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Nominal Rigidities, Monetary Policy and Pigou Cycles: On-line Appendix

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A. Data Sources

With the following exceptions, all data were downloaded from the Bureau of Economic Analysis's web site, http://www.bea.gov/iTable/iTable.cfm?ReqID=9&step=1: the Federal funds rate was obtained from the Board of Governors of the Federal Reserve System, and the 16+ population from the U.S. Census Bureau. More details on the data sources are contained in Table 1. Manipulations of the data are summarised in Table 2.

Total sectoral hours are computed as the product of sectoral employment and average hours worked in that sector. Sectoral average labour productivity is calculated as sectoral output divided by total sectoral hours. Sectoral average labour productivity is detrended by running a linear regression of the logarithm of sectoral average labour productivity against a time trend. Output is similarly detrended.

Table 1: Data sources

Mnemonic	Description
GCN	nominal personal consumption of non-durable goods
GCS	nominal personal consumption of service
GCD	nominal personal consumption of durable goods
GDP	nominal gross domestic product
PDGDP	price index for GDP
PDGCN	price index for the personal consumption of non-durable goods
PDGCS	price index for the personal consumption of service
PDGCD	price index for the personal consumption of durable goods
P16	population above 16 years old

Table 2: Matching the data to the model

Description	Variable	Calculation
Aggregate output	Y_t	(GDP/PDGDP)/P16
Nondurable output	Y_{ct}	(GCN/PDGCN+GCS/PDGCS)/P16
Durable output	Y_{dt}	(GCD/PDGCD)/P16
Inflation rate		$\log(\text{PDGDP}_t/\text{PDGDP}_{t-1})$
Interest rate		Federal funds rate

B. Summary of Equations Describing the Model Equilibrium

The Euler equations are

$$q_t U_c\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right) = U_d\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right) + \beta E_t\left\{q_{t+1} U_c\left(C_{t+1}, D_{t+1}, N_{t+1}, \frac{M_{t+1}}{P_{t+1}}\right)(1-\delta)\right\}, \tag{1}$$

$$\frac{U_c\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right)}{P_{c,t}} = \beta E_t\left\{R_t \frac{U_c\left(C_{t+1}, D_{t+1}, N_{t+1}, \frac{M_{t+1}}{P_{t+1}}\right)}{P_{c,t+1}}\right\}, \tag{2}$$

$$U_n\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right) + \frac{W_t}{P_{c,t}} U_c\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right) = 0, \tag{3}$$

$$\frac{U_c\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right)}{P_{c,t}} = \frac{U_m\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right)}{P_t} + \beta E_t\left\{\frac{U_c\left(C_{t+t}, D_{t+t}, N_{t+t}, \frac{M_{t+t}}{P_{t+t}}\right)}{P_{c,t+1}}\right\}, \tag{4}$$

where $q_t \equiv P_{dt}/P_{ct}$ is the price of durables relative to nondurables. Eq. (1) is the durables accumulation equation, trading off the benefits of an additional unit of durables against its cost in foregone nondurable consumption. Eq. (2) determines the accumulation of bonds. Eq. (3) governs the labour-leisure choice. Finally, Eq. (4) is the money accumulation equation.

The full set of equations for the model are:

$$
\begin{aligned}
\upsilon N_t^{\sigma} &= U_c\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right)\hat{W}_t/\hat{P}_{ct} \\
q_t U_c\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right) &= U_d\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right) + \beta E_t\left\{q_{t+1}U_c\left(C_{t+1}, D_{t+1}, N_{t+1}, \frac{M_{t+1}}{P_{t+1}}\right)(1-\delta)\right\} \\
U_c\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right) &= \beta E_t\left\{R_t\frac{U_c\left(C_{t+1}, D_{t+1}, N_{t+1}, \frac{M_{t+1}}{P_{t+1}}\right)}{\pi_{c,t+1}}\right\} \\
U_c\left(C_t, D_t, N_t, \frac{M_t}{P_t}\right) &= \beta E_t\left\{\frac{U_c\left(C_{t+1}, D_{t+1}, N_{t+1}, \frac{M_{t+1}}{P_{t+1}}\right)}{\pi_{c,t+1}}\right\} + \chi\hat{P}_{ct}\hat{M}_t^{-\mu} \\
P1_{j,t} &= \omega_j\beta\left(\frac{\pi_{t+1}}{\pi}\right)^{\varepsilon_j} P1_{j,t+1} + U_c(C_t, D_t, N_t)MC_{j,t}Y_{j,t}\hat{P}_{j,t}^{\varepsilon_j}/\hat{P}_{c,t} \\
P2_{j,t} &= \omega_j\beta\left(\frac{\pi_{t+1}}{\pi}\right)^{\varepsilon_j-1} P2_{j,t+1} + U_c(C_t, D_t, N_t)Y_{j,t}\hat{P}_{j,t}^{\varepsilon_j}/\hat{P}_{c,t} \\
\hat{P}_{j,t}^* &= \frac{P1_{j,t}}{P2_{j,t}} \\
\hat{P}_{j,t} &= \left[(1-\omega_j)(\hat{P}_{j,t}^*)^{1-\varepsilon_j} + \omega_j(\hat{P}_{j,t-1}\pi/\pi_t)^{1-\varepsilon_j}\right]^{\frac{1}{1-\varepsilon_j}} \\
MC_{j,t} &= \frac{\hat{W}_t}{A_{j,t}} \\
(\hat{P}_{c,t}C_t + \hat{P}_{d,t}I_t)/(C_t + I_t) &= 1 \\
A_{c,t}N_{c,t} &= s_{c,t}C_t \\
A_{d,t}N_{d,t} &= s_{d,t}(D_t - (1-\delta)D_{t-1}) \\
s_{j,t} &= (1-\omega_j)\left(\frac{\hat{P}_{j,t}^*}{\hat{P}_{j,t}}\right)^{-\varepsilon_j} + \omega_j\left(\frac{\pi}{\pi_{j,t}}\right)^{-\varepsilon_j} s_{j,t-1} \\
N_t &= N_{c,t} + N_{d,t} \\
I_t &= D_t - (1-\delta)D_{t-1} \\
Y_t &= C_t + q_t I_t \\
q_t &= \hat{P}_{d,t}/\hat{P}_{c,t} \\
\ln(A_{j,t}) &= \rho_j\ln(A_{j,t-1}) + \varepsilon_{j,t-p} + \zeta_{j,t} \\
\ln(R_t) &= \ln R^* + \rho_\pi(\ln\pi_t - \ln\pi) + \rho_y(\ln Y_t - \ln Y) + e_t
\end{aligned}
$$

Nominal variables are normalised by dividing the aggregate price P_t, that is, $\hat{M}_t = M_t/P_t$, $\hat{W}_t = W_t/P_t$, $\hat{P}_{j,t} = P_{j,t}/P_t$, $\hat{P}_{j,t}^* = P_{j,t}^*/P_t$.

C. Detailed Discussion of the Benchmark Estimation

C.1. Calibrated Parameters

As in Rotemberg and Woodford (1992) and Ireland (2001), the elasticity of demand for final goods, is set to 6 so that the steady-state markup of retail price over intermediate goods price is 20%. The parameter μ, which governs the curvature of preferences over real money balances, is set to 2.56 so that the interest elasticity of money demand is 0.39, the value estimated by Chari *et al.* (2000). The parameter χ, which scales real money balances in preferences, is set to 0.0001 so that the ratio of real money balance to output is equal to 0.13, a value consistent with the ratio of M1 to GDP measured using postwar U.S. data.

C.2. Estimated Parameters

The prior distribution of the model's parameters are formed following the practice in the Bayesian estimation literature. The prior over the elasticity of substitution between durables and non-durables is a gamma with mean 0.2 and standard deviation 0.05. The mean is the same value estimated by Beaudry and Portier (2004). The priors over the coefficients in the interest rate rule are gamma, as in Lubik and Schorfheide (2006) and Smets and Wouters (2007), and centred on conventional values for the Taylor rule. Priors for the autoregressive parameters in the two sectors are beta with mean 0.7 and standard deviation 0.05. Schmitt-Grohé and Uribe (ming) use the same distribution and mean, but a more dispersed prior. Gamma distributions are chosen for the priors over the shocks. As Schmitt-Grohé and Uribe (ming) point out, the use of a gamma distribution, rather than the more usual inverse gamma, allows for positive density at zero, and so allowing for the possibility that some of the shocks simply do not matter. For the standard deviations of the technology shocks, the means are set to 0.05 and the standard deviations to 0.025. The mean for the standard deviation of the monetary policy shock is smaller, 0.01.

Finally, we come to the correlations among the innovations to the shocks. Theory predicts that the monetary policy shocks should be uncorrelated with the other shocks, so this restriction is imposed.[1] Of the remaining six correlations, only two are allowed to be non-zero: the correlation between the two news shocks, and between the two contemporaneous shocks. The priors over these four correlations are normally distributed with means of zero and standard deviations of 0.3.

Figure 1 plots the prior and posterior distributions; see the paper for the means and 90% confidence intervals of the posterior distributions of the model's parameters. The posterior for the elasticity of substitution between durables and nondurables, η, is 0.2563 which means that durables and nondurables are complements in utility. This value is larger than that estimated by Beaudry and Portier (2004), 0.2; an implication is that the estimated value allows more substitution between durables and nondurables than Beaudry and Portier. Table 10 reveals that estimation of this parameter is sensitive to the prior distribution. In Table 10, the prior for η is uniform with a mean of 0.99 (close to the Cobb-Douglas case). The posterior mean is around 0.85, much higher than estimated for the benchmark model (see the paper).

The policy parameters are estimated to be slightly lower than their prior means, but are nonetheless close to those estimated by Taylor (1993) and Clarida *et al.* (2000). Raising the prior mean on the coefficient on inflation or lowering that on output has little effect on the estimated parameters; see Tables 7 and 8.

The level of technology is estimated to be quite persistent. Nondurable sector total factor productivity has an autoregressive parameter of 0.9248 while that for durable sector productivity is 0.9289. Both estimates are fairly close to the conventional value used in the real business cycle literature, 0.95. Table 9 provides estimates under more dispersed priors for these autoregressive parameters. For both parameters, looser priors result in somewhat higher values.

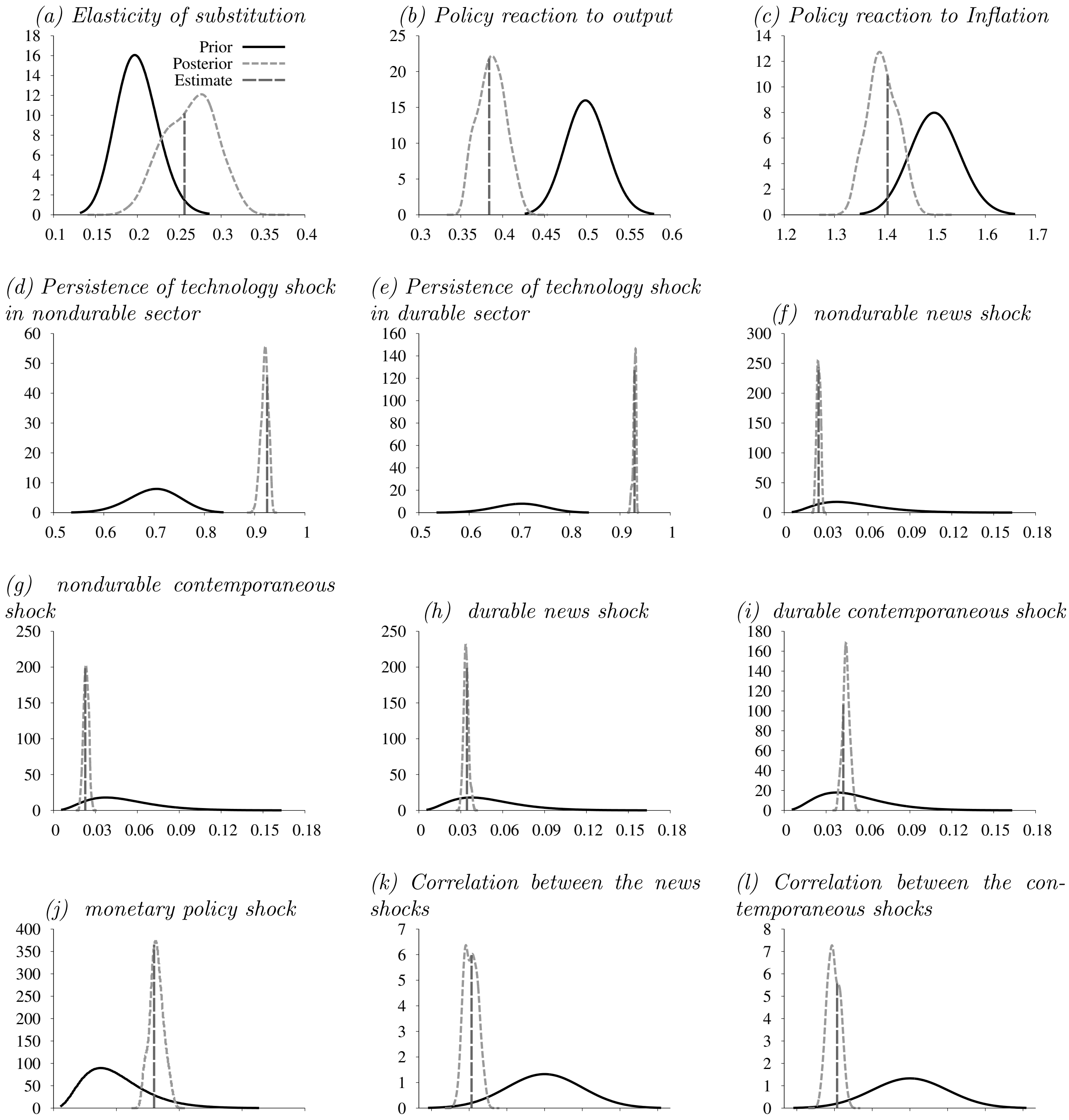
In both sectors, the standard deviation of the news shock is estimated to be smaller than that of the contemporaneous shock. The volatility of the durable sector shocks are considerably higher than the nondurable sector shocks. Since the durable sector is considerably smaller than the non-durable sector, durable sector shocks have a relatively small effect on aggregate output. Table 11 re-estimates the model imposing a prior with a much lower mean on the standard deviations of the contemporaneous shocks; Table 12 repeats the exercise for news shocks. In both cases, the model's estimates are little changed.

[1]Unconstrained estimation reveals that these correlations are insignificantly different from zero.

Turn next to the correlations between the shocks. Recall that the priors over these correlations are quite disperse, allowing the data to speak more forcefully. The correlation between the two news shocks is large and negative (-0.5811), as is that between the two contemporaneous shocks (-0.5792). These last correlations stand in contrast to the two sector interpretation of the one sector growth model in which the correlation between the shocks in the two sectors is necessarily one.

There is a final parameter to comment upon: p, the number of periods in advance that a news shock is revealed. The model is estimated for a variety of values for p; the benchmark estimation corresponds to $p = 7$ which maximises the (log) data density.

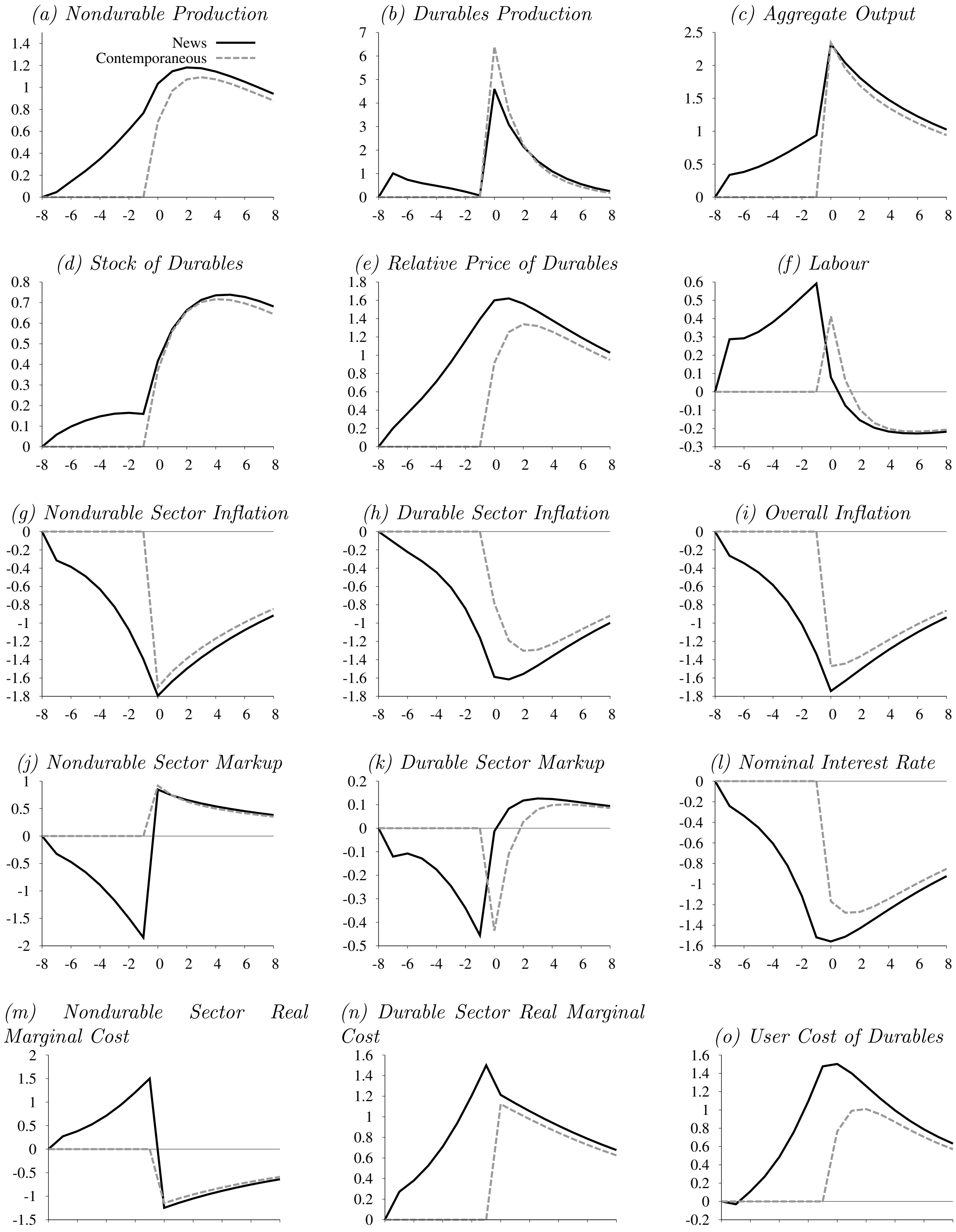
Fig. 1: Prior and posterior distributions



C.3. *Complete Sets of Impulse Responses*

Figures 2–4 present full sets of impulse responses to nondurable good sector shocks, durable good sector shocks and a monetary policy shock, respectively.

Fig. 2: Responses to nondurable good sector shocks



Note: The timing of the shocks is described in the text.

Fig. 3: Responses to durable good sector shocks

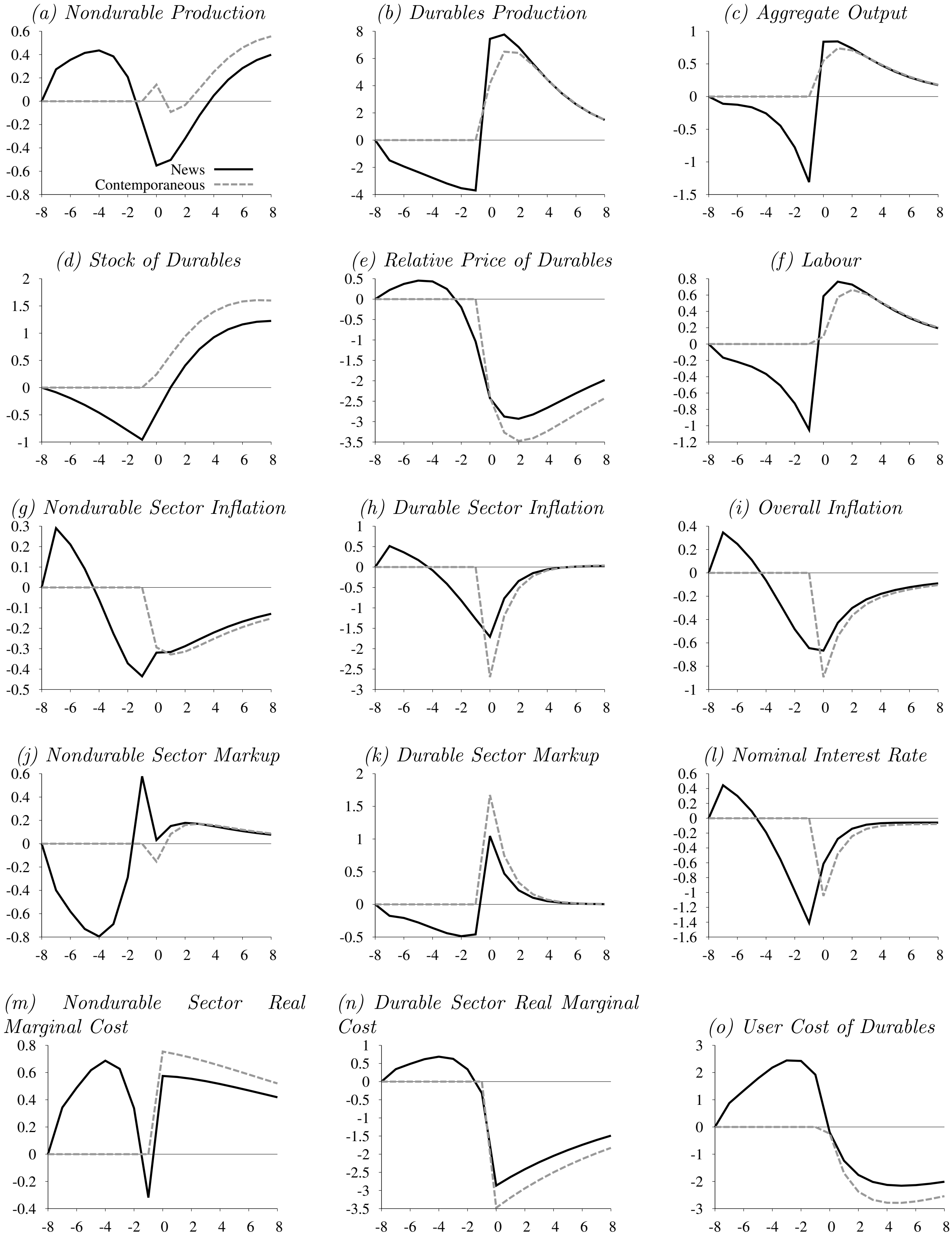
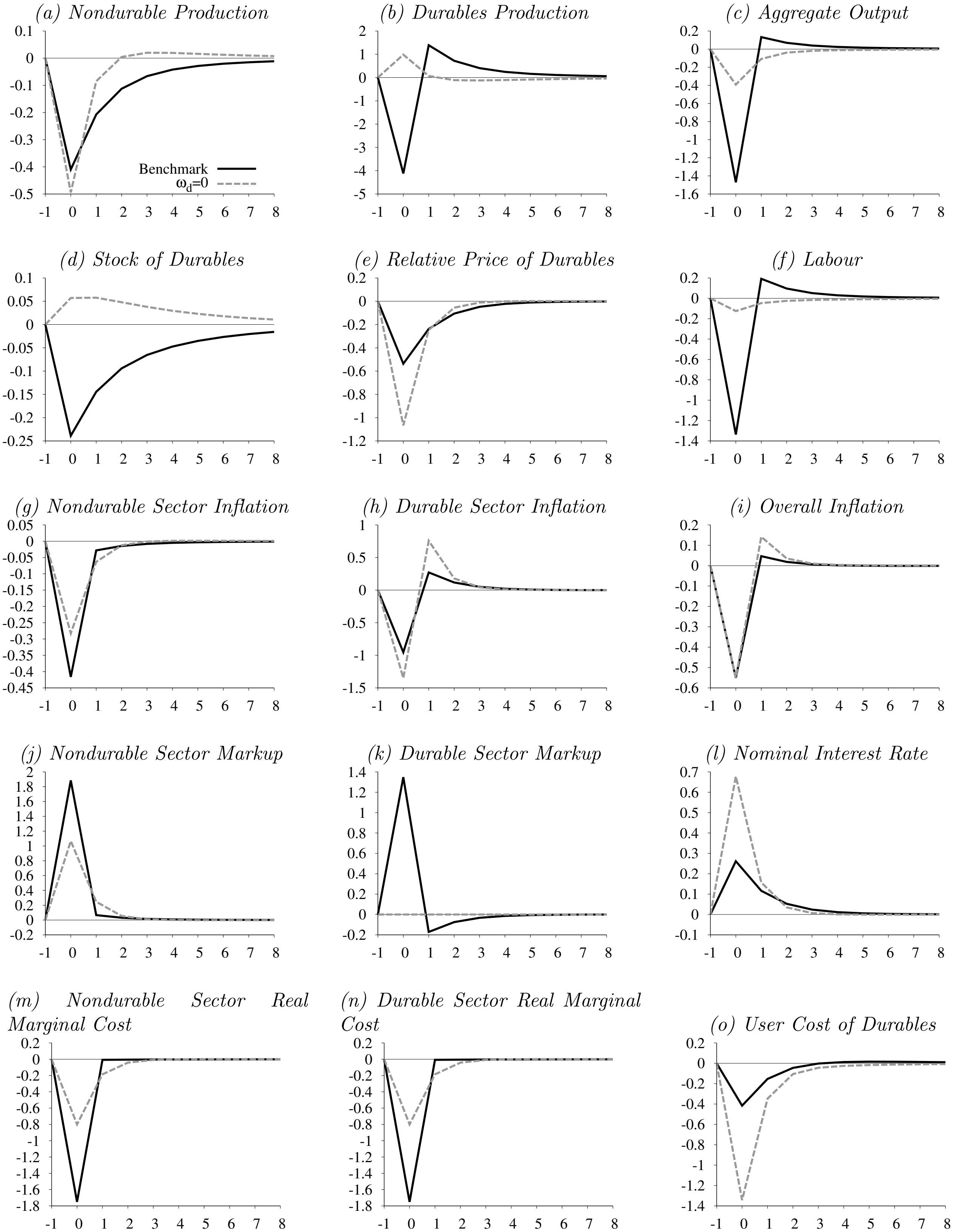


Fig. 4: Responses to a monetary policy shock



Note: The shock is a positive monetary policy shock occurring at time $t = 0$.

D. Sensitivity Analysis

D.1. The Sources of Pigou Cycles

As seen in the paper, Pigou cycles develop in response to nondurable sector news shocks (but not durable sector news shocks). What model features account for the Pigou cycles? This section assesses the roles of our key modeling assumptions in accounting for Pigou cycles.

D.1.1. Nominal rigidities

Figure 5 presents impulse responses for a nondurable sector news shocks for various settings of price rigidities. The alternatives were chosen as follows:

1. Klenow and Malin (2011) report a mean duration of 8.0 months for regular price changes of all goods (that is, durables, nondurables and services). In this case, $\omega_c = \omega_d = 0.625$.

2. Bils and Klenow (2004) report that 29.8% of durables prices, and 29.9% of nondurables prices, change in a month. These fractions imply an average duration of prices of 3 1/3 months, and so $\omega_c = \omega_d = 0.106$.

3. Klenow and Malin (2011) report average price durations for regular and sale price changes; they are 3.0 months for durables and 5.8 months for nondurables. These durations lead to $\omega_d = 0$ and $\omega_c = 0.48$.

Setting $\omega_c = \omega_d = 0.625$ delivers results quite similar to the benchmark model. When prices in both sectors are more flexible – $\omega_c = \omega_d = 0.106$ – the response of the nondurable sector are quite modest until the shock takes effect. When durables prices are flexible (but nondurables prices are not), there is a small bust in the durables sector just prior to the realisation of the shock. So, apart from the flexible durables price case, our Pigou cycle results are not sensitive to other, reasonable settings for nominal rigidities. Figures 6–8 give more detailed presentations of these different price rigidity settings for both nondurable sector news and contemporaneous shocks.

To further investigate the effects of durable sector price rigidities, Figure 9 keeps nondurable sector price rigidity at its benchmark value, varying durable sector rigidity. This figure shows that

Fig. 5: Responses to nondurable good sector news shock: alternative assumptions regarding nominal rigidities

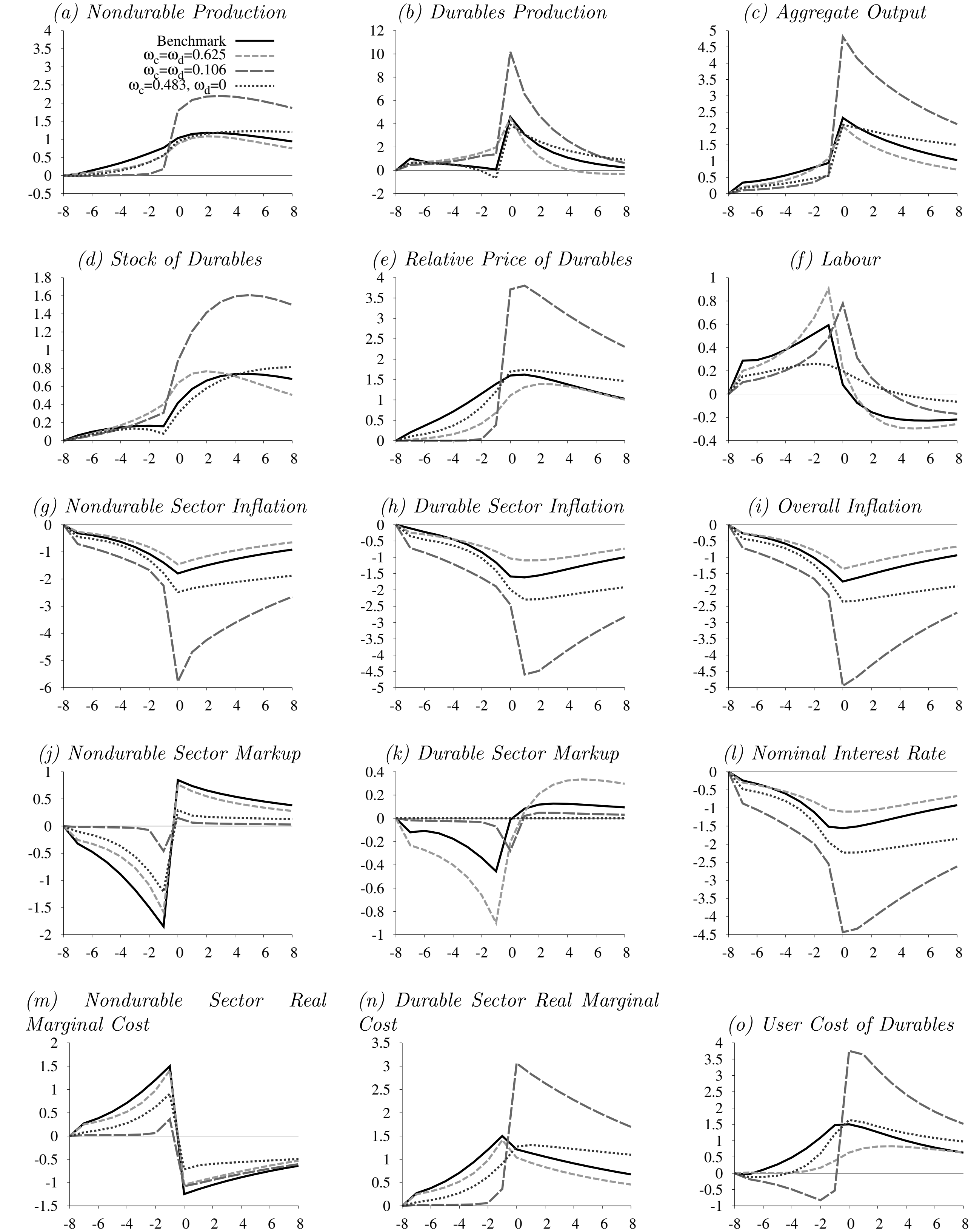


Fig. 6: Responses to nondurable sector shocks: $\omega_c = \omega_d = 0.625$

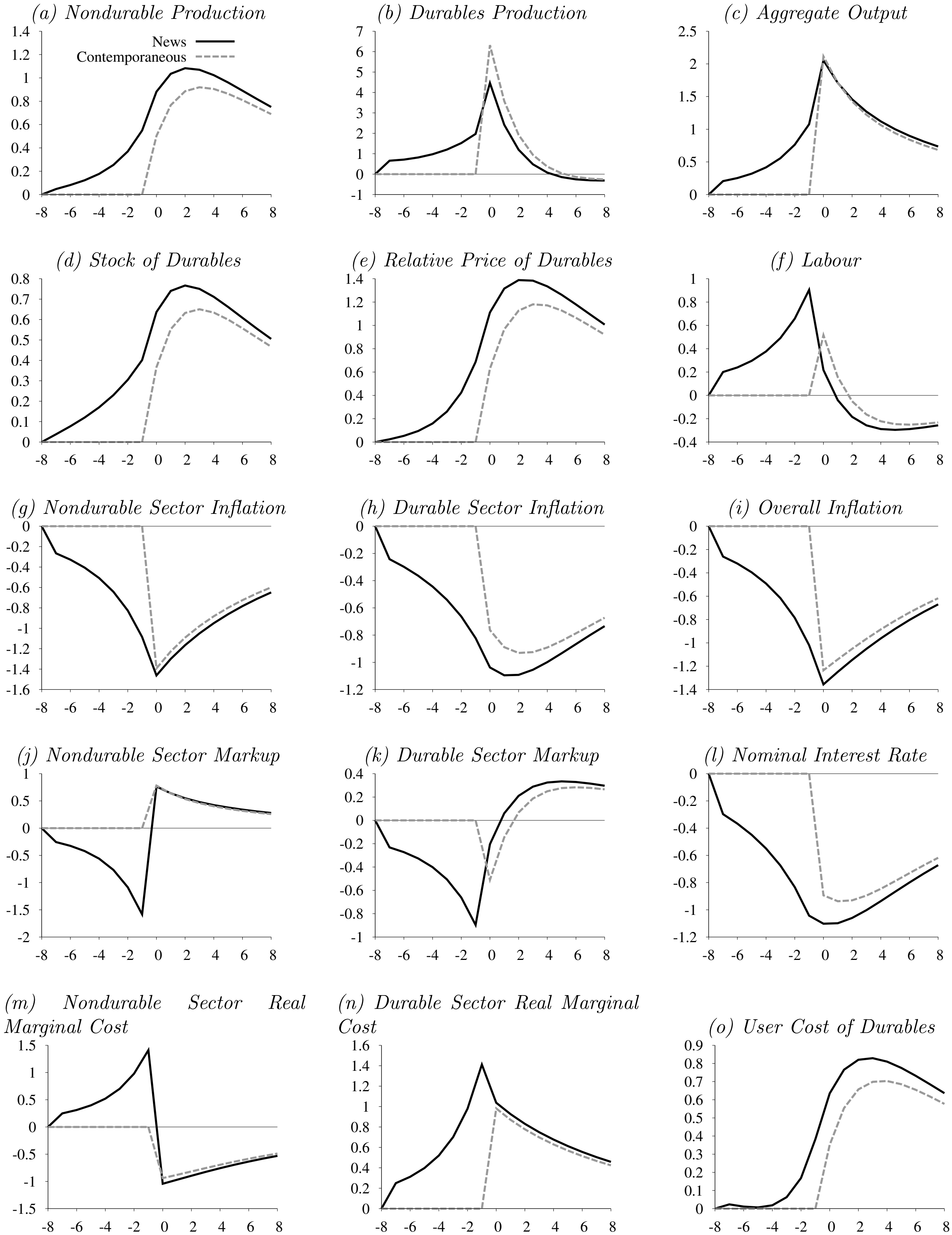


Fig. 7: Responses to nondurable sector shocks: $\omega_c = \omega_d = 0.106$

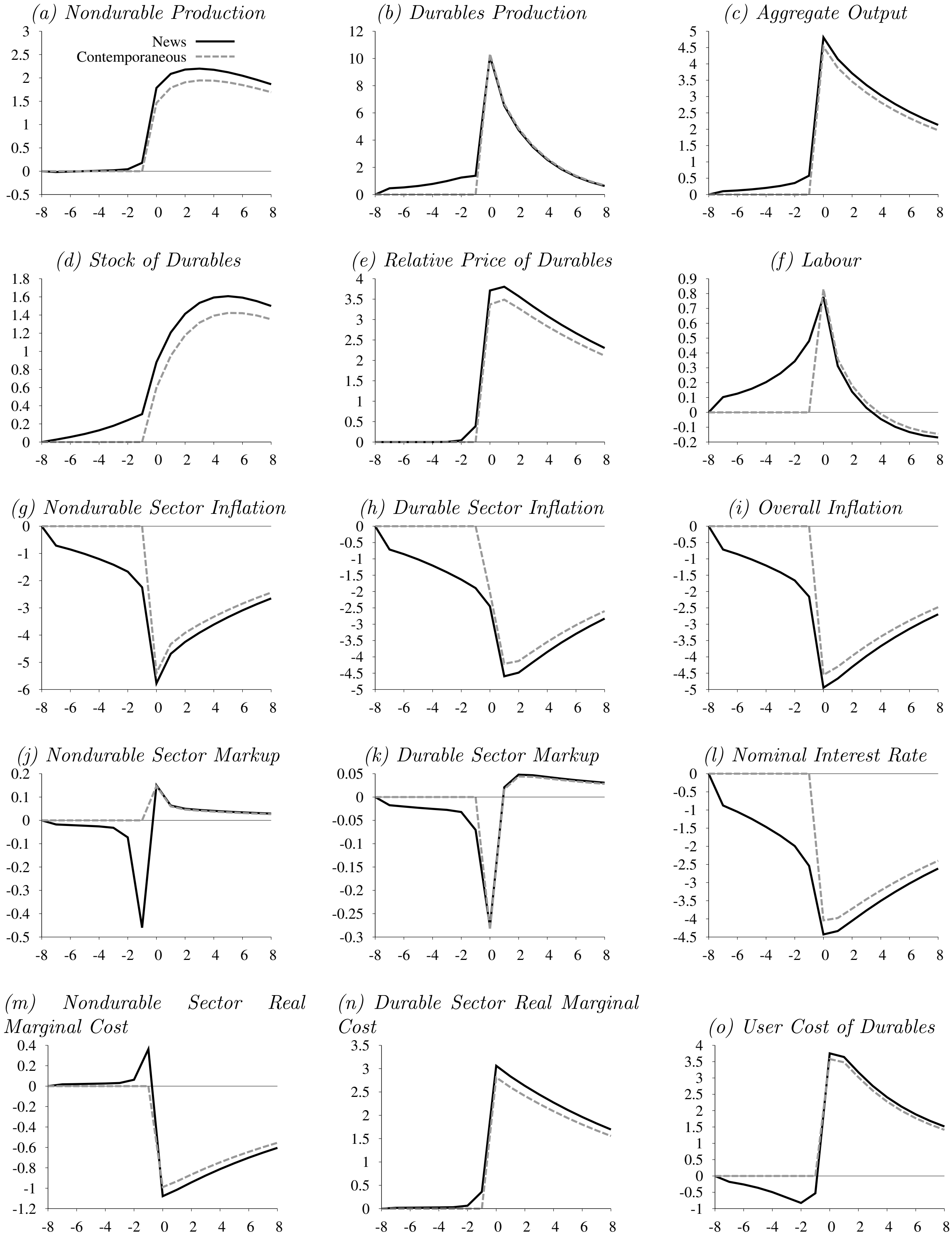
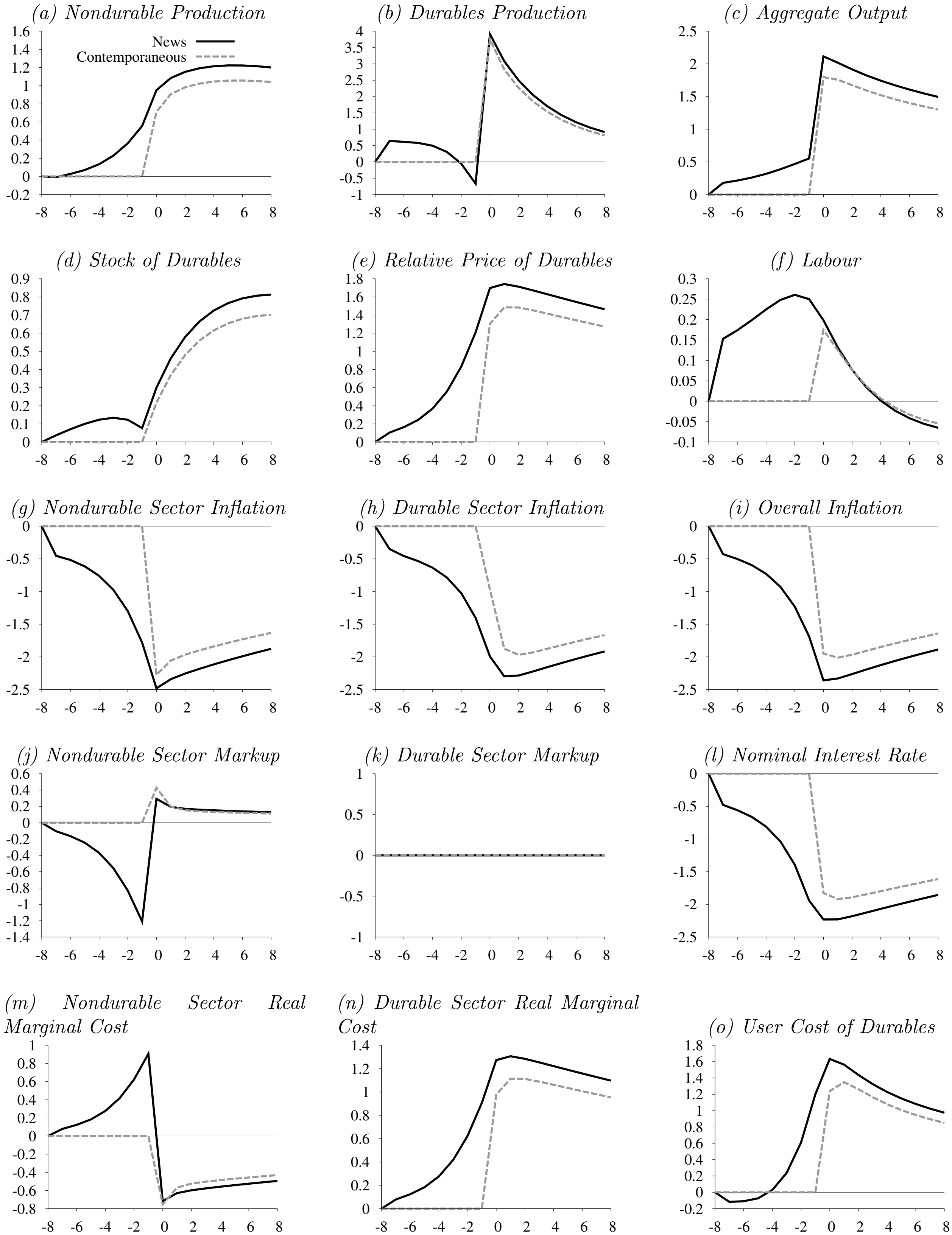


Fig. 8: Responses to nondurable sector shocks: $\omega_c = 0.483$, $\omega_d = 0$



as durables prices become more flexible, durables sector output starts to decline in the period prior to the realisation of the shock, although the 'announcement' effect of the shock is still positive. The Pigou cycle results are driven by how sharply the relative price of durables rises: When the increase is moderate, Pigou cycles emerge as households buy up durables before their price rises too much; when the relative price rise is fairly sharp, durables output falls prior to the realisation of the shock as households put off their purchases of durables in anticipation of the subsequent fall in the relative price of durables.

Finally, Figure 10 presents responses to a nondurable sector news shock for the benchmark model along with the case in which prices are flexible in both sectors. When prices are flexible, the relative price of durables remains at its steady state value until the news shock actually takes effect at $t = 0$. Nondurable sector output also remains at its steady state value while output of durables starts rising before the shock takes effect. Since durables are relatively long lived, households buy up durables before the shock takes effect, when the price of durables rises sharply.

Fig. 9: Responses to nondurable good sector news shock: alternative assumptions regarding durable sector nominal rigidities, $\omega_c = 0.64$

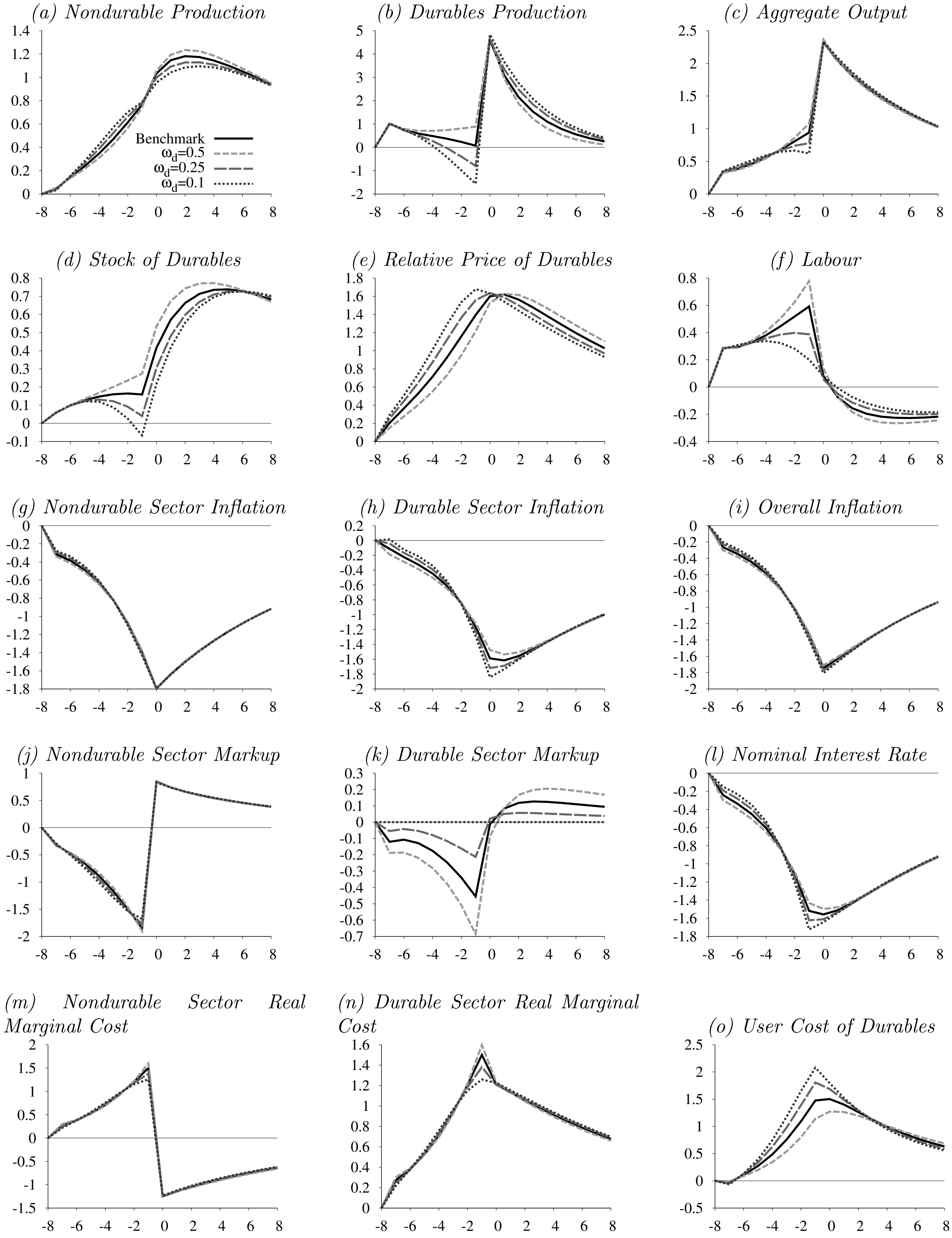
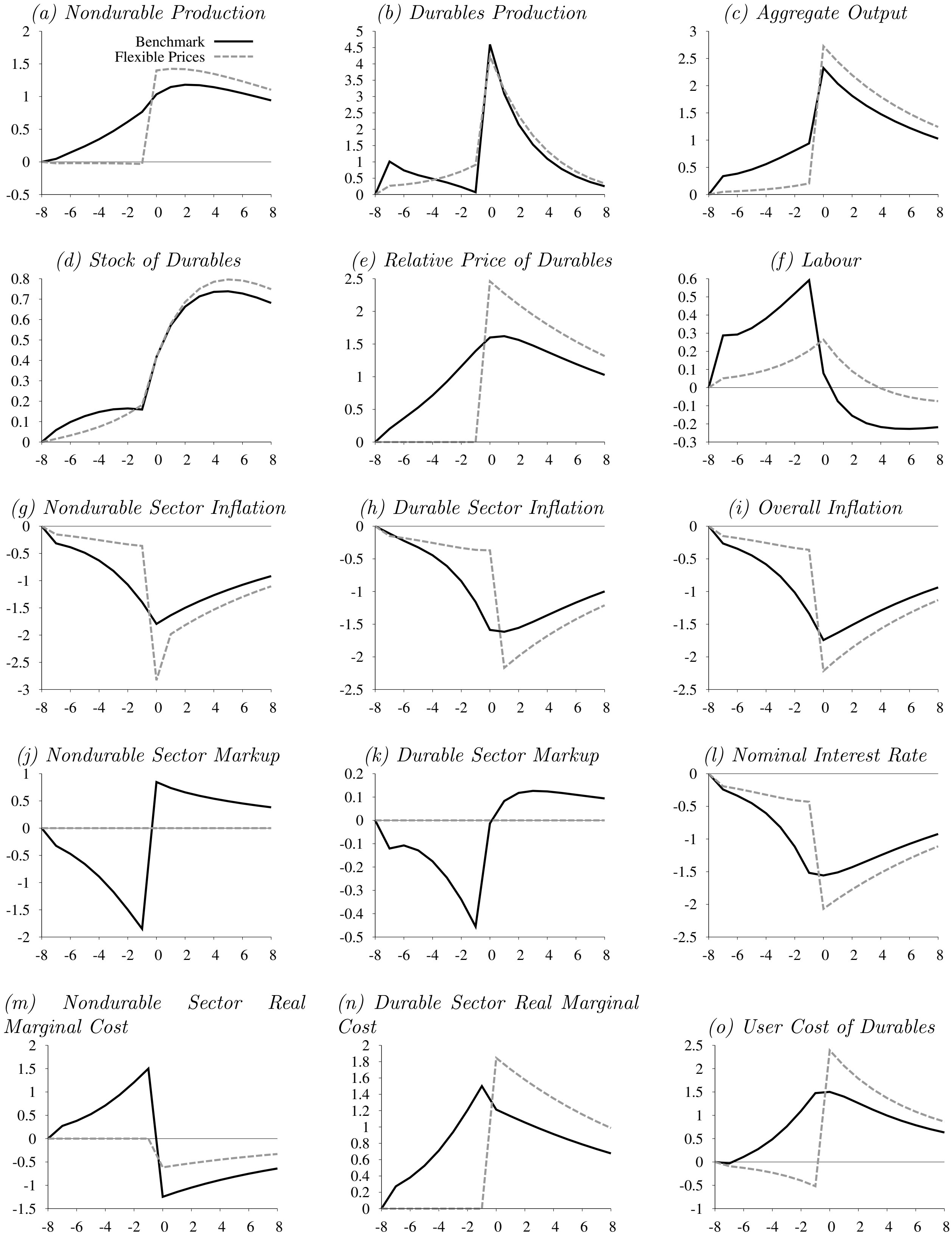


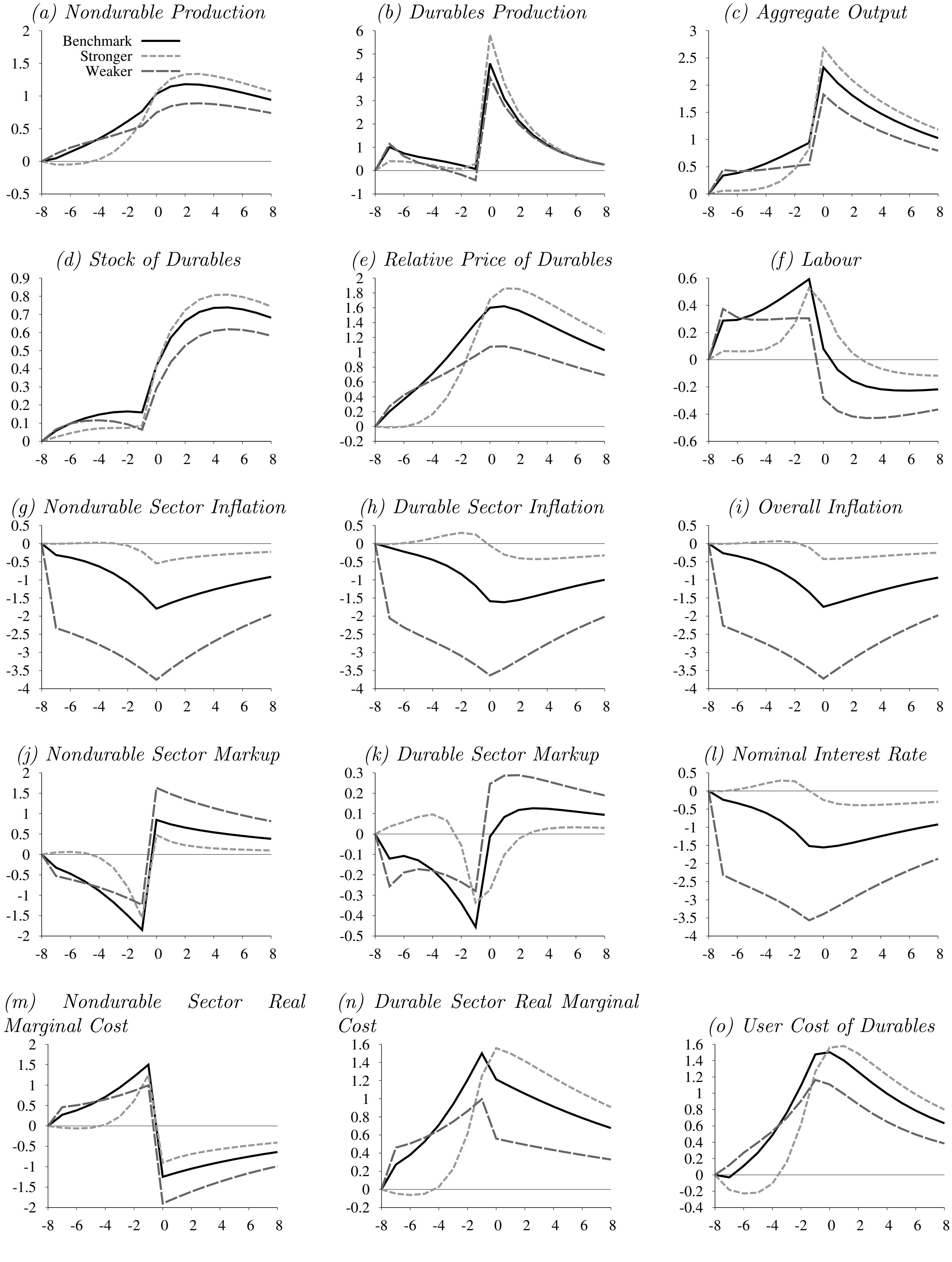
Fig. 10: Responses to nondurable good sector news shock with and without nominal rigidities



D.1.2. Monetary policy

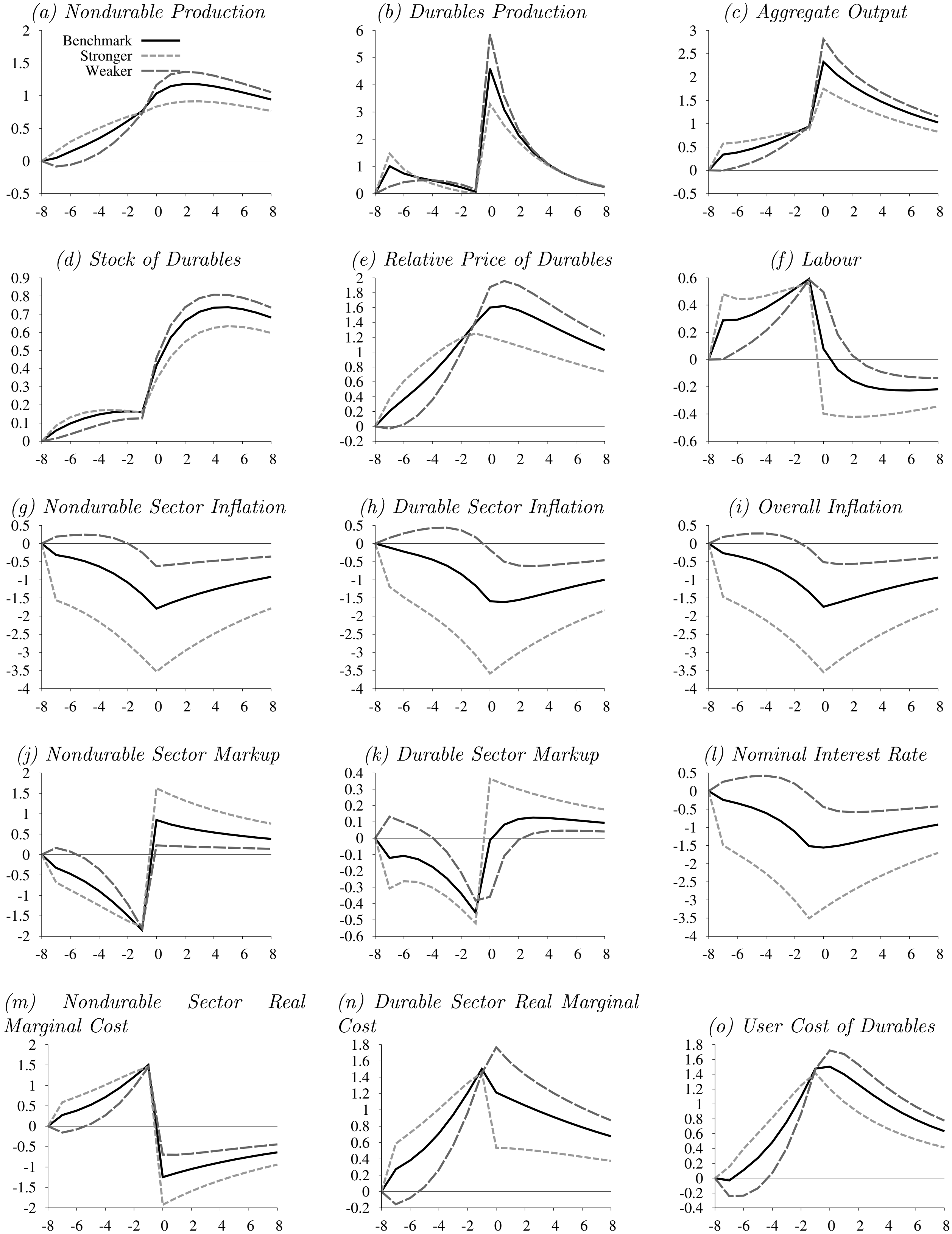
Figures 11 and 12 plot the responses to a nondurable sector news shock for alternative weights on inflation and output in the interest rate rule. When monetary policy responds more strongly to inflation (Figure 11), a nondurable sector news shock is initially associated with a bust in the nondurable sector, and so no Pigou cycle. Similarly, when the interest rate responds to output is muted (Figure 12), the nondurable sector again declines upon receipt of the news shock.

Fig. 11: Responses to nondurable good sector news shock under alternative weights on inflation in the interest rate rule



Note: "Stronger" corresponds to a coefficient of 3 *on inflation while "weaker" sets that coefficient to* 1.1.

Fig. 12: Responses to nondurable good sector news shock under alternative weights on output in the interest rate rule

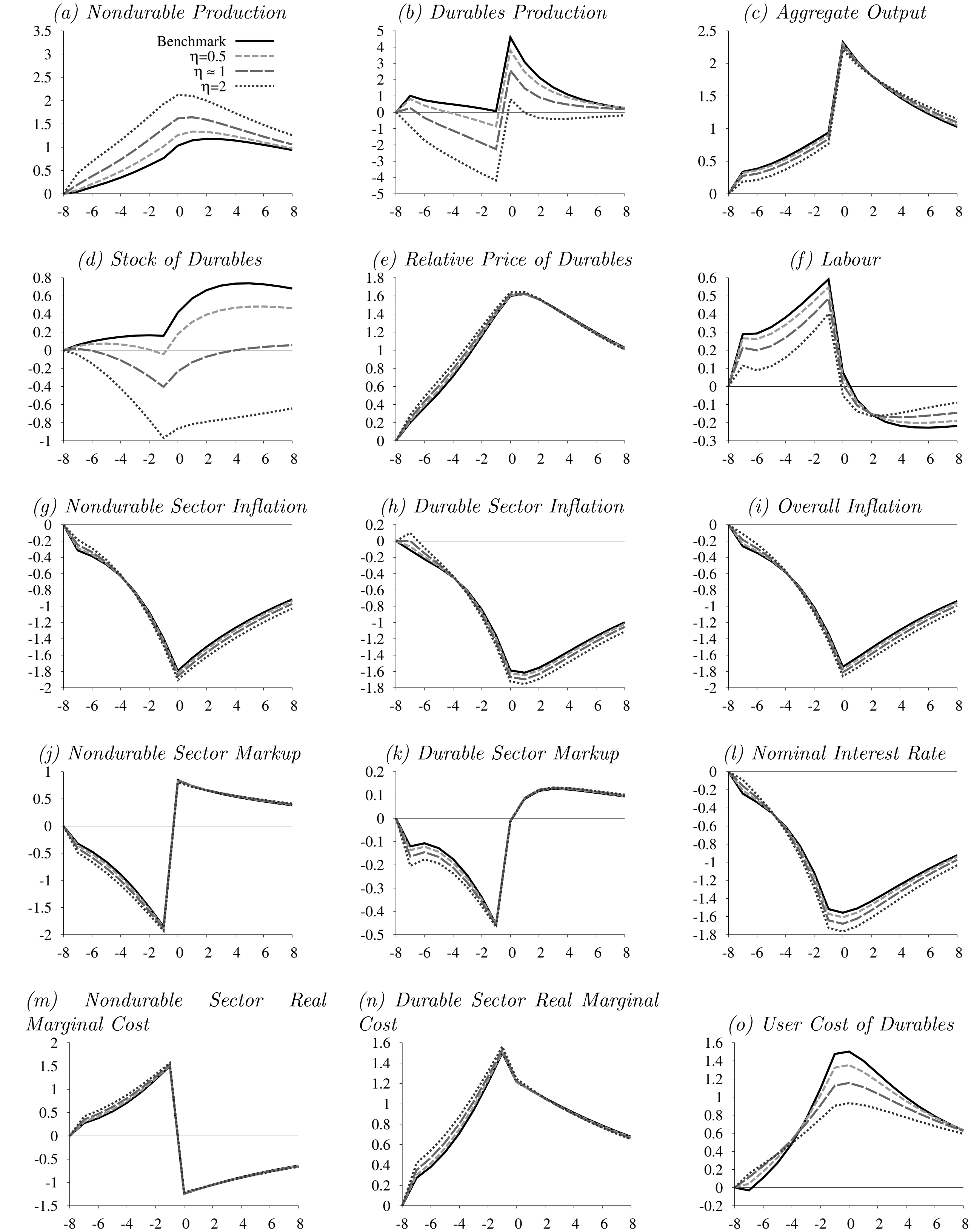


Note: "Stronger" corresponds to a coefficient of 1 *on output while "weaker" sets that coefficient to* 0.1.

D.1.3. The elasticity of substitution between durables and nondurables

Figure 13 gives the full set of impulse responses to a nondurable sector news shock for various alternative values of the elasticity of substitution between durables and nondurables, η. Increasing this elasticity to 0.5 leads to a durable sector bust in the 3 quarters prior to the realisation of the news shock. When the elasticity is 1, it is only in the period that the news shock is 'announced' that the durable sector experiences a slight boom. By the time the elasticity is increased to 2, the durable sector experiences a bust upon receipt of the news shock with this bust lasting until the realisation of the shock at $t = 0$.

Fig. 13: Responses to a nondurable good sector news shock: alternative assumptions regarding the elasticity of substitution between durables and nondurables



Note: The timing of the shocks is described in the text.

D.1.4. Related literature

Two papers deserve special mention. Kobayashi and Nutahara (2010) also focus on the role of monetary policy in generating Pigou cycles. They use a one sector New Keynesian model with investment adjustment costs and sticky prices. There are a number of key differences between Kobayashi and Nutahara and the current paper. First, they provide little justification for their parameter choices whereas we use a combination of calibration and estimation which imposes considerable discipline on our analysis. Second, they do not address the comovement problem.

Christiano *et al.* (2008) build a model with real frictions (internal habit persistence and investment adjustment costs) as well as nominal rigidities (both wage and price stickiness). Their chief finding is that an inflation targeting central bank along with nominal wage rigidities lead to Pigou (boom-bust) cycles. This finding contrasts with our finding that inflation targeting central banks do not experience Pigou cycles. In both cases, an inflation fighting central bank ends up smoothing fluctuations in a relative price – the real wage in Christiano *et al.*, the relative price of durables in this paper. Consider a positive news shock and an inflation fighting central banker. In Christiano *et al.*, such a shock necessitates an increase in the real wage. With wage stickiness, it takes time for the nominal wage to adjust, and with an inflation fighting central bank, the price level cannot do the job very quickly. Consequently, the real wage is lower than it "should" be, firms hire more workers, and a Pigou cycle results. In our paper, a news shock under an inflation fighting central bank leads to a moderately increasing path for the relative price of durables. As discussed above, under such a scenario, households do not buy up durables in anticipation of much higher prices down the road. As a result, there are no Pigou cycles in our model for this scenario; it is only when the central bank weakly targets inflation that the path of the relative price of durables rises rapidly, households push up their purchases of durables, and a Pigou cycle results. In a sense, the mechanics in the two papers is the same: an inflation fighting central bank limits movements in a relative price.[2] The difference is which relative price is affected, and whether or not Pigou cycles occur.

[2] In Christiano *et al.* (2008), the relative price of capital goods is not constant due to the investment adjustment costs. In their paper, if households tried to purchase more capital goods, this would simply push up the effective price of capital goods since the adjustment costs would increase.

D.2. *Cash-in-advance Constraint*

To evaluate the role played by money-in-the-utility function, suppose that money demand is motivated instead by a cash-in-advance constraint. Replace preferences by

$$E_0 \sum_{t=0}^{\infty} \beta^t U\left(C_t, D_t, N_t\right), \quad 0 < \beta < 1 \tag{5}$$

where U is as in the paper except for the omission of the real balances. In addition, the household now faces a cash-in-advance constraint that applies to purchases of both durables and nondurables:

$$P_{ct} C_t + P_{dt}\left[D_t - (1-\delta) D_{t-1}\right] \leq M_{t-1}. \tag{6}$$

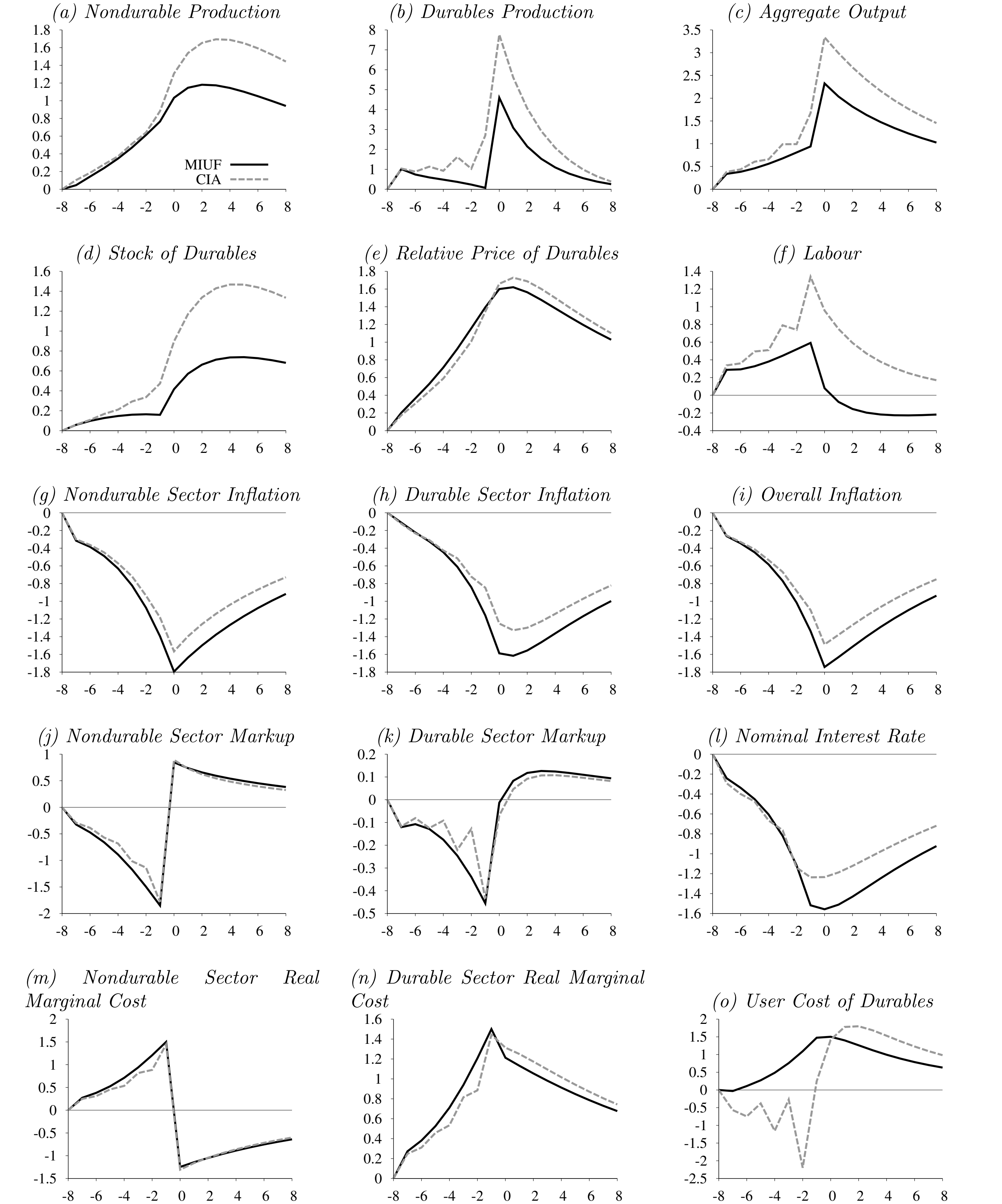
Estimates of the cash-in-advance model are presented in Table 3. The estimates are broadly similar to those obtained for the benchmark model. The parameters governing total factor productivity – the news and contemporaneous shocks – are very similar across the two estimations.

Figure 14 presents impulse responses for a nondurable sector news shock for both the estimated cash-in-advance model as well as the benchmark money-in-the-utility-function model. Overall, the responses of the cash-in-advance model are qualitatively similar to those obtained with money-in-the-utility function. In fact, the responses of most variables are amplified relative to the benchmark model, generating a more robust Pigou cycle.

Table 3: Estimation results: model with cash-in-advance, $\omega_c = 0.64$, $\omega_d = 0.4$

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.1408	0.1132	0.1706
ρ_y	policy reaction to output	gamma	0.5	0.025	0.4060	0.3826	0.4301
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.7505	1.7030	1.8080
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9197	0.9068	0.9324
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.9320	0.9308	0.9327
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.05	0.025	0.0262	0.0240	0.0289
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.05	0.025	0.0248	0.0228	0.0272
$\sigma_{\xi d}$	durable sector news	gamma	0.05	0.025	0.0351	0.0331	0.0376
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.05	0.025	0.0472	0.0431	0.0505
σ_e	monetary	gamma	0.01	0.005	0.0166	0.0148	0.0178
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	-0.7536	-0.8059	-0.7173
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	-0.7103	-0.7814	-0.6474
log data density: -2408.00							

Fig. 14: Responses to nondurable sector news shock: money-in-the-utility function (MIUF) compared to cash-in-advance (CIA)



D.3. Resolving The Comovement Problem

In the interests of exploring reasonable alternative settings, three different values for ω_c and ω_d are considered as described in Section D.1.1. Of these settings, it is only when durables prices are flexible does the comovement problem arise. Even a small amount of price stickiness is enough, in our model, to resolve the comovement problem – at least on impact; see Figure 15.

Figure 16 shows that our resolution of the comovement problem is relatively insensitive to changing the elasticity of substitution between durables and nondurables, holding price stickiness at its benchmark values. Figure 17 presents impulse responses for various elasticities of substitution between durables and nondurables when $\omega_c = \omega_d = 0.625$. Figure 18 does much the same for $\omega_c = \omega_d = 0.106$; Figure 19 for $\omega_c = 0.48$ and $\omega_d = 0$.

Most papers in the literature addressing the comovement problem, starting with Barsky *et al.* (2007), assume a Cobb-Douglas aggregator over durables and nondurables.[3] Figure 20 sets the elasticity of substitution very close to Cobb-Douglas, then runs through the alternative settings for price rigidities. As with the benchmark model, the comovement problem emerges only when durables prices are flexible.

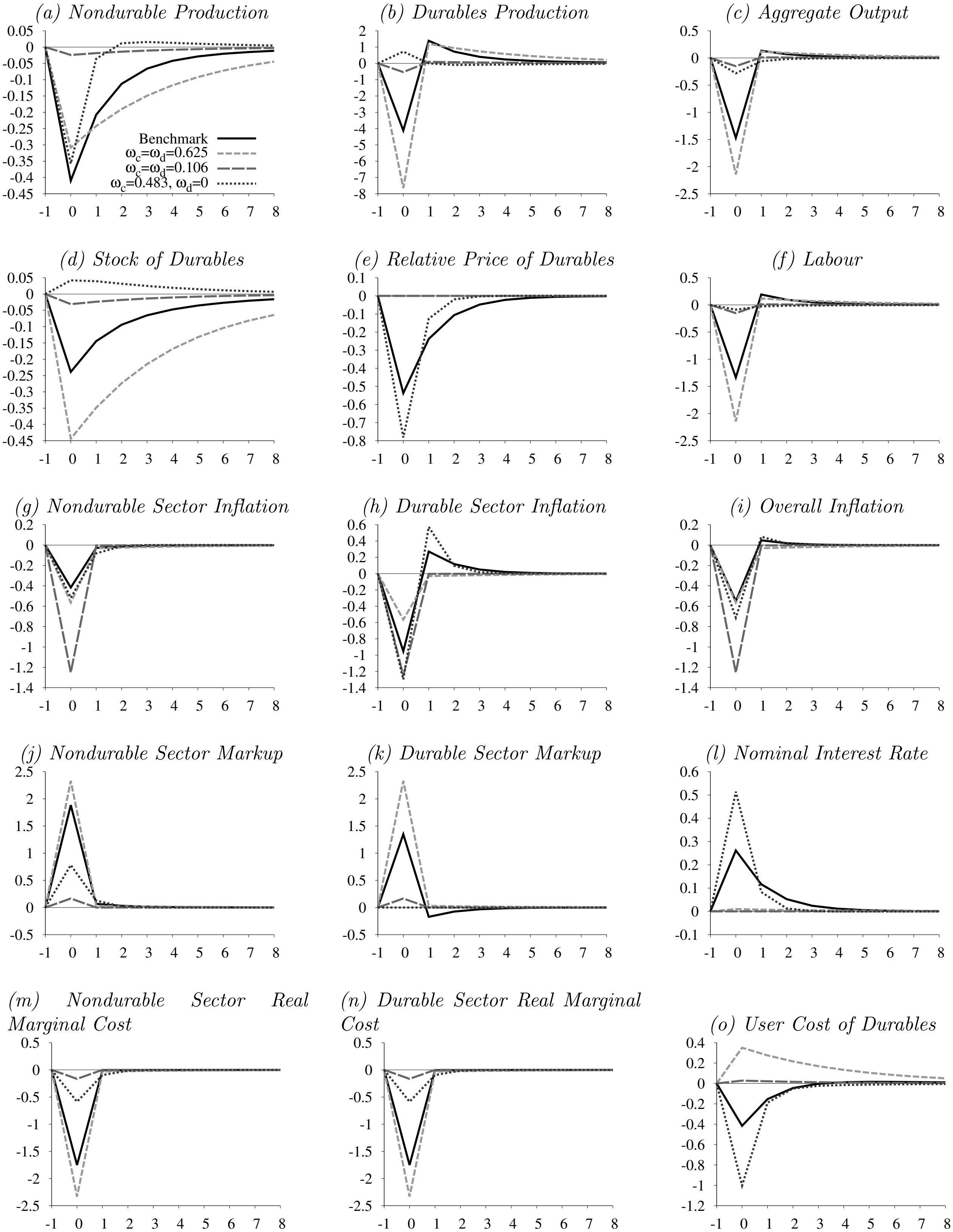
Figures 21–23 vary the parameter η (which governs the elasticity of substitution between durables and nondurables) between 0.5, nearly 1, and 2. For each figure, durable sector price rigidity is set to 0.3, 0.2, 0.1 and 0 with all other parameters at their benchmark values. The message to take away is that smaller values of η (less substitutability between durables and nondurables in preferences) resolve the comovement problem for lower durable sector price rigidity.

The literature typically assigns a low value to the depreciation rate of 'durables' (perhaps because housing is implicitly included in durables). Figure 24 explores the implications of a lower value for the depreciation rate, δ. This figure presents impulse responses for a nondurable sector news shock, varying the degree of durable sector price rigidity, holding all other parameters at their benchmark values. Our resolution of the comovement problem is insensitive to this setting of

[3]There is no particularly compelling reason to think that this elasticity should be equal to one; an elasticity different from one is quite consistent with balanced growth, for example. It should also be kept in mind that the estimated elasticity, 0.2563, is somewhat larger than that estimated by Beaudry and Portier (2004) in their early work on Pigou cycles.

the depreciation rate. Figure 25 in addition sets the elasticity of substitution to the Cobb-Douglas case, as in the literature. In this case, the results are similar to those in Figure 22 which also presents the Cobb-Douglas case, but for our benchmark setting of the depreciation rate.

Fig. 15: Responses to a monetary policy shock



Note: The shock is a positive monetary policy shock occurring at time $t = 0$. Results are presented for alternative nominal rigidities as described in the text.

Fig. 16: Responses to a monetary policy shock: different elasticities of substitution between durables and nondurables

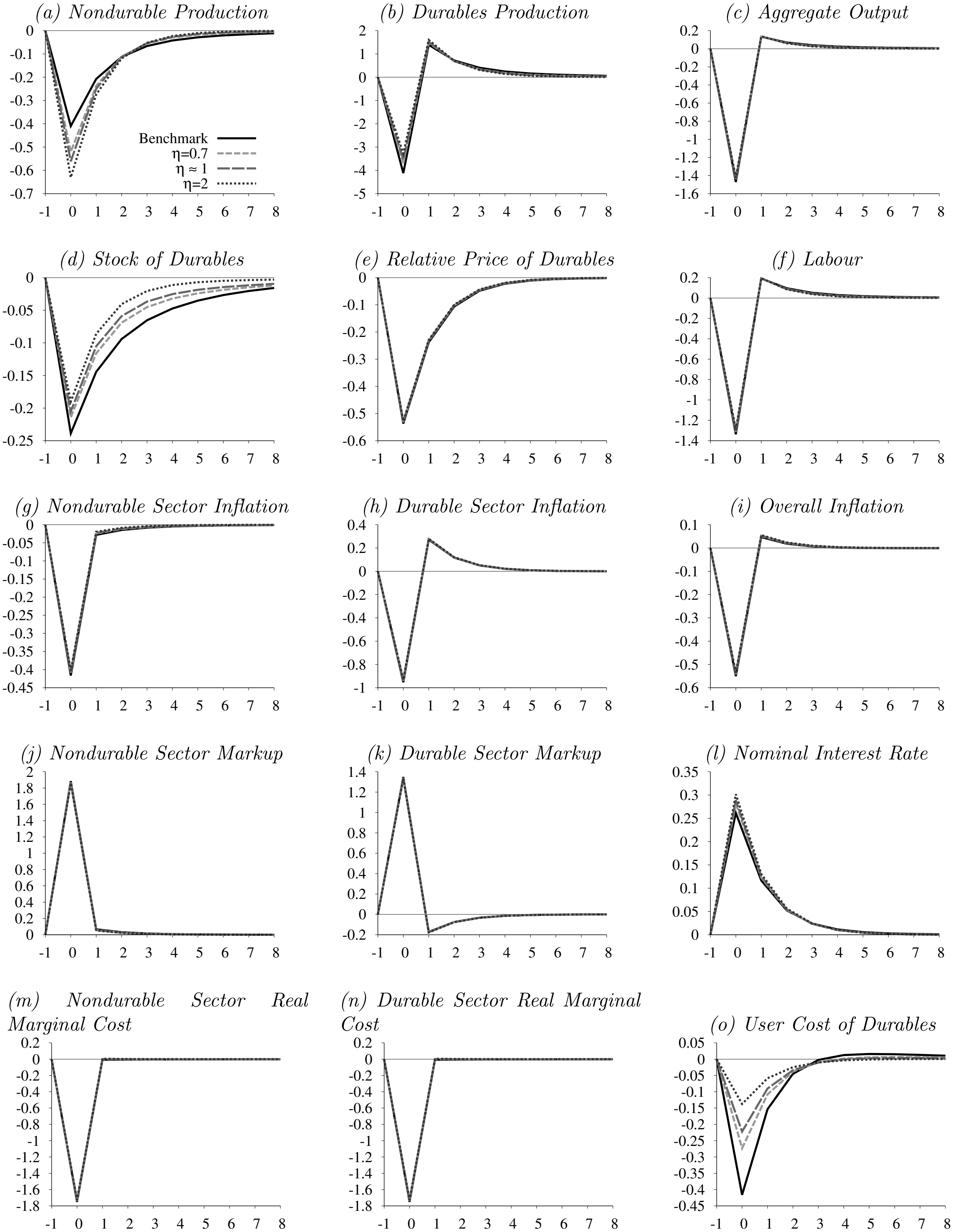


Fig. 17: Responses to a monetary policy shock: different elasticities of substitution between durables and nondurables, $\omega_c = \omega_d = 0.625$

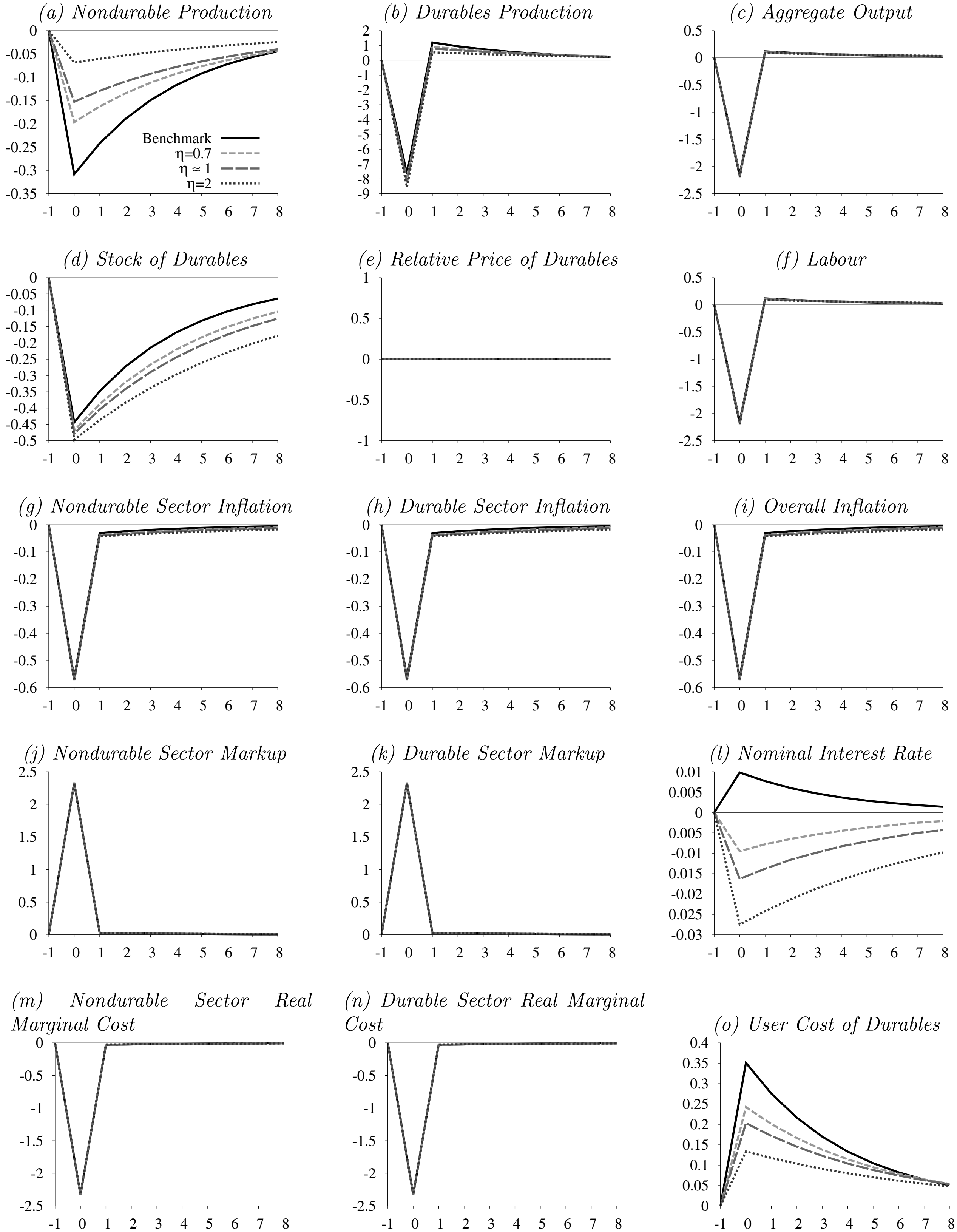


Fig. 18: Responses to a monetary policy shock: different elasticities of substitution between durables and nondurables, $\omega_c = \omega_d = 0.106$

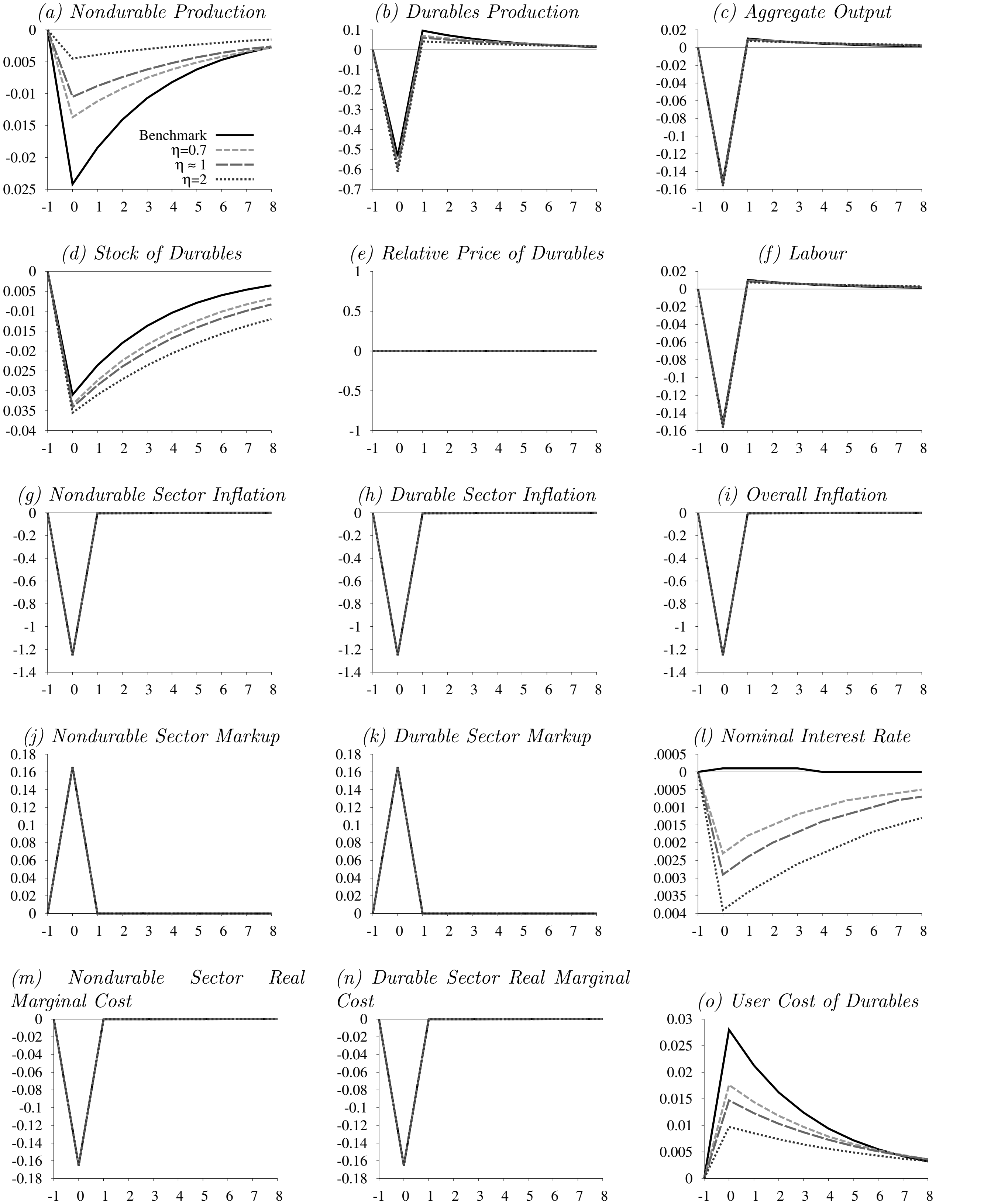


Fig. 19: Responses to a monetary policy shock: different elasticities of substitution between durables and nondurables, $\omega_c = 0.48$, $\omega_d = 0$

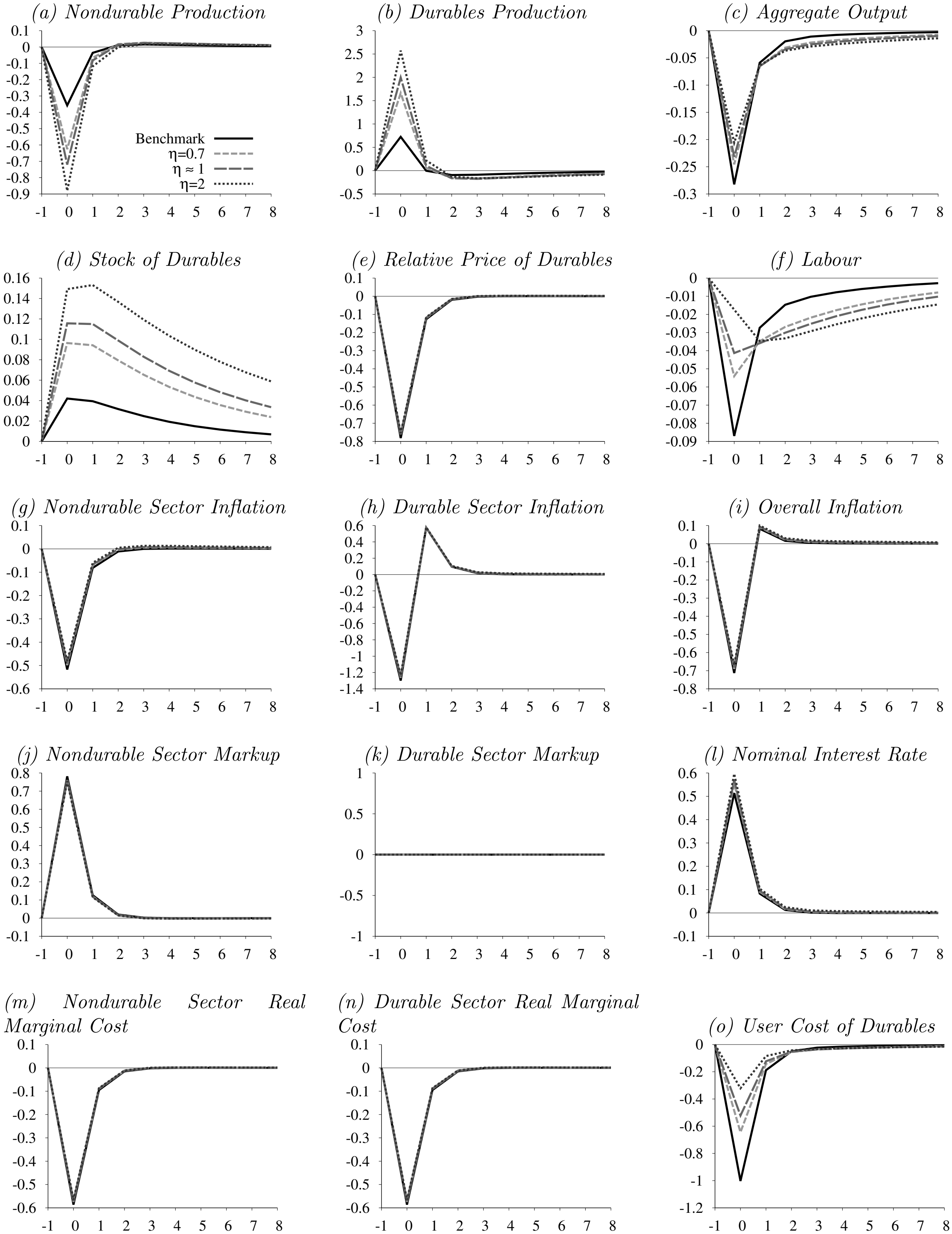


Fig. 20: Responses to a monetary policy shock: higher elasticity of substitution between durables and nondurables ($\eta = 0.9999$), varying degrees of durable sector nominal rigidity

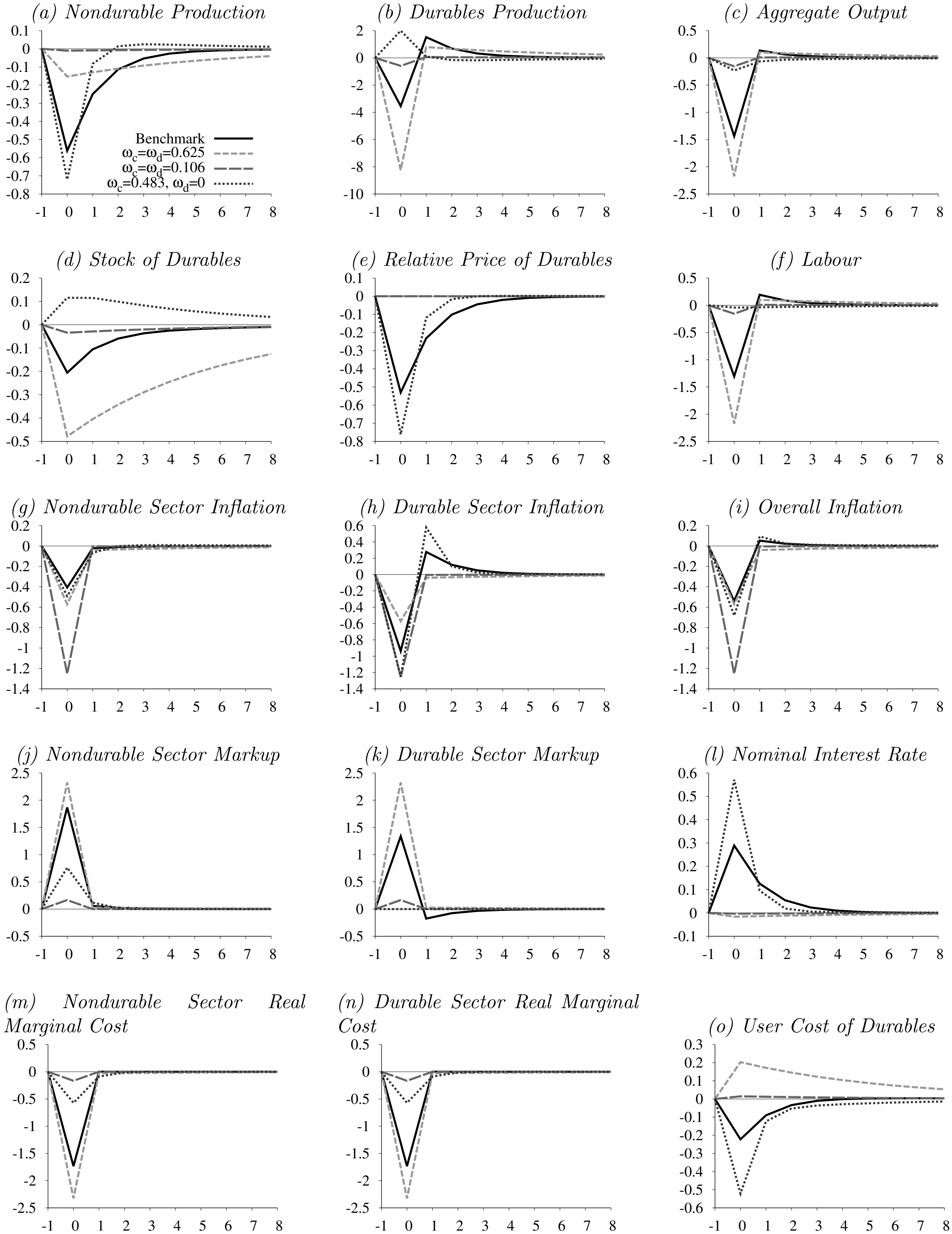


Fig. 21: Responses to a monetary policy shock: $\eta = 0.5$, varying degrees of durable sector nominal rigidity

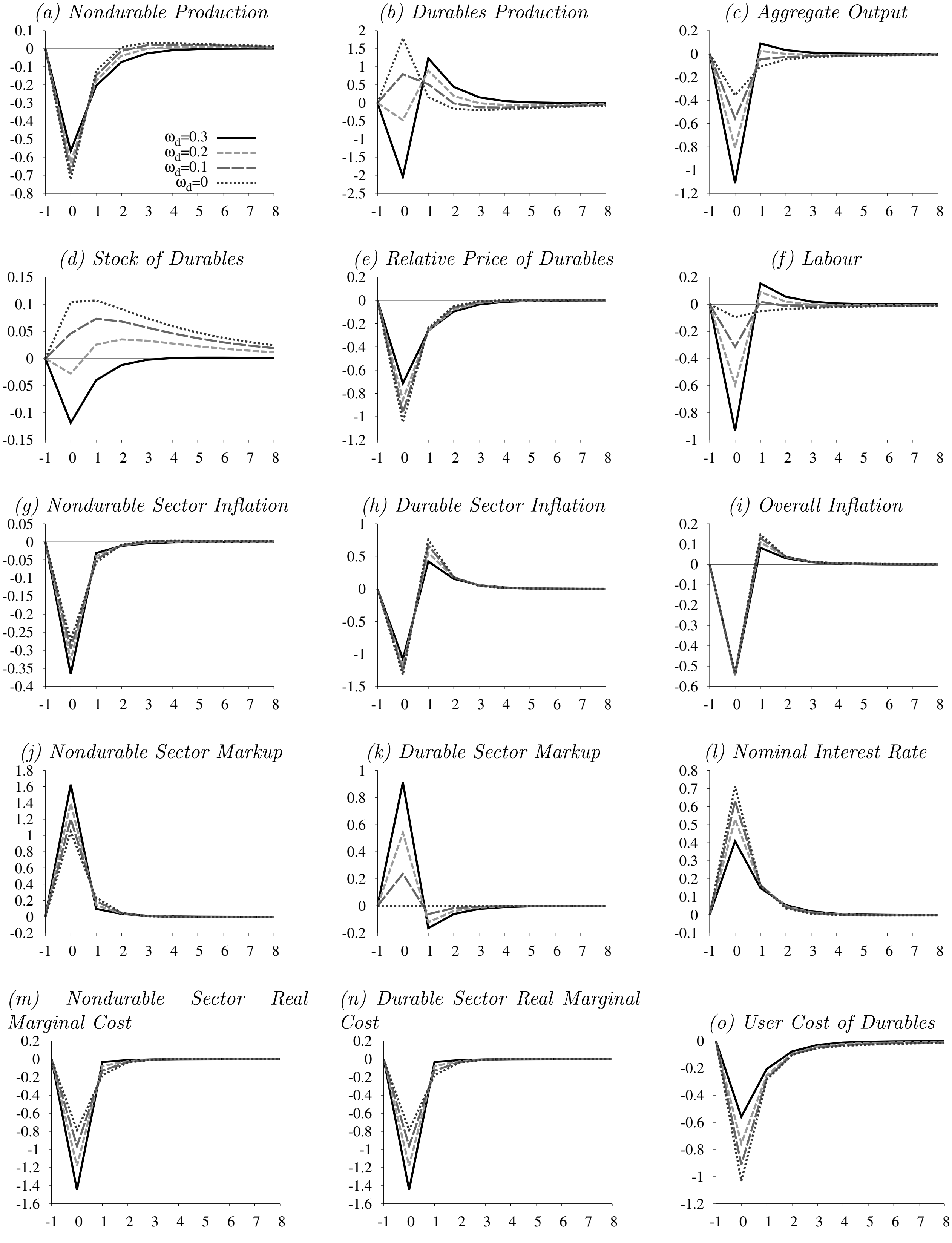


Fig. 22: Responses to a monetary policy shock: $\eta = 0.99999$, varying degrees of durable sector nominal rigidity

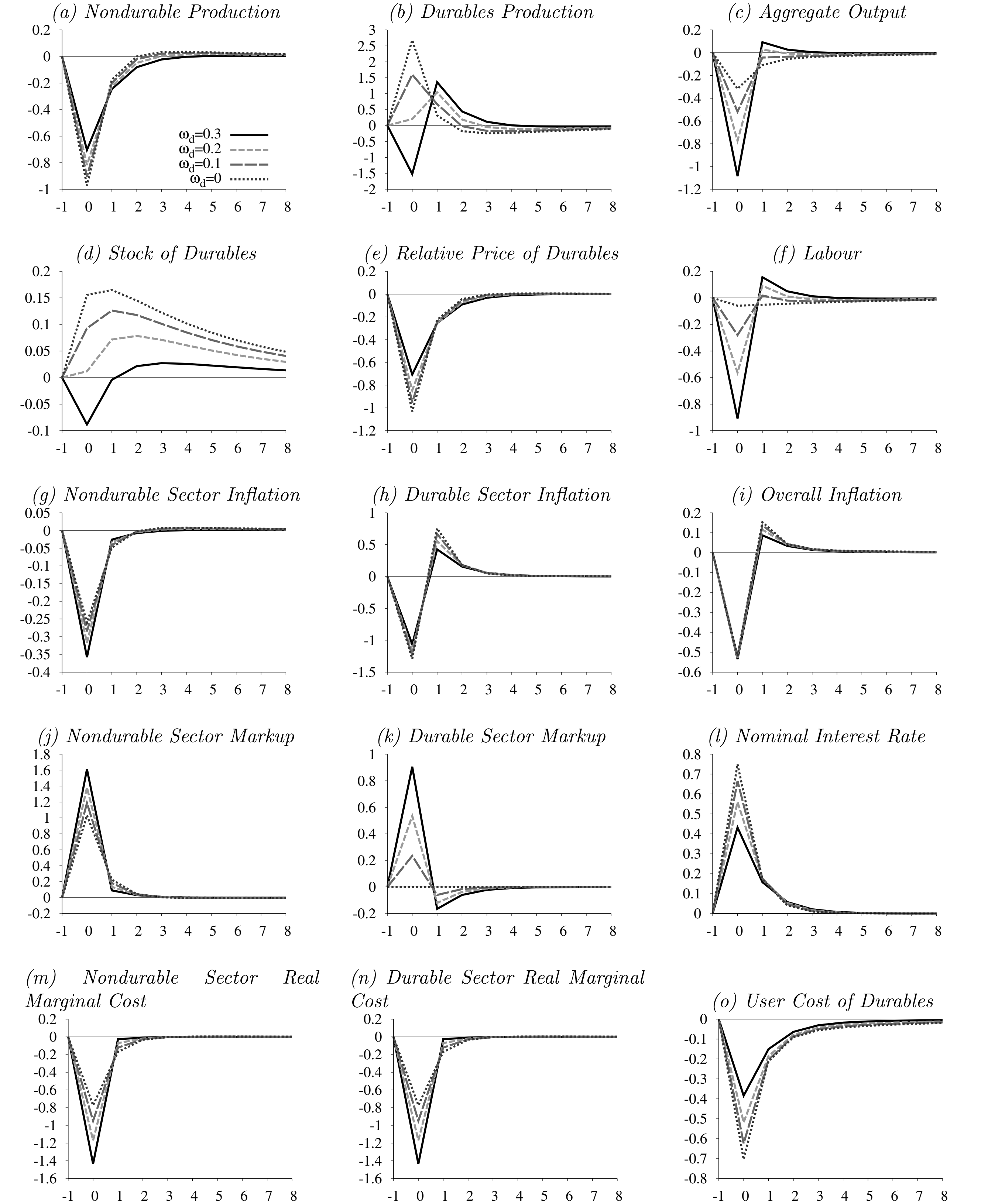


Fig. 23: Responses to a monetary policy shock: $\eta = 2$, varying degrees of durable sector nominal rigidity

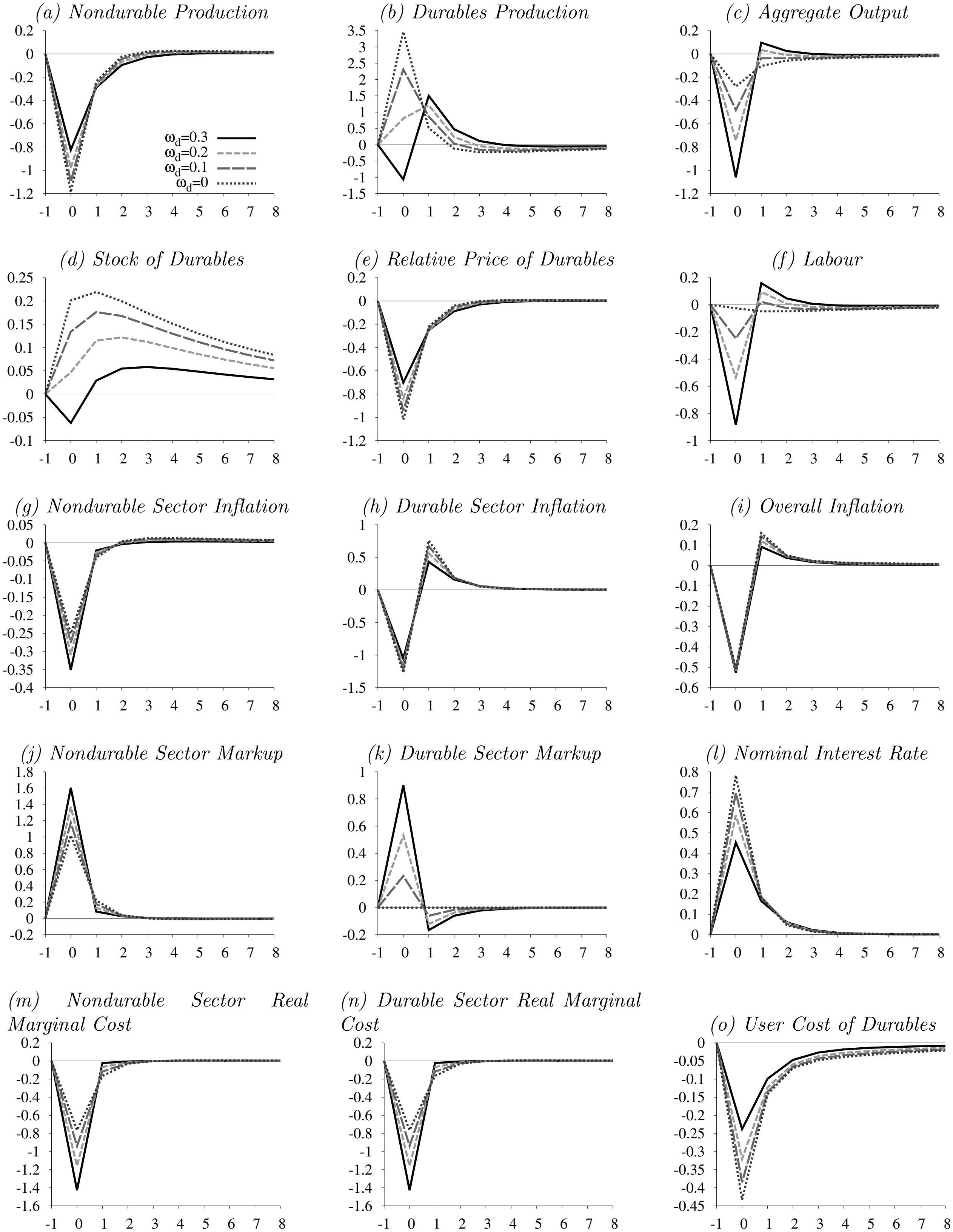


Fig. 24: Responses to a monetary policy shock: $\delta = 0.01$, varying degrees of durable sector nominal rigidity

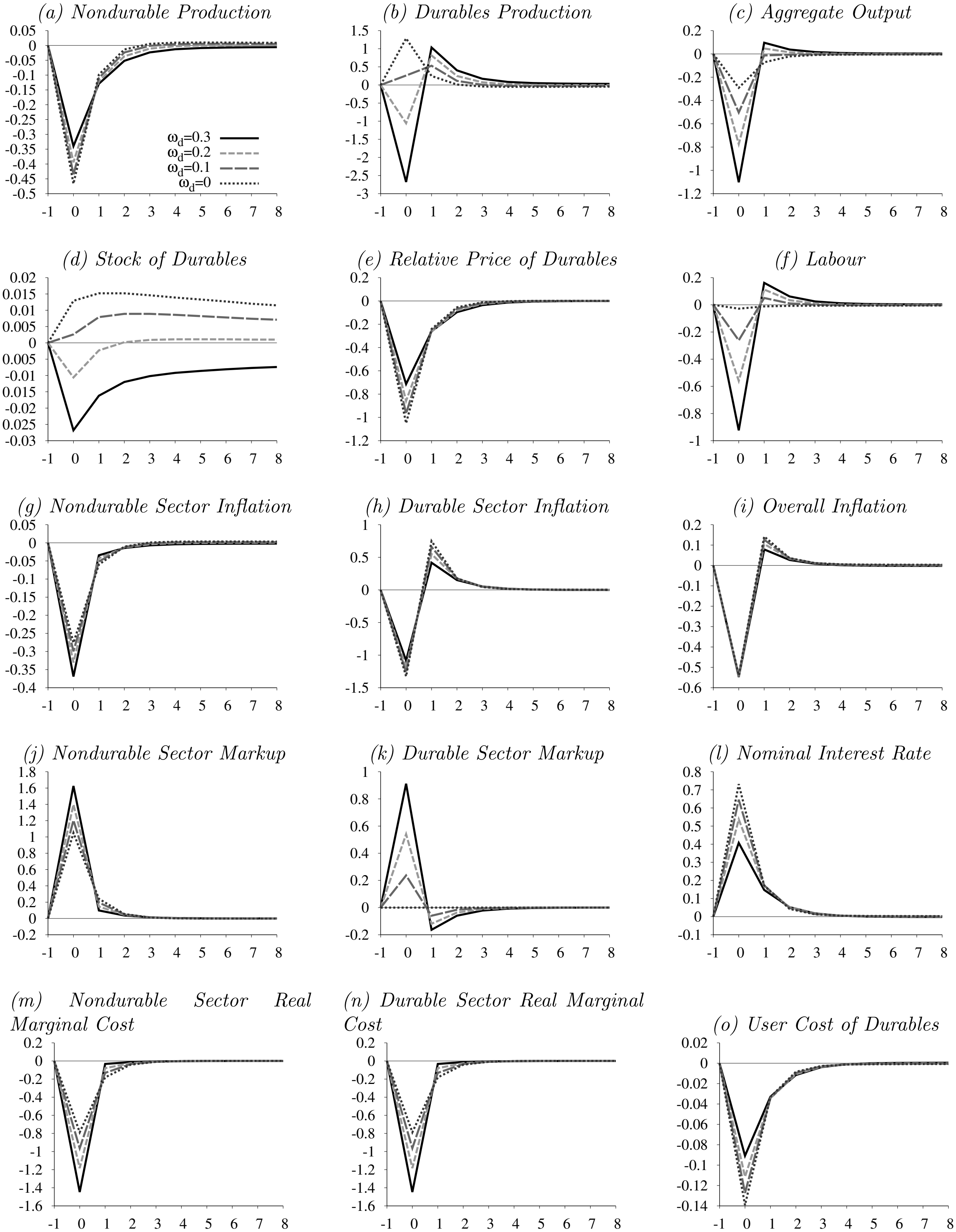
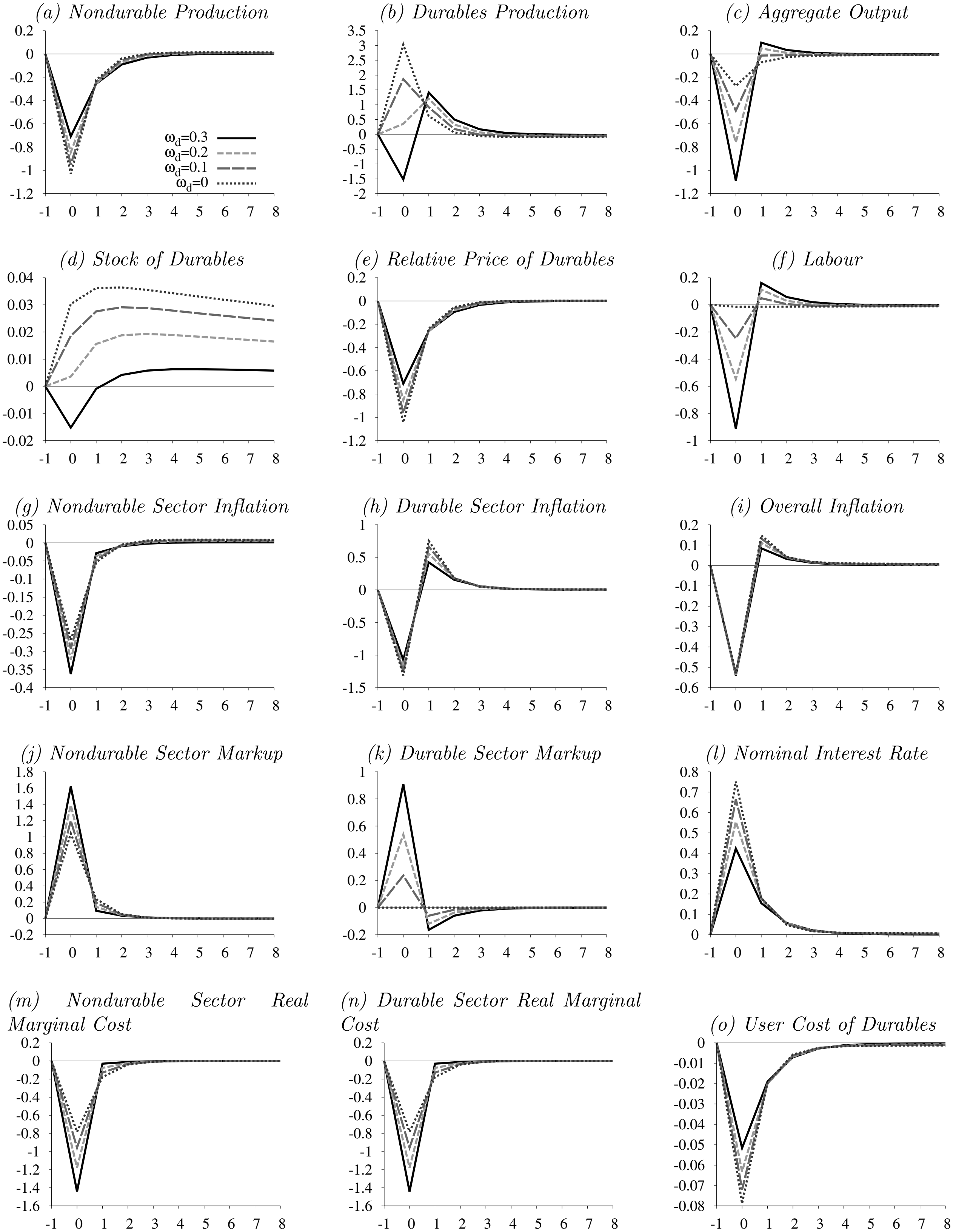


Fig. 25: Responses to a monetary policy shock: $\delta = 0.01$, $\eta = 0.99999$, varying degrees of durable sector nominal rigidity



E. Estimates using Alternative Priors

Tables 4 to 6 show that the estimated parameters are not particularly sensitive to reasonable alternative settings of the price rigidity parameters.

Table 7 imposes a higher mean on the prior for the interest rate coefficient on inflation, ρ_π. This change leads to somewhat larger estimates of the interest rate coefficients, ρ_π and ρ_y. In Table 8, the prior on the output parameter in the interest rate rule, ρ_y, is centred on a lower mean; the primary effect of this change is to lower the two policy parameters, ρ_π and ρ_y.

Table 9 presents estimates when the prior for the mean of the autoregressive coefficients of the technology shocks are increased; the proximate effects are to raise the estimates of these autoregressive coefficients.

Table 10 imposes a more diffuse prior on η, the elasticity of substitution between durable and nondurables. This change has few effects on the estimated coefficients apart from a larger estimate of η.

Finally, Table 11 lowers the mean of the standard deviations of the two contemporaneous shocks while Table 12 does the same for the standard deviations of the news shocks. In both cases, the changes in the estimated parameters are minor.

In summary, the estimated coefficients are not too sensitive to either alternative settings for price stickiness, or alternative priors for the model coefficients.

Table 13 presents results estimating all of the shock correlations. The correlations with the monetary policy shocks are generally close to zero.

Table 15 in addition estimates the degree of price stickiness in both sectors; for both sectors, the estimated probability of non-reoptimization is higher than implied by Klenow and Malin (2011). Although impulse responses are not presented for this case, in our previous work the higher degree of price stickiness was found to improve our results.

Tables 16 and 17 estimate the degree of price stickiness as well as imposing various zero constraints on the correlations among the model's shock innovations. These restrictions do not change the parameter estimates very much.

Table 4: Estimation results: $\omega_c = 0.625$, $\omega_d = 0.625$

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2406	0.1975	0.2784
ρ_y	policy reaction to output	gamma	0.5	0.025	0.4575	0.4160	0.4931
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.5063	1.4536	1.5497
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9112	0.8933	0.9326
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.9290	0.9231	0.9327
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.05	0.025	0.0208	0.0181	0.0228
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.05	0.025	0.0192	0.0170	0.0211
$\sigma_{\xi d}$	durable sector news	gamma	0.05	0.025	0.0539	0.0494	0.0580
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.05	0.025	0.0535	0.0498	0.0576
σ_e	monetary	gamma	0.01	0.005	0.0184	0.0164	0.0197
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.5977	−0.6926	−0.5052
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.5631	−0.6518	−0.4773
log data density: −2354.71							

Table 5: Estimation results: $\omega_c = 0.106$, $\omega_d = 0.106$

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std, Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.1505	0.1199	0.1725
ρ_y	policy reaction to output	gamma	0.5	0.025	0.4004	0.3842	0.4239
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.2857	1.2603	1.3121
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9292	0.9243	0.9325
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.9319	0.9303	0.9327
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.05	0.025	0.0414	0.0358	0.0451
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.05	0.025	0.0380	0.0342	0.0429
$\sigma_{\xi d}$	durable sector news	gamma	0.05	0.025	0.0406	0.0380	0.0426
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.05	0.025	0.0519	0.0460	0.0554
σ_e	monetary	gamma	0.01	0.005	0.0167	0.0152	0.0176
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.6278	−0.6989	−0.5503
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.7562	−0.8056	−0.6932

log data density: −2067.95

Table 6: Estimation results: $\omega_c = 0.483$, $\omega_d = 0$

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2487	0.2136	0.2835
ρ_y	policy reaction to output	gamma	0.5	0.025	0.3605	0.3570	0.3651
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.2690	1.2530	1.2952
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.1	0.9725	0.9620	0.9787
ρ_d	persistence of shocks in durable sector	beta	0.7	0.1	0.9945	0.9924	0.9960
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.05	0.025	0.0199	0.0179	0.0220
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.05	0.025	0.0173	0.0154	0.0190
$\sigma_{\xi d}$	durable sector news	gamma	0.05	0.025	0.0299	0.0285	0.0316
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.05	0.025	0.0475	0.0438	0.0506
σ_e	monetary	gamma	0.01	0.005	0.0152	0.0140	0.0163
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	-0.5020	-0.5656	-0.4405
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	-0.6155	-0.6696	-0.5738

log data density: -2282.20

Table 7: Estimation results: alternative priors for reaction to inflation in monetary policy rule

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2721	0.2295	0.3183
ρ_y	policy reaction to output	gamma	0.5	0.025	0.4281	0.3964	0.4525
ρ_π	policy reaction to inflation	gamma	1.75	0.05	1.5264	1.4806	1.5666
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9217	0.9106	0.9325
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.9242	0.9167	0.9323
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.05	0.025	0.0260	0.0239	0.0284
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.05	0.025	0.0250	0.0224	0.0280
$\sigma_{\xi d}$	durable sector news	gamma	0.05	0.025	0.0336	0.0304	0.0373
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.05	0.025	0.0422	0.0390	0.0457
σ_e	monetary	gamma	0.01	0.005	0.0176	0.0159	0.0193
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.5475	−0.6405	−0.4699
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.5607	−0.6360	−0.4900

log data density: −2309.93

Table 8: Estimation results: alternative priors for reaction to output in monetary policy rule

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2365	0.2018	0.2737
ρ_y	policy reaction to output	gamma	0.35	0.025	0.2661	0.2426	0.2896
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.2796	1.2498	1.3103
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9234	0.9103	0.9327
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.9307	0.9276	0.9328
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.05	0.025	0.0250	0.0225	0.0271
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.05	0.025	0.0238	0.0215	0.0263
$\sigma_{\xi d}$	durable sector news	gamma	0.05	0.025	0.0314	0.0292	0.0342
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.05	0.025	0.0421	0.0398	0.0457
σ_e	monetary	gamma	0.01	0.005	0.0125	0.0114	0.0138
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.5839	−0.6620	−0.4992
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.5896	−0.6652	−0.4977

log data density: −2360.06

Table 9: Estimation results: alternative priors for persistence in the technology

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.3605	0.3150	0.4066
ρ_y	policy reaction to output	gamma	0.5	0.025	0.3748	0.3571	0.3911
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.3477	1.3206	1.3761
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.1	0.9822	0.9724	0.9921
ρ_d	persistence of shocks in durable sector	beta	0.7	0.1	0.9937	0.9724	0.9921
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.05	0.025	0.0155	0.0139	0.0169
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.05	0.025	0.0125	0.0112	0.0139
$\sigma_{\xi d}$	durable sector news	gamma	0.05	0.025	0.0329	0.0301	0.0352
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.05	0.025	0.0424	0.0386	0.0454
σ_e	monetary	gamma	0.01	0.005	0.0158	0.0145	0.0170
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.3642	−0.4636	−0.2524
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.5177	−0.5961	−0.4392
log data density: −2405.90							

Table 10: Estimation results: alternative priors for the elasticity of substitution

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.99	0.3	0.5661	0.4389	0.6678
ρ_y	policy reaction to output	gamma	0.5	0.025	0.4041	0.3762	0.4335
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.4220	1.3728	1.4705
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9133	0.8983	0.9298
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.9306	0.9280	0.9328
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.05	0.025	0.0269	0.0247	0.0296
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.05	0.025	0.0251	0.0224	0.0272
$\sigma_{\xi d}$	durable sector news	gamma	0.05	0.025	0.0316	0.0295	0.0340
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.05	0.025	0.0424	0.0382	0.0462
σ_e	monetary	gamma	0.01	0.005	0.0168	0.0154	0.0182
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.6677	−0.7402	−0.6199
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.6560	−0.7225	−0.6034
log data density: −2336.80							

Table 11: Estimation results: tighter priors on the standard deviations of the contemporaneous shocks

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2459	0.2014	0.2934
ρ_y	policy reaction to output	gamma	0.5	0.025	0.3890	0.3627	0.4136
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.3995	1.3535	1.4450
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9251	0.9168	0.9325
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.9279	0.9187	0.9327
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.05	0.025	0.0238	0.0216	0.0259
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.01	0.025	0.0221	0.0200	0.0242
$\sigma_{\xi d}$	durable sector news	gamma	0.05	0.025	0.0341	0.0309	0.0371
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.01	0.025	0.0422	0.0380	0.0465
σ_e	monetary	gamma	0.01	0.005	0.0165	0.0147	0.0182
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.5393	−0.6347	−0.4486
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.6028	−0.6941	−0.5281

log data density: −2325.62

Table 12: Estimation results: tighter priors on the standard deviations of the news shocks

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2598	0.2099	0.3046
ρ_y	policy reaction to output	gamma	0.5	0.025	0.3854	0.3600	0.4055
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.3968	1.3634	1.4386
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9223	0.9130	0.9324
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.9301	0.9265	0.9328
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.01	0.025	0.0237	0.0216	0.0255
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.05	0.025	0.0226	0.0210	0.0249
$\sigma_{\xi d}$	durable sector news	gamma	0.01	0.025	0.0329	0.0308	0.0352
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.05	0.025	0.0432	0.0388	0.0466
σ_e	monetary	gamma	0.01	0.005	0.0162	0.0147	0.0178
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.5305	−0.6079	−0.4470
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.6003	−0.6628	−0.5236
log data density: −2325.48							

Table 13: Estimation results with correlations among all shocks

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2336	0.2053	0.2670
ρ_y	policy reaction to output	gamma	0.5	0.025	0.4188	0.3860	0.4496
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.2833	1.2348	1.3385
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9307	0.9275	0.9327
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.9273	0.9206	0.9328
Standard deviations:							
$\sigma_{\xi c}$	nondurable news	gamma	0.05	0.025	0.0203	0.0182	0.0226
$\sigma_{\zeta c}$	nondurable contemporaneous	gamma	0.05	0.025	0.0184	0.0167	0.0202
$\sigma_{\xi d}$	durable news	gamma	0.05	0.025	0.0365	0.0314	0.0408
$\sigma_{\zeta d}$	durable contemporaneous	gamma	0.05	0.025	0.0446	0.0395	0.0482
σ_e	monetary	gamma	0.01	0.005	0.0173	0.0155	0.0193
Shock correlations:							
$\sigma_{\xi c\zeta c}$	nondurable news, nondurable contemporaneous	normal	0.0	0.3	−0.5317	−0.6081	−0.4248
$\sigma_{\xi c\xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.5858	−0.6564	−0.4872
$\sigma_{\xi c\zeta d}$	nondurable news, durable contemporaneous	normal	0.0	0.3	0.0109	−0.0748	0.1165
$\sigma_{\xi ce}$	nondurable news, monetary	normal	0.0	0.3	0.0426	−0.0661	0.1482
$\sigma_{\zeta c\xi d}$	nondurable contemporaneous, durable news	normal	0.0	0.3	0.3716	0.2779	0.4754
$\sigma_{\zeta c\zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.6557	−0.7199	−0.5902
$\sigma_{\zeta ce}$	nondurable contemporaneous, monetary	normal	0.0	0.3	−0.0761	−0.1994	0.0344
$\sigma_{\xi d\zeta d}$	durable news, durable contemporaneous	normal	0.0	0.3	−0.1401	−0.2125	−0.0459
$\sigma_{\xi de}$	durable news, monetary	normal	0.0	0.3	0.2642	0.1591	0.3719
$\sigma_{\zeta de}$	durable contemporaneous, monetary	normal	0.0	0.3	−0.2907	−0.3906	−0.1928

log data density: −2399.15

Table 14: Estimation results with four shock correlations

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2394	0.1953	0.2902
ρ_y	policy reaction to output	gamma	0.5	0.025	0.3860	0.3575	0.4138
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.3405	1.2804	1.3808
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9292	0.9247	0.9327
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.9306	0.9278	0.9327
Standard deviations:							
$\sigma_{\xi c}$	nondurable sector news	gamma	0.05	0.025	0.0210	0.0192	0.0229
$\sigma_{\zeta c}$	nondurable sector contemporaneous	gamma	0.05	0.025	0.0212	0.0191	0.0239
$\sigma_{\xi d}$	durable sector news	gamma	0.05	0.025	0.0334	0.0312	0.0359
$\sigma_{\zeta d}$	durable sector contemporaneous	gamma	0.05	0.025	0.0441	0.0405	0.0474
σ_e	monetary	gamma	0.01	0.005	0.0161	0.0146	0.0177
Shock correlations:							
$\sigma_{\xi c \zeta c}$	nondurable news, nondurable contemporaneous	normal	0.0	0.3	−0.4124	−0.4777	−0.3413
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.4556	−0.5355	−0.3407
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.6594	−0.7356	−0.5857
$\sigma_{\xi d \zeta d}$	durable news, durable contemporaneous	normal	0.0	0.3	0.0586	−0.0321	0.1411
log data density: −2356.36							

Table 15: Estimation results including the nominal rigidities and with correlations among all shocks

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2455	0.2092	0.2863
ω_c	nominal rigidity in nondurable sector	beta	0.75	0.1	0.8131	0.8035	0.8233
ω_d	nominal rigidity in durable sector	beta	0.75	0.1	0.7194	0.6934	0.7475
ρ_y	policy reaction to output	gamma	0.5	0.025	0.4750	0.4338	0.5096
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.4995	1.4382	1.5675
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9315	0.9297	0.9327
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.7097	0.6779	0.7464
Standard deviations:							
$\sigma_{\xi c}$	nondurable news	gamma	0.05	0.025	0.0176	0.0162	0.0190
$\sigma_{\zeta c}$	nondurable contemporaneous	gamma	0.05	0.025	0.0171	0.0158	0.0184
$\sigma_{\xi d}$	durable news	gamma	0.05	0.025	0.0701	0.0618	0.0823
$\sigma_{\zeta d}$	durable contemporaneous	gamma	0.05	0.025	0.0671	0.0610	0.0765
σ_e	monetary	gamma	0.01	0.005	0.0192	0.0174	0.0211
Shock correlations:							
$\sigma_{\xi c\zeta c}$	nondurable news, nondurable contemporaneous	normal	0.0	0.3	-0.6251	-0.6743	-0.5434
$\sigma_{\xi c\xi d}$	nondurable news, durable news	normal	0.0	0.3	-0.6392	-0.6899	-0.5670
$\sigma_{\xi c\zeta d}$	nondurable news, durable contemporaneous	normal	0.0	0.3	-0.0999	-0.1867	-0.0200
$\sigma_{\xi ce}$	nondurable news, monetary	normal	0.0	0.3	0.0413	-0.0375	0.1420
$\sigma_{\zeta c\xi d}$	nondurable contemporaneous, durable news	normal	0.0	0.3	0.4935	0.4247	0.5686
$\sigma_{\zeta c\zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	-0.4086	-0.4889	-0.3267
$\sigma_{\zeta ce}$	nondurable contemporaneous, monetary	normal	0.0	0.3	-0.0673	-0.1923	0.0417
$\sigma_{\xi d\zeta d}$	durable news, durable contemporaneous	normal	0.0	0.3	-0.0789	-0.1972	0.0347
$\sigma_{\xi de}$	durable news, monetary	normal	0.0	0.3	-0.0119	-0.1227	0.1174
$\sigma_{\zeta de}$	durable contemporaneous, monetary	normal	0.0	0.3	-0.1264	-0.2330	-0.0384

log data density: -2521.57

Table 16: Estimation results: estimate the nominal rigidities and with four shock correlations

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2519	0.2108	0.2946
ω_c	nominal rigidity in nondurable sector	beta	0.75	0.1	0.8279	0.8194	0.8373
ω_d	nominal rigidity in durable sector	beta	0.75	0.1	0.7191	0.6931	0.7482
ρ_y	policy reaction to output	gamma	0.5	0.025	0.4626	0.4407	0.4922
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.4953	1.4250	1.5749
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9310	0.9277	0.9328
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.7433	0.7118	0.7699
Standard deviations:							
$\sigma_{\xi c}$	nondurable news	gamma	0.05	0.025	0.0174	0.0160	0.0187
$\sigma_{\zeta c}$	nondurable contemporaneous	gamma	0.05	0.025	0.0189	0.0174	0.0203
$\sigma_{\xi d}$	durable news	gamma	0.05	0.025	0.0641	0.0559	0.0738
$\sigma_{\zeta d}$	durable contemporaneous	gamma	0.05	0.025	0.0640	0.0554	0.0710
σ_e	monetary	gamma	0.01	0.005	0.0186	0.0170	0.0200
Shock correlations:							
$\sigma_{\xi c \zeta c}$	nondurable news, nondurable contemporaneous	normal	0.0	0.3	−0.5722	−0.6340	−0.4893
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.3902	−0.4652	−0.3077
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.4652	−0.5530	−0.3808
$\sigma_{\xi d \zeta d}$	durable news, durable contemporaneous	normal	0.0	0.3	0.0439	−0.0574	0.1933

log data density: −2506.89

Table 17: Estimation results: estimate the nominal rigidities and with two shock correlations

Parameter	Description	Prior distribution			Posterior distribution		
		Type	Mean	Std. Dev.	Mean	90% interval	
η	elasticity of substitution between nondurables and durables	gamma	0.2	0.025	0.2490	0.1755	0.3012
ω_c	nominal rigidity in nondurable sector	beta	0.75	0.1	0.8244	0.8146	0.8346
ω_d	nominal rigidity in durable sector	beta	0.75	0.1	0.7200	0.6948	0.7408
ρ_y	policy reaction to output	gamma	0.5	0.025	0.4318	0.4041	0.4606
ρ_π	policy reaction to inflation	gamma	1.5	0.05	1.5995	1.5367	1.6488
ρ_c	persistence of shocks in nondurable sector	beta	0.7	0.05	0.9307	0.9282	0.9328
ρ_d	persistence of shocks in durable sector	beta	0.7	0.05	0.6945	0.6559	0.7299
Standard deviations:							
$\sigma_{\xi c}$	nondurable news	gamma	0.05	0.025	0.0193	0.0180	0.0208
$\sigma_{\zeta c}$	nondurable contemporaneous	gamma	0.05	0.025	0.0190	0.0175	0.0201
$\sigma_{\xi d}$	durable news	gamma	0.05	0.025	0.0671	0.0568	0.0775
$\sigma_{\zeta d}$	durable contemporaneous	gamma	0.05	0.025	0.0651	0.0567	0.0743
σ_e	monetary	gamma	0.01	0.005	0.0177	0.0159	0.0192
Shock correlations:							
$\sigma_{\xi c \xi d}$	nondurable news, durable news	normal	0.0	0.3	−0.6614	−0.7269	−0.5887
$\sigma_{\zeta c \zeta d}$	nondurable contemporaneous, durable contemporaneous	normal	0.0	0.3	−0.3563	−0.4590	−0.2474
log data density: −2468.28							

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