MARKET POWER AND FISCAL POLICY IN THE U.S. AND SWEDEN*

António Afonso[a,b] and Luís F. Costa[a]

Abstract

We analyse the re relationship between market power and the effect of fiscal policy. In particular we compute average mark-ups as a measure of market power throughout time and study their interaction with fiscal policy and macroeconomic variables in a five-variable VAR. From impulse response functions the results with annual data for the U.S. (1964-2007) and Sweden (1971-2007) show that: (i) the mark-up depicts a pro-cyclical behaviour with productivity shocks and (ii) a counter-cyclical behaviour with government spending shocks. Interestingly, we also obtain a non-Keynesian impact of real final government consumption on output for the U.S..

JEL Classification: D5, E0, E3, H6.
Keywords: Fiscal Policy, Mark-up, VAR.

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Non-technical summary

The interaction between imperfect competition and fiscal-policy effectiveness has deserved a fair share of attention in economic theory. Most theoretical models tend to associate larger mark-ups with higher fiscal policy effectiveness due to either a (short-run) pure profits multiplier mechanism or to a (long-run) entry effect that increases factor efficiency – increasing returns to entry or endogenous mark-ups. Nonetheless, there is no consensus on the topic, as preferences, technologies, heterogeneity of firms, and types of taxation are crucial for the theoretical outcomes obtained. Thus, taking the theory to the test of data is an important step in order to derive some useful policy implications, both in qualitative and quantitative terms. However, the empirical analysis of the connection between market power and the effects of fiscal shocks is scant.

In this paper we generate mark-up time series for two OECD countries, the U.S. and Sweden, following Rotemberg and Woodford (1999). However, we introduce two contributions: (i) we explicitly consider a varying total number of firms and (ii) we allow for smooth changes in the technological parameters. Furthermore, we also generate total factor productivity measures compatible with the above-mentioned mark-ups.

Moreover, we then study the interaction between fiscal policy, macroeconomic variables, and market-power measures using a five-variable VAR. Illustrative results with annual data for the U.S. (1964-2007) and Sweden (1971-2007) from impulse response functions, show that: (i) the mark-up depicts a pro-cyclical behaviour with productivity shocks and (ii) a counter-cyclical behaviour with government spending shocks. Furthermore, we also obtain a non-Keynesian impact of real final government consumption on output for the U.S.

Our goal for future research is to expand the analysis to include several other OECD countries, since data availability constrained at this stage our work in this area. For long series for the number of firms in other OECD countries, we could also envisage exploring this issue using panel data analysis.

1. Introduction

The interaction between imperfect competition and fiscal-policy effectiveness has deserved a fair share of attention in economic theory – see Costa and Dixon (2009) for a survey. Most theoretical models tend to associate larger mark-ups with higher fiscal policy effectiveness due to either a (short-run) pure profits multiplier mechanism or to a (long-run) entry effect that increases factor efficiency – increasing returns to entry or endogenous mark-ups. Nonetheless, there is no consensus on the topic, as preferences, technologies, heterogeneity of firms, and types of taxation are crucial for the theoretical outcomes obtained. Thus, taking the theory to the test of data is an important step in order to derive some useful policy implications, both in qualitative and quantitative terms. However, the empirical analysis of the connection between market power and the effects of fiscal shocks is scant.

Imperfect competition has a special role in the transmission mechanism of fiscal policy when mark-ups vary endogenously along the business cycle. New Keynesian synthesis models produce undesired endogenous mark-ups due to nominal rigidity, enhancing the effectiveness of demand-side policy, including fiscal policy – see Linnemann and Schabert (2003) for an example with productive public expenditure. Additionally, recent interest in macroeconomic models where desired mark-ups vary over time make the research topic even more attractive, as they work similarly to technology shocks in the presence of active fiscal policy – see Barro and Tenreyro (2006), Bilbiie et al. (2007), dos Santos Ferreira and Dufourt (2006), dos Santos Ferreira and Lloyd-Braga (2005), Jaimovich (2007), Jaimovich and Floetotto (2008), amongst others.

One of the reasons why empirical research in this area is not abundant is related to the limited availability of time series for mark-ups as a measure of market power. There are several papers that try to measure mark-ups for different industries and sectors over a period, following the seminal paper of Hall (1988), e.g. Christopoulou and Vermeulen (2008), Martins et al. (1996), and Roeger (1995). Despite the fact these studies do not provide time series for mark-ups, there is some evidence on its mildly counter-cyclical behaviour provided in Martins and Scarpetta (2002). However, the production of time series for mark-ups for the U.S. economy has been done by Rotemberg and Woodford (1991,1999) (henceforth RW) using macroeconomic data and simple assumptions on both the technology used and the long-run features exhibited by the variables.

We follow the RW approach to generate mark-up time series for two OECD countries, the U.S. and Sweden. We introduce two contributions: (i) we explicitly consider a varying total number of firms and (ii) we allow for smooth changes in the technological parameters. Furthermore, we also generate total factor productivity measures compatible with the above-mentioned mark-ups.

Moreover, we then study the interaction between fiscal policy, macroeconomic variables, and market-power measures using a five-variable VAR. Illustrative results with annual data for the U.S. (1964-2007) and Sweden (1971-2007) from impulse response functions, show that: (i) real final government consumption has a non-Keynesian impact on real output; (ii) the mark-up depicts a pro-cyclical behaviour in response to productivity shocks and a counter-cyclical behaviour with fiscal shocks.

The remainder of this paper is organised as follows. Section two describes the theoretical underpinnings of our mark-up measures. Section three jointly computes the average mark-up and TFP throughout time. Section four conducts the VAR analysis. Section five concludes.

2. The mark-up: theoretical framework

In this section we use economic theory to produce time series for average mark-ups, a variable that cannot be directly observed. The “mark-up” is usually defined as a measure of the distance between prices and marginal costs. It expresses the power firms have to set a price above its cost of producing an additional unit of output, i.e. the market power.

In the presence of a positive supply shock, we expect the marginal cost function to shift downwards, i.e. the marginal cost tends to decrease for a given output. Therefore, assuming that the indirect effect on prices via demand is small, mark-ups tend to increase implying a pro-cyclical average mark-up.

When a positive shock originates in the demand side (e.g. a fiscal policy shock), the marginal cost function is only indirectly affected and the main effect depends on how the demand function faced by individual producers responds to the shock. Nominal rigidity (Clarida et al. (1999), Goodfriend and King (1997), Hairault and Portier (1993)), varying composition of aggregate demand (Galí (1994a,1994b)), deep habits in consumption (Ravn et al. (2006)), variety-specific subsistence levels (Ravn et al. (2008)), non-CES utility functions (Feenstra (2003)), implicit collusion in the supply side (Rotemberg and Woodford (1991,1992)), Cournot competition (Costa (2004), Portier (1995)), or feedback effects of entry (Linnemann (2001), Jaimovich (2007)) are just examples of models that produce counter-cyclical mark-ups in the presence of demand shocks.

The combination of both types of shocks with the above-described features is a possible explanation for the existing evidence on mildly counter-cyclical mark-ups that can be found in Martins and Scarpetta (2002) or Rotemberg and Woodford (1999), *inter alia*.

2.1. Definitions

There are two widely-used measures of market power:

1. The Lerner index, usually preferred by Industrial Organisation authors

$$\eta_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \ , \qquad (1)$$

where P_{it} represents the price of the good produced by firm i and MC_{it} stands for its marginal cost, both measured for period t. This measure is increasing with market power and ranges between 0, the perfectly competitive case where $P_{it} = MC_{it}$, and 1, the degenerate-monopoly case where the firm can set an infinite price when compared to its marginal cost.

2. The price wedge, usually preferred by macroeconomics authors

$$\mu_{it} = \frac{P_{it}}{MC_{it}} \ , \qquad (2)$$

which is also an increasing function of the market power and it ranges between 1 and $+\infty$. Notice there is also an increasing relationship between both measures given by $\mu_{it} = \frac{1}{1-\eta_{it}}$. In this paper we will use (2) when referring to the "mark-up" as a measure of market power.

The basic problem in determining mark-up measures lies in the fact that marginal costs are not directly observable. Thus, the usual approach consists of using economic relationships to estimate marginal costs. For a cost-minimising and profit-maximising firm, we know that its marginal cost is equal to the ratio between the price of an input and its marginal productivity. Thus, considering that labour is more easily measured than other inputs, we can estimate the marginal cost using the following relationship:

$$MC_{it} = \frac{W_t}{MPL_{it}} \quad , \tag{3}$$

where W_t represents the nominal wage per unit of labour[1] and MPL_{it} stands for the marginal product of labour. However, once again, the latter is not directly observable and we have to postulate a specific production function such that

$$MPL_{it} = \frac{\partial y_{it}}{\partial l_{it}} \quad , \tag{4}$$

where l_{it} is the labour input used in the production of firm i, here represented by y_{it}. A general production function can be represented by

$$y_{it} = F\left(l_{it},\, .\right) \quad , \tag{5}$$

and we can assume it has the usual properties, namely a positive but decreasing MPL_{it}.

2.2. Average mark-ups

Following Rotemberg and Woodford (1991) let us assume the average firm in the economy uses a technology that can be represented by one of the two following production functions:

$$y_t = A_t.\left(k_t^{\alpha}.l_t^{1-\alpha} - \Phi\right) \qquad \text{(A)}, \qquad y_t = A_t.k_t^{\alpha}.\left(l_t - \Lambda\right)^{1-\alpha} \qquad \text{(B)}, \tag{6}$$

where y_t stands for the output, k_t is the capital stock used, and l_t represents the labour input used by the average firm. A_t is a (non-observable) measure of total factor productivity (TFP), $0 < \alpha < 1$, and $\Phi, \Lambda > 0$. Notice that if we had $\Phi = \Lambda = 0$, we would obtain a constant-returns-to-scale Cobb-Douglas production function. However, without a fixed cost it would be impossible to sustain imperfect competition in the long run for this economy.

Real pure profits of this average firm are given by

$$\pi_t = y_t - TC_t \ , \qquad (7)$$

where TC_t represents total costs of producing goods for the average firm in the economy. Since we only consider costs of hiring labour and capital services, total costs are given by

$$TC_t = \frac{W_t.l_t + R_t.k_t}{P_t} \ , \qquad (8)$$

where R_t is the nominal rental price of capital and P_t is the aggregate price index relevant for producers.

Given the existence of imperfect competition in product markets, real factor prices are not equal to their marginal products:

$$\frac{W_t}{P_t} = \frac{MPL_t}{\mu_t} \quad , \qquad \frac{R_t}{P_t} = \frac{MPK_t}{\mu_t} \ , \qquad (9)$$

where *MPK* stands for the marginal product of capital.

Thus, if we substitute (6), (8), and (9) in (7) we obtain the following expressions for profits:

$$\begin{aligned} \pi_t &= A_t.\left(\frac{\mu_t - 1}{\mu_t}.k_t^{\alpha}.l_t^{1-\alpha} - \Phi\right) && \text{(A)} \\ \pi_t &= \left\{1 - \frac{1}{\mu_t}.\left[\alpha + (1-\alpha).\frac{l_t}{l_t - \Lambda}\right]\right\}.A_t.k_t^{\alpha}.(l_t - \Lambda)^{1-\alpha} && \text{(B)} \end{aligned} \ . \qquad (10)$$

[1] Here, for the sake of simplicity, we assume all firms use a homogeneous labour input.

2.3. Aggregate variables long-run constraints

First, let us define the average labour share in aggregate income as

$$s_t = \frac{W_t.L_t}{P_t.Y_t} \ , \tag{11}$$

where L_t stands for total employment and Y_t represents aggregate income.

Let us also define the variables for the average firm in the following way:

$$y_t = \frac{Y_t}{n_t} \quad , \quad l_t = \frac{L_t}{n_t} \quad , \quad k_t = \frac{K_t}{n_t} \ ,$$

where n_t is a measure of the total number of firms in the economy.

Now, using both (6) and (9) in (11), we obtain the following short-run expressions for the labour share:

$$(i = A,B) \qquad s_t^{(i)} = \frac{1-\alpha}{\mu_t}.\frac{1}{1-\phi_t^{(i)}} \ , \tag{12}$$

where $\phi_t^{(i)}$ $(i = A, B)$ is a measure of increasing returns given by

$$\phi_t^{(A)} = \frac{\Phi}{k_t^{\alpha}.l_t^{1-\alpha}} \quad , \quad \phi_t^{(B)} = \frac{\Lambda}{l_t} \ .$$

In the long run entry and exit eliminate pure profits. Thus, the following equalities have to hold in order to obtain $\pi_t^* = 0$ from (10) and where asterisks identify the balanced-growth-path values for variables:

$$\Phi = \frac{\mu_t^* - 1}{\mu_t^*}.k_t^{*\alpha}.l_t^{*1-\alpha} \quad , \quad \Lambda = \frac{\mu_t^* - 1}{\mu_t^* - \alpha}.l_t^* \ . \tag{13}$$

Therefore, using (13) in (12), we can obtain the long-run share of wages in aggregate income that is given by

$$s_t^{(A)*} = 1-\alpha \quad , \quad s_t^{(B)*} = \frac{\mu_t^* - \alpha}{\mu_t^*} \ . \tag{14}$$

3. Computing the average mark-up throughout time

3.1. The data

We consider the U.S. and Sweden for which there was data on average mark-ups for a long recent period and also due to wider data availability regarding the number of firms in the economy.

Macroeconomic variables were taken from the European Commission AMECO database (codes in brackets) and correspond to:

- Y_t represents real GDP (1.1.0.0.OVGD) per capita, i.e. per head between 15 and 64 years old (1.0.0.0.NPAN), measured in 2000 Purchasing Power Standards (PPS).

- K_t stands for real capital stock (1.0.0.0.OKND) per capita, measured in 2000 PPS.

- L_t is total hours worked, i.e. the product of average hours per employee (1.0.0.0.NLHA) and total employment (1.0.0.0.NETN).

- s_t represents the adjusted wage share in total income (1.0.0.0.ALCD0)[2].

- P_t stands for the GDP deflator calculated as the ratio between nominal GDP (1.0.0.0.UVGD) and real GDP. Considering that we want a proxy for the relevant prices for producers, the price deflator is divided by $1 + \tau_t$, where τ_t represents the ratio between indirect taxes (1.0.0.0.UTVG) minus subsidies (1.0.0.0.UYVG) and nominal GDP[3].

- W_t is the adjusted hourly nominal wage rate obtained as $s_t.P_t.Y_t/L_t$.

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[2] This share is adjusted using the ratio between the concepts of employment and number of employees (in full-time equivalents when available) that exist in the national accounts for domestic industries.

[3] Fluctuations in the prices of intermediate goods affect both prices and marginal costs. However, considering that annual information on input-output tables is not available and also that we use a value-added measure for mark-ups, we assume that the effect of price changes in intermediate goods may be important for the level, but not for the cyclical fluctuations of mark-ups. For an extensive treatment of this subject see Rotemberg and Woodford (1995).

The total number of firms per capita (n_t) was taken from several sources: for Sweden the data corresponds to the total number of enterprises (1971-2007) from Statistics Sweden; for the U.S. data corresponds to the total number of establishments (1964-2007) from the U.S. Small Business Administration[4]. For the data on μ^*_t, i.e. the long-run mark-up ratios for the economy, we used two different sources of information. We used the information in Martins et al. (1996), Table 3, and calculated the gross-production-weighted average mark-ups for the period 1980-92 for 14 OECD countries. We also used information from Christopoulou and Vermeulen (2008), Table 1, that present average mark-ups for 9 countries for the period 1981-2004. Additionally, we used the information in that paper's Table 2 to test for time-varying long-run mark-ups, using the periods 1970-79, 1981-92, and 1993-2004 only available for the manufacturing sector.

3.2. Mark-up time series

Considering that we have two functional forms for the production function in (6), there will be two basic measures for the mark-up time-series that we will call cases A and B.

To obtain the first measures of mark-up, A1 and B1, based on the two production functions, we assume the long-run mark-up level is constant (μ^*) along the sample period and is given by the average mark-up obtained using the information in Martins et al. (1996), reported in Table 1.

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[4] Statistics Sweden: http://www.scb.se/; U.S. Small Business Administration: http://www.sba.gov/.

Table 1 – Production-weighted average mark-ups 1980-1992

Country	Average mark-up
Australia	1.293
Belgium	1.269
Canada	1.279
Denmark	1.265
Finland	1.252
France	1.263
Italy	1.376
Japan	1.271
Netherlands	1.262
Norway	1.201
Sweden	**1.199**
UK	1.232
USA	**1.203**
West Germany	1.248

Source: Martins et al. (1996).
NOTE: Sectors considered: Manufacturing; Electricity, Gas, and Water; Construction; Wholesale, Retail Trade, Restaurants, and Hotels (Wholesale and Retail Trade for Australia and Japan); and Transport, Storage, and Communication. Gross-production weights obtained using 1990 data, except for Australia (1989), Belgium, Finland, and Sweden (1995), Italy (1985), and Netherlands (1986).

We assume the parameter α is constant over the sample period and it is given by the average of $1 - s_t$ in case A and it is given by the average of $\mu^*.(1 - s_t)$ in case B.

In order to obtain the values for the parameters associated with the fixed costs, Φ and Λ, we use equation (13). We use l_t and k_t on the right-hand side and calculate the average for these terms to obtain constant values for Φ and Λ over the sample period.

Both time series, denoted $\mu_t^{(A1)}$ and $\mu_t^{(B1)}$, can be obtained for the relevant periods for both countries. However, they show a non-stationary behaviour as we assumed a constant fixed cost for the entire period. This assumption is not easily accepted in the period pre-1983 for the U.S. and pre-1973 and post-1996 for Sweden. Table 2 shows us that both mark-up measures can be considered mildly pro-cyclical in Sweden and weakly counter-cyclical in the U.S.

Table 2 – Cyclical properties of mark-up measures

Country	Correlation with real GDP											
	A1	B1	A2	B2	A3	B3	A4	B4	A5	B5	A6	B6
Sweden	0.11	0.16	-	-	-	-	0.07	0.11	-	-	-	-
USA	-0.01	-0.18	-0.07	-0.27	0.03	-0.01	-0.03	-0.21	-0.09	-0.30	-0.04	-0.16

NOTE: Correlations between the ratios of each variable and its trend component given by a HP filter.

Alternatively, the measures A2 and B2 are obtained by the same method, but we use the average mark-up measures available in Christopoulou and Vermeulen (2008). In this case, time series $\mu_t^{(A2)}$ and $\mu_t^{(B2)}$ are not available for Sweden. For the U.S. they show the same type of problems as for $\mu_t^{(A1)}$ and $\mu_t^{(B1)}$. Again Table 2 presents evidence that support a counter-cyclical behaviour of mark-ups in the U.S.

In addition, for the A3 and B3 measures, we also use the mark-ups available in Christopoulou and Vermeulen (2008), but in this case we consider three different periods with distinct average mark-ups[5]. Within each of these periods, we consider constant values for α and Φ or Λ, which are obtained as in the previous two methods. Again, series $\mu_t^{(A3)}$ and $\mu_t^{(B3)}$ are not available for Sweden. For the U.S. the problems observed with the two previous methods are not substantial, but the method induces sharp structural breaks in the series in 1980 and 1993. According to Table 2 both series are acyclical.

The next three types of measures are closely related to the previous three, but we allow the long-run parameters (α, Φ, Λ) to change smoothly over time. We obtain the balanced-growth-path series for the three parameters using the Hoddrick-Prescott (HP)

[5] Unfortunately values are only available for manufacturing.

filter with $\lambda = 100$. The series for α_t^* is simply given by HP(1 - s_t,100). The series for Φ_t^* and Λ_t^* are obtained by applying the HP filter to the right-hand side of (13).

Measures A4 and B4 correspond to measures A1 and B1, but using time-varying parameters, while the measures A5 and B5 correspond to A2 and B2, and A6 and A6 correspond to A3 and B3.

Given the smooth evolution of the key parameters, mark-up series $\mu_t^{(A4)}$ and $\mu_t^{(B4)}$ do not present a visible trend in any of the countries studied[6]. Table 2 presents cyclical behaviours similar to $\mu_t^{(A1)}$ and $\mu_t^{(B1)}$, though less pro-cyclical for Sweden and more counter-cyclical for the U.S.

Series $\mu_t^{(A5)}$ and $\mu_t^{(B5)}$, available for the U.S. only, are very close to $\mu_t^{(A2)}$ and $\mu_t^{(B2)}$ and also to the previous one. The correlations shown in Table 2 confirm the visual inspection.

Finally, measures $\mu_t^{(A6)}$ and $\mu_t^{(B6)}$ allow a smoother transition between periods keeping stationarity at the same time. Table 2 also shows a counter-cyclical behaviour of mark-ups in the U.S.

Given the features of the series and the availability of data, we opted for using $\mu_t^{(A4)}$ as the benchmark measure of market power, using also $\mu_t^{(B4)}$ as an alternative. Both series show a strong correlation between them (0.93 for Sweden and 0.96 for the U.S.). The other measures, when available, can be used to test the robustness of the results obtained.

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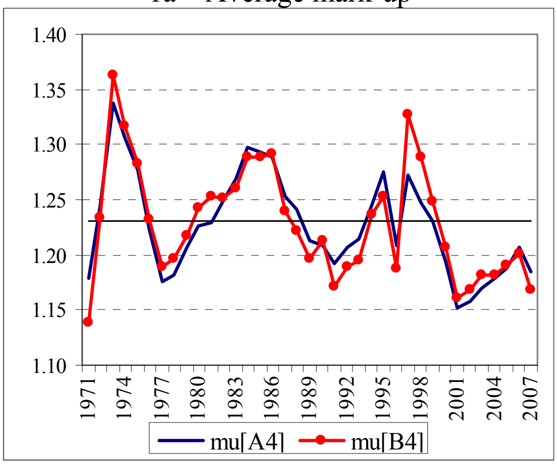
[6] Nonetheless, fixed costs in Sweden show a surprising downward trend.

Figure 1 plots for Sweden and for the U.S. the mark-up and respective total factor productivity measures from cases A4 and B4 mentioned above (in the Appendix the alternative mark-up measures are also plotted for illustration). It is possible to observe a non-stationary behaviour of TFP (in logs), indicating that the series are I(1), and a stationary pattern for the mark-up, I(0) series, which was afterwards confirmed by formal ADF unit root tests.

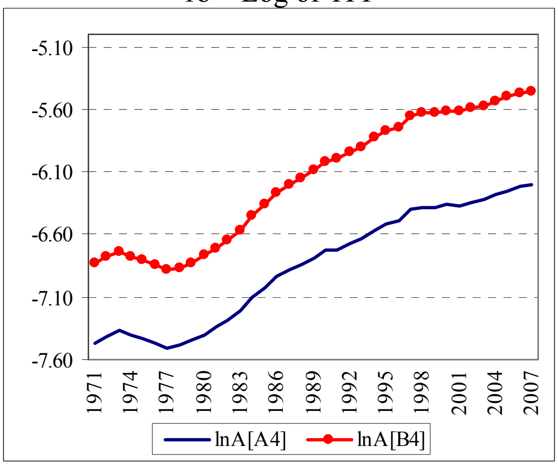
Figure 1 – Mark-up and TFP

Sweden

1a – Average mark-up

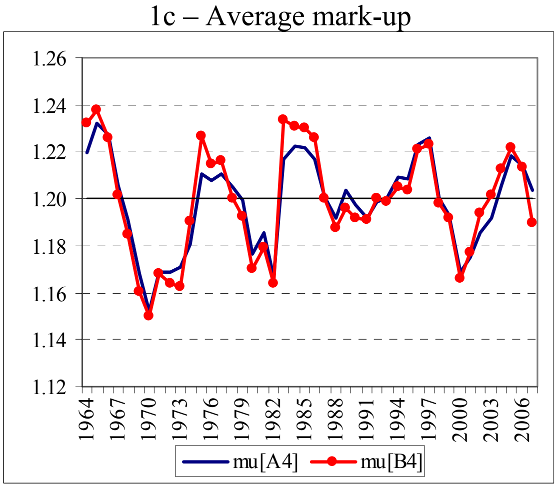


1b – Log of TFP

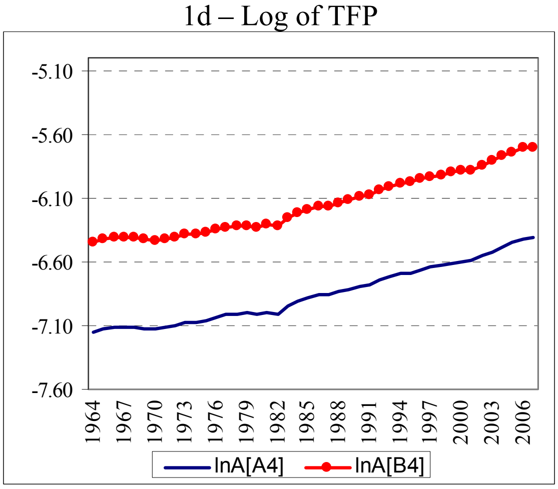


U.S.

1c – Average mark-up



1d – Log of TFP



Notes: mu[A4] = $\mu_t^{(A4)}$ and mu[B4] = $\mu_t^{(B4)}$, represent the mark-ups obtained using equation (13); A[A4] = $A_t^{(A4)}$ and A[B4] = $A_t^{(B4)}$ stand for the corresponding TFP's.

The period-averages for the mark-ups plotted in Figure 1 are 1.198 and 1.199 for the U.S. and 1.229 and 1.231 for Sweden. These values compare with the mark-up of 1.23 reported for the U.S. in Bayoumi et al. (2004).

4. VAR analysis

4.1. Setting up the VAR

For the U.S. and for Sweden, the countries for which we were able to find the longest time series regarding the number of firms, we estimated a VAR with two alternative measures of markup, A4 and B4, which use time-varying parameters.

We estimate a five-variable VAR model for the periods 1971-2007 and 1964-2007 respectively for Sweden and for the US. The variables in the VAR are real total final government consumption expenditure, *G*, real output, *Y*, real taxes *T*, all in logarithms, the mark-up, μ, and the logarithm of the level of productivity, *A* (the corresponding measure of TFP). The macro variables are per head of working-age population (between 15 and 64 years old). Moreover, technology, *A*, real output, real total final government consumption expenditure and real taxes will usually enter in first differences, and the mark-up, μ, enters in levels, in order that all variables in the VAR are I(0).

The VAR model in standard form can be written as

$$\mathbf{X}_t = \mathbf{c} + \sum_{i=1}^{p} \mathbf{V}_i \mathbf{X}_{t-i} + \boldsymbol{\varepsilon}_t \ . \qquad (15)$$

where $\mathbf{X}_t$ denotes the (5×1) vector of the five endogenous variables given by $\mathbf{X}_t \equiv \left[\Delta \ln A_t \quad \Delta \ln G_t \quad \mu_t \quad \Delta \ln Y_t \quad \Delta \ln T_t\right]'$, $\mathbf{c}$ is a (5×1) vector of intercept terms, $\mathbf{V}$ is the matrix of autoregressive coefficients of order (5×5), and the vector of random disturbances $\boldsymbol{\varepsilon}_t \equiv \left[\varepsilon_t^A \quad \varepsilon_t^G \quad \varepsilon_t^\mu \quad \varepsilon_t^Y \quad \varepsilon_t^T \right]'$. The lag length of the endogeneous variables, p, will be determined by the usual information criteria.

The VAR is ordered from the most exogenous variable to the least exogenous one, with the log of TFP in the first position. As a result, a shock to technology may have an instantaneous effect on all the other variables. However, technology does not respond contemporaneously to any structural disturbances to the remaining variables. In the same way, total final government consumption expenditure also does not react contemporaneously to GDP or to taxes due, for instance, to lags in government decision-making. In other words, the mark-up, GDP, taxes, and government spending, may affect technology with a one-period lag. For instance, a shock in the mark-up, the third variable, does not have an instantaneous impact on consumption expenditure of general government or in techonology, but it affects contemporaneously real output and taxes.

In addition to the data used in section three, to compute the average mark-up throughout time, we now used for the VAR also the following series: total final government consumption expenditure (1.1.0.0.OCTG), while government revenues are the sum of direct taxes (1.0.0.0.UTYG), indirect taxes (1.0.0.0.UTVG), and social security contributions (1.0.0.0.UTSG).

4.2. Estimation and results

Since real output, real total final government consumption expenditure, real output, real taxes and technology are I(1) variables, they enter in the VAR in first differences. On the other hand, the mark-up is a I(0) variable entering therefore in levels in the

VAR. The unit root tests provide similar stationarity results for both Sweden and the U.S. (see Table 3).

Table 3 – Unit-root tests: Augmented Dickey-Fuller test statistics

	$\Delta \ln A^{(A4)}$		$\mu^{(A4)}$		$\Delta \ln Y$		$\Delta \ln T$		$\Delta \ln G$	
	t-Statistic	critical value	t-Statistic	critical value	t-Statistic	critical value	t-Statistic	critical value	t-Statistic	critical value
Sweden	-3.62	-2.94$	-2.60	-2.61#	-3.77	-3.63	-3.44	-3.20&	-2.88	-2.61#
US	-4.45	-3.58	-5.10	-3.58	-5.12	-3.58	-5.06	-3.58	-3.41	-2.93$

Notes: critical values are for 1% level unless otherwise mentioned.
\# – 10% level; $ – 5% level; & – with time trend.

In the case of Sweden, there is a break around 1991 in the series for real GDP and real taxes, linked to the banking crisis and economic downturn in the beginning of the 1990's. Therefore, in the VAR for Sweden we also include a dummy variable that assumes the value one for 1991 (zero otherwise) and that turns out to be statistically significant in the regressions for real GDP, real taxes and technology.[7]

The VAR order used in the estimation of each model was selected with the Akaike and the Schwarz information criteria. Those tests led us to choose a parsimonious model with only one lag for both countries, which helped avoid the use of too many degrees of freedom. With such specifications we also could not reject the null hypothesis of no serial residual correlation. In addition, we did not reject the null hypothesis of normality of the VAR residuals in both cases (see Table 4).

[7] We used Zivot and Andrews (1992) recursive approach to test the null of unit root against the alternative of stationarity with structural change at some unknown break date. The results allow the rejection of the unit root hypothesis in particular for the logarithmic growth rate of real taxes and GDP.

Table 4 – Diagnostic tests, dynamic feedback VAR

	Autocorrelation test (p-value)[1]	Normality test (p-value)[2]	Number of lags	Number of observations
Sweden	0.186	0.420	1	36
US	0.343	0.359	1	44

NOTE: We considered the maximum VAR order to be three.
1 – Multivariate residual serial correlation LM test. For the null hypothesis of no serial autocorrelation (of order 1) the test statistic as an asymptotic chi-square distribution with k^2 degrees of freedom.
2 – Multivariate Jarque-Bera residual normality test. For the null hypothesis of normality, the test statistic has an asymptotic chi-square distribution with 8 degrees of freedom.

Figures 2 and 3 in the appendix plot the impulse-response functions to a shock in the variables included in the VAR, respectively for Sweden and for the U.S.

[Insert Figures 2 and 3 here]

Sweden

Figure 2a displays the impulse-response functions of all variables in $\mathbf{X}_t$ to a shock in real total final government consumption expenditure in Sweden. The estimated model shows that real total final government consumption declines steadily following the shock, and the roughly vanishes after four-five periods. Moreover, the increase in real government consumption induces a contemporaneous increase in real GDP, followed by a temporary fall that wears off after five years, and an increase in real government revenue. The evidence also suggests that real government consumption shocks have a small positive impact on the mark-up measure and an initially negative effect on TFP. Thus, we can conclude that, following a shock in real government consumption, mark-ups react overall counter-cyclically to the non-Keynesian effect on GDP that occurs from the second year onwards.

The mark-up depicts a pro-cyclical behaviour vis-à-vis productivity, since it increases alongside real output after a positive shock to productivity (see Figure 2b). On the other hand, a negative response ensues from real total final government consumption in the first three periods after a shock to productivity.

A positive shock in terms of the mark-up measure (see Figure 2c) positively impinges on real ouptut and on real total final government consumption expenditure, but with a one-year lag for the latter. The mark-up shock has a positive effect on real revenues, again with a one-period lag, fading away after six periods, and a negative effect on TFP, in this case taking also six periods to disappear.

From Figure 2d one observes that a positive shock to real ouput in Sweden has an initial positive effect on real revenues, a negative effect on productivity, which fades away after five periods, a small negative effect on real total final government consumption expenditure, but exhibiting a large lag, and a negative impact on the mark-up, which fades away more slowly after roughly nine periods.

U.S.

Despite the considerably different weight of the government in the economy in Sweden and in the U.S.[8], a rather similar set of conclusions is visible for the case of the U.S., regarding a shock to real total final government consumption expenditure (see Figure 3a). For instance, a positive shock to real total final government consumption expenditure roughly vanishes after five periods, has a positive impact on the mark-up, and negative effects on real revenues and on real output. Interestingly, for the case of the U.S., such upward shock on real final government consumption slightly increases productivity between years two and four.

[8] Real total final government consumption expenditure represents around 29 per cent of GDP in Sweden for the period 1970-2006 and it represents less than 18 per cent in the U.S. for the same period.

As in the case of Sweden, also for the U.S. one observes a pro-cyclical behaviour of the mark-up when positive productivity shocks occur (see Figure 3b). However, in this case a positive response from real total final government consumption takes place in the first 6 periods after a shock to TFP.

A positive shock to the mark-up (see Figure 3c) disappears after three periods, rather similar to the illustration above for the case of Sweden. Positive effects occur overall for both real revenue and real final government consumption, and the same is also true for real output, now with a one-year lag also in output. Again, productivity is negatively affected and the effect dies away throughout seven-eight periods.

From Figure 3d, the results of a positive shock to real output in the case of the U.S. show an upward impact on real revenues in the first two periods, which then turns negative and fades away after six periods. In this case, there is also an initial positive effect in real government consumption expenditure in the second period, which then becomes negative until fading away. There are also initial negative effects on productivity and on the mark-up, also for the periods that follow year two.

In the case of the U.S., where we have a longer time series, we also tentatively considered two sub-samples: 1964-1987 and 1988-2007.[9] Results are very similar in the sub-sample 1964-1987. Regarding the second sub-sample, the differences vis-à-vis the full sample stem from a negative (positive) initial response of real final government consumption to productivity (mark-up) shocks, and from the increase of the mark-up to a shock in real final government consumption.

In a nutshell, the relative strength of Keynesian and non-Keynesian effects of fiscal policy is still controversial in the empirical literature and this is not the main contribution of our paper. However, most theoretical models with endogenous mark-ups, either of the undesired or the desired types, predict that we should expect counter-cyclical mark-ups when shocks originate on the demand side of the economy and pro-cyclical mark-ups when shocks are of technological nature (on the supply side). The evidence here produced points precisely in this direction.

To our knowledge, the closest article to our approach is Monacelli and Perotti (2008) that also employ a VAR technology to study the interaction between mark-ups and fiscal policy for the U.S. Using quarterly data, and alternative measures of government spending and different methods for identifying shocks and measuring mark-ups, their results also indicate a counter-cyclical behaviour of the mark-up with fiscal shocks.

In Figures 4 and 5 we plot simultaneously the responses of real output and of the mark-up to a one standard deviation shock to real final government consumption, and to a one standard deviation technological shock, respectively for Sweden and for the U.S.. This allows further illustrating the fact that the mark-up depicts a pro-cyclical behaviour with productivity shocks and a counter-cyclical behaviour with fiscal spending shocks.

[9] This corresponds to the pre- and post-Greenspan eras.

Figure 4 – Responses to a one standard deviation shock (Sweden)

4a – Shock to real final government consumption

4b – Technology shock

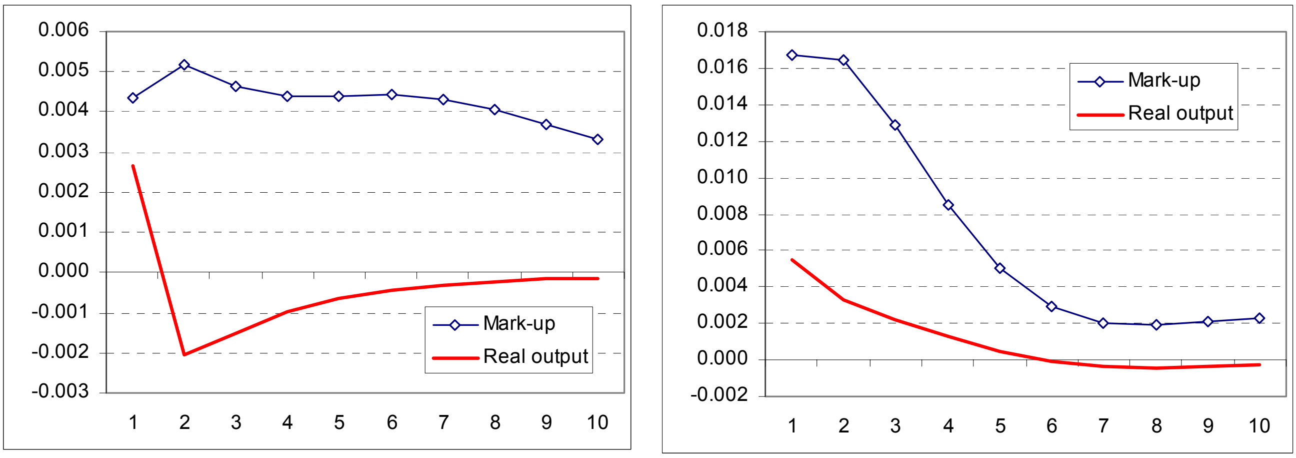
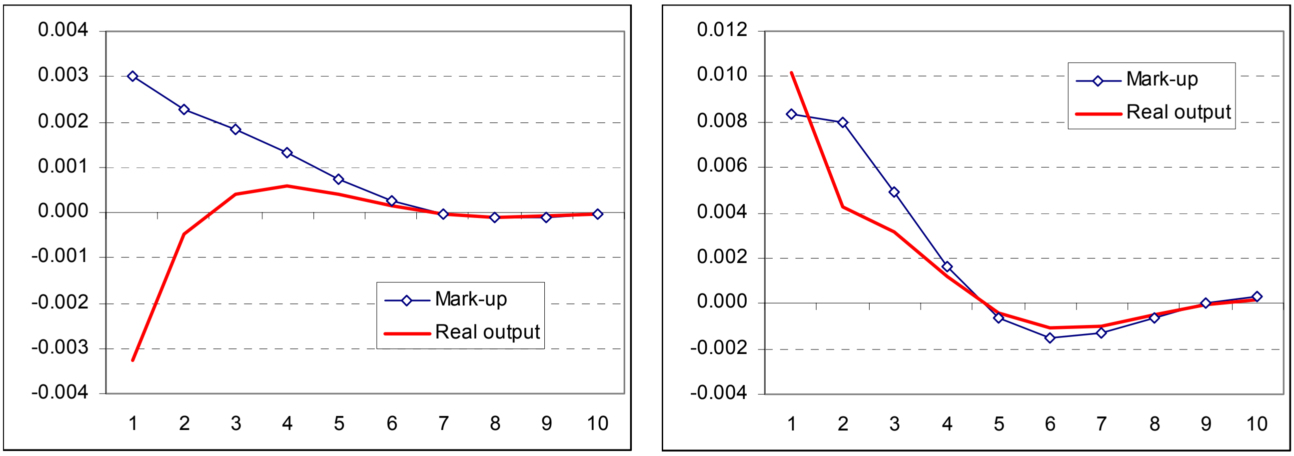


Figure 5 – Responses to a one standard deviation shock (U.S.)

5a – Shock to real final government consumption

5b – Technology shock



4.3. Robustness

Using an alternative mark-up measure ($\mu^{(B4)}$ in Figure 1) and the corresponding TFP measure in the VAR analysis provided very similar results. The same also applies to the other mark-up measures previously presented, when they were available. However, most of them could not be computed for Sweden due to non-existing long-run information on mark-ups and there were also some stationarity issues.

One way to check the robustness of our results is to use equation (12) to generate mark-up time series using the short-run labour share by assuming that $\phi_t^{(i)} = \alpha$, for i = A, B. This is roughly the approach of Monacelli and Perotti (2008). We also derived the TFP measure that corresponds to a mark-up given by $1/s_t$, using the same approach as in the previous cases.

For the U.S. economy the qualitative results are similar and the main conclusions hold. This is not a surprise considering that this mark-up measure (in fact, the reciprocal of the labour share) is highly correlated with the other mark-up measures for the U.S., especially when the trend is extracted using a HP filter[10].

For Sweden, the changes occur in the now negative response of the mark-up to a positive shock to real final government consumption while a shock to the mark-up itself also now reduces real final government consumption. In addition, a positive shock to real taxes now also reduces the mark-up. The other responses to shocks in variables in the VAR are similar to the results uncovered in the previous section for the baseline model. The correlations of the reciprocal of the labour share with the other mark-up measures are in fact smaller than the ones found for the U.S[11].

Finally, we also estimated the VAR models using first differences of the level of the variables, instead of logarithmic differences, but the results were broadly similar.

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[10] Correlations of the new mark-up measure with A4 and B4, de-trended with a HP filter, are respectively of 0.92 and 0.81 for the U.S.. The correlation between the same basic measures and the first difference of $1/s_t$ used here are respectively 0.47 and 0.52.

[11] Correlations of the new mark-up measure with A4 and B4, de-trended with a HP filter, are respectively of 0.88 and 0.71 for the Swedish economy. The correlation between the same basic measures and the first difference of $1/s_t$ used here are respectively 0.29 and 0.22. Notice the sample is also shorter for Sweden.

5. Conclusions

In this paper we have computed the average mark-ups throughout time as market-power measures, and studied their interaction with fiscal policy and other macroeconomic variables, using a five-variable annual VAR for Sweden and the U.S. The mark-up measures are calculated in a standard fashion, but two innovations were introduced: (i) explicitly considering the effect of a varying number of firms and (ii) assuming smooth changes in the long-run technological parameters.

Illustrative results with annual data for the U.S. (1964-2007) and Sweden (1971-2007) from the VAR impulse response functions show that: (i) the mark-up depicts a pro-cyclical behaviour with productivity shocks and (ii) a counter-cyclical behaviour with government spending shocks. Furthermore, we also obtain a non-Keynesian impact of real final government consumption on output for the U.S.

Our goal for future research is to expand the analysis to include several other OECD countries, since data availability constrained at this stage our work in this area. For long series for the number of firms in other OECD countries, we could also envisage exploring this issue using panel data analysis.

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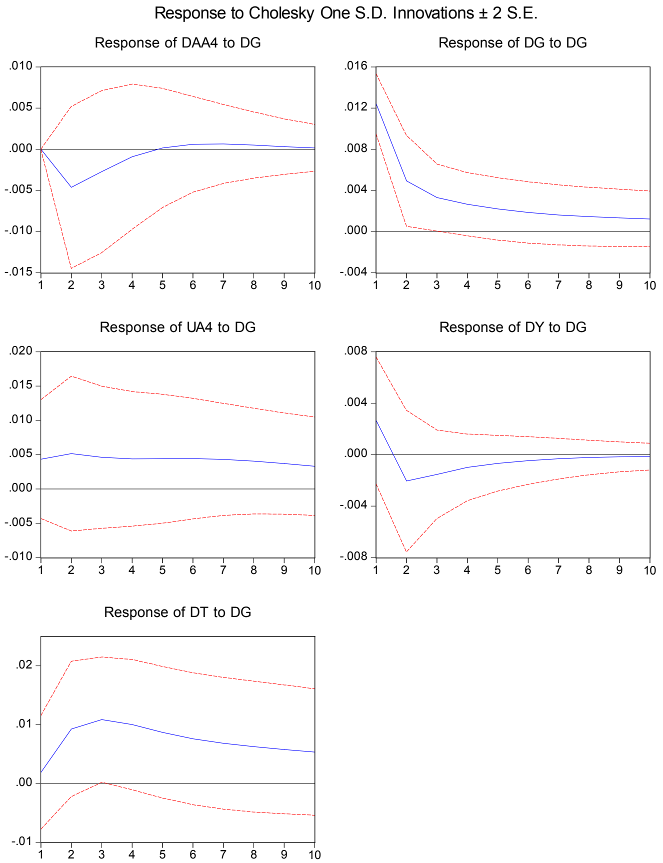
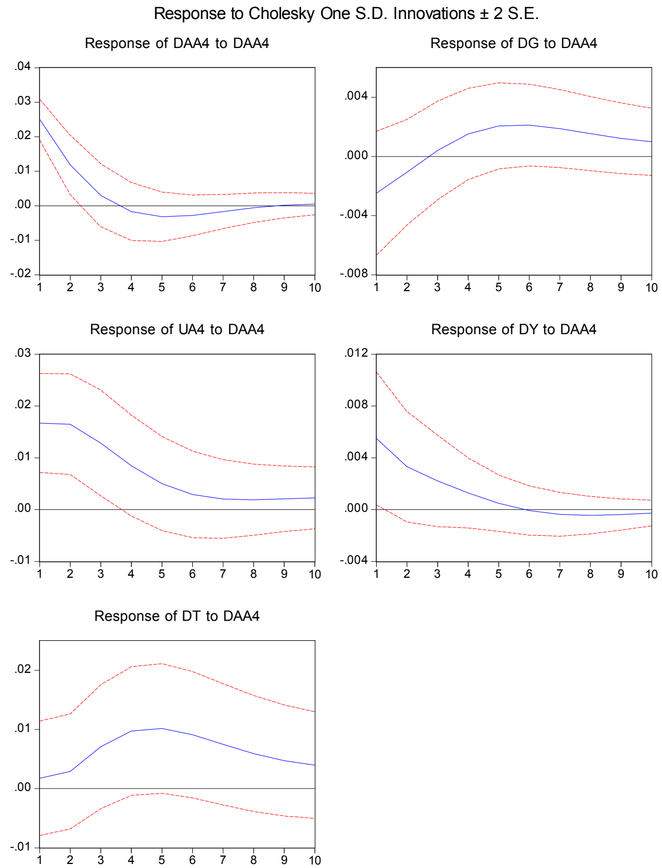
Figure 2 – Impulse-response functions, Sweden

2a – spending shock



2b – productivity



2c – mark-up

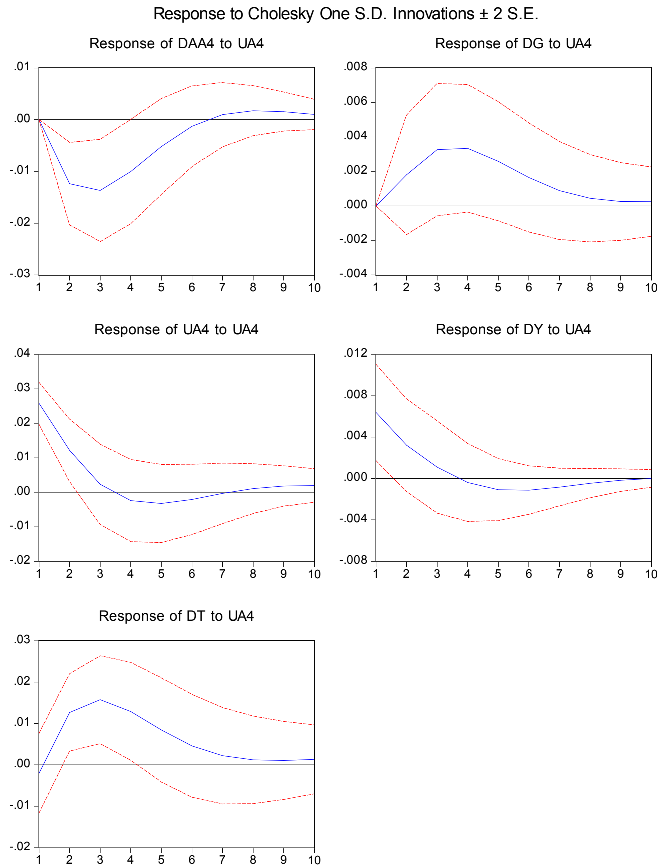


Figure 2 (cont.) – Impulse-response functions, Sweden

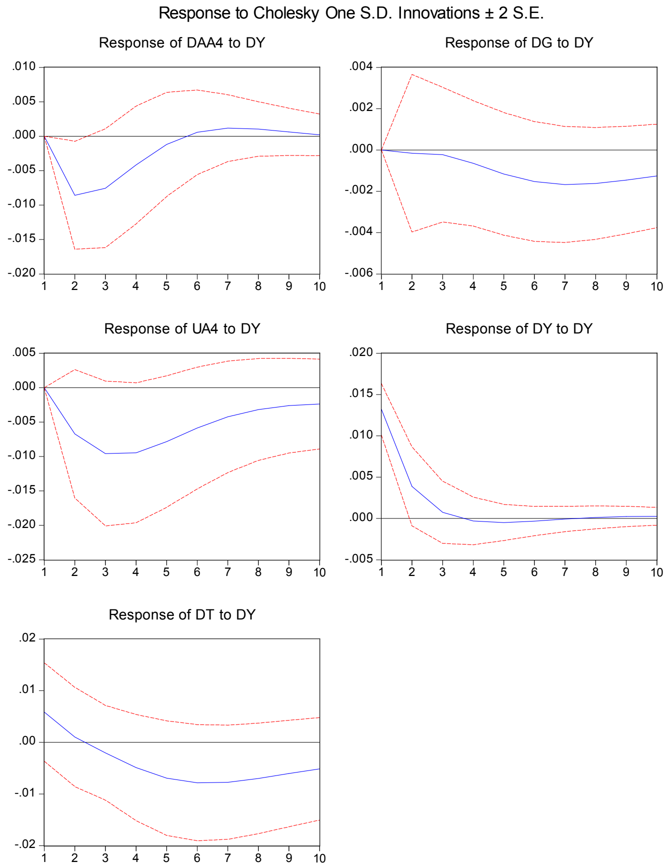
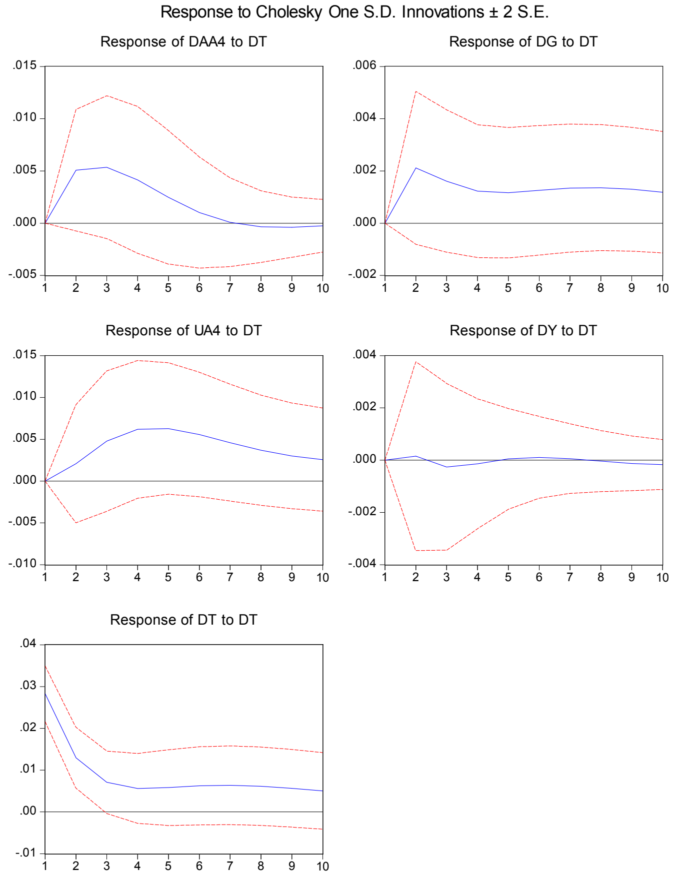
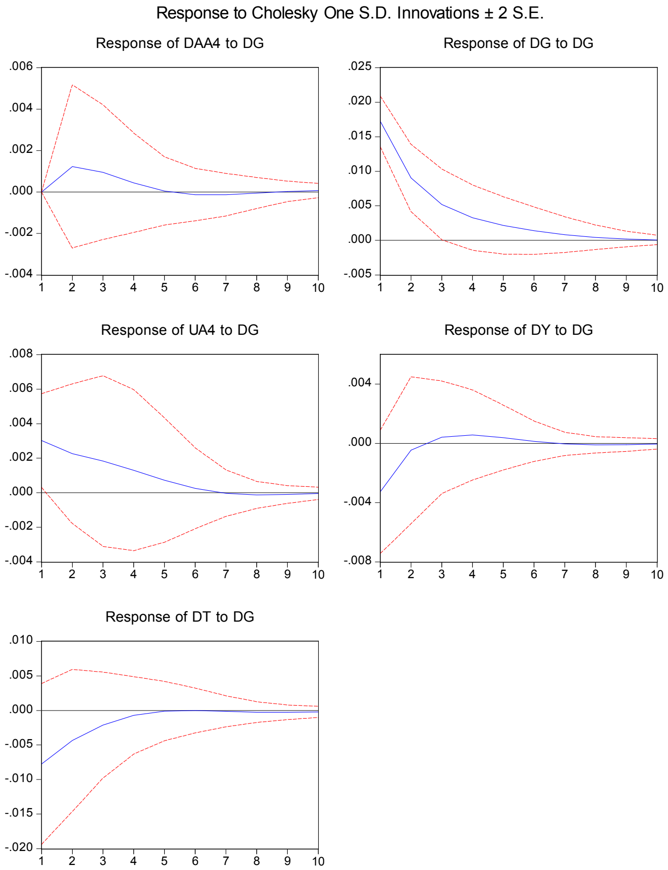
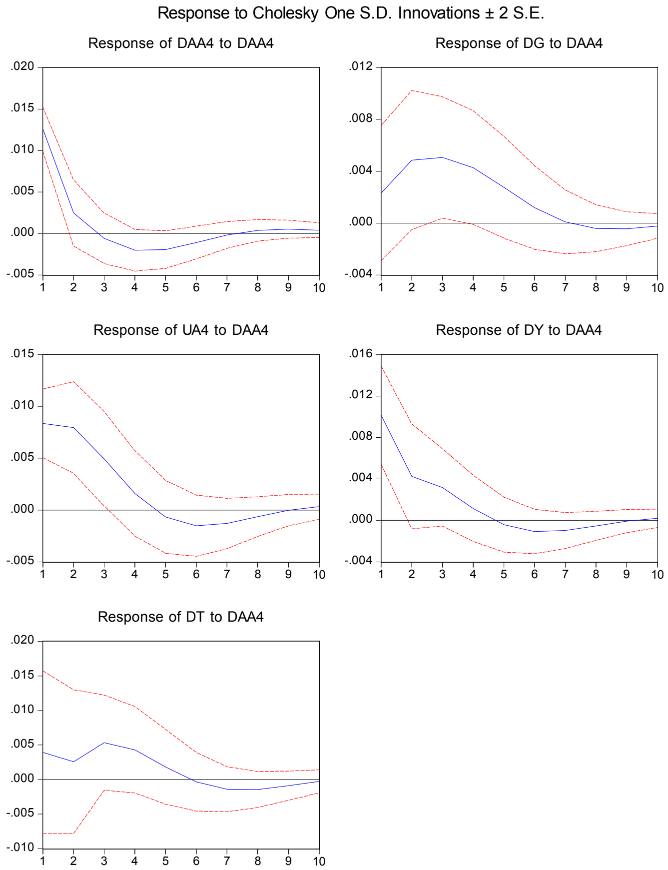
2d – income shock	2e – revenue
	

Figure 3 – Impulse-response functions, U.S.

3a – spending shock	3b – productivity	3c – mark-up





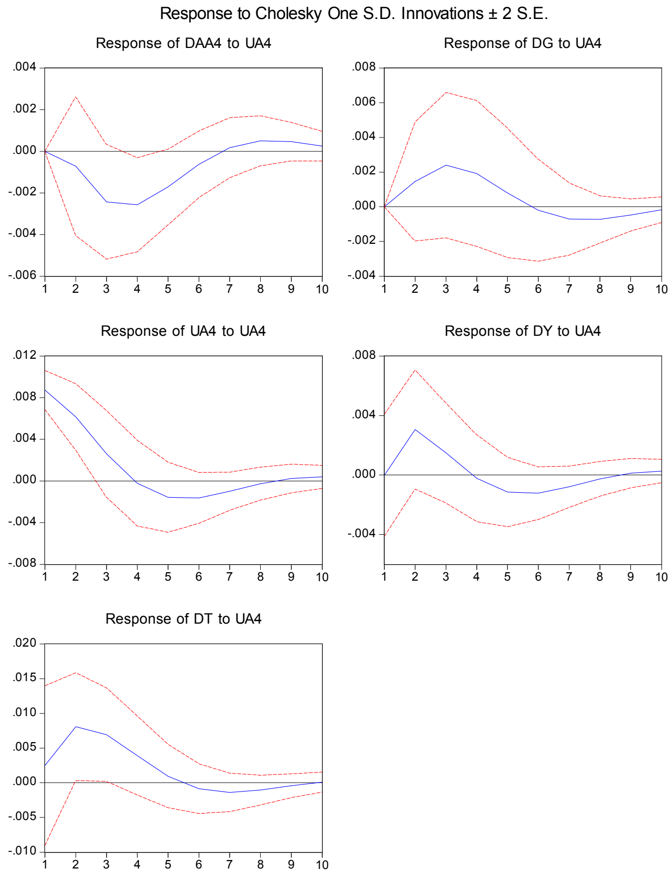
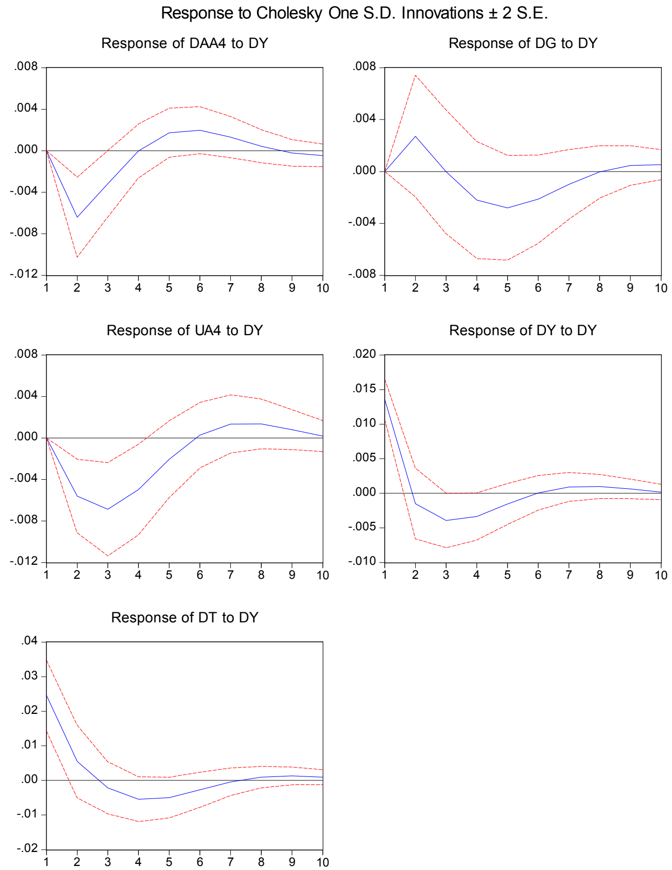
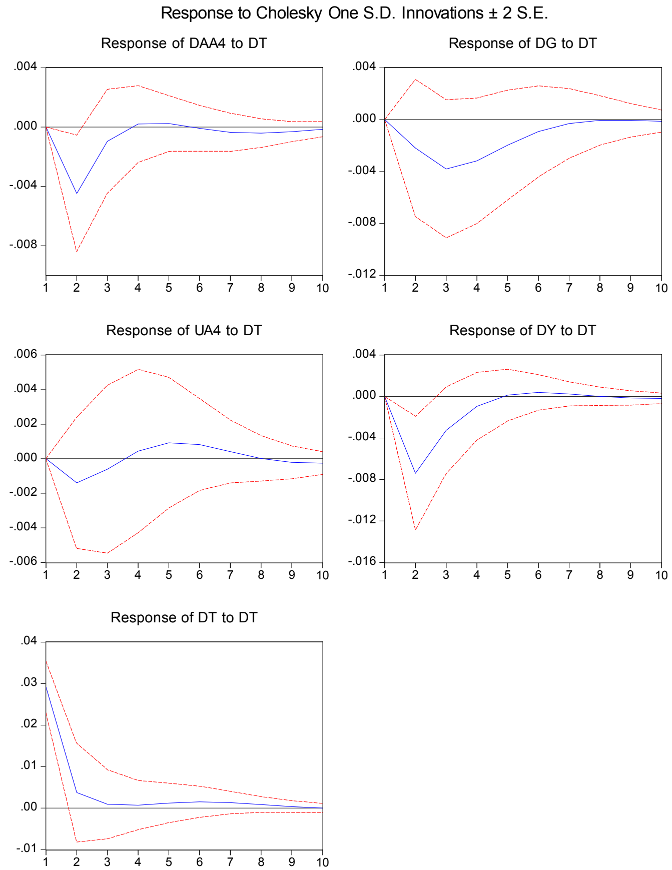


Figure 3 (cont.) – Impulse-response functions, U.S.

3d – income shock	3e – revenue





Appendix

Figure A1

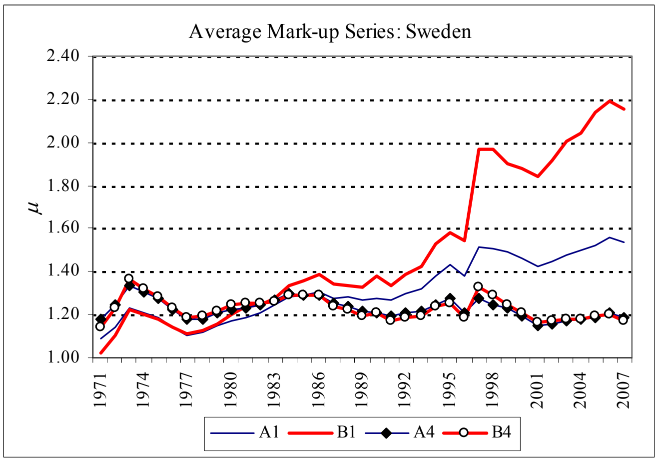


Figure A2

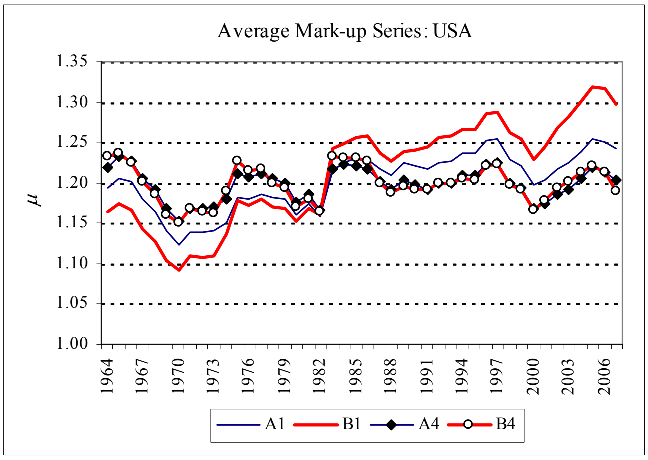


Figure A3

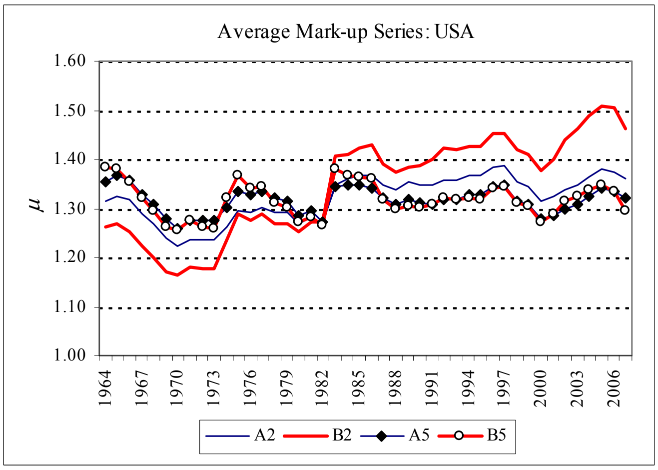


Figure A4