Appendix

This appendix includes details about the data, the empirical exercises, the model, and the quantitative results.

A Capital share data

A.1 U.S. data

We construct the net capital share in the corporate business sector from BEA Table 1.14. "Gross Value Added of Domestic Corporate Business in Current Dollars and Gross Value Added of Nonfinancial Domestic Corporate Business in Current and Chained Dollars" and focus on the data on nonfinancial corporate businesses. We compute the net capital share as compensation of employees (mnemonic A460RC1) relative to the sum of compensation and the net operating surplus (mnemonic W326RC1). Figure A.1 plots the resulting series.

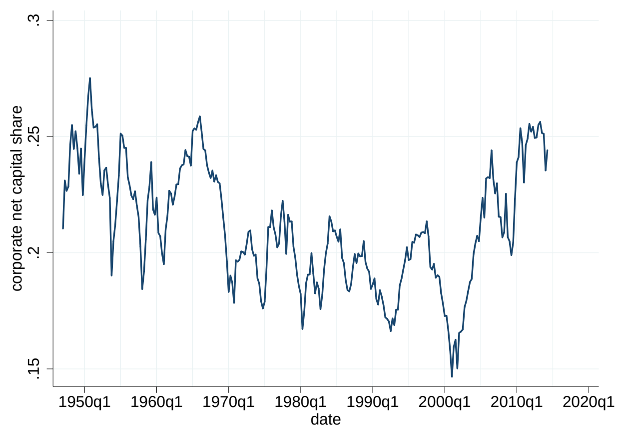


Figure A.1: Net capital share levels: quarterly U.S. data.

We also consider a number of alternative measures of the U.S. capital share for comparison:

1. Alternative measure for the corporate business sector: We compute the capital share as the reciprocal of wages over net value added (mnemonic A457RC1), effectively treating taxes as coming out of the capital share only.

2. BLS data on the (reciprocal of the) labor share in the overall business sector (mnemonic PRS84006173), the non-farm business sector (mnemonic PRS85006173), and in the corporate non-financial sector (mnemonic PRS88003173). The BLS defines the labor share as the ratio of current labor compensation paid to current dollar output, imputing a cost for labor services by proprietors. See p. 7 of `http://www.bls.gov/lpc/lpcmethods.pdf` for the definition and `http://www.bls.gov/data/#productivity` for the data.

3. Data on the capital share as the reciprocal of the U.S. labor share in the Penn World Tables (Feenstra et al., 2013).

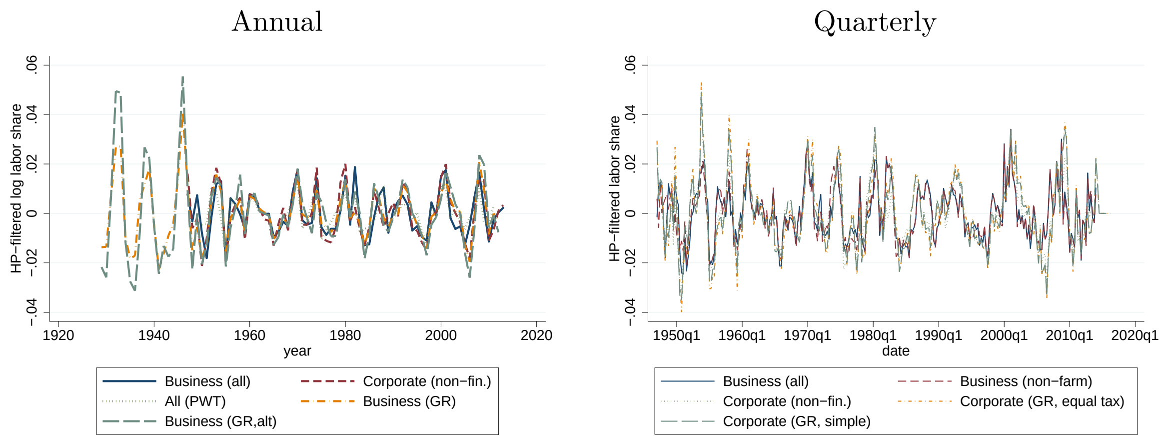


Figure A.2: Detrended labor shares in the U.S.

The different measures are reported in the two panels of Figure A.2.

Figure A.3 compares the different measures of the labor share which are available in levels. The left panel shows the annual time series, and the right panel shows the shorter quarterly series. In both annual and quarterly data, there is no clear evidence of a trend in the labor share over the full sample period. However, most measures of the labor share are close to their minimum at the end of the sample period. Note that in the quarterly data, adjusting for the share of taxes in corporate net value added only results in a roughly parallel shift of the labor share, whereas taking out net government production in the annual series changes the trend behavior. The different labor shares average between about 65 and 80%.

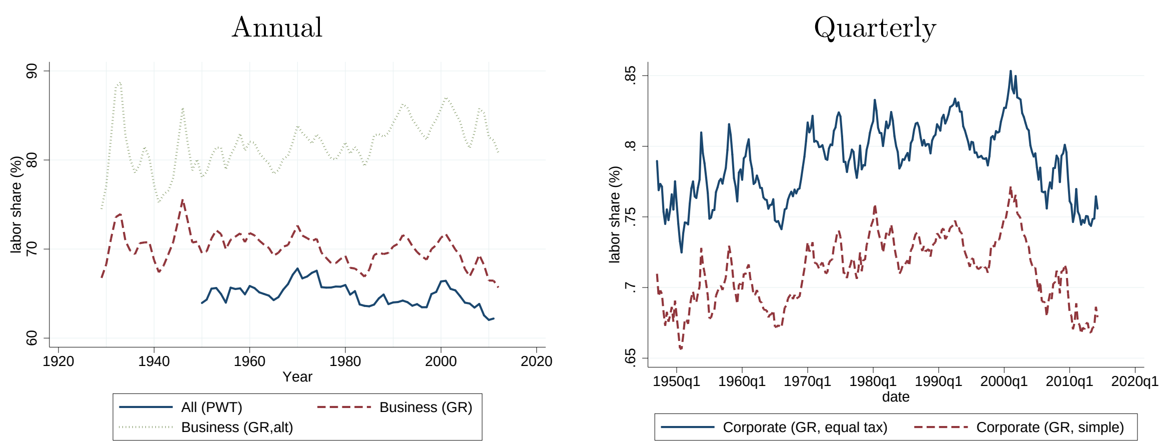


Figure A.3: Labor share levels data: Annual and quarterly.

Extending the comparison to include the BLS data comes at the cost of losing the level information. Figure A.4 shows that the raw data, indexed to 100 in 2009, correlates positively at higher frequencies, but may exhibit different time trends. Figure A.2, therefore, uses HP-filtered data on the log-labor share. Eyeballing both the annual and the quarterly filtered time series suggests a very high agreement. Correlation tables (not shown here) confirm this impression: Raw time series exhibit sometimes low correlations, but filtered correlations are above 0.6 for annual data and above 0.7 for quarterly data except for correlations between manufacturing sectors and broader measures.

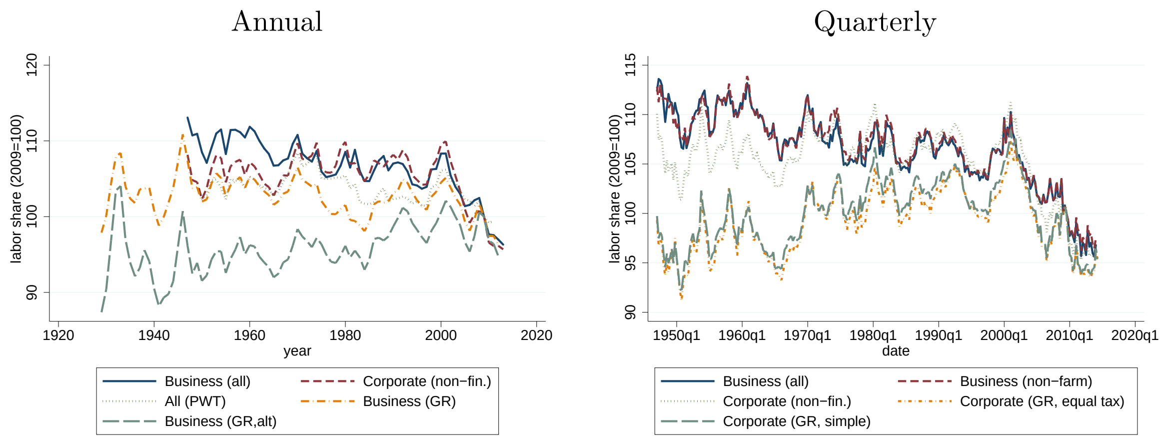


Figure A.4: Raw indexed labor shares: Annual and quarterly.

A.2 International and U.S. state level data

- Long-run capital share data: We downloaded the data in Piketty and Zucman (2014) from http://gabriel-zucman.eu/capitalisback/ and use the net capital share ("net profit share") from the data sheets on "profits & wages in the corporate sector."

- OECD capital share data: We use the OECD business sector database cited in Blanchard (1997), downloaded from http://fmwww.bc.edu/ec-p/data/oecd/oecd.bsdb.html.

- ECLAC/CEPAL capital share data: We use the "CEPALSTAT Base de Datos," available at http://interwp.cepal.org/sisgen/ConsultaIntegrada.asp?idIndicador=2197&idioma=e to obtain the wage bill ("remuneración de los asalariados") and total profits ("excedente de explotación") on an annual basis in local currency. We compute the capital share as profits over the sum of profits to the wage bill, yielding the net capital share.

- U.S. state capital share and GDP data: We use the Bureau of Economic Analysis Regional Accounts, section "Annual Gross Domestic Product By State" from http://www.bea.gov/regional/ to obtain data on "compensation of employees," "taxes on production and imports less subsidies" and "GDP in current dollars" to compute the gross capital share as one minus the compensation of employees over GDP minus taxes net of subsidies. All data are confined to (total) "private industry." Since the five-year periods in the states we are studying do not include 1997, when the BEA switches from SIC to NAICS, we pool the changes in GDP growth and the capital share based on either underlying classification.

- Annual GDP data: We use the data from the web appendix of Barro (2009) on real per capita GDP along with real GDP data from the Penn World Tables (Feenstra et al., 2013). We detrend the data with a quadratic trend after taking logarithms.

- Stock market capitalization: We used the following (nominal) indices, downloaded from http://globalfinancialdata.com/ unless otherwise stated:
  - France: "France SBF Industrials," ticker symbol "_FISID"
  - Western Germany: "Germany CDAX Industrials Price Index," ticker symbol "_CXKNXD"
  - Spain: "Madrid SE Index (old)," ticker symbol, ESMADM

  - Portugal: "Portugal Industrials," ticker symbol "PTINDUSM"
  - Argentina: "Buenos Aires SE General Index (IVBNG)," ticker symbol, "_IBGD"
  - Chile (financials): "Chile BEC Finance Index," ticker symbol "_FINANCD"
  - Chile (industrials): "Chile BEC Industrials Index (w/GFD extension)," ticker symbol "_INDUSTD"

- Price indices: We use consumer price indices to deflate the stock market indices. Except for Argentina and Chile, we downloaded the data from http://research.stlouisfed.org/fred2/:

  - France: Ticker symbol "FRACPIALLMINMEI"
  - Western Germany: Ticker symbol "DEUCPIALLMINMEI"
  - Spain: Ticker symbol "ESPCPIALLMINMEI"
  - Portugal: Ticker symbol "PRTCPIALLMINMEI"
  - Argentina: Global Financial Database "Argentina Consumer Price Index Inflation Rate," ticker symbol CPARGM
  - Chile: "Índice de Precios al Consumidor - Antecedentes históricos" from http://www.ine.cl/canales/chile_estadistico/estadisticas_precios/ipc/series_antecedentes_historicos/index.php

B Controlling for industry composition

To control for industry composition in the effect of capital income share movements in France, the U.K., and the U.S. as described in Section 2 of the main text, we use EU KLEMS data: http://www.euklems.net/. We compute the gross labor share as labor compensation relative to gross value added at basic prices. We drop the following industries from our calculations as the division between labor and capital income is less straightforward than in other industries:

- Agriculture (code: "AtB").
- Mining (code: "C").
- Government (code: "L").
- Financial intermediation (code: "J").

We keep the most disaggregated industries available, leaving a total of 27 industries with data available for the three countries.

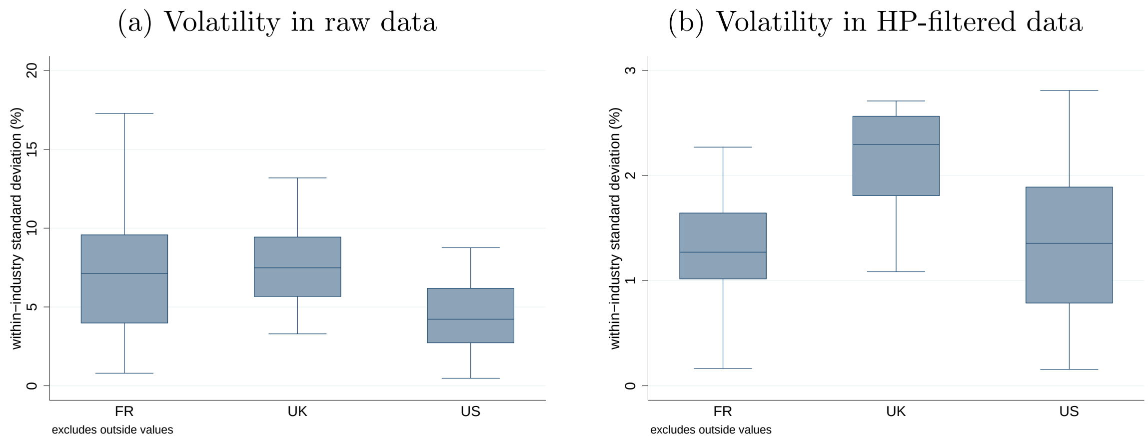


Figure B.5: Within-industry volatility of the gross labor share.

C Additional results on the international evidence

Here we present additional material on the international evidence: First, on the case studies and, second, on labor regulation and capital shares.

C.1 Additional results on the case studies

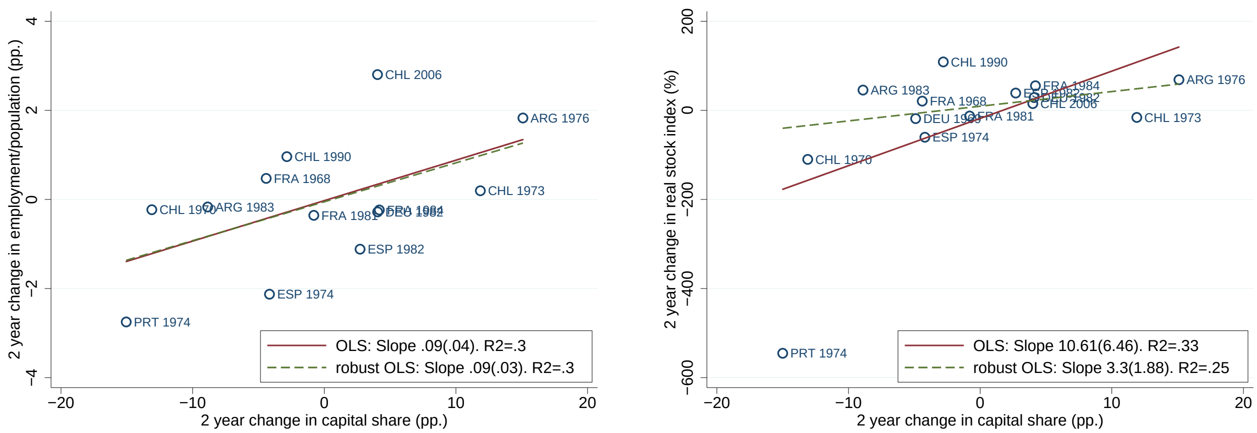
As a supplement to the time series discussed in the main text, we summarize the effect of the political events in the case studies in Table C.1. The table shows the change in the available capital share measure one year after the event year compared to one year before the event, i.e., two-year changes. Also, we show the corresponding changes in the employment-to-population ratio, computed using the Feenstra et al. (2013) data, and the change in the real stock index.

Table C.1: Political events, 2-year changes in capital shares, and employment

	Date		Δ capital share	Δ employment / population	Δ stock index
OECD data	Year	Month	pp.	pp.	%
Spain: Franco's illness	1974	7	-4.2	-2.1	-60.4
Spain: Gonzalez administration	1982	12	2.7	-1.1	38.8
Argentina: Coup against J. Peron	1955	9	5.5		
Argentina: Coup against I. Peron	1976	3	15.1	1.8	68.7
Argentina: Democratic transition	1983	12	-8.9	-.2	45.5
Chile: Allende election	1970	11	-13.1	-.2	-110.1
Chile: Pinochet coup	1973	9	11.9	.2	-15.9
Chile: Democratic election	1990	3	-2.8	1	108.7
Chile: Democratic transition	2006	3	4	2.8	15.1
France: 1968 strikes	1968	5	-4.4	.5	20.7
France: Mitterrand's election	1981	5	-.8	-.4	-12.8
France: Mitterrand's policy change	1984	7	4.2	-.2	55.2
Portugal: Carnation Revolution	1974	4	-15	-2.7	-545.3
W Germany: Brandt election	1969	10	-4.9		-18.6
W Germany: Kohl administration	1982	10	4.1	-.3	28.7

Figure C.6 shows the robust positive association between capital share changes and both employment and stock market changes. We compute both OLS regressions and weighted OLS regressions, where the weights are generated by Stata's robust regression `rreg` command that weighs down outliers and, in the case of the stock market change in Portugal, drops extreme observations. The relationship with capital share changes is always positive and particularly robust for employment changes, with implied t-statistics between 2.25 and 3.00. The t-statistics for the stock index slopes are somewhat lower, between 1.64 and 1.76. The R^2 statistics are 0.30 for the employment relationship and between 0.25 and 0.33 for the stock market regressions, indicating a moderate to strong correlation.

(a) Employment-population ratio (b) Real stock index



Heteroskedasticity-robust standard errors for slope coefficients in parentheses.

Figure C.6: Political events: 2-year changes in capital shares vs 2-year changes in employment and stock indices.

C.2 Additional results on labor regulation and capital shares

We report here some additional regression results on labor regulation and capital shares. Table C.2 documents the regression estimates for the three-year effects of changes in labor regulation on capital shares. Table C.3 does the same for the one-year effects of changes in labor regulation on capital shares. We try different specifications, such as examining only changes within the year of the political event or labor-regulation change, and using all countries for which we have labor share and capital share data with OLS, following our algorithm blindly by assigning 1976 as the democratization date for Portugal, or using the Carnation Revolution date of 1974.

In both tables, "5y FE" refers to a fixed effect for the five-year period surrounding the event. "Initial conditions" are the level of capital share and real per capita GDP growth in the year prior to the estimation period. In the baseline IV regressions, we only include countries with political events, as defined in the main text. Alternatively, we include all observations for the countries with political events. For the OLS case, we also run the regression of the sample of all countries with capital share and labor regulation data.

Table C.2: Three-year effects of changes in labor regulation on capital shares: Regression estimates

Specification	5y FE	Initial conditions	Effect on capital share	t-stat	1-stage t-stat
All countries: OLS	–	–	-0.92	-5.20	.
	y	–	-0.86	-4.08	.
All countries: OLS	–	y	-0.90	-4.67	.
	y	y	-0.84	-4.01	.
Event countries: OLS	–	–	-1.49	-3.47	.
	y	–	-1.56	-3.72	.
	–	y	-1.40	-3.13	.
	y	y	-1.49	-3.41	.
Event episodes: OLS	–	–	-5.21	-3.16	.
	y	–	-6.21	-2.86	.
	–	y	-5.43	-2.48	.
	y	y	-5.22	-2.40	.
Carnation Revolution date					
Event episodes: IV	–	–	-6.94	-2.98	2.28
	y	–	-8.39	-3.62	2.62
	–	y	-7.94	-2.18	1.72
	y	y	-8.94	-2.90	1.85
Event countries: IV	–	–	-4.58	-3.21	2.09
	y	–	-4.06	-2.81	3.00
	–	y	-4.06	-2.55	2.01
	y	y	-4.17	-2.90	2.96
Pure algorithm					
Event episodes: IV	–	–	-5.28	-2.31	2.27
	y	–	-5.35	-2.01	2.69
	–	y	-4.74	-1.83	1.89
	y	y	-4.96	-1.63	2.03
Event countries: IV	–	–	-3.99	-3.48	2.29
	y	–	-3.52	-2.91	3.03
	–	y	-3.66	-2.90	2.23
	y	y	-3.61	-2.95	3.01

Table C.3: One-year effects of changes in labor regulation on capital shares: Regression estimates

Specification	5y FE	Initial conditions	Effect on capital share	t-stat	1-stage t-stat
All countries: OLS	–	–	-0.45	-3.34	.
	y	–	-0.44	-3.00	.
All countries: OLS	–	y	-0.43	-3.29	.
	y	y	-0.43	-2.95	.
Event countries: OLS	–	–	-0.82	-2.71	.
	y	–	-0.84	-2.68	.
	–	y	-0.81	-2.73	.
	y	y	-0.84	-2.73	.
Event episodes: OLS	–	–	-3.03	-1.56	.
	y	–	-2.85	-1.24	.
	–	y	-2.89	-1.39	.
	y	y	-2.99	-1.12	.
	Carnation Revolution date				
Event episodes: IV	–	–	-5.67	-2.01	2.34
	y	–	-5.35	-2.10	2.45
	–	y	-5.79	-2.01	2.24
	y	y	-5.61	-2.46	2.26
Event countries: IV	–	–	-2.35	-2.43	2.03
	y	–	-2.33	-2.28	2.23
	–	y	-2.25	-2.32	2.02
	y	y	-2.26	-2.22	2.23
	Pure algorithm				
Event episodes: IV	–	–	-5.77	-2.00	2.37
	y	–	-5.86	-2.45	2.60
	–	y	-5.40	-2.08	2.37
	y	y	-6.13	-3.20	2.62
Event countries: IV	–	–	-2.10	-2.34	2.12
	y	–	-2.09	-2.27	2.35
	–	y	-2.06	-2.33	2.12
	y	y	-2.05	-2.25	2.34

D Additional evidence regarding right-to-work legislation

We repeat the same exercise as in Subsection 2.3, but now we look at real GDP growth instead of labor shares. Real GDP growth is computed using the change in state total private-sector GDP deflated by the national GDP deflator. Since the data start only in 1963, the year Wyoming adopted the new legislation, the GDP growth in Wyoming is normalized to zero for the first year after adoption. Before 1997 we use private SIC industries. From 1997, we use private NAICS industries.

Figure D.7 reports the evolution of real state private industry GDP growth after the adoption of right-to-work legislation (in absolute levels and relative to the U.S.). Table D.4 presents a panel regression analysis of the data. Standard errors are clustered by state and industry, and two-sided p-values are in parentheses.

Change in real GDP growth and change relative to U.S.

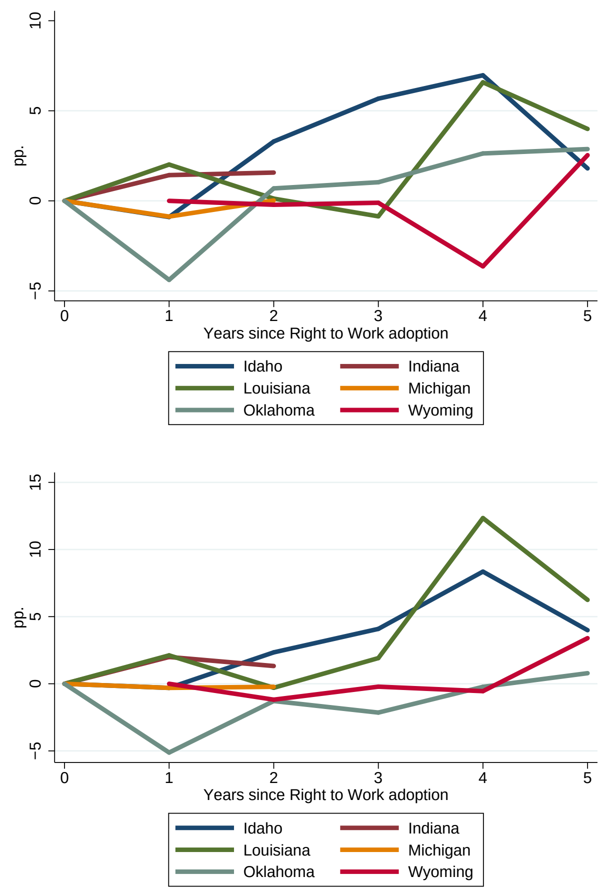


Figure D.7: Change in real state private industry GDP growth after right-to-work adoption.

Table D.4: State-Industry panel regression: Right-to-work laws and real GDP growth

Controlling for census region FE, year FE, and industry FE

	Level	1y change	2y change	3y change	4y change	5y change
Right to Work	1.02					
	(0.00)					
Change in RtW		0.41	-0.31	-0.12	-0.13	-0.09
		(0.70)	(0.69)	(0.82)	(0.78)	(0.85)

Controlling for state FE, and industry FE

	Level	1y change	2y change	3y change	4y change	5y change
Right to Work	-0.01					
	(0.99)					
Change in RtW		0.83	0.15	0.96	1.12	0.96
		(0.43)	(0.84)	(0.08)	(0.02)	(0.06)

Controlling for state FE, quadratic trend, and industry FE

	Level	1y change	2y change	3y change	4y change	5y change
Right to Work	0.65					
	(0.08)					
Change in RtW		0.96	0.14	0.96	1.12	0.97
		(0.36)	(0.86)	(0.08)	(0.02)	(0.05)

Controlling for state FE, year FE, and industry FE

	Level	1y change	2y change	3y change	4y change	5y change
Right to Work	0.41					
	(0.27)					
Change in RtW		0.56	-0.22	-0.02	-0.02	-0.04
		(0.60)	(0.79)	(0.97)	(0.97)	(0.94)

E Additional VAR results

We plot here, in Figure E.8, the IRFs from the small VAR with a quadratic trend.

F Large VAR

To better control for the state of the economy and check the robustness of the VAR exercise in the main text, we now present results using a larger VAR. In addition to the labor market and the non-corporate business sector, this VAR captures asset prices, consumption, and investment. As a result, we arrive at the following ten-variable VAR: (1) the (log) of the federal minimum wage relative to the PCE deflator, (2) the net capital share in the corporate non-financial sector, (3) the average of the total returns of consumer and manufacturing firms, (4) the unemployment rate, (5) non-farm labor productivity in the business sector, (6) labor market tightness, (7) capacity utilization, (8) real private investment, (9) real private consumption, and (10) the average corporate tax rate. Instead of using the cumulative total return in Greenwald et al. (2014), we use the (unweighted) average of the cumulative total return in the consumer and manufacturing sectors based on the five-sector Fama-French industry classification because we expect the minimum wage to be more important in these sectors.[29] Again, we use four lags in the estimation.

[29]We use these sectors because our empirical model does not speak much to the other three sectors. We focus on the non-financial corporate business sectors and thus drop the "other" sector that includes financial firms. Also, given that less than 10% of paid hours are directly affected by the minimum wage and spillovers to higher wage groups are limited, we conjecture the consumer sector (including wholesale and retail) and manufacturing sector are the most affected. See Ken French's data library for the source data: http://mba.tuck.dartmouth.edu/pages/faculty/ken.

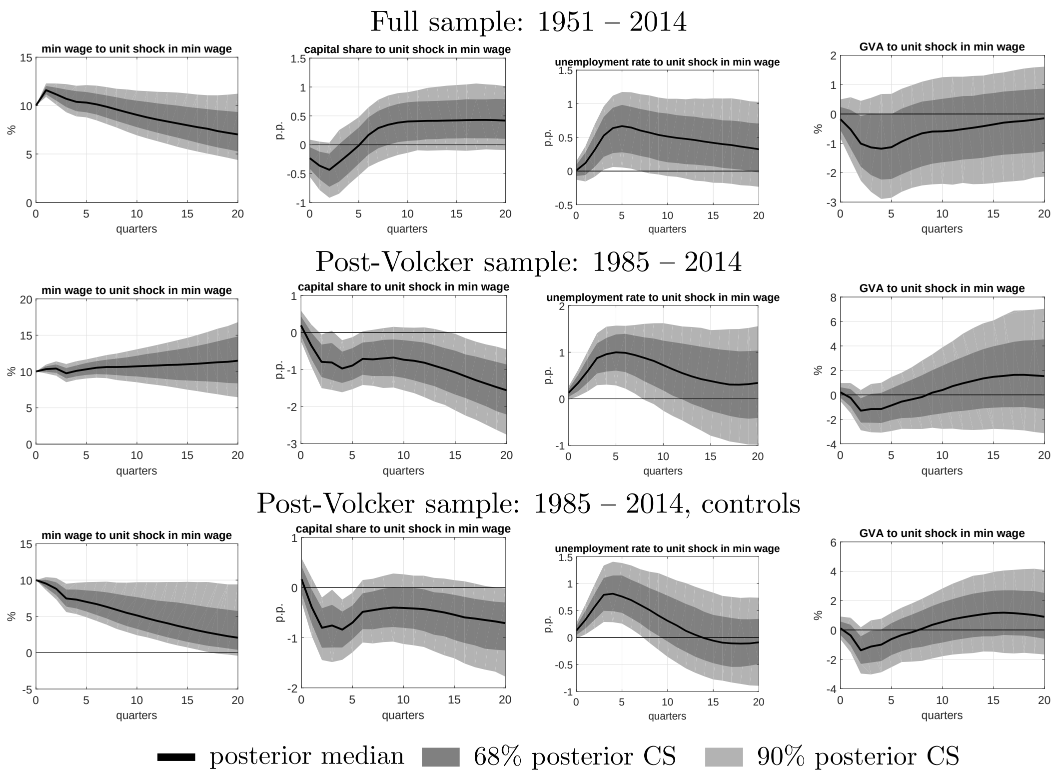


Figure E.8: Responses to a 10% real minimum wage shock in small VAR, quadratic trend.

Minimum wage shocks are also clearly redistributive in this large VAR. Figure F.9 shows the IRFs to a typical minimum wage shock of 10%. Such a shock causes the capital share to drop by 0.25 to 0.5 pp. for two to five quarters with 68% posterior credibility. The labor market worsens, with unemployment rising by 0.5 to 1.5 pp. about a year after the initial shock. Labor productivity increases slightly with a delay, consistent with a selection effect. We also find that the stock market valuation drops significantly. Investment drops 5% at the peak and with it capacity utilization. Finally, there is a delayed decline in the average corporate tax rate. This decline may reflect the progressivity of the corporate tax code as corporate profits fall.

Many states set minimum wages above the federal level, particularly in the second half of our full sample (cf. Autor et al., 2016). Hence, we incorporate state minimum wage changes in our analysis. More concretely, prior to estimation, we aggregate minimum wages across states by weighting them with the relative populations of each state. This weighting is imperfect given that the unemployment rate in our VAR is labor force weighted and stock returns are weighted by market capitalization.[30]

Combining state and federal minimum wage strengthens the redistributive effects we estimate; see Figure F.10. After a minimum wage shock, there is a drop in the capital share that lasts for three to four years and peaks -1 to -1.5 pp. after six quarters. With a delay, unemployment rises significantly after five quarters, while stock values, consumption, and utilization fall. The differences in the size and shape of the IRFs of this exercise are not due to the different sample

`french/data_library.html`. Our results change little when we include only one of the sectors at a time.

[30]We use the data from Autor et al. (2016). Their coverage of Washington, D.C., has a gap so that we drop it. For the other states, we compute the change in the maximum of the state and the federal minimum wage, quarter by quarter. We deflate this nominal increase and average it across states using population annual weights.

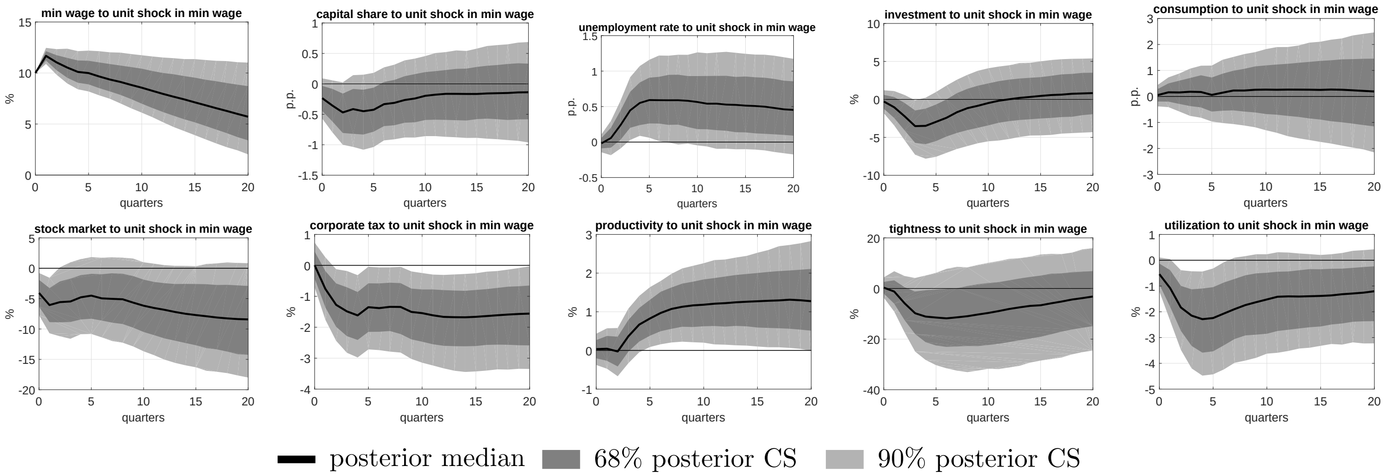


Figure F.9: Responses to a 10% real minimum wage shock in extended VAR: 1951–2014.

period compared to our large VAR baseline.

We also report several robustness exercises. First, in Figure F.11, we plot the IRFs from the large VAR in the post 1974 sample. Second, in Figure F.12, we plot the IRFs from the same VAR, but now with a quadratic trend and using shocks to the real effective state-level minimum wage. Third, in Figure F.13, we plot the IRFs of the same VAR with a quadratic trend for the full 1951-2014 sample.

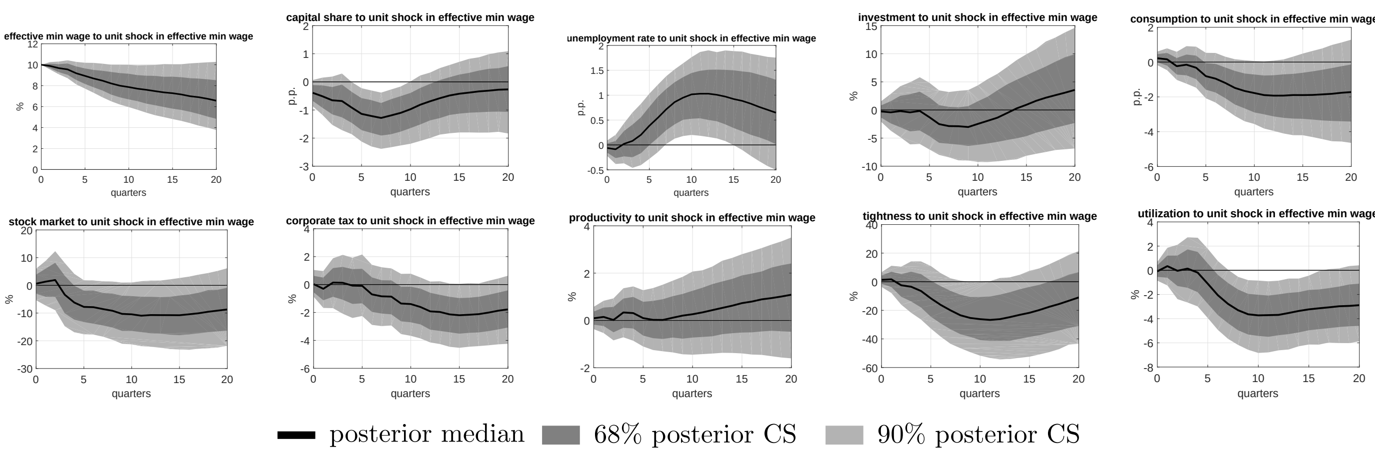


Figure F.10: Responses to a 10% real effective state level minimum wage shock in extended VAR: 1974–2014.

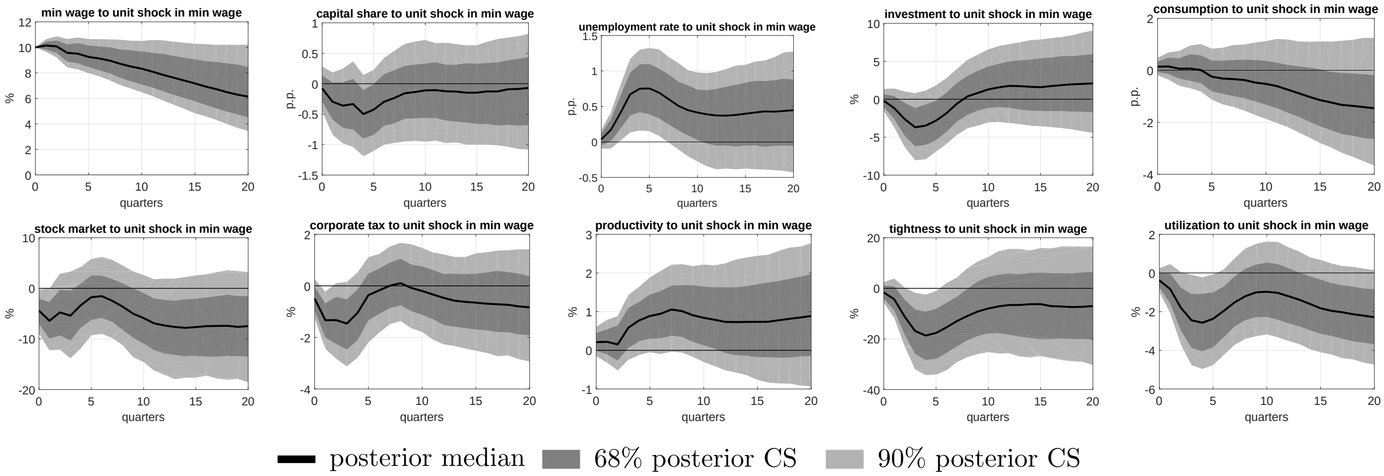


Figure F.11: Responses to a 10% real minimum wage shock in extended VAR: 1974–2014.

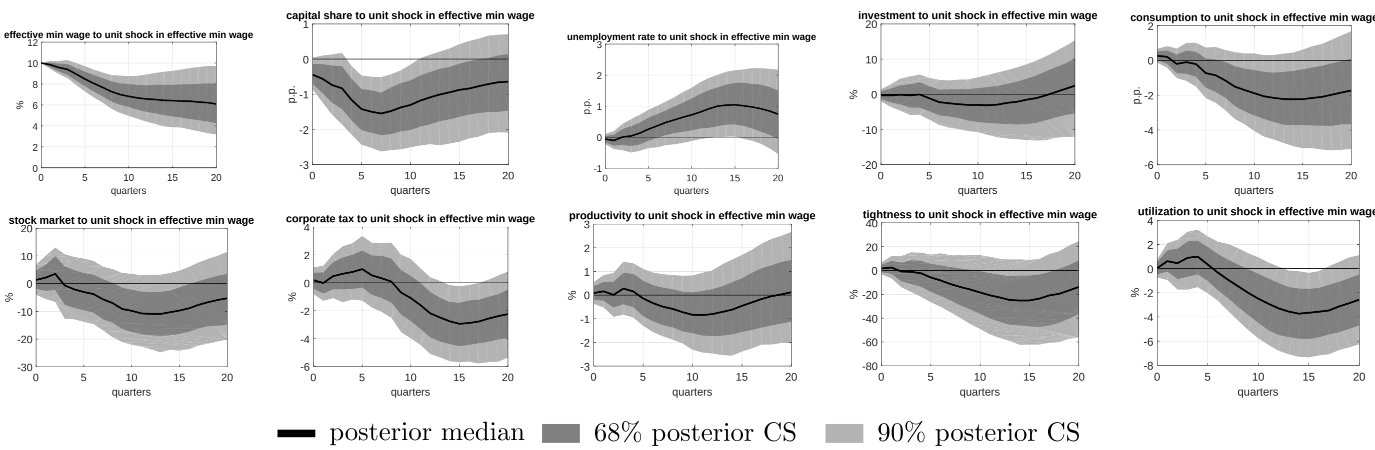


Figure F.12: Responses to a 10% real effective state-level minimum wage shock in extended VAR: 1974–2014, quadratic trend.

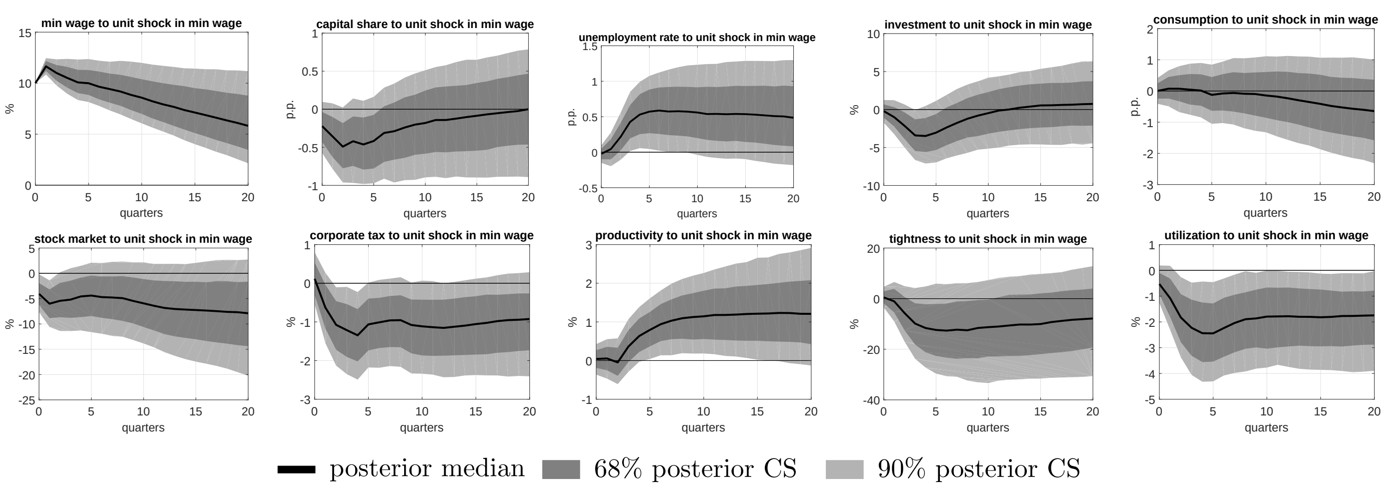


Figure F.13: Responses to a 10% real minimum wage shock in extended VAR: 1951–2014, quadratic trend.

G Model appendix

Our business cycle model with search frictions in the labor market is in the spirit of those in Andolfatto (1996) and Merz (1995) and builds on the formulation of Shimer (2010, ch. 3). Relative to the notation in Shimer (2010), we change the timing convention so that capital k_t and employment n_t are time t measurable, but not time $t-1$ measurable.

G.1 Households

G.1.1 Preferences and constraints

There is a representative household that perfectly ensures its members against idiosyncratic risk. The following utility function represents its preferences:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{(c_{e,t} - hc^a_{e,t-1})^{1-\sigma}(1+(\sigma-1)\gamma)^{\sigma} - 1}{1-\sigma} n_{t-1} + \frac{(c_{u,t} - hc^a_{u,t-1})^{1-\sigma} - 1}{1-\sigma}(1-n_{t-1}) \right), \quad \text{(G.1)}$$

where $c_{e,t}$ and $c_{u,t}$ are the consumption of the employed and unemployed household members, respectively, and n_{t-1} denotes the fraction of employed households. The parameter $h \in [0,1)$ controls the strength of the external habit.

The household faces a lifetime budget constraint given the stochastic discount factor m_t:

$$a_{-1} = \mathbb{E}_0 \sum_{t=0}^{\infty} \left(\prod_{s=0}^{t} m_t \right) (c_{e,t} n_{t-1} + c_{u,t}(1-n_{t-1}) - (1-\tau_n) w_t n_{t-1} - T_t), \quad \text{(G.2)}$$

where the present discounted value of consumption equals the beginning of the period financial wealth a_{-1} plus net labor income $(1-\tau_n)w_t n_{t-1}$ and lump-sum transfers T_t.

When making its decisions, the representative household considers that workers lose their jobs at rate x and find new jobs at rate $f(\theta_t)$, where θ_t is the recruiter-unemployment ratio that the household takes as given. Thus, the fraction of household members employed next period will be:

$$n_t = (1-x)n_{t-1} + f(\theta_t)(1-n_{t-1}) \quad \text{(G.3)}$$

where $f(\theta_t) = \xi\theta_t^{\eta}$.

G.1.2 Aggregation

Under perfect insurance within the family, a necessary condition for the household's optimality is that consumption of the employed and unemployed satisfy:

$$\beta^t (c_{e,t} - hc^a_{e,t-1})^{-\sigma}(1+(\sigma-1)\gamma)^{\sigma} = \beta^t (c_{u,t} - hc^a_{u,t-1})^{-\sigma} = \lambda m_t,$$

where λ is the Lagrangian multiplier associated with the budget constraint. If $h=0$ or given the initial condition that $c^a_{e,t-1} = c^a_{u,t-1}(1+(\sigma-1)\gamma)$, it follows that:

$$c_{e,t} = c_{u,t}(1+(\sigma-1)\gamma)$$

and

$$
\begin{aligned}
c_t &\equiv c_{e,t}n_{t-1} + c_{u,t}(1-n_{t-1}) \\
c_{u,t} &= \frac{c_t}{1+(\sigma-1)\gamma n_{t-1}} \\
c_{e,t} &= \frac{c_t(1+(\sigma-1)\gamma)}{1+(\sigma-1)\gamma n_{t-1}}.
\end{aligned}
$$

Hence, the utility function can be simplified as:

$$
U_0 = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\left(c_t - hc_{t-1}^a \frac{1+(\sigma-1)\gamma n_{t-1}}{1+(\sigma-1)\gamma n_{t-2}^a}\right)^{1-\sigma} (1+(\sigma-1)\gamma n_{t-1})^{\sigma} - 1}{1-\sigma}, \tag{G.4}
$$

and the budget constraint becomes:

$$
a_{-1} = \mathbb{E}_0 \sum_{t=0}^{\infty} \left(\prod_{s=0}^{t} m_t \right) (c_t - (1-\tau_n)w_t n_{t-1} - T_t). \tag{G.5}
$$

With $h > 0$, the household partially internalizes that increasing employment changes the size of habit one period ahead. Setting $h = 0$ recovers equation (4.1) in the main text.

G.1.3 Equilibrium conditions

We start the analysis of the labor market by writing the household problem using a recursive formulation:

$$
V(a_{-1}, n_{-1}; S) = \max_{a(S'),c,n} \frac{(c - \hat{h}(n_{-1})c_{-1}^a)^{1-\sigma}(1+(\sigma-1)\gamma n_{-1})^{\sigma} - 1}{1-\sigma} + \beta \mathbb{E}[V(a(S'), n; S')|S]
$$

subject to:

$$
n = (1-x)n_{-1} + f(\theta)(1-n_{-1}) \tag{G.6}
$$

$$
c = a_{-1} + (1-\tau_n)w_t n_{-1} + T_t - \mathbb{E}[m(S')a(S')|S] \tag{G.7}
$$

and where:

$$
\hat{h}(n_{-1}) = h \frac{1+(\sigma-1)\gamma n_{-1}}{1+(\sigma-1)\gamma n_{-2}^a}.
$$

Complete markets ensure that the household can pick next period's assets as a function of the future state S'.

The equilibrium conditions for an interior equilibrium are:

$$
\lambda = (c - \hat{h}(n_{-1})c_{-1}^a)^{-\sigma}(1+(\sigma-1)\gamma n_{-1})^{\sigma} \tag{G.8}
$$

$$
\lambda m(S') = \beta V_a(a(S'), n; S') = \beta \lambda(S') = \beta (c(S') - \hat{h}(n)c^a)^{-\sigma}(1+(\sigma-1)\gamma n)^{\sigma}. \tag{G.9}
$$

Thus, the stochastic discount factor of the economy is:

$$m(S') = \beta \frac{(c(S') - \hat{h}(n)c^a)^{-\sigma}(1 + (\sigma - 1)\gamma n)^{\sigma}}{(c - \hat{h}(n_{-1})c^a_{-1})^{-\sigma}(1 + (\sigma - 1)\gamma n_{-1})^{\sigma}}. \tag{G.10}$$

In equilibrium, $c^a = c$. In what follows, we use m_t as a short-hand for $m(S_t)$ with $m_0 = 1$.

The marginal value of employment is given by:

$$\begin{aligned} V_n(a_{-1}, n_{-1}; S) = &\left(\frac{c - \hat{h}(n_{-1})c^a_{-1}}{1 + (\sigma - 1)\gamma n_{-1}} \right)^{-\sigma} (1 - \tau_n) w \\ &- \left(\frac{c - \hat{h}(n_{-1})c^a_{-1}}{1 + (\sigma - 1)\gamma n_{-1}} \right)^{1-\sigma} \gamma \left(\sigma + (\sigma - 1) \frac{\hat{h}(n_{-1})c^a_{-1}}{c - \hat{h}(n_{-1})c^a_{-1}} \right) \\ &+ \beta(1 - x - f(\theta)) \mathbb{E}\left[V_n(a(S'), n; S') | S \right]. \end{aligned} \tag{G.11}$$

A useful equilibrium object is the value of having a worker employed at an arbitrary wage $\tilde{w}$ this period and at the equilibrium wage thereafter:

$$\tilde{V}_n(a, n_{-1}; S) = \left(\frac{c - \hat{h}(n_{-1})c^a_{-1}}{1 + (\sigma - 1)\gamma n_{-1}} \right)^{-\sigma} (1 - \tau_n)(\tilde{w} - w) + V_n(a_{-1}, n_{-1}; S). \tag{G.12}$$

$\tilde{V}_n$ differs from the marginal value of an extra worker employed at the equilibrium wage both this period and thereafter, i.e., V_n, by the marginal utility of income times the difference in the net wage income.

In what follows, we write $\mathbb{E}_t[\cdot]$ for the conditional expectation $\mathbb{E}[\cdot|S_t]$ and similarly index the value function instead of explicitly carrying the state vector and its other arguments.

G.2 Firm

G.2.1 Firm environment

There is a representative firm with n_{-1} workers and capital k_{-1}. It assigns a fraction ν_0 of its n_{-1} workers to recruiting and the remaining $n_{-1}(1 - \nu_0)$ to production. The firm produces a homogeneous output with production function:

$$\begin{aligned} y_t = &\left(\alpha^{1/\varepsilon}(u_t k_{t-1})^{1-1/\varepsilon} + (1 - \alpha)^{1/\varepsilon}(e^{g_z t} z_t n_{t-1}(1 - \nu_t))^{1-1/\varepsilon} \right)^{\frac{\varepsilon}{\varepsilon - 1}} \\ \equiv &\, \psi(u_t k_{t-1}, z_t n_{t-1}(1 - \nu_t)). \end{aligned} \tag{G.13}$$

The constant elasticity of substitution between effective capital and labor in production is given by ε, labor-augmenting growth trend g_z, and the productivity process z_t that follows, for the moment, the AR(1) specified in the main text.

The law of motion for capital is:

$$k_t = (1 - \delta(u_t))k_{t-1} + \chi i_t \left(1 - \frac{1}{2}\kappa \left(\frac{i_t}{k_{t-1}} - \tilde{\delta} \right)^2 \right), \tag{G.14}$$

where $\tilde{\delta} \equiv g_z - (1-\delta(\bar{u}))$, χ is the marginal efficiency of investment, and

$$\delta(u) = \delta_0 + \delta_1(u-1) + \frac{1}{2}\delta_2(u-1)^2. \tag{G.15}$$

The firm's value is given by:

$$J(n_{-1}, k_{-1}) = \mathbb{E}\sum_{t=0}^{\infty}\left(\prod_{s=1}^{t} m_t\right)\left((1-\tau_k)(y_t - w_t n_t) + \tau_k \delta(\bar{u})\bar{q}k_{t-1} - i_t\right),$$

where production and capital follow from equations (G.73) and (G.14) and employment growth satisfies:

$$n_t = (\nu_t \mu(\theta_t) + 1 - x)n_{t-1},$$

where $\mu(\theta_t) \equiv f(\theta_t)/\theta_t$ is the hiring probability per recruiter.

The firm's value can be expressed recursively as:

$$\begin{aligned} J(n_{-1}, k_{-1}) = \max_{\nu,u,k,I}\Bigg(&(1-\tau_k)\left(\psi(uk_{-1}, zn_{-1}(1-\nu)) - n_{-1}w\right) + \tau_k\bar{\delta}k_{t-1} - I \\ &+ q\left(-k + (1-\delta(u))k_{-1} + \chi I\left(1 - \frac{1}{2}\kappa\left(\frac{I}{k_{-1}} - \tilde{\delta}\right)^2\right)\right) \\ &+ \mathbb{E}\left[mJ(n_{-1}(\nu\mu(\theta)+1-x), k)\right]\Bigg). \end{aligned} \tag{G.16}$$

G.2.2 Firm optimality

At an interior solution for the share of recruiters, the following optimality condition holds:

$$(1-\tau_k)\underbrace{z_t\left((1-\alpha)\frac{Y_t}{z_t n_{t-1}(1-\nu_t)}\right)^{\frac{1}{\varepsilon}}}_{\equiv mpl_t} = \mu(\theta_t)\mathbb{E}[m_{t+1}J_n(n_t, k_t,)]. \tag{G.17}$$

Thus, the marginal value of employment is given by:

$$\begin{aligned} J_n(n_{t-1}, k_{t-1}) &= (1-\tau_k)\left(mpl_t \times (1-\nu_t) - w_t\right) + (\nu_t\mu(\theta_t) + 1 - x)\,\mathbb{E}\left[m_{t+1}J_n(n_t, k_t)\right] \\ &= (1-\tau_k)\left(mpl_t\left(1 + \frac{1-x}{\mu(\theta_t)}\right) - w_t\right), \end{aligned} \tag{G.18}$$

using equation (G.17) to substitute for $\mathbb{E}\left[m_{t+1}J_n(n_t, k_t)\right]$. The constant taxes τ_k do not distort the recruiting decision because they affect costs and benefits proportionally.

In a similar way to the household problem, define the marginal profit of employing a worker at an arbitrary (off-equilibrium) wage $\tilde{w}$ and at the equilibrium wage from then on, given employment and capital at the firm:

$$\tilde{J}_n(n,k) = (1-\tau_k)(w_t - \tilde{w}) + J_n(n,k). \tag{G.19}$$

The optimality condition for the utilization rate is:

$$\delta'(u_t)q_t k_{t-1} = (\delta_1 + \delta_2(u_t - 1))\, q_t k_{t-1} = (1-\tau_k)\left(\alpha \frac{y_t}{u_t k_{t-1}}\right)^{1/\varepsilon} k_{t-1} \equiv (1-\tau_k)\frac{mpk_t}{u_t}, \tag{G.20}$$

and for investment:

$$1 = q_t \chi \left(\left(1 - \frac{1}{2}\kappa \left(\frac{i_t}{k_{t-1}} - \tilde{\delta}\right)^2\right) - \kappa \left(\frac{i_t}{k_{t-1}} - \tilde{\delta}\right) \frac{i_t}{k_{t-1}} \right). \tag{G.21}$$

The optimality condition for capital k' is given by:

$$\begin{aligned} q_t &= \mathbb{E}[m_{t+1} J_k(n_t, k_t)] \\ &= \mathbb{E}\left[m_{t+1} \left(mpk_{t+1}(1-\tau_k) + \tau_k \bar{\delta} + \left((1 - \delta(u_{t+1})) + \chi\kappa \left(\frac{i_{t+1}}{k_t}\right)^2 \left(\frac{i_{t+1}}{k_t} - \tilde{\delta}\right)\right) q_{t+1} \right)\right] \end{aligned} \tag{G.22}$$

where the marginal product of physical capital is:

$$mpk_{t+1} \equiv u_{t+1}\left(\alpha \frac{Y_{t+1}}{u_{t+1} k_t}\right)^{\frac{1}{\varepsilon}}. \tag{G.23}$$

G.3 Wage determination

Under Nash bargaining, the equilibrium wage solves, for a generic time-varying ϕ_t:

$$w_t = \arg\max_{\tilde{w}} \tilde{V}_n(\tilde{w})^{\phi_t} \tilde{J}_n(\tilde{w})^{1-\phi_t}.$$

The solution of this bargaining problem requires that, after plugging in from equations (G.19) and (G.12), the following condition holds

$$(1-\phi_t)(1-\tau_k) \underbrace{V_n(a_t, n_{t-1})}_{\equiv V_{n,t}} \left(\frac{c_t - \hat{h}_{t-1} c^a_{t-1}}{1 + (\sigma - 1)\gamma n_{t-1}}\right)^{\sigma} = \phi_t (1-\tau_n) \underbrace{J_n(n_{t-1}, k_{t-1})}_{\equiv J_{n,t}}. \tag{G.24}$$

We use this expression to simplify equation (G.11) - after multiplying (G.11) through by $(1-\tau_k)$. First, we rewrite:

$$\begin{aligned} &(1-\phi_t)(1-\tau_k)V_{n,t}\left(\frac{c_t - \hat{h}_{t-1}c^a_{t-1}}{1+(\sigma-1)\gamma n_{t-1}}\right)^{\sigma} \\ =&(1-\phi_t)(1-\tau_k)(1-\tau_n)w_t - (1-\phi_t)(1-\tau_k)\left(\frac{c_t - \hat{h}_{t-1}c^a_{t-1}}{1+(\sigma-1)\gamma n_{t-1}}\right)\gamma\left(\sigma + (\sigma-1)\frac{\hat{h}_{t-1}c^a_{t-1}}{c_t - \hat{h}_{t-1}c^a_{t-1}}\right) \\ &+ (1 - x - f_t(\theta_t))\mathbb{E}_t\left[\beta_t \left(\frac{(c_t - \hat{h}_{t-1}c^a_{t-1})/(1+(\sigma-1)\gamma n_{t-1})}{(c_{t+1} - \hat{h}_t c^a_t)/(1+(\sigma-1)\gamma n_t)}\right)^{\sigma} \frac{1-\phi_t}{1-\phi_{t+1}} \right. \\ &\qquad \left. \times (1-\phi_{t+1})\left(\frac{c_{t+1} - \hat{h}_t c^a_t}{1+(\sigma-1)\gamma n_t}\right)^{\sigma}(1-\tau_k)V_{n,t+1}\right]. \end{aligned}$$

Next, we substitute from equation (G.24):

$$
\begin{aligned}
&\phi_t(1-\tau_n)J_{n,t}\\
=&(1-\phi_t)(1-\tau_k)(1-\tau_n)w_t-(1-\phi_t)(1-\tau_k)\left(\frac{c_t-\hat{h}_{t-1}c^a_{t-1}}{1+(\sigma-1)\gamma n_{t-1}}\right)\gamma\left(\sigma+(\sigma-1)\frac{\hat{h}_{t-1}c^a_{t-1}}{c_t-\hat{h}_{t-1}c^a_{t-1}}\right)\\
&+(1-x-f_t(\theta_t))\mathbb{E}_t\left[\frac{1-\phi_t}{1-\phi_{t+1}}m_{t+1}\phi_{t+1}(1-\tau_n)J_{n,t+1})\right].
\end{aligned}
$$

Then, we substitute from equation (G.18) for current J_n:

$$
\begin{aligned}
&\phi_t(1-\tau_k)(1-\tau_n)\left(mpl_t\left(1+\frac{1-x}{\mu(\theta_t))}\right)-w_t\right)\\
=&(1-\phi_t)(1-\tau_k)(1-\tau_n)w_t-(1-\phi_t)(1-\tau_k)\left(\frac{c_t-\hat{h}_{t-1}c^a_{t-1}}{1+(\sigma-1)\gamma n_{t-1}}\right)\gamma\left(\sigma+(\sigma-1)\frac{\hat{h}_{t-1}c^a_{t-1}}{c_t-\hat{h}_{t-1}c^a_{t-1}}\right)\\
&+(1-\tau_n)(1-x-f_t(\theta_t))\mathbb{E}_t\left[\frac{1-\phi_t}{1-\phi_{t+1}}\phi_{t+1}m_{t+1}J_{n,t+1}\right].
\end{aligned}
\tag{G.25}
$$

If ϕ_t were constant, we could substitute out for future J_n conveniently from the recruiting optimality condition (G.17).

G.4 Market clearing

Market clearing involves, first, the resource constraint of the economy:

$$y_t\equiv\left(\alpha^{1/\varepsilon}(u_tk_{t-1})^{1-1/\varepsilon}+(1-\alpha)^{1/\varepsilon}(z_tn_{t-1}(1-\nu_t))^{1-1/\varepsilon}\right)^{\frac{\varepsilon}{\varepsilon-1}}=c_t+i_t. \tag{G.26}$$

Second, the law of motion of capital:

$$k_t=(1-\delta(u_t))k_{t-1}+\chi i_t\left(1-\frac{\kappa}{2}\left(\frac{i_t}{k_{t-1}}-\tilde{\delta}\right)^2\right). \tag{G.27}$$

Third, the law of motion for employment:

$$n_t=(1-x)n_{t-1}+f_t(\theta_t)(1-n_{t-1}). \tag{G.28}$$

Finally, the recruiter-unemployment ratio (analogous to market tightness):

$$\theta_t=\frac{\nu_tn_{t-1}}{1-n_{t-1}}. \tag{G.29}$$

G.5 Efficiency

Following Hosios (1990), we assess the allocative efficiency of the decentralized equilibrium. We consider a social planner's problem that is subject to the same set of distortionary taxes as the equilibrium allocation, but that recognizes the externalities embodied in the matching function. Because the external habit would introduce an additional externality, we set habit $h=0$ in this section to derive a cleaner result.

The planner solves:

$$W(n_{-1},k_{-1};S)=\max_{x,i,k,n,\nu,u}\frac{c^{1-\sigma}(1+(\sigma-1)\gamma n_{-1})^{\sigma}-1}{1-\sigma}+\beta\mathbb{E}[W(n,k;S')|S] \tag{G.30}$$

subject to:

$$c+i=(1-\tau_n)wn_{-1}+(1-\tau_k)(y-n_{-1}w)+\tau_k\bar{\delta}k_{-1}+T \tag{G.31a}$$

$$k=(1-\delta(u))k_{-1}+\chi i\left(1-\frac{\kappa}{2}\left(\frac{i}{k_{-1}}-\tilde{\delta}\right)^2\right) \tag{G.31b}$$

$$n=(1-x)n_{-1}+\xi(\nu n_{-1})^{\eta}(1-n_{-1}). \tag{G.31c}$$

Let λ_b be the multiplier on the budget constraint (G.31a), λ_k the multiplier on the law of motion for capital (G.31b), and λ_n the multiplier on the law of motion for employment n.

The optimality conditions for c,u,ν,i,n, and k are, respectively:

$$\lambda_b=\left(\frac{c}{1+(\sigma-1)\gamma n_{-1}}\right)^{-\sigma} \tag{G.32a}$$

$$\lambda_k k_{-1}\delta'(u)=\lambda_b\frac{mpk}{u}k_{-1}(1-\tau_k) \tag{G.32b}$$

$$\lambda_n\eta\underbrace{\xi\left(\frac{\nu n_{-1}}{1-n_{-1}}\right)^{\eta-1}}_{\equiv\mu(\theta)}n_{-1}=\lambda_b(1-\tau_k)mpl\times n_{-1} \tag{G.32c}$$

$$\lambda_b=\lambda_k\chi\left(1-\frac{\kappa}{2}\left(\frac{i}{k_{-1}}-\tilde{\delta}\right)^2-\kappa\frac{i}{k_{-1}}\left(\frac{i}{k_{-1}}-\tilde{\delta}\right)\right) \tag{G.32d}$$

$$\lambda_n=\beta\mathbb{E}[W_n(S')|S] \tag{G.32e}$$

$$\lambda_k=\beta\mathbb{E}[W_k(S')|S]. \tag{G.32f}$$

We also have two envelope conditions with respect to n_{-1} and k_{-1}:

$$W_n=\lambda_n\Bigg(1-x+\eta\nu\underbrace{\xi\left(\frac{\nu n_{-1}}{1-n_{-1}}\right)^{\eta-1}}_{\equiv\mu(\theta)}-(1-\eta)\underbrace{\left(\frac{\nu n_{-1}}{1-n_{-1}}\right)^{\eta}}_{\equiv f(\theta)}\Bigg)$$

$$\lambda_b((1-\tau_n)-(1-\tau_k))w+\lambda_b(1-\tau_k)mpl(1-nu)-\lambda_b\frac{\gamma\sigma c}{1+(\sigma-1)\gamma n_{-1}} \tag{G.33a}$$

$$W_k=\lambda_k\left(1-\delta(u)+\tau_k\bar{\delta}+\left(\frac{i}{k_{-1}}\right)^2\kappa\chi\left(\frac{i}{k_{-1}}-\tilde{\delta}\right)\right)+\lambda_b mpk. \tag{G.33b}$$

We now guess and verify that, when we appropriately choose a constant bargaining power ϕ, the allocation of the planner's problem and the decentralized equilibrium coincide. Define:

$$q\equiv\frac{\lambda_k}{\lambda_b} \tag{G.34a}$$

$$m \equiv \beta \frac{\lambda_b'}{\lambda_b} \tag{G.34b}$$

$$J_n \equiv \eta^{-1} \frac{W_n}{\lambda_b'} \tag{G.34c}$$

$$\phi \equiv 1 - \eta. \tag{G.34d}$$

Guessing that allocations are the same, we can verify that we also obtain the private sector optimality conditions for utilization, recruiting, investment, and capital. From equation(G.32) and the equilibrium for capital (G.33b) along with the optimality condition for employment (G.32e):

$$q\delta'(u) = \frac{mpk}{u}(1-\tau_k) \tag{G.32b'}$$

$$(1-\tau_k)mpl = \mathbb{E}\left[m' \frac{W_n'}{\lambda_b'} \middle| S\right] \eta\mu(\theta) = \mathbb{E}[m' J_n' | S]\mu(\theta) \tag{G.32c'}$$

$$q = \chi^{-1}\left(1 - \frac{\kappa}{2}\left(\frac{i}{k_{-1}} - \tilde{\delta}\right)^2 - \kappa \frac{i}{k_{-1}}\left(\frac{i}{k_{-1}} - \tilde{\delta}\right)\right)^{-1} \tag{G.32d'}$$

$$q = \mathbb{E}\left[m'\left(q'(1-\delta(u)) + q'\left(\frac{i}{k_{-1}}\right)^2 \kappa\chi\left(\frac{i}{k_{-1}} - \tilde{\delta}\right) + \tau_k \bar{\delta} + mpk'\right) \middle| S\right]. \tag{G.32f'}$$

Therefore, we checked that the guess satisfies all the optimality conditions and the equilibrium condition for capital. We now check the remaining condition, the equilibrium condition for employment, using equation (G.32c'):

$$\eta^{-1} J_n = \left(\left(1 + \frac{1-x}{\mu(\theta)}\right) mpn - w\right)(1-\tau_k) + (1 - x - f(\theta))\mathbb{E}[m' J_n' | S] \frac{1-\eta}{\eta}$$
$$(1-\tau_n)w + -\frac{\gamma\sigma c}{1 + (\sigma - 1)\gamma n_{-1}}. \tag{G.33a'}$$

Plug in from equation (G.18) for $\left(\left(1 + \frac{1-x}{\mu(\theta)}\right) mpn - w\right)(1-\tau_k)$:

$$\frac{1-\eta}{\eta} J_n = (1-\tau_n)w + -\frac{\gamma\sigma c}{1 + (\sigma-1)\gamma n_{-1}} + (1 - x - f(\theta))\mathbb{E}[m' J_n' | S] \frac{1-\eta}{\eta}. \tag{G.33a''}$$

Compare this to equation (G.25) with constant ϕ and dividing that equation through by $(1 - \phi)(1-\tau_k)$ and substituting from equation (G.18):

$$\frac{\phi}{1-\phi} J_n \frac{1-\tau_n}{1-\tau_k}$$
$$= (1-\tau_n)w - \left(\frac{c}{1 + (\sigma-1)\gamma n_{t-1}}\right)\gamma\sigma + (1 - x - f(\theta))\mathbb{E}\left[m' J_n' | S\right] \frac{\phi}{1-\phi} \frac{1-\tau_n}{1-\tau_k}. \tag{G.25'}$$

Comparing this equation to equation (G.33a") shows that the two equations are equal with $\phi = 1 - \eta$ if and only if $\tau_n = \tau_k$.

G.6 Detrended economy

In this subsection, we augment the model by allowing for a stochastic trend in z_t:

$$\ln \frac{z_t}{z_{t-1}} = \ln(g_z) + \epsilon_{p,t} \equiv \ln(g_{z,t}), \tag{G.36}$$

where $\epsilon_{p,t}$ is the permanent shock to productivity (and where we drop the trend growth from the production function).

Capital, consumption, investment, the marginal value of employment, and wages grow with z_t, while all other variables are stationary. We denote detrended variables by $\sim$. To simplify notation, define the (detrended) marginal products of capital and labor as:

$$\widetilde{mpk}_t \equiv u_t \left(\alpha \frac{\tilde{y}_t}{u_t \tilde{k}_{t-1}} g_{z,t} \right)^{\frac{1}{\varepsilon}} = mpk_t \tag{G.37}$$

$$\widetilde{mpl}_t \equiv \tilde{z}_t \left((1-\alpha) \frac{\tilde{y}_t}{\tilde{z}_t n_{t-1}(1-\nu_t)} \right)^{\frac{1}{\varepsilon}}. \tag{G.38}$$

We substitute out for the number of recruiters by using the definition for market tightness:

$$n_{t-1} - \nu_{t-1} n_{t-1} = n_{t-1} - \theta_{t-1}(1 - n_{t-1}). \tag{G.39}$$

Similarly, for the capital law of motion:

$$\tilde{k}_t = (1 - \delta(u_t)) g_{z,t}^{-1} \tilde{k}_{t-1} + \chi \tilde{i}_t \left(1 - \frac{\kappa}{2} \left(\frac{\tilde{i}_t}{\tilde{k}_{t-1}} g_{z,t} - \tilde{\delta} \right)^2 \right), \tag{G.40}$$

the resource constraint

$$\left(\alpha^{1/\varepsilon} (u_t \tilde{k}_{t-1} g_{z,t}^{-1})^{1/\varepsilon} + (1-\alpha)^{1/\varepsilon} (\tilde{z}_t n_{t-1}(1-\nu_t))^{1-1/\varepsilon} \right)^{\frac{\varepsilon}{\varepsilon-1}} = \tilde{i}_t + \tilde{c}_t, \tag{G.41}$$

and the firm value with equilibrium choices for investment, capital, utilization, and recruiting:

$$\begin{aligned} \tilde{J}_t = \Bigg(& (1-\tau_k)(\tilde{y}_t - n_{t-1}\tilde{w}_t) - \tilde{i}_t + \bar{\delta} \tilde{k}_{t-1}/g_{z,t} \\ & + q_t \left(-\tilde{k}_t + (1-\delta(u)) g_{z,t}^{-1} \tilde{k}_{t-1} + \chi \tilde{i}_t \left(1 - \frac{1}{2} \kappa \left(\frac{\tilde{i}_t}{\tilde{k}_{t-1}} g_{z,t} - \tilde{\delta} \right)^2 \right) \right) \\ & + \mathbb{E}_t \left[m_{t+1} g_z \tilde{J}_{t+1} \right] \Bigg). \end{aligned}$$

Since the constraint on capital accumulation binds, firm value is simply the present discounted value of the cash flow:

$$\tilde{J}_t = \left((1-\tau_k)(\tilde{y}_t - n_{t-1}\tilde{w}_t) - \tilde{i}_t + \bar{\delta} \tilde{k}_{t-1}/g_{z,t} + \mathbb{E}_t \left[m_{t+1} g_{z,t+1} \tilde{J}_{t+1} \right] \right). \tag{G.42}$$

We also have the marginal value of employment

$$\tilde{J}_{n,t} = (1-\tau_k) \left(\widetilde{mpl}_t \left(1 + \frac{1-x}{\mu(\theta_t)} \right) - \tilde{w}_t \right), \tag{G.43}$$

the recruiting optimality condition:

$$(1-\tau_k)\widetilde{mpl}_t = \mu(\theta_t)\mathbb{E}_t[m_{t+1}g_{z,t+1}\tilde{J}_{n,t+1}], \tag{G.44}$$

and wage setting:

$$\begin{aligned}
&\phi_t(1-\tau_k)(1-\tau_n)\left(\widetilde{mpl}_t\left(1+\frac{1-x}{\mu(\theta_t))}\right)-\tilde{w}_t\right) \\
&= (1-\phi_t)(1-\tau_k)(1-\tau_n)\tilde{w}_t - (1-\phi_t)(1-\tau_k)\left(\frac{\tilde{c}_t-\tilde{h}_{t-1}\tilde{c}^a_{t-1}}{1+(\sigma-1)\gamma n_{t-1}}\right)\gamma\left(\sigma+(\sigma-1)\frac{\tilde{h}_{t-1}\tilde{c}^a_{t-1}}{c_t-\tilde{h}_{t-1}\tilde{c}^a_{t-1}}\right) \\
&\quad + (1-x-f_t(\theta_t))\mathbb{E}\left[\frac{1-\phi_t}{1-\phi_{t+1}}m_{t+1}\phi_{t+1}(1-\tau_n)g_z\tilde{J}_{n,t+1})\right],
\end{aligned} \tag{G.45}$$

where $\tilde{h}_{t-1} = \hat{h}_{t-1}/g_{z,t}$ incorporates trend growth. Specifically, in equilibrium with $n^a_{t-2} = n_{t-2}$:

$$\tilde{h}_{t-1} = \frac{h}{g_{z,t}}\frac{1+(\sigma-1)\gamma n_{t-1}}{1+(\sigma-1)\gamma n_{t-2}}. \tag{G.46}$$

Other equilibrium conditions are optimal utilization:

$$(\delta_1+\delta_2(u_t-1))\,q_t = (1-\tau_k)\frac{mpk_t}{u_t}, \tag{G.47}$$

optimal capital:

$$q_t = \mathbb{E}_t\left[m_{t+1}\left((1-\tau_k)\widetilde{mpk}_{t+1}+\bar{\delta}\frac{\tilde{k}_{t-1}}{g_{z,t}}+\left((1-\delta(u_{t+1}))+\kappa\chi\left(\frac{\tilde{i}_{t+1}}{\tilde{k}_t}g_{z,t+1}\right)^2\left(\frac{\tilde{i}_{t+1}}{\tilde{k}_t}g_{z,t+1}-\tilde{\delta}\right)\right)q_{t+1}\right)\right], \tag{G.48}$$

optimal investment:

$$q_t = \left(\left(1-\frac{1}{2}\kappa\left(\frac{\tilde{i}_t}{\tilde{k}_{t-1}}g_{z,t}-\tilde{\delta}\right)^2\right)-\kappa\left(\frac{\tilde{i}_t}{\tilde{k}_{t-1}}g_{z,t}-\tilde{\delta}\right)\frac{\tilde{i}_t}{\tilde{k}_{t-1}}g_{z,t}\right)^{-1}, \tag{G.49}$$

and the stochastic discount factor:

$$m_{t+1} = \beta_t g_{z,t+1}^{-\sigma}\left(\frac{\tilde{c}_t-\tilde{h}_{t-1}\tilde{c}^a_{t-1}}{\tilde{c}_{t+1}-\tilde{h}_t\tilde{c}^a_t}\frac{1+(\sigma-1)\gamma n_t}{1+(\sigma-1)\gamma n_{t-1}}\right)^{\sigma}. \tag{G.50}$$

Equations (G.40) to (G.50) determine:

1. Detrended capital $\tilde{k}_t$ from equation(G.40).
2. Detrended consumption $\tilde{c}_t$ from the resource constraint (G.41).
3. Detrended firm value $\tilde{J}$ from the Bellman equation (G.42).
4. Detrended marginal value of employment $\tilde{J}_n$ from the envelope condition (G.43).
5. Recruiting intensity ν_t from equation (G.44).

6. Detrended wages $\tilde{w}_t$ from the Nash bargaining equation (G.45).
7. The utilization rate u_t from the utilization equation (G.47).
8. The shadow price of capital q_t from the capital equation (G.48).
9. Detrended investment $\tilde{i}_t$ from the investment equation (G.49).
10. The stochastic discount factor m_{t+1} from equation(G.50).

In addition, the following variables and equations matter:

11. Employment n_t is determined from equation(G.28).
12. Market tightness θ_t (or the number of recruiters) from equation (G.39).

And, for completeness, we add a few definitions:

13. The (detrended) marginal product of capital $\widetilde{mpk}_t$ from equation (G.37).
14. The (detrended) marginal product of labor $\widetilde{mpl}_t$ from equation (G.38).
15. Final goods production $\tilde{y}_t$

$$\tilde{y}_t \equiv \left(\alpha^{1/\varepsilon}(u_t\tilde{k}_{t-1}g_{z,t}^{-1})^{1/\varepsilon} + (1-\alpha)^{1/\varepsilon}(\tilde{z}_t n_{t-1}(1-\nu_t))^{1-1/\varepsilon}\right)^{\frac{\varepsilon}{\varepsilon-1}}. \tag{G.51}$$

16. GDP including recruiting services $\widetilde{yr}_t$ from equation (G.52):

$$\widetilde{yr}_t \equiv \left(\alpha^{1/\varepsilon}(u_t\tilde{k}_{t-1}g_{z,t}^{-1})^{1/\varepsilon} + (1-\alpha)^{1/\varepsilon}(\tilde{z}_t n_{t-1}(1-\nu_t))^{1-1/\varepsilon}\right)^{\frac{\varepsilon}{\varepsilon-1}} + n_{t-1}\nu_t\tilde{w}_t. \tag{G.52}$$

17. The gross capital share cs_t from equation (G.53):

$$cs_t \equiv 1 - \frac{n_{t-1}w_t}{\widetilde{yr}_t}. \tag{G.53}$$

18. The net capital share ncs_t from equation (G.54):

$$ncs_t \equiv 1 - \frac{n_{t-1}w_t}{\widetilde{yr}_t} - \delta_t\frac{\tilde{k}_{t-1}}{\widetilde{yr}_t g_{z,t}}. \tag{G.54}$$

In this version of the model, there are three exogenous processes:

19. The bargaining power

$$\log\phi_t = (1-\rho_\phi)\log(\bar{\phi}) + \rho_\phi\log\phi_{t-1} + \epsilon_{\phi,t}. \tag{G.55}$$

20. Stationary labor productivity

$$\log z_t = (1-\rho_z)\log(\bar{z}) + \rho_z\log z_{t-1} + \epsilon_{z,t}. \tag{G.56}$$

21. Permanent labor productivity

$$\log(g_{z,t}) = \log(g_z) + \epsilon_{p,t}. \tag{G.57}$$

G.7 Balanced growth path and data matching

Along the balanced growth path, the discount factor becomes:

$$\bar{m} = \beta g_z^{-\sigma} \tag{G.58}$$

and the number of recruiters is given from (G.59):

$$\bar{\nu}\bar{n} = \bar{\theta}(1-\bar{n}) \quad \Leftrightarrow \quad \bar{n} - \bar{\nu}\bar{n} = \bar{n} - \bar{\theta}(1-\bar{n}). \tag{G.59}$$

In an initial calibration, we can normalize capacity utilization to be 1 along the balanced growth path to get:

$$\bar{u} = 1 \tag{G.60}$$

$$\delta_1 = (1-\tau_k)\overline{mpk}. \tag{G.61}$$

If δ_1 is given, rather than calibrated, utilization solves:

$$\left(\delta_1 + \delta_2(\bar{u})\right)\bar{q} = (1-\tau_k)\frac{\overline{mpk}}{\bar{u}}. \tag{G.62}$$

Clearly, if $\bar{u} = \bar{u} = 1$, equation (G.61) holds.

The balanced growth path optimality condition for capital can be written as:

$$1 = \bar{m}\left((1-\tau_k)\overline{mpk} + (1-(1-\tau_k)\delta(\bar{u}))\bar{q} + \kappa\Big(\frac{\bar{i}}{\bar{k}/g_z}\Big)^2\Big(\frac{\bar{i}}{\bar{k}/g_z} - \tilde{\delta}\Big)\bar{q}\right)$$

$$\Leftrightarrow \quad \frac{\bar{q}/\bar{m} - (1-(1-\tau_k)\delta(\bar{u})) - \kappa\left(\frac{\bar{i}}{\bar{k}/g_z}\right)^2\left(\frac{\bar{i}}{\bar{k}} - \tilde{\delta}\right)}{1-\tau_k} = \overline{mpk}. \tag{G.63}$$

If $\bar{u} = 1$ holds, the marginal product of capital does not depend on adjustment costs in the steady state.

Investment along the balanced growth path is given by:

$$\bar{i} = \frac{(g_z - (1-\delta(\bar{u})))}{1 - \frac{1}{2}\kappa\Big(\frac{\bar{i}}{\bar{k}/g_z} - \tilde{\delta}\Big)^2}\frac{\bar{k}}{g_z}, \tag{G.64}$$

where $\tilde{\delta} \equiv 1 - \frac{1}{1-\delta_0}g_z$.

The steady-state price of capital is given by:

$$\bar{q} = \frac{1}{1 - \frac{1}{2}\left(\frac{\bar{i}}{\bar{k}/g_z} - \tilde{\delta}\right)^2 - \left(\frac{\bar{i}}{\bar{k}/g_z}\right)^2\left(\frac{\bar{i}}{\bar{k}/g_z} - \tilde{\delta}\right)}. \tag{G.65}$$

If we cannot calibrate the adjustment costs in investment and utilization, then $\frac{\bar{i}}{\bar{k}/g_z}, \bar{u}, \bar{q}$, and $\overline{mpk}$ are jointly determined by equations (G.62), (G.63), (G.68), and (G.65). If $\bar{q} = \bar{u} = 1$, then $\frac{\bar{i}}{\bar{k}/g_z}$ and $\overline{mpk}$ are available in closed form.

Using the recruiting optimality condition (G.44), the wage equation (G.45) becomes:

$$\begin{aligned}
&\bar{\phi}(1-\tau_k)(1-\tau_n)\left(\widetilde{mpl}_t\left(1+\frac{1-x}{\mu(\bar{\theta}))}\right)-\bar{w}\right)\\
=&(1-\bar{\phi})(1-\tau_k)(1-\tau_n)\bar{w}-(1-\bar{\phi})(1-\tau_k)\left(\frac{\bar{c}(1-\tilde{h})}{1+(\sigma-1)\gamma\bar{n}}\right)\gamma\left(\sigma+(\sigma-1)\frac{\tilde{h}}{1-\tilde{h}}\right)\\
&+\frac{1-x-f(\bar{\theta})}{\mu(\bar{\theta})}\bar{\phi}(1-\tau_k)\widetilde{mpl}_t.
\end{aligned}$$

Because $1-\tau_k$ cancels and using that $f(\theta_t)\equiv\theta_t\mu(\theta_t)=\bar{\xi}\theta^{\eta-1}$.

$$(1-\tau_n)\bar{w}=\bar{\phi}(1-\tau_n)\widetilde{mpl}\left(1+\bar{\theta}\right)+(1-\bar{\phi})\left(\frac{\bar{c}(1-\tilde{h})}{1+(\sigma-1)\gamma\bar{n}}\right)\sigma\left(\gamma+(\sigma-1)\frac{\tilde{h}}{1-\tilde{h}}\right).$$

Thus, after detrending there are two equivalent useful expressions:

$$\begin{aligned}
\bar{w}&=\bar{\phi}\overline{mpl}(1+\bar{\theta})+\frac{1-\bar{\phi}}{1-\tau_n}\left(\frac{\bar{c}(1-\tilde{h})}{1+(\sigma-1)\gamma\bar{n}}\right)\gamma\left(\sigma+(\sigma-1)\frac{\tilde{h}}{1-\tilde{h}}\right)\\
&=\bar{\phi}\overline{mpl}(1+\bar{\theta})+\frac{1-\bar{\phi}}{1-\tau_n}\left(\frac{\bar{c}}{1+(\sigma-1)\gamma\bar{n}}\right)\gamma(\sigma-\tilde{h}) \qquad \text{(G.66a)}\\
\gamma&\equiv\frac{RHS}{1-(\sigma-1)\bar{n}\times RHS},\quad RHS\equiv\frac{1-\tau_n}{(1-\phi)\bar{c}(\sigma-\tilde{h})}\left(\bar{w}-\phi\overline{mpl}(1+\bar{\theta})\right), \qquad \text{(G.66b)}
\end{aligned}$$

where the marginal product of labor along the balanced growth path is given by:

$$\overline{mpl}=\left((1-\alpha)\frac{\bar{y}}{\bar{n}-\bar{\theta}(1-\bar{n})}\right)^{1/\varepsilon}.$$

Note that we can rewrite the definition of $\overline{mpk}$ as:

$$\frac{\bar{k}}{g_z}=\bar{n}(1-\bar{\nu})\left(\left(\frac{\alpha}{1-\alpha}\right)^{1/\varepsilon}\left(\frac{(\overline{mpk}/\bar{u})^{\varepsilon-1}}{\alpha}-1\right)\right)^{-\frac{\varepsilon}{\varepsilon-1}}\overset{\varepsilon\to 1}{\to}\bar{n}(1-\bar{\nu})\frac{\alpha}{1-\alpha}(\overline{mpk}/\bar{u})^{-\frac{1}{1-\alpha}}.$$

This expression is useful to express output in terms of $\overline{mpk}$ and employment. Recall the expression for detrended production net of recruiting services:

$$\begin{aligned}
\bar{y}&=\left(\alpha^{1/\varepsilon}(u_t\tilde{k}_{t-1}g_z^{-1})^{1/\varepsilon}+(1-\alpha)^{1/\varepsilon}(\tilde{z}_tn_{t-1}(1-\nu_t))^{1-1/\varepsilon}\right)^{\frac{\varepsilon}{\varepsilon-1}}\quad\Leftrightarrow\\
\bar{y}&=\frac{(\overline{mpk})^{\varepsilon}}{\alpha}\frac{\bar{k}}{g_z}\bar{u}^{1-\epsilon}=\bar{n}(1-\bar{\nu})\frac{(\overline{mpk}/\bar{u})^{\varepsilon}}{\alpha}\left(\left(\frac{\alpha}{1-\alpha}\right)^{1/\varepsilon}\left(\frac{\overline{mpk}^{\varepsilon-1}}{\alpha}-1\right)\right)^{-\frac{\varepsilon}{\varepsilon-1}} \qquad \text{(G.67)}\\
&\overset{\varepsilon\to 1}{\to}\bar{n}(1-\bar{\nu})(\overline{mpk}/\bar{u})^{-\frac{\alpha}{1-\alpha}}\frac{\alpha}{1-\alpha}.
\end{aligned}$$

The law of motion for capital gives us:

$$\frac{\bar{c}}{\bar{y}}=1-\left(1-\frac{1-\delta_0}{g_z}\right)\frac{\bar{k}}{\bar{y}g_z}=1-\left(1-\frac{1-\delta_0}{g_z}\right)\frac{\bar{k}g_z}{\bar{y}g_z}\frac{\alpha}{\overline{\overline{mpk}}^{\varepsilon}}\bar{u}^{\varepsilon-1}. \qquad \text{(G.68)}$$

The law of motion for employment implies:

$$\bar{n} = \frac{f(\bar{\theta})}{x + f(\bar{\theta})}. \tag{G.69}$$

If we combine equation (G.17) with (G.18):

$$\bar{w} = \overline{mpl} \left(1 - \frac{1 - (1-x)\bar{m}g_z}{\bar{m}g_z \mu(\bar{\theta})} \right). \tag{G.70}$$

Per definition:

$$\mu(\bar{\theta}) = \frac{f(\bar{\theta})}{\bar{\theta}} = \xi \theta^{\eta - 1}.$$

In general, we have the following unknowns and equations:

1. Employment $\bar{n}$ from the law of motion (G.69).
2. Capital $\bar{k}$ from the first-order condition (G.63).
3. Investment from the capital law of motion (G.68).
4. Capacity utilization follows from equation(G.60) when δ_1 is calibrated or, more generally, from (G.62).
5. The derivative of capacity utilization along the balanced growth path δ_1 from equation (G.61).
6. The price of capital follows from equation (G.65).
7. Consumption $\bar{c}$ from the resource constraint (G.68).
8. Wages $\bar{w}$ from wage setting (G.66).
9. Number of recruiters $\bar{n}\bar{\nu}$ from the definition of market tightness (G.59).
10. The stochastic discount factor $\bar{m}$ from no arbitrage (G.58).
11. Production $\bar{y}$ per definition (G.67).
12. Market tightness $\bar{\theta}$ from the recruiting optimality condition (G.70).

In our calibration, we set the production function parameters as follows:

- Capital share: $\alpha = (\text{NIPA capital share})^{\varepsilon} \left(\frac{\bar{y}\bar{g}}{\bar{k}} \right)^{1-\varepsilon}$.
- Average depreciation rate: $\delta_0 = \frac{\text{NIPA depreciation}}{\bar{y}\bar{g}} \times \frac{\bar{y}\bar{g}}{\bar{k}}$.
- Rate of time preference: $\bar{\beta} = \bar{g}_z^{\sigma} \left(1 - \delta_0(1-\tau_k) + (1-\tau_k) \left(\alpha \frac{\bar{k}}{\bar{y}\bar{g}_z} \right)^{1/\varepsilon} \right)^{-1}$.

We can also fix $\bar{n}$ and choose γ:

1. Preference for leisure γ given n from wage setting (G.66b).

2. Tightness $\bar{\theta}$ from the law of motion (G.69)

$$\bar{\theta} = \left(\frac{\bar{n}x}{\xi \times (1 - \bar{n})} \right)^{1/\eta}. \tag{G.69'}$$

3. Capital-to-production ratio $\frac{\bar{k}}{\bar{y}\bar{g}}$ from the first-order condition (G.63).
4. Investment-to-production ratio from the law of motion of capital (G.68).
5. Capacity utilization follows from equation (G.60) when δ_1 is calibrated or, more generally, from (G.62).
6. The derivative of capacity utilization along the balanced growth path δ_1 from equation (G.61).
7. The price of capital follows from equation(G.65).
8. Consumption-to-production ratio $\frac{\bar{c}}{\bar{y}}$ from the resource constraint (G.68).
9. Wages to production $\frac{\bar{w}}{\bar{y}}$ from the recruiting optimality condition (G.70).
10. Number of recruiters $\bar{n}\bar{\nu}$ from the definition of market tightness (G.59).
11. The stochastic discount factor $\bar{m}$ from equation (G.58).
12. Production $\bar{y}$ per definition (G.67).

In addition, six definitions and the three exogenous processes follow directly from the detrended economy.

G.8 U.S. business cycle data

To map observations into variables in the model we proceed as follows. First, we compute consumption as the sum of real services and non-durable consumption, divided by the civilian non-institutionalized population above 16. Specifically:

$$C_t = \frac{\frac{\text{DSERRA3Q086SBEA}_t}{\text{DSERRA3Q086SBEA in 2009}} \times \text{PCESVC96 in 2009} + \frac{\text{DGOERA3Q086SBEA}_t}{\text{DGOERA3Q086SBEA in 2009}} \times \text{PCNDGC96 in 2009}}{\text{CN16OV}_t}.$$

We multiply the base year (2009 average) value of the real consumption expenditure by the corresponding quantity index to obtain dollar amounts for longer horizons, i.e., before 1999.

We compute investment as the sum of consumer durables and gross private domestic investment, divided by the civilian non-institutionalized population above 16. Specifically:

$$I_t = \frac{\text{GPDIC96}_t + \frac{\text{DDURRA3Q086SBEA}_t}{\text{DDURRA3Q086SBEA in 2009}} \times \text{PCDGCC96 in 2009}}{\text{CN16OV}_t}.$$

Real GDP per capita is defined as the sum of real per capita investment and consumption:

$$Y_t = C_t + I_t.$$

G.9 Introducing product market power

An interesting extension of the model is to introduce market power of firms. To do so, we need to differentiate among firms. There is a representative final goods producing firm that produces aggregate output $\bar{y}_t$ as a CES aggregate of intermediate goods $y_t(i)$ with elasticity $\zeta > 1$:

$$\bar{y}_t = \left(\int_0^1 y_t(i)^{1-1/\zeta} di \right) \frac{\zeta}{\zeta - 1}. \tag{G.71}$$

Let $p_t(i)$ denote the price of each individual variety and $\bar{p}_t$ the optimal aggregate price index. Standard cost minimization for the representative final goods firm then implies demand for variety i is given by:

$$y_t(i) = \bar{y}_t \left(\frac{p_t(i)}{\bar{p}_t} \right)^{-\zeta}. \tag{G.72}$$

Each variety is produced according to the following production function:

$$\begin{aligned} y_t(i) &= \left(\alpha^{1/\varepsilon} (u_t(i) k_{t-1}(i))^{1-1/\varepsilon} + (1-\alpha)^{1/\varepsilon} (z_t n_{t-1}(i)(1-\nu_t(i)))^{1-1/\varepsilon} \right)^{\frac{\varepsilon}{\varepsilon-1}} - \Phi_t \\ &\equiv \psi(u_t(i) k_{t-1}(i), z_t n_{t-1}(i)(1-\nu_t(i)); \Phi_t), \end{aligned} \tag{G.73}$$

where $\Phi_t \geq 0$ is the fixed cost of operating. Along the balanced growth path, it grows at the rate of labor productivity.

The intermediate goods producing firm takes its demand schedule (G.72) into account and has revenues of $p_t(i) \left(\frac{p_t(i)}{\bar{p}_t} \right)^{-\zeta} \bar{y}_t$. Equivalently, revenue as a function of quantities becomes:

$$\bar{p}_t y_t(i)^{1-1/\zeta} \bar{y}_t^{-1/\zeta}.$$

In a symmetric equilibrium, each firm sets the same price so that $\bar{y}_t = y_t(i)$ and $\bar{p}_t = p_t(i)$ for all i. We choose the final good as the numeraire in the period.

With market power, as firms consider employing an extra worker or unit of capital, they take into account that the marginal revenue product is smaller than the marginal product. Importantly, the functional form for the match surplus $\tilde{J}_n(n,k)$ is unchanged but, as (G.18') shows, the marginal value of employment that enters into it reflects the lower marginal revenue product.

To see this, note that now the following optimality condition holds for recruiting:

$$(1-\tau_k) \underbrace{(1-1/\zeta) z_t \left((1-\alpha) \frac{Y_t}{z_t n_{t-1}(1-\nu_t)} \right)^{\frac{1}{\varepsilon}}}_{\equiv mrpl_t} = \mu(\theta_t) \mathbb{E}[m_{t+1} J_n(n_t, k_t,)]. \tag{G.17'}$$

Thus, the marginal value of employment is given by:

$$\begin{aligned} J_n(n_{t-1}, k_{t-1}) &= (1-\tau_k)(mrpl_t \times (1-\nu_t) - w_t) + (\nu_t \mu(\theta_t) + 1 - x) \mathbb{E}[m_{t+1} J_n(n_t, k_t)] \\ &= (1-\tau_k) \left(mrpl_t \left(1 + \frac{1-x}{\mu(\theta_t)} \right) - w_t \right), \end{aligned} \tag{G.18'}$$

using equation (G.17') to substitute for $\mathbb{E}[m_{t+1} J_n(n_t, k_t)]$.

The optimality condition for the utilization rate becomes:

$$\delta'(u_t)q_t k_{t-1} = (\delta_1 + \delta_2(u_t - 1))\, q_t k_{t-1} = (1-\tau_k)(1-1/\zeta)\left(\alpha \frac{y_t}{u_t k_{t-1}}\right)^{1/\varepsilon} k_{t-1}$$

$$\equiv (1-\tau_k)\frac{mrpk_t}{u_t}. \tag{G.20'}$$

The optimality condition for capital k' becomes:

$$q_t = \mathbb{E}\left[m_{t+1}\left(mrpk_{t+1}(1-\tau_k) + \tau_k\bar{\delta} + \left((1-\delta(u_{t+1})) + \chi\kappa\left(\frac{i_{t+1}}{k_t}\right)^2\left(\frac{i_{t+1}}{k_t} - \tilde{\delta}\right)\right) q_{t+1}\right)\right]. \tag{G.22'}$$

The marginal revenue product of physical capital is:

$$mrpk_{t+1} \equiv u_{t+1}(1-1/\zeta)\left(\alpha\frac{y_{t+1}}{u_{t+1}k_t}\right)^{\frac{1}{\varepsilon}}. \tag{G.23'}$$

Market power also has an impact on the calibration. Monopolistic competition is an extra source of profits in the economy: In the detrended economy, the flow profit is $\bar{y}/\zeta$ along the balanced growth path. We consider two variants for calibrating the model with market power that keep the aggregate capital share in the economy unchanged:

1. No fixed cost, lower capital share in production. Here, we set the fixed cost of production Φ_t to zero. Then, we calibrate ζ and adjust α so that the gross capital share in the economy is unchanged. Specifically, we target a capital share in production of $1-(1-0.31)(1-1/\zeta)^{-1/\epsilon}$.

2. Fixed cost, same capital share in production. Here, we set the detrended fixed cost of production equal to the share of profits from monopolistic competition: $\tilde{\Phi}_t = \bar{y}/\zeta$.

G.10 Identification: Additional relationships

Recall that we use three moments to pin down three parameters: ω_z, ω_ϕ, and κ/δ_0^2. In the main text, we show the three bivariate plots that show the important interaction terms among these three parameters. For completeness, we show here in Figure G.14 the additional bivariate plots. It is clear from this figure that the required standard deviations vary little with the adjustment cost and the adjustment cost depends little on ω_ϕ.

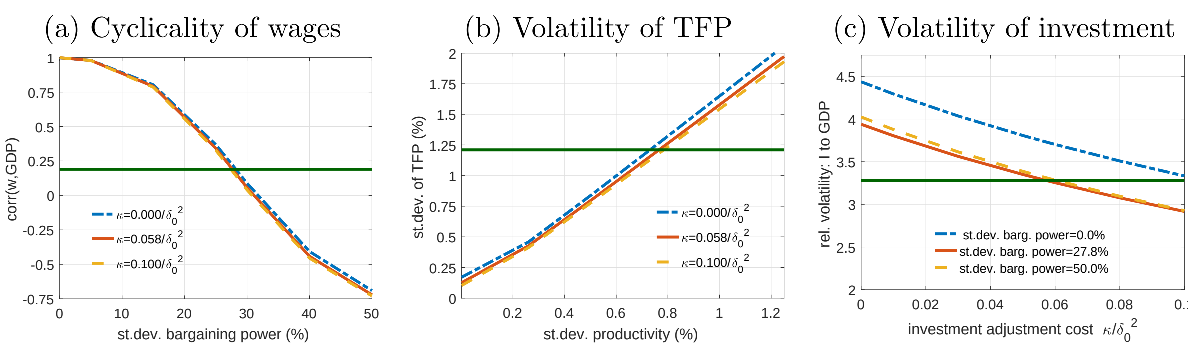


Figure G.14: Identifying ω_z, ω_ϕ, and κ/δ_0^2. Additional relationships.

G.11 Euler equation errors

Our model has two Euler equations: (1) The recruiting optimality condition (G.44) and (2) the capital optimality condition (G.48). We transform the Euler equation error to consumption units. To do so, take an a Euler equation with a generic return R^i_{t+1}. Following Fernandez-Villaverde and Rubio-Ramirez (2006), the Euler equation error in state s_t is:

$$EE(s_t) = \left| 1 - \frac{u_c^{-1}\left(\mathbb{E}_t\left[\beta_t g_z^{-\sigma} u_c(c(s_{t+1}); n(s_{t+1}))R^i(s_{t+1})\right]; n(s_t)\right)}{c(s_t)} \right|. \tag{G.74}$$

Here:

$$R^{\nu}_{t+1} = \left(1 - \tau_k)\widetilde{mpl}_t\right)^{-1} \mu(\theta_t) g_{z,t+1} \tilde{J}_{n,t+1}$$

$$R^k_{t+1} = q_t^{-1}\left(\widetilde{mpk}_{t+1}(1-\tau_k) + \bar{\delta}\tau_k + \left((1-\delta(u_{t+1})) + \chi_{t+1}\left(\frac{\tilde{I}_{t+1}}{\tilde{k}_t} g_{z,t+1}\right)^2 \left(\frac{\tilde{I}_{t+1}}{\tilde{k}_t} g_{z,t+1} - \tilde{\delta}\right)\right) q_{t+1}\right)$$

$$u_c^{-1}(\tilde{u}_c; n) = \tilde{u}_c^{-\frac{1}{\sigma}} \times (1 + (\sigma - 1)\gamma n).$$

The difficulty in our setup is that, because of the pruning, the state in terms of the endogenous observables is not uniquely defined: Any given level of capital can be reached by different combinations of the first-, second-, and third-order components of the solution. Thus, as in Andreasen et al. (2017), we resort to Monte Carlo integration (with a burn-in of 1,000 simulations). The pseudo-code below outlines the algorithm.

`Pseudo-code for Monte Carlo integration`

1. `Simulate the model for 6,000 periods.`
2. `Discard the first 1,000 periods and save the remaining 5,000 draws for the state` s_t `as` $\{s_t^{(\ell)}\}_\ell$.
3. `For` $\ell = 1, \ldots, 5,000$:
   (a) $s_t^{(\ell)}$, `compute the vector of current policies and stack it with the state vector:` $s_t^{+,(\ell)}$.
   (b) `For` $m = 1, \ldots, 1,000$:
      i. `Draw` $\epsilon_{t+1}^{(m)} \sim \mathcal{N}(0, I)$.
      ii. `Compute` $s_t^{+,(\ell,m)} = f(s_t^{(ell)}, \epsilon_{t+1}^{(m)})$,
   (c) `Average over` d:

$$EE(s_t^{(\ell)}) = \left| 1 - \frac{u_c^{-1}\left(1,000^{-1}\sum_{m=1}^{1,000}\left(\beta_t^{(\ell)} g_z^{-\sigma} u_c\left(c_{t+1}^{(\ell,m)}); n_{t+1}^{(\ell,m)}\right) R^i_{t+1}{}^{(\ell,m)}\right); n(s_t^{(\ell)})\right)}{c(s_t^{(\ell)})} \right|$$

4. `Compute moments of` $EE(s_t)$.

We find that the implied Euler equation errors are reasonably small for both the capital and recruiting Euler equations. Table G.5(a) reports the mean of the Euler equation errors for both

Euler equations along with their distribution. The average Euler equation error is below 10^{-2}, implying that agents would pay less than 1% of their period consumption to avoid the approximation error. The 99th percentile of approximation is only slightly above 1%. This is only a bit worse than the real business cycle analogue of our search model, as panel (c) shows. Errors in the search and matching model without bargaining shocks in panel (b) are smaller than in the RBC model.

(a) Baseline search & matching model

Euler Equation	Mean	Min	p1	p5	Median	p95	p99	Max
Capital EE	-3.12	-7.67	-5.58	-4.98	-3.86	-2.42	-2.03	-1.56
Recruiting EE	-2.67	-6.38	-4.48	-3.84	-2.79	-2.25	-1.97	-1.55

(b) Search & matching model without bargaining shocks

Euler Equation	Mean	Min	p1	p5	Median	p95	p99	Max
Capital EE	-4.35	-8.87	-6.16	-5.49	-4.42	-3.97	-3.84	-3.64
Recruiting EE	-3.70	-8.04	-5.47	-4.83	-3.78	-3.29	-3.14	-2.87

(c) Hansen-Rogerson RBC model

Euler Equation	Mean	Min	p1	p5	Median	p95	p99	Max
Capital EE	-4.04	-8.41	-6.05	-5.34	-4.29	-3.52	-3.08	-2.53
Labor supply EE	-3.37	-7.51	-5.58	-4.86	-3.76	-2.77	-2.39	-1.86

Table G.5: Euler equation errors: Mean and distribution.

Figure G.15 shows the mean, minimum, and maximum Euler equation errors also as a function of the endogenous state of the economy, i.e., capital and employment. The errors are largely independent of the value of capital or employment, except for some extreme values of employment (although, even in this case, they still average below 1% of consumption).

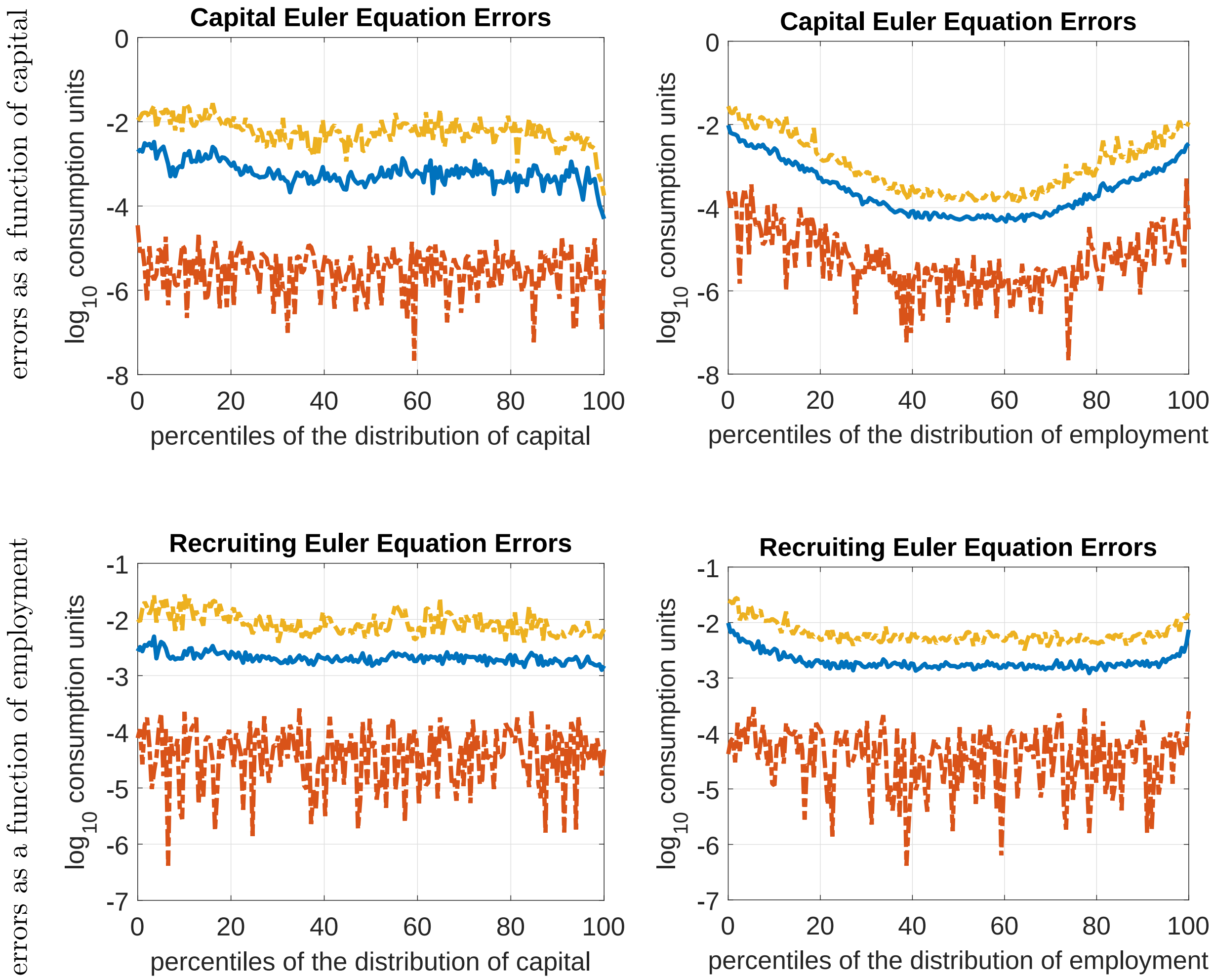


Figure G.15: Euler equation errors as a function of capital and employment: Mean, maximum, and minimum.

G.12 Partial filter for bargaining power

G.12.1 Derivation

We use three equations to derive the partial filter: (1) The wage-setting equation (G.25), (2) recruiting optimality condition (G.17), and (3) the marginal value of employment (G.18).

$$
\begin{aligned}
&\phi_t(1-\tau_k)(1-\tau_n)\left(mpl_t\left(1+\frac{1-x}{\mu(\theta_t))}\right)-w_t\right)\\
=&(1-\phi_t)(1-\tau_k)(1-\tau_n)w_t-(1-\phi_t)(1-\tau_k)\left(\frac{c_t-\hat{h}_{t-1}c^a_{t-1}}{1+(\sigma-1)\gamma n_{t-1}}\right)\gamma\left(\sigma+(\sigma-1)\frac{\hat{h}_{t-1}c^a_{t-1}}{c_t-\hat{h}_{t-1}c^a_{t-1}}\right)\\
&+(1-\tau_n)(1-x-f_t(\theta_t))\mathbb{E}_t\left[\frac{1-\phi_t}{1-\phi_{t+1}}\phi_{t+1}m_{t+1}J_{n,t+1}\right], \qquad (G.25)
\end{aligned}
$$

$$
(1-\tau_k)\underbrace{z_t\left((1-\alpha)\frac{Y_t}{z_t n_{t-1}(1-\nu_t)}\right)^{\frac{1}{\varepsilon}}}_{\equiv mpl_t}=\mu(\theta_t)\mathbb{E}[m_{t+1}J_{n,t+1}], \qquad (G.17)
$$

$$
\begin{aligned}
J_{n,t}&=(1-\tau_k)\left(mpl_t\times(1-\nu_t)-w_t\right)+\left(\nu_t\mu(\theta_t)+1-x\right)\mathbb{E}\left[m_{t+1}J_{n,t+1}\right]\\
&=(1-\tau_k)\left(mpl_t\left(1+\frac{1-x}{\mu(\theta_t)}\right)-w_t\right). \qquad (G.18)
\end{aligned}
$$

In what follows, we ignore habit ($h=0$). Then divide (G.25) by $1-\phi_t$ and $1-\tau_n$:

$$
\begin{aligned}
&\frac{\phi_t}{1-\phi_t}(1-\tau_k)\left(mpl_t\left(1+\frac{1-x}{\mu(\theta_t))}\right)-w_t\right)\\
=&(1-\tau_k)w_t-\frac{1-\tau_k}{1-\tau_n}\left(\frac{c_t}{1+(\sigma-1)\gamma n_{t-1}}\right)\gamma\sigma+(1-x-f_t(\theta_t))\mathbb{E}_t\left[\frac{\phi_{t+1}}{1-\phi_{t+1}}m_{t+1}J_{n,t+1}\right].
\end{aligned}
$$

Next, re-write the expectation as a covariance and substitute from (G.18) for the expected discounted value of labor to the firm, $E_t[m_{t+1}J_{n,t+1}]$ and from (G.17) for the value of labor $J_{n,t+1}$.

$$
\begin{aligned}
&\mathbb{E}_t\left[\frac{\phi_{t+1}}{1-\phi_{t+1}}m_{t+1}J_{n,t+1}\right]=\\
&\mathbb{E}_t\left[\frac{\phi_{t+1}}{1-\phi_{t+1}}\left(m_{t+1}J_{n,t+1}-\mathbb{E}_t[m_{t+1}J_{n,t+1}]\right)\right]+\mathbb{E}_t\left[\frac{\phi_{t+1}}{1-\phi_{t+1}}\right]\mathbb{E}_t[m_{t+1}J_{n,t+1}]\\
&=\mathrm{Cov}_t\left[\frac{\phi_{t+1}}{1-\phi_{t+1}},(1-\tau_k)m_{t+1}\left(mpl_{t+1}\left(1+\frac{1-x}{\mu(\theta_{t+1})}\right)-w_{t+1}\right)\right]+\\
&\mathbb{E}_t\left[\frac{\phi_{t+1}}{1-\phi_{t+1}}\right](1-\tau_k)\frac{mpl_t}{\mu(\theta_t)} \qquad (G.75)
\end{aligned}
$$

Note that, as in the main paper, we work with a transform of bargaining power $\ln\frac{\phi_t}{1-\phi_t}$ that follows:

$$
\ln\frac{\phi_t}{1-\phi_t}=\underbrace{(1-\rho_\phi)\ln\frac{\bar{\phi}}{1-\bar{\phi}}}_{\equiv\kappa_\phi}+\rho_\phi\ln\frac{\phi_{t-1}}{1-\phi_{t-1}}+\omega_\phi\epsilon_{\phi,t}. \qquad (G.76)
$$

Next, use (G.75) and (G.76) in the surplus splitting rule and divide by $1-\tau_k$:

$$\begin{aligned}
&e^{\ln\frac{\phi_t}{1-\phi_t}}\left(mpl_t\left(1+\frac{1-x}{\mu(\theta_t))}\right)-w_t\right)\\
=&w_t-\frac{1}{1-\tau_n}\left(\frac{c_t}{1+(\sigma-1)\gamma n_{t-1}}\right)\gamma\sigma+e^{\kappa_\phi+\rho_\phi\ln\frac{\phi_t}{1-\phi_t}}(1-x-f_t(\theta_t))\times\\
&\times\left(\text{Cov}_t\left[e^{\omega_\phi\epsilon_{\phi,t+1}},m_{t+1}\left(mpl_{t+1}\left(1+\frac{1-x}{\mu(\theta_{t+1})}\right)-w_{t+1}\right)\right]+e^{\frac{1}{2}\omega_\phi^2}\frac{mpl_t}{\mu(\theta_t)}\right). \qquad (G.77)
\end{aligned}$$

Now, we need only an estimate of the conditional covariance between $\frac{\phi_t}{1-\phi_t}$ and the discount firm surplus to back out the bargaining power. We propose to estimate a VAR to back out this covariance (this VAR could be time-varying, we will come back to this point below). We could either proceed with the VAR in levels of $\frac{\phi_{t+1}}{1-\phi_{t+1}}$ and $m_{t+1}\left(mpl_{t+1}\left(1+\frac{1-x}{\mu(\theta_{t+1})}\right)-w_{t+1}\right)$, plus a vector of controls, and neglect that $\frac{\phi_{t+1}}{1-\phi_{t+1}}$ is strictly positive. Alternatively, if joint (conditional) normality of all variables is a good approximation, (G.77) simplifies due to Stein's Lemma as follows:[31]

$$\begin{aligned}
&\frac{\phi_t}{1-\phi_t}\left(mpl_t\left(1+\frac{1-x}{\mu(\theta_t))}\right)-w_t\right)\\
=&w_t-\frac{1}{1-\tau_n}\left(\frac{c_t}{1+(\sigma-1)\gamma n_{t-1}}\right)\gamma\sigma\\
&+(1-x-f_t(\theta_t))\left(e^{\kappa_\phi+\rho_\phi\ln\frac{\phi_t}{1-\phi_t}+\frac{1}{2}\omega_\phi^2}\text{Cov}_t\left[\omega_\phi\epsilon_{\phi,t+1},m_{t+1}\left(mpl_{t+1}\left(1+\frac{1-x}{\mu(\theta_{t+1})}\right)-w_{t+1}\right)\right]\right.\\
&\left.+e^{\kappa_\phi+\rho_\phi\ln\frac{\phi_t}{1-\phi_t}+\frac{1}{2}\omega_\phi^2}\frac{mpl_t}{\mu(\theta_t)}\right),
\end{aligned}$$

and after rearranging:

$$\begin{aligned}
&e^{\ln\frac{\phi_t}{1-\phi_t}}\left(mpl_t\left(1+\frac{1-x}{\mu(\theta_t))}\right)-w_t\right)\\
&-(1-x-f_t(\theta_t))e^{\kappa_\phi+\rho_\phi\ln\frac{\phi_t}{1-\phi_t}+\frac{1}{2}\omega_\phi^2}\left(\text{Cov}_t\left[\omega_\phi\epsilon_{\phi,t+1},m_{t+1}\left(mpl_{t+1}\left(1+\frac{1-x}{\mu(\theta_{t+1})}\right)-w_{t+1}\right)\right]+\frac{mpl_t}{\mu(\theta_t)}\right)\\
=&w_t-\frac{1}{1-\tau_n}\left(\frac{c_t}{1+(\sigma-1)\gamma n_{t-1}}\right)\gamma\sigma \qquad (G.78)
\end{aligned}$$

We can write the covariance term equivalently as $\text{Cov}_t\left[\omega_\phi\epsilon_{\phi,t+1},m_{t+1}\left(mpl_{t+1}\left(1+\frac{1-x}{\mu(\theta_{t+1})}\right)-w_{t+1}\right)\right]$ and as $\text{Cov}_t\left[\ln\frac{\phi_{t+1}}{1-\phi_{t+1}},m_{t+1}\left(mpl_{t+1}\left(1+\frac{1-x}{\mu(\theta_{t+1})}\right)-w_{t+1}\right)\right]$, because only $\omega_\phi\epsilon_{\phi,t+1}$ is a surprise to $\ln\frac{\phi_{t+1}}{1-\phi_{t+1}}$ given the time t information set. Below and in the main text we therefore write the covariance in terms of $\ln\frac{\phi_{t+1}}{1-\phi_{t+1}}$.

[31] $\text{Cov}_t[g(X),Y]=\mathbb{E}_t[g'(X)]\text{Cov}_t[X,Y]$, where Y is the discounted match surplus, $X=\omega_\phi\epsilon_{\phi,t+1}$, $g(\circ)=\exp(\circ)$, and $\mathbb{E}_t[g'(X)]=e^{\frac{1}{2}\omega^2}$.

G.12.2 Sampler

We estimate a VAR(p) in X_t, where X_t includes $\left(\ln \frac{\phi_t}{1-\phi_t}\right)$ and the discounted firm surplus, and an AR(1) for $\left(\ln \frac{\phi_t}{1-\phi_t}\right)$ given an estimate of the bargaining power process. Given the parameter estimates, we back out the implied bargaining power process. Formally:

1. Initialize $\text{Cov}_t = 0$ and ρ_ϕ, ω_ϕ as calibrated in the model. Back out $\left(\ln \frac{\phi_t}{1-\phi_t}\right)^{(0)}$.

2. Estimate parameters:

   (a) Set $X_t^{(d)} \equiv \left[\left(\ln \frac{\phi_t}{1-\phi_t}\right)^{(d-1)}, m_t\left(mpl_t\left(1+\frac{1-x}{\mu(\theta_t)}\right)-w_t\right), mpl_t, \theta_t, w_t, c_t\right]$. Alternatively, use a VAR in just the first two variables.

   (b) Draw $\Sigma^{(d)}$ from $\mathcal{IW}$ using standard results for a Bayesian VAR with p lags: $X_t = \sum_{\ell=1}^{p} A_{\ell,t}X_{t-\ell} + B_t\epsilon_t$. Set $\text{Cov}_t^{(d)} = \Sigma^{(d)}(2,1)\forall t$.

   (c) Draw $\rho_\phi^{(d)}, \omega_\phi^{(d)}$ from the normal-gamma posterior for the AR(1) $\left(\ln \frac{\phi_t}{1-\phi_t}\right)^{(d-1)} = \mu^{(d)} + \rho_\phi^{(d)}\left(\ln \frac{\phi_{t-1}}{1-\phi_{t-1}}\right)^{(d-1)} + \omega_\phi^{(d)}\epsilon_{\phi,t}$.

3. Solve for $\left\{\left(\ln \frac{\phi_t}{1-\phi_t}\right)^{(d)}\right\}_t$ given data and, $\text{Cov}_t^{(d)}, \omega_{\phi,t}^{(d)}, \rho_\phi^{(d)}$.

4. Iterate on Steps 2 and 3.

5. Discard the first third of the sample.

It would be conceptually appealing to allow for a time-varying parameter VAR to generate time-variation in the conditional covariances that may be generated from the non-linearities in our underlying model. As we explained in the main text, we find that the covariance term is so small that our results are unlikely to change much if we allowed for time-variation in parameters.

As a check of overfit, we estimate a VAR just in $\left(\ln \frac{\phi_t}{1-\phi_t}\right)^{(d-1)}$ and $m_t\left(mpl_t\left(1+\frac{1-x}{\mu(\theta_t)}\right)-w_t\right)$. Results do not change noticeably.

G.12.3 Measurement

To implement our filter, we need data on: (1) The real wage, (2) the marginal product of labor, (3) labor market tightness, (4) the unemployment rate, and (5) consumption. The data sources are the same as for our main model, so we just discuss the mapping into model variables.

1. We use either raw consumption, real wages, and real GVA or first remove a log-linear trend.

2. We rescale the average real-wage (an index) to the steady-state wage in the model.

3. We implement our model for the Cobb-Douglas case of the production function. Thus, the average product of labor ss proportional to the marginal product of labor.[32] We consider two different measures:

[32]Unfortunately, there is no easy way to differentiate in the data the marginal productivity of production workers (the object of interest in the model) from the marginal productivity of recruiters. Our prior is that the bias induced by considering the aggregate marginal productivity of both types of workers is negligible.

- Real GVA in the business sector divided by (1-unemployment) and re-scaled.
- Real GVA in the business sector population ratio instead of 1-unemployment.

We first rescale the average marginal product of labor to the steady-state marginal product of labor in the model. Second, we shift the marginal product of labor up so that it lies weakly above the real wage.

4. We compute the monthly job finding rate implied by labor market tightness as $f_m(\theta_t)$. We then adjust the job finding rate and the separation rate x for the quarterly data frequency in the following way: The quarterly separation rate is $x_q = (1+x_m/100)^3 - 1$. The quarterly job finding rate is $f_q = f_m + (1-f_m)f_m + (1-f_m)^2 f_m$. This neglects within-quarter separations.

5. Given the real-wage rate, the static component of the household surplus turns negative in the 1990s. We shift the average disutility of working up until the implied average bargaining power in the data [ignoring covariance terms] equals 0.5 as in the model.

6. When we use the employment-to-population ratio to compute labor productivity, we also use the employment-to-population ratio to compute the disutility from working. However, our model is calibrated to an average employment-to-participation ratio of 0.95. To avoid having the data counterpart to n_t in the model exceed unity, we re-scale the employment-to-participation ration so that it averages 0.95 and has the same range (max − min) as the unemployment rate.

G.12.4 Additional results

When we use an alternative measure of labor productivity or detrend non-stationary variables prior to filtering, we find only small changes in the implied moments: See Table G.6(a) to (c).

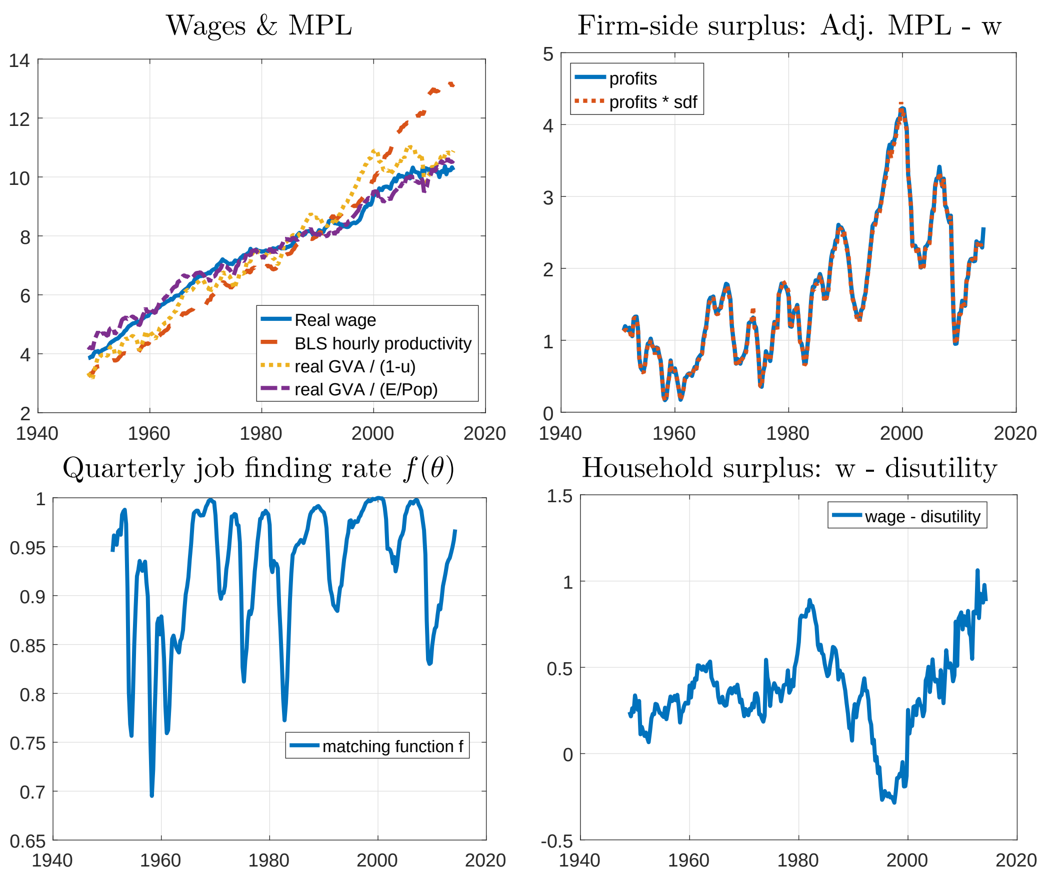


Figure G.16: Variables entering the filter

Table G.6: Implied bargaining power process moments

(a) Productivity based on complement of the unemployment rate, log-linear detrending

	Median	5th percentile	95th percentile
In-sample autocorrelation	0.9568	0.9567	0.9569
Posterior autocorrelation	0.9560	0.9269	0.9834
In-sample AR(1) st.dev.	0.1728	0.1727	0.1729
Posterior AR(1) st.dev.	0.1719	0.1610	0.1850
In-sample $\text{Cov}_t[\circ]$	0.0013	0.0013	0.0013
Posterior $\text{Cov}_t[\circ]$	0.0015	0.0008	0.0023
In-sample average bargaining power	0.4992	0.4991	0.4993

(b) Productivity based on employment-to-population ratio, no detrending

	Median	5th percentile	95th percentile
In-sample autocorrelation	0.9483	0.9482	0.9485
Posterior autocorrelation	0.9474	0.9157	0.9774
In-sample AR(1) st.dev.	0.1424	0.1423	0.1426
Posterior AR(1) st.dev.	0.1417	0.1326	0.1525
In-sample $\text{Cov}_t[\circ]$	0.0008	0.0008	0.0008
Posterior $\text{Cov}_t[\circ]$	0.0009	0.0005	0.0014
In-sample average bargaining power	0.4992	0.4991	0.4994

(c) Productivity based on employment-to-population ratio, log-linear detrending

	Median	5th percentile	95th percentile
In-sample autocorrelation	0.9662	0.9662	0.9662
Posterior autocorrelation	0.9655	0.9414	0.9881
In-sample AR(1) st.dev.	0.1173	0.1173	0.1174
Posterior AR(1) st.dev.	0.1167	0.1093	0.1256
In-sample $\text{Cov}_t[\circ]$	0.0015	0.0015	0.0015
Posterior $\text{Cov}_t[\circ]$	0.0017	0.0011	0.0023
In-sample average bargaining power	0.4993	0.4993	0.4994

G.12.5 A comparison with an alternative bargaining power index

Levy and Temin (2007) propose to measure bargaining power as the inverse of the real unit labor cost. They call this measure the "bargaining power index." We compute their measure for our longer sample as the real hourly compensation divided by the real hourly output, both measured in the non-farm business sector.[33] This measure exhibits a pronounced downward trend, perhaps due to changes in the underlying industry or occupation mix. To compare our measures, we remove a quadratic trend from (the log of) their measure and do the same for our measure. Figure G.17 shows the resulting time series. Despite the very different methodological approaches, the two series move together. The overall correlation between the detrended series is 0.42. They track each other particularly well from the beginning of our sample period to the mid-1970s and again during the 2000s.

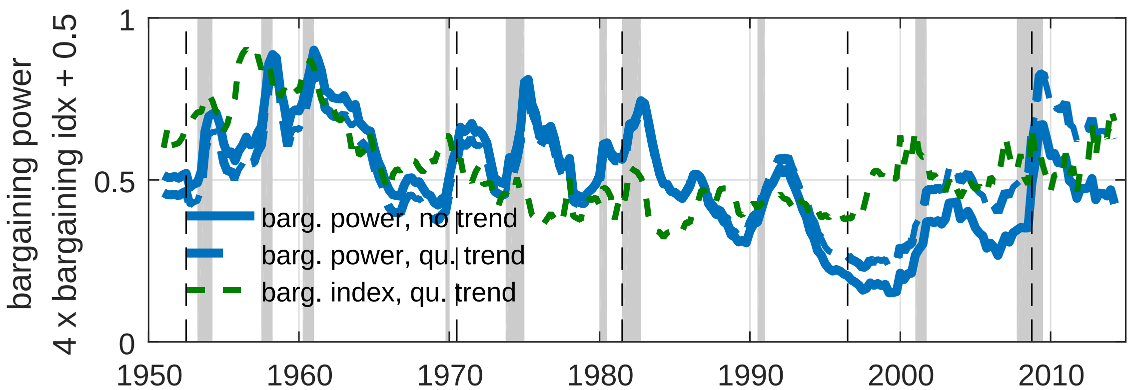


Figure G.17: Filtered bargaining power and Levy and Temin (2007) bargaining index

Quarterly changes in our filtered bargaining power tend to move with the changes in (log of) the Levy and Temin (2007) bargaining index, as Figure G.18 shows. The overall correlation is 0.45, and both measures pick up on the increased bargaining power due to the extension of unemployment benefits in late 2008 and the reversal during several periods after the Great Recession. While both measures may contain measurement error, it is reassuring that the 10 lowest and highest changes in our bargaining power index also tend to be classified as such in the bargaining power index. The figure dates these data points, and their correlation is 0.69.

We have also argued in the main text that increases in the real minimum wage resemble increases in the bargaining power, as pointed out by Flinn (2006). Figure G.19 plots the real minimum wage alongside our bargaining power – the real federal minimum wage (green solid line) and the real effective minimum wage, that is, the population-weighted average of the maximum of the state and federal minimum wage. Overall, the correlation between the real federal minimum wage and our bargaining power is a low 0.18. However, from 1974 on, when the federal minimum wage is unified and has the broadest coverage, the correlation is 0.57. For most of the period since 1974, we also have data on state minimum wages from Autor et al. (2016) and the correlation with the effective minimum wage is 0.48. Given that our filtered bargaining power was high before 1974 and the minimum wage was less broadly applicable, we view this evidence as consistent with the notion that our bargaining power index reflects redistributive measures such as the minimum wage when the bargaining power is low.

[33] Levy and Temin (2007) use the median, not the mean compensation. We prefer the mean because, due to demographic changes, who the median worker is has noticeably changed over the last few decades.

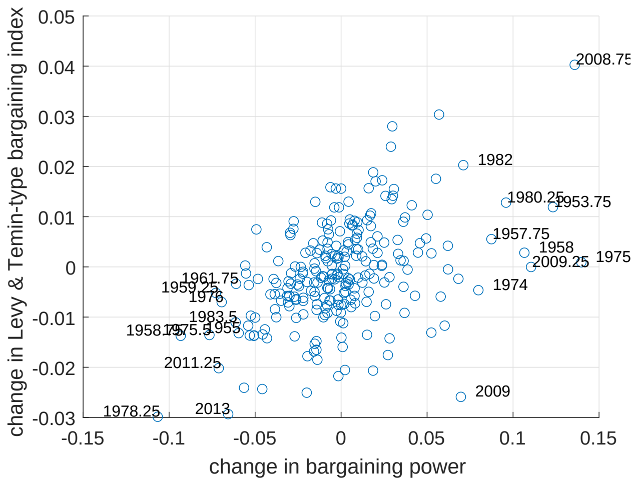
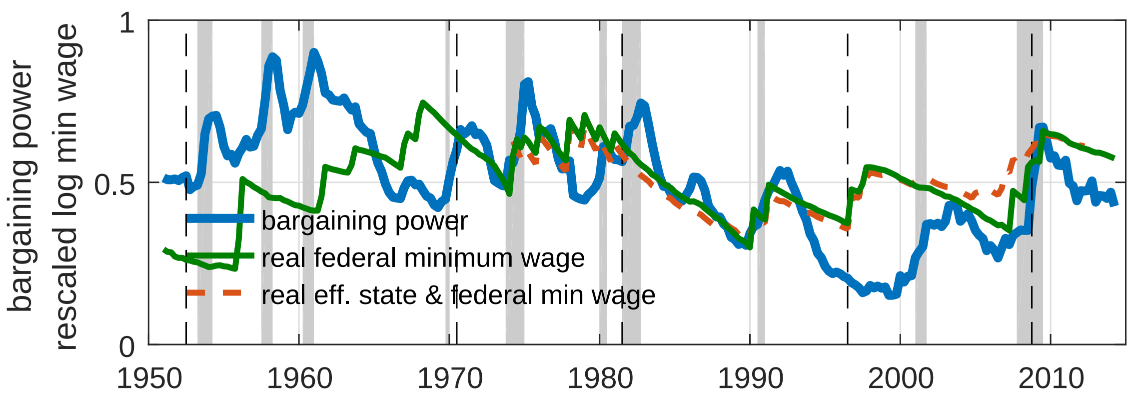


Figure G.18: Change in filtered bargaining power and Levy and Temin (2007) bargaining index



We demean the log real minimum wage measures, divide them by 100, and re-center them at 0.5 to ease the comparison.

Figure G.19: Filtered bargaining power and real minimum wage measures

G.13 Search and matching model: All IRFs

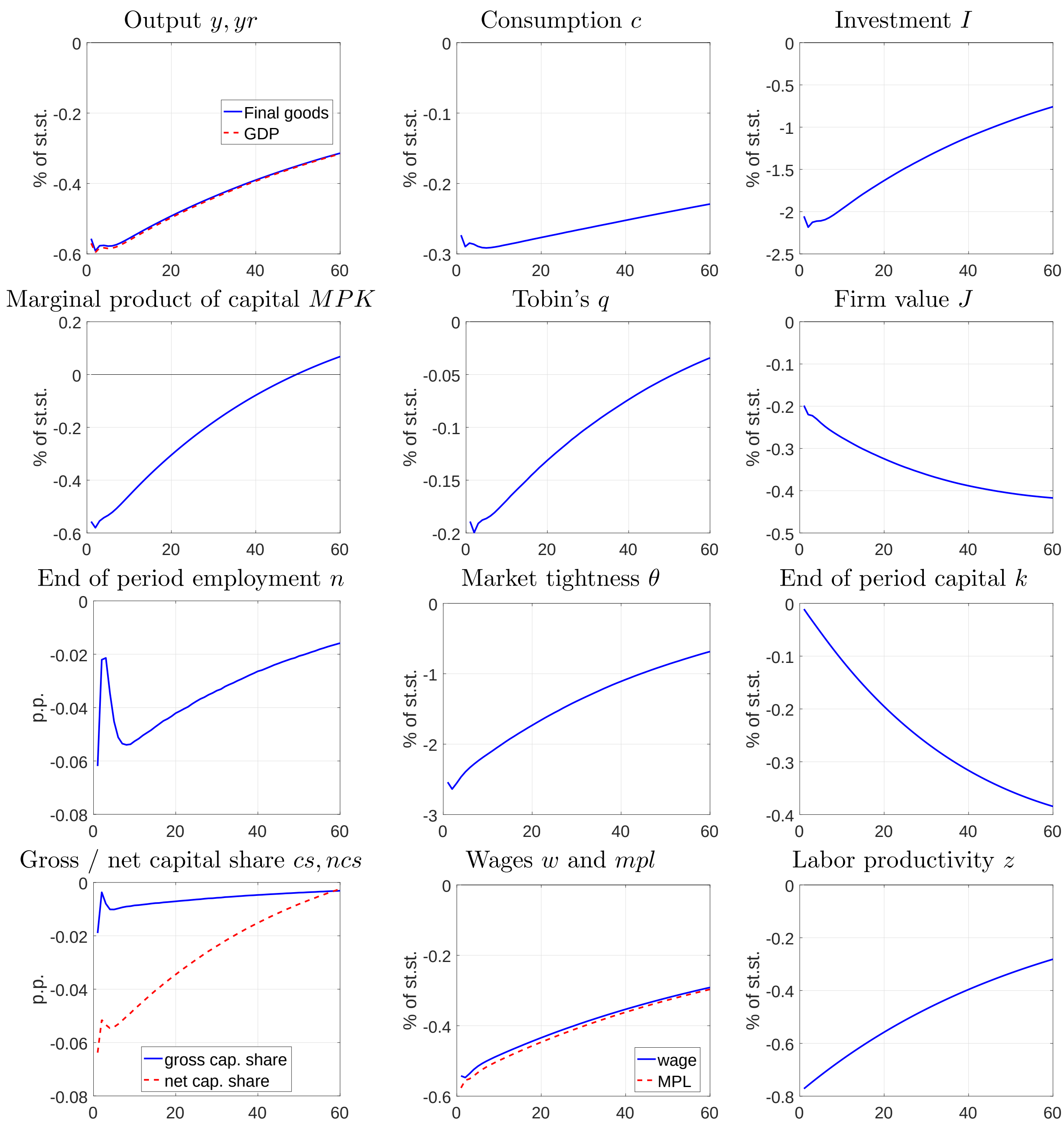


Figure G.20: IRFs to a negative one-standard deviation shock to labor productivity with Cobb-Douglas technology.

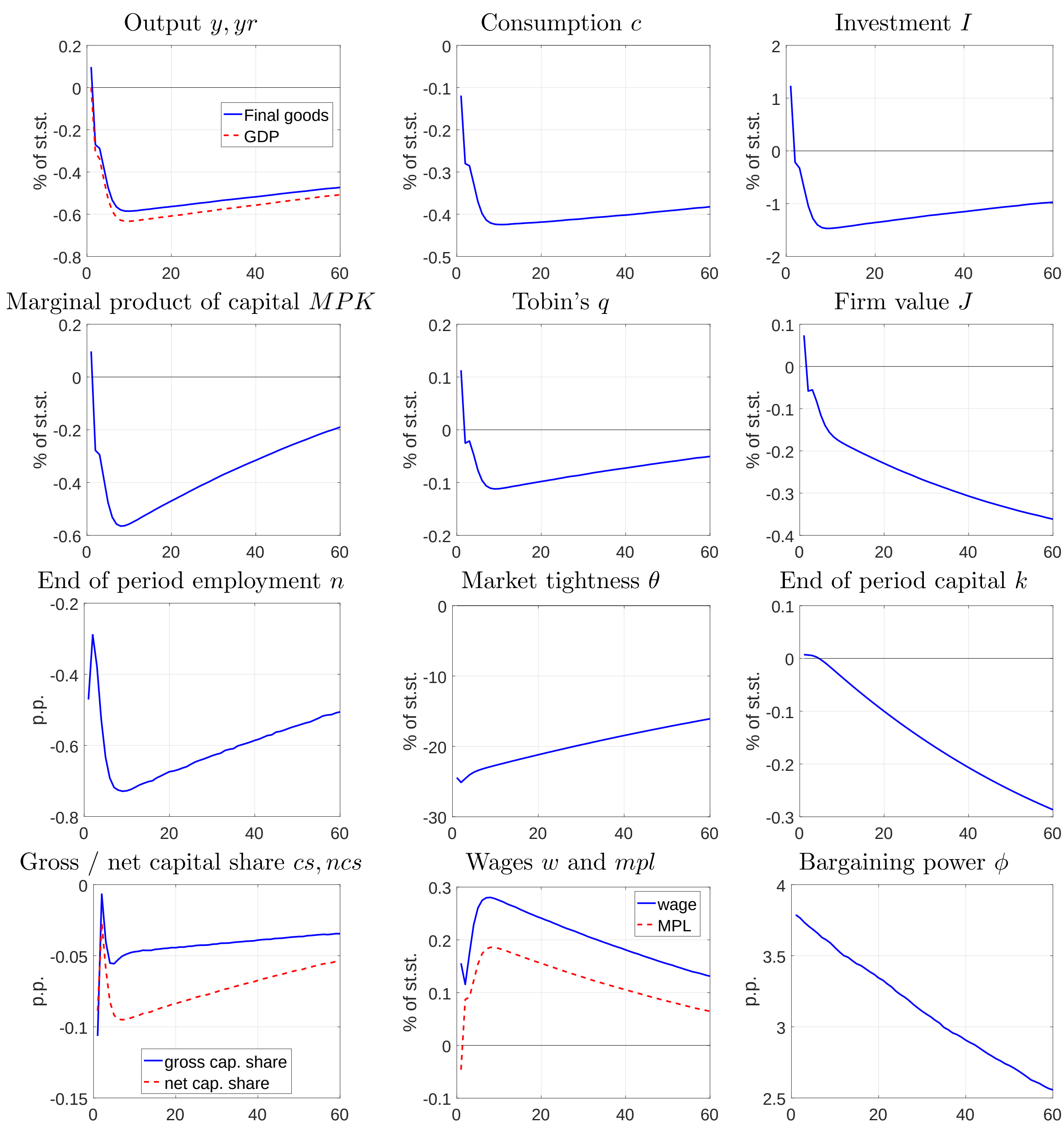


Figure G.21: IRFs to a one-standard deviation shock to workers' bargaining power with Cobb-Douglas technology.

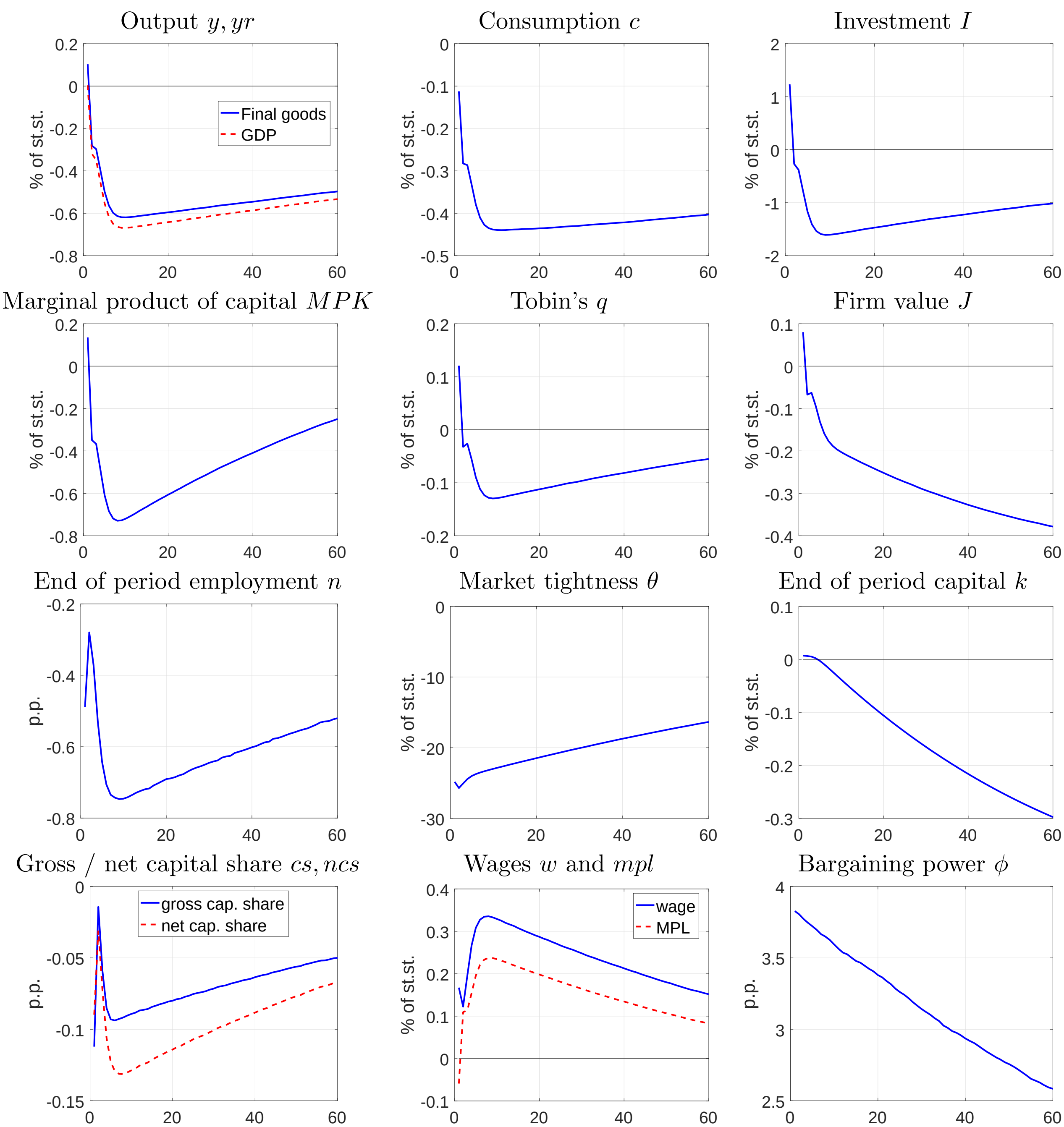


Figure G.22: IRFs to a one-standard deviation shock to workers' bargaining power with CES $\varepsilon = 0.75$.

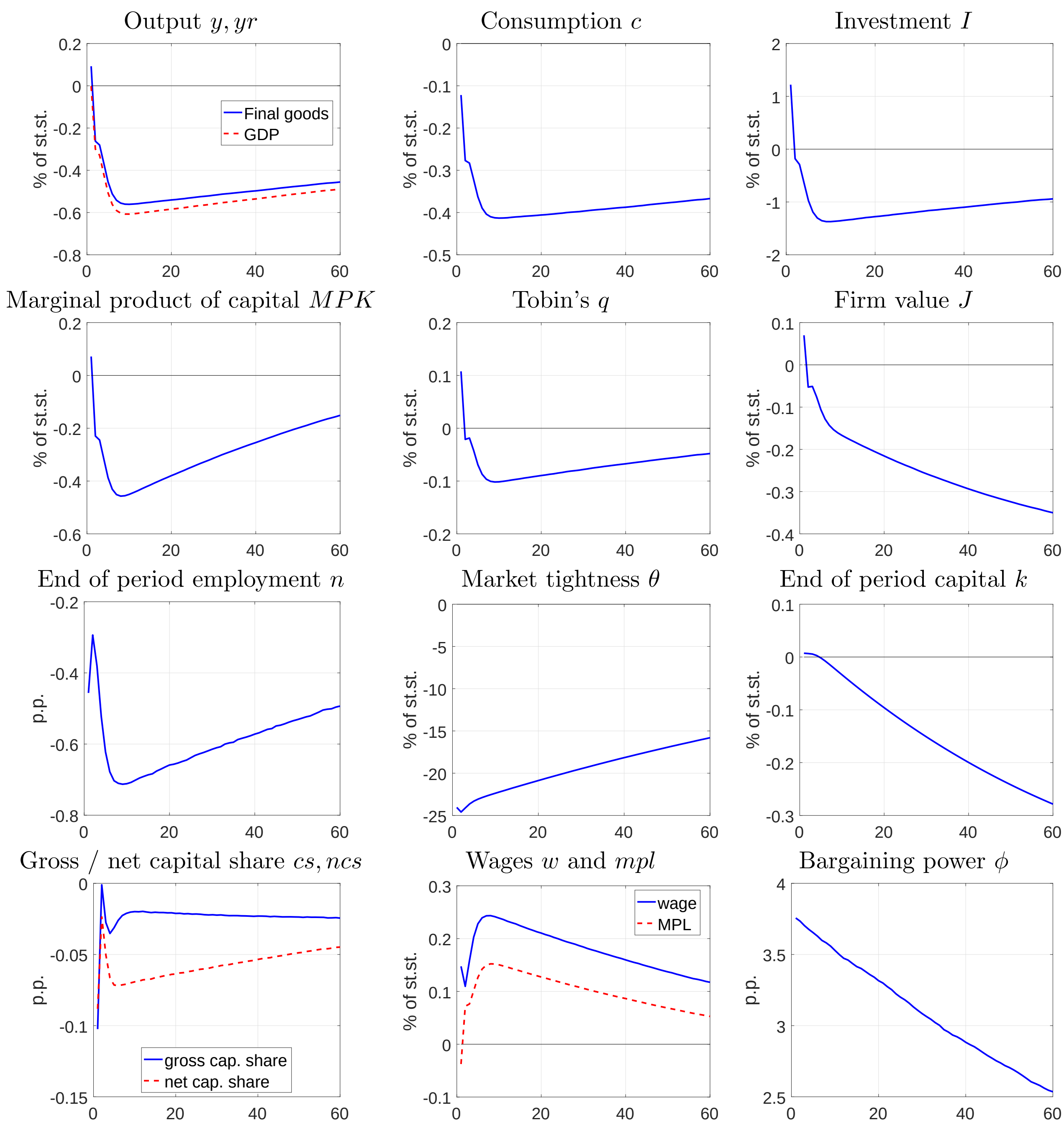


Figure G.23: IRFs to a one-standard deviation shock to workers' bargaining power with CES $\varepsilon = 1.25$.

G.14 IRF comparison: Search and matching vs. RBC model

We benchmark our model against a real business cycle analogue to our economy. Since our baseline model features indivisible labor, its real business cycle analogue is closest to Hansen (1985) and Rogerson (1988). In keeping with our timing convention, however, labor is also hired and paid one period in advance. Also, employed and unemployed agents have the same consumption and hence the period utility function is simply:

$$U_t = \frac{(c_t - hc^a_{t-1})^{1-\sigma} - 1}{1-\sigma} - \gamma n_{t-1}.$$

Compared to the solution of the search model, this implies the following changes:

- The detrended habit function $\tilde{h}(\cdot)$ in (G.46) is constant at $\tilde{h} = hg_z^{-\frac{1}{1-\alpha}}$.
- The law of motion for employment (G.6) drops out as well as the recruiting optimality condition (G.17) – the fraction of recruiter ν_t and labor market tightness θ_t are not defined.
- There are alternative ways of setting wages that allow us to retain the assumption that labor is set one period in advance. We pick a structure where labor supply is predetermined:
  - The equation (G.43) for the marginal value of employment J_n is replaced by

    $$\widetilde{mpl}_t - w_t = 0.$$

    In words, the wage rate equals the marginal product of labor state by state – keeping the labor share of income constant with a Cobb-Douglas production function.
  - The wage-setting equation (G.66a) is replaced by an indifference condition for the household:

    $$\mathbb{E}_t \left[m_{t+1} g^{\frac{1}{1-\alpha}} \left((1-\tau_n)w_t - \sigma\gamma \frac{c_{t+1} - h\bar{c}_t}{1 + (\sigma-1)\gamma n_t} \right) \right] = 0.$$

    Households choose labor supply one period in advance so that, on expectation, they are indifferent between leisure and work.

We can then compare the responses to the common productivity shock, using the same deep parameters that we calibrated for our baseline model – except that we also recalibrate γ to make sure the employment levels in both models are the same.

We show the comparison of IRFs from this model and our baseline model in Figures G.24 (for unitary elasticity of substitution) and G.25 (for $\epsilon = 0.75$). Finally, in Figure G.27, we show the comparison of IRFs with the RBC model with factor share shocks.

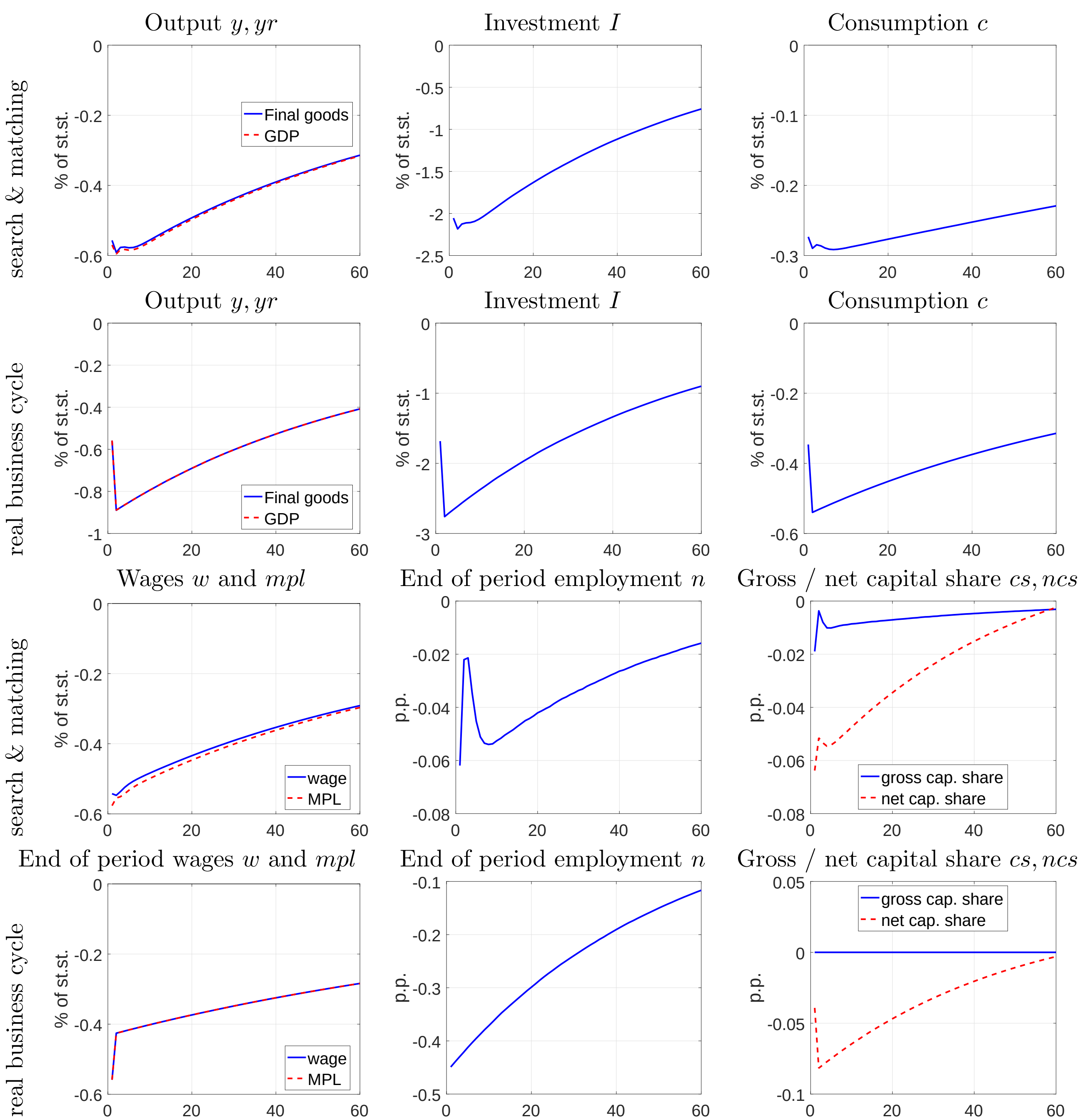


Figure G.24: IRFs to a negative one-standard deviation labor productivity shock: Search and matching vs. RBC model with Cobb-Douglas production function.

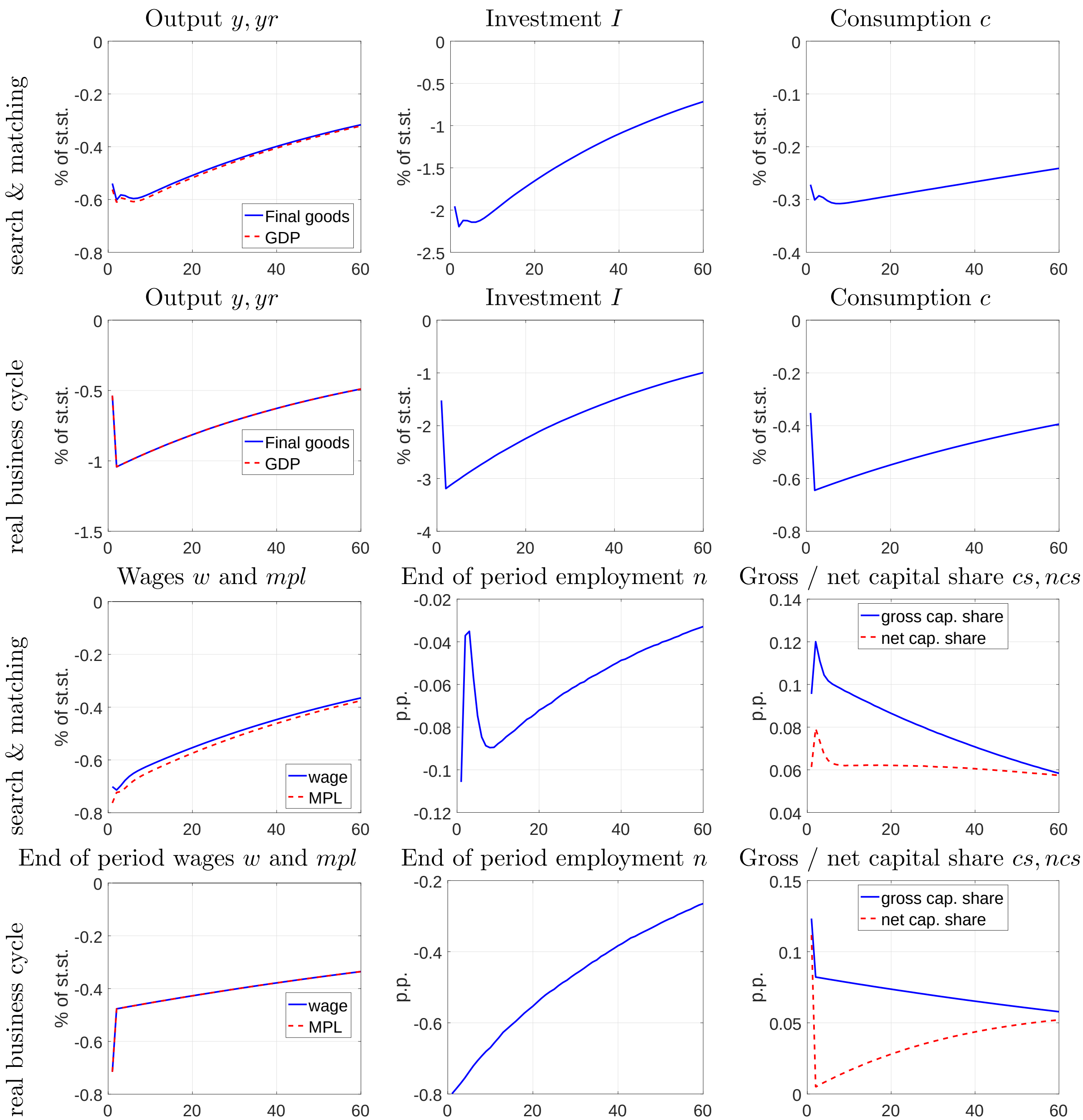


Figure G.25: IRFs to a negative one-standard deviation labor productivity shock: Search and matching vs. RBC model with CES $\varepsilon = 0.75$.

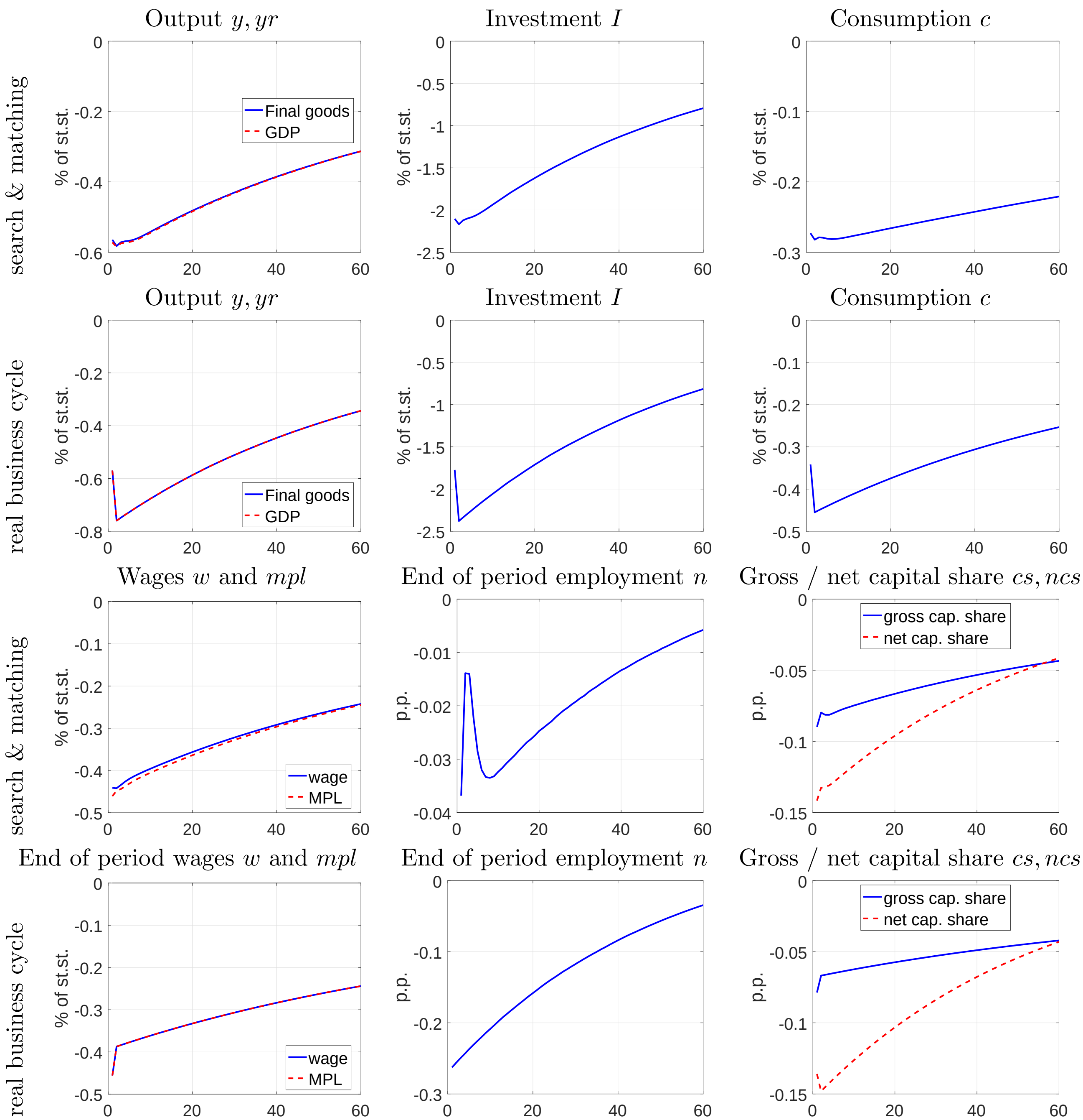


Figure G.26: IRFs to a negative one-standard deviation labor productivity shock: Search and matching vs. RBC model with CES $\varepsilon = 1.25$.

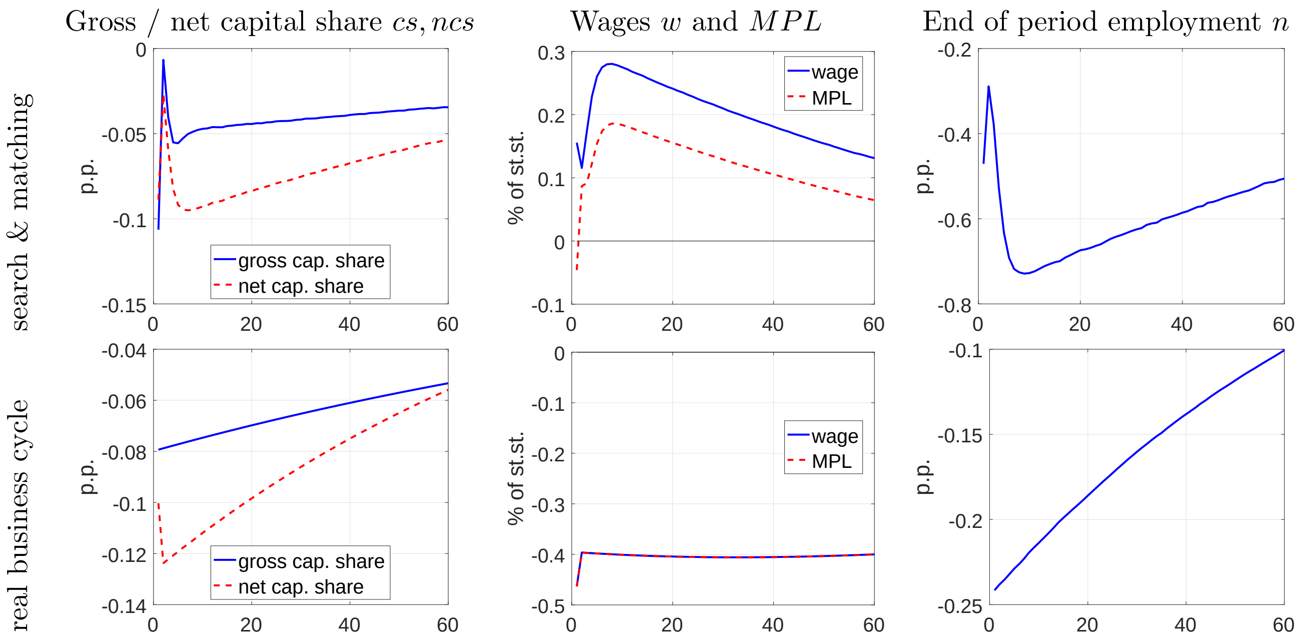


Figure G.27: Bargaining shock in search and matching model compared to factor share shock in RBC.

G.15 Sensitivity analysis

In this final subsection, we include an extensive sensitivity analysis of the quantitative properties of the model.

G.15.1 The role of persistence

First, we consider different values of the persistence of the bargaining power shock in addition to the baseline value of $\rho_\phi = 0.98^{1/3}$. For the low persistence, we choose $\rho_\phi = 0.95^{1/3}$. For the high persistence, we choose $\rho_\phi = 0.9914^{1/3}$. For each value, we re-calibrate the model.

Table G.7 and Figure G.28 summarize the results. In short, the output effects of bargaining power shocks are roughly invariant to the persistence. In contrast, with shorter-lived shocks the bargaining power shock explains more variation in the capital share. This is unsurprising, given that, as argued in the main text, steady-state changes in the bargaining power have virtually no effects on capital shares.

Table G.7: Business cycle statistics with different persistence for the bargaining power shock and re-calibrated persistence and investment adjustment cost: 1947Q1–2015Q2.

	Volatility							
	Y [%]	$\frac{std(I)}{std(Y)}$	$\frac{std(C)}{std(Y)}$	std(ncs) [pp.]	std(cs) [pp.]	std(w) [%]	std(u) [%]	std(TFP) [%]
U.S. data	1.99	3.28	0.58	1.07	0.86	0.95	0.83	1.21
Models								
S&M, $\rho_\phi^3 = 0.95$	1.98	3.28	0.57	0.38	0.21	1.34	1.84	1.21
S&M, $\rho_\phi^3 = 0.95$: no barg. shock	1.30	3.52	0.53	0.18	0.02	1.14	0.14	1.20
S&M, $\rho_\phi^3 = 0.98$ (baseline)	2.01	3.28	0.59	0.36	0.17	1.31	1.86	1.21
S&M, $\rho_\phi^3 = 0.98$: no barg. shock	1.33	3.86	0.46	0.19	0.02	1.15	0.16	1.21
S&M, $\rho_\phi^3 = 0.9914$	2.03	3.28	0.61	0.35	0.14	1.28	1.98	1.21
S&M, $\rho_\phi^3 = 0.9914$: no barg. shock	1.31	3.88	0.46	0.18	0.02	1.13	0.16	1.20

	Cyclicality							
	Y	I	C	ncs	cs	w	u	TFP
U.S. data	1.00	0.91	0.84	0.57	0.36	0.19	-0.76	0.78
Models								
S&M, $\rho_\phi^3 = 0.95$	1.00	0.97	0.99	0.82	0.30	0.19	-0.77	0.71
S&M, $\rho_\phi^3 = 0.95$: no barg. shock	1.00	0.99	0.99	0.98	0.87	1.00	-0.96	1.00
S&M, $\rho_\phi^3 = 0.98$ (baseline)	1.00	0.96	0.98	0.87	0.33	0.19	-0.76	0.71
S&M, $\rho_\phi^3 = 0.98$: no barg. shock	1.00	0.99	0.99	0.97	0.91	1.00	-0.96	1.00
S&M, $\rho_\phi^3 = 0.9914$	1.00	0.94	0.96	0.91	0.43	0.19	-0.70	0.72
S&M, $\rho_\phi^3 = 0.9914$: no barg. shock	1.00	0.99	0.99	0.97	0.91	1.00	-0.96	1.00

	Persistence							
	Y	I	C	ncs	cs	w	u	TFP
U.S. data	0.87	0.82	0.78	0.76	0.74	0.67	0.90	0.78
Models								
S&M, $\rho_\phi^3 = 0.95$	0.82	0.80	0.83	0.76	0.65	0.79	0.83	0.78
S&M, $\rho_\phi^3 = 0.95$: no barg. shock	0.79	0.80	0.80	0.78	0.58	0.78	0.82	0.78
S&M, $\rho_\phi^3 = 0.98$ (baseline)	0.83	0.79	0.85	0.78	0.66	0.79	0.81	0.78
S&M, $\rho_\phi^3 = 0.98$: no barg. shock	0.80	0.80	0.80	0.79	0.62	0.78	0.82	0.78
S&M, $\rho_\phi^3 = 0.9914$	0.83	0.76	0.86	0.78	0.61	0.78	0.65	0.79
S&M, $\rho_\phi^3 = 0.9914$: no barg. shock	0.80	0.80	0.80	0.79	0.62	0.78	0.82	0.78

Note: Quarterly data, HP-filtered with smoothing parameter $\lambda = 1,600$. We average the monthly model-generated data first within quarters before HP-filtering.

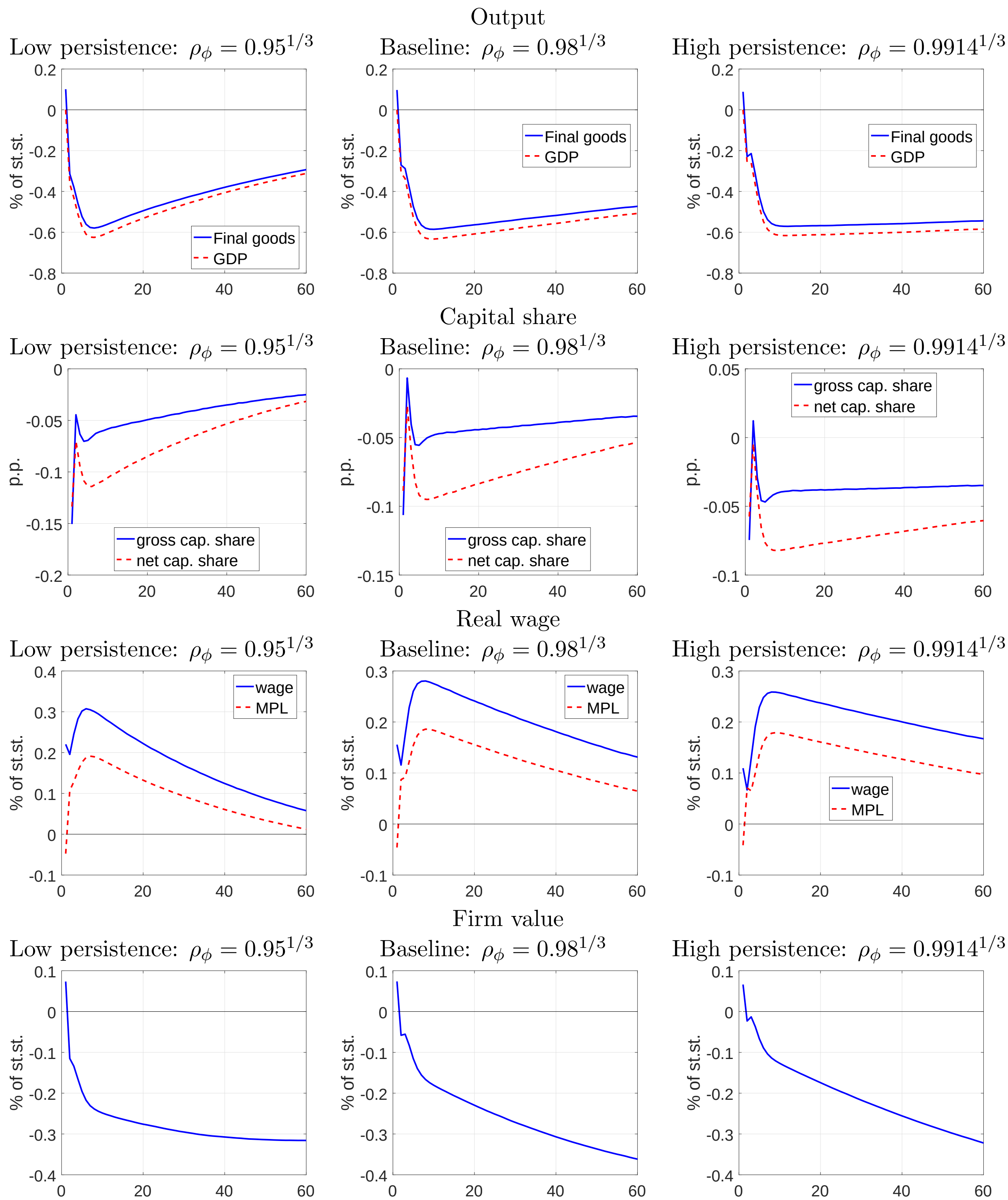


Figure G.28: IRF of output, capital share, real wage, and firm value with the model calibrated to different levels of persistence.

G.15.2 The role of the elasticity of substitution

Next, we document in Table G.8, some properties of the model as we change the elasticity of substitution.

Table G.8: Elasticity of substitution and business cycle statistics: 1947Q1-2015Q2. Full results.

Volatility

	Y [%]	$\frac{\text{std(I)}}{\text{std(Y)}}$	$\frac{\text{std(C)}}{\text{std(Y)}}$	std(ncs) [pp.]	std(cs) [pp.]	std(w) [%]	std(u) [%]	std(TFP) [%]
U.S. data	1.99	3.28	0.58	1.07	0.86	0.95	0.83	1.21
				$\varepsilon = .75$				
S&M	2.12	3.28	0.58	0.35	0.33	1.67	1.92	1.21
S&M	1.37	3.68	0.50	0.15	0.24	1.47	0.27	1.20
RBC	2.22	3.28	0.61	0.07	0.18	1.04	2.41	1.21
				$\varepsilon = 1.25$				
S&M	1.94	3.28	0.59	0.41	0.24	1.08	1.81	1.21
S&M	1.27	3.76	0.48	0.33	0.17	0.93	0.09	1.20
RBC	1.62	3.28	0.59	0.35	0.14	0.83	0.63	1.21

Cyclicality

	Y	I	C	ncs	cs	w	u	TFP
U.S. data	1.00	0.91	0.84	0.57	0.36	0.19	-0.76	0.78
				$\varepsilon = 0.75$				
S&M	1.00	0.97	0.98	0.61	-0.02	0.19	-0.79	0.72
S&M	1.00	0.99	0.99	-0.79	-0.99	1.00	-0.95	0.99
RBC	1.00	0.97	0.99	0.80	-0.95	0.95	-0.77	0.99
				$\varepsilon = 1.25$				
S&M	1.00	0.96	0.97	0.84	0.42	0.19	-0.75	0.70
S&M	1.00	0.99	0.99	0.99	1.00	1.00	-0.96	1.00
RBC	1.00	0.99	0.99	0.99	0.98	0.98	-0.93	0.99

Persistence

	Y	I	C	ncs	cs	w	u	TFP
U.S. data	0.87	0.82	0.78	0.76	0.74	0.67	0.90	0.78
				$\varepsilon = 0.75$				
S&M	0.83	0.79	0.85	0.75	0.72	0.78	0.80	0.79
S&M	0.80	0.80	0.80	0.62	0.79	0.78	0.82	0.78
RBC	0.80	0.80	0.80	0.24	0.75	0.75	0.79	0.79
				$\varepsilon = 1.25$				
S&M	0.83	0.78	0.84	0.77	0.74	0.79	0.81	0.78
S&M	0.79	0.79	0.79	0.79	0.78	0.78	0.82	0.78
RBC	0.80	0.80	0.80	0.79	0.78	0.77	0.79	0.78

Note: Quarterly data, HP-filtered with smoothing parameter $\lambda = 1,600$. We average the monthly model-generated data first within quarters before HP-filtering.

G.15.3 The role of market power

Table G.9 summarizes our findings on the role of market power.

Table G.9: Business cycle statistics: 1947Q1–2015Q2. The role of market power.

	Volatility							
	Y [%]	$\frac{\text{std(I)}}{\text{std(Y)}}$	$\frac{\text{std(C)}}{\text{std(Y)}}$	std(ncs) [pp.]	std(cs) [pp.]	std(w) [%]	std(u) [%]	std(TFP) [%]
U.S. data	1.99	3.28	0.58	1.07	0.86	0.95	0.83	1.21
	Fixed cost							
S&M: with bargaining shock	1.99	3.28	0.54	0.49	0.23	1.14	1.66	1.21
S&M: no bargaining shock	1.28	3.73	0.41	0.28	0.10	0.99	0.14	1.18
RBC	1.81	3.28	0.54	0.39	0.13	0.78	0.87	1.21
	No fixed cost							
S&M: with bargaining shock	2.16	3.28	0.59	0.38	0.17	1.25	1.95	1.21
S&M: no bargaining shock	1.29	3.75	0.48	0.18	0.01	1.12	0.15	1.18
RBC	1.89	3.28	0.60	0.25	0.00	0.92	1.06	1.21

	Cyclicality							
	Y	I	C	ncs	cs	w	u	TFP
U.S. data	1.00	0.91	0.84	0.57	0.36	0.19	-0.76	0.78
	Fixed cost							
S&M: with bargaining shock	1.00	0.96	0.96	0.95	0.83	0.19	-0.78	0.79
S&M: no bargaining shock	1.00	0.99	0.99	0.99	1.00	1.00	-0.97	1.00
RBC	1.00	0.99	0.99	0.99	1.00	0.97	-0.97	0.99
	No fixed cost							
S&M: with bargaining shock	1.00	0.96	0.98	0.87	0.33	0.19	-0.79	0.74
S&M: no bargaining shock	1.00	0.99	0.99	0.97	0.88	1.00	-0.96	1.00
RBC	1.00	0.98	0.99	0.98	NaN	0.96	-0.95	0.99

	Persistence							
	Y	I	C	ncs	cs	w	u	TFP
U.S. data	0.87	0.82	0.78	0.76	0.74	0.67	0.90	0.78
	Fixed cost							
S&M: with bargaining shock	0.83	0.78	0.85	0.83	0.79	0.79	0.82	0.79
S&M: no bargaining shock	0.80	0.80	0.80	0.80	0.78	0.78	0.82	0.79
RBC	0.80	0.80	0.80	0.81	0.80	0.77	0.79	0.79
	No fixed cost							
S&M: with bargaining shock	0.83	0.79	0.85	0.79	0.64	0.78	0.80	0.79
S&M: no bargaining shock	0.80	0.80	0.80	0.79	0.60	0.78	0.82	0.78
RBC	0.80	0.80	0.80	0.81	NaN	0.77	0.79	0.79

Note: Quarterly data, HP-filtered with smoothing parameter $\lambda = 1,600$. We average the monthly model-generated data first within quarters before HP-filtering.

G.15.4 The role of exogenous shocks

Table G.10 reports business cycle statistics with endogenous policy changes.

Table G.10: Business cycle statistics with endogenous policy changes: 1947Q1–2015Q2.

	Volatility							
	Y [%]	$\frac{\text{std(I)}}{\text{std(Y)}}$	$\frac{\text{std(C)}}{\text{std(Y)}}$	std(ncs) [pp.]	std(cs) [pp.]	std(w) [%]	std(u) [%]	std(TFP) [%]
U.S. data	1.99	3.28	0.58	1.07	0.86	0.95	0.83	1.21
Models								
S&M model: policy rule	2.13	3.28	0.65	0.34	0.12	1.28	2.22	1.21
S&M model: no bargaining shock	1.32	4.03	0.43	0.19	0.02	1.13	0.17	1.20
RBC model: baseline	1.90	3.28	0.60	0.25	0.00	0.92	1.04	1.21

	Cyclicality							
	Y	I	C	ncs	cs	w	u	TFP
U.S. data	1.00	0.91	0.84	0.57	0.36	0.19	-0.76	0.78
Models								
S&M model: policy rule	1.00	0.92	0.94	0.91	0.29	0.19	-0.67	0.72
S&M model: no bargaining shock	1.00	0.99	0.99	0.97	0.92	1.00	-0.97	1.00
RBC model: baseline	1.00	0.98	0.99	0.98	NaN	0.96	-0.95	0.99

	Persistence							
	Y	I	C	ncs	cs	w	u	TFP
U.S. data	0.87	0.82	0.78	0.76	0.74	0.67	0.90	0.78
Models								
S&M model: policy rule	0.79	0.80	0.80	0.78	0.60	0.78	0.82	0.78
S&M model: no bargaining shock	0.80	0.80	0.80	0.79	0.62	0.78	0.82	0.78
RBC model: baseline	0.80	0.80	0.80	0.81	NaN	0.76	0.79	0.78

Note: Quarterly data, HP-filtered with smoothing parameter $\lambda = 1,600$. We average the monthly model-generated data first within quarters before HP-filtering.

G.15.5 Alternative calibrations

We close with information regarding two alternative calibrations: matching the industry- and occupation-adjusted wage rate (Table G.11) and matching the unemployment rate volatility and business cycle statistics (Table G.12).

Table G.11: Matching the industry- and occupation-adjusted wage rate. Business cycle statistics: 1980Q1-2014Q4.

	Volatility							
	Y [%]	$\frac{\text{std(I)}}{\text{std(Y)}}$	$\frac{\text{std(C)}}{\text{std(Y)}}$	std(ncs) [pp.]	std(cs) [pp.]	std(w) [%]	std(u) [%]	std(TFP) [%]
U.S. data	1.77	3.06	0.47	0.94	0.72	0.48	0.77	0.96
Models								
S&M model: matching ECI wage	2.25	3.06	0.60	0.45	0.22	1.23	2.42	0.96
S&M model: no bargaining shock	1.03	3.57	0.48	0.15	0.01	0.90	0.12	0.95
RBC model: baseline	1.51	3.06	0.60	0.21	0.00	0.73	0.79	0.96

	Cyclicality							
	Y	I	C	ncs	cs	w	u	TFP
U.S. data	1.00	0.95	0.81	0.46	0.21	-0.25	-0.85	0.68
Models								
S&M model: matching ECI wage	1.00	0.96	0.98	0.84	0.33	-0.25	-0.83	0.59
S&M model: no bargaining shock	1.00	0.99	0.99	0.97	0.91	1.00	-0.98	1.00
RBC model: baseline	1.00	0.99	0.99	0.98	NaN	0.97	-0.97	0.99

	Persistence							
	Y	I	C	ncs	cs	w	u	TFP
U.S. data	0.89	0.86	0.76	0.78	0.74	0.78	0.93	0.79
Models								
S&M model: matching ECI wage	0.84	0.78	0.86	0.77	0.67	0.79	0.75	0.79
S&M model: no bargaining shock	0.79	0.80	0.80	0.79	0.61	0.78	0.81	0.78
RBC model: baseline	0.80	0.80	0.80	0.82	NaN	0.76	0.79	0.78

Note: Quarterly data, HP-filtered with smoothing parameter $\lambda = 1,600$. We average the monthly model-generated data first within quarters before HP-filtering.

Table G.12: Matching the unemployment rate volatility and business cycle statistics: 1947Q1-2015Q2.

	Volatility							
	Y [%]	$\frac{\text{std(I)}}{\text{std(Y)}}$	$\frac{\text{std(C)}}{\text{std(Y)}}$	std(ncs) [pp.]	std(cs) [pp.]	std(w) [%]	std(u) [%]	std(TFP) [%]
U.S. data	1.99	3.28	0.58	1.07	0.86	0.95	0.83	1.21
Models								
S&M model: matching std(u)	1.46	3.28	0.57	0.23	0.07	1.19	0.83	1.21
S&M model: no bargaining shock	1.31	3.47	0.54	0.18	0.02	1.16	0.14	1.21
RBC model: baseline	1.89	3.28	0.60	0.25	0.00	0.92	1.04	1.21

	Cyclicality							
	Y	I	C	ncs	cs	w	u	TFP
U.S. data	1.00	0.91	0.84	0.57	0.36	0.19	-0.76	0.78
Models								
S&M model: matching std(u)	1.00	0.98	0.99	0.93	0.38	0.76	-0.57	0.90
S&M model: no bargaining shock	1.00	0.99	0.99	0.98	0.87	1.00	-0.96	1.00
RBC model: baseline	1.00	0.98	0.99	0.98	NaN	0.96	-0.95	0.99

	Persistence							
	Y	I	C	ncs	cs	w	u	TFP
U.S. data	0.87	0.82	0.78	0.76	0.74	0.67	0.90	0.78
Models								
S&M model: matching std(u)	0.80	0.79	0.81	0.78	0.55	0.78	0.84	0.78
S&M model: no bargaining shock	0.79	0.80	0.80	0.78	0.57	0.78	0.82	0.78
RBC model: baseline	0.80	0.80	0.80	0.81	NaN	0.76	0.79	0.78

Note: Quarterly data, HP-filtered with smoothing parameter $\lambda = 1,600$. We average the monthly model-generated data first within quarters before HP-filtering.