"The Propagation of Monetary Policy Shocks in a Heterogeneous Production Economy"

by

E. Pasten, R. Schoenle, and M. Weber

Discussion by

Francisco Ruge-Murcia

(*McGill University*)

Outline of the Discussion

Brief overview of the paper

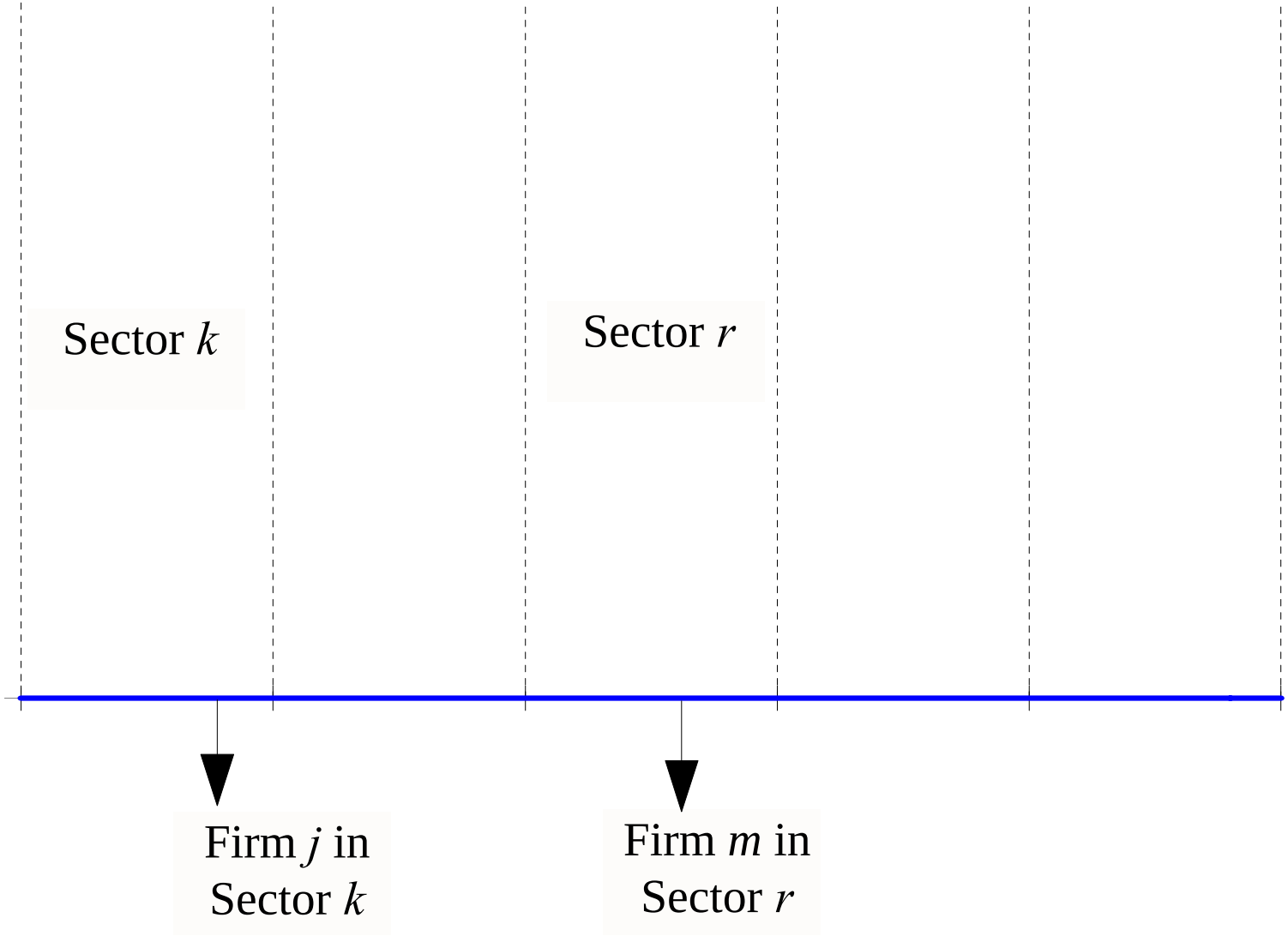
What I liked about this paper

Comments:

- Expenditure shares
- Production function parameters
- The role of capital

Summary

Brief Overview
Sectors and Firms



Brief Overview

Production by firm j in sector k is given by

$$Y_{kjt} = (L_{kjt})^{1-\delta}(Z_{kjt})^{\delta}$$

where

$$Z_{kjt} = \left(\sum_{r=1}^{K}(\omega_k)^{1/\eta}(Z_{kjt}(r))^{(\eta-1)/\eta}\right)^{\eta/(\eta-1)}$$

$$Z_{kjt}(r) = \left((n_r)^{-1/\theta}\int(Z_{kjt}(r,j'))^{(\theta-1)/\theta}\right)^{\theta/(\theta-1)}$$

with $\eta < \theta$

$\eta < \theta$ means that the elasticity of substitution across sectors is smaller than within sectors

Brief Overview

Sectors interact with each following the U.S. Input-Output tables

Some Columns of the 1992 Use Table
Column = Consumer, Row = Producer

	1	10	12	13	14	15	20	21	22	23
1	0.39	0.00	0.00	0.00	0.00	0.01	0.38	0.22	0.04	0.00
10	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.27	0.00	0.01	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.09	0.01	0.00	0.00	0.00	0.00
15	0.02	0.03	0.01	0.04	0.02	0.00	0.01	0.01	0.01	0.01
20	0.12	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00
22	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.49	0.58
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05
24	0.00	0.01	0.01	0.00	0.00	0.10	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.01	0.00	0.00	0.00	0.00	0.01	0.05	0.04	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
28	0.08	0.08	0.02	0.02	0.05	0.02	0.01	0.02	0.16	0.04
29	0.03	0.04	0.06	0.01	0.09	0.03	0.00	0.00	0.00	0.00
30	0.01	0.01	0.02	0.00	0.03	0.03	0.03	0.02	0.01	0.03
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
32	0.00	0.01	0.01	0.00	0.00	0.08	0.01	0.00	0.00	0.00
33	0.00	0.05	0.01	0.02	0.03	0.03	0.00	0.00	0.00	0.00
34	0.00	0.02	0.02	0.01	0.01	0.13	0.04	0.00	0.00	0.00
35	0.01	0.07	0.13	0.01	0.16	0.04	0.00	0.00	0.01	0.01
36	0.01	0.00	0.01	0.00	0.01	0.06	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00
40	0.07	0.18	0.18	0.10	0.25	0.05	0.06	0.04	0.06	0.06
50	0.09	0.05	0.08	0.02	0.10	0.15	0.08	0.06	0.07	0.08
60	0.11	0.03	0.07	0.33	0.06	0.03	0.02	0.03	0.02	0.04
70	0.04	0.07	0.08	0.06	0.09	0.19	0.08	0.31	0.09	0.06

Brief Overview

Prices are rigid as in Calvo (1983)

Households consume and supply labor

Monetary policy follows a Taylor rule

What I Liked about This Paper

Interesting question and interesting data

High level of disaggregation (350 sectors!)

Elegant analytical results

Clear intuition obtained by nesting different versions of the model sequentially

Comment 1: Expenditure Shares

The demand function for materials from sector r is

$$Z_{kjt}(r) = \omega_{kr}\left(\frac{P_{rt}}{P_t^k}\right)^{-\eta} Z_{kjt}$$

The equilibrium is not symmetric and, thus, $P_{rt} \neq P_t^k$

This implies that ω_{kr} is the share of the expenditure on goods from sector r by firms in sector k only if $\eta = 1$

$$\omega_{kr} = \frac{Z_{kjt}(r)P_{rt}}{Z_{kjt}P_t^k}$$

Comment 1: Expenditure Shares

In this paper, η is calibrated to be 2

With $\eta = 2$, expenditures shares may not be equal to those implied by the Input-Output table

Comment 2: Production Function Parameters

The production function of a firm j in sector k is

$$Y_{kjt} = (L_{kjt})^{1-\delta}(Z_{kjt})^{\delta}$$

where δ is the same in all sectors

In the calibration, $\delta = 0.5$

This implies:

The share of expenditures on materials is 0.5

The share of expenditures on labor is also 0.5

Comment 2: Production Function Parameters

Consider the more general production function with capital

$$Y_{kjt} = (L_{kjt})^{\nu^k}(K_{kjt})^{\alpha^k}(Z_{kjt})^{\delta^k}$$

where the parameters $\nu^k + \alpha^k + \delta^k = 1$ and vary across sectors

Comment 2: Production Function Parameters

Consider the more general production function with capital

$$Y_{kjt} = (L_{kjt})^{\nu^k}(K_{kjt})^{\alpha^k}(Z_{kjt})^{\delta^k}$$

where the parameters $\nu^k + \alpha^k + \delta^k = 1$ and vary across sectors

Estimate production function parameters using the sectoral KLEM data collected by Dale Jorgenson for the period 1958 to 1996 (see Bouakez et al., 2009, 2014)

These data contains yearly observations on nominal expenditures on capital, labor and material inputs for 35 sectors (roughly two-digit level SIC)

Sectoral Production Functions

Sector	SIC	ν^k	α^k	δ^k
Agriculture	1 – 9	0.261	0.142	0.597
Coal Mining	12	0.432	0.194	0.374
Oil Extraction	13	0.176	0.456	0.368
Construction	15 – 17	0.394	0.052	0.554
Food Products	20	0.161	0.084	0.755
Textiles	22	0.229	0.067	0.704
Oil Refining	29	0.091	0.103	0.806
Electric Machinery	36	0.350	0.127	0.523
Transportation Equip.	37	0.283	0.080	0.637
Transport and Utilities	40 – 49	0.314	0.248	0.437
Trade	50 – 59	0.500	0.148	0.352
FIRE	60 – 67	0.283	0.356	0.361
Other Services	70 – 87	0.427	0.195	0.378

Observations Based on these Estimates

The calibration $\delta = 0.5$ is reasonable, but it ignores substantial heterogeneity in materials input intensity across sectors

Sectoral Production Functions

Sector	SIC	ν^k	α^k	δ^k
Agriculture	1 – 9	0.261	0.142	0.597
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Observations Based on these Estimates

The calibration $1 - \delta = 0.5$ overstates the importance of labor in most sectors

Sectoral Production Functions

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Coal Mining	12	0.432	0.194	0.374
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Observations Based on these Estimates

Key issue: The production function abstracts from capital

Sectoral Production Functions

Sector	SIC	ν^k	α^k	δ^k
Agriculture	1 – 9	0.261	0.142	0.597
Coal Mining	12	0.432	0.194	0.374
Oil Extraction	13	0.176	0.456	0.368
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Other Services	70 – 87	0.427	0.195	0.378

Comment 3: **Capital Matters**

The effect of a monetary policy shock via capital accumulation amplifies its real effects

Capital producing sectors interact with (in particular, sell to) all sectors of the economy

Ignoring capital may (or may not) affect conclusions about aggregates, but it has big implications for sectoral variables

Some Columns of the 1992 Use Table
Column = Consumer, Row = Producer

	1	10	12	13	14	15	20	21	22	23
1	0.39	0.00	0.00	0.00	0.00	0.01	0.38	0.22	0.04	0.00
10	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.27	0.00	0.01	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.09	0.01	0.00	0.00	0.00	0.00
15	0.02	0.03	0.01	0.04	0.02	0.00	0.01	0.01	0.01	0.01
20	0.12	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00
22	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.49	0.58
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05
24	0.00	0.01	0.01	0.00	0.00	0.10	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.01	0.00	0.00	0.00	0.00	0.01	0.05	0.04	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
28	0.08	0.08	0.02	0.02	0.05	0.02	0.01	0.02	0.16	0.04
29	0.03	0.04	0.06	0.01	0.09	0.03	0.00	0.00	0.00	0.00
30	0.01	0.01	0.02	0.00	0.03	0.03	0.03	0.02	0.01	0.03
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
32	0.00	0.01	0.01	0.00	0.00	0.08	0.01	0.00	0.00	0.00
33	0.00	0.05	0.01	0.02	0.03	0.03	0.00	0.00	0.00	0.00
34	0.00	0.02	0.02	0.01	0.01	0.13	0.04	0.00	0.00	0.00
35	0.01	0.07	0.13	0.01	0.16	0.04	0.00	0.00	0.01	0.01
36	0.01	0.00	0.01	0.00	0.01	0.06	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00
40	0.07	0.18	0.18	0.10	0.25	0.05	0.06	0.04	0.06	0.06
50	0.09	0.05	0.08	0.02	0.10	0.15	0.08	0.06	0.07	0.08
60	0.11	0.03	0.07	0.33	0.06	0.03	0.02	0.03	0.02	0.04
70	0.04	0.07	0.08	0.06	0.09	0.19	0.08	0.31	0.09	0.06

Some Colums of the 1992 Capital Flow Table
Column = Consumer, Row = Producer

	1	10	12	13	14	15	20	21	22	23
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.01	0.08	0.68	0.02	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.18	0.43	0.36	0.12	0.14	0.01	0.24	0.22	0.18	0.25
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
25	0.00	0.01	0.00	0.00	0.01	0.03	0.02	0.02	0.01	0.05
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.01	0.00	0.00	0.01	0.00	0.01	0.03	0.01	0.01	0.02
35	0.40	0.26	0.34	0.08	0.44	0.30	0.36	0.34	0.65	0.37
36	0.00	0.01	0.01	0.00	0.01	0.05	0.02	0.04	0.01	0.04
37	0.12	0.14	0.13	0.05	0.21	0.33	0.12	0.17	0.03	0.13
38	0.04	0.05	0.01	0.03	0.02	0.05	0.04	0.07	0.01	0.02
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.02	0.01	0.01	0.00	0.02	0.03	0.01	0.00	0.01	0.01
50	0.19	0.07	0.02	0.02	0.10	0.14	0.11	0.08	0.06	0.08
60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70	0.03	0.00	0.04	0.01	0.03	0.03	0.04	0.04	0.03	0.03

Comment 3: **Capital Matters**

In order to explore the importance of capital, let me consider a more general model with capital and heterogenous production function parameters (Bouakez et al., 2009)

Number of sectors $=$ 6

The more general model also has heterogenous price rigidity, but modeled as a quadratic adjustment cost

Sectoral Production Functions

Sector	ν^j	α^k	δ^k
Agriculture	0.261	0.142	0.597
Mining	0.243	0.380	0.377
Construction	0.394	0.052	0.554
Durable manufacturing	0.321	0.100	0.579
Nondurable manufacturing	0.225	0.113	0.662
Services	0.399	0.222	0.379

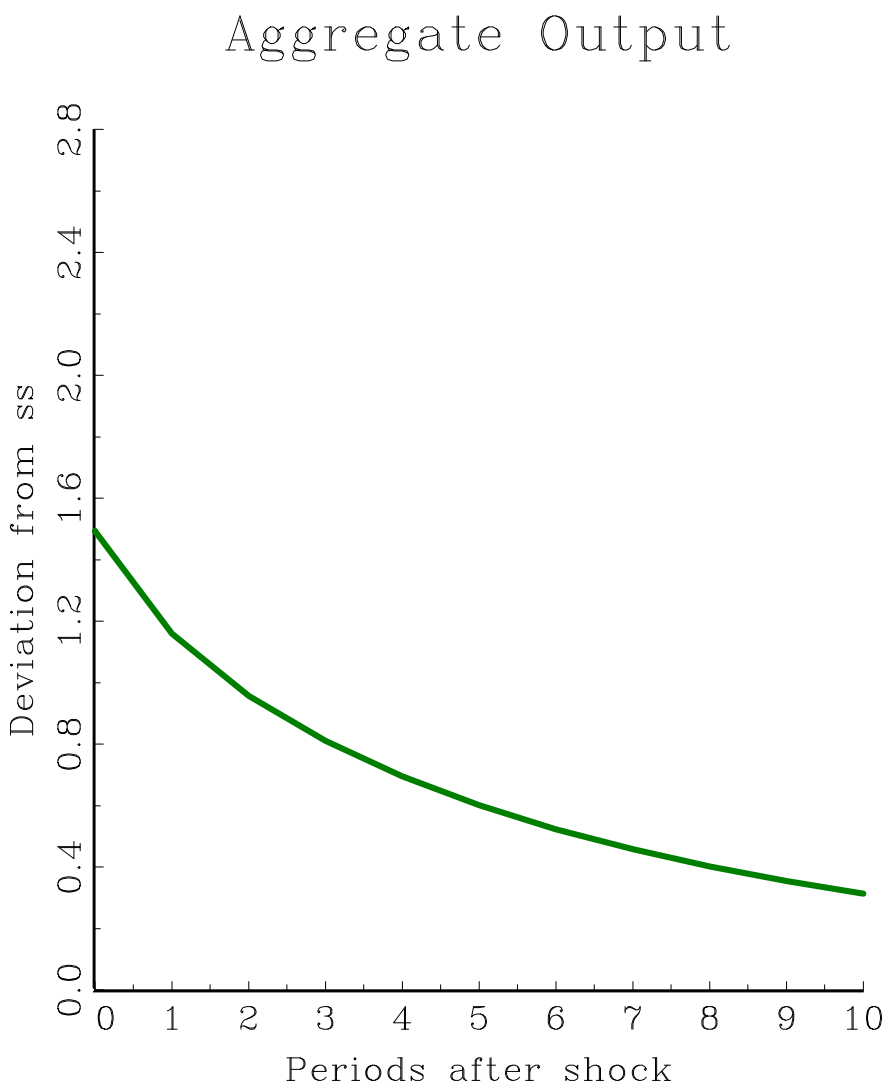
Notes: Taken from Bouakez et al. (2009)

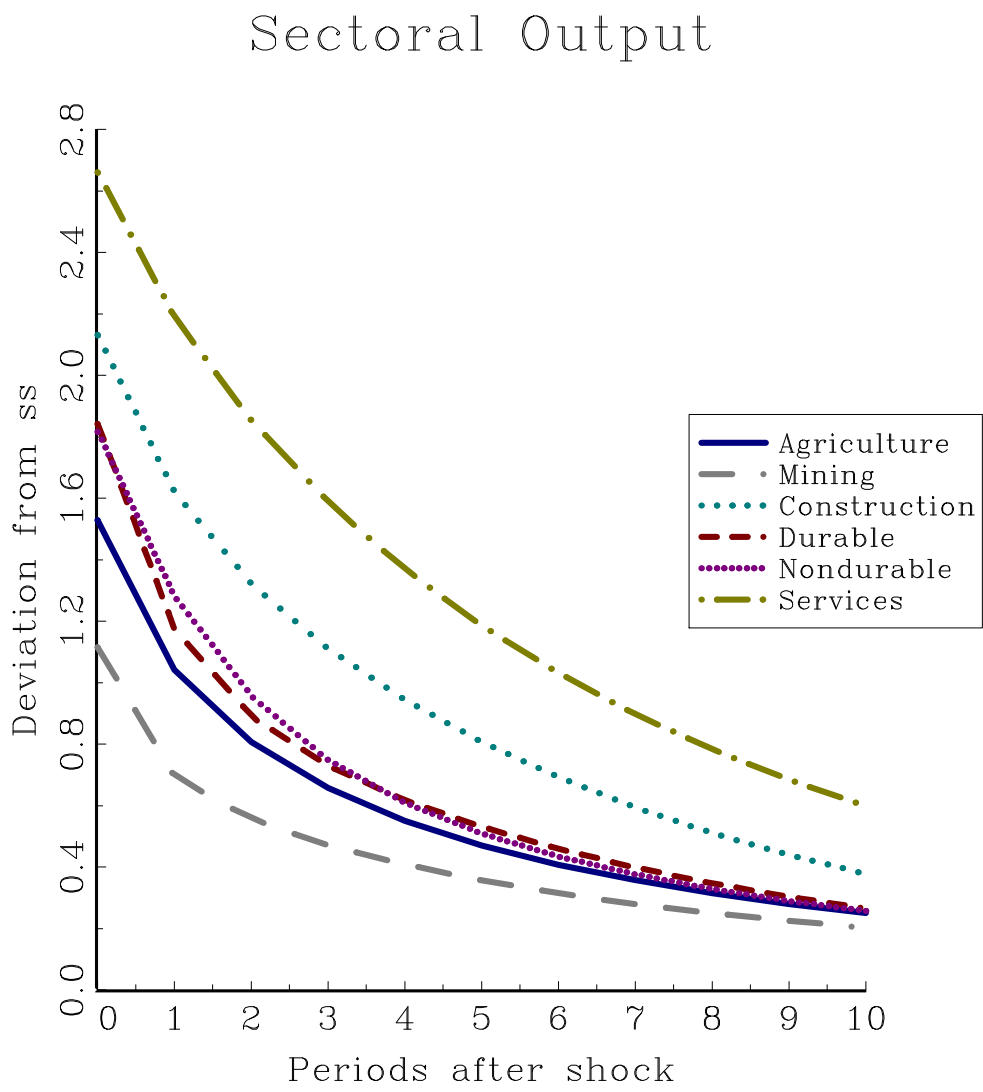
Price Rigidity in a Six-Sector Economy

Sector	Estimate	s.e.
Agriculture	0.90	(1.90)
Mining	2.08	(1.35)
Construction	0.01	(1.26)
Durable manufacturing	4.24	(7.50)
Nondurable manufacturing	19.99*	(4.79)
Services	500.23*	(16.93)

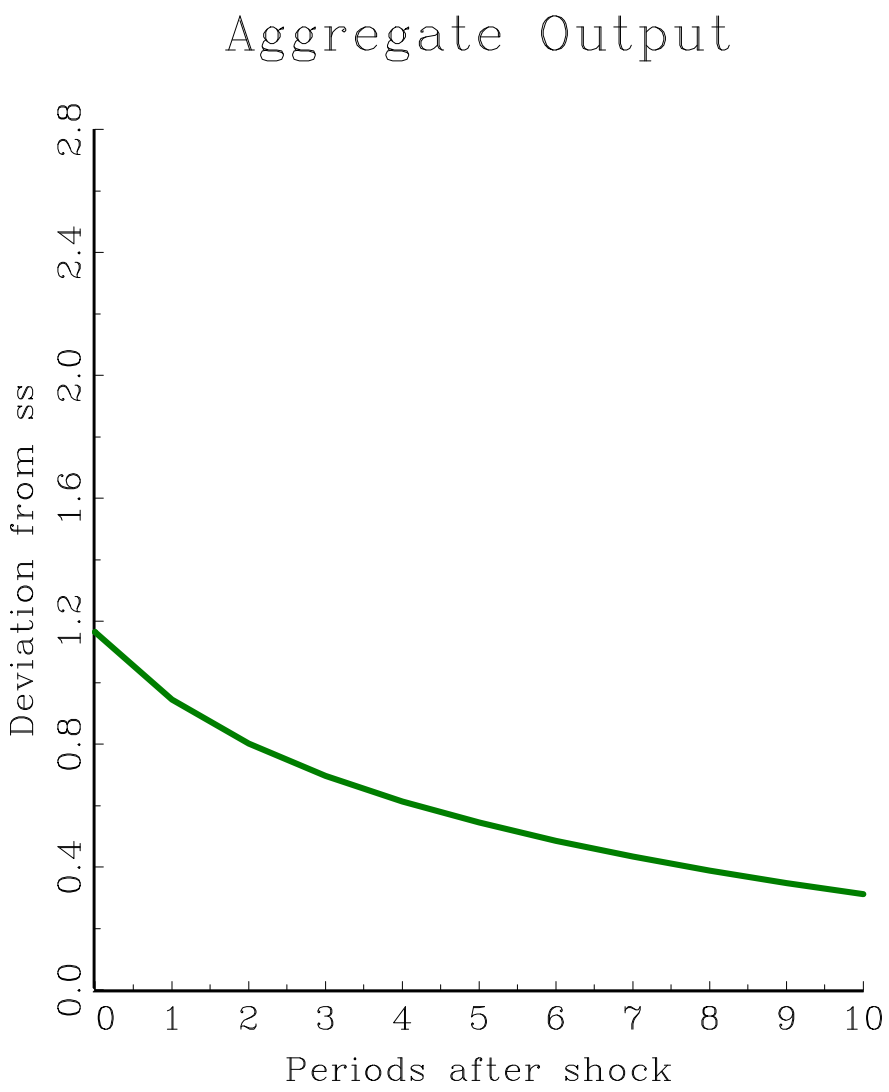
Notes: The table reports estimate of sectoral price rigidity in a specification where rigidity takes the form $\Phi_t^j = (\phi^j/2)\left(p_t^j/(\pi_{ss}p_{t-1}^j) - 1\right)^2$. Taken from Bouakez et al. (2009)

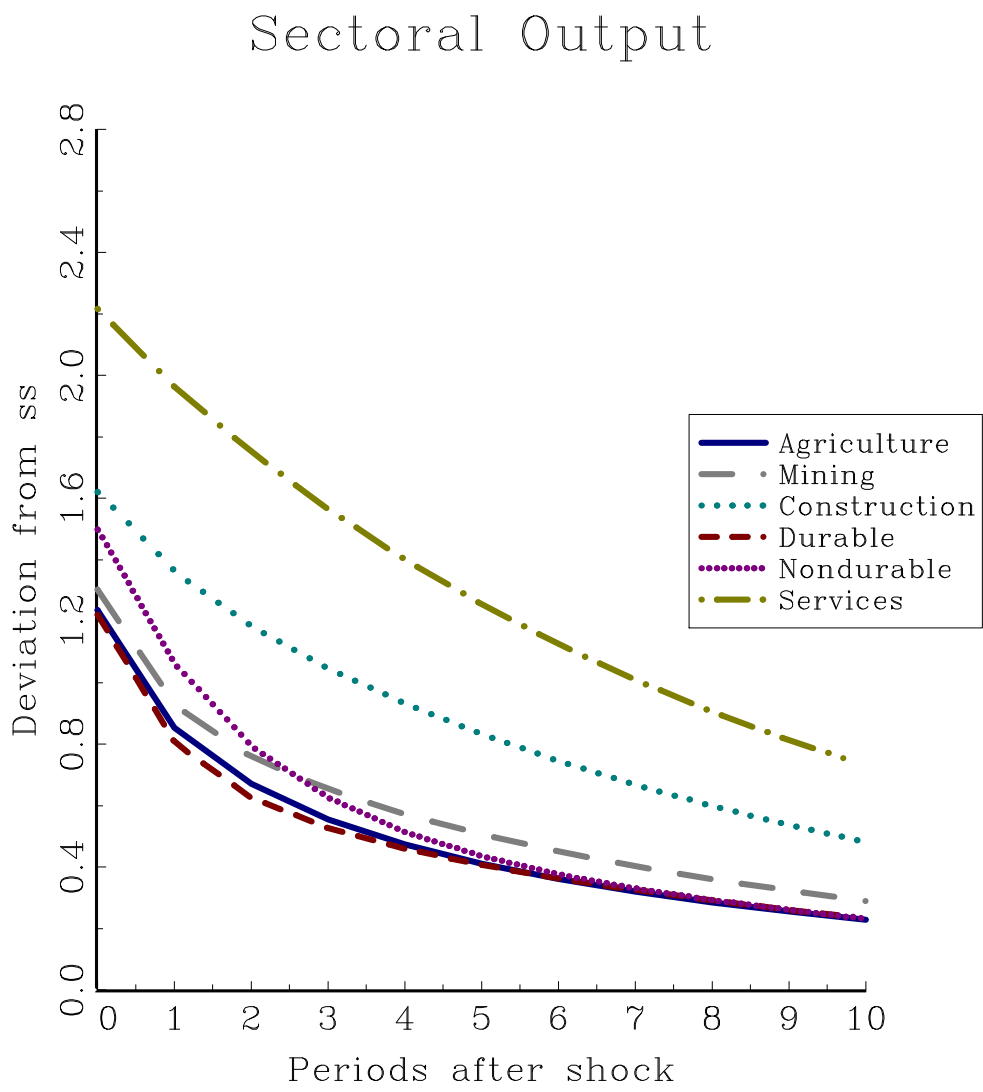
Effect of a Monetary Policy Shock on Output
Model with Capital



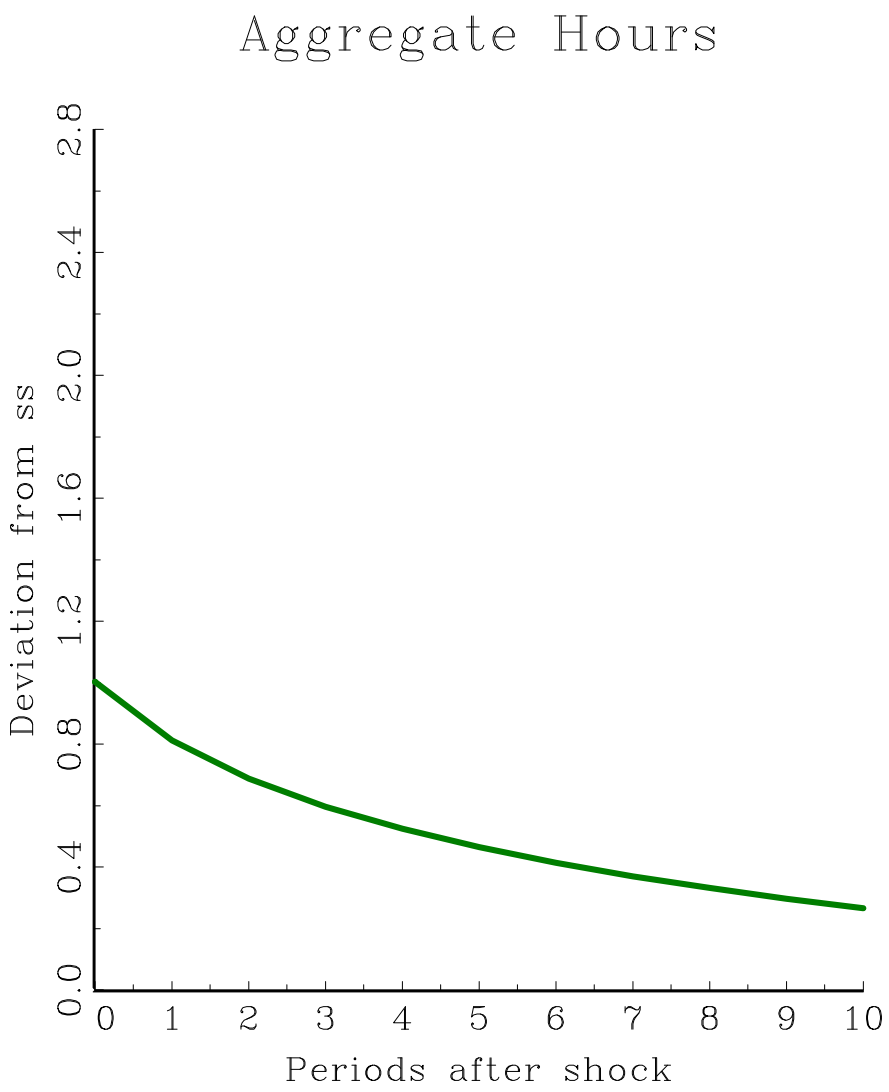


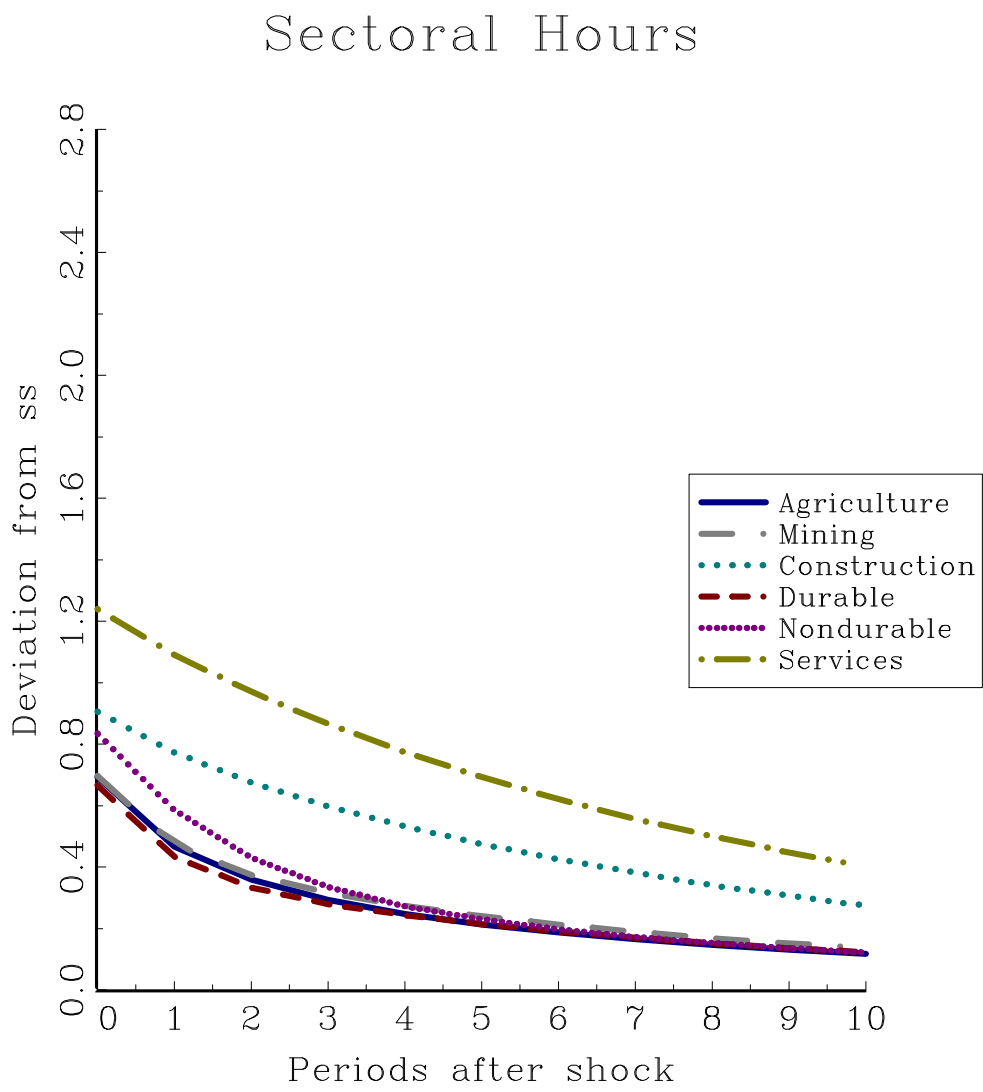
Effect of a Monetary Policy Shock on Output
Model without Capital



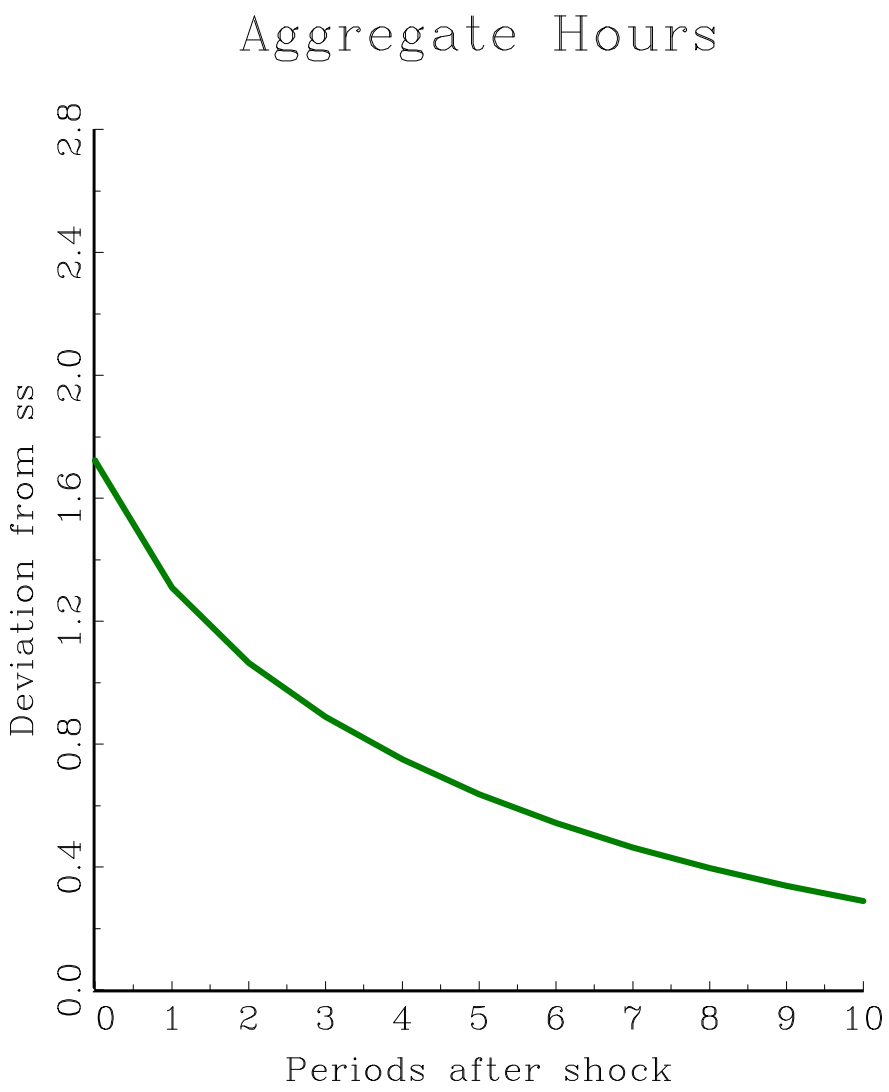


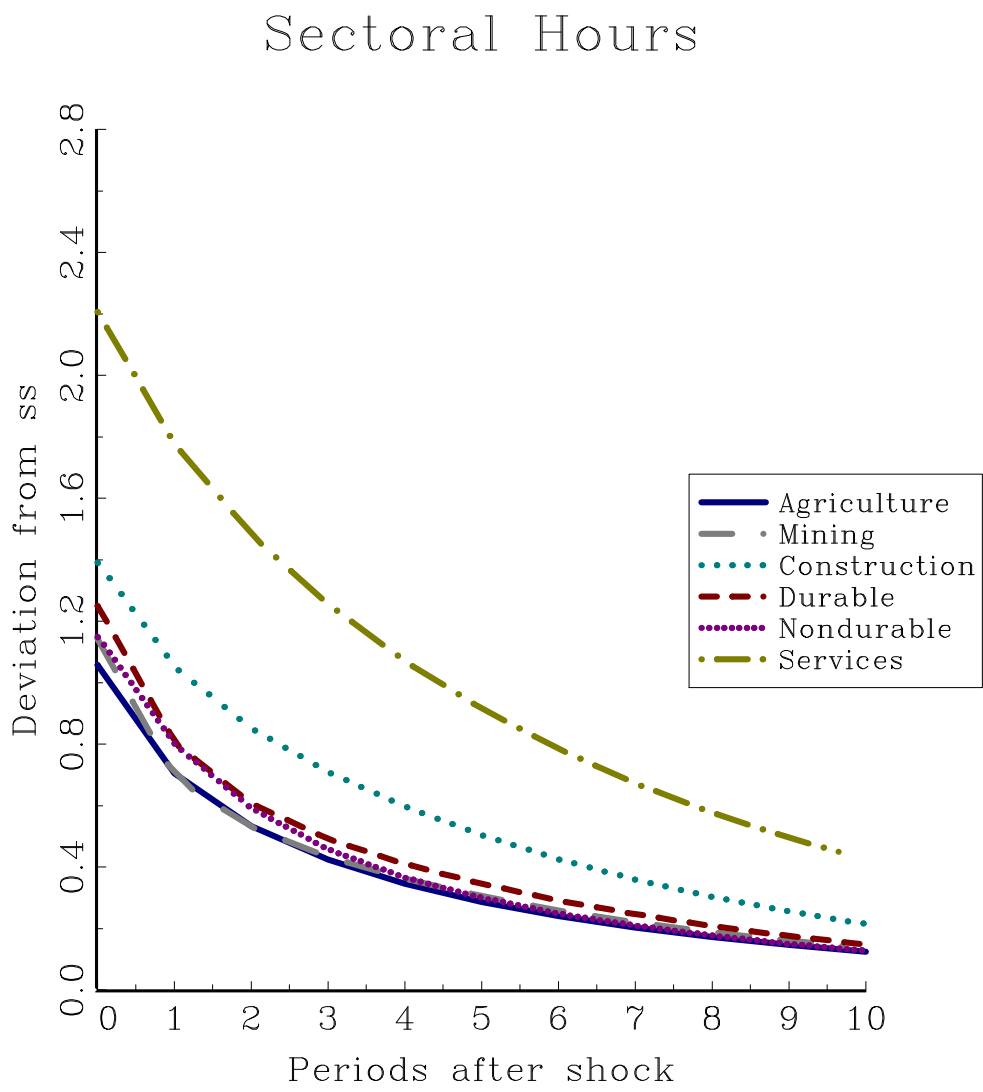
Effect of a Monetary Policy Shock on Hours Worked
Model with Capital



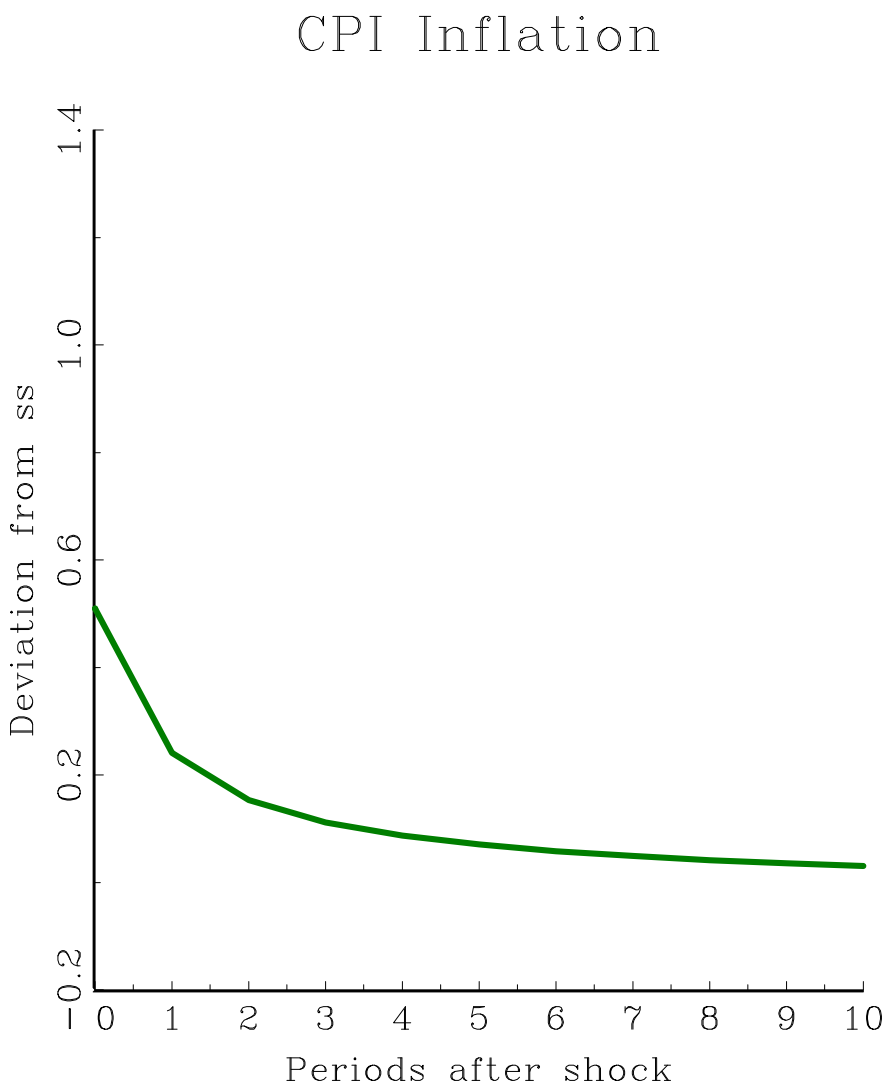


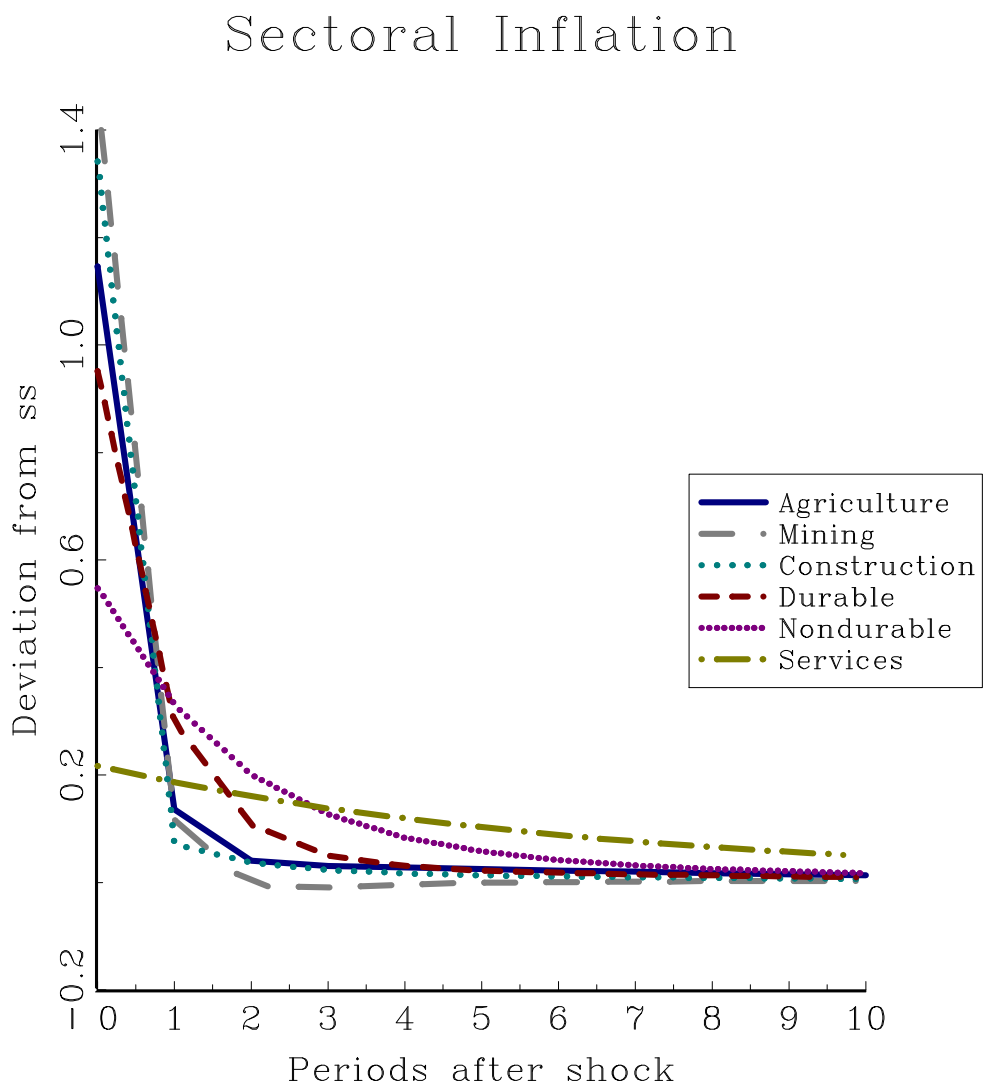
Effect of a Monetary Policy Shock on Hours Worked
Model without Capital



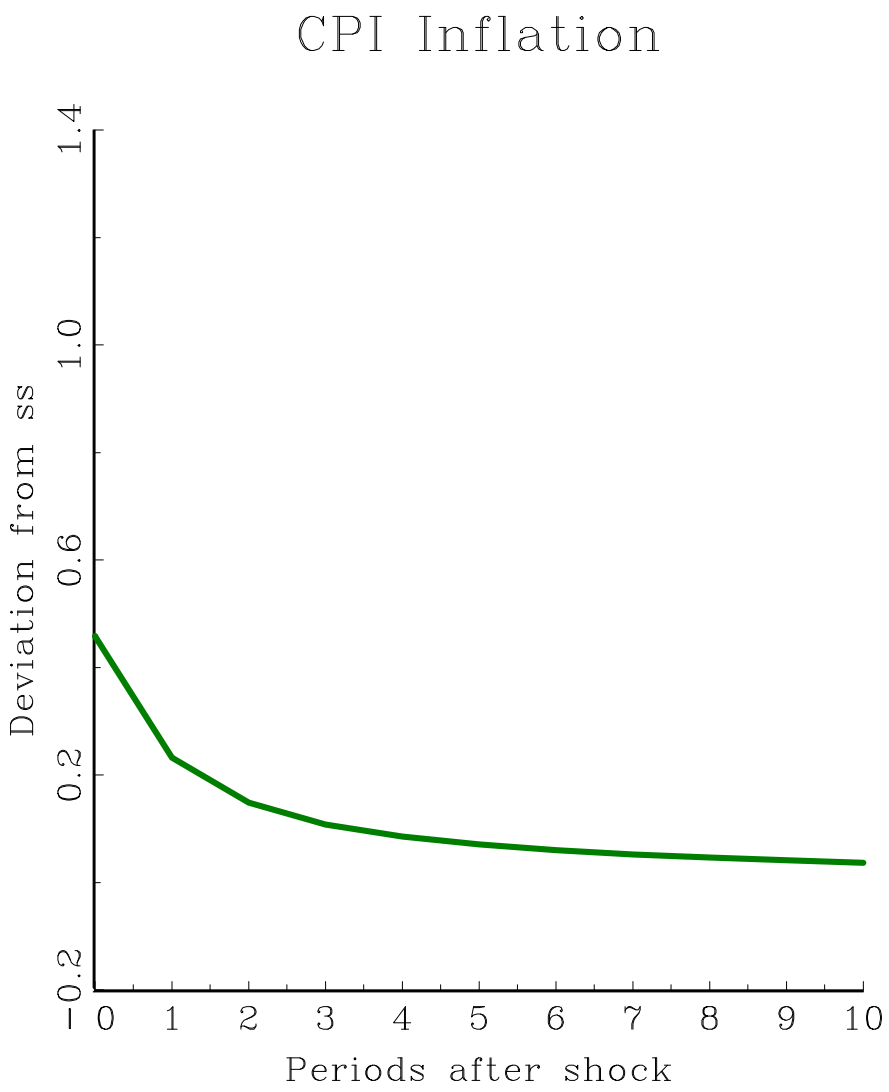


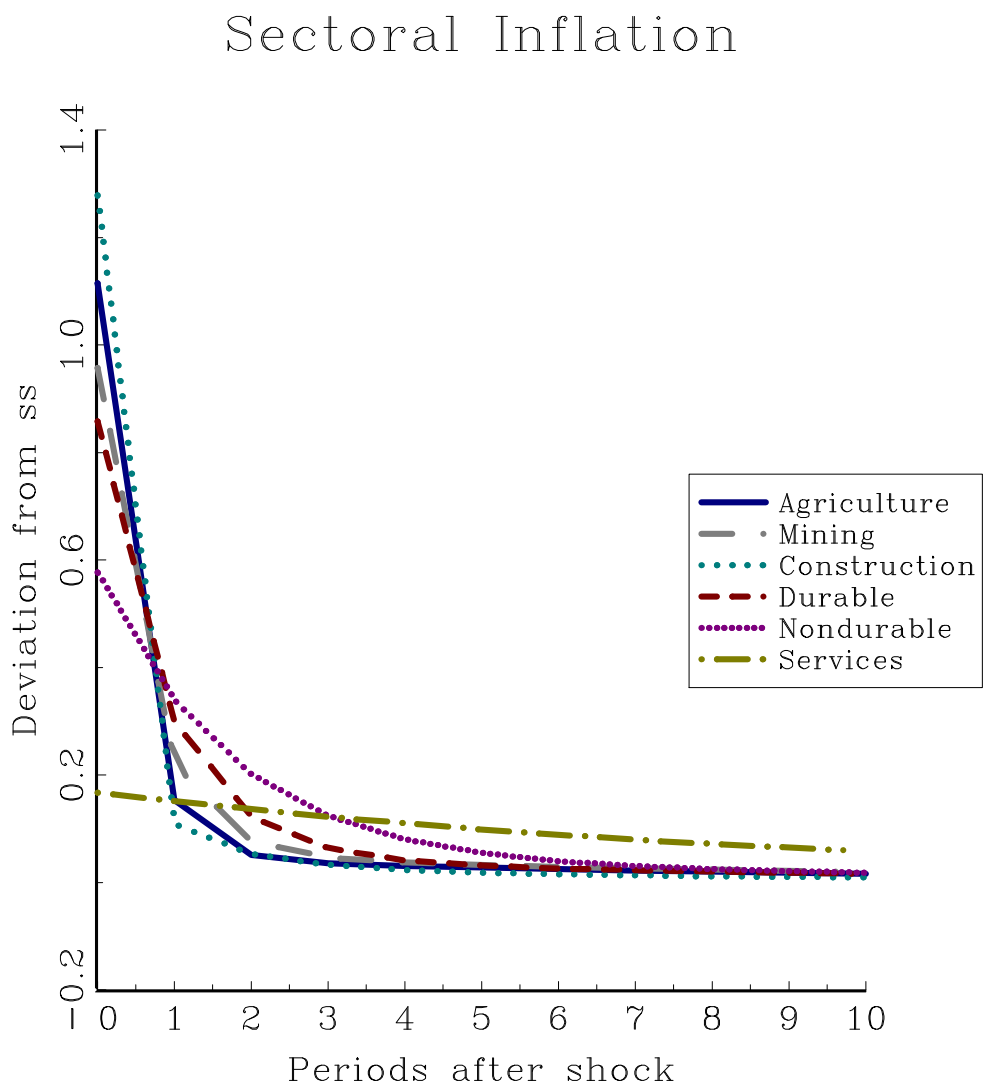
Effect of a Monetary Policy Shock on Inflation
Model with Capital





Effect of a Monetary Policy Shock on Inflation
Model without Capital





Summary

Promising research project

Aggregate implications of the heterogeneity in price rigidity are quantitatively interesting

The high level of disaggregation allows the detailed study of the sectoral effects of monetary policy shocks, but great realism is required