Fiscal Policy and Occupational Employment Dynamics*

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Abstract

We document substantial heterogeneity in occupational employment dynamics in response to government spending shocks. Employment rises most strongly in service, sales, and office ("pink-collar") occupations. By contrast, employment in blue-collar occupations is hardly affected by fiscal stimulus which is striking in light of its strong exposure to the cycle and its long-run decline due to technical change and globalization. We provide evidence that occupation-specific changes in labor demand are key for understanding these findings. We develop a business-cycle model that explains the heterogeneous occupational employment dynamics as a consequence of differences in the short-run substitutability between labor and capital services across occupations.

Keywords: Fiscal Policy, Composition of Employment, Occupations, Industries, Heterogeneity

JEL classification: E62, E24, J21, J23

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1 Introduction

A recurring question in macroeconomics is how fiscal policy affects the economy. An extensive empirical literature examines the impact on macroeconomic aggregates like output, consumption, and employment (e.g., Blanchard and Perotti 2002, Pappa 2009, Ramey 2011a, 2011b) and most theoretical studies rely on the representative agent paradigm (e.g., Baxter and King 1993, Linnemann and Schabert 2003). However, important aspects of fiscal policy require taking into account heterogeneity explicitly. First, the distributional consequences of a policy are interesting from a political and societal perspective, e.g., because they affect the welfare assessment of the policy and determine public support for it. Second, distributional aspects can also be key for understanding fully the aggregate effects of fiscal policy. Against this background, the literature is showing substantial interest in the disaggregated effects of fiscal policy.[1]

To assess the effects of fiscal policy on an individual, it is important to understand how fiscal policy affects the individual's employment possibilities, as labor income is the most important income component for most households. An individual's employment possibilities are to a large degree determined by the labor-market situation in the individual's industry and occupation. In related contexts, Artuç and McLaren (2015) have shown that an individual's industry (i.e., the business activity of the employer) is a major determinant for the individual employment risk associated with international trade while the individual's occupation (i.e., the type of work or job of the individual) is the main factor behind the risk of employment loss due to offshoring. In a short-run context closely related to our study on fiscal policy effects, Jaimovich and Siu (2012) and Hershbein and Kahn (2016) show that both industries and occupations are important determinants of the risk of cyclical job losses. Hence, an important aspect of fiscal stimulus is whether and how strongly it affects employment across industries and occupations. While there exists some evidence on the distribution across industries of the jobs created by fiscal policy (see Chodorow-Reich, Feiveson, Liscow, and Woolston 2012, Giavazzi and McMahon 2012, Nekarda and Ramey 2011, and Wilson 2012), to our knowledge, little is known about their distribution across

[1]For empirical analyses see, e.g., Anderson, Inoue, and Rossi (2016), Cloyne and Surico (2017), De Giorgi and Gambetti (2012), Giavazzi and McMahon (2012), Johnson, Parker, and Souleles (2006), Misra and Surico (2014), and Nekarda and Ramey (2011). Theoretical analyses on fiscal policy and heterogeneity are provided by, among others, Brinca, Holter, Krusell, and Malafry (2016), Galí, López-Salido, and Vallés (2007), Heathcote (2005), Kaplan and Violante (2014), McKay and Reis (2016), and Oh and Reis (2012).

occupations. This paper fills this gap by investigating the occupation dimension of the employment dynamics induced by fiscal policy.

Considering occupations is important because the costs of switching occupation are estimated to be as high as several annual earnings for switches between major occupation groups (see Artuç and McLaren 2015 and Cortes and Gallipoli 2017). In particular, the returns to occupational tenure are found to be almost as large as the total returns to labor-market experience and to exceed the returns to firm or industry tenure, see, e.g., Shaw (1984), Kambourov and Manovskii (2009), and Sullivan (2010). These returns would have to be given up upon an occupation switch. For instance, Kambourov and Manovskii (2009) find that a displaced worker switching occupation suffers an 18% reduction in weekly earnings, whereas for a displaced worker whose next job is in the same occupation the drop is only 6%. Hence, even if fiscal policy fosters employment growth in a worker's industry, the worker does not necessarily benefit strongly if job growth is concentrated in other occupations within the industry. The distribution across occupations of the employment effects of fiscal policy is therefore important for understanding the distributional consequences of fiscal policy and its overall effects.

To analyze how fiscal policy affects employment in different occupation groups, we include occupational employment data from the U.S. Current Population Survey (CPS) into otherwise standard expectations-augmented vector-autoregressive models (VARs). We focus on a classical fiscal-policy scenario: an unexpected increase in government spending. As our benchmark, we identify unanticipated government spending shocks through short-run restrictions on the automatic response of government spending to economic activity, taking into account possible anticipation effects due to fiscal foresight that are found to be important by Ramey (2011b). We account for anticipation by incorporating a fiscal news variable in the VARs. Specifically, we use spending forecasts of professional forecasters, following, e.g., Auerbach and Gorodnichenko (2012).

We find important differences in occupational employment dynamics in response to government spending shocks. Employment rises disproportionately in service, sales, and office – so called "pink-collar" – occupations. By contrast, we find no discernible employment changes for production, construction, transport, and installation ("blue-collar") occupations. Our results imply that the share of blue-collar employment in total employment falls significantly. Employment in management, professional, and related ("white-collar") occupations rises as well but more or less proportionately with aggregate employment. Quantitatively, our baseline results imply that, over the first year, about two thirds of the additional job-years due to a government spending expansion accrue in pink-collar occupations and only about 10% in blue-collar occupations. We show that our results are a robust feature of the data by conducting a series of robustness checks including different identification schemes, detrending methods, and sample periods.

Importantly, we provide evidence that the documented heterogeneity in occupational employment dynamics is not a simple relabeling of heterogeneity in industry-specific employment dynamics.[2] Though employment rises disproportionately in industries employing a disproportionate share of pink-collar workers, we document important occupational employment dynamics *within* industries.[3]

We further document that the effects of fiscal policy on other labor-market outcomes mirror those we document for employment. In particular, we find that also hours and wage rates in pink-collar occupations rise relative to those in blue-collar occupations. The co-movement between relative occupational employment and relative occupational wages reveals that labor-demand forces shape occupational differences in labor market outcomes.

To understand why firms in a given industry expand their demand for pink-collar labor more strongly than their demand for blue-collar labor in response to an increase in government spending, we embed occupational labor into an otherwise standard New Keynesian business-cycle model. An alternative model in which the occupational employment dynamics would simply result from composition effects reflecting industry dynamics could not explain the occupational employment dynamics *within* industries. Key in our model is that we allow for differences in the short-run substitutability between labor and capital services across occupations (similar to Autor and Dorn 2013). Our model replicates our empirical findings for a calibration where blue-collar labor is the closer substitute to capital services in the short run than is pink-collar labor. This difference in the

[2] Occupations are not evenly distributed across industries giving rise to potential composition effects which translate heterogeneous employment dynamics across industries into heterogeneous employment dynamics across occupations. However, the link between industries and occupations is far from perfect. For example, in our sample, workers with blue-collar occupations make up 24% of total employment but 58% of employment in the manufacturing, construction, and resource-extraction industries. Still, 48% of workers with blue-collar occupations work in other industries.

[3] Likewise, we observe a disproportionate rise in public employment which also exerts a composition effect on occupational employment as the government employs disproportionately many pink-collar workers, but we also document a strong rise in relative pink-collar employment within the private sector.

elasticity of substitution with capital services reflects the typical tasks in the different occupation groups. Labor in blue-collar occupations includes mainly routine-manual tasks (Jaimovich and Siu 2012, Foote and Ryan 2014) which can in principle also be performed by machines. Accordingly, capital services and blue-collar labor are, on average, relatively close substitutes. By contrast, labor in pink-collar occupations involves a substantial share of direct human interaction that is difficult to provide by machines. Thus, capital services are a relatively poor substitute for pink-collar labor. Together with a relatively inelastic supply of labor compared to capital services, this implies that expansionary fiscal shocks induce pink-collar employment booms, i.e., that firms raise their demand for pink-collar labor by more than their demand for blue-collar labor.

The intuition is as follows. Government spending expansions induce firms to demand more factor inputs to meet increased product demand. In this process, firms raise their demand for capital services by more than their demand for labor due to changes in relative factor costs in favor of capital use compared to labor (the latter being a consequence of the less elastic supply of labor compared to capital services). The more intense use of capital lowers the marginal productivity of blue-collar labor relative to pink-collar labor because blue-collar labor is the closer substitute to capital services. Thus, the relative demand for pink-collar labor increases which leads to a rise in the pink-collar to blue-collar employment and wage ratio, in line with what we find in the data.

Our results concerning the heterogenous employment effects of fiscal policy are particularly remarkable in the light of other heterogeneous patterns in occupational employment. It is well known that blue-collar workers are hit hardest by cyclical job losses mostly due to their strong connection to disproportionately cyclical industries like manufacturing and construction (see, e.g., Hoynes, Miller, and Schaller 2012). The same group of workers also suffered the most from job losses due to technical change and globalization (see, e.g., Acemoglu and Autor 2011). In fact, the share of blue-collar occupations in total employment sharply decreased over the last decades. It has also been shown that this development has an important cyclical component as blue-collar job losses appear to happen foremost in economic downturns (e.g., Jaimovich and Siu 2012, Hershbein and Kahn 2016). According to our evidence, the same group of workers benefit the least from fiscal stimulus in the sense that government spending hikes hardly create improved employment opportunities within blue-collar occupations such that unemployed blue-collar workers, e.g., would have to bear the costs of occupation switches.[4] This implies that countercyclical fiscal policy destabilizes the distribution of employment and contributes to the accelerated relative decline of blue-collar employment in recessions. Note that, in line with previous literature on the macroeconomic effects of fiscal policy, our main empirical analysis considers the *average* spending expansion, while specific fiscal policy measures may have different effects. In fact, we find evidence that the employment effects of expansions of government investment are less strongly biased towards pink-collar occupations than those of government consumption expansions.

The remainder of this paper is organized as follows. In Section 2, we discuss the occupational employment data and our empirical strategy. In Section 3, we present empirical results. In Section 4, we develop a theoretical model which can explain our empirical findings. In Section 5, we discuss implications of our results. Section 6 concludes.

2 Data and econometric method

In this section, we describe the occupational employment data and present our econometric approach for estimating the effects of fiscal shocks on labor market outcomes by occupation.

2.1 Occupational employment data

We construct quarterly data on aggregate employment and on occupational employment using the Current Population Survey (CPS). This data is available from 1983Q1 and our sample ends in 2015Q4. The U.S. Census Bureau provides conversion factors to adjust for re-classifications of the occupation and industry codes in the CPS, see Shim and Yang (2016) for details. We use these conversion factors to construct consistent time series of employment in ten major occupation groups according to the 2002 Census classification, which we aggregate to three broader occupation groups. The first group are high-skill or white-collar occupations and include management, business, and financial occupations as well as professional and related occupations. The second group are traditional blue-collar occupations and include construction and extraction occupations, installation, maintenance, and repair occupations, production occupations, as well as transportation and material moving occupations. The third group include service occupations, sales and

[4] According to Foote and Ryan (2014), however, middle-skill (blue-collar) workers rarely exit unemployment for either high-skill (white-collar) or low-skill (pink-collar) jobs. In line with this, we do not find evidence for a reduction in the number of unemployed blue-collar workers in response to government spending shocks.

related occupations, as well as office and administrative support occupations (service, sales, and office occupations). Service occupations such as nursing aides, waiters and waitresses, and childcare workers are the largest subgroup in this group while sales occupations are the smallest. Due to the traditional high share of female workers in service, sales, and office occupations and to distinguish them from white-collar and blue-collar occupations, these occupations are sometimes referred to as "pink-collar" occupations, see, e.g., Lee and Wolpin (2006) and Gemici and Wiswall (2014). In our sample, 61% of employed workers in service, sales, and office occupations are women, but only 16% of blue-collar workers. In the following, we borrow the term "pink-collar" occupations as a concise label for service, sales, and office occupations. Note that the results for the broad groups of white, blue, and pink-collar occupations are not driven by specific subcategories of these groups. Our results show that the subcategories of the pink-collar occupation group display employment dynamics in response to fiscal stimulus which are similar to one another. Also the subcategories within the blue-collar occupation group display similar employment dynamics to one another but are distinctly different from pink-collar employment dynamics.[5]

Before turning to the estimation of the effects of fiscal policy on employment of these occupation groups, we describe some descriptive properties of the occupational employment data which will be important for our subsequent analysis and the interpretation of our results. White-collar, blue-collar, and pink-collar occupations differ in a number of dimensions. Over our sample period, workers in white-collar occupations represent on average about 34% of total employment while the shares are 24% and 42% for workers in blue-collar and pink-collar occupations, respectively. These shares are not constant over our sample period due to differences in trend growth across occupations, see Figure A1 in Appendix B which shows the time series of employment in our three occupation groups. White-collar employment grows disproportionately with an average sample growth rate of around 0.5 percent per quarter, relative to 0.27 percent growth of aggregate employment. Also pink-collar employment rises and shows a quarterly growth rate of 0.22 percent on average. Blue-collar employment, however, remains almost constant such that the share of blue-

[5] Other studies consider two occupation categories distinguishing only between blue-collar occupations and a broader understanding of white-collar occupations which also include some pink-collar occupations. Our results show that there are, however, important differences in employment dynamics between our pink-collar occupation category and our white-collar occupation category. Again other studies consider four occupation categories disentangling pink-collar occupations into service occupations on the one hand and sales and office occupations on the other hand (e.g., Jaimovich and Siu 2012, Foote and Ryan 2014). As discussed above, we find that major subcategories of the pink-collar occupation group display similar employment dynamics.

collar employment in total employment exhibits a downward trend. This heterogeneity in long-run employment dynamics is well documented in the literature and referred to as job polarization, see, e.g., Autor and Dorn (2013).[6] In our econometric analysis focusing on short-run effects, we control for employment trends and consider different ways of handling trends in the data.

Besides differences in long-run employment trends, there is also pronounced heterogeneity across occupations with respect to unconditional short-run employment dynamics, i.e., cyclical employment components which we measure by percentage deviations from log-linear trends. While employment of all three groups are highly correlated over the business cycle, they differ markedly in terms of volatility.[7] Blue-collar employment is the most volatile group. The standard deviation of cyclical blue-collar employment is 4.7% in our sample while white-collar and pink-collar employment fluctuate with standard deviations of 3.3% and 3.1%, respectively.

Besides employment, we also extend the analysis to further labor-market outcomes by occupation such as hours and wage rates as well as the allocation of occupations across industries.[8] For instance, we use information on relative wage dynamics to discriminate between alternative explanations of occupational employment dynamics. Descriptively, there are considerable differences in pay between occupation groups. On average over our sample, the hourly wage rate, measured in 2015 dollars, is about $23 for workers in white-collar occupations, $18 for workers in blue-collar occupations, and $15 for workers in pink-collar occupations. Average weekly hours per worker amount to roughly 38, 33, and 32.5 for white-collar, blue-collar, and pink-collar occupations, respectively, showing that differences in hours per worker between blue-collar and pink-collar occupations are rather small. As discussed before, in particular between blue-collar and service, sales, and office occupations, there is a substantial gender segregation. Men constitute 84% of employed workers in blue-collar occupations but only 39% in service, sales, and office occupations.

Finally, blue-collar occupations and pink-collar occupations are not distributed evenly across industries. Blue-collar occupations are concentrated in natural-resource extraction, construction,

[6]The term polarization is used because of the secular downward trend in the share of (medium pay) blue-collar employment relative to (low pay) service employment and (high pay) white-collar employment.

[7]The correlations of the cyclical components of employment in white-collar, blue-collar, and pink-collar occupations with the cyclical component of aggregate employment are 0.95, 0.94, and 0.96, respectively.

[8]For this, we take into account that the official conversion factors used to construct consistent times series of employment by occupation do not necessarily yield consistent time series of other outcomes by occupation or of occupational employment within industries. We circumvent this issue by including dummies for reclassification dates when identifying cyclical and trend components, see Appendix A.1 for details.

manufacturing, and transportation industries where they represent more than 50% of total employment. By contrast, service, sales, and office occupations are over-represented especially in leisure and hospitality as well as in wholesale and retail sales industries. In the following, we document heterogenous occupational employment dynamics conditional on fiscal-policy shocks and present empirical evidence that these heterogeneous dynamics are not simply reflections of industry dynamics or of the demographic characteristics of workers in different occupations.

2.2 Econometric method

As our baseline econometric strategy, we identify exogenous variations in government spending by estimating expectations-augmented vector-autoregressive models on quarterly U.S. data and using short-run identifying restrictions on the automatic response of government spending to economic activity. To take into account anticipation effects of government spending that are found to be important by Ramey (2011b), we include a fiscal news variable in our VAR.

The reduced-form VAR reads

$$Y_t = C + \sum_{i=1}^{q} B_0^{-1} B_i Y_{t-i} + B_0^{-1} \varepsilon_t \, , \tag{1}$$

where Y_t is a $k \times 1$ vector of k endogenous variables, C is a $k \times 1$ vector of constants, ε_t a $k \times 1$ vector of serially and mutually uncorrelated structural shocks, B_i is a $k \times k$ matrix (for every $i = 0, \ldots, q$), where B_0 comprises the parameters on the contemporaneous endogenous variables, and q is the maximal lag length. An equation-by-equation ordinary least squares regression of the reduced-form VAR (1) yields estimates of the coefficients $B^{-1}C_i$ (for every $i = 1, \ldots, q$) and the reduced form residuals $B^{-1}\varepsilon_t$, as well as the covariance matrix of the reduced-form residuals Σ.

Our baseline set of variables Y_t consists of government spending (real government consumption and gross investment per capita), output (real GDP per capita), the forecast for total government spending growth from the Survey of Professional Forecasters (the forecast made at time t for the growth rate of real government purchases for time $t + 1$), tax receipts (real value of government current tax receipts, deflated with the GDP deflator and expressed in per capita terms), the ratio of government debt to GDP, and the real interest rate (the annualized difference between the federal funds rate and the log-change in the GDP deflator). Our main interest lies in the analysis of the effects of government spending shocks on labor market outcomes. We follow Burnside, Eichenbaum, and Fisher (2004)'s strategy of using a fixed set of macroeconomic aggregates (the variables mentioned above) and rotating different labor market variables of interest in.

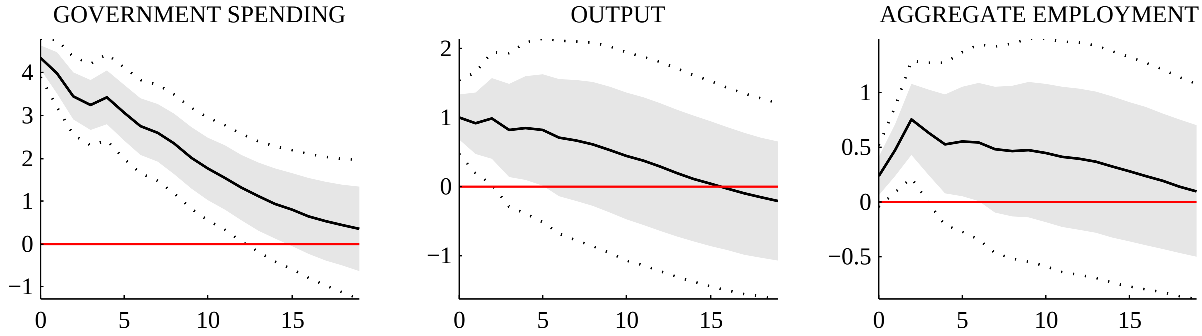
Our baseline sample period is 1983Q1-2015Q4, while we also consider a robustness check where we exclude the Great Recession and its aftermath. In our preferred specification, all variables are measured as deviations from linear trends, we include constants in the VAR and choose a lag length of three. In robustness checks, we consider alternative ways of handling trends in the data and find that our key results do not depend on the specific detrending method.

Identification of government spending shocks is achieved through a standard recursive identification scheme with government spending ordered first. Technically, we assume that B_0 is lower triangular. This implies that fiscal spending shocks are identified by assuming that government spending is exogenous within the quarter, for example due to institutional delays in the political and administrative process (Blanchard and Perotti 2002). We address Ramey (2011b)'s anticipation critique by incorporating as a fiscal news variable the spending growth forecast following, e.g., Auerbach and Gorodnichenko (2012). The innovation in government spending orthogonal to the forecast is an unanticipated shock to government spending in the sense that it was not foreseen by professional forecasters. Relying on professional forecasts to address anticipation follows Ramey (2011b)'s recommendation for a post-Korean war sample, for which Ramey (2011b, 2016) has shown that her military news variable has insufficient instrument relevance for identifying exogenous variation in government spending. The real interest rate, tax receipts, and public debt enter the VAR to control for the monetary policy stance and for the effects of the financing side of the government budget when identifying government spending shocks (Perotti 1999, Rossi and Zubairy 2011, Ramey 2011b). In the robustness section, we present results of alternative identifications schemes for government spending shocks.

3 Empirical results

In this section, we first present our main results regarding occupational employment dynamics and corroborate these findings in a series of robustness checks, including alternative identifications of fiscal VARs. Afterwards, we consider further labor-market outcomes such as hours, wages,

Figure 1: The effects of government spending shocks on macroeconomic aggregates.



Notes: The solid lines are the impulse responses to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. The 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.

earnings, and unemployment by occupation. Finally, we provide evidence that occupation-specific changes in labor demand are key to understand the documented employment dynamics.

Before turning to occupational labor market outcomes, we briefly discuss the aggregate effects of fiscal policy. Figure 1 displays the estimated responses of government spending, output, and aggregate employment to a fiscal policy shock.[9] 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.

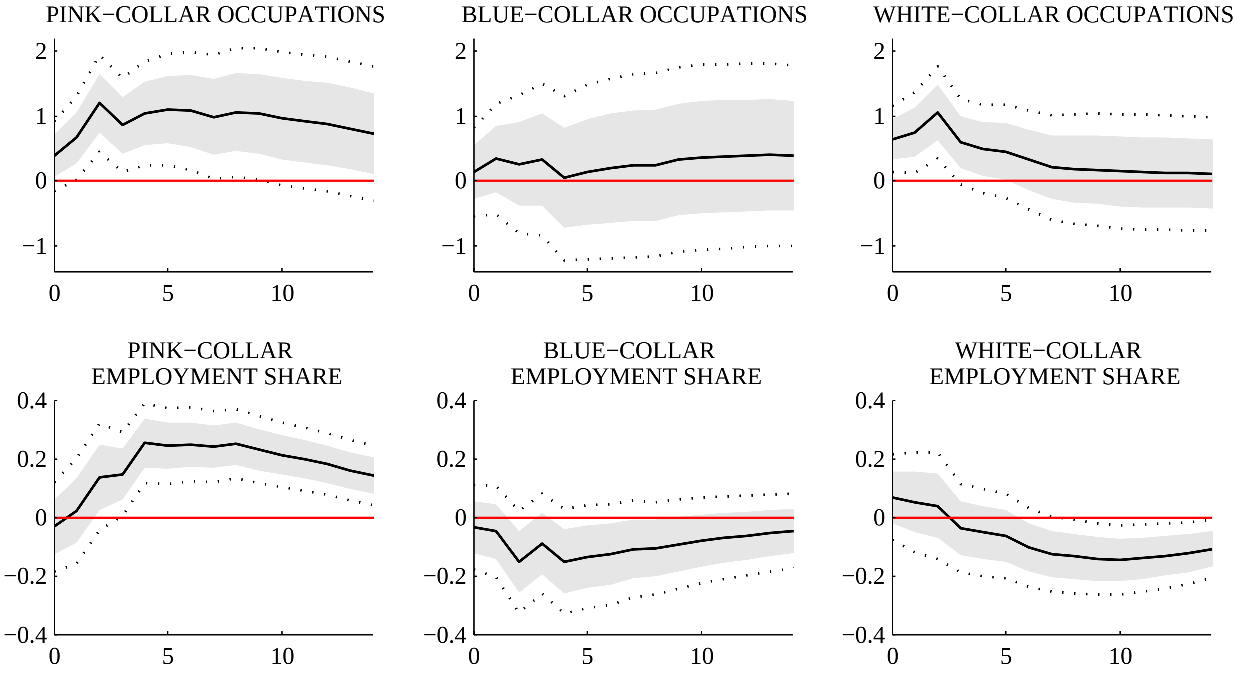
We observe a persistent rise in government spending and a significant increase in output. Government spending rises by 4.2 percent on impact that translates, together with an average share of government spending in GDP in our sample of around 20 percent, into an impact output multiplier of around 1. A government spending expansion also leads to a significant increase in aggregate employment. These results are well in line with the literature, see, e.g., Ramey (2011a, 2011b), Pappa (2009), and Monacelli, Perotti, and Trigari (2010).

3.1 Occupational employment dynamics

Our main interest is on the occupational employment dynamics after fiscal policy shocks. The columns of Figure 2 compare the employment effects of fiscal policy for different occupation groups by showing the employment responses in levels (first line) and as shares in total employment (second line). The figure reveals that employment reactions differ markedly across occupations.

[9] The VAR further includes the real interest rate, tax receipts, the debt-to-gdp ratio, and the spending forecast as control variables. Figure A2 in Appendix C.1 shows the full set of impulse responses.

Figure 2: The effects of government spending shocks on employment by occupation.



Notes: The solid lines are the impulse responses to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. The 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. White collar: management, business, and financial occupations; professional and related occupations.

In particular, the responses of blue-collar employment and employment in pink-collar occupations differ considerably relative to aggregate employment.

Employment in pink-collar occupations, i.e., service, sales, and office occupations, increases after a government spending expansion, as does aggregate employment, see the upper left panel of Figure 2. A similar pattern is found for all three major subcategories of pink-collar occupations, see Figure A3 in Appendix C.2 which shows impulse responses of employment in service occupations, in sales occupations, and in office occupations separately. Importantly, employment in pink-collar occupations rises significantly more strongly than aggregate employment. As shown in the lower left panel of Figure 2, there is a significant, strong, and long-lasting increase in the share of pink-collar employment in total employment.

By contrast, for blue-collar employment, we do not observe a discernible change after a government spending expansion, see the upper-middle panel of Figure 2. Figure A4 in Appendix C.2 shows that there is also no significant employment increase in any of the four major occupation groups in the blue-collar category. Together with the rise in aggregate employment, this implies that the share of blue-collar employment in total employment declines considerably.

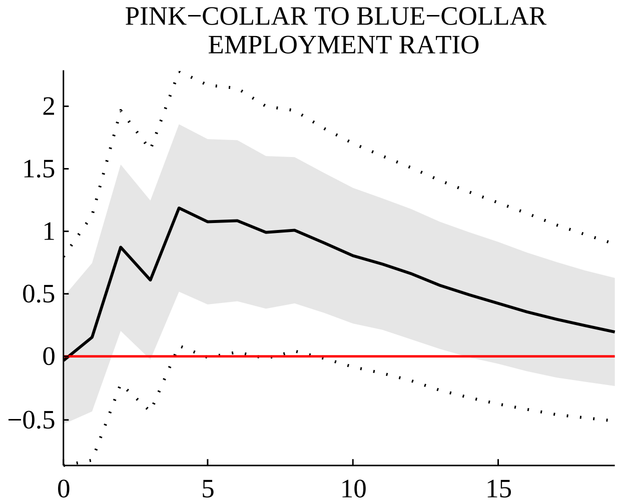
Employment in white-collar occupations also expands after a government spending shock, see the upper-right panel in Figure 2. Note, however, that the increase in white-collar employment is more or less proportionate relative to the rise in economy-wide employment. The response of the share of white-collar employment in total employment is small and indistinguishable from zero for the first 6 quarters; only in the medium run, there is a significant decline in the white-collar employment share which stems from the more short-lived increase in white-collar employment relative to aggregate employment.

The most substantial finding suggested by Figure 2 is that pink-collar employment increases disproportionately, while at the same time there is no discernible change in blue-collar employment. In the following, we concentrate on the resulting shift in the composition of employment from blue-collar employment to employment in pink-collar occupations since it marks the most substantial heterogeneous occupational employment dynamics induced by fiscal policy.

The documented shift in the composition of employment from blue-collar to pink-collar occupations is significant and quantitatively important. This is documented by Figure 3, which shows the response of the ratio of employment in pink-collar occupations to employment in blue-collar occupations and, thus, the relative occupational employment dynamics between these two groups. The significant rise in the ratio implies that the difference in employment dynamics between the two occupation groups is statistically significant. Quantitatively, employment in service, sales, and office occupations rises by about one percentage point relative to blue-collar employment.

To translate percentage employment changes into jobs, we provide some back-of-the-envelope calculations using the mean responses and the average employment levels by occupation. During the first year after an expansionary fiscal shock, employment rises by about 0.5 percent, which corresponds to about 680,000 jobs. Of these additional jobs, 450,000 are jobs in pink-collar occupations, which corresponds to a percentage change of about 0.8 percent. Blue-collar employment rises by only around 0.2 percent which corresponds to around 68,000 new jobs. Relative to the average share of pink-collar workers in total employment of 40 percent, 67 percent of the jobs are created for pink-collar workers. By contrast, only 10 percent of the jobs created by fiscal policy

Figure 3: The effects of government spending shocks on pink-collar employment relative to blue-collar employment.



Notes: The solid line is the impulse response 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. 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.

accrue to blue-collar workers. This is considerably below the 25 percent average share of blue-collar workers in total employment.

Robustness. Our main finding – expansionary fiscal policy leads to a shift in the composition of employment from blue-collar to pink-collar employment – is not specific to the baseline specification of our VAR but is obtained for a wide range of re-specifications of the empirical model. Two results are noteworthy. First, 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. In Appendix C.3, we document that our results are robust to alternative ways of handling trends in the data. Second, 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. In Appendix C.3, we show that this is not the case.

Moreover, we show that the documented shift from blue-collar employment to employment in pink-collar occupations is also obtained when we employ alternative identification schemes for government spending shocks. 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 (2012). 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. 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. We follow Auerbach and Gorodnichenko (2012) and use real-time forecast errors, i.e., the difference between the actual, first-release series and the forecast series. 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. Figure A6 in Appendix C.4 displays results of these alternative identification schemes. In both cases, 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). To address this, we identify unanticipated and exogenous changes to government investment and government consumption in separate estimations, in which we include the spending category of interest and identify, as in our baseline specification, the respective spending shock via a recursive identification scheme with the spending category of interest ordered first. The effects on the pink-collar to blue-collar employment ratio are found to be stronger for variations in government consumption but we find a significant rise in pink-collar employment relative to blue-collar employment for both components of government spending, see Figure A6 in Appendix C.4. We will come back to this when we discuss implications of our results.

3.2 Further labor market outcomes by occupation

In the previous analysis, we have documented pronounced heterogeneity in the responses of employment by occupation to government spending expansions. In this subsection, we complete our analysis by investigating further labor market outcomes by occupation: hours, wage rates, earnings, unemployment, and labor-force participation. This analysis is important because, first, it allows to fully assess the occupational labor market effects of fiscal policy and, second, it provides guidance for the theoretical model that is developed in Section 4.

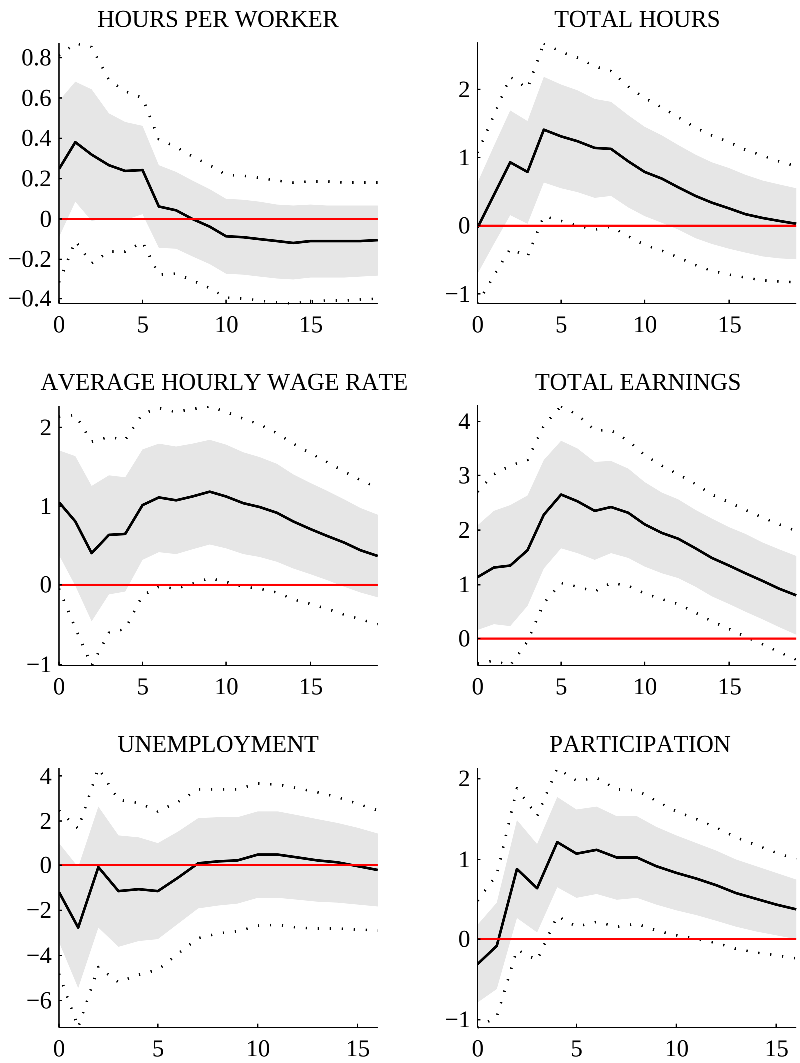
Since the most pronounced heterogeneous employment pattern is the shift from blue-collar to pink-collar employment, we concentrate here on the relative dynamics between these two groups, measured by the response of the ratio of pink-collar to blue-collar labor-market outcomes. The upper left panel of Figure 4 shows that, for average hours of a working individual, we find the same qualitative response as for employment in our baseline specification. Hours per employed pink-collar worker tend to rise relative to hours per blue-collar worker after government spending expansions. Accordingly, the response of the total hours ratio (upper right panel of Figure 4) is more pronounced than the response of the employment ratio. Put differently, developments at both the intensive and the extensive margin work in the same direction.

The middle-left panel of Figure 4 shows the response of the relative hourly wage rate. We find that wage rates of pink-collar workers rise relative to those of blue-collar workers. Thus, there is a positive co-movement of relative occupational employment and relative occupational wage rates. This is important because it indicates that occupation-specific changes in labor demand rather than in labor supply are key for understanding the heterogenous occupational employment effects of fiscal expansions – an insight which is key for our modelling strategy in Section 4.

The middle-right panel of Figure 4 displays the response of relative occupational labor earnings. As employment, hours, and wage rates shift in favor of pink-collar workers, also their earnings increase relative to blue-collar workers. Put differently, in response to an increase in government spending, the distribution of labor earnings shifts towards workers in pink-collar occupations.

Finally, we investigate the flows into pink-collar jobs induced by fiscal expansions using information on unemployment and participation by occupation from the CPS. Note that, for unemployed individuals, the CPS provides information on the occupation of the last job. Thus, for example, pink-collar unemployment measures the number of unemployed individuals whose last job was in a pink-collar occupation (and not the number of individuals searching for a pink-collar job). The lower-left panel of Figure 4 shows that, in response to government spending expansions, relative

Figure 4: The effects of government spending shocks on relative labor market outcomes: pink-collar to blue-collar ratios.



Notes: The solid lines are the impulse responses of the ratio of the respective pink-collar to blue-collar labor market variable to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. The 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. Total hours is the sum of hours worked by individuals in the respective occupation. Total earnings is the sum of labor earnings of individuals in the respective occupation. Hours per worker is total hours worked divided by employment. Average hourly wage rate is total earnings divided by total hours worked. Unemployment is the number of unemployed individuals by occupation of the last job that the unemployed person held. Participation is the sum of employed and unemployed individuals in the respective occupation. 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.

pink-collar unemployment tends to fall. The decline in relative pink-collar unemployment indicates that, among individuals working in the additionally created pink-collar jobs, there are relatively more workers whose last job also was in a pink-collar occupation than those whose last job was in a blue-collar occupation. Hence, occupation switches from blue-collar to pink-collar occupations do not seem to be the dominant flow into the additional pink-collar jobs. This evidence of limited occupation switches in response to a temporary fiscal expansion motivates our modeling of the labor market in terms of stocks rather than flows in Section 4. It is also consistent with Foote and Ryan (2014) who show that middle-skill (blue-collar) workers rarely exit unemployment for either high-skill (white-collar) or low-skill (pink-collar) jobs. Likewise, Fujita and Moscarini (2013) show that unemployed workers often return to their former employers. However, some switches between occupation groups may occur as total participation in pink-collar occupations rises relative to blue-collar occupations, see lower right panel of Figure 4. However, the evidence regarding the response of relative occupational unemployment suggests that the increase in relative pink-collar participation mostly reflects flows from non-participation to pink-collar employment. Flows into pink-collar employment induced by fiscal policy may also originate from people who enter the labor market for the first time taking up pink-collar jobs. We will address this point when we take into account information on workers' age in the next section.

3.3 The role of sectors, industries, and workers' characteristics

In this subsection, we present empirical evidence that *occupation*-specific shifts in labor demand are responsible for the heterogenous employment dynamics after government spending expansions that we have documented before. In particular, we rule out that the heterogenous employment dynamics across occupations simply reflect heterogenous employment dynamics across industries or sectors. Moreover, we obtain similar occupational employment dynamics within groups of workers with similar characteristics, which shows that workers' characteristics cannot be the driving force behind the dynamics in the aggregate.

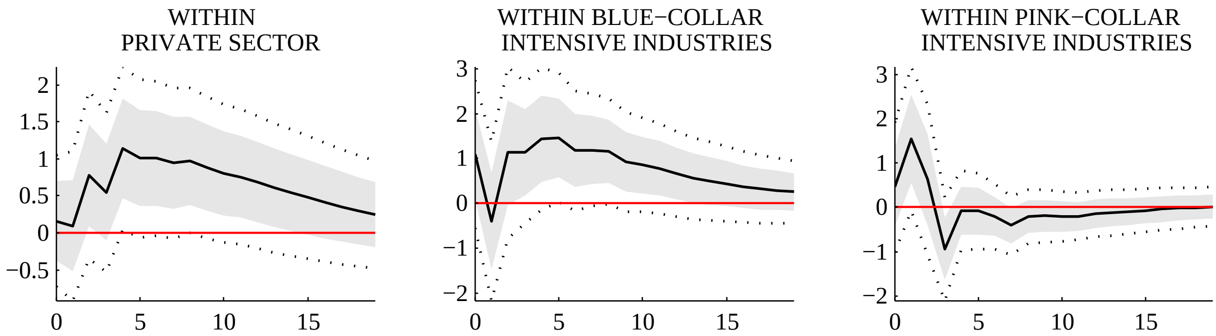
To start with, note that we also observe a shift from blue-collar to pink-collar employment when excluding employees working in the public sector from the analysis. This is important because the government wage bill is a major part of government expenditures and, at the same time, the share of pink-collar 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 53 percent, as compared to 42 percent economy-wide. The blue-collar share in public sector employment is 6 percent, relative to 24 percent in total employment. Since government employment rises slightly more than aggregate employment in response to fiscal expansions (see Figure A7 in Appendix C.5), the shift from blue-collar employment to employment in service, sales, and office occupations may in part be a consequence of a composition effect due to a disproportionate expansion of government employment. Importantly, though, the left panel of Figure 5 shows that we observe the same heterogenous 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 to a very limited degree 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 (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 lower left panel of Figure A6 in Appendix C.4. This reveals that the disproportionate rise in pink-collar employment is not just a consequence of spill-over effects from government wage bill expansions.[10]

Next, we provide evidence that the documented heterogenous occupational employment dynamics are not a simple relabeling of heterogenous employment dynamics across industries. Occupations are not equally distributed among industries. On the one hand, industries such as con-

[10]For completeness, we also re-estimate our VAR using government wage-bill expenditures. In this VAR, we find somewhat stronger increases in relative pink-collar employment, see the lower right panel of Figure A6 in Appendix C.4. The results of the VAR excluding the wage bill show that wage bill expansions are not the dominant driving force of our main results.

Figure 5: The effects of government spending shocks on the pink-collar to blue-collar employment ratio in the private sector and in broad industry groups.



Notes: The solid lines are the impulse responses to a government spending shock. Grey shaded areas and dotted lines show 68 percent and 90 percent confidence bands. The 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.

struction, manufacturing, and transportation are blue-collar intensive compared to the economy as a whole; taking the average of our sample, the blue-collar employment share in these industries is far above 50 percent, relative to 24 percent economy-wide. On the other hand, industries such as financial activities, wholesale and retail trade, as well as leisure and hospitality employ a disproportionate share of service, sales, and office occupation workers. Thus, the disproportionate employment growth in service, sales and office occupations observed in the data may in part be a result of disproportionate employment growth in industries employing workers in these occupations disproportionately. The latter in turn may be a consequence of the high share of services in the government consumption bundle.[11] Likewise, blue-collar workers may not benefit much from fiscal expansions because fiscal expansions do not trigger significant employment growth in blue-collar intensive industries such as production and manufacturing, for example, because of the moderate share of government investment in total government spending. In fact, when we estimate the effects of fiscal shocks on employment in different industries, we find evidence for a disproportionate increase in employment of pink-collar intensive industries and a less than proportionate increase in employment of blue-collar intensive industries (see Figure A7 in Appendix C.5). Importantly, though, Figure 5 shows that there are substantial changes in the composition of occupational employment *within* industry groups. In particular, we observe a substantial rise in the employment

[11] From 1999 to 2015, where the respective NIPA data is available, the share of purchased services in total government consumption expenditures averaged at 25%. Excluding the wage bill, the share of purchased services even amounts to 72% on average.

ratio of pink-collar to blue-collar occupations within blue-collar intensive industries (middle panel) as well as within pink-collar intensive industries (right panel), as we do in the aggregate.

To corroborate this point, we construct a formal test that allows to reject the hypothesis that our results are solely reflecting between-industry employment dynamics. For this, we construct a hypothetical time series of occupational employment implied only by between-industry dynamics and isolate a residual component of occupational employment unrelated to industries (details can be found in Appendix C.6). Also for the component unrelated to industry dynamics, we find occupational employment effects favoring pink-collar workers. Hence, the documented occupational employment dynamics are certainly not just a consequence of industry dynamics.

Finally, we provide evidence that the heterogenous 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. First, recall that a fiscal expansion induces a positive co-movement of the employment and wage ratio between pink-collar and blue-collar workers, see the lower-left panel in Figure 4. This suggests that firms increase their demand for service, sales, and office workers by more than their demand for blue-collar workers. Still, 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. Importantly, we find a significant shift towards pink-collar occupations also among female workers as well as among male workers, see the upper panels of Figure A9 in Appendix C.7.

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, 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 A9 in Appendix C.7. 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.

From this, we conclude that occupation-specific shifts in labor demand in favor of pink-collar workers independent of industry or workers' characteristics are key for understanding the documented heterogenous employment dynamics in response to government spending expansions. Pink-collar employment appears to attract individuals in different industries and with different characteristics. This suggests that there are labor-demand forces that pull individuals into pink-collar employment, as is also strongly indicated by the evidence on relative occupational wages, see Section 3.2. In the next section, we build a model explaining these occupation-specific labor-demand forces.

4 Explaining occupational employment dynamics

In order to understand why firms adjust their demand for labor in different occupations differently, it is important to understand what distinguishes pink-collar occupations from blue-collar occupations. Autor and Dorn (2013) have established that the degree of substitutability between capital and labor differs across occupations. While their analysis relates to the long-run, we highlight the role of differences in the degree of substitutability for short-run dynamics. Specifically, our explanation builds on the notion that labor provided by blue-collar occupations is on average more easily substitutable with capital than labor provided by pink-collar occupations. In a short-run business-cycle context, this amounts to the assumption that there are differences in the substitutability of occupational labor with capital *services*, i.e., the stock of physical capital times the intensity with which it is used.[12] Pink-collar employees, the majority of whom are workers in service occupations, perform tasks that include a substantial share of human interaction that is difficult to provide through machines. Accordingly, pink-collar labor and capital services are,

[12]This distinguishes our approach from Autor and Dorn (2013) who explain differences in long-run occupational employment trends as a consequence of some types of occupational labor being substitutes, while others are complements, to quality-improved, new generations of capital. In our short-run perspective, what matters are differences in the degree of substitutability of occupational labor with the quantity of existing capital types and the intensity with which existing capital is used.

on average, relatively poor substitutes. Blue-collar workers, by contrast, perform routine-manual labor including a substantial share of interaction with capital/machines (Jaimovich and Siu 2012; Foote and Ryan 2014) that can be used in different intensities, making blue-collar labor and capital services relatively close substitutes.

In the following, we will embed differences in the short-run substitutability of capital services with blue-collar and pink-collar labor into an otherwise standard New Keynesian business-cycle model. Our model considers a representative industry wherein we distinguish between labor in pink-collar and blue-collar occupations. This modeling choice is motivated by the importance of occupation-specific factors in explaining employment dynamics both within industries and across all industries, as documented in Section 3.3.

The model is able to replicate the empirical evidence on the effects of fiscal shocks on output, aggregate employment, and relative occupational labor market outcomes. The model's mechanism can be described as follows. After a fiscal expansion, firms demand more factor inputs to meet increased product demand. In this process, they raise their demand for capital services more than their demand for labor, in line with empirical evidence showing a significant increase in the utilization to labor ratio after fiscal expansions, see Figure A10 in Appendix C.8. In our model, firms behave like this because relative factor costs change in favor of capital use compared to labor. This is the consequence of a relatively elastic short-run supply of capital services compared to labor.[13] The disproportionate surge in capital usage lowers the marginal productivity of its closer substitute, blue-collar labor, relative to pink-collar labor. As a consequence, firms increase their demand for pink-collar labor by more than their demand for blue-collar labor, thereby generating a relative pink-collar employment boom that is associated with a relative rise in pink-collar wages, in line with what is found in the data.

4.1 The model

The model economy consists of firms, households, and the government. Firms produce differentiated goods under monopolistic competition and face costs of price adjustment. Production inputs are capital services and different types of occupational labor. Households are families whose

[13]There is strong empirical support for this assumption. The elasticity of capital utilization is usually estimated to be considerably larger than Frisch labor supply elasticities. See, for example, Schmitt-Grohé and Uribe (2012), Smets and Wouters (2007), or Christiano, Eichenbaum, and Evans (2005).

members differ by occupation. The government consists of a monetary and fiscal authority. The monetary authority sets the short-term nominal interest rate while the fiscal authority collects income taxes, issues short-term government bonds, pays transfers, and purchases goods for government consumption. A variable without a time subscript denotes its steady-state level.

Firms. There is a unit mass of firms. Each firm $j \in [0,1]$ is a monopolistic supplier of a different variety $y_{j,t}$ of the final good $y_t = \left(\int_0^1 y_{j,t}^{(\epsilon-1)/\epsilon} di\right)^{\epsilon/(\epsilon-1)}$, where $\epsilon > 1$ is the elasticity of substitution between different varieties. Firm j produces its output $y_{j,t}$ using capital services $\tilde{k}_{j,t}$ and two types of labor, blue-collar labor $n_{j,t}^b$ and pink-collar labor $n_{j,t}^p$.

Firm j uses the following nested CES production technology:

$$y_{j,t} = z \cdot \left(\alpha \cdot (v_{j,t})^{\frac{\theta-1}{\theta}} + (1-\alpha) \cdot \left(a_t \cdot n_{j,t}^p\right)^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}}, \tag{2}$$

where $v_{j,t}$ is a CES bundle of capital services and blue-collar labor:

$$v_{j,t} = \left(\gamma \cdot \left(\tilde{k}_{j,t}\right)^{\frac{\phi-1}{\phi}} + (1-\gamma) \cdot \left(a_t \cdot n_{j,t}^b\right)^{\frac{\phi-1}{\phi}}\right)^{\frac{\phi}{\phi-1}}.$$

The parameter $\phi > 0$ measures the elasticity of substitution between capital services and labor in the representative blue-collar occupation, the parameter $\theta > 0$ measures the elasticity of substitution between the input bundle $v_{j,t}$ and labor in the representative pink-collar occupation. $\alpha \in (0,1)$ and $\gamma \in [0,1]$ are exogenous parameters, $z > 0$ is total factor productivity, and a_t is labor productivity which follows the exogenous AR(1) process $\log a_t = (1-\rho_a)\log a + \rho_a \log a_{t-1} + \varepsilon_t^a$, where ε_t^a is $i.i.d. N(0, \sigma_{\varepsilon^a}^2)$. This production technology resembles the one used by Autor and Dorn (2013).[14] The production function (2) allows for different degrees of substitutability between capital services on the one hand and pink-collar or blue-collar labor, respectively, on the other hand. For $\phi > \theta$, blue-collar labor is the closer substitute to capital services compared to pink-collar labor and vice versa for $\phi < \theta$. For $\phi \to 1$ and simultaneously $\theta \to 1$, the production function collapses to Cobb-Douglas where the elasticity of substitution between any two factors is one.

[14] In their model, there is a CES aggregate of "routine goods production" (blue-collar) labor and capital which is aggregated with "manual services" (pink-collar) labor. In contrast to Autor and Dorn (2013), we abstract from "high skill" labor, as this type of labor moves roughly proportionately with aggregate employment in response to fiscal policy shocks.

The firm chooses $\tilde{k}_{j,t}$, $n^b_{j,t}$, and $n^p_{j,t}$ to minimize real costs

$$\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\lambda_t}{\lambda_0} \left(w^b_t n^b_{j,t} + w^p_t n^p_{j,t} + r^k_t \tilde{k}_{j,t} + \frac{\kappa_n}{2} \left(\frac{n^b_{j,t}}{n^b_{j,t-1}} - 1 \right)^2 y_t + \frac{\kappa_n}{2} \left(\frac{n^p_{j,t}}{n^p_{j,t-1}} - 1 \right)^2 y_t \right) , \tag{3}$$

subject to (2), where w^b_t and w^p_t are real wages for blue-collar and pink-collar labor, respectively, and r^k_t is the rental rate of capital services. The firm takes factor prices as given. The term $\beta^t \lambda_t / \lambda_0$ denotes the stochastic discount factor for real payoffs, where λ_t is the marginal utility of real income of the representative household that owns the firm, and $\beta \in (0, 1)$ is the households' discount factor. The last two terms are quadratic labor adjustment costs, expressed in units of the final good, where the parameter $\kappa_n \geq 0$ measures the extent of labor adjustment costs.[15] Let $mc_{j,t}$, the Lagrange multiplier of the firm's cost minimization problem, denote real marginal costs.

The firm faces a quadratic cost of price adjustment. It chooses its price $p_{j,t}$ to maximize the discounted stream of real profits

$$\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\lambda_t}{\lambda_0} \left(\frac{p_{j,t}}{p_t} \cdot y_{j,t} - mc_{j,t} \cdot y_{j,t} - \frac{\psi}{2} \left(\frac{p_{j,t}}{p_{j,t-1}} - 1 \right)^2 y_t \right) ,$$

subject to the demand function for variety j, $y_{j,t} = (p_{j,t}/p_t)^{-\epsilon} y_t$, where y_t is aggregate demand, $p_{j,t}/p_t$ is the relative price of variety j, and $p_t = \left(\int_0^1 p_{j,t}^{1-\epsilon} di \right)^{1/(1-\epsilon)}$ is the price index. The final term represents the costs of price adjustment, where $\psi \geq 0$ measures the degree of nominal price rigidity.

Since all firms choose the same prices and quantities in equilibrium, we now drop the index j. The optimal demand for capital services, blue-collar labor, and pink-collar labor are described by the first-order conditions of the cost minimization problem:

$$mc_t \cdot mpk_t = r^k_t \, , \tag{4}$$

$$mc_t \cdot mpl^b_t = w^b_t + \kappa_n \left(\frac{n^b_t}{n^b_{t-1}} - 1 \right) \frac{y_t}{n^b_{t-1}} - \kappa_n \beta \, \mathrm{E}_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left(\frac{n^b_{t+1}}{n^b_t} - 1 \right) \left(\frac{y_{t+1} n^b_{t+1}}{(n^b_t)^2} \right) \right\} , \tag{5}$$

$$mc_t \cdot mpl^p_t = w^p_t + \kappa_n \left(\frac{n^p_t}{n^p_{t-1}} - 1 \right) \frac{y_t}{n^p_{t-1}} - \kappa_n \beta \, \mathrm{E}_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left(\frac{n^p_{t+1}}{n^p_t} - 1 \right) \left(\frac{y_{t+1} n^p_{t+1}}{(n^p_t)^2} \right) \right\} , \tag{6}$$

where the marginal products of capital, blue-collar and pink-collar labor, mpk_t, mpl^b_t, and mpl^p_t,

[15] Accounting for labor adjustment costs allows the model to generate the delayed hump-shaped responses of aggregate employment and of employment ratios that we observe in the data. Model mechanisms and the qualitative results do not depend on this model feature.

respectively, are given by

$$
\begin{aligned}
mpk_t &= \alpha \cdot \gamma \cdot z^{\frac{\theta-1}{\theta}} \left(\frac{y_t}{v_t}\right)^{1/\theta} \left(\frac{v_t}{\tilde{k}_t}\right)^{1/\phi} , \\
mpl_t^b &= \alpha \cdot (1-\gamma) \cdot z^{\frac{\theta-1}{\theta}} \cdot a_t^{\frac{\phi-1}{\phi}} \left(\frac{y_t}{v_t}\right)^{1/\theta} \left(\frac{v_t}{n_t^b}\right)^{1/\phi} , \\
mpl_t^p &= (1-\alpha) \cdot (z \cdot a_t)^{\frac{\theta-1}{\theta}} \left(\frac{y_t}{n_t^p}\right)^{1/\theta} .
\end{aligned}
$$

Optimal pricing behavior is described by the first-order condition of the profit maximization problem:

$$
\psi(\pi_t - 1)\pi_t = \psi\beta \, \mathrm{E}_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \frac{y_{t+1}}{y_t} (\pi_{t+1} - 1)\pi_{t+1} \right\} + \epsilon \left(mc_t - \frac{\epsilon - 1}{\epsilon} \right) , \tag{7}
$$

where $\pi_t = p_t/p_{t-1}$ is the gross inflation rate and $\frac{\epsilon}{\epsilon-1}$ is the desired price mark-up in the absence of price adjustment costs ($\psi = 0$). The system of first-order conditions for firms differs from a standard model only in that there are two first-order conditions for labor demand. For $\gamma = 1$ (or $\alpha = 1$), the model collapses to the standard case with capital and only one type of labor as input factors.

Households. The economy consists of a continuum of infinitely-lived households, with mass normalized to one. Each household supplies pink-collar and blue-collar labor. We deliberately keep the labor-supply side of our model simple and do not model flows between occupations in order to focus on the occupation-specific demand forces which, according to our evidence, are key to understand the occupational employment dynamics in response to fiscal stimulus. We consider a unitary household that cares about its total consumption level c_t and receives disutility from both types of labor, n_t^p and n_t^b. With this modelling assumption, our theoretical analysis should be understood as a positive analysis, while our model is not supposed to allow a normative analysis of the distributional effects of fiscal policy. We do not distinguish between the extensive margin and the intensive margin of employment. This is supported by the empirical evidence showing that similar developments occur at both margins, see Section 3.2. A representative household maximizes its lifetime utility function

$$
\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t, n_t^p, n_t^b), \tag{8}
$$

where $u(c_t, n_t^p, n_t^b)$ is the period utility function which, following Jaimovich and Rebelo (2009), takes a form that allows to parameterize the wealth effect on labor supply:

$$u(c_t, n_t^p, n_t^b) = \frac{\left(c_t - \left(\frac{\Omega^p}{1+1/\eta}(n_t^p)^{1+1/\eta} + \frac{\Omega^b}{1+1/\eta}(n_t^b)^{1+1/\eta}\right) x_t\right)^{1-1/\sigma} - 1}{1-1/\sigma},$$

where $\sigma > 0$ is the intertemporal elasticity of substitution in consumption, $\Omega^p > 0$ and $\Omega^b > 0$ are scale parameters, x_t is a weighted average of current and past consumption evolving over time according to

$$x_t = c_t^{\chi} x_{t-1}^{1-\chi}, \tag{9}$$

$\chi \in (0, 1]$ governs the wealth elasticity of labor supply, and $\eta > 0$ is the Frisch elasticity of labor supply in the limiting case $\chi \to 0$. In this case, there is no wealth effect on labor supply and preferences are of the type considered by Greenwood, Hercowitz, and Huffman (1988).

The household's period-by-period budget constraint (in real terms) is given by

$$c_t + i_t + b_t = (1 - \tau_t)\left(w_t^p n_t^p + w_t^b n_t^b + r_t^k \tilde{k}_t\right) - e(u_t)k_{t-1} + (1 + r_{t-1})\frac{b_{t-1}}{\pi_t} + s_t + d_t, \tag{10}$$

where c_t is consumption, i_t is investment into physical capital that is owned by households, b_{t-1} is the beginning-of-period stock of real government bonds, τ_t is the income tax rate, k_{t-1} denotes the beginning-of-period capital stock, u_t is capital utilization, $e(u_t)$ are the costs of capital utilization, s_t are government transfers, d_t are dividends from the ownership of firms, and r_t is the nominal interest rate.

Capital evolves according to the following law of motion

$$k_t = (1 - \delta)k_{t-1} + \left(1 - \frac{\kappa_i}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2\right) i_t, \tag{11}$$

where $\delta \in (0, 1)$ is the capital depreciation rate and $\frac{\kappa_i}{2}(i_t/i_{t-1} - 1)^2$ represents investment adjustment costs with $\kappa_i \geq 0$.

Households choose the capital utilization rate u_t, which transforms physical capital into capital services $\tilde{k}_t$ according to $\tilde{k}_t = u_t k_{t-1}$. Costs of capital utilization are given by

$$e(u_t) = \delta_1(u_t - 1) + \frac{\delta_2}{2}(u_t - 1)^2, \tag{12}$$

which implies the absence of capital utilization costs at the deterministic steady state in which capital utilization is normalized to $u = 1$. The elasticity of capital utilization with respect to the rental rate of capital, evaluated at the steady state, is given by $\Delta = \delta_1/\delta_2 > 0$. As capital is predetermined, Δ corresponds to the short-run elasticity of the supply of capital services. The relative size between this elasticity and the elasticity of labor supply, η, will be important for replicating the empirical evidence, as illustrated below.

Households choose quantities c_t, x_t, b_t, k_t, i_t, u_t, n_t^b, and n_t^p, taking as given prices, dividends, transfers, and taxes w_t^p, w_t^b, p_t, r_t^k, r_t, d_t, s_t, τ_t to maximize (8) subject to (9), (10) and (11). Let λ_t, $q_t\lambda_t$, and ι_t denote Lagrange multipliers on the budget constraint, the capital accumulation equation and the definition of x_t, respectively, where q_t is the shadow value of installed capital. The first-order conditions for consumption, the composite of current and past consumption, bond holdings, capital holdings, investment, capital utilization, and labor supply for both occupation types, respectively, read

$$\lambda_t = \xi_t + \chi \iota_t \frac{x_t}{c_t}\,, \tag{13}$$

$$\iota_t = -\xi_t \left(\frac{\Omega^p}{1+1/\eta} (n_t^p)^{1+1/\eta} + \frac{\Omega^b}{1+1/\eta} (n_t^b)^{1+1/\eta} \right) + \beta(1-\chi)\,\mathrm{E}_t \left\{ \iota_{t+1} \frac{x_{t+1}}{x_t} \right\}, \tag{14}$$

$$\lambda_t = \beta\,\mathrm{E}_t \left\{ \lambda_{t+1} \frac{(1+r_t)}{\pi_{t+1}} \right\}, \tag{15}$$

$$\lambda_t q_t = \beta\,\mathrm{E}_t \left\{ \lambda_{t+1} \Big((1-\tau_{t+1}^k) r_{t+1}^k u_{t+1} - e(u_{t+1}) + q_{t+1}(1-\delta) \Big) \right\}, \tag{16}$$

$$\begin{aligned} 1 = q_t & \left(1 - \frac{\kappa_i}{2} \left(\frac{i_t}{i_{t-1}} - 1 \right)^2 - \kappa_i \left(\frac{i_t}{i_{t-1}} - 1 \right) \frac{i_t}{i_{t-1}} \right) \\ & + \beta\,\mathrm{E}_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} q_{t+1} \kappa_i \left(\frac{i_{t+1}}{i_t} - 1 \right) \left(\frac{i_{t+1}}{i_t} \right)^2 \right\}, \end{aligned} \tag{17}$$

$$(1-\tau_t) r_t^k = \delta_1 + \delta_2 (u_t - 1)\,, \tag{18}$$

$$w_t^b (1-\tau_t) \lambda_t = \Omega^b \left(n_t^b \right)^{1/\eta} x_t \xi_t\,, \tag{19}$$

$$w_t^p (1-\tau_t) \lambda_t = \Omega^p \left(n_t^p \right)^{1/\eta} x_t \xi_t\,, \tag{20}$$

where $\xi_t = \left(c_t - \left(\frac{\Omega^p}{1+1/\eta} (n_t^p)^{1+1/\eta} + \frac{\Omega^b}{1+1/\eta} (n_t^b)^{1+1/\eta} \right) x_t \right)^{-\frac{1}{\sigma}}$. The only difference to a standard model is that there are two labor-supply conditions, one for each occupation.

Market clearing, monetary and fiscal policy. Monetary policy is described by a standard interest rate rule of the form

$$\log\left((1+r_t)/(1+r)\right) = \delta_\pi \log\left(\pi_t/\pi\right) + \delta_y \log\left(y_t/y\right) , \tag{21}$$

where the parameters $\delta_\pi > 1$ and $\delta_y \geq 0$ measure the responsiveness of the nominal interest rate to deviations of inflation and output from their steady-state values, respectively.

The fiscal authority faces the following budget constraint (in real terms):

$$b_t + \tau_t \left(w_t^b n_t^b + w_t^p n_t^p + r_t^k \tilde{k}_t^s \right) = g_t + s_t + (1+r_{t-1}) \frac{b_{t-1}}{\pi_t} .$$

Government spending, g_t, is described by the following process:

$$\log g_t = (1-\rho_g) \log g + \rho_g \log g_{t-1} - \gamma_g \cdot \frac{(b_{t-1}-b)}{y} + \varepsilon_t^g , \tag{22}$$

where ε_t^g is $i.i.d.N(0, \sigma_{\varepsilon^g}^2)$ and $(b_{t-1}-b)/y$ denotes previous period's deviation of real debt from its steady state, expressed in terms of steady-state output y. Following, e.g., Corsetti, Meier, and Müller (2012), we allow for a systematic feedback effect of public debt on government spending, captured by the parameter $\gamma_g \geq 0$. The income tax rate is kept constant at its steady-state level, $\tau_t = \tau$. In order to guarantee the stability of government debt, transfers follow the rule $\log(s_t) = (1-\rho_s)\log(s) + \rho_s \log(s_{t-1}) - \gamma_b \cdot (b_{t-1}-b)/y$, where the parameter γ_b is positive and sufficiently large.

Goods market clearing requires aggregate production, y_t, to be equal to aggregate demand which includes resources needed for capital utilization, price adjustment, and labor adjustment:

$$y_t = c_t + i_t + g_t + e(u_t)k_{t-1} + \frac{\psi}{2}(\pi_t - 1)^2 y_t + \frac{\kappa_n}{2}\left(\frac{n_t^p}{n_{t-1}^p} - 1\right)^2 y_t + \frac{\kappa_n}{2}\left(\frac{n_t^b}{n_{t-1}^b} - 1\right)^2 y_t . \tag{23}$$

4.2 Analytical results from a simplified model version

We now investigate the effects of an expansion in government spending. We proceed in two steps. First, we consider a simplified version of the model that allows us to provide analytical results. We use this model version to understand the basic mechanism driving the response of the pink-collar to blue-collar employment ratio. Then, we consider a calibrated version of the model and present numerical results.

To facilitate the derivation of analytical results, we simplify the model by applying the parameter restrictions $\rho_a = \rho_g = \rho_s = 0$, $\delta_y = 0$, $\kappa_i \to \infty$, $\delta = 0$, $\gamma_g = 0$, $\sigma \to 1$, $\chi \to 0$, $\kappa_n = 0$, and $\theta \to 1$, which imply that there is no autocorrelation of shocks or fiscal policy, no output reaction of monetary policy, no feedback effect from debt on government spending, a constant stock of physical capital, log utility, no wealth effect on labor supply, no labor adjustment costs, and a degree of substitutability between the composite input, v_t, and pink-collar labor normalized to unity. To facilitate the exposition, we further apply the simplifying restrictions $\gamma = \alpha = 1/2$, $\eta = 1$, and normalize the steady-state values of all input factors to one which also implies $y = 1$. The normalizations of the Frisch elasticity η and the elasticity of substitution between pink-collar labor and the composite input θ imply that capital services are in more elastic supply than labor if $\Delta > 1$ and that blue-collar labor is the closer substitute to capital services than pink-collar labor if $\phi > 1$.

Applying these simplifications and log-linearizing the equilibrium conditions allows to express the output reaction to fiscal shocks as

$$\widehat{y}_t = \Lambda^{-1} \cdot \Xi \cdot g \cdot \widehat{g}_t \,, \tag{24}$$

where hats indicate log deviations from steady state and

$$\begin{aligned} \Lambda = & \Gamma \cdot \left(1 - \frac{g}{y}\right) \cdot \left(5 + 3\Delta^{-1} + \phi + 7\Delta^{-1}\phi\right) + 2 \cdot \frac{1}{\varepsilon} \cdot (1 + \phi) \\ & + \frac{1}{\varepsilon} \cdot \left(1 + \frac{g}{y} \cdot \kappa\psi\right) \cdot \left(5 + \Delta^{-1} + \phi 5\Delta^{-1}\phi\right) > 0, \end{aligned}$$

$\Xi = \Delta^{-1} + 3\phi + 5\Delta^{-1}\phi + 7 > 0$, $\Gamma = \delta_\pi \cdot \kappa \cdot \lambda^2 > 0$, and $\kappa = (\varepsilon - 1)/\psi > 0$ is the slope of the linearized Phillips curve, see Appendix D for a detailed derivation. An increase in government spending raises output as long as prices are not perfectly flexible, i.e., $\psi > 0$. Then, also both types of employment and hence aggregate employment increase if $\widehat{g}_t > 0$, see Appendix D.

Our primary focus is on the reaction of the ratio of pink-collar to blue-collar employment to government spending shocks, as in our empirical analysis. In log-linear terms, this reaction is described by

$$\widehat{n}_t^p - \widehat{n}_t^b = \frac{2}{\Lambda \cdot \Delta} \cdot (\Delta - 1) \cdot (\phi - 1) \cdot g \cdot \widehat{g}_t. \tag{25}$$

The pink-collar to blue-collar employment ratio rises in response to a fiscal stimulus if the supply of capital services is relatively elastic compared to the supply of labor ($\Delta > 1$) and if blue-collar labor is a closer substitute to capital services than pink-collar labor ($\phi > 1$). If the former condition is fulfilled, firms raise their use of capital services more than employment since capital services become cheaper relative to labor. This relative price shift occurs because the increase in factor demands after the spending expansion leads to a relatively stronger price increase for the production factor that is supplied less elastically which is labor. If also the condition $\phi > 1$ is fulfilled, firms raise their demand for blue-collar labor by less than their demand for pink-collar labor due to the relatively high substitutability between capital services and blue-collar labor. As a result, the pink-collar to blue-collar employment ratio rises, corresponding to a pink-collar job boom.[16]

4.3 Numerical results

While the results of the previous section help to understand the basic mechanism, we now investigate the effects of government spending expansions in a calibrated version of our model. Rather than matching the exact profiles of the estimated impulse responses from the empirical VAR model, our aim is to investigate whether the calibrated model generates impulse responses that are generally consistent with our empirical evidence.

We parameterize the model targeting the U.S. economy. The parametrization is a combination of using empirical estimates from the literature for some parameters and calibrating others. Time is measured in quarters. We set the elasticity of substitution in consumption, σ, to 1, a value commonly used in the literature. The weights on labor in the utility function are chosen to imply a steady-state ratio of $n^p/n^b = 1.72$, consistent with its sample mean in our CPS data. The wealth elasticity, the Frisch elasticity, investment adjustment costs, and the elasticity of capital utilization are calibrated according to the estimates in Schmitt-Grohé and Uribe (2012). Specifically, we set $\chi = 0.0001$ implying a near-zero wealth elasticity of labor supply. As a robustness check, we also discuss results for two alternative values of the wealth elasticity of labor supply, $\chi = 0.5$ and $\chi = 1$.

[16] $\Delta < 1$ and $\phi < 1$ would deliver the same result for $\widehat{n}_t^p - \widehat{n}_t^b$ but appears rather unreasonable empirically.

The parameter η, which is equal to the Frisch elasticity of labor supply if χ approaches zero, is set to 1/2. The parameter of the investment adjustment cost function is set to $\kappa_i = 9$ and the elasticity of capital utilization $\Delta = \delta_1/\delta_2$ is set to 3. Hence, in our calibration, the supply of capital services is more elastic than the supply of labor, $\Delta > \eta$, which is an important ingredient of our mechanism as explained before.

Total factor productivity z is chosen such that steady-state output is normalized to $y = 1$. Steady-state capital is set to $k = 4$ to obtain the standard capital output ratio. The quarterly capital depreciation rate, δ, is calibrated to imply a value for the discount factor equal to $\beta = 0.9927$, consistent with a sample mean of the annualized real interest rate of around 3 percent. This delivers $\delta = 0.022$. The share parameters γ and α are calibrated to generate a steady-state labor income share of 67% and a pink-collar to blue-collar wage ratio in the steady state of 0.86, consistent with its sample mean in our CPS data. This requires $\alpha = 0.51$ and $\gamma = 0.13$. We determine the elasticities of substitution between factors, ϕ and θ, to match two targets. First, we use our empirical evidence on the response of relative occupational wage rates following fiscal shocks. Our VAR suggests that, in the first year, relative pink-collar wages increase on average by 0.7%. Second, to discipline our analysis, we target an elasticity of substitution between capital services and aggregate labor of one, as in the canonical Cobb-Douglas case.[17] Our model matches these targets when we set the elasticities of substitution to $\phi = 2.8$ and $\theta = 0.32$. This calibration implies that capital services and blue-collar labor are rather close substitutes in production and that pink-collar labor and capital services are complements. To demonstrate how ϕ and θ affect our results, we also show impulse responses for the limiting case $\phi = 1$ where blue-collar labor and capital services are a Cobb-Douglas aggregate. In addition, we consider the case $\theta = 1$ where the composite input and pink-collar labor are a Cobb-Douglas aggregate. The price elasticity of demand is set to $\epsilon = 6$, which implies a steady-state markup of prices over marginal costs equal to 20%, a value commonly used in the literature. We parameterize the cost of price adjustment, ψ, so as to generate a slope of the Phillips curve consistent with a probability of adjusting prices in the Calvo model equal to 1/3, as estimated by Smets and Wouters (2007). This delivers $\psi \approx 30$ and

[17] We calculate the elasticity of substitution between capital and aggregate labor as the relative change of the capital to aggregate labor ratio to a one percent change in relative factor prices, i.e., a 0.5% increase in the rental rate of capital services, r^k, and a simultaneous 0.5% decrease in both wage rates, w^p and w^n.

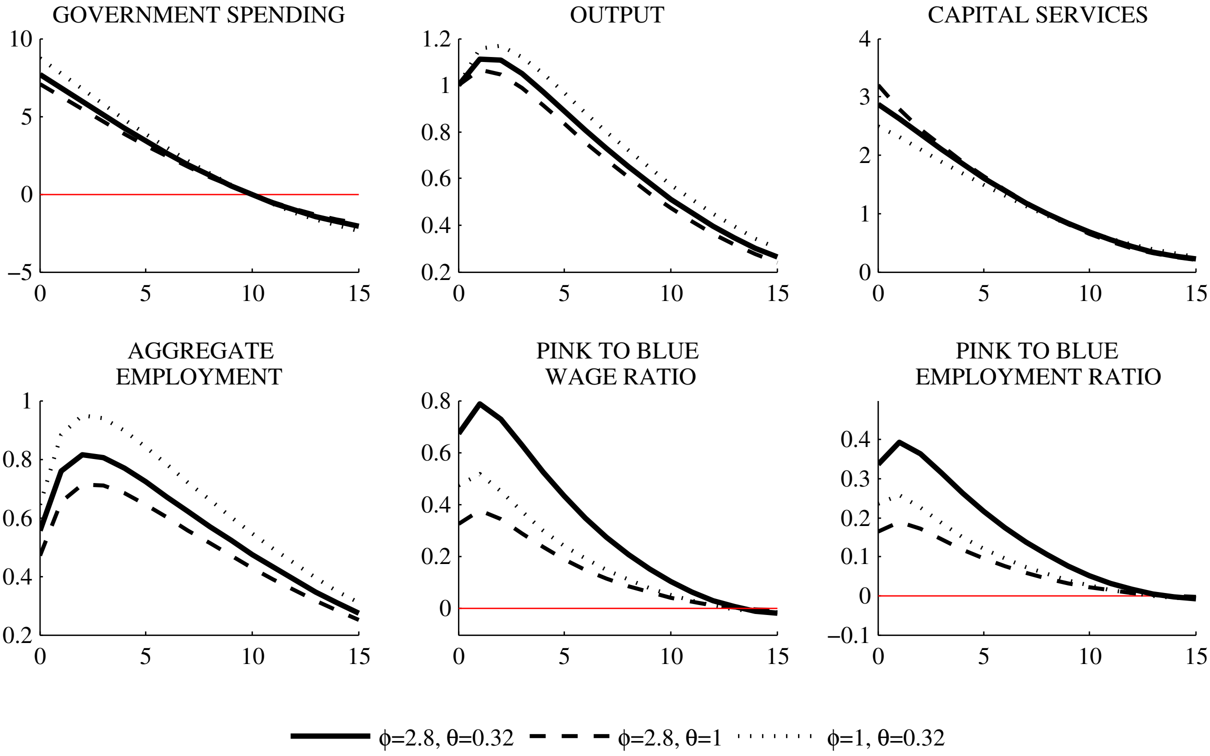
thus $\kappa \approx 0.17$. The parameter governing the size of labor adjustment costs, κ_n, is set to 1.85, as estimated by Dib (2003). The coefficients of the Taylor rule measuring the responsiveness of the interest rate to inflation and output, respectively, are set to $\delta_\pi = 1.5$ and $\delta_y = 0.5/4$, as proposed by Taylor (1993). We impose a zero net inflation steady state, that is $\pi = 1$. The steady-state tax rate, steady-state government spending, and the annualized steady-state debt to GDP ratio are set to $\tau = 0.28$, $g/y = 0.18$, and $b/(4y) = 0.63$, which are values calculated by Trabandt and Uhlig (2011). The responsiveness of government transfer to changes in government debt is calibrated to $\gamma_{sb} = 0.1$ to insure debt sustainability. The parameter γ_g, which captures the feedback effect of public debt on government spending, is set to 0.05. This implies a reaction of spending to debt that is slightly weaker than in Corsetti, Meier, and Müller (2012), consistent with our evidence of a more delayed spending reversal, i.e., a reduction in spending below trend during the course of adjustment after an exogenous increase in government spending. The autocorrelation of the exogenous processes is set to $\rho_j = 0.9$ for $j = a, g$. To facilitate the comparison to the empirical impulse responses, we normalize the size of the innovations so as to generate an impact change in output by one percent.

Using this calibration, the model generates responses of government spending g_t, output y_t, aggregate employment $n_t^p + n_t^b$, capital services $\widetilde{k}_t$, the pink-collar to blue-collar wage ratio w_t^p/w_t^b and the pink-collar to blue-collar employment ratio n_t^p/n_t^b to a government spending shock as summarized in Figure 6. Impulse responses are expressed in percentage deviations from steady state. We display the impulse responses for three different parameterizations of the elasticities of substitution in production: $\phi = 2.8$, $\theta = 0.32$ (the baseline calibration, solid lines), $\phi = 2.8$, $\theta = 1$ (dashed lines), and $\phi = 1$, $\theta = 0.32$ (dotted lines).[18]

The lower right panel of Figure 6 shows that fiscal expansions trigger a pink-collar job boom, i.e. employment in pink-collar occupations rises more strongly than employment in blue-collar occupations. This result is in line with both, the empirical evidence presented in Section 3 and the analytical results of the simplified model version. As discussed before, after fiscal expansions, firms raise their demand for capital services disproportionately due to a shift in relative factor prices in favor of capital use. This relative price movement is due to labor supply being less elastic than

[18]Shock sizes are re-scaled such as to generate a change in output by one percent for each parametrization of ϕ and θ.

Figure 6: Model-implied effects of government spending shocks.



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 spending innovation is normalized such that the response of output is one percent on impact.

the supply of capital services. The increased use of capital services reduces the marginal product of blue-collar labor relative to pink-collar labor. This, in turn, lowers the relative demand for blue-collar labor. As a result, fiscal expansions induce a positive co-movement of the pink-collar to blue-collar employment and wage ratio, in line with our empirical results. The higher the substitutability between capital services and blue-collar labor relative to the substitutability between capital services and pink-collar labor, captured by the ratio of ϕ and θ, the more pronounced is the pink-collar job boom.

4.4 Discussion

In this section, we first discuss how our results are affected by the parametrization of the wealth elasticity of labor supply χ. Then, we discuss how our explanation squares with the unconditional moments of employment by occupation that we observe in the data.

Wealth elasticity. After a government spending expansion, the associated wealth effect dampens the response of the pink-collar to blue-collar employment ratio, see Figure A11 in Appendix D.2

which compares our baseline results for $\chi \approx 0$ to the results for two alternative parameterizations, $\chi = 0.5$ and $\chi = 1$. The wealth effect leads to a rightward shift of the labor supply curve which tends to reduce wages. This, in isolation, tends to raise the costs of capital services relative to the costs of labor. This, in turns, tends to lower the relative demand for capital services and with it the demand for its complement, which is pink-collar labor. In sum, the wealth effect on labor supply works against a rise in the pink-collar to blue-collar employment ratio after government spending expansions. Importantly, though, the model generates a pink-collar employment boom even if we consider the limiting case $\chi = 1$, where the wealth effect is strongest.

Unconditional moments. The conditional relative occupational employment dynamics after government spending shocks differ markedly from the unconditional moments. We have shown that government spending expansions induce a rise in the pink-collar to blue-collar employment ratio. Thus, conditional on government spending shocks, pink-collar employment is more volatile than blue-collar employment. Blue-collar employment, though, exhibits a stronger unconditional volatility than pink-collar employment. Note that these patterns are not contradictive. First, we can look at other shocks than shocks to fiscal policy in our model and some of those other shocks induce employment dynamics favoring blue-collar occupations. Second, in the data, the unconditional fluctuations are arguably also affected by industry dynamics, which are absent in our model due to their limited importance in explaining patterns of occupational employment after fiscal shocks in the data.

To demonstrate the first point, we consider a favorable labor productivity shock in our model. In fact, this shock leads to stronger employment growth for blue-collar workers relative to pink-collar workers, making blue-collar employment conditionally more volatile than pink-collar employment, and thus induces diametrically opposite dynamics compared to the government spending shock. Figure A12 in Appendix D.2 shows the responses of output, total employment, and the pink-collar to blue-collar employment ratio to a labor productivity shock. The intuition for the disproportionate rise in blue-collar employment is as follows. As labor becomes more productive, firms raise their demand for capital services by less than their effective labor input. With relatively less capital services used, the marginal productivity of its substitute blue-collar labor increases relative to pink-collar labor. Hence, firms raise their demand for blue-collar labor relative to pink-collar labor. In Appendix D.2, we also show this result analytically in the simplified model version.

Note that this does not necessarily imply that all demand shocks trigger shifts towards service, sales, and office occupations and that the high unconditional volatility of blue-collar employment is only driven by supply shocks. Recall that we consider a representative-industry model in order to understand *occupation*-specific employment dynamics. By construction, we thus abstract from composition effects due to disproportionate changes of employment in cyclical industries that employ a disproportionate share of blue-collar workers (such as construction and manufacturing). Instead, we focus on occupational dynamics within industries that we have found to be empirically important (see Figure 5). Other demand shocks than our identified government spending shock may in fact trigger considerable between-industry dynamics and may thus lead to blue-collar employment booms through those industry effects. This seems plausible for shocks that lead, for instance, to disproportionate changes in the demand for investment goods such as investment-specific technology shocks. Hence, the unconditional moments in the data are potentially also driven by such demand shocks which trigger strong industry effects favoring blue-collar intensive industries. Thus, while we have shown that occupations are key for understanding the occupational employment effects of fiscal policy, industries may arguably be important to fully understand reactions to other shocks and the unconditional employment dynamics.

5 Implications

Our results have interesting implications for the discussion about the effects of economic policy on inequality. De Giorgi and Gambetti (2012) and Anderson, Inoue, and Rossi (2016) study the distributional consequences of government spending expansions, focusing on consumption rather than on labor-market outcomes. Their results show that fiscal policy raises foremost the consumption of poorer households. Anderson, Inoue, and Rossi (2016) point towards borrowing constraints as an explanation for these results. Our results imply a complementary role of relative labor-market outcomes since we document that employment and labor earnings shift in favor of pink-collar occupations, which are on average relatively low-pay.

Coibion, Gorodnichenko, Kueng, and Silvia (2012), Mumtaz and Theophilopoulou (2016), and Gornemann, Kuester, and Nakajima (2016), among others, study heterogenous effects of monetary policy. Coibion, Gorodnichenko, Kueng, and Silvia (2012) document that expansionary monetary policy reduces income inequality and propose an explanation based on labor earnings heterogeneity resulting from unequal income gains. Our paper shows that a similar development occurs after expansionary government spending shocks, which trigger an increase in relative labor income of low-pay pink-collar occupations.

Another interesting implication of our results arises from the fact that, in general, blue-collar occupations are most strongly affected by cyclical employment fluctuations (see, e.g., Hoynes, Miller, and Schaller 2012), i.e., blue-collar workers are hit hardest during recessions. We have shown that blue-collar workers benefit the least from employment growth induced by fiscal expansions. Thus, our results imply that countercyclical fiscal policy, that stabilizes aggregate employment in recessions, de-stabilizes the composition of employment.

An episode where we believe this is particularly relevant is the Great Recession and its aftermath. Blue-collar workers suffered most strongly from job losses in 2008 and 2009 because they are over-represented in industries where most jobs were cut. In 2008 and 2009, blue-collar employment fell by around 15 percent relative to its pre-crisis level, as compared to a 3 percent decline in aggregate employment. Afterwards, blue-collar workers benefitted the least from the (slow) job growth in the recovery. In 2009, the government responded to the recession by enacting the ARRA fiscal stimulus package. The purpose of the ARRA stimulus was, first, to 'preserve and create jobs and promote economic recovery' and, second, to 'assist those most impacted by the recession'. These were predominantly blue-collar workers. We are aware of the limits of applying our findings related to government spending shocks to the ARRA stimulus which also included changes in taxes and transfers and was conducted in exceptional times. With these caveats in mind, it is nevertheless worth noting that our results imply that part of the jobless recovery in blue-collar employment is due to blue-collar jobs being left out of the jobs created by the government spending expansion. In line with this, note that we find a smaller reaction of the pink-collar to blue-collar employment ratio when we exclude the post-2008 period compared to our baseline sample period which is at least indicative that the ARRA stimulus did have similar effects as those we document.

Another implication of our results relates to long-run trends in the employment and income distribution. There is a downward trend in the employment possibilities of blue-collar workers which is mostly attributed to technological developments and globalization (see, e.g., Acemoglu and Autor 2011 and Autor and Dorn 2013). This, in turn, is associated with a secular decline in relative income of blue-collar workers. Our results imply that the trend in relative employment possibilities is actually accelerated rather than attenuated by expansionary fiscal policy. Moreover, since labor earnings are the primary source of income for most households, the absence of employment gains in (medium-pay) blue-collar occupations tends to accelerate the trend in the income distribution away from blue-collar workers, thereby contributing to rising income polarization.[19] In fact, the decline in blue-collar employment appears to happen foremost in recessions (see Jaimovich and Siu 2012; Hershbein and Kahn 2016). Our results imply that expansionary fiscal policy in recessions contributes to this observation.

Note that our main results apply to the broad body of all government expenditures. This does, however, not imply that all fiscal-policy measures necessarily benefit pink-collar occupations as we have shown for the average spending expansion. It is plausible that specific measures directly targeted at industries employing high shares of blue-collar workers can induce industry-specific employment dynamics that may outweigh the occupational employment dynamics within industries such that, in total, blue-collar workers benefit disproportionately. In fact, our evidence regarding isolated innovations to government investment and government consumption, discussed in Section 3.1, supports this view. Both types of innovations lead to surges also in the other component of government spending but they affect the composition of government spending in markedly different ways. In response to innovations to government investment, government consumption rises less than proportionately such that the composition of government spending shifts towards investment goods which can broadly be understood as output of blue-collar intensive industries. In line with this view, we indeed find that these innovations induce occupational employment dynamics that are less strongly biased towards pink-collar workers. Hence, if policy makers want to promote employment possibilities for blue-collar workers, this may be achieved with infrastructure programs or measures targeting specific industries such as the "Cash for Clunkers" program. However, our

[19] According to our results, employment rises in sales and office occupations which are usually considered as middle-skill along with blue-collar occupations. However, employment rises most persistently in low-skill service occupations and not significantly in blue-collar occupations which play an important role in the public debate about the shrinking middle class. Further, also within the group of middle-skill occupations, workers in sales and office occupations earn less than those in blue-collar occupations. In our sample, the average weekly earnings, measured in 2005 dollars, are 496 and 578 in sales occupations and service occupations, respectively, while these numbers are 616, 661, 610, and 584 for construction, installation, production, and transport occupations, respectively.

results indicate that most government spending expansions in recent decades have not been of this type.

The emphasis of our analysis was on explaining occupation-specific employment dynamics. This focus was guided by the evidence pointing towards important differences in occupational employment dynamics within industries. We have empirically ruled out that differences in employment dynamics across occupations simply reflect differences in employment dynamics across industries. In fact, our proposed mechanism implies a different pattern: differences in employment dynamics across industries are – at least in part – a relabeling of differences in employment dynamics across occupations. To illustrate this, recall that different industries are characterized by different shares of blue-collar and pink-collar labor in total labor. As a consequence, the average degree of substitutability of capital with labor differs across industries. In industries where the share of pink-collar workers is relatively high, labor in total is a rather poor substitute to capital services. In contrast, in blue-collar intensive industries, labor in total is a rather close substitute to capital services. In the latter types of industries, firms can hence meet increased demand without raising labor input by much while this is not possible for firms in pink-collar intensive industries (for instance, because of the high degree of human interaction that characterizes many services in general). Put differently, our mechanism implies that industries employing many pink-collar workers experience disproportionate employment growth even if output grew in an exactly proportionate way across industries. Thus, at least part of differences in employment dynamics between industries is a consequence of occupation-specific factors. For example, Nekarda and Ramey (2011) document that the effects of government spending on labor input are weaker in industries where unionization rates are high. High unionization rates coincide with high shares of blue-collar workers such that these finding may actually reflect the importance of occupations.[20] Finally, our analysis also suggest that the aggregate effects of government spending shocks depend on the occupational composition of employment. According to our results, the aggregate employment response to a government spending shock is enforced by the share of employment in pink-collar occupations in total employment because, with a high share of pink-collar occupations, labor in total is a relatively poor substitute to capital services.

[20] In 2014 and 2015, among all major occupation groups, the unionization rates were highest in the four blue-collar major occupations and the major industries with the highest unionization rates in the private sector were transportation and utilities, construction, and manufacturing all of which employ blue-collar occupations disproportionately (source: BLS: Union affiliation of employed wage and salary workers by occupation and industry, 2014-2015 annual averages).

6 Conclusion

In this paper, we have documented pronounced occupational differences in the employment effects of government spending shocks. Fiscal expansions trigger a pink-collar job boom, i.e., a disproportionate increase in the employment of service, sales, and office occupations relative to aggregate employment. In contrast, we find no discernible employment changes for blue-collar occupations. Thus, government spending expansions induce a significant shift in the composition of employment away from employment in blue-collar occupations towards employment in pink-collar occupations. We have shown that occupation-specific shifts in labor demand are responsible for the heterogenous employment dynamics after government spending expansions. We have presented a business-cycle model that explains the heterogenous occupational employment dynamics as a consequence of occupational differences in the short-run substitutability between capital services and labor. In our model, fiscal expansions induce a rise in pink-collar employment relative to blue-collar employment, in line with what is found in the data.

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