications for the theoretical and empirical literature. Our finding that an unexpected positive monetary shock leads to a sharp increase in job destruction rate but only a mild response in job creation rate reveals that monetary shocks have important allocative effect, which could explain the nonlinearities in the response of output to monetary shocks. Our results are also relevant for the empirical literature interested in estimating the impact of monetary shocks on job flows. In particular, our results underline the importance of testing the statistical significance of the asymmetries implied from the impulse response functions, rather than making conclusions by observing the impulse response functions. Finally, this paper provides additional evidence of a cost channel for monetary transmission and show that the role of this channel has become weaker since the start of the Great Moderation.

This paper is organized as follows. Section 2 discusses the data. In Section 3 we present the econometric model. Section 4 explores the estimation results for the full sample of observations. Section 5 conducts an impulse response based test of symmetry inspired by KV (2011b) to assess the statistical significance of the asymmetric responses of job creation and job destruction rates to a positive spread shock. Section 6 addresses the changing importance of costly labor reallocation during the Great Moderation. Section 7 concludes.

4.2 Spread shocks and Job flows data

In this paper, we use quarterly data on output gap, inflation, quality spread and job creation and job destruction data for total manufacturing and 2-digit SIC code and selected 4 digit SIC code industries to evaluate the impact of monetary shocks on sectoral labor reallocation.

We use data on capacity utilization produced by the Federal Reserve board as a measure for output gap (see Giordani, 2004), and use the growth rate in the consumer price index to compute the inflation rate. We define quality spread as the difference between the 3 month Treasury bill rate and the 3 month commercial paper rate, which we obtain from the FRED database. We convert monthly data to quarterly by using the middle month for each quarter. As in Davis and Haltiwanger (2001), this measure will be used to estimate the impact of monetary shocks on job creation and job destruction in manufacturing. The data on job creation and job destruction was obtained from the Gross Job Flows database created by Davis, Haltiwanger and Schuh (hereafter DHS) in 1996 and updated in 2009. This database contains quarterly data on aggregate and sectoral job flows. Aggregate data is available until 2005: Q1 while industry level data at the 2-digit and 4-digit SIC code are only available from 1972: Q2 to 1998:Q4.

DHS define job creation as the sum of employment gains at expanding and entering establishments and job destruction as the sum of employment losses at contracting and exiting establishments, and express those job flows measures as job creation and job destruction rates (see Davis and Haltiwanger 1996). Thus in Davis and Haltiwanger (1996), the net growth rate of employment for an industry j at time t is defined as:

$$NET_{S,t} = POS_{S,t} - NEG_{S,t}, \tag{1}$$

where $POS_{S,t}$ and $NEG_{S,t}$ represent the job creation rate and job destruction rate in industry j at time t or in the aggregate manufacturing sector. The job reallocation rate is defined as the sum of $POS_{S,t}$ and $NEG_{S,t}$.

$$SUM_{S,t} = POS_{S,t} + NEG_{S,t}, \tag{2}$$

As an indicator regarding the flexibility of labor markets DHS define the excess job reallocation rate as:

$$EXC_{S,t} = POS_{S,t} - |NET_{S,t}|\,. \tag{3}$$

The excess labor reallocation rate rises with the simultaneous increase in job creation and job destruction but decreases with the increase in the absolute value of net employment. For this reason, excess job reallocation is a more adequate measure for labor market flexibility since it measures the amount of reallocation that would have been necessary to offset changes in the net employment growth.

The net employment growth, reallocation rate and the excess reallocation rates will be used to quantify the impact of monetary shocks on job flows. In the next section, we present the model used in this study and discuss the identification restrictions imposed.

4.3 Model

To study the impact of monetary shocks on job flows we estimate the following five equation structural vector autoregressive model (SVAR):

$$B_0 y_t = B(L) y_{t-1} + \epsilon_{t-1} \tag{4}$$

$$B_0 = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ b_{0,21} & 1 & 0 & 0 & 0 \\ b_{0,31} & b_{0,32} & 1 & 0 & 0 \\ b_{0,41} & b_{0,42} & b_{0,43} & 1 & 0 \\ b_{0,51} & b_{0,52} & b_{0,53} & b_{0,54} & 1 \end{bmatrix}, y_t = \begin{bmatrix} y_{1t} \\ y_{2t} \\ y_{3t} \\ y_{4t} \\ y_{5t} \end{bmatrix} = \begin{bmatrix} Ygap_t \\ INF_t \\ SPR_t \\ NEG_t \\ POS_t \end{bmatrix}, \epsilon_t = \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \\ \epsilon_{3t} \\ \epsilon_{4t} \\ \epsilon_{5t} \end{bmatrix}$$

Where $Ygap_t$ refers to the output gap, INF_t refers to the inflation rate SPR_t refers to the quality spread stands for the quality spread, $NEG_{j,t}$ is the job destruction rate in industry j, $POS_{j,t}$ is the job creation rate in the industry j, and $\varepsilon_t = [\varepsilon_{1,t}, \varepsilon_{2,t}, \varepsilon_{3,t}, \varepsilon_{4,t}, \varepsilon_{5,t}]'$ is a vector of contemporaneously and serially uncorrelated innovations. Note that for identification purposes, we assume that output gap is exogenous and that inflation does not respond contemporaneously to the quality spread, job destruction and job creation. We also assume that the quality spread does not respond contemporaneously to changes in job destruction or job creation, and that job destruction does not respond contemporaneously to changes in job creation. Finally, the model is estimated efficiently by OLS since we do not impose any exclusion restrictions on the lags of the endogenous variables and that we assume the innovations are orthogonal.

Davis and Haltiwanger (2001) have studied the impact of spread shock on job flows and included a system of 7 variables, which includes oil prices, absolute oil prices, total job creation in manufacturing, total job destruction in manufacturing, quality spread, job creation for industry i, and job destruction for industry i. In this paper, we use the model in (4) for two reasons. First, our identification restrictions are in line with the VAR model proposed by Giordani (2004) to solve the price puzzle. Second, as indicated in Kilian and Vigfusson (2011b), the use of a censored VAR as in Davis and Haltiwanger (2001) could possibly lead to biased and inconsistent estimates. We are sensitive to these findings and prefer to implement a linear five variable structural VAR while analyzing the impact of spread shocks on job flows.

In this paper, we compute unconditional generalized impulse response function (see Koop, Pesaran and Potter (1996) to study the impact of a positive typical spread shock. Textbook or the so called orthogonolized impulse response functions are also suitable to illustrate the impact of a shock on a set of variables in a linear system of equations. However, we prefer to compute generalized impulse response functions (GIRF) because GIRF are robust to the composition dependence, or in other words, the GIRFs are robust to the ordering of the variables (see Pesaran and Shin, 1998).

4.4 Empirical findings

Figure 7a-b report the responses of job creation and job destruction to a positive 1 standard deviation spread shock. For ease of comparison, we plot the negative of job destruction. Our estimated responses show asymmetries in the response of job creation and job destruction especially for h<8. Upon an unexpected positive 1 standard deviation spread shock, the responses show an increase in job destruction and a mild change in job creation for aggregate manufacturing. To quantify the impact of the positive 1 standard deviation shock on job flows, we compute the cumulative net employment growth (NET), the cumulative job reallocation rate (SUM) and the cumulative excess job reallocation rate (EXC), as discussed in section 2.

Table 19 reports that the 1 year (2 year) cumulative net employment growth for aggregate manufacturing is -0.81 (-0.48) percentage points and the 1 year (2 year) cumulative reallocation rate is 0.84 (1.51) percentage points. To evaluate the amount of reallocation that exceeds the net change in employment growth, we compute the excess reallocation rate. The 1 year (2 year) cumulative excess reallocation rate for aggregate manufacturing is -0.01(0.33) percentage points. These low excess reallocation rates indicate that at the aggregate level, spread shocks generates mild labor reallocation. However, the disparity in industry characteristics across different sectors in manufacturing might lead to changes in the responses of job creation and job destruction across establishments in different industries. As a result, we examine the impact of a positive spread shock on labor reallocation at the industry level.

Figure 7 shows that the magnitude of the asymmetries changes as we move to more disaggregated industries. Table 19 reports the impact of a typical spread shock on job creation and job destruction for industries at the 2 digit SIC level. The one-year (two-year) cumulative net employment growth is -1.29 (-0.41), -2.69 (-1.89), -2.08 (-2.22), -1.97 (-1.36) and -1.20 (-0.52) percentage points for rubber and plastics, primary metals, industrial machinery, electronics and other electric equipments and transportation equipment. Our results indicate that the impact of a typical positive spread shock on net employment growth is negative and economically significant, and that the effect of a spread shock has a stronger effect a year rather than two years after the shock.

In addition, the one-year (two-year) cumulative reallocation rate is 0.38 (0.23), 1.58 (1.99), 0.97 (1.59) and 0.23 (-0.59) percentage points for lumber, rubber and plastics, primary metals, industrial machinery and transportation equipment. Moreover, the one-year (two-year) cumulative excess job reallocation rate is -1.56 (-2.58), -1.30 (-1.70) and -2.53 (-4.34) percentage points for rubber and plastics, primary metals and transportation equipment. We observe that the excess job reallocation rate is large in absolute terms for several industries, which indicates that there is a significant process of costly labor reallocation associated with a positive spread shock.

In line with Herrera and Karaki (2012), we investigate the impact of a positive spread shock on four 4-digit SIC code industries in the transportation equipment sector. We observe stronger asymmetries especially for motor vehicles and car passenger, and truck trailers. Table 19 reports the impact of a 1 standard deviation increase in spread shock on job flows in 4-digit SIC code industries. The one-year (two-year) cumulative net employment growth is -1.34 (0.88), -1.34 (0.24), and -6.14 (-3.14) percentage points for motor vehicles, passenger car bodies, motor vehicles parts and accessories, and truck trailers.

Furthermore, the cumulative one-year (two-year) cumulative job reallocation rate is 2.64 (-1.50), 0.99(0.22), 3.87 (5.67) percentage points for motor vehicles and passenger car bodies, motor vehicles parts and accessories and truck trailers. Moreover, the one-year (two-year) excess job reallocation rate is -3.98 (-10.35) percentage points for motor vehicles and passenger car bodies. This strong reallocative effect emphasizes the importance of using disaggregated data while analyzing the impact of monetary shocks on job flows.

To evaluate whether the observed asymmetries in the responses of job creation and job destruction to a positive spread shock are statistically significant, we conduct an impulse response function based test in the light of Kilian and Vigfusson (2011b). In other words, after computing the impulse responses functions, we generate pseudo series using bootstrapping methods to compute T impulse response functions ($T = 100$). Those impulse response functions are used to construct the variance covariance matrix needed to compute a Wald test where the null of symmetry is:

$$H_o : I_{NEG}(h,\delta) + I_{POS}(h,\delta) = 0 \text{ for } h = 0,1,2,...,H.$$

where I_{POS} stands for the response of job creation and I_{NEG} stands for the response in job destruction to a positive spread shock. Table 21 reports the p-value for the impulse response function based test of symmetries where values in bold refers to 5 % level of statistical significance and italic values to refers to a statistical significance at the 10% level. The asymmetries in the response of job creation and job destruction to a positive spread shock are statistically significant for numerous sectors for at least one horizon (h). The null of symmetry is rejected at the 5% statistically significance level for Textile (for $h = 4$), furniture and fixtures (for $h = 1-5$), primary metals (for $h = 3-12$), industrial machinery ($h = 4$), electronic and electric equipment (for $h = 2-7$), transportation equipment (for$h = 1-12$), truck and bus bodies ($h = 0-12$), motor vehicles parts and accessories (for h=3-8), and truck trailers (for $h = 2-10$). Interestingly, Herrera and Karaki (2012) show evidence of significant asymmetries in the response of job creation and job destruction to a positive typical oil price shock in the following industries: textiles, furniture and fixtures, electronics and other electric equipment, motor vehicles and parts and truck trailers.

Our results suggest that monetary shocks trigger costly labor reallocation especially in industries that show evidence of cost shocks effect in work by Barth and Ramey (2002). Our finding that the magnitude of the asymmetries in the response of job creation and job destruction to a positive typical spread shock is mild for the aggregate level but stronger for the 2-digit and 4-digit industries emphasizes the importance of using disaggregated data while estimating the impact of monetary shocks on job flows.

4.5 Monetary shocks and the Great Moderation

The reduction in the effects of monetary shocks on output since the Great Moderation has been attributed to the reduced effect of the cost channel associated with monetary policy (see Barth and Ramey, 2002; Höppner, Melzer and Neumann, 2008). In this section, we investigate whether the decline in the impact of monetary shocks since the Great Moderation is attributed to a reduction in the costly reallocation of labor. To proceed with this task, we split the sample into two subsamples: 1972:Q2-1983:Q4 and 1984:Q1-1998:Q4

(1984:Q1-2005:Q1 for total manufacturing).

Figure 8a-b displays the impulse response functions of job creation and job destruction rates to a one standard deviation positive monetary shock. Recall that to facilitate the comparison and to visually assess the magnitude of the asymmetries, we plot the negative of job destruction rate. The left panel in Figure 8 plots the estimated responses based on the 1973-1983 sample and the right panel plots the estimated responses based on the 1984-1998 for 2 digit and 4 digit industries (1984-2005 for total manufacturing). In the pre-1983 sample, the responses of job creation and job destruction for aggregate manufacturing show an important increase in job destruction 3 quarters after the shock and a muted change in job creation. On the other hand based on the sample during the Great Moderation, Figure 8 shows that an unexpected positive spread shock leads to a muted change in the response of job creation and a mild increase in job destruction. The responses of job creation and job destruction to monetary shocks for aggregate manufacturing appear to be milder during the Great moderation than those observed during the pre-1984 period.

For the 2-digit SIC code industries, Figure 8 shows that the effect of monetary shocks on job creation and job destruction in the pre-1983 sample is much stronger than the effect reported for the Great Moderation period for all industries. For instance during the Great Moderation, the response of job destruction to a typical positive shock are 10 times smaller for transportation equipment and primary metals, whereas the response of job creation is relatively the same for both sample specifications (see Figure 8). In the pre-1983 sample, the cumulative one-year (two- year) net employment growth is -1.74 (0.43), -4.56 (-3.22), -3.03 (-2.21), -3.06 (-3.08), -2.51 (-1.19) percentage points for rubber and plastics, primary metals, fabricated metals, industrial machinery and transportation equipment respectively. On the other hand in the post-1984 sample, the cumulative one-year and (two-year) net employment growth is 0.22 (0.00), 0.54 (-0.44), 0.28 (-0.09), 0.09 (-0.43), 0.31 (0.30) percentage points for rubber and plastics, primary metals, fabricated metals, industrial machinery and transportation equipment respectively (see table 20).

In the 4 digit SIC code industries in the transportation equipment sector, the disparity in the responses of the job flows to a monetary shock for the pre-1984 sample and the post-1984 sample become larger. For instance, the response of job destruction is 5 times larger in the pre-1983 sample than the one observed during the post-1984 sample for motor vehicles and car passenger and truck trailers, whereas the response of job creation is largely the same in both subsamples. In the pre-1983 sample, the cumulative one-year (two-year) net employment growth is -3.25 (0.67) and -7.54 (-2.97) percentage points for motor vehicle parts and accessories, and truck trailers respectively. On the other hand in the Great Moderation sample, the cumulative one-year (two-year) net employment growth is -0.15 (-1.14), -1.84 (-3.55) percentage points for motor vehicles parts and access and car passenger, and truck trailers respectively.

Our results are consistent with Barth and Ramey (2002) findings that the effect of monetary shocks on output in motor vehicle industries has been reduced since the mid-1980s. Moreover, as in Herrera and Karaki (2012) who found a reduction in the effects oil price shocks on job flows since the mid-1980s, we find a reduction in the effects of a positive spread shock on net employment growth since the start of the Great Moderation.

In the pre-1983 sample, the cumulative one-year (two-year) job reallocation rate is 3.24 (4.30), 2.92 (3.78), 1.85 (1.08), 2.23 (1.42), 4.24 (6.19) percentage points for furniture and fixtures, primary metal, transportation equipment, motor vehicles and parts and accessories and truck trailers respectively. On the other, the cumulative 1 year (2 year) job reallocation rate in the post-1984 sample is –0.77 (-1.04), -0.28 (-0.58), -0.41 (-0.07), -0.70 (-0.66) and 2.22 (4.83) percentage points for furniture and fixtures, primary metal, transportation equipment, motor vehicles and parts and accessories and truck trailers respectively.

Nevertheless, regardless of the sample period, Table 20 shows that the cumulative excess job reallocation rate is negative for all sectors. Our results indicate that the reallocation that occurs following a monetary shock does not exceed the changes in net employment growth. Moreover, the magnitude of the one-year and two-year excess job reallocation is quite large in absolute terms for some sectors such as motor vehicles and passenger car bodies. The two-year excess job reallocation rate for the pre-1983 (post1984) sample is -16.67 (-2.59).

To test for symmetry in the response of job creation and job destruction to a positive spread shock, we conduct the impulse response based test of symmetry on the subsamples. Table 22 reports the p-value for aggregate manufacturing and the 2-digit and 4-digit SIC code industries for both sample specifications: 1973-1983 and 1984-1998 (1984-2005 for the aggregates only). Even though the null of symmetry is not rejected for total manufacturing, we find evidence of asymmetries for 9 out of 24 industries (apparel, furniture and fixtures, leather, primary metals, industrial machinery, transportation, instruments and related products, truck and bus bodies) in the pre-1984 sample for at least 1 horizon. Based on the post-1984 sample, the asymmetries in the response of job creation and job destruction to a positive monetary shock are rejected at the 5% level for only one industry: instruments and related products.

Our results suggest that the impact of monetary shocks on labor reallocation has been reduced since the Great Moderation. Interestingly, the asymmetries in the response of job creation and job destruction to a positive spread shock are no longer statistically significant for most industries in manufacturing. This result indicates a reduction in the effect of monetary shocks on job flows and supports the claim by Barth and Ramey (2002) regarding the weaker evidence for the cost channel of monetary transmission since the Great Moderation and the reduced effect of monetary policy over time (see Höppner, Melzer and Neumann, 2008).

4.6 Conclusion

In this paper, we study the impact of monetary shocks on job creation and job destruction in manufacturing. Our motivation stems from the theoretical and empirical literature on the nonlinearities in the response of output to positive and negative monetary shocks. Previous research has found that a positive monetary shock lead to economic downturn while a negative shock has a limited effect in stimulating the economy. In this paper, we show empirically that the asymmetric effect associated with a monetary shock could be explained with the costly labor reallocation triggered by unexpected increases in the quality spread.

We use data on aggregate manufacturing and 2-digit and 4-digit SIC code industries on job creation and job destruction and compute impulse response functions to estimate the impact of a typical positive spread shock on job creation and job destruction. We find important asymmetries in the responses of job creation and job destruction in several industries such as rubber and plastics, primary metals, transportation equipment, motor vehicles and car passenger bodies, and truck trailers. To determine whether the observed asymmetries in the impulse response functions are statistically significant, we compute an impulse response function based test in the light of Kilian and Vigfusson (2011b). We reject the null of symmetry in the response of job creation and job destruction to a positive spread shock for most industries in manufacturing for several horizons. Our results indicate that a positive spread shock trigger significant costly labor reallocation across industries indicating an important for the cost channel in the transmission mechanism of monetary policy.

Finally, to track the changes in how the economy responded to an unexpected positive monetary shock during the Great Moderation, we compute the responses of job creation and job destruction to a 1 standard deviation spread shock for two subsamples where we create a sample split around 1984:Q1 following Blanchard and Gali (2010). We found that the labor reallocation triggered by a positive spread shock has been significantly reduced since the Great Moderation especially in motor vehicles and car passenger bodies, an industry that constitutes 10% of the employment share in manufacturing. Our results indicate that the reduced impact of spread shock on output during the Great Moderation could be explained with the reduction in the labor reallocation triggered with a positive spread shock during that period. Our results reveal a weaker evidence for the cost channel of monetary transmission since the Great Moderation.

Table 19: Cumulative change in job flows due to a typical monetary shock. Sample: 1972:Q2 - 1998:Q4

	1973-1998					
	NET		SUM		EXC	
Sector	4	8	4	8	4	8
Total Manufacturing up to 2005	-0.81	-0.48	0.84	1.51	-0.01	0.33
Total Manufacturing up to 1998	-1.04	-0.78	0.62	0.82	-0.42	-0.48
Food and Kindred Products	-0.76	-0.84	0.28	0.27	-0.49	-0.63
Tobacco Products	-0.53	-0.76	-0.03	-0.03	-0.98	-1.45
Textile Mill Products	-1.04	-0.36	0.70	0.86	-0.62	-1.14
Apparel and Other Textile Products	-1.23	-0.65	0.39	0.51	-0.89	-1.34
Lumber and Wood Products	-1.13	-0.43	0.92	1.21	-0.60	-1.02
Furniture and Fixtures	-1.60	-0.64	1.21	1.69	-0.65	-1.14
Paper and Allied Products	-0.87	-0.39	0.42	0.37	-0.55	-1.08
Printing and Publishing	-0.76	-0.65	0.13	0.20	-0.63	-0.83
Chemicals and Allied Products	-0.73	-0.45	0.56	0.68	-0.26	-0.43
Petroleum and Coal Products	-1.10	-1.18	0.77	0.37	-0.67	-1.64
Rubber and Misc. Plastics Products	-1.29	-0.41	0.38	0.23	-1.56	-2.58
Leather and Leather Products	-1.54	-1.04	0.51	0.62	-1.23	-1.62
Stone, Clay, and Glass Products	-1.68	-1.17	0.78	0.73	-0.90	-1.45
Primary Metal Industries	-2.69	-1.89	1.58	1.99	-1.30	-1.70
Fabricated Metal Products	-1.63	-1.36	0.51	0.70	-1.12	-1.35
Industrial Machinery and Equipment	-2.08	-2.22	0.97	1.59	-1.10	-1.06
Electronic and Other Electric Equipment	-1.97	-1.36	0.92	1.13	-1.05	-1.45
Transportation Equipment	-1.20	-0.52	0.23	-0.59	-2.53	-4.34
Instruments and Related Products	-1.33	-1.44	0.33	0.52	-1.14	-1.22
Miscellaneous Manufacturing Industries	-1.61	-1.20	0.14	0.46	-1.47	-1.56
Motor Vehicles and Passenger Car Bodies	-1.34	0.88	2.64	-1.50	-3.98	-10.35
Truck and Bus Bodies	-0.91	0.10	-2.50	-2.84	-4.71	-6.33
Motor Vehicle Parts and Accessories	-1.34	0.24	0.99	0.22	-2.62	-4.98
Truck Trailers	-6.14	-3.14	3.87	5.67	-2.27	-3.46

Table 20: Cumulative change in job flows due to a typical monetary shock.

	1973-1983						1984-1998					
	NET		SUM		EXC		NET		SUM		EXC	
Sector	4	8	4	8	4	8	4	8	4	8	4	8
Total Manufacturing up to 2005							-0.08	-0.15	0.05	0.29	-0.06	0.10
Total Manufacturing up to 1998	-1.61	-0.82	1.48	1.77	-0.22	-0.72	-0.01	-0.21	-0.47	-0.35	-0.61	-0.70
Food and Kindred Products	-1.02	-1.18	1.34	1.28	0.05	-0.36	-0.21	-0.06	-0.35	-0.73	-0.75	-1.42
Tobacco Products	-0.90	-1.25	0.19	0.53	-0.82	-1.22	1.68	1.00	-0.85	-0.82	-4.19	-4.84
Textile Mill Products	-1.59	-0.35	1.93	2.20	-0.37	-1.33	0.98	0.97	-0.65	-0.75	-1.63	-1.93
Apparel and Other Textile Products	-2.37	-0.76	1.88	2.67	-0.48	-1.31	0.63	0.65	-1.46	-2.52	-2.09	-3.43
Lumber and Wood Products	-2.47	-1.18	2.72	3.64	-0.39	-0.75	0.67	0.28	-1.03	-1.17	-2.01	-2.54
Furniture and Fixtures	-2.86	-0.52	3.24	4.30	-0.23	-1.51	-0.06	-0.27	-0.77	-1.04	-1.21	-1.93
Paper and Allied Products	-1.56	-0.44	0.71	0.82	-1.27	-2.27	0.34	0.40	-0.17	-0.40	-0.51	-0.86
Printing and Publishing	-1.07	-1.29	0.27	0.66	-0.80	-0.76	-0.10	-0.04	-0.72	-1.23	-1.34	-2.09
Chemicals and Allied Products	-1.38	-1.00	1.23	1.77	-0.14	0.02	0.23	0.29	-0.35	-0.76	-0.79	-1.33
Petroleum and Coal Products	-0.65	-1.05	0.50	0.40	-1.66	-3.08	-0.26	-0.30	-0.33	-0.45	-0.62	-0.92
Rubber and Misc. Plastics Products	-1.74	0.43	1.71	1.44	-1.55	-4.00	0.22	0.00	-0.37	-0.42	-0.77	-1.04
Leather and Leather Products	-2.16	-1.65	1.44	1.42	-0.72	-1.45	1.26	1.81	-0.87	-1.84	-2.13	-3.71
Stone, Clay, and Glass Products	-2.63	-1.42	1.88	2.01	-0.76	-1.84	0.05	-0.35	-0.23	-0.43	-0.69	-1.29
Primary Metal Industries	-4.56	-3.22	2.92	3.78	-1.80	-2.29	0.54	0.44	-0.28	-0.58	-0.81	-1.32
Fabricated Metal Products	-3.03	-2.21	1.65	2.33	-1.38	-1.61	0.28	-0.09	-0.41	-0.54	-0.88	-1.49
Industrial Machinery and Equipment	-3.06	-3.08	2.21	3.41	-0.87	-0.03	0.09	-0.43	-0.61	-1.19	-0.98	-2.08
Electronic and Other Electric Equipment	-2.92	-1.22	2.17	2.53	-0.75	-2.08	0.01	-0.46	-0.30	-0.42	-0.81	-1.41
Transportation Equipment	-2.51	-1.19	1.85	1.08	-3.19	-5.81	0.31	0.03	-0.41	-0.07	-0.95	-0.90
Instruments and Related Products	-1.92	-0.78	1.69	2.01	-0.55	-1.37	0.69	0.48	-1.16	-1.54	-1.85	-2.44
Miscellaneous Manufacturing Industries	-2.45	-1.45	1.38	2.51	-1.06	-0.93	0.12	-0.30	-0.86	-0.76	-1.70	-2.23
Motor Vehicles and Passenger Car Bodies	-1.21	2.93	4.70	0.58	-8.42	-16.67	-1.29	-2.17	-0.96	0.13	-2.80	-2.59
Truck and Bus Bodies	-1.42	1.19	-2.47	-1.64	-6.67	-8.44	1.68	0.33	-1.89	-1.73	-4.38	-5.57
Motor Vehicle Parts and Accessories	-3.25	0.67	2.23	1.42	-1.84	-6.57	-0.15	-1.14	-0.70	-0.66	-1.52	-2.49
Truck Trailers	-7.54	-2.97	4.24	6.19	-3.91	-6.54	-1.84	-3.55	2.22	4.83	0.36	1.26

Table 21: Impulse response function based test for a typical spread shock.

	1973-1998												
Sector	0	1	2	3	4	5	6	7	8	9	10	11	12
Total Manufacturing up to 2005	0.42	0.24	*0.06*	**0.03**	**0.05**	**0.05**	*0.09*	0.11	0.15	0.20	0.18	0.24	0.29
Total Manufacturing up to 1998	0.68	0.44	*0.09*	0.15	0.24	0.32	0.42	0.46	0.45	0.52	0.58	0.66	0.73
Food and Kindred Products	0.67	0.86	0.96	0.98	0.98	0.97	0.98	0.99	1.00	1.00	0.99	1.00	1.00
Tobacco Products	0.78	0.91	0.64	0.77	0.68	0.77	0.83	0.84	0.89	0.91	0.94	0.96	0.98
Textile Mill Products	0.80	0.15	0.23	0.31	**0.05**	*0.07*	*0.10*	0.14	0.19	0.25	0.32	0.36	0.42
Apparel and Other Textile Products	0.74	0.45	0.65	0.73	0.42	0.55	0.56	0.65	0.74	0.82	0.87	0.87	0.91
Lumber and Wood Products	0.47	0.52	0.70	0.83	0.79	0.87	0.93	0.91	0.94	0.96	0.97	0.97	0.97
Furniture and Fixtures	0.45	**0.02**	**0.01**	**0.02**	**0.02**	**0.04**	*0.06*	*0.08*	0.11	0.16	0.19	0.25	0.28
Paper and Allied Products	0.68	0.41	0.15	0.25	0.20	0.29	0.36	0.41	0.45	0.49	0.58	0.58	0.57
Printing and Publishing	0.22	0.48	0.53	0.62	0.55	0.67	0.72	0.72	0.80	0.86	0.88	0.92	0.93
Chemicals and Allied Products	0.82	0.56	0.29	0.44	0.48	0.60	0.68	0.77	0.84	0.86	0.90	0.91	0.89
Petroleum and Coal Products	0.15	0.31	0.50	0.33	0.32	0.42	0.13	0.19	0.24	0.31	0.38	0.46	0.52
Rubber and Misc. Plastics Products	0.20	0.42	0.24	0.12	0.16	0.24	0.30	0.33	0.41	0.49	0.42	0.49	0.55
Leather and Leather Products	0.79	0.49	0.70	0.84	0.28	0.30	0.34	0.40	0.49	0.57	0.65	0.73	0.80
Stone, Clay, and Glass Products	0.77	0.92	0.52	0.33	0.23	0.32	0.38	0.47	0.56	0.65	0.70	0.71	0.78
Primary Metal Industries	0.58	0.79	0.18	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**
Fabricated Metal Products	0.83	0.94	0.42	0.28	0.35	0.47	0.57	0.67	0.75	0.78	0.80	0.85	0.84
Industrial Machinery and Equipment	0.75	0.19	0.31	0.15	**0.05**	*0.07*	*0.10*	0.15	0.21	0.28	0.34	0.39	0.47
Electronic and Other Electric Equipment	0.47	*0.09*	**0.01**	**0.01**	**0.01**	**0.02**	**0.03**	**0.05**	*0.06*	*0.09*	0.12	0.15	0.20
Transportation Equipment	0.17	**0.04**	**0.01**	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.02**	**0.02**	**0.02**	**0.03**	**0.04**
Instruments and Related Products	0.72	0.15	0.28	0.42	0.47	0.58	0.69	0.78	0.83	0.87	0.91	0.94	0.95
Miscellaneous Manufacturing Industries	0.30	0.53	0.73	0.86	0.31	0.43	0.52	0.63	0.72	0.76	0.82	0.88	0.92
Motor Vehicles and Passenger Car Bodies	0.41	0.23	*0.07*	*0.07*	*0.10*	0.12	0.19	0.24	0.24	0.31	0.27	0.34	0.35
Truck and Bus Bodies	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Motor Vehicle Parts and Accessories	0.82	0.42	0.19	**0.01**	**0.01**	**0.01**	**0.02**	**0.04**	**0.05**	*0.06*	*0.06*	*0.05*	*0.06*
Truck Trailers	0.35	0.24	**0.01**	**0.00**	**0.00**	**0.01**	**0.01**	**0.01**	**0.02**	**0.02**	**0.04**	*0.06*	*0.07*

Table 22: Impulse response function based test for a typical spread shock.

	1973-1983							1984-1998						
Sector	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total Manufacturing up to 2005								0.94	0.88	0.90	0.95	0.65	0.77	0.86
Total Manufacturing up to 1998	0.13	0.28	0.11	*0.06*	*0.10*	0.17	0.16	0.53	0.39	0.52	0.44	0.51	0.63	0.61
Food and Kindred Products	*0.06*	0.17	0.20	0.22	0.32	0.35	0.45	0.77	0.96	0.99	0.85	0.87	0.90	0.95
Tobacco Products	0.15	0.15	0.27	0.41	0.48	0.57	0.64	0.42	0.25	0.43	0.60	0.53	0.65	0.76
Textile Mill Products	0.13	*0.07*	0.15	*0.10*	0.14	0.21	0.30	0.73	0.94	0.22	0.28	0.41	0.52	0.63
Apparel and Other Textile Products	0.83	**0.04**	*0.09*	0.16	*0.10*	0.12	0.17	0.79	0.93	0.46	*0.08*	*0.06*	*0.07*	0.11
Lumber and Wood Products	0.25	0.50	0.45	0.57	0.64	0.76	0.66	0.56	0.74	*0.10*	0.15	0.18	0.26	0.35
Furniture and Fixtures	0.94	*0.06*	**0.02**	**0.04**	*0.06*	*0.10*	0.14	0.76	0.95	0.67	0.18	0.19	0.27	0.37
Paper and Allied Products	0.96	0.72	0.58	0.74	0.74	0.71	0.77	0.69	0.88	0.95	0.73	0.83	0.85	0.91
Printing and Publishing	0.22	0.39	0.59	0.75	0.72	0.83	0.89	0.37	0.34	0.49	0.24	0.22	*0.07*	*0.10*
Chemicals and Allied Products	0.53	0.47	0.44	0.49	0.55	0.64	0.71	0.62	0.69	0.86	0.48	0.47	0.53	0.42
Petroleum and Coal Products	0.31	0.53	0.71	0.67	0.59	0.68	0.68	0.25	0.29	0.20	0.33	0.44	0.50	0.62
Rubber and Misc. Plastics Products	0.71	0.85	0.70	0.12	0.20	0.27	0.26	0.88	0.69	0.78	0.29	0.36	0.46	0.46
Leather and Leather Products	0.77	0.14	0.19	0.21	**0.05**	*0.08*	*0.10*	0.39	0.63	0.82	0.75	0.86	0.82	0.89
Stone, Clay, and Glass Products	0.78	0.66	0.58	0.12	0.19	0.27	0.31	0.42	0.72	0.87	0.72	0.82	0.84	0.85
Primary Metal Industries	0.58	0.24	0.28	**0.00**	**0.00**	**0.00**	**0.01**	0.87	0.82	0.94	0.90	0.96	0.98	0.99
Fabricated Metal Products	0.24	0.27	0.12	**0.02**	**0.04**	*0.07*	*0.06*	0.91	0.68	0.34	0.25	0.26	0.35	0.45
Industrial Machinery and Equipment	0.12	**0.03**	*0.07*	**0.01**	**0.01**	**0.02**	**0.01**	0.64	0.48	0.40	0.28	0.20	0.25	0.34
Electronic and Other Electric Equipment	0.55	0.17	*0.06*	*0.09*	0.15	0.18	*0.07*	0.89	0.67	0.65	0.27	0.39	0.51	0.58
Transportation Equipment	0.77	0.40	0.11	**0.04**	*0.07*	0.11	0.17	0.33	0.55	0.74	0.49	0.61	0.72	0.61
Instruments and Related Products	0.22	**0.04**	*0.08*	0.15	0.22	0.31	0.37	0.25	0.47	**0.01**	**0.00**	**0.01**	**0.01**	**0.02**
Miscellaneous Manufacturing Industries	0.53	*0.06*	*0.10*	0.14	*0.06*	*0.09*	0.14	0.67	0.45	0.46	0.59	0.69	0.73	0.75
Motor Vehicles and Passenger Car Bodies	0.22	0.15	0.13	0.21	0.31	0.34	0.44	0.14	0.31	0.47	0.64	0.67	0.75	0.80
Truck and Bus Bodies	0.17	**0.01**	**0.03**	**0.03**	**0.05**	*0.06*	*0.10*	0.40	0.15	0.14	0.22	0.33	0.41	0.52
Motor Vehicle Parts and Accessories	0.67	0.72	0.50	0.30	0.41	0.46	0.51	0.84	0.92	0.98	0.54	0.68	0.73	0.82
Truck Trailers	0.76	0.88	0.69	0.26	0.38	0.47	0.11	0.70	*0.09*	0.14	0.23	0.17	0.22	0.30

Figure 7a: Job creation and job destruction responses to a positive monetary shock shock of 1 s.d. Full Sample

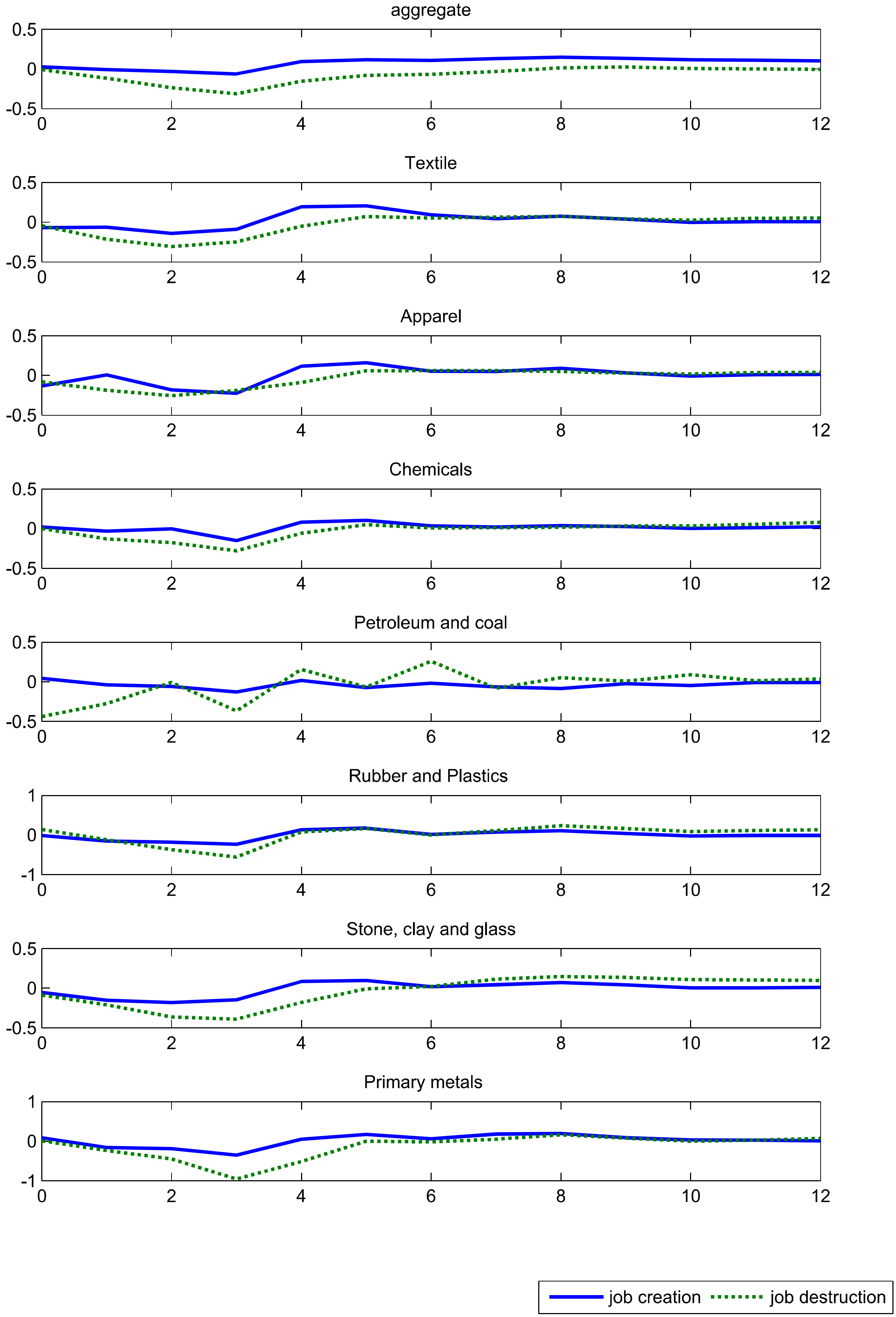


Figure 7b: Job creation and job destruction responses to a positive monetary shock shock of 1 s.d. Full sample

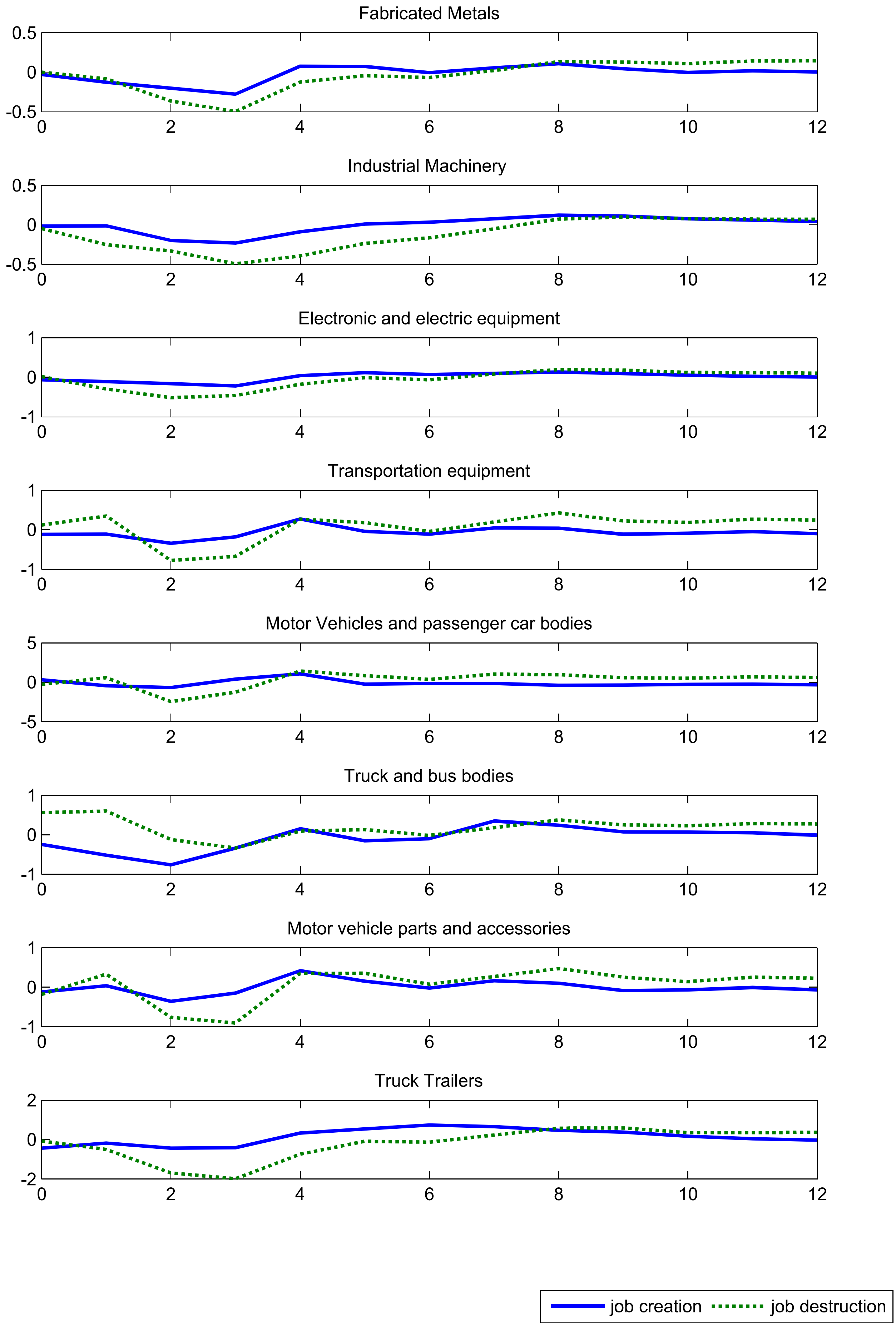


Figure 8a: Job creation and job destruction responses to a positive monetary shock shock of 1 s.d.

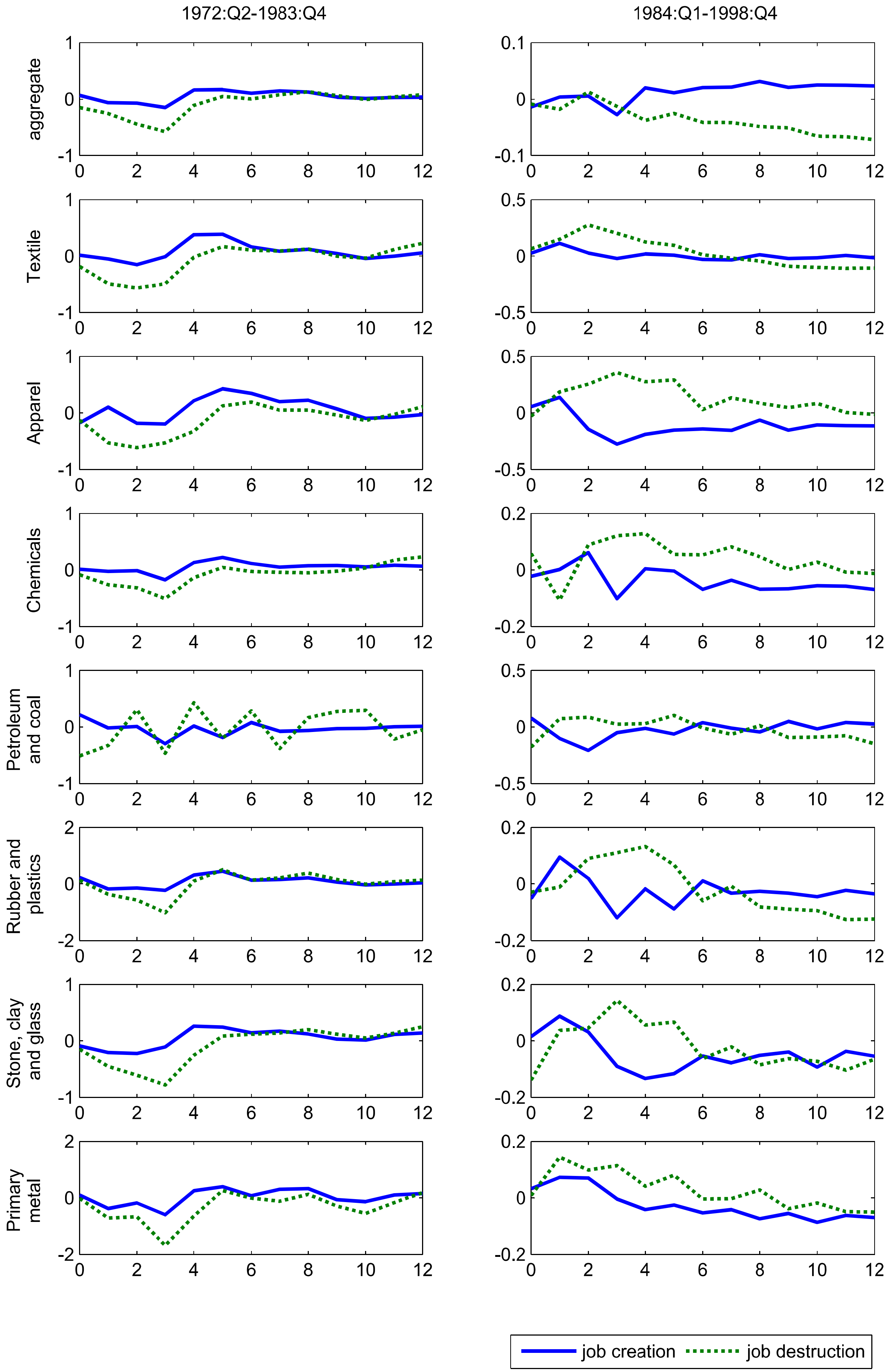
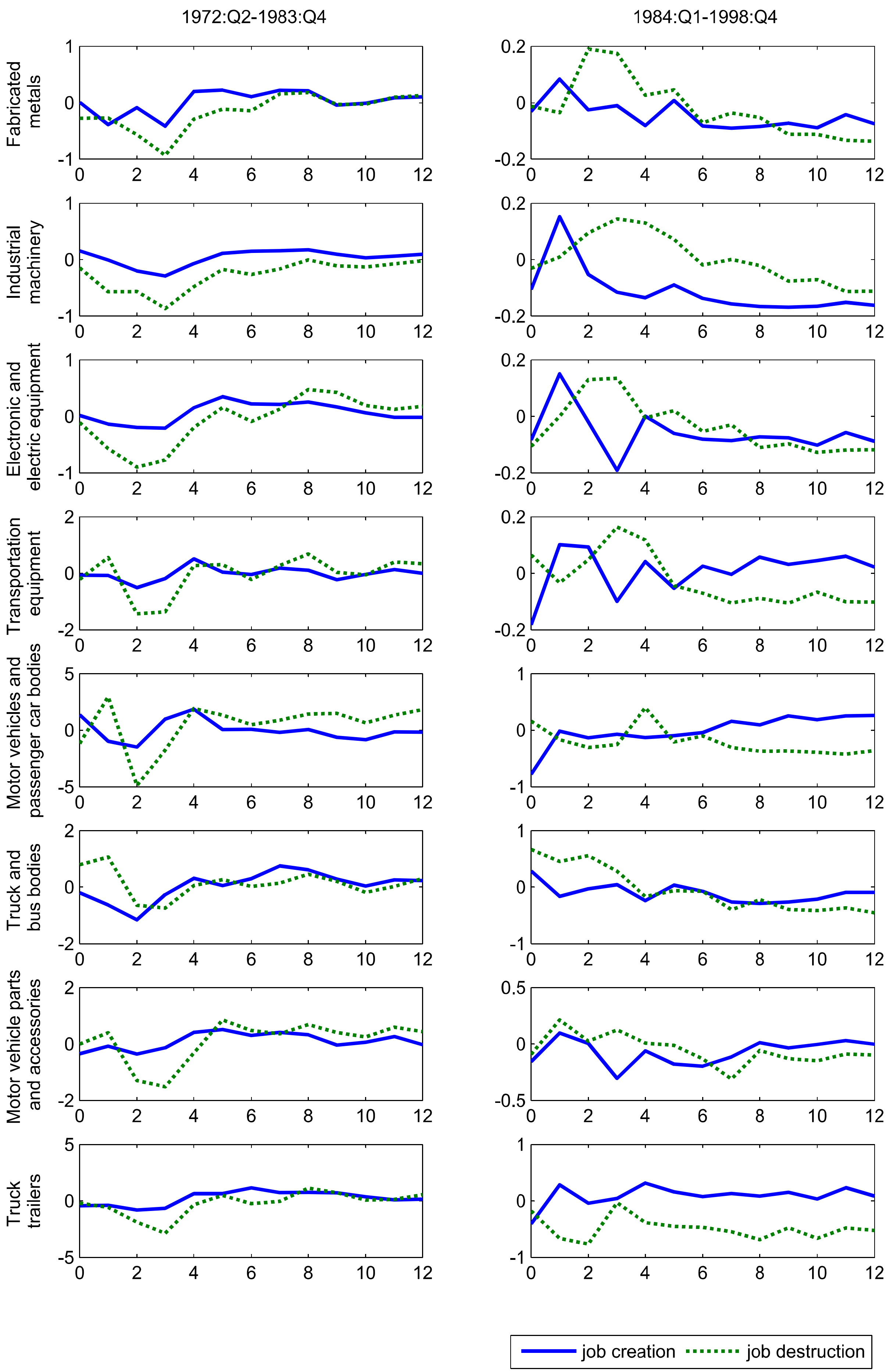


Figure 8b: Job creation and job destruction responses to a positive monetary shock shock of 1 s.d.



Chapter 5: Summary and conclusions

Using quarterly data on job creation and job destruction, this dissertation offers important contributions to the theoretical literature interested in analyzing the transmission mechanism of oil price shocks and monetary shocks on the economy. Our findings and methods also contribute to the empirical literature interested in testing for the significance of the asymmetries associated with oil price (monetary shocks).

We find significant evidence that an unexpected increase in real oil prices generates significant asymmetries in the response of sectoral and regional job creation and job destruction. We also find significant costly labor reallocation triggered by an unanticipated positive monetary shock. These findings indicate that the allocative channel plays an important role in the transmission mechanism of oil and monetary shocks.

In addition, we find limited evidence of asymmetry in the response of sectoral and regional job creation (job destruction) to positive and negative typical oil price shocks. Unlike Herrera, Lagalo and Wada (2011) who found important asymmetries in the response of industrial production at the disaggregated level, we fail to reject the null of symmetry for a typical shock for most sectors. We also don't find evidence of asymmetries in the response of regional job creation (job destruction) to positive and negative unexpected oil price shocks for a typical shock for most regions. This result is in line with Owyang and Wall (2012) who find no evidence of asymmetry in the response of payroll employment across states to positive and negative oil price innovations.

Furthermore, we investigate whether the effect of oil and monetary shocks on job flows have changed since the Great Moderation. In line with Blanchard and Gali (2010), we found that the costly labor reallocation triggered by an unanticipated oil price shock has decreased since the start of the Great Moderation. We also find a reduction in the reallocative effect associated with a positive monetary shock. This result is in line with Barth and Ramey (2002) who found a less important role for the cost channel in the transmission mechanism of monetary policy on the economic activity.

It's worth mentioning that there are few limitations for our research. First, there is little knowledge about the power of the impulse response function based test especially for small samples. We are mainly referring to our analysis on the effect of oil shocks and monetary shocks on job flows before the start of the

Great Moderation where the sample is based on 47 observations. .

In addition, our computation of 26 impulse response function based test for 26 sectors and 12 horizons, involves an issue of datamining. The critical values for the test do not account for repeated application of the impulse response function based test.

On the other hand, this dissertation could be extended in several ways. First, our sample spans the 1972:Q2 to 1998:Q4 period for industry level data and 1972:Q2 to 2005:Q1 for total manufacturing job flows data. Having a larger number of observations especially at the industry level, would allow us to explore whether the effects of oil price shocks on job flows have been muted in the early 2000s. Furthermore, the increase in the number of observations does help in increasing the power of the test.

Second, the allocative channel discussed by Davis (1987a), Davis (1987b) and Hamilton (1988) involves the reshuffling of labor and capital across industries. It would be interesting to explore as a future research question the impact of shocks on capital reallocation using industry level data. This analysis will provide a deeper insight on the role of the allocative channel in the transmission of shocks on the economy.

Appendix:

Table A.1: Cumulative change in job flows after a typical positive oil price shock, $(x_t^{\#} = x_t^4)$

	sample 1973-1983						sample 1984-1998					
	NET		SUM		EXC		NET		SUM		EXC	
Sectors	4	8	4	8	4	8	4	8	4	8	4	8
Total manufacturing (1972:Q2-2005:Q1)							-0.35	-0.72	0.25	0.46	-0.11	-0.28
Total manufacturing (1972:Q2-1998:Q4)	0.10	-0.67	-0.43	-0.02	-1.10	-1.45	-0.49	-0.62	0.87	1.11	0.37	0.50
Food	0.55	0.08	-1.18	-0.85	-2.52	-2.66	0.12	-0.07	0.91	1.55	0.31	0.70
Tobacco	1.46	1.04	0.24	0.20	-1.48	-2.71	2.56	2.83	0.13	-0.05	-2.96	-3.96
Textiles	0.53	-0.55	-0.78	0.39	-2.93	-3.22	-0.62	-0.55	0.68	0.85	0.06	0.16
Apparel	0.15	-0.61	-0.58	-0.16	-1.81	-2.61	0.61	0.80	1.01	0.99	0.33	0.11
Lumber	-2.61	-3.26	-0.99	-0.41	-3.60	-4.03	-1.16	-1.27	0.95	0.99	-0.46	-0.65
Furniture and fixtures	-1.25	-1.93	-0.17	0.36	-1.71	-2.06	-0.60	-0.59	1.17	1.34	0.47	0.38
Paper	-1.26	-1.47	0.29	0.85	-0.97	-1.58	-0.02	0.03	-0.06	-0.09	-0.37	-0.50
Printing	0.42	0.02	-0.56	-0.64	-1.26	-1.75	-0.40	-0.34	0.95	0.79	0.23	0.01
Chemicals	0.96	0.45	-0.52	0.26	-2.31	-2.74	0.19	0.16	0.19	0.18	-0.22	-0.34
Petroleum	1.78	2.07	-0.22	-0.61	-4.20	-5.26	0.17	0.04	0.46	0.66	-0.20	-0.13
Rubber and plastics	-0.45	-0.99	0.33	1.42	-0.49	-0.54	-0.88	-0.84	1.06	1.02	0.18	-0.03
Leather	1.27	-0.10	-0.67	0.42	-2.98	-3.26	0.20	0.44	-0.03	-0.11	-1.36	-1.95
Stone, clay and glass	-0.35	-1.19	-0.93	-0.34	-1.96	-2.47	-0.95	-1.00	0.79	0.63	-0.27	-0.66
Primary metals	5.71	2.18	-3.57	-3.27	-9.28	-12.5	-0.05	0.02	-0.17	-0.11	-0.49	-0.56
Fabricated metals	-0.60	-1.63	-1.13	-0.41	-2.10	-2.66	0.16	0.48	0.51	0.28	-0.15	-0.71
Industrial machinery	2.80	0.86	-2.56	-2.97	-5.55	-7.90	0.10	0.32	0.25	0.04	0.09	-0.34
Electronic and electric equipment	-0.61	-1.55	0.39	0.95	-1.13	-1.50	-0.19	0.06	0.60	0.81	0.05	-0.05
Transportation equipment	-0.22	-2.65	0.88	2.68	-1.70	-2.33	-0.98	-1.23	1.62	2.31	0.59	1.03
Instruments and related products	2.25	0.22	-0.58	-0.17	-3.25	-4.86	0.38	0.59	0.10	0.09	-0.30	-0.53
Miscellaneous manufacturing	-0.58	-0.94	0.41	1.04	-1.58	-2.03	-0.23	0.26	1.40	0.90	0.53	-0.45
Motor vehicles and passenger car bodies	-6.12	-6.14	11.12	11.75	2.62	1.30	-0.44	-0.51	3.58	6.59	2.23	4.5
Truck and bus bodies	-6.55	-5.84	-1.43	-0.86	-7.98	-8.52	-1.08	-2.79	0.79	1.78	-1.84	-2.55
Motor vehicle parts and accessories	-4.40	-4.70	2.02	4.28	-2.37	-1.95	-0.94	-0.23	1.65	2.08	0.64	0.37
Truck trailers	4.94	-0.54	-1.91	2.87	-13.35	-17.32	-3.64	-1.84	5.13	7.25	1.49	1.82

Notes: This table reports the cumulative change (measured in percentage points) in net employment (NET), job reallocation (SUM), and excess reallocation (EXC) due to a positive one standard deviation shock to real oil prices. Computations are based on 10,000 simulations of model (8).

Table A.2: Cumulative change in job flows after a large positive oil price shock, $(x_t^{\#} = x_t^4)$

	1973-1983						1984-1998					
	NET		SUM		EXC		NET		SUM		EXC	
Sectors	4	8	4	8	4	8	4	8	4	8	4	8
Total manufacturing (1972:Q2-2005:Q1)							-0.93	-1.76	0.37	0.80	-0.76	-1.17
Total manufacturing (1972:Q2-1998:Q4)	-0.99	-2.19	0.07	1.07	-1.19	-1.62	-1.58	-1.89	2.63	3.39	0.90	1.31
Food	-0.23	-1.17	-0.55	0.92	-2.83	-2.30	0.48	0.20	0.93	1.79	-1.59	-1.31
Tobacco	1.19	0.81	-1.84	-1.39	-3.03	-4.01	6.38	6.99	0.69	-0.05	-7.70	-10.09
Textiles	-0.96	-2.13	0.00	2.71	-3.76	-3.32	-0.94	-0.89	1.63	1.82	0.51	0.61
Apparel	-0.94	-1.91	0.15	1.86	-2.59	-3.25	1.32	1.61	0.86	0.43	-1.04	-2.02
Lumber	-6.92	-6.94	-0.27	1.41	-7.18	-7.40	-2.45	-2.44	1.18	1.24	-2.27	-2.64
Furniture and fixtures	-4.24	-4.52	1.27	3.40	-3.08	-3.36	-2.33	-2.65	2.66	3.23	0.33	0.46
Paper	-3.00	-3.51	0.39	1.71	-2.61	-3.66	-0.10	-0.06	0.33	0.34	-0.53	-0.76
Printing	-0.04	-0.93	-0.52	-0.26	-1.47	-2.19	-2.33	-2.41	2.1	1.51	-0.23	-1.37
Chemicals	0.39	-0.61	0.00	1.62	-2.63	-3.12	0.23	0.06	0.08	0.07	-1.17	-1.53
Petroleum	-0.26	0.28	2.26	2.04	-4.24	-5.51	1.31	1.15	1.07	1.26	-1.79	-1.94
Rubber and plastics	-2.91	-2.85	1.32	3.74	-1.79	-1.56	-3.01	-2.74	2.91	2.78	-0.10	-0.66
Leather	0.09	-1.67	0.14	2.25	-2.6	-2.74	1.29	1.81	-1.18	-1.97	-4.96	-7.44
Stone, clay and glass	-4.00	-5.16	0.39	2.37	-3.61	-3.84	-4.23	-4.88	2.60	2.19	-1.62	-2.69
Primary metals	4.23	-1.52	-2.89	-0.08	-7.83	-10.78	-2.24	-1.84	0.80	1.14	-1.45	-1.53
Fabricated metals	-3.15	-4.65	-1.03	0.79	-4.18	-4.83	-0.67	-0.23	0.83	0.64	-0.59	-1.22
Industrial machinery	2.79	-2.31	-3.48	-2.54	-6.49	-10.66	-0.62	-0.25	0.21	-0.35	-0.49	-1.42
Electronic and electric equipment	-2.95	-4.81	1.00	2.85	-2.76	-3.36	-0.63	0.32	2.15	2.67	0.55	0.08
Transportation equipment	-4.01	-6.53	4.25	6.72	0.24	-0.23	-3.30	-4.30	4.69	6.77	1.39	2.47
Instruments and related products	1.65	-1.5	0.01	1.07	-3.38	-5.48	0.50	0.95	-0.68	-0.98	-1.95	-2.70
Miscellaneous manufacturing	-2.60	-3.04	1.72	4.23	-2.02	-2.12	-1.93	-0.79	3.50	2.50	-0.37	-2.53
Motor vehicles and passenger car bodies	-16.31	-14.00	31.40	29.98	15.09	10.20	-3.23	-4.60	15.64	25.97	4.52	13.35
Truck and bus bodies	-13.09	-11.44	-2.61	-1.32	-15.73	-16.57	-3.64	-7.02	0.98	3.88	-5.44	-5.91
Motor vehicle parts and accessories	-12.11	-9.00	7.64	10.68	-4.47	-7.23	-3.37	-1.09	5.28	6.19	1.87	0.50
Truck trailers	0.87	-5.99	2.87	13.11	-13.53	-19.09	-10.45	-5.60	14.75	20.57	2.77	3.73

Notes: This table reports the cumulative change (measured in percentage points) in net employment (NET), job reallocation (SUM), and excess reallocation (EXC) due to a positive one standard deviation shock to real oil prices. Computations are based on 10,000 simulations of model (8).

Table A.3: IRF based test for a tyical positive oil price shock on job flows

	$x_t^{\#}=x_t^1$							$x_t^{\#}=x_t^4$						
Sectors	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total manufacturing (1972:Q2-2005:Q1)	0.53	0.39	0.18	0.18	0.27	0.32	0.43	0.86	0.42	0.24	0.29	0.40	0.32	0.40
Total manufacturing (1972:Q2-1998:Q4)	0.44	0.45	0.32	0.23	0.34	0.40	0.52	0.49	0.50	*0.10*	*0.09*	0.14	0.11	0.16
Food	0.39	0.60	0.72	0.73	0.81	0.86	0.89	0.53	0.29	0.48	0.14	0.21	0.25	0.31
Tobacco	0.75	0.70	0.85	0.75	0.84	0.90	0.95	0.87	0.84	0.94	0.94	0.98	0.99	1.00
Textiles	0.23	0.47	0.55	0.11	*0.08*	0.13	0.19	0.16	0.37	0.58	*0.10*	*0.07*	*0.10*	0.15
Apparel	0.30	0.56	0.59	0.61	0.71	0.69	0.76	0.32	0.54	0.57	0.58	0.65	0.69	0.73
Lumber	0.88	0.29	0.18	**0.05**	*0.08*	0.11	0.17	0.67	0.32	**0.05**	**0.03**	**0.05**	*0.09*	0.14
Furniture and fixtures	0.90	0.99	0.90	**0.03**	**0.05**	*0.08*	0.12	0.78	0.91	0.58	**0.03**	**0.05**	*0.07*	*0.10*
Paper	0.49	0.49	0.70	0.47	0.42	0.39	0.51	0.82	0.91	0.91	0.36	0.32	0.28	0.35
Printing	0.38	0.67	0.58	0.73	0.72	0.82	0.89	0.57	0.84	0.70	0.81	0.88	0.93	0.96
Chemicals	0.68	0.45	0.66	0.46	0.55	0.64	0.73	0.93	0.21	0.37	0.18	0.22	0.17	0.17
Petroleum	0.94	0.85	0.16	0.27	0.40	0.48	0.53	0.84	0.41	*0.06*	0.11	0.11	0.17	0.22
Rubber and plastics	0.22	0.48	0.50	0.12	**0.04**	*0.07*	0.12	0.11	0.28	0.27	**0.02**	**0.01**	**0.02**	**0.04**
Leather	0.21	0.17	0.29	0.44	0.49	0.39	0.39	0.46	0.37	0.56	0.65	0.78	0.74	0.82
Stone, clay and glass	0.86	0.95	0.22	*0.08*	*0.10*	0.14	0.21	1.00	0.90	0.21	**0.04**	**0.04**	*0.07*	*0.10*
Primary metals	0.53	0.79	0.88	0.79	0.61	0.60	0.71	0.80	0.93	0.94	0.35	0.37	0.19	0.23
Fabricated metals	0.42	0.43	0.46	0.30	0.41	0.54	0.63	0.32	0.38	0.31	0.20	0.26	0.35	0.40
Industrial machinery	0.87	0.94	0.99	0.83	0.80	0.85	0.89	0.99	0.97	0.99	0.80	0.89	0.91	0.91
Electronic and electric equipment	0.86	0.58	0.76	0.39	0.53	0.56	0.62	0.88	0.64	0.79	0.17	0.26	0.15	0.15
Transportation equipment	0.25	0.21	0.22	0.14	0.22	0.27	0.35	0.14	0.15	0.11	*0.07*	0.12	0.16	0.23
Instruments and related products	0.34	0.62	0.47	0.48	0.62	0.74	0.82	0.32	0.52	0.30	0.20	0.30	0.40	0.49
Miscellaneous manufacturing	0.19	0.24	0.32	0.21	0.32	0.41	0.49	0.15	0.28	0.45	0.23	0.32	0.44	0.55
Motor vehicles and passenger car bodies	0.20	*0.07*	0.11	0.11	0.18	0.23	0.32	*0.08*	**0.05**	*0.08*	*0.08*	0.13	0.19	0.27
Truck and bus bodies	0.90	0.49	0.55	0.67	0.66	0.68	0.78	0.85	0.41	0.36	0.48	0.37	0.46	0.57
Motor vehicle parts and accessories	0.42	0.11	**0.05**	*0.06*	0.11	0.15	0.22	0.80	0.12	*0.06*	**0.04**	*0.07*	*0.09*	0.14
Truck trailers	0.69	0.92	0.11	0.11	**0.05**	*0.08*	0.11	0.32	0.58	*0.10*	**0.02**	**0.01**	**0.02**	**0.03**

Notes: Tests are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Table A.4: IRF based test for a large positive oil price shock on job flows

	$x_t^{\#} = x_t^1$							$x_t^{\#} = x_t^4$						
Sectors	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total manufacturing (1972:Q2-2005:Q1)	0.26	0.43	0.45	0.36	0.49	0.60	0.71	0.53	*0.10*	0.19	0.29	0.38	0.25	0.32
Total manufacturing (1972:Q2-1998:Q4)	0.26	0.43	0.52	0.29	0.42	0.50	0.61	0.32	0.42	0.32	**0.03**	*0.06*	**0.05**	*0.09*
Food	0.71	0.93	0.82	0.92	0.87	0.92	0.95	0.95	0.35	0.55	0.29	0.35	0.46	0.54
Tobacco	0.88	0.71	0.87	0.70	0.71	0.79	0.87	0.78	0.95	0.99	0.98	0.99	1.00	1.00
Textiles	0.41	0.71	0.64	0.17	0.14	0.22	0.31	0.12	0.27	0.44	**0.01**	**0.01**	**0.02**	**0.04**
Apparel	0.46	0.75	0.75	0.81	0.83	0.83	0.88	0.57	0.85	0.66	0.65	0.70	0.59	0.71
Lumber	0.68	0.48	0.49	*0.09*	0.13	0.20	0.27	0.32	0.39	*0.06*	**0.01**	**0.02**	**0.04**	*0.06*
Furniture and fixtures	0.88	0.95	0.98	**0.03**	**0.04**	*0.07*	0.11	0.72	0.60	0.74	**0.00**	**0.00**	**0.00**	**0.01**
Paper	0.28	0.26	0.39	0.31	0.36	0.31	0.41	0.74	0.92	0.97	0.14	0.13	*0.08*	0.13
Printing	0.41	0.71	0.58	0.74	0.65	0.77	0.84	0.56	0.73	0.71	0.69	0.81	0.89	0.94
Chemicals	0.49	0.57	0.77	0.47	0.50	0.62	0.71	0.64	0.23	0.40	0.21	0.13	0.11	0.13
Petroleum	0.75	0.95	**0.02**	**0.05**	*0.09*	0.13	0.18	0.87	0.95	**0.00**	**0.00**	**0.01**	**0.01**	**0.02**
Rubber and plastics	0.27	0.51	0.67	0.28	*0.07*	0.11	0.17	**0.04**	0.11	0.21	**0.00**	**0.00**	**0.00**	**0.00**
Leather	0.28	*0.07*	0.14	0.24	0.26	0.28	0.32	0.64	0.43	0.64	0.77	0.85	0.74	0.81
Stone, clay and glass	0.92	0.99	0.18	0.12	0.17	0.24	0.33	0.85	0.94	*0.09*	**0.02**	**0.02**	**0.04**	*0.06*
Primary metals	0.45	0.75	0.88	0.87	0.53	0.61	0.72	0.95	1.00	0.96	0.29	0.16	0.14	0.20
Fabricated metals	0.43	0.70	0.79	0.46	0.60	0.71	0.79	0.17	0.37	0.48	*0.07*	*0.10*	0.16	0.24
Industrial machinery	0.65	0.62	0.80	0.72	0.76	0.83	0.87	0.82	0.73	0.89	0.60	0.73	0.67	0.72
Electronic and electric equipment	0.64	0.72	0.85	0.45	0.57	0.67	0.72	0.88	0.95	0.99	**0.01**	**0.03**	**0.03**	**0.04**
Transportation equipment	0.35	0.31	0.38	0.33	0.47	0.53	0.63	0.14	0.13	0.11	**0.05**	*0.09*	0.12	0.17
Instruments and related products	0.29	0.53	0.48	0.54	0.68	0.79	0.86	0.31	0.56	0.44	0.13	0.20	0.30	0.39
Miscellaneous manufacturing	0.29	0.44	0.38	0.41	0.55	0.66	0.76	0.24	0.50	0.56	0.26	0.34	0.44	0.52
Motor vehicles and passenger car bodies	0.23	**0.05**	*0.10*	0.12	0.17	0.22	0.30	*0.08*	**0.01**	**0.01**	**0.01**	**0.02**	**0.04**	*0.06*
Truck and bus bodies	0.74	0.88	0.79	0.80	0.79	0.83	0.90	0.92	0.91	0.48	0.53	0.32	0.39	0.51
Motor vehicle parts and accessories	0.22	*0.08*	**0.03**	**0.04**	*0.07*	*0.10*	0.15	0.53	*0.09*	**0.02**	**0.01**	**0.02**	**0.03**	**0.05**
Truck trailers	0.81	0.97	0.11	0.15	*0.06*	*0.08*	0.11	0.23	0.43	0.27	**0.01**	**0.00**	**0.00**	**0.00**

Notes: Tests are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Table A.5: Test of symmetry in the response of job creation to a typical positive shock

	$x_t^{\#} = x_t^1$							$x_t^{\#} = x_t^4$						
Sectors	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total manufacturing (1972:Q2-2005:Q1)	0.35	0.55	0.65	0.70	0.71	0.81	0.88	*0.08*	0.19	0.34	0.43	0.46	0.58	0.68
Total manufacturing (1972:Q2-1998:Q4)	0.41	0.60	0.69	0.67	0.67	0.73	0.83	0.19	0.41	0.61	0.72	0.74	0.81	0.86
Food	0.76	0.91	0.97	0.99	1.00	0.99	1.00	0.41	0.58	0.73	0.86	0.93	0.94	0.97
Tobacco	0.20	0.42	0.63	0.49	0.27	0.38	0.48	0.45	0.72	0.87	0.95	0.89	0.94	0.96
Textiles	0.55	0.82	0.86	0.93	0.96	0.98	0.99	0.40	0.68	0.84	0.91	0.95	0.95	0.94
Apparel	0.66	0.70	0.83	0.89	0.95	0.98	0.99	0.47	0.77	0.89	0.87	0.79	0.86	0.92
Lumber	**0.03**	*0.08*	0.15	0.24	0.35	0.47	0.54	**0.05**	0.13	0.26	0.40	0.54	0.58	0.69
Furniture and fixtures	0.18	0.40	0.60	0.72	0.83	0.87	0.85	0.25	0.48	0.69	0.76	0.67	0.77	0.72
Paper	0.23	0.49	0.69	0.76	0.78	0.85	0.87	0.68	0.91	0.97	0.99	0.76	0.84	0.83
Printing	0.68	0.46	0.42	0.53	0.68	0.79	0.87	0.43	0.48	0.67	0.80	0.75	0.85	0.90
Chemicals	0.27	0.26	0.39	0.52	0.64	0.76	0.81	0.14	0.18	0.31	0.43	0.50	0.62	0.63
Petroleum	0.85	0.94	0.96	0.55	0.31	0.39	0.39	0.22	0.46	0.64	0.45	0.56	0.63	0.69
Rubber and plastics	*0.10*	0.25	0.32	0.47	0.54	0.66	0.74	0.19	0.42	0.54	0.69	0.80	0.77	0.83
Leather	0.57	0.37	0.48	0.31	0.44	0.51	0.60	0.22	0.47	0.62	0.60	0.67	0.71	0.81
Stone, clay and glass	0.11	0.21	0.34	0.45	0.60	0.72	0.81	0.14	0.26	0.44	0.60	0.72	0.67	0.75
Primary metals	0.41	0.36	0.54	0.64	0.77	0.85	0.91	0.20	0.33	0.51	0.63	0.76	0.81	0.89
Fabricated metals	0.33	0.49	0.57	0.62	0.75	0.84	0.91	0.11	0.26	0.44	0.61	0.73	0.79	0.87
Industrial machinery	0.52	0.70	0.87	0.94	0.94	0.94	0.97	0.28	0.54	0.75	0.87	0.73	0.83	0.90
Electronic and electric equipment	0.20	0.43	0.64	0.68	0.81	0.89	0.92	0.87	0.96	0.90	0.93	0.91	0.93	0.94
Transportation equipment	0.08	0.22	0.26	0.29	0.36	0.48	0.60	0.40	0.70	0.87	0.90	0.94	0.90	0.95
Instruments and related products	0.14	0.23	0.41	0.38	0.53	0.59	0.69	0.99	0.55	0.74	0.86	0.82	0.87	0.89
Miscellaneous manufacturing	0.96	0.86	0.62	0.67	0.67	0.78	0.84	0.53	0.61	0.52	0.67	0.72	0.78	0.86
Motor vehicles and passenger car bodies	0.05	0.08	0.16	0.19	0.28	0.39	0.50	0.43	0.45	0.56	0.67	0.79	0.86	0.91
Truck and bus bodies	0.41	0.54	0.73	0.80	0.89	0.94	0.97	0.33	0.53	0.73	0.78	0.88	0.91	0.94
Motor vehicle parts and accessories	*0.08*	0.21	0.31	0.32	0.43	0.56	0.67	0.14	0.32	0.52	0.66	0.79	0.76	0.84
Truck trailers	0.23	0.45	0.65	0.45	0.49	0.50	0.62	0.71	0.92	0.70	0.75	0.86	0.87	0.91

Notes: Tests are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Table A.6: Test of symmetry in the response of job creation to a large positive shock

	$x_t^{\#}= x_t^1$							$x_t^{\#}= x_t^4$						
Sectors	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total manufacturing (1972:Q2-2005:Q1)	0.34	0.53	0.62	0.64	0.60	0.71	0.81	**0.01**	**0.02**	**0.04**	**0.04**	**0.01**	**0.01**	**0.02**
Total manufacturing (1972:Q2-1998:Q4)	0.34	0.51	0.56	0.49	0.42	0.46	0.58	**0.04**	0.11	0.21	0.25	0.16	0.12	0.14
Food	0.74	0.90	0.96	0.99	1.00	0.99	0.99	0.39	0.58	0.71	0.83	0.92	0.91	0.95
Tobacco	0.15	0.34	0.54	0.32	**0.04**	*0.07*	0.11	0.39	0.65	0.82	0.92	0.80	0.87	0.90
Textiles	0.52	0.79	0.82	0.90	0.93	0.97	0.98	0.24	0.48	0.68	0.71	0.78	0.76	0.63
Apparel	0.63	0.64	0.77	0.84	0.92	0.96	0.98	0.38	0.67	0.82	0.73	0.44	0.56	0.68
Lumber	**0.01**	**0.03**	**0.05**	*0.09*	0.14	0.21	0.22	**0.01**	**0.01**	**0.02**	**0.03**	**0.05**	*0.06*	*0.09*
Furniture and fixtures	0.11	0.27	0.45	0.56	0.68	0.74	0.65	*0.09*	0.19	0.33	0.31	*0.09*	0.14	0.08
Paper	0.15	0.35	0.55	0.59	0.54	0.62	0.59	0.62	0.88	0.95	0.99	0.32	0.41	0.24
Printing	0.66	0.41	0.31	0.39	0.53	0.66	0.76	0.35	0.30	0.48	0.64	0.38	0.50	0.61
Chemicals	0.23	0.17	0.25	0.35	0.45	0.58	0.62	*0.07*	*0.06*	0.11	0.16	0.18	0.26	0.21
Petroleum	0.84	0.92	0.96	0.37	*0.07*	*0.09*	*0.10*	0.14	0.33	0.46	*0.07*	*0.10*	0.13	0.13
Rubber and plastics	**0.05**	0.13	0.13	0.22	0.23	0.33	0.40	*0.07*	0.18	0.16	0.20	0.30	0.25	0.28
Leather	0.53	0.30	0.38	0.16	0.25	0.30	0.36	0.14	0.35	0.43	0.35	0.33	0.31	0.41
Stone, clay and glass	*0.06*	*0.10*	0.16	0.23	0.34	0.46	0.58	**0.04**	**0.05**	*0.09*	*0.10*	0.12	0.12	0.18
Primary metals	0.37	0.25	0.40	0.48	0.62	0.72	0.81	*0.08*	*0.09*	0.18	0.28	0.36	0.41	0.52
Fabricated metals	0.24	0.34	0.33	0.32	0.44	0.56	0.68	**0.02**	**0.05**	*0.09*	0.17	0.19	0.22	0.31
Industrial machinery	0.46	0.62	0.81	0.89	0.90	0.88	0.92	0.19	0.38	0.59	0.71	0.31	0.40	0.51
Electronic and electric equipment	0.16	0.36	0.57	0.58	0.72	0.82	0.85	0.85	0.95	0.85	0.86	0.77	0.83	0.83
Transportation equipment	0.04	0.13	0.11	0.11	0.10	0.16	0.24	0.30	0.57	0.78	0.81	0.87	0.68	0.76
Instruments and related products	0.12	0.19	0.35	0.26	0.38	0.39	0.50	0.99	0.40	0.59	0.71	0.55	0.49	0.58
Miscellaneous manufacturing	0.96	0.86	0.55	0.57	0.54	0.66	0.74	0.50	0.52	0.27	0.34	0.25	0.34	0.45
Motor vehicles and passenger car bodies	**0.02**	**0.02**	**0.05**	**0.04**	*0.07*	0.11	0.17	0.33	0.25	0.29	0.27	0.37	0.32	0.43
Truck and bus bodies	0.35	0.42	0.60	0.66	0.78	0.86	0.92	0.15	0.22	0.38	0.23	0.29	0.41	0.52
Motor vehicle parts and accessories	*0.06*	0.15	0.20	0.17	0.23	0.33	0.43	*0.07*	0.15	0.29	0.43	0.57	0.38	0.46
Truck trailers	0.21	0.42	0.62	0.41	0.41	0.38	0.49	0.66	0.89	0.56	0.59	0.72	0.67	0.72

Notes: Tests are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Table A.7: Test of symmetry in the response of job destruction rate to a typical positive shock

	$x_t^{\#} = x_t^1$							$x_t^{\#} = x_t^4$						
Sectors	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total manufacturing (1972:Q2-2005:Q1)	0.13	0.20	0.36	0.53	0.66	0.77	0.85	0.19	0.40	0.58	0.51	0.61	0.72	0.77
Total manufacturing (1972:Q2-1998:Q4)	0.14	0.27	0.46	0.60	0.73	0.83	0.90	0.25	0.51	0.69	0.62	0.73	0.81	0.86
Food	0.51	0.61	0.24	0.23	0.27	0.38	0.49	0.32	0.57	0.73	0.83	0.83	0.90	0.94
Tobacco	0.43	0.73	0.87	0.93	0.77	0.81	0.88	0.40	0.44	0.61	0.77	0.82	0.90	0.94
Textiles	1.00	0.99	0.91	0.68	0.77	0.83	0.90	0.30	0.28	0.46	0.35	0.48	0.53	0.65
Apparel	0.83	0.70	0.78	0.82	0.81	0.90	0.94	0.96	0.69	0.61	0.48	0.59	0.72	0.81
Lumber	0.31	0.56	0.76	0.62	0.40	0.52	0.59	0.58	0.85	0.85	0.47	0.42	0.50	0.61
Furniture and fixtures	0.21	0.33	0.38	0.19	0.30	0.40	0.50	0.29	0.38	0.43	0.27	0.38	0.48	0.53
Paper	0.82	0.79	0.61	0.67	0.78	0.86	0.91	0.94	0.98	0.99	0.73	0.72	0.82	0.85
Printing	0.35	0.64	0.83	0.91	0.84	0.92	0.95	0.30	0.49	0.70	0.60	0.74	0.84	0.90
Chemicals	0.74	0.38	0.45	0.56	0.70	0.79	0.86	0.75	0.70	0.87	0.60	0.46	0.59	0.69
Petroleum	0.34	0.36	**0.04**	*0.06*	*0.10*	0.16	0.23	0.53	0.43	*0.08*	0.15	0.23	0.33	0.43
Rubber and plastics	0.23	0.30	0.47	0.63	0.69	0.79	0.85	*0.09*	0.16	0.29	0.34	0.44	0.53	0.62
Leather	0.42	0.29	0.43	0.51	0.64	0.76	0.80	0.60	0.70	0.87	0.93	0.97	0.97	0.98
Stone, clay and glass	0.43	0.72	0.50	0.66	0.76	0.85	0.92	0.24	0.48	0.45	0.57	0.71	0.76	0.82
Primary metals	0.99	0.61	0.80	0.82	0.73	0.79	0.87	0.25	0.48	0.67	0.81	0.71	0.79	0.86
Fabricated metals	0.30	0.44	0.63	0.77	0.87	0.93	0.96	0.08	0.19	0.33	0.41	0.54	0.63	0.71
Industrial machinery	0.72	0.60	0.75	0.86	0.93	0.97	0.99	0.78	0.59	0.75	0.72	0.81	0.86	0.92
Electronic and electric equipment	0.97	0.87	0.89	0.71	0.81	0.88	0.93	0.87	0.68	0.82	0.30	0.41	0.51	0.59
Transportation equipment	0.28	0.55	0.72	0.82	0.91	0.94	0.95	0.29	0.52	0.72	0.83	0.88	0.94	0.95
Instruments and related products	0.99	0.61	0.71	0.63	0.74	0.83	0.90	0.54	0.72	0.88	0.45	0.58	0.66	0.75
Miscellaneous manufacturing	0.85	0.97	0.90	0.96	0.99	0.99	1.00	0.35	0.52	0.70	0.70	0.79	0.87	0.93
Motor vehicles and passenger car bodies	0.15	0.28	0.47	0.61	0.66	0.74	0.83	0.32	0.31	0.49	0.65	0.78	0.86	0.89
Truck and bus bodies	0.78	0.69	0.83	0.90	0.95	0.97	0.99	0.25	0.46	0.49	0.65	0.72	0.82	0.88
Motor vehicle parts and accessories	0.70	0.76	0.74	0.86	0.93	0.95	0.98	0.89	0.59	0.62	0.67	0.78	0.86	0.91
Truck trailers	0.52	0.80	0.56	0.55	0.34	0.45	0.57	0.61	0.80	0.92	0.88	0.51	0.63	0.64

Notes: Tests are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Table A.8: Test of symmetry in the response of job destruction rate to a large positive shock

	$x_t^{\#} = x_t^1$							$x_t^{\#} = x_t^4$						
Sectors	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total manufacturing (1972:Q2-2005:Q1)	*0.10*	0.14	0.26	0.41	0.52	0.65	0.74	**0.05**	0.12	0.22	*0.06*	*0.06*	*0.08*	0.12
Total manufacturing (1972:Q2-1998:Q4)	*0.09*	0.16	0.31	0.43	0.55	0.68	0.78	*0.07*	0.19	0.33	**0.05**	*0.06*	*0.10*	0.16
Food	0.47	0.55	*0.10*	**0.05**	**0.04**	*0.07*	0.11	0.32	0.58	0.73	0.81	0.73	0.83	0.88
Tobacco	0.37	0.66	0.82	0.89	0.63	0.65	0.76	0.32	0.32	0.45	0.61	0.64	0.76	0.85
Textiles	1.00	0.99	0.89	0.52	0.61	0.68	0.78	0.14	**0.04**	*0.09*	**0.00**	**0.00**	**0.01**	**0.01**
Apparel	0.81	0.65	0.71	0.74	0.69	0.80	0.88	0.95	0.58	0.35	0.11	0.13	0.18	0.26
Lumber	0.28	0.52	0.72	0.52	0.17	0.25	0.27	0.54	0.81	0.76	*0.09*	*0.07*	0.11	0.16
Furniture and fixtures	0.18	0.27	0.28	**0.04**	*0.07*	0.12	0.16	0.14	0.14	0.11	**0.00**	**0.00**	**0.00**	**0.01**
Paper	0.80	0.73	0.46	0.44	0.56	0.64	0.72	0.93	0.98	0.98	0.40	0.17	0.22	0.29
Printing	0.32	0.61	0.80	0.90	0.80	0.88	0.92	0.18	0.29	0.47	0.19	0.29	0.39	0.46
Chemicals	0.74	0.32	0.35	0.44	0.57	0.67	0.75	0.73	0.69	0.85	0.46	*0.10*	0.15	0.22
Petroleum	0.28	0.28	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**	0.44	0.25	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Rubber and plastics	0.20	0.24	0.38	0.54	0.57	0.68	0.75	**0.02**	**0.03**	*0.08*	**0.02**	**0.02**	**0.03**	*0.06*
Leather	0.37	0.17	0.26	0.29	0.40	0.51	0.55	0.54	0.62	0.81	0.86	0.93	0.94	0.96
Stone, clay and glass	0.41	0.70	0.39	0.55	0.65	0.76	0.84	0.17	0.35	0.19	0.16	0.24	0.34	0.43
Primary metals	0.99	0.54	0.74	0.76	0.60	0.64	0.75	0.16	0.30	0.48	0.59	0.22	0.31	0.41
Fabricated metals	0.24	0.36	0.52	0.68	0.79	0.87	0.91	**0.01**	**0.02**	**0.05**	**0.01**	**0.02**	**0.05**	*0.07*
Industrial machinery	0.69	0.52	0.67	0.80	0.89	0.94	0.97	0.77	0.52	0.70	0.55	0.60	0.58	0.68
Electronic and electric equipment	0.97	0.86	0.87	0.63	0.75	0.84	0.90	0.86	0.65	0.81	**0.01**	**0.02**	**0.03**	*0.06*
Transportation equipment	0.26	0.51	0.68	0.78	0.88	0.91	0.93	0.21	0.34	0.50	0.57	0.55	0.66	0.75
Instruments and related products	0.99	0.59	0.68	0.53	0.64	0.75	0.84	0.47	0.62	0.81	*0.09*	0.12	0.19	0.27
Miscellaneous manufacturing	0.85	0.97	0.90	0.96	0.98	0.99	1.00	0.30	0.43	0.61	0.50	0.59	0.71	0.78
Motor vehicles and passenger car bodies	*0.10*	0.18	0.33	0.46	0.47	0.56	0.67	0.21	*0.08*	0.12	0.18	0.25	0.35	0.46
Truck and bus bodies	0.76	0.64	0.79	0.86	0.92	0.96	0.98	0.11	0.22	0.14	0.23	0.27	0.36	0.46
Motor vehicle parts and accessories	0.67	0.72	0.66	0.80	0.88	0.92	0.96	0.88	0.47	0.37	0.31	0.33	0.45	0.57
Truck trailers	0.52	0.81	0.52	0.50	0.20	0.29	0.38	0.57	0.74	0.87	0.73	**0.03**	**0.05**	*0.08*

Notes: Tests are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Table A.9: IRF based test of symmetry for a typical positive shock ($x_t^{\#} = x_t^1$)

	1973-1983							1984-1998						
Sectors	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total manufacturing (1972:Q2-2005:Q1)								0.53	0.39	0.18	0.18	0.27	0.32	0.43
Total manufacturing (1972:Q2-1998:Q4)	0.67	0.80	0.79	0.64	0.73	0.83	0.90	0.16	*0.06*	**0.01**	**0.01**	**0.02**	**0.03**	*0.06*
Food	0.21	0.27	0.32	0.44	0.23	0.30	0.41	0.16	0.38	0.57	0.59	0.73	0.83	0.89
Tobacco	1.00	0.96	0.89	0.91	0.96	0.99	0.99	0.90	0.41	0.62	0.57	0.69	0.79	0.87
Textiles	0.84	0.93	0.98	0.97	0.97	0.99	0.99	*0.07*	*0.08*	0.14	0.19	0.16	0.24	0.33
Apparel	0.96	1.00	0.96	0.97	0.92	0.95	0.95	0.15	0.28	0.45	0.56	0.71	0.79	0.87
Lumber	0.85	0.61	0.75	0.85	0.92	0.96	0.98	0.54	0.18	0.20	0.22	0.30	0.41	0.51
Furniture and fixtures	0.89	0.97	0.76	0.44	0.41	0.53	0.62	0.33	0.62	0.14	0.11	0.13	0.17	0.23
Paper	0.17	0.37	0.55	0.12	0.18	0.26	0.36	0.49	0.77	0.91	0.95	0.95	0.98	0.99
Printing	0.34	0.54	0.52	0.66	0.68	0.77	0.84	0.13	0.22	0.18	0.29	0.34	0.39	0.50
Chemicals	0.56	0.83	0.86	0.86	0.71	0.77	0.79	0.95	0.82	0.93	0.80	0.85	0.88	0.94
Petroleum	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.89	0.43	0.29	0.38	0.31	0.37	0.46
Rubber and plastics	0.32	0.32	0.52	0.67	0.38	0.42	0.54	0.53	0.27	0.18	**0.04**	**0.05**	*0.08*	0.13
Leather	0.98	0.55	0.75	0.87	0.88	0.93	0.97	*0.08*	0.18	0.29	0.39	0.47	0.55	0.51
Stone, clay and glass	0.55	0.61	0.68	0.72	0.72	0.83	0.88	1.00	0.96	0.70	0.28	0.39	0.46	0.57
Primary metals	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.28	0.53	0.71	0.77	0.69	0.70	0.80
Fabricated metals	1.00	0.96	0.99	1.00	1.00	1.00	1.00	0.45	0.39	0.26	0.31	0.44	0.53	0.64
Industrial machinery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.87	0.87	0.95	0.69	0.78	0.87	0.93
Electronic and electric equipment	0.40	0.66	0.66	0.56	0.70	0.80	0.87	0.89	0.54	0.48	0.61	0.73	0.83	0.81
Transportation equipment	0.22	0.32	0.40	0.56	0.69	0.80	0.86	0.40	0.47	0.25	*0.08*	0.13	0.20	0.29
Instruments and related products	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.83	0.95	0.74	0.84	0.91	0.96	0.98
Miscellaneous manufacturing	0.36	0.65	0.66	0.79	0.89	0.94	0.97	*0.09*	**0.05**	*0.10*	0.09	0.15	0.23	0.31
Motor vehicles and passenger car bodies	0.81	0.19	0.26	0.32	0.40	0.53	0.64	0.59	0.86	0.83	0.22	0.33	0.44	0.54
Truck and bus bodies	0.20	0.37	0.48	0.49	0.62	0.71	0.79	0.82	0.31	0.50	0.65	0.63	0.74	0.77
Motor vehicle parts and accessories	0.93	0.57	0.47	0.60	0.74	0.72	0.80	0.26	0.42	0.43	0.36	0.40	0.46	0.56
Truck trailers	0.52	0.14	0.22	0.27	*0.08*	0.12	0.16	0.90	0.96	**0.00**	**0.00**	**0.00**	**0.01**	**0.02**

Notes: Tests are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Table A.10: IRF based test of symmetry for a large positive shock, ($x_t^{\#} = x_t^1$)

	1973-1983							1984-1998						
Sectors	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total manufacturing (1972:Q2-2005:Q1)								**0.04**	**0.02**	**0.02**	**0.02**	**0.04**	*0.06*	*0.09*
Total manufacturing (1972:Q2-1998:Q4)	0.96	0.96	0.96	0.62	0.75	0.85	0.91	0.26	0.43	0.45	0.36	0.49	0.60	0.71
Food	0.43	0.65	0.64	0.77	0.54	0.59	0.70	0.36	0.49	0.70	0.84	0.84	0.91	0.95
Tobacco	0.69	0.92	0.81	0.92	0.94	0.96	0.98	0.77	0.24	0.41	0.36	0.42	0.54	0.62
Textiles	0.96	0.99	1.00	1.00	1.00	1.00	1.00	*0.09*	*0.09*	*0.07*	0.14	*0.10*	0.12	0.17
Apparel	0.98	1.00	0.97	0.99	0.99	0.99	1.00	0.30	0.59	0.69	0.82	0.91	0.93	0.96
Lumber	1.00	0.98	1.00	0.99	1.00	1.00	1.00	0.65	0.37	0.58	0.61	0.67	0.77	0.83
Furniture and fixtures	0.83	0.97	0.88	0.28	0.31	0.43	0.53	0.37	0.63	0.31	0.37	0.27	0.29	0.37
Paper	0.48	0.77	0.85	0.22	0.32	0.42	0.53	0.47	0.35	0.52	0.69	0.80	0.88	0.93
Printing	0.58	0.77	0.64	0.79	0.87	0.87	0.91	0.21	0.42	0.44	0.52	0.51	0.50	0.62
Chemicals	0.82	0.90	0.93	0.96	0.72	0.78	0.80	0.83	0.98	0.99	0.86	0.93	0.91	0.95
Petroleum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.59	0.66	0.48	0.63	0.61	0.65	0.72
Rubber and plastics	0.49	0.56	0.76	0.75	0.31	0.37	0.48	0.39	0.27	0.28	0.17	0.15	0.20	0.28
Leather	0.79	0.64	0.81	0.91	0.91	0.95	0.98	*0.08*	*0.08*	0.15	0.19	0.18	0.27	0.36
Stone, clay and glass	0.82	0.96	0.91	0.94	0.82	0.86	0.88	0.95	0.97	0.67	0.42	0.53	0.52	0.62
Primary metals	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.37	0.53	0.73	0.81	0.39	0.49	0.59
Fabricated metals	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.65	0.81	0.68	0.75	0.85	0.85	0.90
Industrial machinery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.99	1.00	0.86	0.92	0.95	0.98
Electronic and electric equipment	0.69	0.90	0.95	0.70	0.82	0.90	0.94	0.87	0.63	0.36	0.50	0.62	0.71	0.71
Transportation equipment	0.38	0.63	0.59	0.68	0.81	0.89	0.94	0.31	0.38	0.27	0.19	0.27	0.37	0.46
Instruments and related products	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.90	0.85	0.74	0.85	0.92	0.96
Miscellaneous manufacturing	0.33	0.60	0.75	0.82	0.91	0.95	0.97	0.13	**0.04**	*0.06*	*0.10*	0.15	0.23	0.31
Motor vehicles and passenger car bodies	0.83	0.18	0.21	0.27	0.38	0.50	0.61	0.12	0.28	0.43	0.17	0.25	0.36	0.47
Truck and bus bodies	0.52	0.81	0.85	0.92	0.96	0.97	0.98	0.93	0.69	0.85	0.83	0.69	0.79	0.84
Motor vehicle parts and accessories	0.72	0.61	0.32	0.35	0.48	0.54	0.63	0.16	0.23	0.19	0.18	0.17	0.20	0.28
Truck trailers	0.39	0.33	0.49	0.48	0.19	0.24	0.28	0.97	0.96	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Notes: Tests are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Table A.11: IRF based test of symmetry for a typical positive shock ($x_t^{\#} = x_t^4$)

	1973-1983							1984-1998						
Sectors	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total manufacturing (1972:Q2-2005:Q1)								0.86	0.42	0.24	0.29	0.40	0.32	0.40
Total manufacturing (1972:Q2-1998:Q4)	0.58	0.73	0.84	0.69	0.81	0.82	0.88	0.48	0.14	**0.01**	**0.01**	**0.02**	**0.03**	**0.04**
Food	0.22	0.18	*0.07*	0.12	*0.07*	*0.09*	0.13	0.34	0.33	0.31	0.15	0.24	0.33	0.42
Tobacco	0.84	0.98	0.89	0.64	0.77	0.85	0.90	0.57	0.29	0.44	0.36	0.50	0.62	0.65
Textiles	0.50	0.73	0.88	0.95	0.59	0.56	0.23	0.11	0.24	0.41	0.50	0.60	0.69	0.79
Apparel	0.53	0.32	0.36	0.36	0.35	0.34	0.40	0.26	0.40	0.54	0.52	0.66	0.67	0.77
Lumber	0.37	0.67	0.72	0.83	0.81	0.88	0.93	0.70	0.60	0.23	0.30	0.43	0.50	0.61
Furniture and fixtures	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.57	0.84	0.21	*0.10*	0.15	0.18	0.25
Paper	0.20	0.42	0.57	0.28	0.33	0.44	0.55	0.89	0.76	0.87	0.93	0.97	0.99	0.99
Printing	0.29	0.39	0.53	0.54	0.69	0.80	0.87	0.20	0.34	0.21	0.29	0.42	0.52	0.63
Chemicals	1.00	0.58	0.78	0.83	0.36	0.36	0.31	0.98	0.40	0.60	0.64	0.71	0.80	0.87
Petroleum	*0.08*	0.17	**0.04**	*0.06*	*0.10*	0.14	0.21	0.48	0.46	0.36	0.49	0.39	0.43	0.54
Rubber and plastics	0.15	0.11	0.19	0.30	0.17	*0.10*	0.13	0.67	0.57	0.29	**0.05**	*0.09*	0.13	0.19
Leather	0.97	0.43	0.59	0.73	0.64	0.76	0.83	0.16	0.37	0.54	0.70	0.70	0.80	0.87
Stone, clay and glass	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.61	0.85	0.48	0.31	0.45	0.44	0.56
Primary metals	0.96	1.00	0.99	0.98	0.84	0.85	0.96	0.42	0.66	0.81	0.52	0.64	0.72	0.75
Fabricated metals	0.11	0.23	0.40	0.46	0.61	0.50	0.62	0.96	0.47	0.47	0.46	0.61	0.39	0.50
Industrial machinery	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.97	0.96	0.98	0.78	0.81	0.77	0.85
Electronic and electric equipment	0.35	0.59	0.23	0.13	0.21	0.27	0.28	0.92	0.60	0.60	0.56	0.49	0.60	0.59
Transportation equipment	0.45	0.48	0.69	0.83	0.91	0.94	0.89	0.75	0.71	0.26	*0.07*	0.12	0.19	0.26
Instruments and related products	*0.06*	*0.08*	0.16	0.22	0.23	0.33	0.40	0.49	0.76	0.66	0.78	0.88	0.93	0.96
Miscellaneous manufacturing	0.39	0.67	0.48	0.52	0.50	0.62	0.67	*0.06*	0.15	0.25	0.27	0.36	0.40	0.52
Motor vehicles and passenger car bodies	0.69	0.17	0.31	0.34	0.40	0.51	0.61	0.59	0.86	0.62	0.43	0.57	0.65	0.76
Truck and bus bodies	0.16	0.23	0.39	0.16	0.24	0.32	0.43	0.76	0.12	0.22	0.34	0.44	0.57	0.63
Motor vehicle parts and accessories	0.81	0.82	0.77	0.89	0.93	0.62	0.70	0.70	0.49	0.54	0.13	0.20	0.25	0.34
Truck trailers	0.98	*0.07*	0.15	0.15	**0.03**	*0.06*	*0.09*	0.84	0.47	**0.01**	**0.03**	**0.05**	*0.08*	0.12

Notes: Tests are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Table A.12: IRF based test for a large positive shock ($x_t^{\#} = x_t^4$)

	1973-1983							1984-1998						
Sectors	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Total manufacturing (1972:Q2-2005:Q1)								0.67	**0.00**	**0.00**	**0.01**	**0.01**	**0.02**	**0.03**
Total manufacturing (1972:Q2-1998:Q4)	0.85	0.92	0.97	0.62	0.76	0.81	0.87	0.53	*0.10*	0.19	0.29	0.38	0.25	0.32
Food	0.43	0.61	0.30	0.45	0.31	0.36	0.46	0.97	0.34	*0.08*	**0.03**	*0.06*	*0.09*	0.13
Tobacco	0.76	0.95	0.65	0.75	0.85	0.91	0.95	0.52	0.65	0.23	0.17	0.23	0.33	0.40
Textiles	0.66	0.85	0.93	0.97	0.73	0.83	0.55	**0.01**	**0.03**	*0.06*	**0.05**	*0.08*	0.14	0.20
Apparel	0.48	0.58	0.66	0.67	0.64	0.60	0.69	0.68	0.79	0.45	0.28	0.41	0.50	0.58
Lumber	0.38	0.59	0.78	0.85	0.81	0.87	0.93	0.44	0.74	0.43	0.29	0.36	0.46	0.55
Furniture and fixtures	1.00	0.98	0.99	1.00	1.00	1.00	1.00	0.37	0.52	0.46	0.15	0.21	0.24	0.32
Paper	0.45	0.73	0.89	0.49	0.58	0.66	0.77	0.35	0.58	0.78	0.78	0.85	0.90	0.93
Printing	0.38	0.61	0.70	0.80	0.87	0.93	0.96	0.13	0.32	0.47	0.27	0.36	0.45	0.55
Chemicals	1.00	0.87	0.96	0.93	0.74	0.73	0.65	0.48	0.43	0.64	0.74	0.83	0.89	0.94
Petroleum	0.35	0.65	**0.05**	**0.05**	*0.10*	0.13	0.19	0.23	0.49	0.30	0.22	0.26	0.35	0.44
Rubber and plastics	0.32	0.24	0.41	0.52	0.19	0.17	0.23	0.22	0.41	0.59	**0.01**	**0.02**	**0.03**	**0.05**
Leather	0.80	0.74	0.89	0.96	0.85	0.91	0.95	0.97	0.66	0.45	0.57	0.45	0.58	0.66
Stone, clay and glass	0.52	0.69	0.38	0.54	0.56	0.68	0.78	0.85	0.98	0.36	*0.09*	0.11	0.12	0.18
Primary metals	0.97	0.68	0.85	0.78	0.76	0.84	0.91	0.69	0.88	0.93	0.33	0.46	0.59	0.69
Fabricated metals	0.33	0.47	0.67	0.49	0.64	0.59	0.70	0.64	0.54	0.75	0.29	0.37	0.32	0.40
Industrial machinery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.95	0.98	0.50	0.48	0.47	0.59
Electronic and electric equipment	0.84	0.94	0.76	0.40	0.50	0.54	0.57	0.67	0.85	0.92	0.30	0.32	0.42	0.45
Transportation equipment	0.43	0.66	0.70	0.76	0.84	0.89	0.91	0.62	0.47	0.17	0.06	0.11	0.16	0.24
Instruments and related products	0.22	0.35	0.39	0.45	0.56	0.67	0.73	0.65	0.45	0.63	0.64	0.75	0.84	0.90
Miscellaneous manufacturing	0.38	0.66	0.74	0.74	0.77	0.84	0.90	**0.01**	**0.04**	*0.08*	*0.07*	0.12	0.18	0.23
Motor vehicles and passenger car bodies	0.91	0.12	0.18	0.19	0.26	0.36	0.47	*0.09*	0.23	0.25	0.27	0.39	0.51	0.61
Truck and bus bodies	0.37	0.64	0.79	0.68	0.77	0.84	0.90	0.94	0.39	0.58	0.55	0.67	0.78	0.72
Motor vehicle parts and accessories	0.74	0.70	0.48	0.50	0.62	0.55	0.65	0.29	0.11	0.18	*0.08*	*0.08*	0.12	0.18
Truck trailers	0.52	0.14	0.26	0.21	0.07	0.11	0.17	0.97	0.12	**0.01**	**0.01**	**0.01**	**0.02**	**0.03**

Notes: Tests are based on 10,000 simulations of model (8). p-values are based on the χ^2_{H+1}. Bold and italics refer to significance at the 5% and 10% significance level.

Figure A.1: Job creation and job destruction responses to a positive oil price shock of 1 s.d.

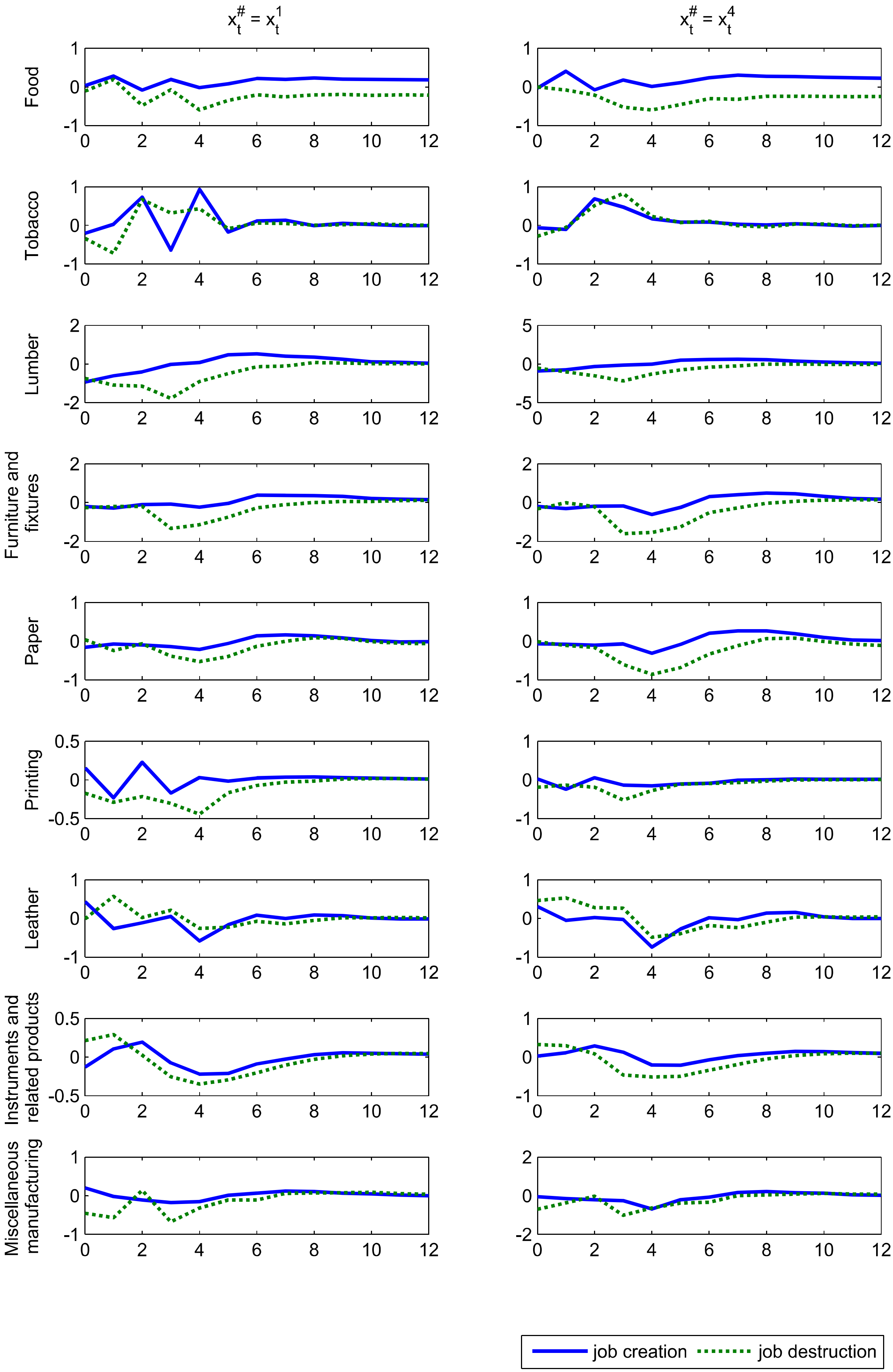


Figure A.2a: Job creation and job destruction responses to a positive oil price shock of 2 s.d.

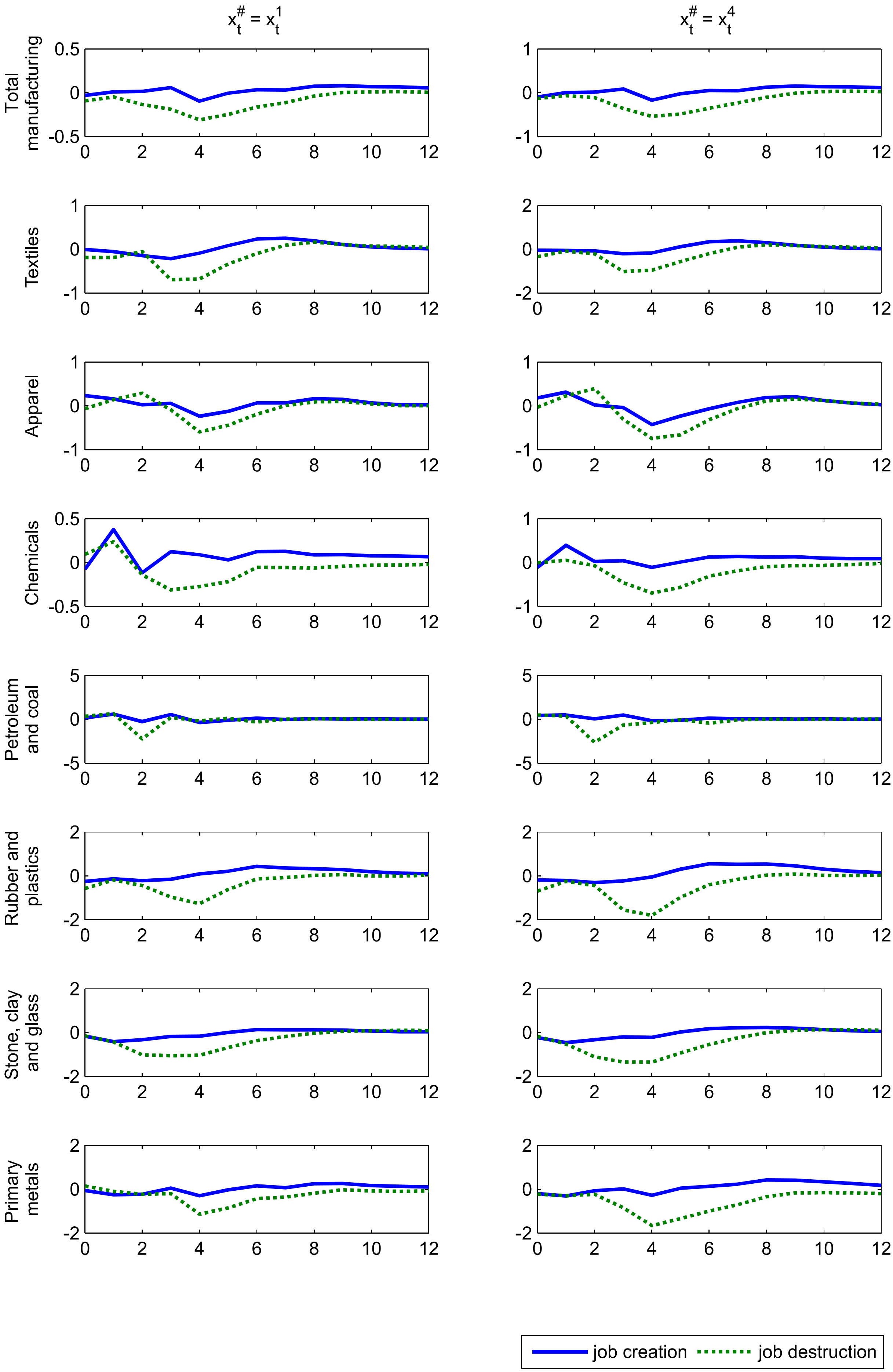


Figure A.2b: Job creation and job destruction responses to a positive oil price shock of 2 s.d.

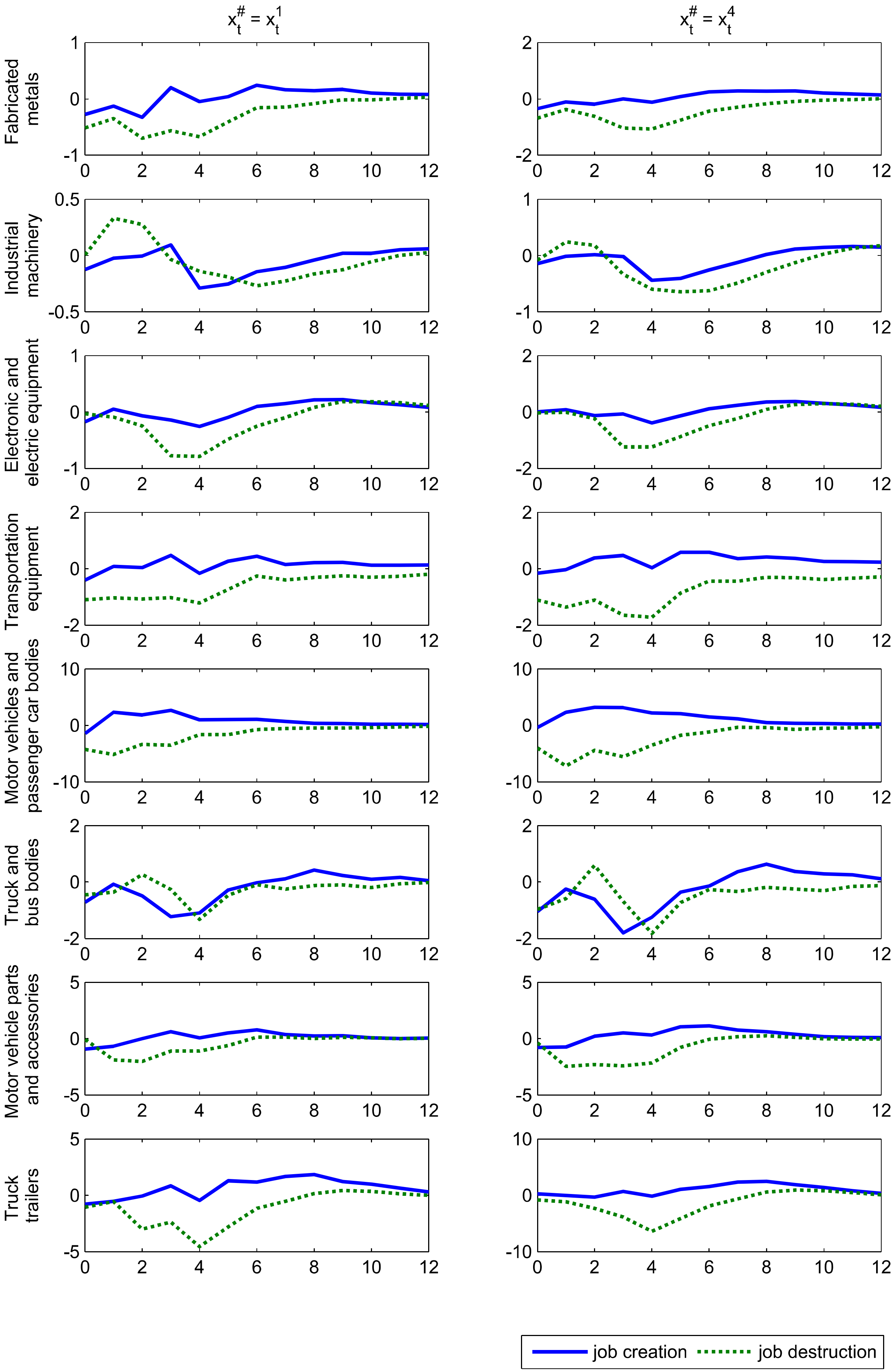


Figure A.3: Job creation and job destruction responses to a positive oil price shock of 1 s.d. - 1972:Q2 to 1988:Q4

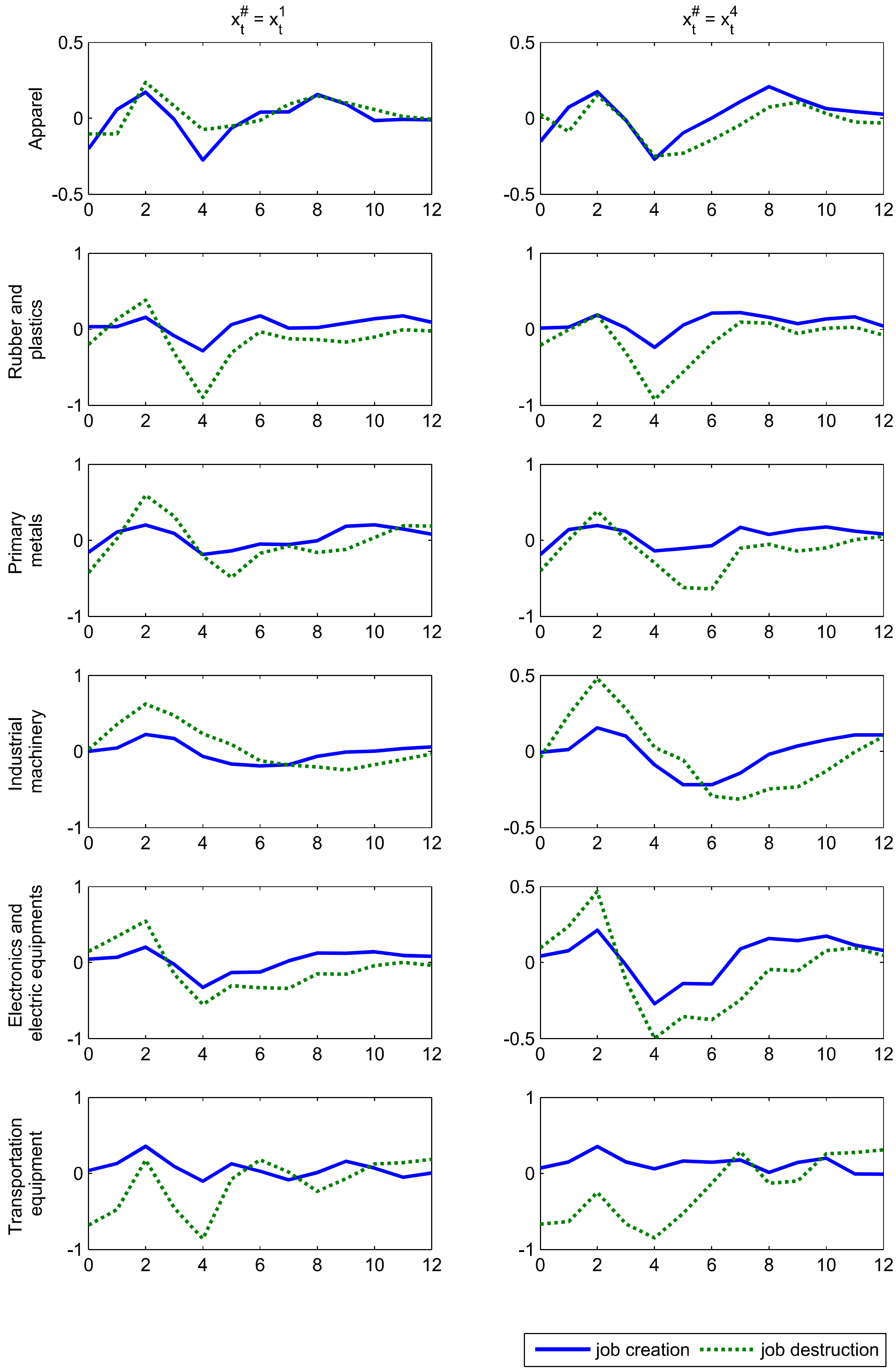


Figure A.4a: Job creation and job destruction responses to a positive oil price shock of 1 s.d., using $x_t^{\#} = x_t^4$

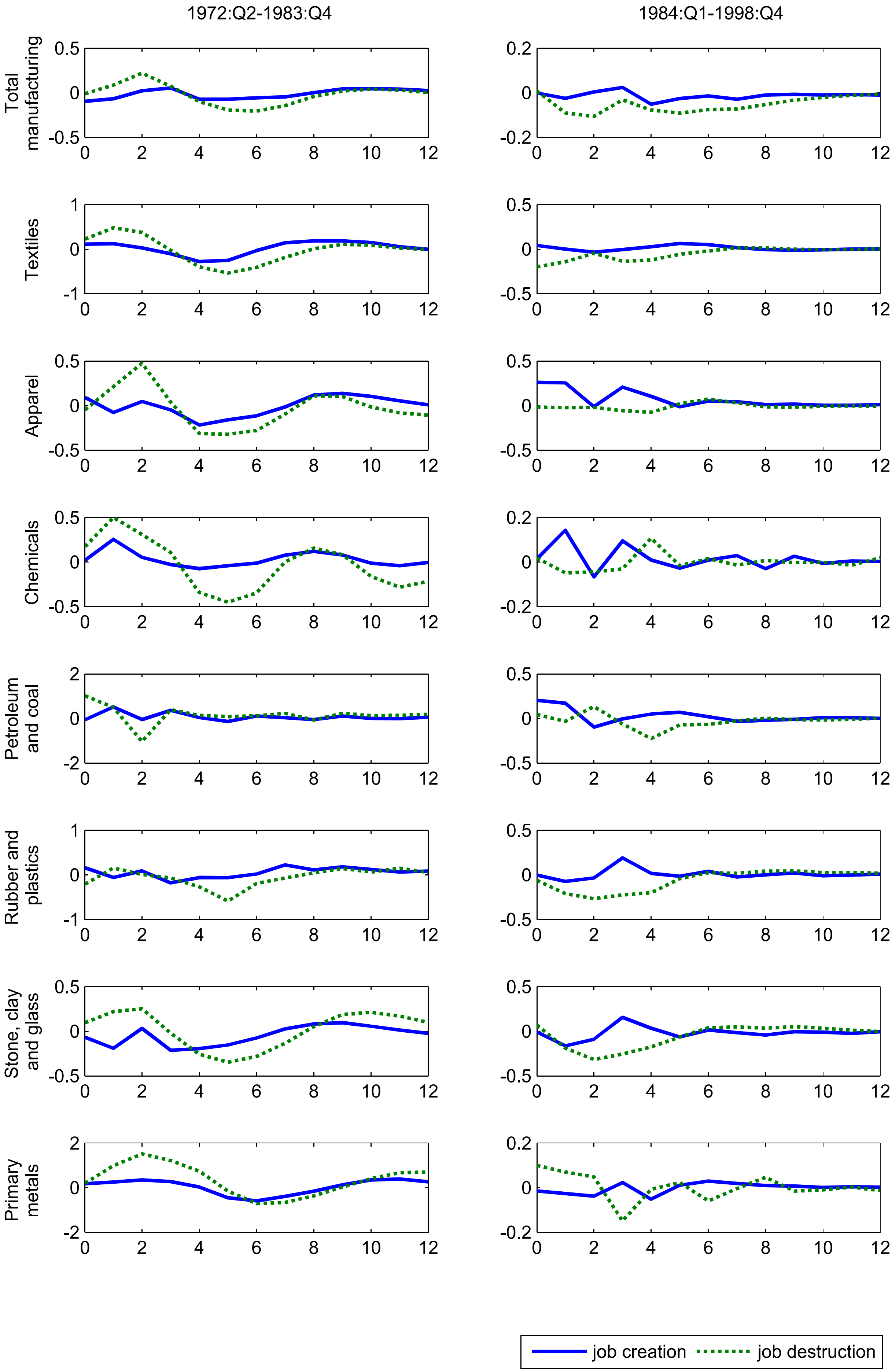


Figure A.4b: Job creation and job destruction responses to a positive oil price shock of 1 s.d., using $x_t^{\#} = x_t^4$

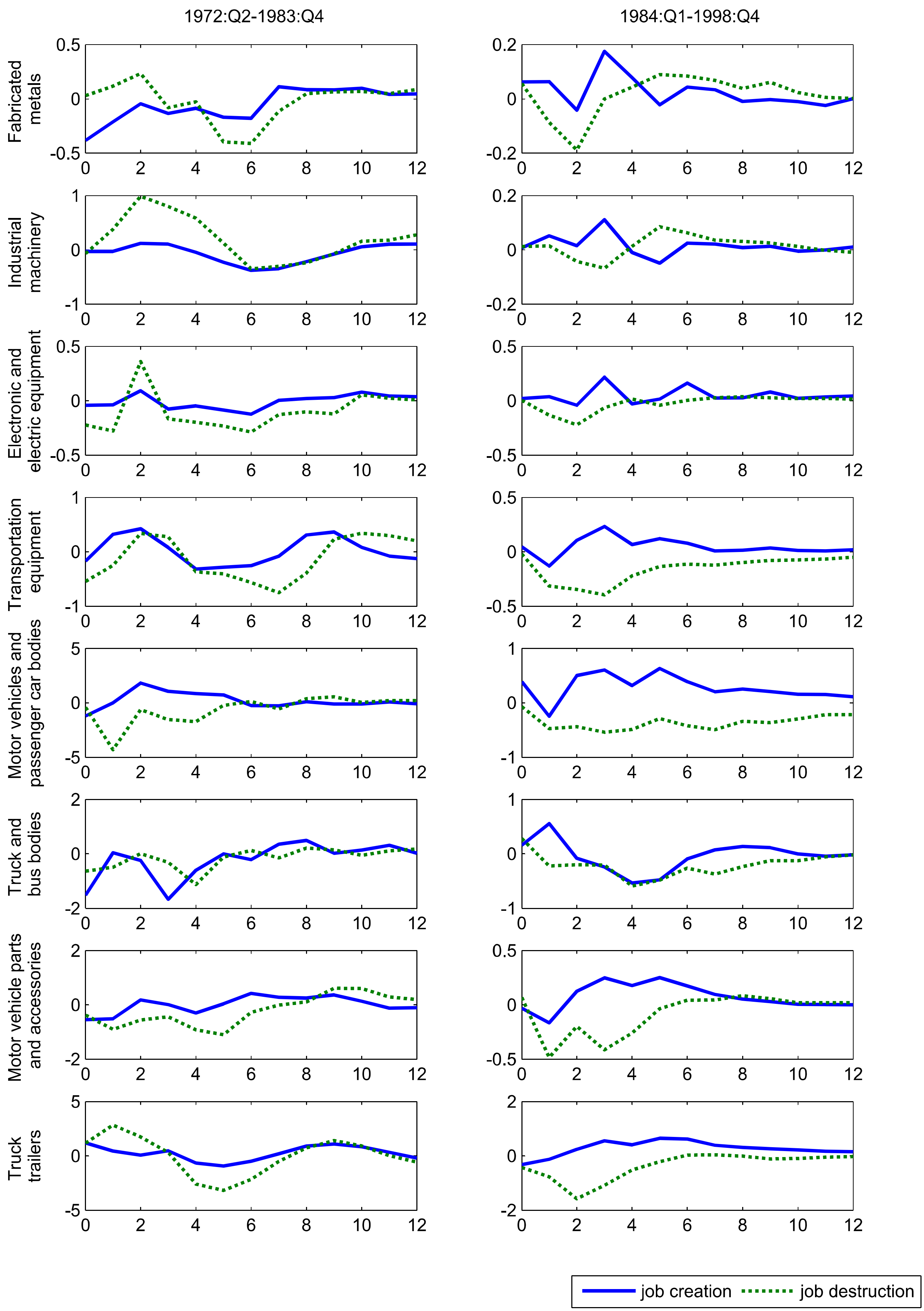


Figure A.5a: Job creation and job destruction responses to a positive oil price shock of 2 s.d., using $x_t^{\#} = x_t^1$

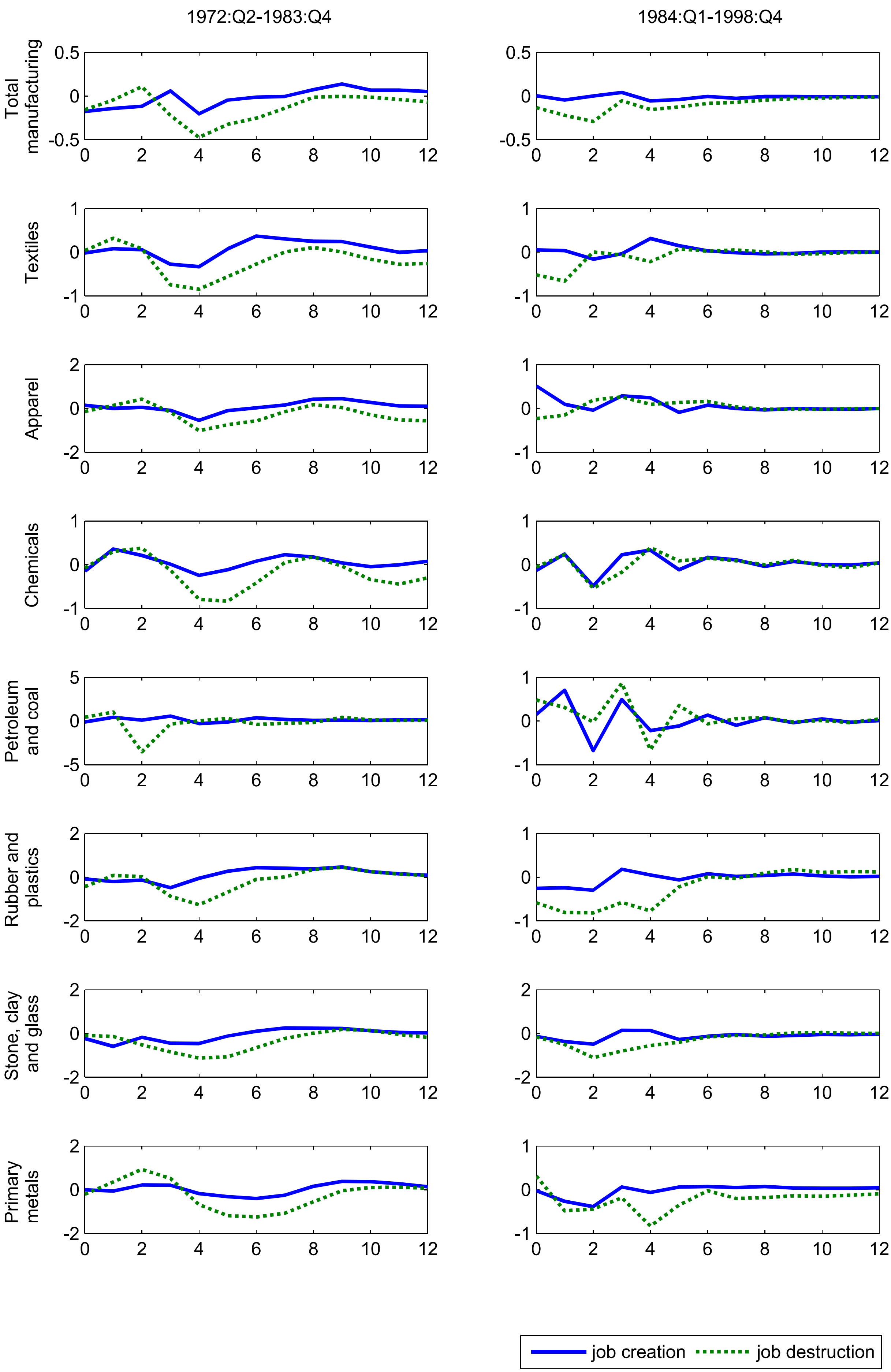


Figure A.5b: Job creation and job destruction responses to a positive oil price shock of 2 s.d., using $x_t^{\#} = x_t^1$

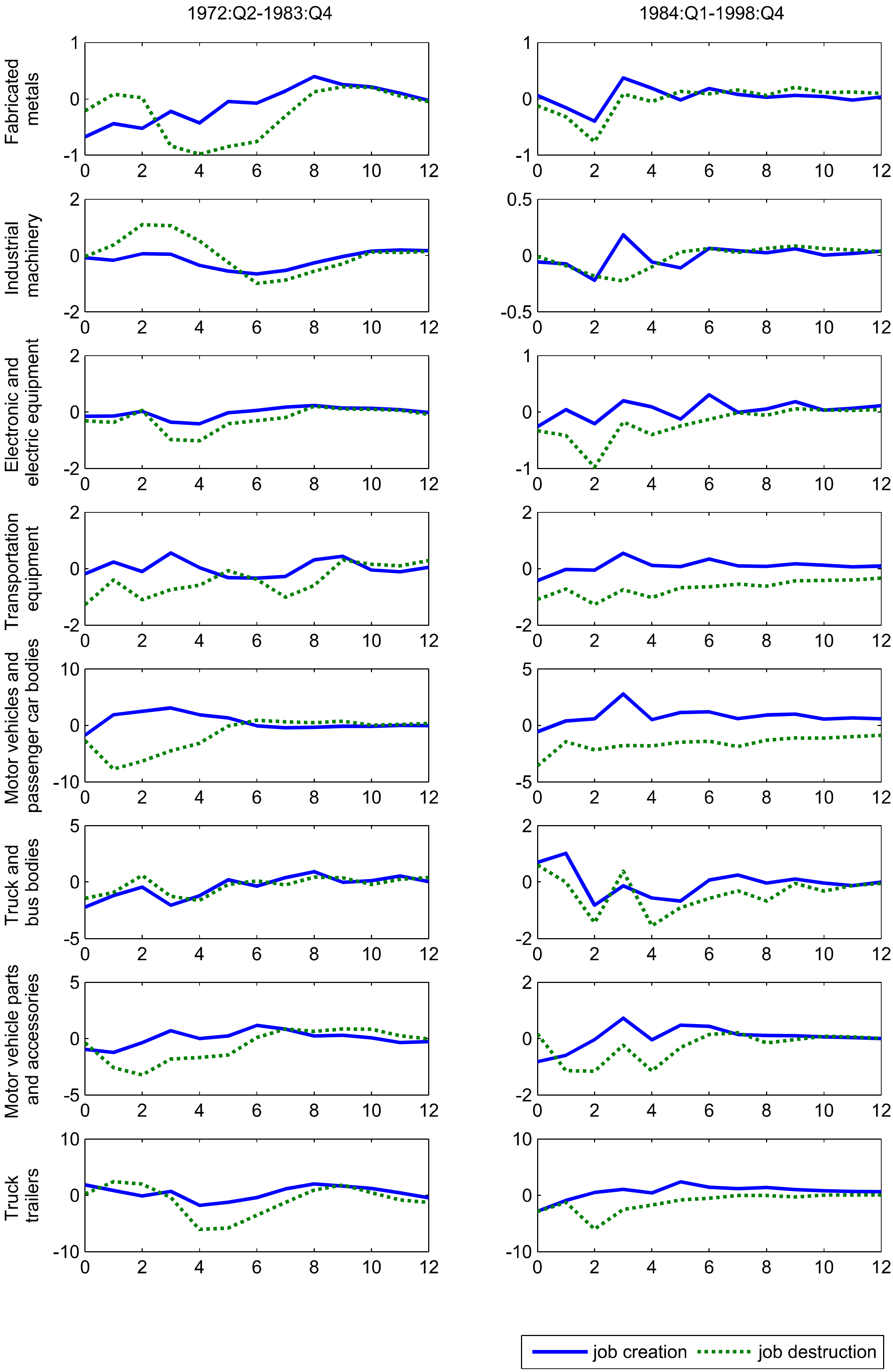


Figure A.6a: Job creation and job destruction responses to a positive oil price shock of 2 s.d., using $x_t^{\#} = x_t^4$

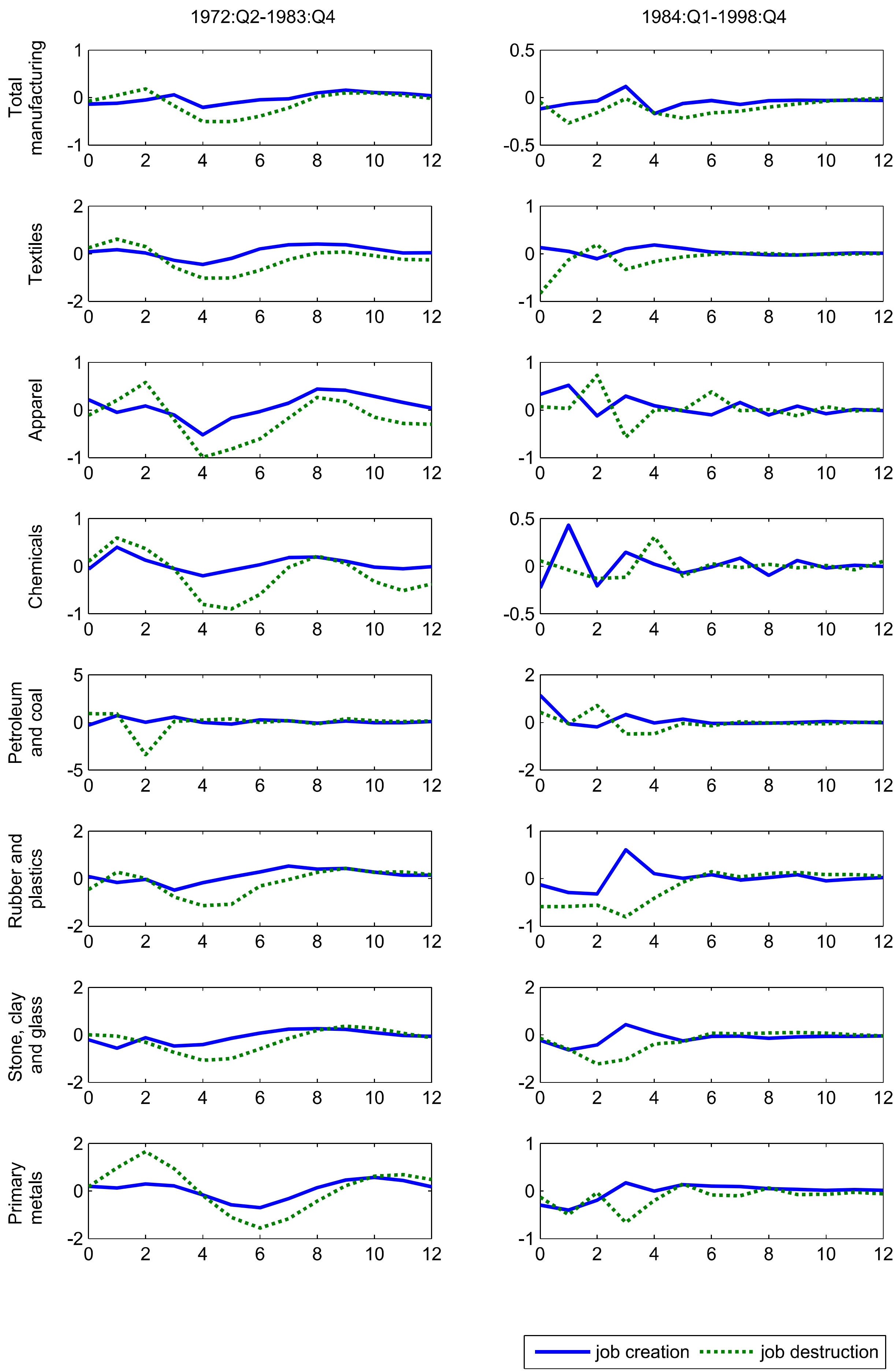


Figure A.6b: Job creation and job destruction responses to a positive oil price shock of 2 s.d., using $x_t^{\#} = x_t^4$

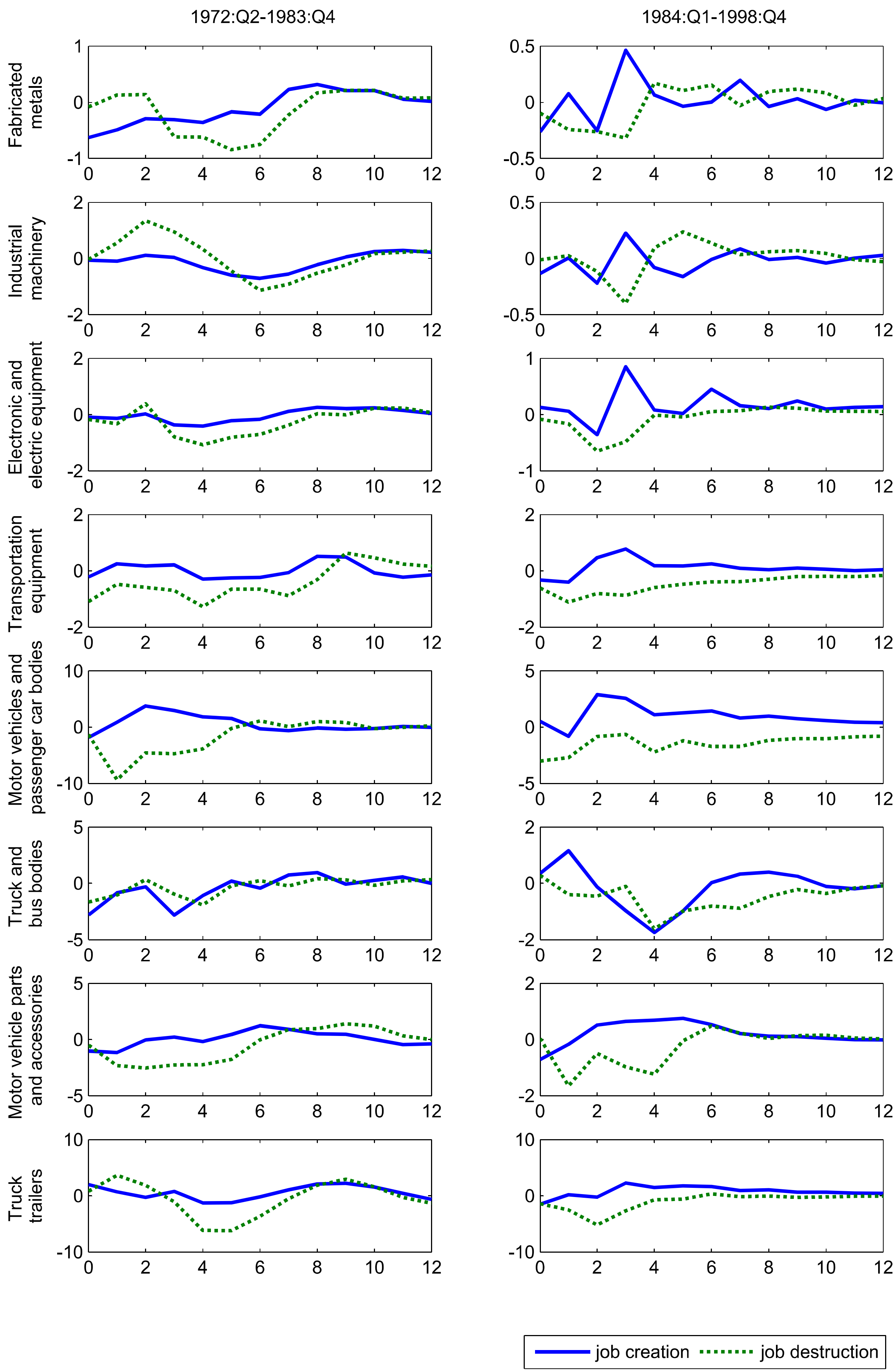


Figure A.7a: Job creation positive and negative oil price shocks of 1 s.d.

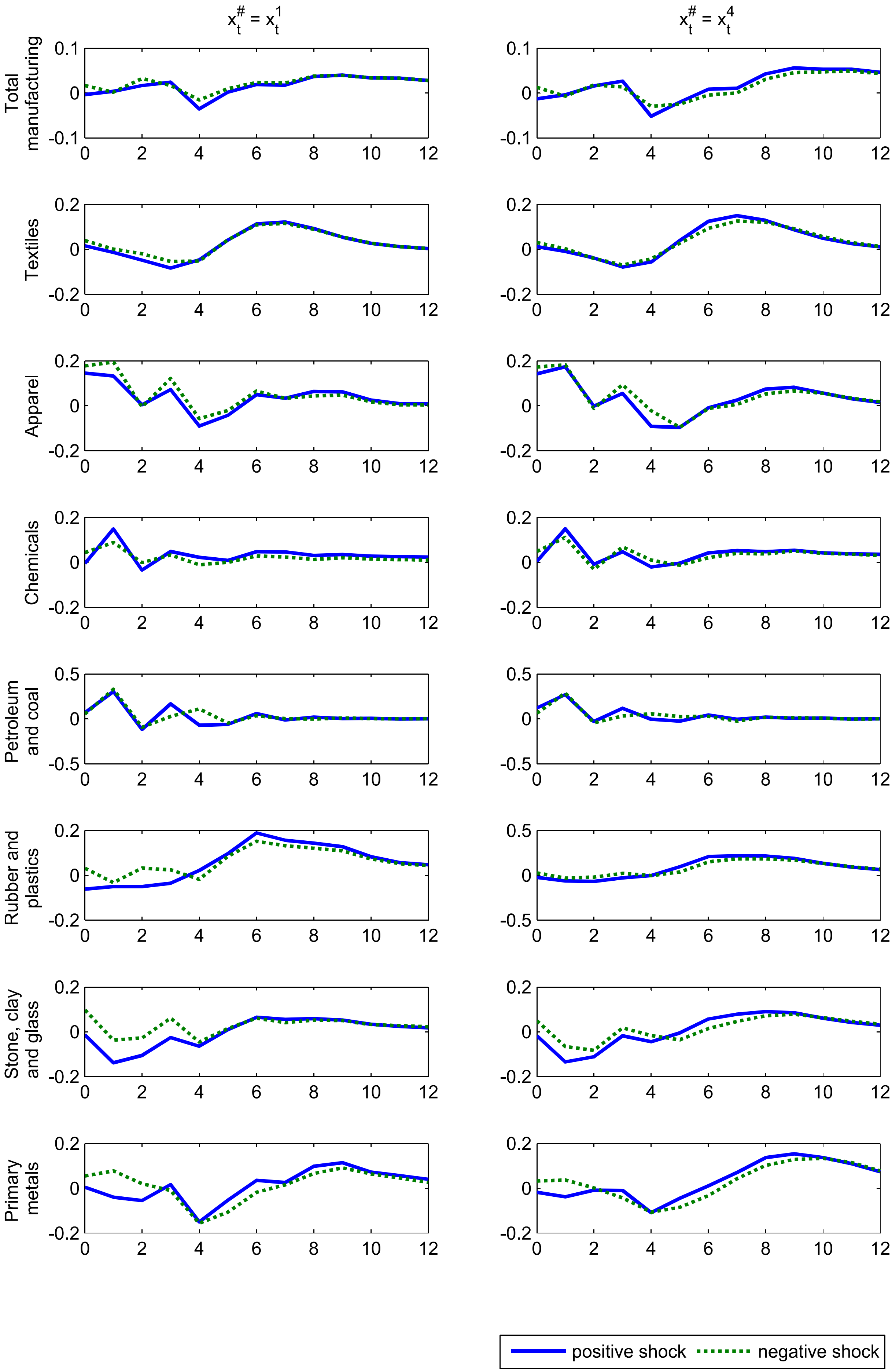


Figure A.7b: Job creation positive and negative oil price shocks of 1 s.d.

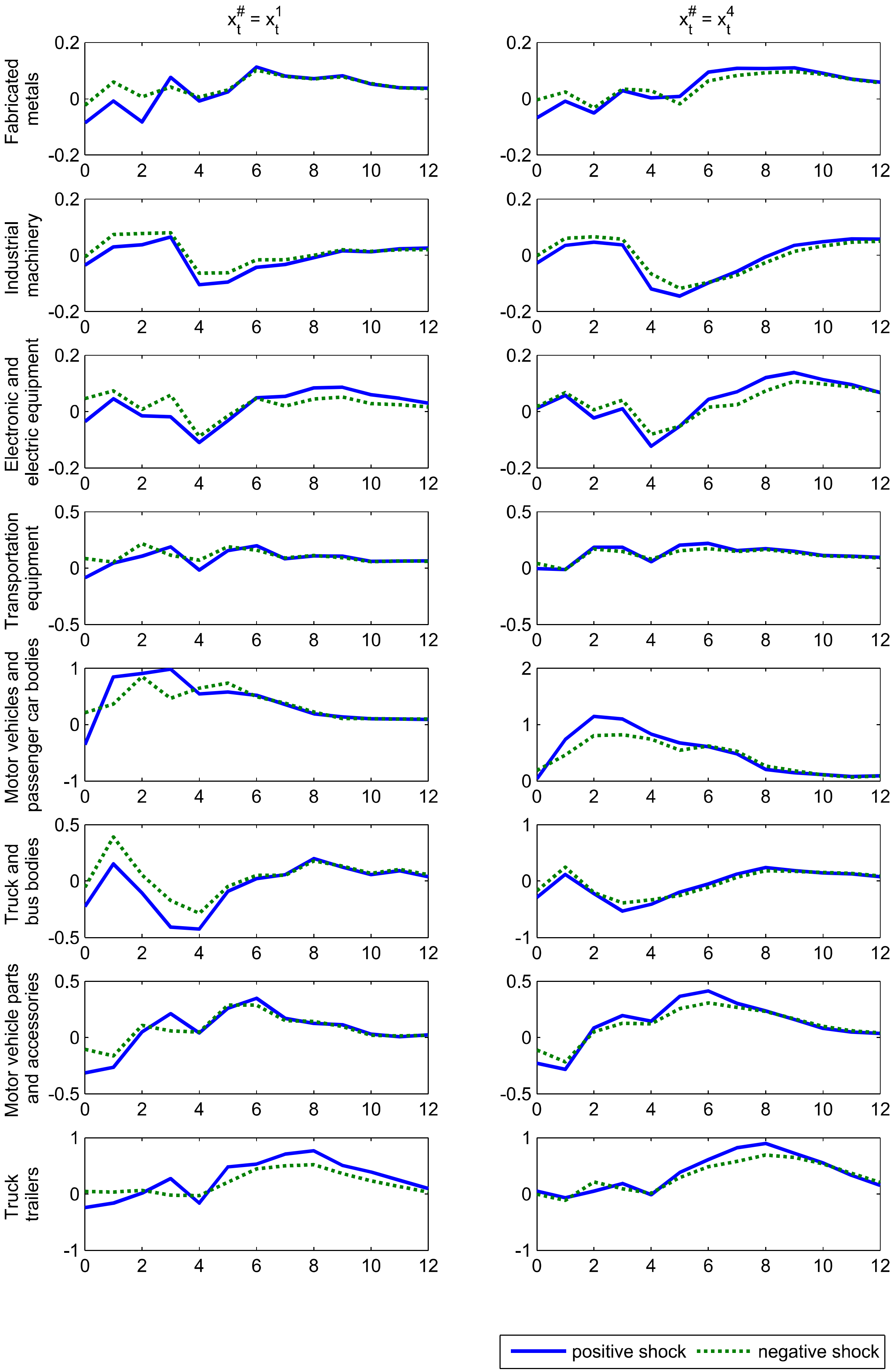


Figure A.8a: Job creation positive and negative oil price shocks of 2 s.d.

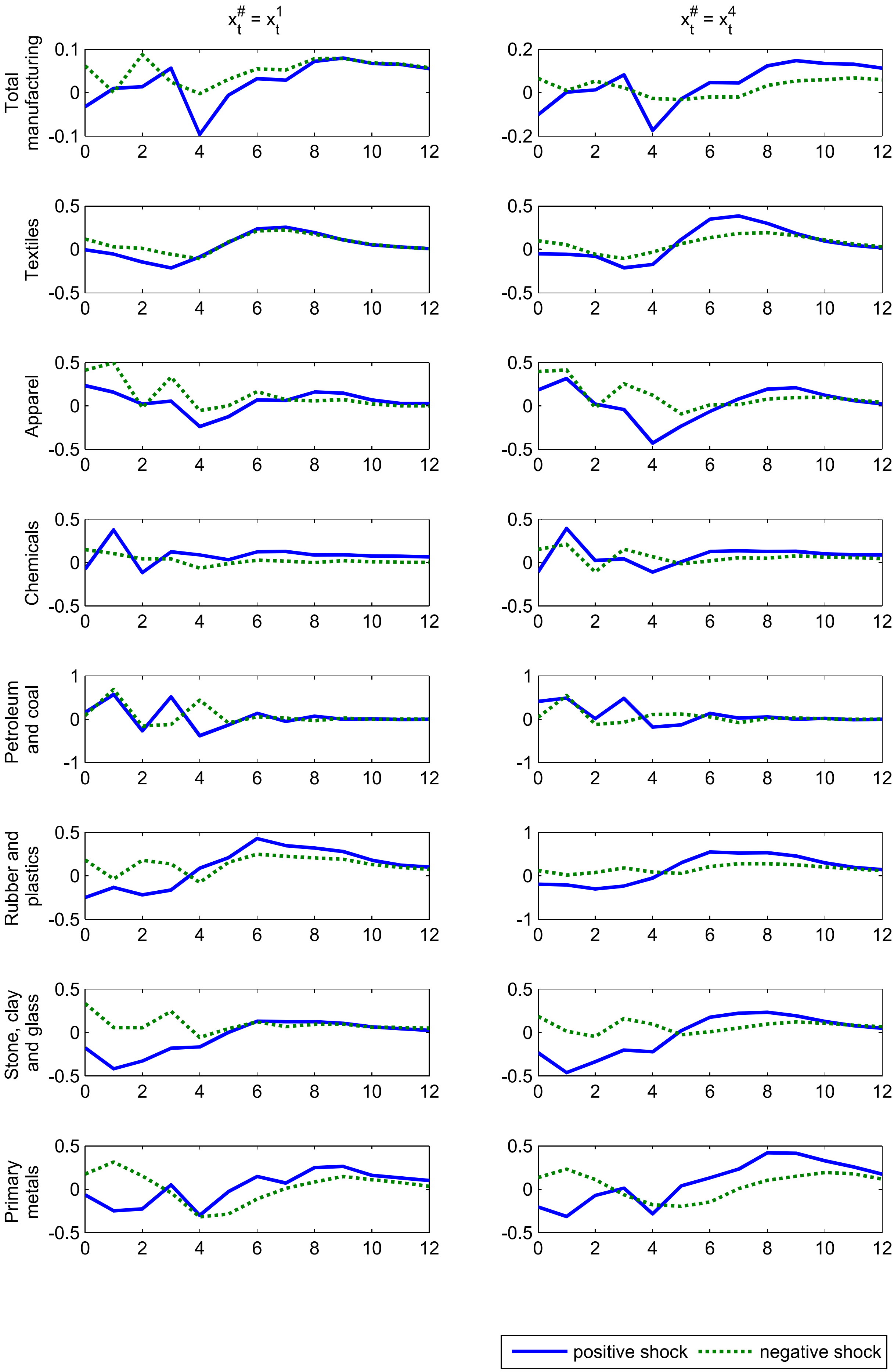


Figure A.8b: Job creation positive and negative oil price shocks of 2 s.d.

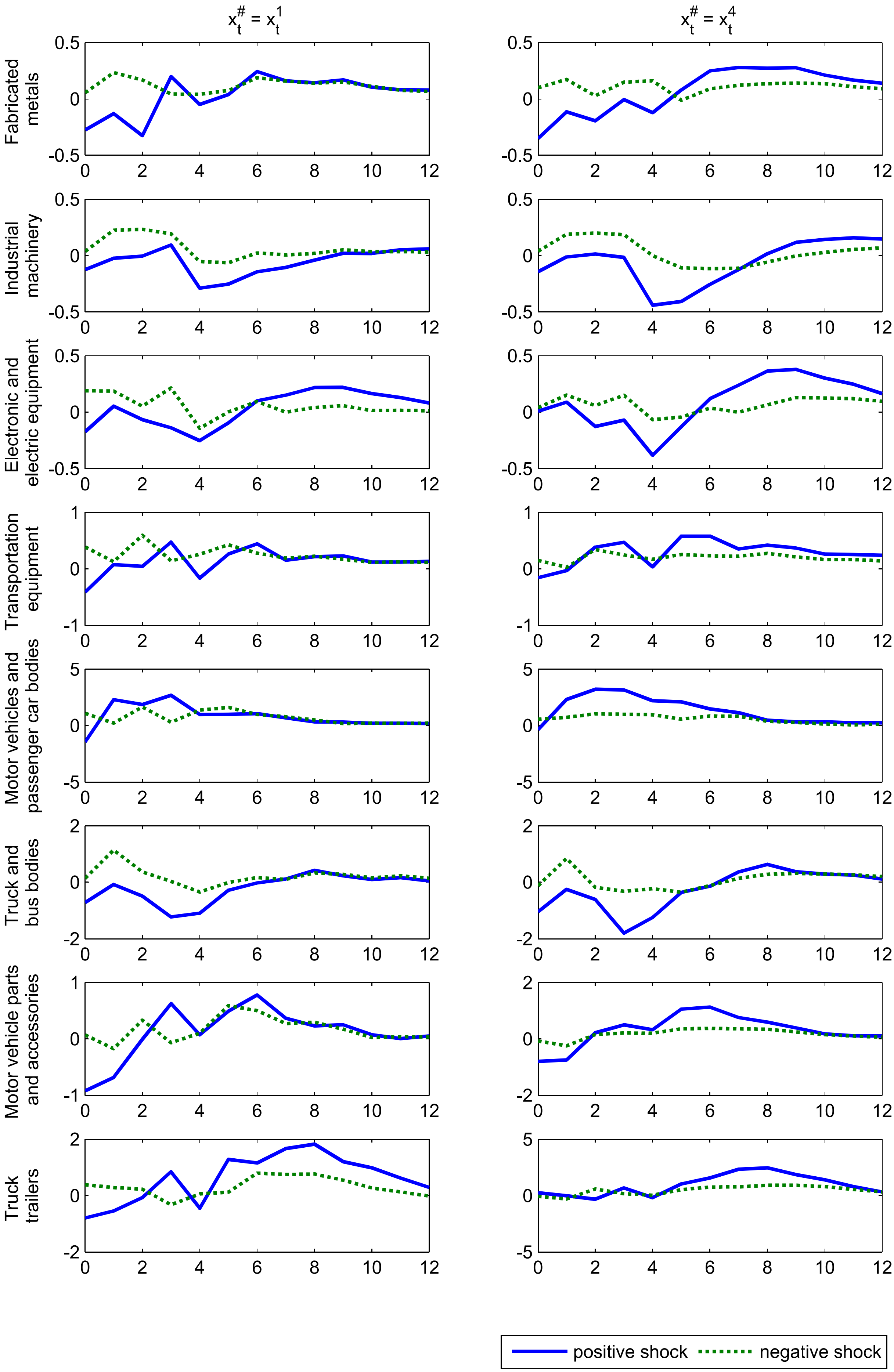


Figure A.9a: Job destruction positive and negative oil price shocks of 1 s.d.

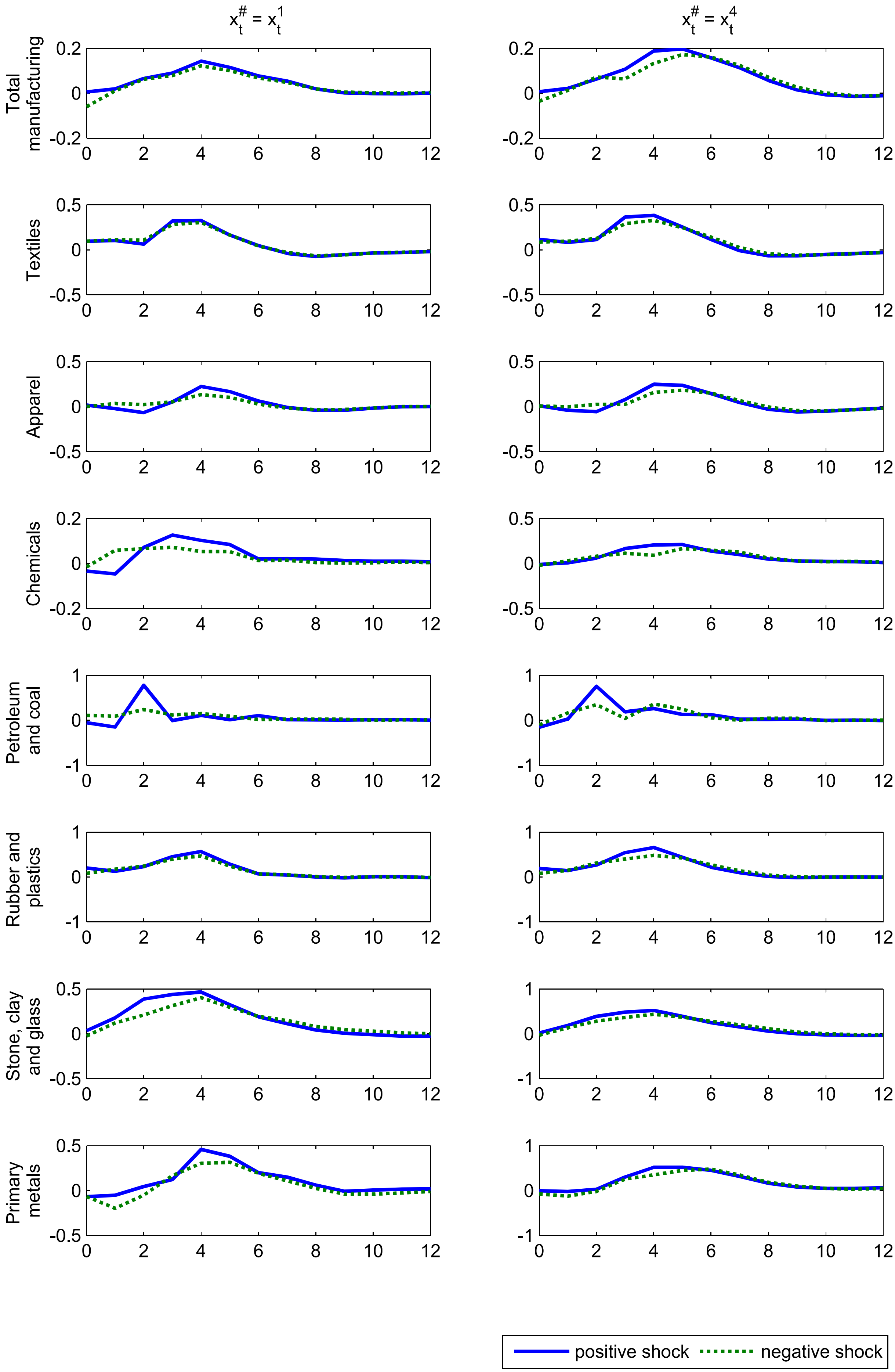


Figure A.9b: Job destruction positive and negative oil price shocks of 1 s.d.

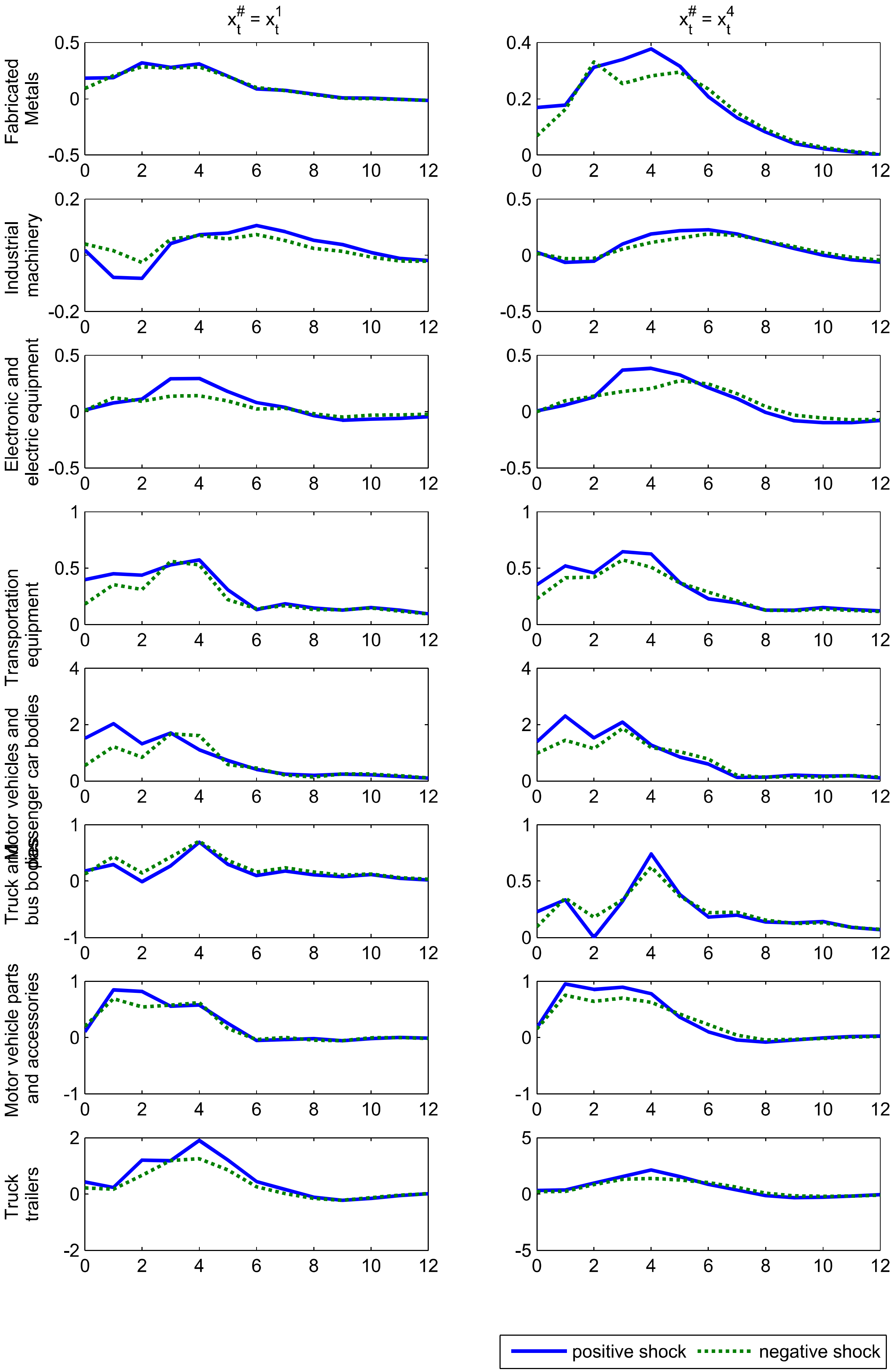


Figure A.10a: Job destruction positive and negative oil price shocks of 2 s.d.

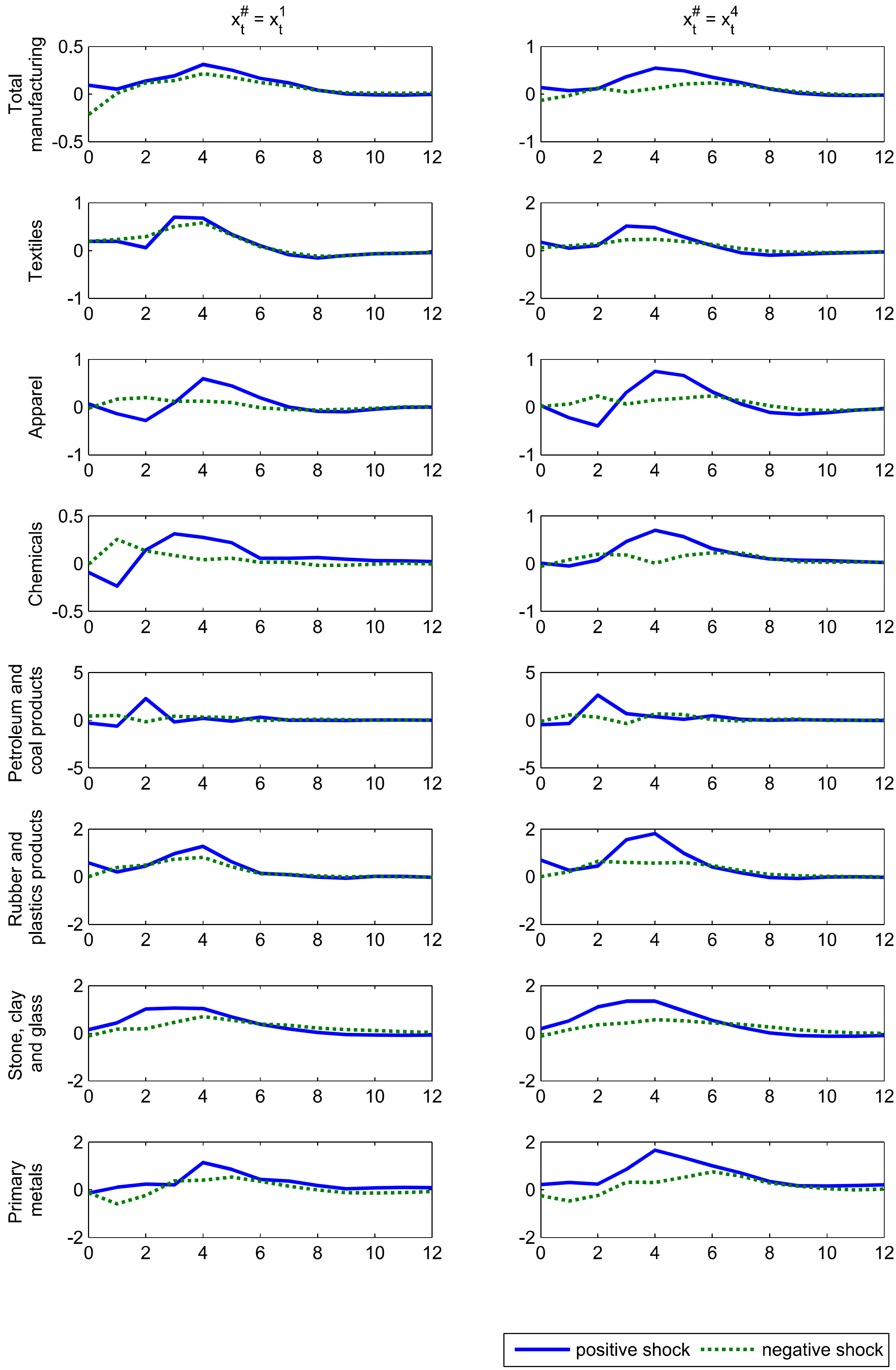
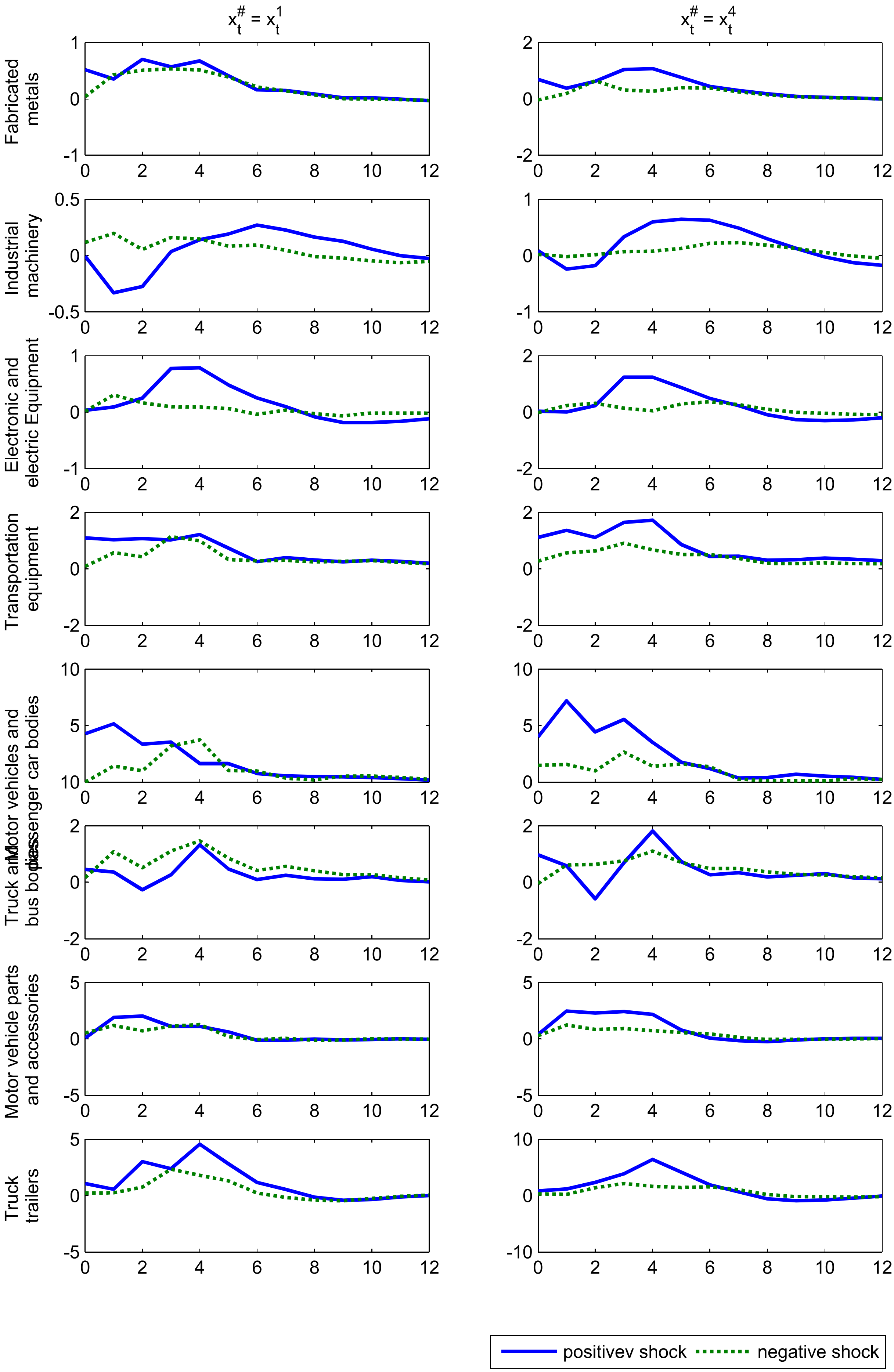


Figure A.10b: Job destruction positive and negative oil price shocks of 2 s.d.



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ABSTRACT

ESSAYS ON THE EFFECTS OF OIL PRICE SHOCKS AND MONETARY SHOCKS ON LABOR REALLOCATION

by

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The debate regarding the asymmetric effects associated with oil and monetary shocks on the economy has revived interest in analyzing the channels of transmission that generate asymmetries in the response of economic activity to these shocks. This dissertation examines the role of the allocative channel in the transmission mechanism of oil shocks and monetary shocks on economic activity. Using methods by Kilian and Vigfusson (2011b), we analyze the impact of oil and monetary shocks on job creation and job destruction in manufacturing industries.

We found that an unanticipated positive oil price shock triggers costly reallocation of labor across sectors and regions. Yet, no evidence of asymmetry was found in the response of job creation (job destruction) to positive and negative oil price shocks. Moreover, we found significant evidence of asymmetries in the response of job creation and job destruction to a positive monetary shock. This finding indicates that there is a significant costly labor reallocation process associated with an unanticipated increase in interest rates. Finally we inquire on whether the reduction in the effect of shocks since the Great moderation could be explained with the decline in the role of the allocative channel. We found that the effect of both oil price shocks and monetary shocks on Labor reallocation has reduced since the start of the Great Moderation.

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