Online Appendix to 'Fiscal Policy and Occupational Employment Dynamics'

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A Data appendix

A.1 Occupational labor-market data

The CPS is a representative monthly household survey conducted by the U.S. Bureau of Labor Statistics, covering a number of demographic and labor-market related questions. The Merged Outgoing Rotation Group (MORG) is a subset of the full CPS sample (more than 25,000 individuals per month) and can be downloaded from the National Bureau of Economic Research. CEPR has prepared several consistent datasets from the CPS available for download. We use these data and checked that aggregating the monthly CPS micro data to quarterly, seasonally adjusted time series yields virtually identical time series as published by the BLS.

Changes in the way the Census defines industries and occupations affect the comparability of the employment series over time. To construct consistent occupational employment data over time, we follow the procedure outlined in Shim and Yang (2016) and use conversion factors provided by the U.S. Census Bureau. Analogously, we use the Census-provided conversion factors for industries to construct consistent employment series by industries. The major occupation and industry groups follow the 2010 Census classification.

We include individuals aged 16 and over and use the CPS Earnings Weight when collapsing the micro data. The CPS Labor Force Status variable is used to classify individuals as employed. To measure hours worked, we use the CPS information on hours worked last week at all jobs. The earnings variable is taken from the CEPR extracts and is defined as usual weekly earnings for hourly and non-hourly workers, including overtime compensation. Nominal variables are converted to $2015 using the U.S. Consumer Price Index.

Note that the conversion factors have been determined for constructing consistent employment series by occupation or industry, respectively. To construct consistent time series for other labor-market outcomes than employment, we use the original conversion factors but adjust the resulting time series using dummies when detrending the (log) data. The dummies shift the series by a constant factor, analogous to the procedure used by Foote and Ryan (2014), and hence assumes that the constant difference between the employment-specific conversion factor matrices and the respective matrix for other labor-market outcomes affects mostly the level of the resulting series. We determine the cyclical component of $\ln x$ in occupation o as the residual to the regression

$\ln \widehat{x}_{o,t} = const_{x,o} + \beta_{x,o} \cdot t + \gamma_{x,o} \cdot 1_{t<2003} + \varepsilon_{x,o,t}$, where $1_{t<2003}$ is an indicator variable for the time before 2003, the year where the classification of major occupations has changed to the current classification. We proceed analogously to construct the time series of employment by occupation *and* industry.

A.2 Aggregate data

Table A.1 summarizes the data sources for the aggregate data and Table A.2 shows how we construct the aggregate variables that enter the VARs.

Table A1: Data sources

Series Title	Series ID	Source
Government Consumption Expenditures	A955RC1Q027SBEA	FRED
Gross Government Investment	A782RC1Q027SBEA	FRED
Gross Domestic Product	GDP	FRED
Gross Domestic Product: Implicit Price Deflator	GDPDEF	FRED
Civilian Noninstitutional Population	CNP16OV	FRED
Effective Federal Funds Rate	FEDFUNDS	FRED
Current Tax Receipts	W054RC1Q027SBEA	FRED
Public Debt as Percent of GDP	GFDEGDQ188S	FRED
Mean Forecast for Real Federal Government Consumption Expenditures and Gross Investment	Mean_RFEDGOV_Level	SPF
Mean Forecast for Real State and Local Government Consumption Expenditures and Gross Investment	Mean_RSLGOV_Level	SPF
Government Consumption Expenditures: Gross Output of General Government: Value Added: Compensation of General Government Employees	A194RC1Q027SBEA	FRED
Capacity Utilization: Total Industry	TCU	FRED

Notes: FRED: Federal Reserve Bank of St. Louis Economic Database, SPF: Survey of Professional Forecasters.

Table A2: Definition of variables

Variable	**Definition**	**Description**
Output	$\log \frac{GDP}{GDPDEF \cdot CNP16OV}$	real GDP per capita
Government Spending	$\log \frac{(A955...)+(A782...)}{GDPDEF \cdot CNP16OV}$	real government spending per capita
Government Consumption	$\log \frac{(A955...)}{GDPDEF \cdot CNP16OV}$	real government consumption per capita
Government Investment	$\log \frac{(A782...)}{GDPDEF \cdot CNP16OV}$	real government investment per capita
Tax Receipts	$\log \frac{W054RC1Q027SBEA}{GDPDEF \cdot CNP16OV}$	real government tax receipts per capita
Debt-to-GDP Ratio	$GFDEGDQ188S$	public debt as percent of GDP
Real Interest Rate	$\frac{FEDFUNDS}{100} - \left(\frac{GDPDEF(+1)}{GDPDEF}\right)^4 - 1$	annualized real interest rate
Government Spending Forecast	$\left(\frac{(RFEDGOV+RLSGOV)(+1)}{(RFEDGOV+RLSGOV)}\right)^4 - 1$	forecast made at time t for growth rate of government spending at time $t+1$, annualized
Government Wage-Bill Expenditures	$\log \frac{A194RC1Q027SBEA}{GDPDEF \cdot CNP16OV}$	real government wage bill per capita
Government Non-Wage Expenditures	$\log \frac{(A955...)+(A782...)-(A194...)}{GDPDEF \cdot CNP16OV}$	real government non-wage bill expenditure per capita
Labor market variables	see Appendix A.1	–

Notes: (+1) indicates a one-quarter lead.

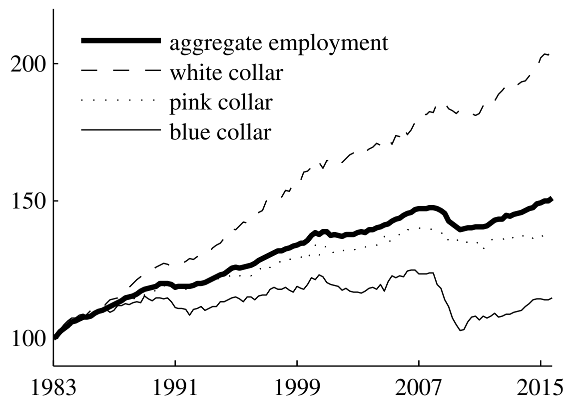
B Descriptive developments in occupational employment

Figure A1 shows seasonally adjusted, quarterly time series for aggregate employment and employment in the three broad occupation groups white-collar, blue-collar, and pink-collar. We have normalized the first value (1983Q1) to 100.

The figure shows that the different occupation groups have different employment trends. Aggregate employment grows at an average rate of 0.27 percent per quarter or 1.1 percent per year, roughly the rate of population growth in our sample. Employment growth is about 0.5 percent per quarter (2 percent per year) for white-collar occupations, 0.22 percent per quarter (0.88 percent per year) for pink-collar occupations, and 0.1 percent per quarter (0.4 percent per year) for blue-collar occupations. As a consequence, the share of blue-collar employment in total employment falls, from 27.7 percent in 1983Q1 to 21.0 percent in 2015Q4.

The figure also illustrates that blue-collar employment is more volatile than employment in other occupation groups. Clearly, blue-collar employment exhibits the strongest fall during the Great Recession. It also shows the most pronounced drops during the other two recessions in our sample, i.e., in the early 1990s and the early 2000s. The main text provides some unconditional moments of cyclical occupational employment, i.e., percentage deviations from log-linear trends.

Figure A1: Descriptive development in aggregate, white-collar, pink-collar, and blue-collar employment (1983Q1 = 100).



Notes: Seasonally adjusted time series of aggregate, white-collar, pink-collar, and blue-collar employment. Consistent occupational employment series achieved through conversion factors provided by the BLS. For each series, the value in 1983.I is normalized to 100. The non-normalized values in 1983Q1 are about 99.2 million for aggregate employment, 28.5 million for white-collar employment, 43.3 million for pink-collar employment, and 27.4 million for blue-collar employment. Pink collar: service occupations; sales and related occupations; office and administrative support occupations. Blue collar: construction and extraction occupations; installation, maintenance, and repair occupations; production occupations; transportation and material moving occupations. White collar: management, business, and financial occupations; professional and related occupations.

C Empirical results

C.1 Detailed estimation results

Figure A2 displays the estimated responses of macroeconomic aggregates to government spending shocks. The horizontal axes show quarters after the shock and the responses are expressed in percentage terms. The shock is normalized such that output changes by 1% on impact. We observe a persistent rise in government spending, a significant increase in output, and a significant and hump-shaped increase in aggregate employment. The debt-to-GDP ratio increases, indicating that the fiscal stimulus is partly debt-financed. Monetary policy seems to accommodate fiscal policy as the real interest rate falls. This finding is consistent with evidence provided by, e.g., Mountford and Uhlig (2009) and Ramey (2016).

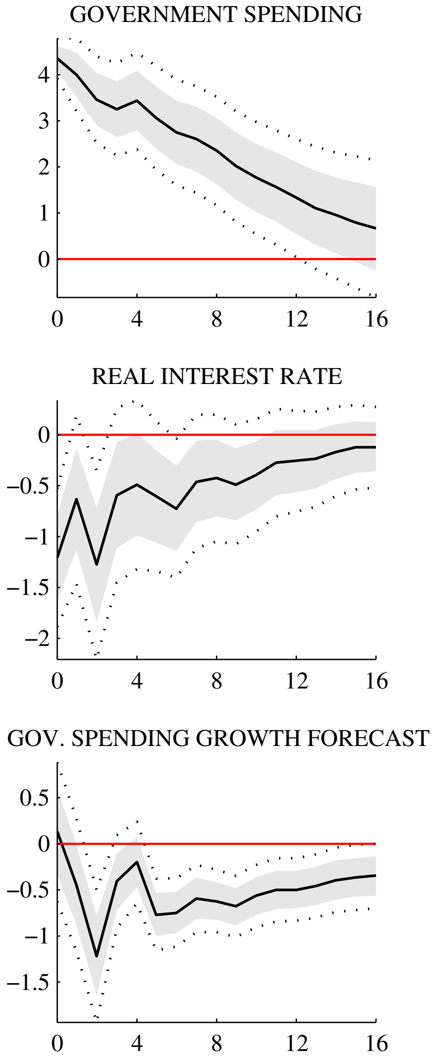
C.2 Additional results on occupational employment dynamics

Figure A3 shows the responses of employment in the major subcategories of pink-collar occupations, i.e., service occupations, sales occupations, and office occupations, to the government spending shock. Employment rises in all subcategories of pink-collar occupations. The most significant and most persistent increase is observed for service occupations.

Figure A4 repeats the analysis for the four subcategories of blue-collar occupations. In sharp contrast to the subcategories of pink-collar occupations, we do not find a significant surge in employment for any blue-collar major occupation.

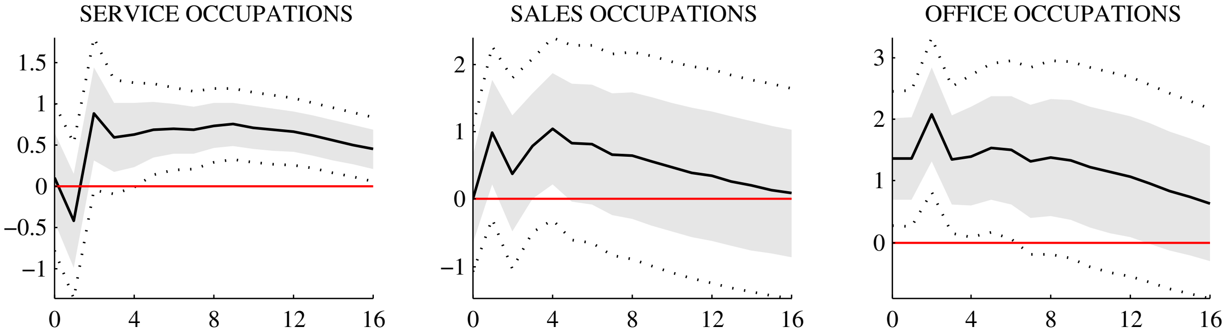
Figure A5 shows results for the subcategories of white-collar occupations. Both for management, business, and financial occupations and for professional and related occupations, we find significant employment growth in response to fiscal expansions.

Figure A2: The effects of government spending shocks on macroeconomic aggregates.



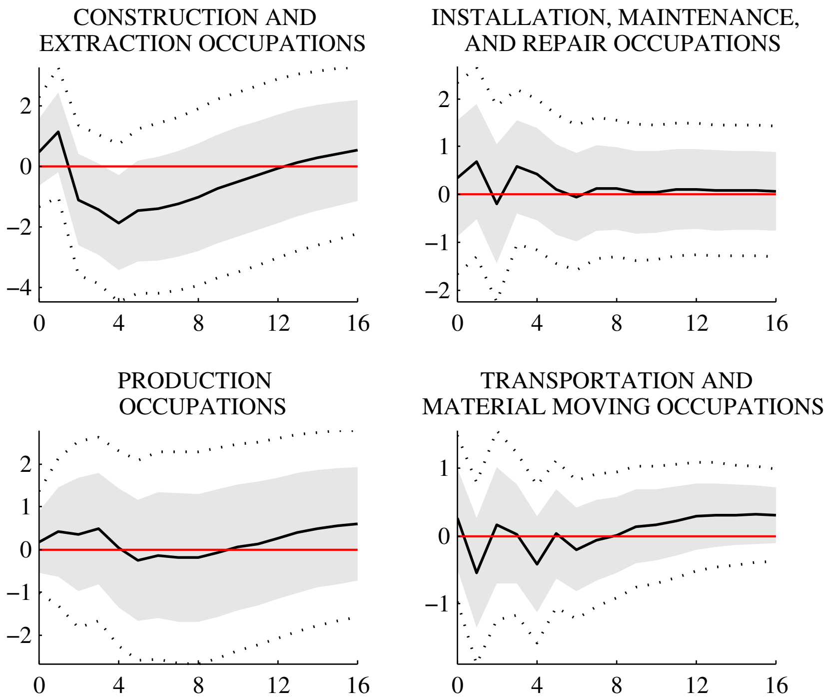
Notes: Solid lines are impulse responses to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output is normalized to one percent.

Figure A3: The effects of government spending shocks on employment in service occupations, sales occupations, and office occupations.



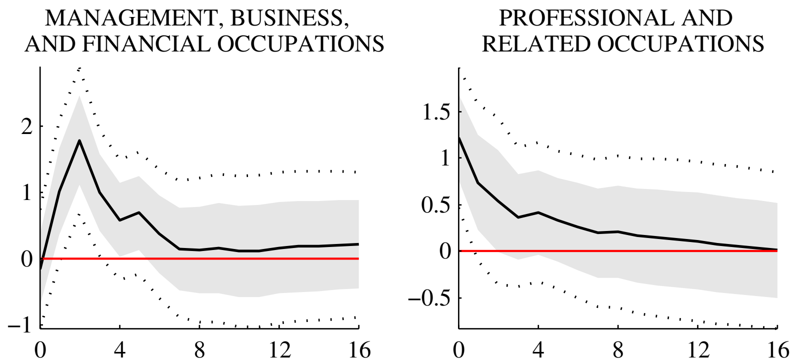
Notes: Solid lines are impulse responses of employment in the major subcategories of pink-collar occupations to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output (not shown) is normalized to one percent.

Figure A4: The effects of government spending shocks on employment in construction and extraction occupations, installation, maintenance, and repair occupations, production occupations, and transportation and material moving occupations.



Notes: Solid lines are impulse responses of employment in the major subcategories of blue-collar occupations to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output (not shown) is normalized to one percent.

Figure A5: The effects of government spending shocks on employment in management, business, and financial occupations and in professional and related occupations.



Notes: Solid lines are impulse responses of employment in the major subcategories of white-collar occupations to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output (not shown) is normalized to one percent.

C.3 Sensitivity

In this appendix, we investigate the robustness of the document relative occupational employment dynamics in response to fiscal policy shocks. We start with the gain in pink-collar employment relative to blue-collar employment. Figure A6(a) summarizes the results of alternative VAR specifications (the upper left panel repeats our baseline specification for the sake of comparison). Our results are robust to excluding the Great Recession from the data sample (i.e., to re-estimating the model on a sample period that ends in 2006). This is important because our baseline sample includes the ARRA stimulus, which was a large fiscal policy impulse in extraordinary times, and we want to make sure that our results are not solely driven by the observations pertaining to the period of the Great Recession and its aftermath. The upper right panel of Figure A6(a) shows that this is not the case.

As discussed before, there is substantial trend heterogeneity in occupational employment and we want to rule out that our results are driven by the way we treat these trends. The lower left panel of Figure A6(a) shows the response of the pink-collar to blue-collar employment ratio when the data series have been detrended with a linear-quadratic trend, and the lower right panel refers to the case where the variables enter as year-on-year growth rates. The results show that the rise in pink-collar employment relative to blue-collar employment is robust to alternative ways of handling trends in the data.

Finally, we investigate whether our focus on the extensive margin of employment is driving the results. The left panel of Figure A7(a) shows that hours per employed pink-collar worker tend to rise relative to hours per blue-collar worker after government spending expansions, in line with our baseline results for employment. Accordingly, the response of the total hours ratio (right panel of Figure A7(a)) is more pronounced than the response of the employment ratio. Put differently, for the dynamics of pink-collar relative to blue-collar employment, developments at both the intensive and the extensive margin work in the same direction.

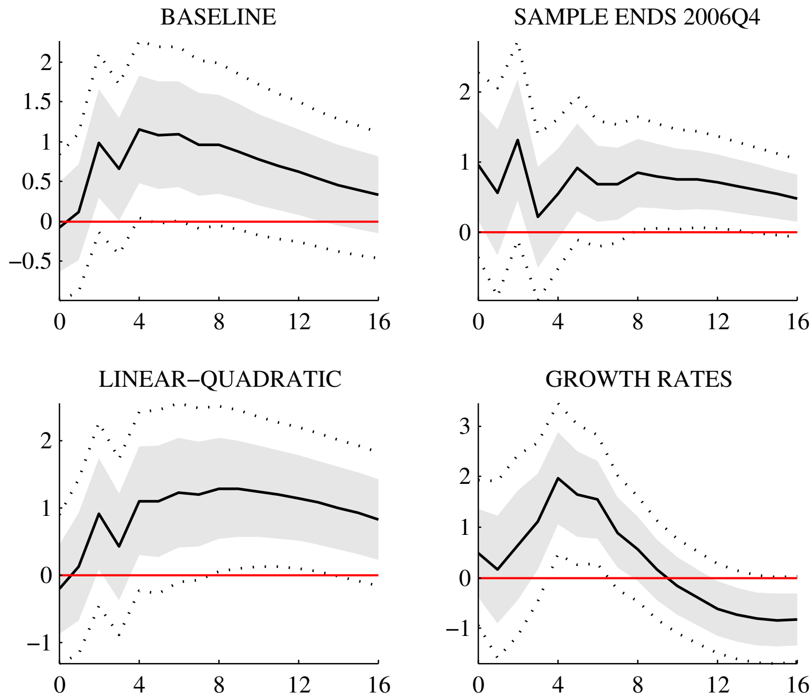
Figures A6(b) and A7(b) show the responses of white-collar to blue-collar ratios and are set up analogously to Figures A6(a) and A7(a). For this variable, results are sensitive to the specification of the VAR. Overall, white-collar employment rather tends to rise relative to blue-collar employment but this is significant only in some specifications. Specifically, we find a significant increase in relative white-collar employment in the shorter sample excluding the Great Recession and when the VAR is estimated in growth rates. We also observe a significant increase in relative white-collar hours per worker. By contrast, linear and log-linear detrending do not yield significant increases in relative white-collar employment.

We now turn to alternative identification schemes for government spending shocks. Figure A8(a) shows that the documented shift away from blue-collar employment toward employment in pink-collar occupations is robust to the applied identification scheme. First, we consider an alternative approach to account for anticipation effects when identifying unanticipated government spending shocks which was suggested by Ramey (2011b, 2016) and also used by Auerbach and Gorodnichenko (2012b). Instead of including the forecast for the growth rate of government spending, we augment the VAR with the forecast error for the growth rate of government spending. We follow Auerbach and Gorodnichenko (2012b) and use real-time forecast errors, i.e., the difference between the actual, first-release series and the forecast series. The forecast error is ordered first and the identification scheme is again recursive. In this specification, an innovation in the forecast error is interpreted as an unanticipated spending shock. The upper left panel of Figure A8(a) shows that the pink-collar to blue-collar employment ratio increases when the government spending shock is identified in this way. Second, we identify fiscal shocks using sign restrictions. In particular, we follow Mountford and Uhlig (2009) and Pappa (2009) and identify fiscal shocks by imposing that they raise GDP and the primary budget deficit, and are orthogonal to business cycle shocks that affect GDP and the deficit in opposite directions. The lower left panel of Figure A8(a) displays results of this identification. Again, we observe a strong and significant increase in the ratio of pink-collar to blue-collar employment, as in our baseline identification.

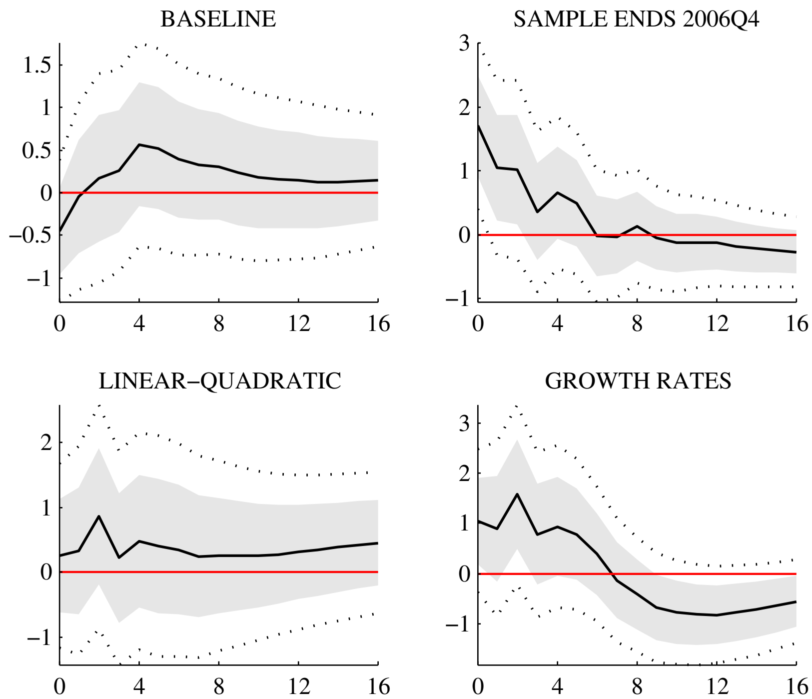
A number of researchers argue that it can make a difference whether one considers total government spending or components of government expenditures in fiscal VARs (see, e.g., Ramey, 2011b, Ilzetzki, Mendoza, and Végh, 2013). The middle column in Figure A8(a) shows results from an exercise where we separately identify exogenous variations in government investment and government consumption. In these VARs, we include the series of government investment and government consumption instead of total government spending. Identification of shocks to government investment (consumption) is achieved by ordering the respective variable first in the Cholesky or-

Figure A6: Relative occupational employment dynamics; alternative detrending methods and alternative sample period.

(a) Pink-collar to blue-collar employment ratio.



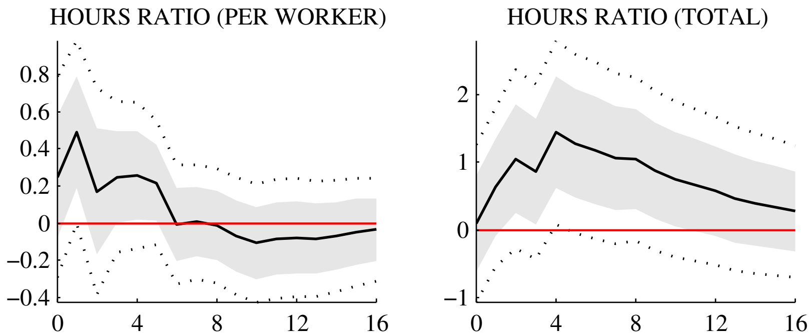
(b) White-collar to blue-collar employment ratio.



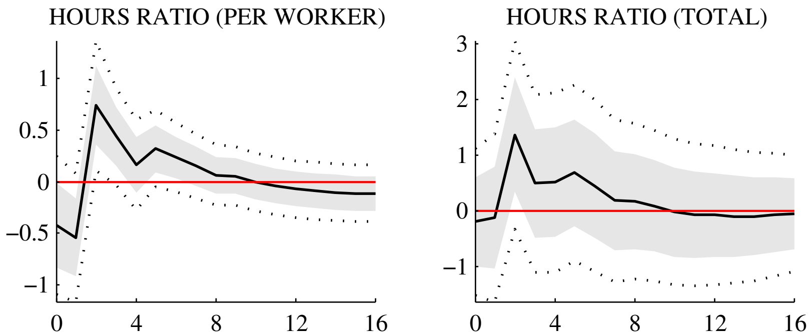
Notes: Solid lines are impulse responses of the pink-collar to blue-collar employment ratio to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output (not shown) is normalized to one percent.

Figure A7: Relative occupational labor-market outcomes.

(a) Pink-collar to blue-collar.



(b) White-collar to blue-collar.



Notes: Solid lines are impulse responses to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output (not shown) is normalized to one percent. Hours per worker is total hours worked divided by employment.

dering of the VAR. The effects are found to be stronger for variations in government consumption. Most importantly, we find a significant rise in pink-collar relative to blue-collar employment for both components of government spending.[1]

The right column of Figure A8(a) shows results from a specification where we separately identify exogenous variations in government non-wage expenditures and government wage-bill expenditures. In these VARs, we include the series of government non-wage expenditures and government wage-bill expenditures instead of total government spending. Identification of shocks to government non-wage-bill expenditures is achieved by ordering the respective variable first in the Cholesky ordering of the VAR. The lower left panel shows that the pink-collar to blue-collar employment ratios rises significantly (as in our baseline specification) when we focus on non-wage bill expenditures. The lower right panel displays the results of a shock to wage-bill expenditures. Also in this specification, we observe a significant increase in relative pink-collar employment.

Figure A8(b) shows the response of the white-collar to blue-collar employment ratio for the alternative identification schemes. For this variable, results are sensitive to the identification scheme. We do find a significant increase in relative white-collar employment when the VAR is identified by sign restrictions and when a shock to government consumption is considered. By contrast, the forecast error identification does not yield significant increases in relative white-collar employment and neither does a shock to government investment.

C.4 Shift-share decomposition

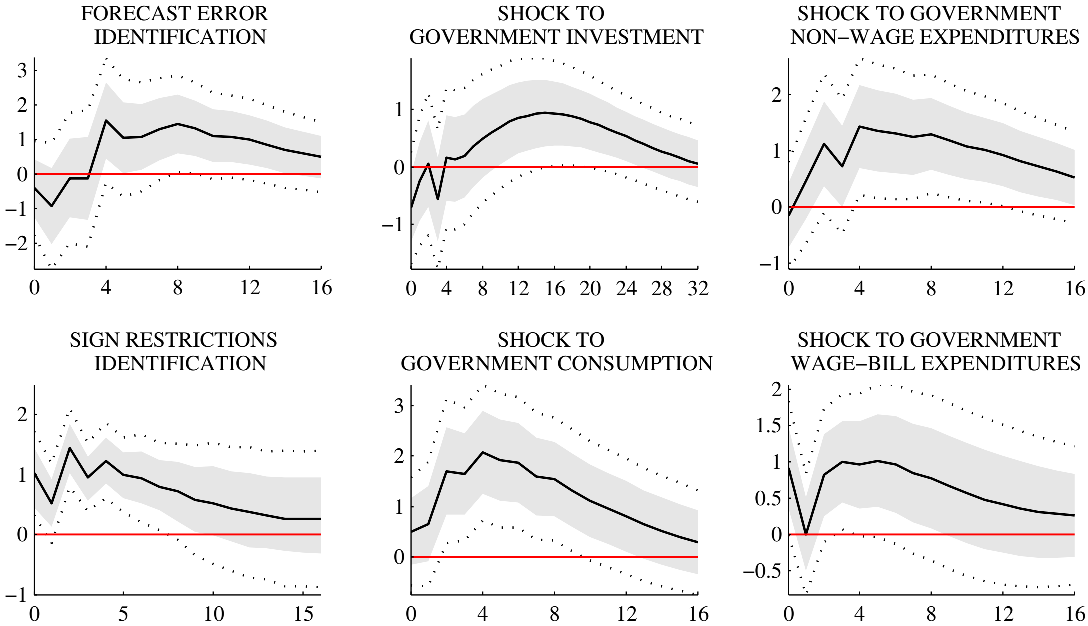
We decompose the change in employment in an occupation group o into a shift component and a share component. Employment in occupation o at time is given by $emp_{o,t} = \sum_i s_{o,i,t} \cdot emp_{i,t}$, where $s_{o,i,t}$ is the employment share of occupation o in industry i at time t (the share of industry-i workers who have occupation o) and $emp_{i,t}$ is employment in industry i at time t. The change in employment can be decomposed using the total differential,

$$\Delta emp_{o,t} = \underbrace{\sum_i \lambda_{o,i,t} \cdot \Delta emp_{i,t}}_{\Delta emp_{o,t}^{between}} + \underbrace{\sum_i \Delta s_{o,i,t} \cdot emp_{i,t}}_{\Delta emp_{o,t}^{within}}.$$

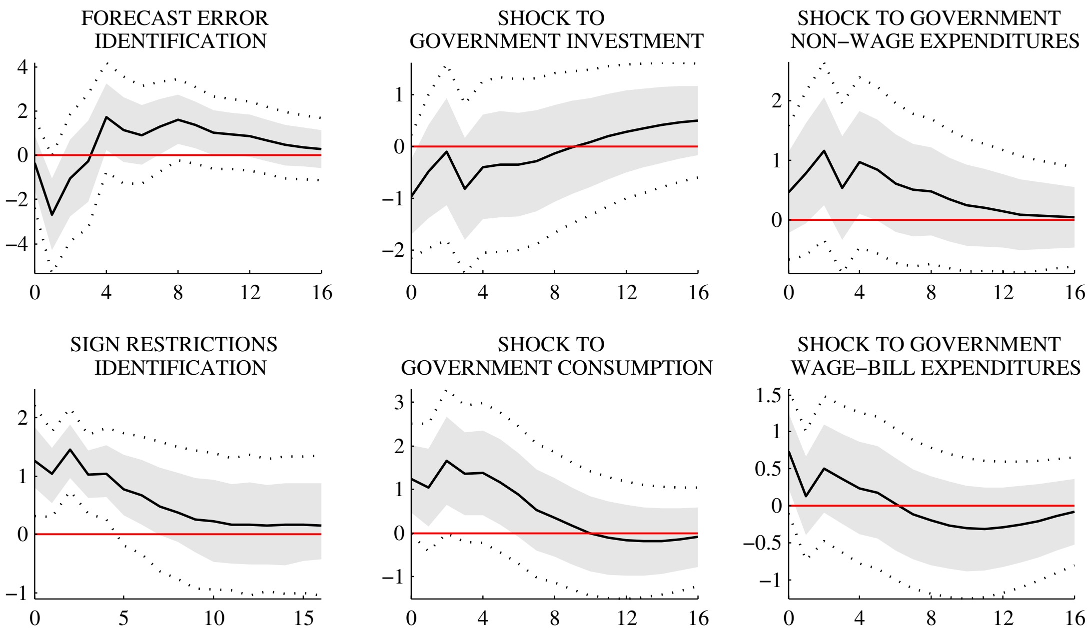
[1] After an innovation to government investment, the rise in the pink-collar to blue-collar employment ratio is more delayed compared to the case of government consumption (which is why we show the respective response over a longer horizon in the figure).

Figure A8: Relative occupational employment dynamics; alternative identifications.

(a) Pink-collar to blue-collar employment ratio.



(b) White-collar to blue-collar employment ratio.



Notes: Solid lines are impulse responses of the pink-collar to blue-collar employment ratio to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output (not shown) is normalized to one percent. In the lower right panel, we normalize the maximum response of output to one percent due to a hump-shaped increase in wage-bill spending.

Then, we use initial conditions and write the employment level in occupation o at a particular point in time, t, as

$$emp_{o,t} = emp_{o,0} + \underbrace{\sum_{\tau=1}^{t} \Delta emp_{o,\tau}^{between}}_{emp_{o,t}^{between}} + \underbrace{\sum_{\tau=1}^{t} \Delta emp_{o,\tau}^{within}}_{emp_{o,t}^{within}},$$

where $t = 0$ refers to January 1983, the beginning of our sample period. Since this decomposition is additive, aggregation to larger occupation groups such as blue-collar occupations is straightforward and gives, e.g., $emp_{blue,t} = emp_{blue,0} + emp_{blue,t}^{between} + emp_{blue,t}^{within}$ where the three components are simply the sums of the respective components of employment in the subcategories. When we consider percentage deviations from mean, the initial condition term drops out and we obtain

$$\frac{emp_{blue,t} - emp_{blue}}{emp_{blue}} = \frac{emp_{blue,t}^{between} - emp_{blue}^{between}}{emp_{blue}} + \frac{emp_{blue,t}^{within} - emp_{blue}^{within}}{emp_{blue}},$$

where variables without a time index refer to sample means. From this, we obtain the deviation from mean of the relative pink-collar to blue-collar employment as

$$\begin{aligned}
\frac{emp_{pink,t} - emp_{pink}}{emp_{pink}} - \frac{emp_{blue,t} - emp_{blue}}{emp_{blue}} \\
= \underbrace{\frac{emp_{pink,t}^{between} - emp_{pink}^{between}}{emp_{pink}} - \frac{emp_{blue,t}^{between} - emp_{blue}^{between}}{emp_{blue}}}_{\text{shift factor } (\textit{between} \text{ industries})} \\
+ \underbrace{\frac{emp_{pink,t}^{within} - emp_{pink}^{within}}{emp_{pink}} - \frac{emp_{blue,t}^{within} - emp_{blue}^{within}}{emp_{blue}}}_{\text{share factor } (\textit{within} \text{ industries})}.
\end{aligned}$$

The shift factor captures between-industry dynamics and the share factor captures within-industry occupation dynamics. We then include these factors separately in our VAR analysis to study how the two components of relative occupational employment respond to fiscal expansions.

C.5 Panel-data evidence on the within-industry effect

Data. In constructing the data, we exactly follow Nekarda and Ramey (2011). We construct industry-specific government demand variables by using information from input-output tables and merge these variables with the NBER Manufacturing Industry Database (MID) yielding a panel of 274 manufacturing industries (based on Standard Industrial Classification (SIC) codes). We extend the Nekarda-Ramey data to include the extension of the MID up to 2011 which allows us to use a similar sample period (1983-2011) as in our baseline VAR analysis (1983-2015). As Nekarda and Ramey, we use the IO tables that are available based on SIC codes, i.e., those for 1963, 1967, 1972, 1977, 1982, 1987, and 1992.[2]

Government demand instrument. The government demand instrument is constructed as

$$\Delta \ln g_{it} = \theta_i \cdot \Delta \ln G_t,$$

where $\Delta \ln G_t$ is the aggregate change in real federal government spending (from NIPA data) and θ_i is a time-invariant industry-specific weight measured as the long-run average share of shipments to the government in industry i (from the IO tables belonging to our estimation sample).

Since we use a different sample period, we first replicate main results of Nekarda and Ramey (2011) concerning the output effects of government spending in our sample. This replication is meant as a check of the validity of the instrument-approach in our sample period and the updated data including revisions of the MID and NIPA data. Table A3 shows that the we obtain similar, though not identical, estimates regarding the output effects of government spending for both sample periods. For comparison, column (1) repeats results from Nekarda and Ramey (2011, see column (1) of their Table 3). Column (2) refers to our sample period 1983-2011 and the revised data. The estimated coefficients are smaller than in the original Nekarda and Ramey sample, but the government demand instrument enters positively and is statistically significant at the 1% level.

Specification. To remain comparable with our baseline VAR analysis where we evaluate impulse response functions to government spending shocks, we have extended the Nekarda and Ramey (2011) approach to local projections in the spirit of Jordà (2005). This allows us to capture richer forms of dynamics and to calculate impulse responses using the Nekarda-Ramey identification. We obtain the h-quarter-ahead impulse response for the employment-growth difference $z_{i,t+h} = \Delta \ln n_{i,t+h}^{\text{nonprod}} - \Delta \ln n_{i,t+h}^{\text{prod}}$ by regressing it on the government demand instrument, $\Delta \ln g_{it}$, as well as on a set of control variables,

$$z_{i,t+h} = \gamma_h \cdot \Delta \ln g_{i,t} + \beta_h \cdot X_{i,t} + \zeta_{i,t+h}. \tag{1}$$

[2] We also follow Nekarda and Ramey in not merging NAICS-based IO tables from 1997 onwards (see their Web Appendix for a discussion).

Table A3: Reduced-Form Regressions of Industry Output on Government Demand (compare Nekarda and Ramey (2011), Table 3)

	(1)	(2)
Dependent variable: Real shipments		
Lagged dependent variable	0.021**	0.041***
	(0.009)	(0.011)
$\Delta g_{i,t}$	2.239***	1.5440***
	(0.165)	(0.251)
Observations	12,536	7,491
F-statistic on $\Delta g_{i,t}$	183.0***	37.9***
Dependent variable: Real gross output		
Lagged dependent variable	-0.012	−0.087***
	(0.009)	(0.011)
$\Delta g_{i,t}$	2.317***	1.431***
	(0.176)	(0.326)
Observations	12,262	7,491
F-statistic on $\Delta g_{i,t}$	173.1***	19.3***
Sample	1960-2005	1983-2011

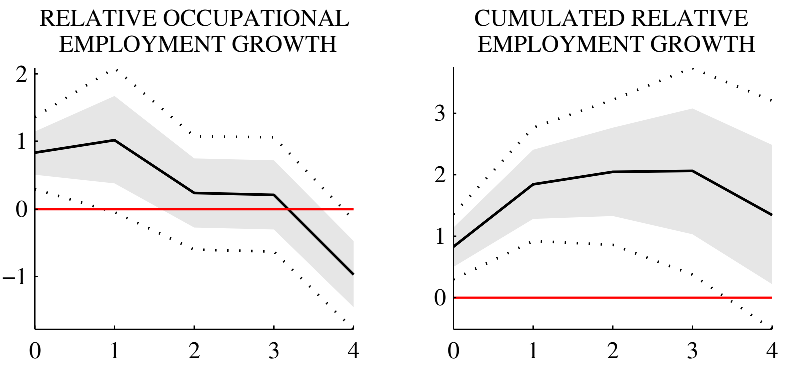
Notes: See notes to Table 3 of Nekarda and Ramey (2011).

The control variables account for industry-specific factors as well as common trend and cycle through an industry-fixed effect, a linear trend, and the growth rate of real GDP. We further include lags of the government demand variable and the endogenous variable. Following Auerbach and Gorodnichenko (2012a), standard errors are computed using the Driscoll and Kraay (1998) correction, which takes into account heteroskedasticity as well as serial and cross-sectional correlation. When we re-estimate (1) for cumulated employment growth (right panel of Figure 9), the dependent variable is $\sum_{j=0}^{h}(z_{t+j} - z_{t-1})$.

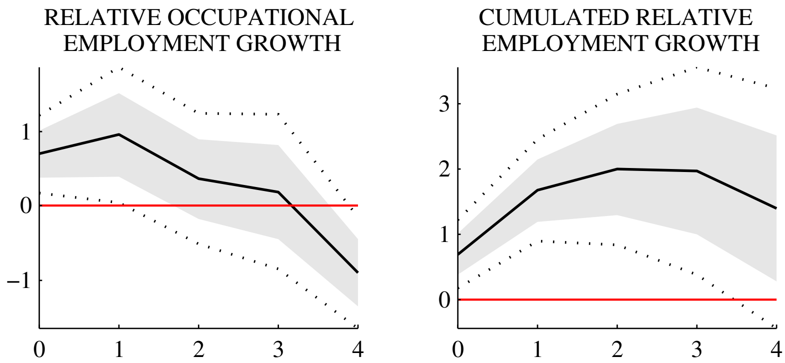
Robustness checks. To investigate the robustness of our results, we calculated the weights θ_i for the original Nekarda-Ramey (2011) sample and also considered the alternative instrument definition developed by Nekarda and Ramey, using the initial share of shipments to the government rather than the long-term average. Results of these checks are presented in Figure A9. Figure A9(a) refers to an estimation where the weight θ_i in the instrument is measured as the long-term average using data from the 1963-1992 IO tables, as in Nekarda and Ramey (2011). In Figure A9(b), we used the shares from the 1982 IO tables, the year before the start of our estimation period. In both

Figure A9: Panel-data evidence on the within-industry effect; robustness checks.

(a) Weight: 1960-2011 shipment share to government.



(b) Weight: 1982 shipment share to government.



Notes: The figure shows outcomes for non-production occupations (supervisors above the line-supervisor level, clerical, sales, office, professional, and technical workers) relative to production occupations (other occupations). Solid lines are impulse responses to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands.

Figures A9(a) and A9(b), the left panel shows relative occupational employment growth and the right panel shows cumulated relative employment growth. In these robustness checks, we obtain very similar estimates of the impulse responses as in our baseline estimations shown in Figure 9.

Discussion. For a number of reasons, the results of the panel-data approach are not directly comparable to the ones obtained from our baseline VARs. First, the Nekarda and Ramey (2011) approach is not applicable to all industries but restricted to manufacturing industries only. Thus, in our terminology, the Nekarda and Ramey (2011) sample consists of mostly blue-collar intensive industries. Second, the occupation data in the Manufacturing Industry Database is very broadly classified with two types of occupations only, allowing to distinguish between blue-collar occupations and other occupations. Third, as discussed by Nekarda and Ramey (2011), their approach is only informative about the partial-equilibrium effects of government spending. Fourth, the Nekarda-Ramey approach based on input-output data applies to federal government spending only while our VAR analysis also includes spending by state and local governments which plays an important rule in fiscal stimulus programs such as the ARRA package.

C.6 Alternative explanations

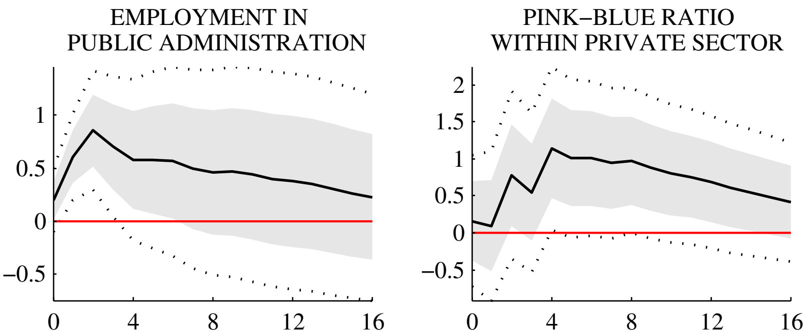
In this appendix, we discuss potential alternative explanations for our finding that fiscal expansions raise pink-collar employment relative to blue-collar employment.

To start with, we address composition effects stemming from expansions of government employment. The government wage bill is a major part of government expenditures and, at the same time, the share of pink-collar occupations in public sector employment is higher than in the economy as a whole. In our sample, the average share of pink-collar workers in public sector employment amounts to 52 percent, as compared to 42 percent economy-wide. The blue-collar share in public sector employment is 8 percent, relative to 24 percent in total employment. Conversely, of all workers with a pink-collar occupation, 5.7% work in public administration while this number is only 1.8% for blue-collar occupations and the total employment share in public administration is 4.7%.[3] The left panel of Figure A10 shows that public employment surges after government spending expansions. This surge is only slightly more pronounced than the increase in aggregate employment; the share of public employment in total employment (not shown) rises by only about 0.1 percentage points compared to an average public employment share of about 4.5 percent in our sample. Hence, an expansion of government employment – where pink-collar occupations are over-represented – contributes to the documented occupational employment dynamics but only to a limited degree. Importantly, the right panel of Figure A10 shows that we observe the same heterogeneous employment response in the private sector. Also quantitatively, the response is very similar implying that the increase in government employment and the resulting composition effect contributes only partially to the overall dynamics of employment by occupation.

Another way how the government wage bill may affect the distribution of employment across occupations is through spill-over effects to the private sector which have been discussed by Ardagna

[3] Also white-collar occupations are somewhat overrepresented in public administration where their employment share amounts to 40% compared to 34% economy-wide. Conversely, 5.6% of all workers with a white-collar occupation work in public administration.

Figure A10: The effects of government spending shocks on employment in the public sector and on relative occupational employment in the private sector.



Notes: Solid lines are impulse responses of public employment (left panel) and relative occupational employment in the private sector (right panel) to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output (not shown) is normalized to one percent.

(2007) and documented empirically by Bermperoglou, Pappa, and Vella (2017). When wage increases in the public sector spill over to the private sector, this may be particularly relevant in pink-collar occupations since the government is an important employer in this labor-market segment. Hence, relative pink-collar wages may increase which would foster entry of workers into these occupations. We address this point by distinguishing between government non-wage expenditures and government wage-bill expenditures in our VAR. When we exclude wage-bill expenditures from the series for government spending, we still find a significant and substantial increase in the pink-collar to blue-collar employment ratio as in our baseline specification (see the upper right panel of Figure A8(a) in Appendix C.3). This reveals that the disproportionate rise in pink-collar employment is not just a consequence of spill-over effects from government wage bill expansions.

Finally, we provide further evidence that the heterogeneous occupational employment responses to fiscal shocks are due to occupation-specific shifts in labor demand and not due to occupation-specific changes in labor supply. There may be different labor-supply reactions across occupation groups due to different workers' characteristics within occupations. For example, genders are not equally distributed among occupations. Women are overrepresented in service, sales, and office occupations while men constitute the majority of workers in blue-collar occupations. It is well documented that women and men have different elasticities of labor supply and different attachments to the labor market. To rule out that gender-specific labor supply factors explain the occupation-specific employment dynamics after fiscal expansions, we re-estimate our model on samples that include only female and only male workers, respectively. If our results were solely driven by, e.g., women raising their labor supply after fiscal expansions, we would also observe a rise in the aggregate pink-collar to blue-collar employment ratio due to a composition effect. We would, however, not observe an increase in the pink-collar to blue-collar employment ratio *within* the groups of men and women, respectively. However, we do find a significant shift toward pink-collar occupations within the group of female workers and within the group of male workers (see upper row of Figure A11).

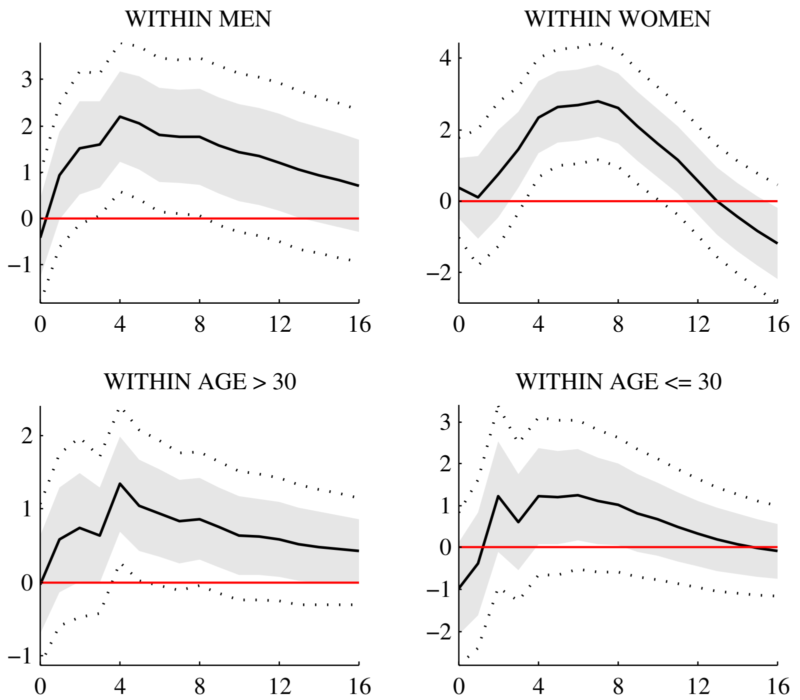
Similar arguments apply for workers in different age groups. For example, it may be that the relative decline in blue-collar employment reflects that new entrants to the labor market specialize in pink-collar (or white-collar) occupations in light of the secular decline in blue-collar employment possibilities and that this trend is accelerated in periods of government spending expansions. To investigate this hypothesis, we distinguish between young workers (aged below 30) and old workers (aged above 30) and estimate the effects of fiscal policy on relative occupational employment within these age groups. We find that pink-collar employment increases relative to blue-collar employment in both age groups (see the lower panels of Figure A11). The pronounced increase in relative pink-collar employment among older workers indicates that the additional pink-collar jobs are not primarily taken up by individuals who enter the labor market for the first time.

C.7 Capital utilization

In our model, firms increase their demand for pink-collar labor by more than their demand for blue-collar labor after a government spending expansion due to substitution away from labor toward a more intensive use of capital. We now provide direct empirical evidence for this substitution between factors. We do so by including data on the capital utilization to labor ratio in our baseline VAR. Since capital utilization is not directly observable, we follow Fernández-Villaverde, Guerrón-Quintana, Kuester, and Rubio-Ramírez (2015) and use the series 'Capacity Utilization: Total Industry' from the Board of Governors of the Federal Reserve System as a proxy for capital utilization. Consistent with our model, labor is measured as total hours worked by workers in pink-collar and blue-collar occupations.[4] We re-estimate our baseline VAR with the utilization to

[4] We obtain similar results when we also include white-collar workers.

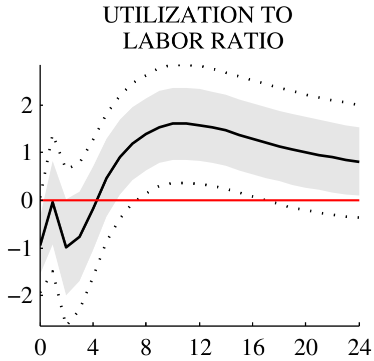
Figure A11: The effects of government spending shocks on pink-collar employment relative to blue-collar employment within gender and within age groups.



Notes: Solid lines are impulse responses of the pink-collar to blue-collar employment ratio to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output (not shown) is normalized to one percent. Pink collar: service occupations; sales and related occupations; office and administrative support occupations. Blue collar: construction and extraction occupations; installation, maintenance, and repair occupations; production occupations; transportation and material moving occupations.

labor ratio as seventh variable. Figure A12 shows a significant increase in this ratio, in line with the prediction of our theoretical model.

Figure A12: The effect of government spending shocks on the utilization-labor ratio.



Notes: The solid line is the impulse response of the utilization to labor ratio to a government spending shock. The grey shaded area and the dotted lines show 68 percent and 90 percent confidence bands. The response is expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output (not shown) is normalized to one percent.

C.8 White-collar occupations

Figure A13 shows the responses of labor-market outcomes for white-collar occupations relative to blue-collar occupations. The upper left panel shows relative wage rates. The upper right panel repeats the evidence on the ratio of total hours worked from Figure A7(b). The lower panels show the white-collar to blue-collar employment ratio within gender groups.

Figure A13: White-collar to blue-collar labor-market outcomes.

Notes: Solid lines are impulse responses to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The impact response of output (not shown) is normalized to one percent.

D Model appendix

This appendix first collects the equilibrium conditions of our model. Then, it derives the analytical solution of the simplified model discussed in Section 5.2 of the main text. Finally, it presents additional model results discussed in Section 5.4.

D.1 Equilibrium conditions

In a symmetric equilibrium, $y_{s,t} = y_{j,s,t}$, $\widetilde{k}_{j,s,t} = \widetilde{k}_{s,t}$, $n^p_{j,s,t} = n^p_{s,t}$, $n^b_{j,s,t} = n^b_{s,t}$, $mc_{j,s,t} = mc_{s,t}$, and $p_{j,s,t} = p_{s,t}$. Let $\pi_{s,t} = p_{s,t}/p_{s,t-1}$ denote gross price growth in industry s. The first-order conditions of firms in industry $s = 1, 2$ are then given by

$$y_{s,t} = y_s \cdot \left(\alpha_s \cdot \left(\frac{v_{s,t}}{v_s} \right)^{\frac{\theta-1}{\theta}} + (1-\alpha_s) \cdot \left(a_t \cdot \frac{n^p_{s,t}}{n^p_s} \right)^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}} \tag{2}$$

$$v_{s,t} = v_{j,s} \cdot \left(\gamma_s \cdot \left(\frac{\tilde{k}_{s,t}}{\tilde{k}_s} \right)^{\frac{\phi-1}{\phi}} + (1-\gamma_s) \cdot \left(a_t \cdot \frac{n^b_{s,t}}{n^b_s} \right)^{\frac{\phi-1}{\phi}} \right)^{\frac{\phi}{\phi-1}} \tag{3}$$

$$\log a_t = \rho_a \log a_{t-1} + \varepsilon^a_t \tag{4}$$

$$mc_{s,t} \cdot mpk_{s,t} = r^k_{s,t} \tag{5}$$

$$\begin{aligned} mc_{s,t} \cdot mpl^b_{s,t} = {} & w^b_{s,t} + \kappa_{n,s} \left(\frac{n^b_{s,t}}{n^b_{s,t-1}} - 1 \right) \frac{p_{s,t}}{p_t} \frac{y_{s,t}}{n^b_{s,t-1}} \\ & - \kappa_{n,s} \beta \, \mathrm{E}_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left(\frac{n^b_{s,t+1}}{n^b_{s,t}} - 1 \right) \frac{p_{s,t+1}}{p_{t+1}} y_{s,t+1} \left(\frac{n^b_{s,t+1}}{(n^b_{s,t})^2} \right) \right\} \end{aligned} \tag{6}$$

$$\begin{aligned} mc_{s,t} \cdot mpl^p_{s,t} = {} & w^p_t + \kappa_{n,s} \left(\frac{n^p_{s,t}}{n^p_{s,t-1}} - 1 \right) \frac{p_{s,t}}{p_t} \frac{y_{s,t}}{n^p_{s,t-1}} \\ & - \kappa_{n,s} \beta \, \mathrm{E}_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left(\frac{n^p_{s,t+1}}{n^p_{s,t}} - 1 \right) \frac{p_{s,t+1}}{p_{t+1}} y_{s,t+1} \left(\frac{n^p_{s,t+1}}{(n^p_{s,t})^2} \right) \right\} \end{aligned} \tag{7}$$

$$mpk_{s,t} = \alpha_s \cdot \gamma_s \cdot \left(\frac{y_s}{\tilde{k}_s} \right) \left(\frac{y_{s,t}/y_s}{v_{s,t}/v_s} \right)^{1/\theta} \left(\frac{v_{s,t}/v_s}{\tilde{k}_{s,t}/\tilde{k}_s} \right)^{1/\phi} \tag{8}$$

$$mpl^b_{s,t} = \alpha_s \cdot (1-\gamma_s) \cdot \left(\frac{y_s}{n^b_s} \right) \cdot a_t^{\frac{\phi-1}{\phi}} \left(\frac{y_{s,t}/y_s}{v_{s,t}/v_s} \right)^{1/\theta} \left(\frac{v_{s,t}/v_s}{n^b_{s,t}/n^b_s} \right)^{1/\phi} \tag{9}$$

$$mpl^p_{s,t} = (1-\alpha_s) \cdot \left(\frac{y_s}{n^p_s} \right) \cdot a_t^{\frac{\theta-1}{\theta}} \left(\frac{y_{s,t}/y_s}{n^p_{s,t}/n^p_s} \right)^{1/\theta} \tag{10}$$

$$\psi(\pi_{s,t} - 1)\pi_{s,t} = \psi\beta \, \mathrm{E}_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \frac{y_{s,t+1}}{y_{s,t}} \frac{\pi_{s,t+1}}{\pi_{t+1}} (\pi_{s,t+1} - 1)\pi_{s,t+1} \right\} + \epsilon \left(mc_{s,t} - \frac{p_{s,t}}{p_t} \frac{(\epsilon - 1)}{\epsilon} \right) \tag{11}$$

The first-order conditions of the household problem are given by

$$c_{1,t} = \zeta \left(\frac{p_{1,t}}{p_t}\right)^{-\mu} c_t \tag{12}$$

$$c_{2,t} = (1-\zeta) \left(\frac{p_{2,t}}{p_t}\right)^{-\mu} c_t \tag{13}$$

$$1 = \left(\zeta \cdot \left(\frac{p_{1,t}}{p_t}\right)^{1-\mu} + (1-\zeta) \cdot \left(\frac{p_{2,t}}{p_t}\right)^{1-\mu}\right)^{1/(1-\mu)} \tag{14}$$

$$n^p_{1,t} = \aleph^p \left(\frac{w^p_{1,t}}{w^p_t}\right)^{\omega} n^p_t \tag{15}$$

$$n^p_{2,t} = (1-\aleph^p) \left(\frac{w^p_{2,t}}{w^p_t}\right)^{\omega} n^p_t \tag{16}$$

$$n^b_{1,t} = \aleph^b \left(\frac{w^b_{1,t}}{w^b_t}\right)^{\omega} n^b_t \tag{17}$$

$$n^b_{2,t} = (1-\aleph^b) \left(\frac{w^b_{2,t}}{w^b_t}\right)^{\omega} n^b_t \tag{18}$$

$$w^p_t = \left(\aleph^p \cdot (w^p_{1,t})^{1+\omega} + (1-\aleph^p) \cdot (w^p_{2,t})^{1+\omega}\right)^{1/(1+\omega)} \tag{19}$$

$$w^b_t = \left(\aleph^b \cdot (w^b_{1,t})^{1+\omega} + (1-\aleph^b) \cdot (w^b_{2,t})^{1+\omega}\right)^{1/(1+\omega)} \tag{20}$$

$$\lambda_t = \xi_t + \chi \iota_t \frac{x_t}{c_t} \tag{21}$$

$$x_t = c_t^{\chi} x_{t-1}^{1-\chi} \tag{22}$$

$$\iota_t = -\xi_t \left(\frac{\Omega^p}{1+1/\eta}(n^p_t)^{1+1/\eta} + \frac{\Omega^b}{1+1/\eta}(n^b_t)^{1+1/\eta}\right) + \beta(1-\chi)\,\mathrm{E}_t \left\{\iota_{t+1}\frac{x_{t+1}}{x_t}\right\} \tag{23}$$

$$\lambda_t = \beta\,\mathrm{E}_t \left\{\lambda_{t+1}\frac{(1+r_t)}{\pi_{t+1}}\right\} \tag{24}$$

$$\lambda_t q_{s,t} = \beta\,\mathrm{E}_t \left\{\lambda_{t+1}\left((1-\tau^k_{t+1})r^k_{s,t+1}u_{s,t+1} - \frac{p_{s,t+1}}{p_{t+1}}e(u_{s,t+1}) + q_{s,t+1}(1-\delta)\right)\right\} \tag{25}$$

$$\frac{p_{s,t}}{p_t} = q_{s,t}\left(1 - \frac{\kappa_i}{2}\left(\frac{i_{s,t}}{i_{s,t-1}} - 1\right)^2 - \kappa_i\left(\frac{i_{s,t}}{i_{s,t-1}} - 1\right)\frac{i_{s,t}}{i_{s,t-1}}\right) \tag{26}$$

$$+\, \beta\,\mathrm{E}_t \left\{\frac{\lambda_{t+1}}{\lambda_t} q_{s,t+1}\kappa_i \left(\frac{i_{s,t+1}}{i_{s,t}} - 1\right)\left(\frac{i_{s,t+1}}{i_{s,t}}\right)^2\right\} \tag{27}$$

$$(1-\tau_t)r^k_{s,t} = \frac{p_{s,t}}{p_t}\left(\delta_1 + \delta_2(u_{s,t}-1)\right) \tag{28}$$

$$w^b_t(1-\tau_t)\lambda_t = \Omega^b \left(n^b_t\right)^{1/\eta} x_t \xi_t \tag{29}$$

$$w^p_t(1-\tau_t)\lambda_t = \Omega^p \left(n^p_t\right)^{1/\eta} x_t \xi_t \tag{30}$$

$$\xi_t = \left(c_t - \left(\frac{\Omega^p}{1+1/\eta}(n^p_t)^{1+1/\eta} + \frac{\Omega^b}{1+1/\eta}(n^b_t)^{1+1/\eta}\right) x_t\right)^{-\frac{1}{\sigma}} \tag{31}$$

$$k_{s,t} = (1-\delta)k_{s,t-1} + \left(1 - \frac{\kappa_i}{2}\left(\frac{i_{s,t}}{i_{s,t-1}} - 1\right)^2\right) i_{s,t} \tag{32}$$

$$e(u_{s,t}) = \delta_1(u_{s,t}-1) + \frac{\delta_2}{2}(u_{s,t}-1)^2 \tag{33}$$

where $s = 1, 2$, and λ_t, $q_{s,t}\lambda_t$, and ι_t denote Lagrange multipliers on the household's budget constraint, the capital accumulation equations, and the definition of x_t, respectively, where $q_{s,t}$ is the shadow value of installed capital in industry s.

Fiscal and monetary policy are described by

$$\frac{p_{g,t}}{p_t} g_t + T_t + (1 + r_{t-1}) \frac{b_{t-1}}{\pi_t} = b_t + \tau_t \left(w_t^b n_t^b + w_t^p n_t^p + r_{1,t}^k \tilde{k}_{1,t} + r_{2,t}^k \tilde{k}_{2,t} \right) \tag{34}$$

$$g_{1,t} = \zeta_g \left(\frac{p_{1,t}}{p_{g,t}} \right)^{-\mu} g_t \tag{35}$$

$$g_{2,t} = (1 - \zeta_g) \left(\frac{p_{2,t}}{p_{g,t}} \right)^{-\mu} g_t \tag{36}$$

$$\frac{p_{g,t}}{p_t} = \left(\zeta_g \cdot \left(\frac{p_{1,t}}{p_t} \right)^{1-\mu} + (1 - \zeta_g) \cdot \left(\frac{p_{2,t}}{p_t} \right)^{1-\mu} \right)^{1/(1-\mu)} \tag{37}$$

$$\log g_t = (1 - \rho_g) \log g + \rho_g \log g_{t-1} + \varepsilon_t^g \tag{38}$$

$$\log (T_t) = (1 - \rho_T) \log(T) + \rho_T \log (T_{t-1}) - \gamma_b \cdot (b_{t-1} - b)/y \tag{39}$$

$$\log ((1 + r_t)/(1 + r)) = \delta_\pi \log (\pi_t/\pi) + \delta_y \log (y_t/y) + \delta_g \log (g_t/g) \tag{40}$$

The following conditions describe goods market clearing for good $s = 1, 2$, inflation in industry s, and aggregate output y_t:

$$\begin{aligned} y_{s,t} = {} & c_{s,t} + i_{s,t} + g_{s,t} + e(u_{s,t}) k_{s,t-1} + \frac{\psi}{2} (\pi_{s,t} - 1)^2 \\ & + \frac{\kappa_{n,s}}{2} \left[\left(\frac{n_{s,t}^b}{n_{s,t-1}^b} - 1 \right)^2 + \left(\frac{n_{s,t}^p}{n_{s,t-1}^p} - 1 \right)^2 \right] y_{s,t} \end{aligned} \tag{41}$$

$$\pi_{s,t} = \frac{p_{s,t}/p_t}{p_{s,t-1}/p_{t-1}} \pi_t \,, \qquad s = 1, 2 \tag{42}$$

$$y_t = (p_{1,t}/p_t) y_{1,t} + (p_{2,t}/p_t) y_{2,t} \tag{43}$$

D.2 Simplified model

Applying the parameter restrictions discussed in the main text and log-linearizing, the set of equilibrium conditions simplifies to the following system:

$$\widehat{y}_t = \frac{1}{4} \cdot \left(\widehat{u}_t + \widehat{a}_t + \widehat{n}_t^b\right) + \frac{1}{2} \cdot (\widehat{a}_t + \widehat{n}_t^p)\,, \tag{44}$$

$$\widehat{a}_t = \varepsilon_t^a$$

$$\widehat{r}_t^k = \widehat{mc}_t - \frac{2+\phi}{4\phi}\widehat{u}_t + \frac{2+\phi}{4\phi} \cdot \widehat{a}_t + \frac{2-\phi}{4\phi} \cdot \widehat{n}_t^b + \frac{1}{2} \cdot \widehat{n}_t^p\,, \tag{45}$$

$$\widehat{w}_t^b = \widehat{mc}_t + \frac{2-\phi}{4\phi} \cdot \widehat{u}_t + \frac{5\phi-2}{4\phi} \cdot \widehat{a}_t - \frac{2+\phi}{4\phi}\widehat{n}_t^b + \frac{1}{2} \cdot \widehat{n}_t^p, \tag{46}$$

$$\widehat{w}_t^p = \widehat{mc} + \frac{1}{4} \cdot \left(\widehat{u}_t + \widehat{a}_t + \widehat{n}_t^b\right) + \frac{1}{2} \cdot \widehat{a}_t - \frac{1}{2}\widehat{n}_t^p, \tag{47}$$

$$\widehat{\pi}_t = \beta\, \mathrm{E}_t\, \widehat{\pi}_{t+1} + \kappa \cdot \widehat{mc}_t\,, \tag{48}$$

$$\lambda^{-1} \cdot \widehat{\lambda}_t = -c \cdot \widehat{c}_t + \Omega^p \cdot \widehat{n}_t^p + \Omega^b \cdot \widehat{n}_t^b\,, \tag{49}$$

$$\widehat{\lambda}_t = \mathrm{E}_t\, \widehat{\lambda}_{t+1} + \widehat{R}_t - \mathrm{E}_t\, \widehat{\pi}_{t+1}\,, \tag{50}$$

$$\widehat{r}_t^k = \Delta^{-1} \cdot \widehat{u}_t\,, \tag{51}$$

$$\widehat{w}_t^b = \widehat{n}_t^b\,, \tag{52}$$

$$\widehat{w}_t^p = \widehat{n}_t^p\,, \tag{53}$$

$$\widehat{R}_t = \delta_\pi \widehat{\pi}_t \tag{54}$$

$$\widehat{g}_t = \varepsilon_t^g,$$

$$\widehat{y}_t = \frac{c}{y}\widehat{c}_t + \frac{g}{y}\widehat{g}_t + \frac{\delta_1}{y}\widehat{u}_t, f \tag{55}$$

which uses that $\chi = 0$ implies $x_t = x_{t-1} = x$ which we normalize to one and that $\kappa_i \to \infty$ together with $\delta = 0$ imply that the stock of physical capital is constant, i.e. $k_t = k_{t-1} = k$, and hence $\widetilde{k}_t = k \cdot u_t$, and where $\kappa = (\varepsilon - 1)/\psi$ is the slope of the linearized Phillips curve, and $R_t = 1 + r_t$.

Combining (45), (46), (47), (51), (52), and (53) yields the following factor market clearing conditions:

$$\left(\Delta^{-1} + \frac{2+\phi}{4\phi}\right) \cdot \widehat{u}_t = \widehat{mc}_t + \frac{2+\phi}{4\phi} \cdot \widehat{a}_t + \frac{2-\phi}{4\phi} \cdot \widehat{n}_t^b + \frac{1}{2} \cdot \widehat{n}_t^p, \tag{56}$$

$$\frac{2+5\phi}{4\phi} \cdot \widehat{n}_t^b = \widehat{mc}_t + \frac{2-\phi}{4\phi} \cdot \widehat{u}_t + \frac{5\phi-2}{4\phi} \cdot \widehat{a}_t + \frac{1}{2} \cdot \widehat{n}_t^p, \tag{57}$$

$$\frac{3}{2} \cdot \widehat{n}_t^p = \widehat{mc}_t + \frac{1}{4} \cdot \left(\widehat{u}_t + \widehat{a}_t + \widehat{n}_t^b\right) + \frac{1}{2} \cdot \widehat{a}_t. \tag{58}$$

Further, with serially uncorrelated disturbances and endogenous state variables, $\mathrm{E}_t\, \widehat{\pi}_{t+1} =$

$\mathrm{E}_t\,\widehat{\lambda}_{t+1} = 0$ which allows to combine conditions (48), (49) (50), (54), and (55) to

$$y \cdot \widehat{y}_t - g \cdot \widehat{g}_t - \delta_1 \cdot \widehat{u}_t = \Omega^p \cdot \widehat{n}_t^p + \Omega^b \cdot \widehat{n}_t^b - \Gamma \cdot \widehat{mc}_t, \tag{59}$$

where $\Gamma = \delta_\pi \cdot \kappa \cdot \lambda^{-1} > 0$.

Together with the linearized production function (44), (56)-(58) and (59) form a system in five equations and five endogenous variables each period. In this system, $\widehat{u}_t$, $\widehat{n}_t^b$, $\widehat{n}_t^p$, $\widehat{y}_t$, and $\widehat{mc}_t$ are endogenous while $\widehat{g}_t = \varepsilon_t^g$ and $\widehat{a}_t = \varepsilon_t^a$ are determined exogenously. Since there is no persistence, the system of linear equations is static in each period and can be solved for the following equations for output and both types of labor:

$$\widehat{y}_t = \Lambda^{-1}\left(\Delta^{-1} + 3\phi + 5\Delta^{-1}\phi + 7\right) g \cdot \widehat{g}_t + \xi_{y,a} \cdot \widehat{a}, \tag{60}$$

$$\widehat{n}_t^b = \Lambda^{-1}\left(8\Delta^{-1}\phi + 8\right) g \cdot \widehat{g}_t + \xi_{b,a} \cdot \widehat{a}_t, \tag{61}$$

$$\widehat{n}_t^p = \Lambda^{-1}\left(2\Delta^{-1} + 2\phi + 6\Delta^{-1}\phi + 6\right) g \cdot \widehat{g}_t + \xi_{p,a} \cdot \widehat{a}_t, \tag{62}$$

where Λ is defined as in the main text and $\xi_{y,a} = \frac{1}{4}\Lambda_2^{-1}(3(\varepsilon-1)\Lambda_2 + \Gamma\cdot\varepsilon\cdot(-15\Delta - 37\phi - 4\Delta\phi - 18 + 3\varepsilon(6\Delta+8\phi+\Delta\phi+3)))$, $\xi_{b,a} = \frac{1}{4}\Lambda_2^{-1}(\Gamma\cdot(18\Delta\varepsilon+34\phi\varepsilon+4\Delta\phi\varepsilon-12\varepsilon)-52\phi-3\Delta\phi-38\Delta+4+24\varepsilon(\Delta+\phi))$, $\xi_{p,a} = \frac{1}{4}\Lambda_2^{-1}(\Gamma\cdot(6\varepsilon + 12\Delta\varepsilon + 5\phi\varepsilon + \Delta\phi\varepsilon) - 2\Delta - 21\phi - 11\Delta\phi - 14 + 3\varepsilon(4\Delta + 4\phi + 2\Delta\phi + 2))$, and $\Lambda_2 = 6\Delta + 4\phi + 3\Delta\phi + 1 - \Gamma\varepsilon(3 + 6\Delta + 8\phi + \Delta\phi)$. Setting $\widehat{a}_t = 0$ yields equation (14) in the main text and subtracting (61) from (62) gives equation (15) in the main text.

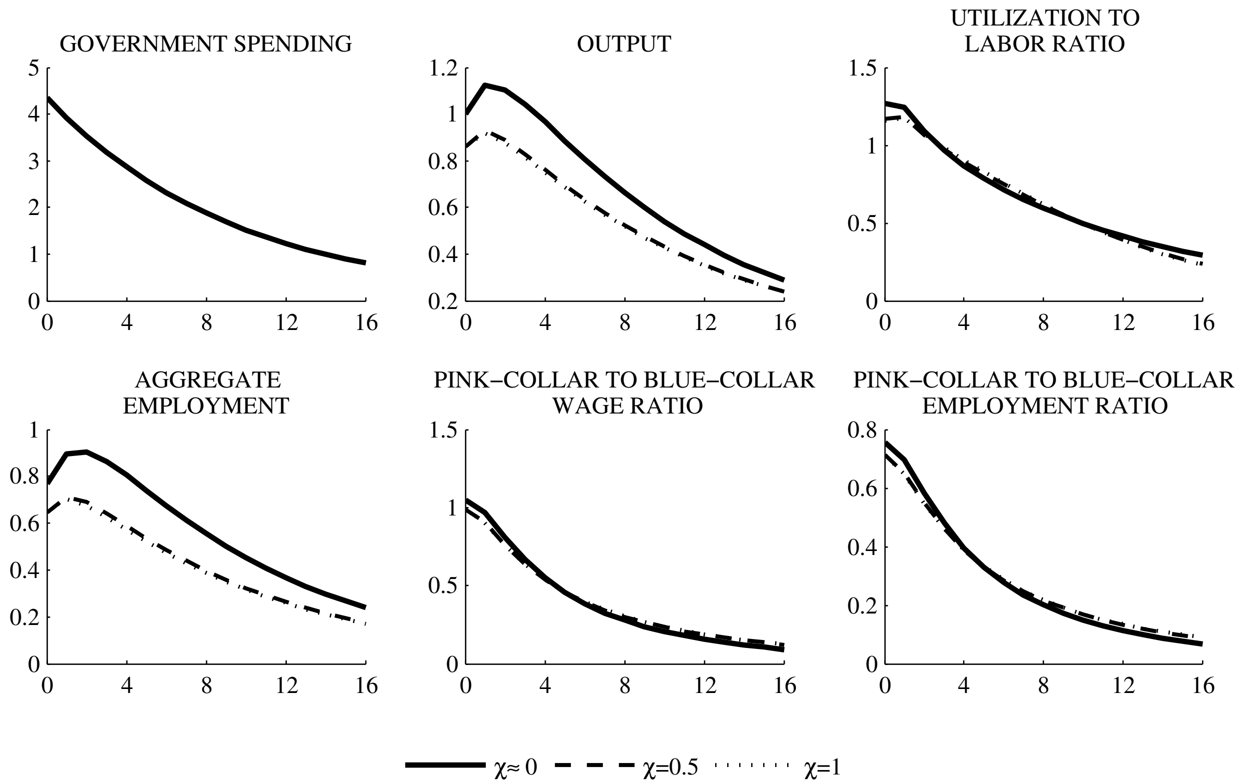
D.3 Additional model results

We present two additional model results. First, we demonstrate that, qualitatively, our results do not hinge on how we parameterize the wealth effect on labor supply. Second, we show that labor productivity shocks lead to a *decline* in the pink-collar to blue-collar employment ratio.

Wealth elasticity. Figure A14 displays results for alternative values of the wealth elasticity of labor supply. The figure shows that we obtain similar results as in our baseline calibration when we use $\chi = 0.5$ and $\chi = 1$ (the limiting case).

Labor productivity shocks. In the simplified model version, the effects of an innovation to labor productivity, a_t, are not unambiguous but depend on the slope of the Phillips curve as

Figure A14: Model-implied effects of government spending shocks for different wealth elasticities.



Notes: Model-implied impulse responses to a rise in government spending. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The size of the innovation is normalized such that the response of output (not shown) is one percent on impact.

measured by the composite parameter κ. If the Phillips curve is not too flat, i.e., κ not too small, a positive labor productivity shock raises output and aggregate employment but lowers the pink-collar to blue-collar employment ratio provided that blue-collar labor is a closer substitute to capital services than pink-collar labor. To demonstrate this, consider the limiting cases $\epsilon \to \infty$ (perfect competition) or $\psi \to 0$ (no price adjustment costs) which both lead to $\kappa \to \infty$.

In the limiting case where $\kappa \to \infty$, condition (48) implies $\widehat{mc}_t = 0$ such that conditions (44) and (56)-(58) form a system in four equations and four endogenous variables, $\widehat{u}_t$, $\widehat{n}_t^b$, $\widehat{n}_t^p$, and $\widehat{y}_t$ while $\widehat{mc}_t = 0$ and $\widehat{a}_t = \varepsilon_t^a$ is determined exogenously. Solving the static system of linear equations in each period yields

$$\widehat{y}_t = \Pi^{-1}\Delta^{-1} \cdot (2 + 2\phi\Delta + 10\phi + 10\Delta) \cdot \widehat{a}_t, \tag{63}$$

and

$$\widehat{n}_t^b = \Pi^{-1}\Delta^{-1} \cdot (5\Delta + \phi\Delta + 9\phi - 3) \cdot \widehat{a}_t, \tag{64}$$

$$\widehat{n}_t^p = \Pi^{-1}\Delta^{-1} \cdot (1 + \phi\Delta + 5\phi + 5\Delta) \cdot \widehat{a}_t. \tag{65}$$

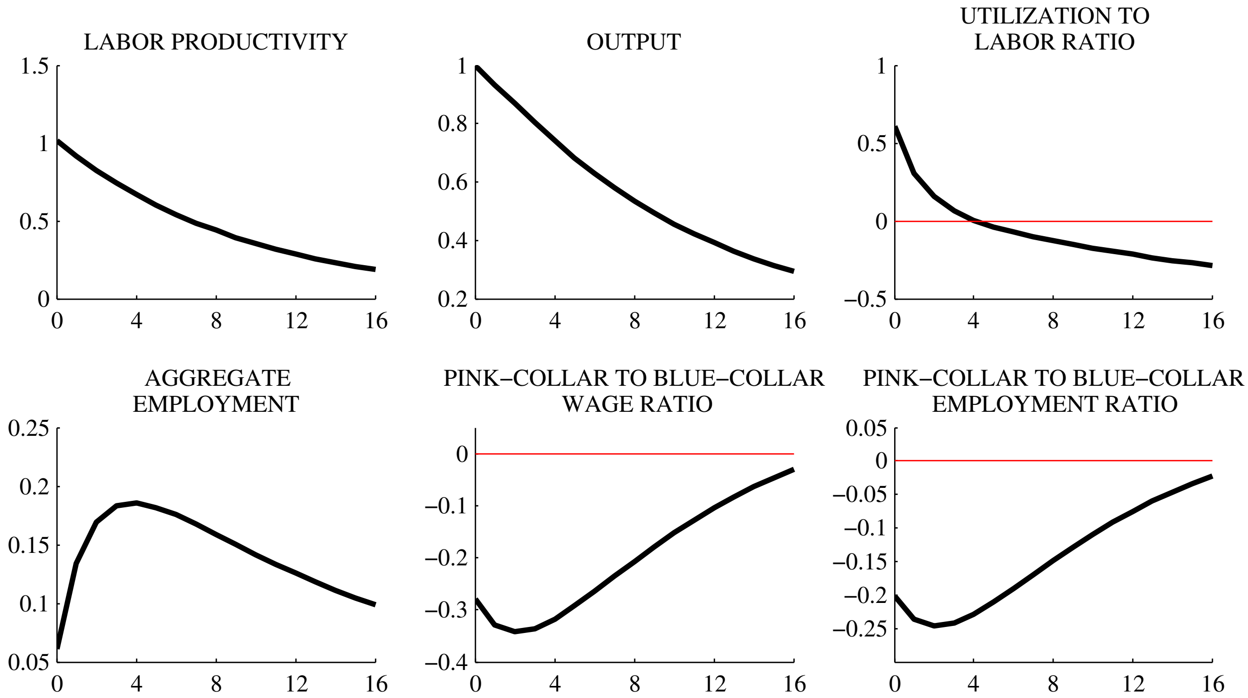
Subtracting (64) from (65) gives

$$\widehat{n_t}^p - \widehat{n_t}^b = \Pi^{-1}\Delta^{-1} \cdot 4 \cdot (1 - \phi) \cdot \widehat{a}_t, \tag{66}$$

where $\Pi > 0$ is defined as in the main text. Output rises unambiguously in $\widehat{a}$. If blue-collar labor is a closer substitute to capital services than pink-collar labor ($\phi > 1$), the pink-collar to blue-collar employment ratio falls in response to a positive labor productivity shock ($\widehat{a} > 0$, $\widehat{g} = 0$). The intuition is as follows. As labor becomes more productive, firms increase their demand for capital services by less than their effective labor input, i.e., the product of labor productivity and aggregate employment. With relatively less capital services used, the marginal productivity of the substitute blue-collar labor increases relative to pink-collar labor. Hence, firms raise their demand for blue-collar labor relative to pink-collar labor.

Similar relations also hold for less restrictive assumptions concerning the slope of the Phillips curve. By continuity, there exists a $\kappa^* < \infty$ such that the following results hold: If blue-collar labor is a closer substitute to capital services than pink-collar labor ($\phi > 1$) and the Phillips curve

Figure A15: Model-implied effects of labor productivity shocks.



Notes: Model-implied impulse responses to a favorable labor productivity shock. Responses are expressed in percentage terms. On the horizontal axes, the horizon is given in quarters. The size of the innovation is normalized such that the response of output (not shown) is one percent on impact.

is sufficiently steep ($\kappa > \kappa^*$), a positive labor productivity shock also raises output and aggregate employment but reduces the pink-collar to blue-collar employment ratio.

Figure A15 shows impulse responses from the calibrated full model. In response to an increase in labor productivity a_t, relative pink-collar employment declines.