Structural Transformation and the Efficacy of Monetary Policy*

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– work in progress –

Abstract

Has the structural transformation of the US economy reduced the capacity of the Federal Reserve to influence labor market activity? To answer this question, we construct a quarterly panel of industry employment shares at the core based statistical area (CBSA) level. By leveraging the longitudinal and geographical variation in our data, we estimate that employment in CBSAs with a higher share of workers in the service industry reacts less to changes in the stance of monetary policy. Specifically, we find that the response of total employment to a one percentage point unexpected increase in the policy interest rate is about two percentage points smaller in CBSAs with a high service share. The opposite is true for CBSAs with a high manufacturing share. Our findings are robust across a range of econometric controls and for different levels of geographic aggregation. They indicate that the transformation of the US towards a service oriented economy has reduced the capacity of the Federal Reserve to influence the trajectory of total employment.

Keywords: Monetary Policy, Employment, Service Industry, Regional Heterogeneity

JEL Classification: E5, E24, L8, R11

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1 Introduction

The capacity of US monetary policy makers to boost or reduce employment has been declining over the past decades. One explanation for this decline is the structural transformation of the economy which manifests in a growing share of employment in new industries such as services while the share of old industries such as manufacturing is declining.

Firms in the service industry tend to have lower capital-employment ratios and demand for services is less sensitive to interest rates than demand for manufactured goods. Hence, employment decisions of service firms depend less on financial conditions which are determined by policy interest rates. Moreover, due to different degrees of worker unionization, markups and market concentration, these two industries also differ with respect to nominal rigidities which leads to distinct employment responses to monetary policy interventions.[1]

Having the capacity to influence employment is a key prerequisite for the Federal Reserve to achieve one of its dual mandate objectives. However, estimating the effect of structural transformation on monetary policy efficacy remains a scientific challenge; measures like the rise of the service share illustrate that structural transformation is a slow moving process which is accompanied by a host of confounding factors reducing the efficacy of monetary policy.

For instance, financial innovation, the integration of global capital markets and the growing presence of foreign lenders have made it easier for American firms and households to borrow abroad. This development has helped to reduce the transmission of policy rate changes to domestic financial conditions. At the same time, the share of imported goods and services has grown substantially during the last decades and the emergence of multinational corporations has further decoupled the demand for US workers from domestic interest rates.

In this paper, we estimate the effect of structural transformation on monetary policy efficacy by leveraging both longitudinal and regional variation in the number of workers employed by different industries. Our approach exploits that different geographic units in the US are exposed to the same changes of monetary policy and the same set of non-industry related determinants of monetary policy efficacy. Yet, they differ substantially in the levels of industry employment shares as well as in their evolution over time.

[1] For example, Klenow and Kryvtsov (2008) and Nakamura and Steinsson (2008) document that prices of manufactured goods are about three to four times as sticky than those of services.

Specifically, we construct a quarterly panel dataset with industry employment shares at the core based statistical area (CBSA) level and use local projections to estimate differences in employment responses to monetary policy shocks. We focus on CBSAs as they represent suitable proxies for local labor markets, allowing us to maximize the number of observations included in our analysis while focusing on a relevant level of economic disaggregation.

We restrict our analysis to years between 1977 to 2000 for several reasons; first, monetary policy was not restricted by the zero lower bound during this period. Second, the absence of forward guidance in the Federal Reserve's communication allowed for genuine monetary policy surprises. Third, these years provide us with time consistent industry classifications.[2]

We find that after a one percentage point unexpected increase in the policy interest rate employment decreases by 2 percentage points more in CBSAs with low service shares than in those with high service shares. The opposite is true for CBSAs with high manufacturing shares. Hence, as we think of structural transformation as manifesting in a growing service and declining manufacturing share, this finding quantifies the extent to which structural transformation has reduced the capacity of the Federal Reserve to influence total employment.

In our analysis, we control for differences in average per capita incomes at the CBSA level. To rule out the possibility that regional differences in labor force characteristics, such as education, age, race or gender determine the response of labor market activity to monetary policy shocks, we repeat our estimations at the state level. At this geographic aggregation, detailed information on labor force characteristics is available. Compared to the baseline estimation, we lose some cross-sectional variation and a large number of observations. Still, our CBSA and state level results are similar which indicates that labor force characteristics are of secondary order importance relative to industry composition.

Our paper contributes to a growing field of research which exploits geographic heterogeneity to study determinants of the transmission and effects of monetary policy. Two prominent examples are Beraja, Fuster, Hurst, and Vavra (2018) and Hazell, Herreno, Nakamura, and Steinsson (2022) who study how spatial differences in housing equity and prices determine the regional response of consumption spending and unemployment to monetary policy shocks. Another paper close to ours is Herreno and Pedemonte (2022) who show that, at the level of US cities, average incomes

[2] Fort and Klimek (2018) illustrate that changes in industry classification, especially during the SIC-NAICS transition in the late 1990s, confound measures of the US industry composition, in particular with respect to the service industry.

are an important predictor of the local employment and inflation responses to monetary policy shocks.

Our paper also relates to research on the consequences of the rise in service industry employment. Most of the papers in this field of research focus on pertinent implications for economic growth, the skill premium, markups or home production. To the best of our knowledge, there are currently only two papers investigating its consequences on the overall efficacy of monetary policy and its optimal conduct. Using a two-sector model, Kreamer (2022) argues that optimal monetary policy should account for the interest rate elasticity of different sectors and use forward guidance to reduce sectoral fluctuations. Galesi and Rachedi (2018) is particularly close to our paper as they study the effect of the rising service share and monetary policy efficacy. However, unlike us, they focus on its effect on inflation while we study its effect on employment. Also, their estimation uses country data and sign restricted VARs while ours uses regional heterogeneity within one country and identified monetary policy shocks.

The remainder of this paper is organized as follows. In section 2, we present two stylized facts on the evolution of the service and manufacturing industry in our years of interest and provide summary statistics of our CBSA level dataset. Section 3 presents our estimation methodology and discusses our results while section 5 concludes our paper.

2 Data

2.1 Time and Spatial Variation in the Structural Transformation of the US Economy

We begin our analysis by presenting two stylized facts on the longitudinal and regional structural transformation of the US economy by focusing on the service and manufacturing industry as a measure for this transformation.

Fact 1: As shown by the left panel of figure 1, the share of service workers has increased from about 16% in 1969 to about 28% in 1997 at the US aggregate level. During the same time period, the employment share of manufacturing has fallen from about 33% to 16%. The right panel illustrates that these differential trajectories corresponded to an expansion of employment in the service sector by about 22 million workers while employment in manufacturing was close to stagnant.

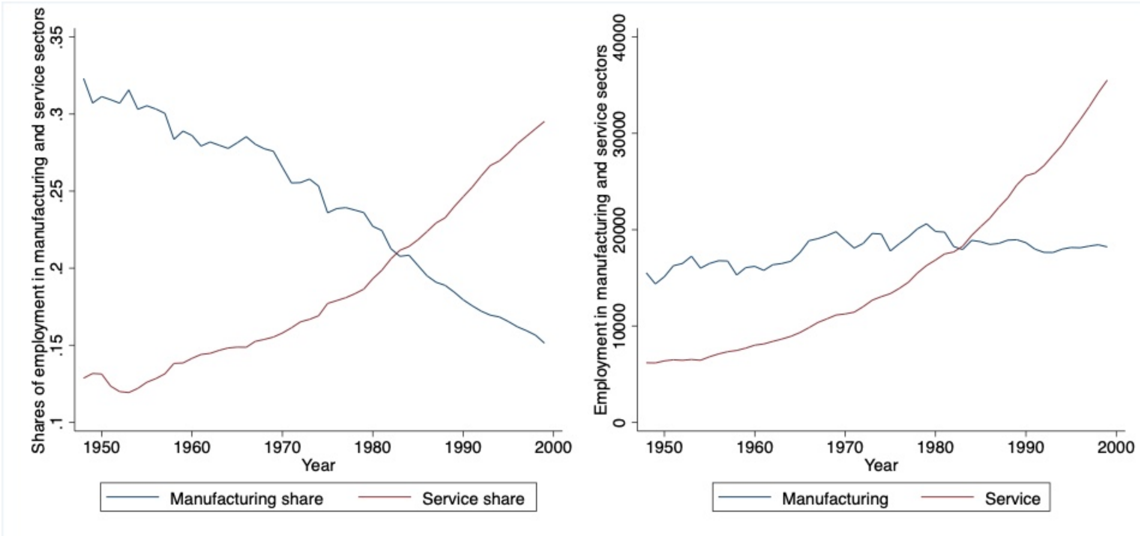

Figure 1: *Manufacturing and service employment growth between 1969 and 1997; left: employment shares; right: employment numbers. Computed from BEA data using SIC industry classifications.*

Fact 2: Neither the service nor the manufacturing employment share have uniformly increased in all US counties between 1977 and 2000. However, as the two panels of figure 2 show, those industries have seen substantial geographic variation in the evolution of their employment shares with counties in the southwest and the Eastern heartland losing most in manufacturing shares and counties in the Western US gaining most in service shares.

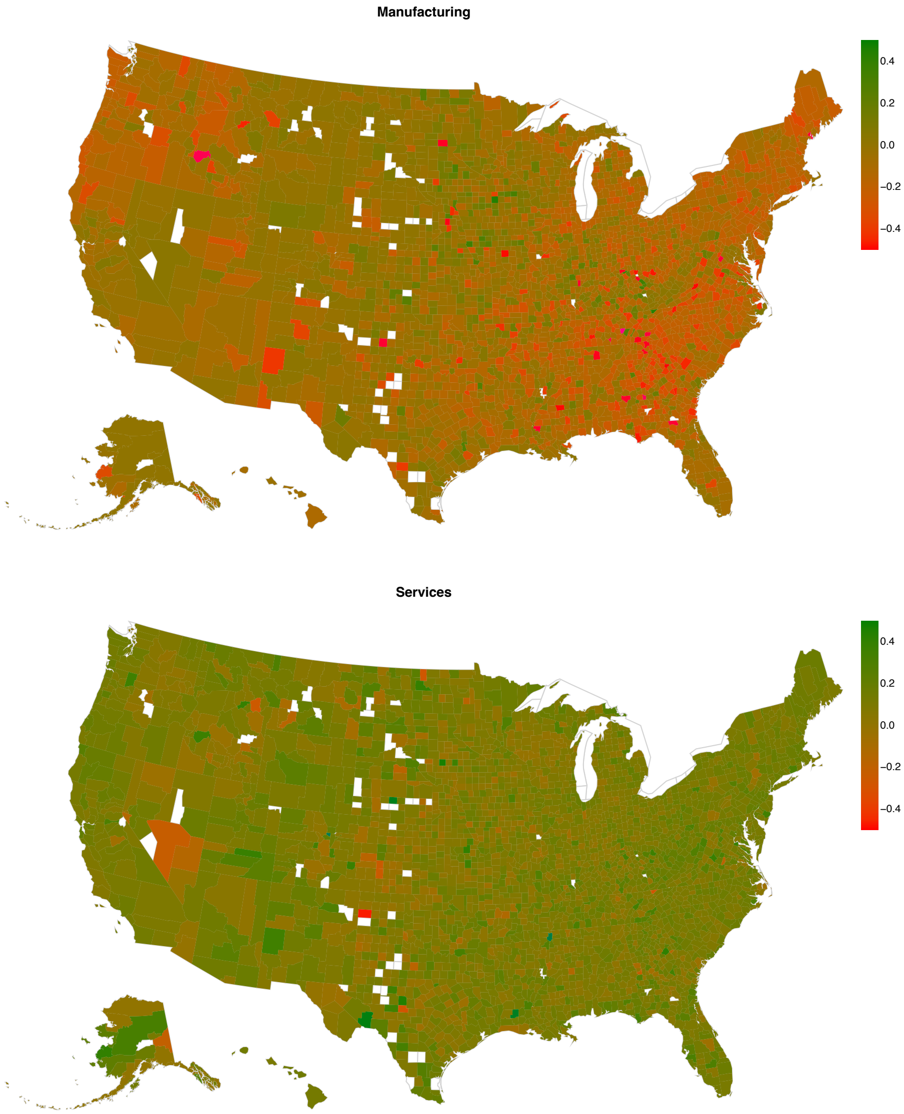

Figure 2: *Change in manufacturing and service employment shares between 1977 and 2000; computed from QCEW county level data using SIC industry classifications.*

Furthermore, the top panel of figure 3 further illustrates that, while the average service share increased by about 10% and the average manufacturing share fell by about 10% during this period, some counties have seen much stronger than average changes. Indeed, some counties increased their service share by up to 80% while others saw their manufacturing share decrease by about 90%.

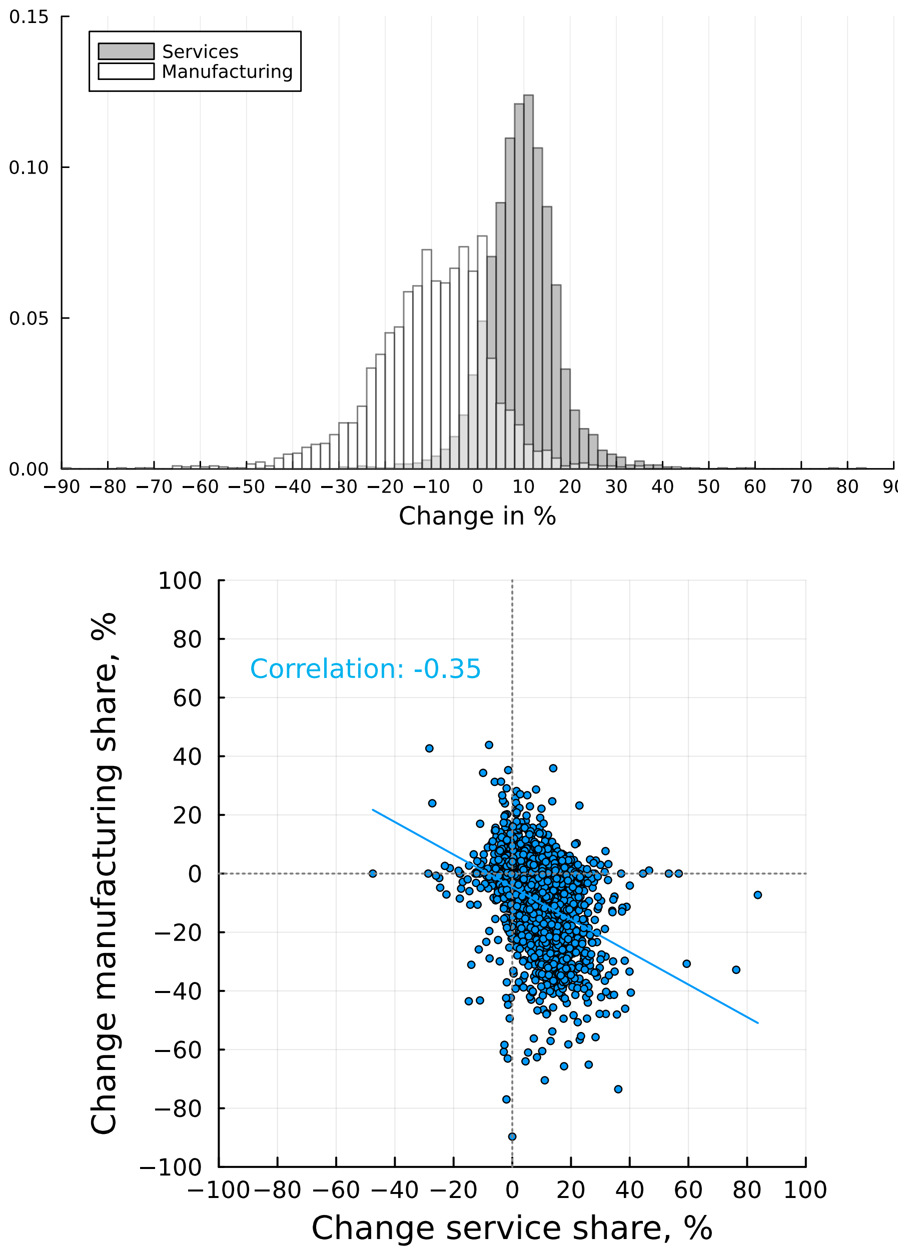

Figure 3: *Change in manufacturing and service employment shares between 1977 and 2000; computed from QCEW county level data using SIC industry classifications.*

Finally, the bottom panel of this figure shows that, while those changes tend to move in tandem, they are far from being perfectly correlated. In other words, a decline in a county's manufacturing share does not mechanically lead to an increase in its service share.[3]

[3]This observation addresses the potential concern that these employment shares are colinear which would make them unsuitable measures for the econometric analysis we conduct in this paper.

2.2 CBSA Industry Employment Shares

While the previous section focused on the county as a regional unit, we conduct our baseline estimation at the level of Core Based Statistical Areas (CBSA). We choose this regional unit for several reasons. First, CBSAs consist of counties which tile the US. Hence, our dataset captures the entirety of the American economy, the labor market in particular.

Second, as our interest is to understand how the change in the shares of the service and manufacturing employment industries determine the efficacy of monetary policy, we require geographic units which represent local labor markets. CBSAs are ideal representations as they contain areas which are closely integrated, in particular with respect to commuting ties, i.e. share a common demand and supply of labor.

Finally, while the Bureau of Labor Statistics (BLS) does not publish CBSA level data in its Quarterly Census of Employment and Wages (QCEW), we can easily construct them from the provided county level information by aggregating the counties contained within each CBSA.

Our dataset Table 1 shows summary statistics of the main variables of interest in our dataset.

	Observations	Mean	Std dev	Min	Max
Service share	82,613	.22142	.0795903	0	.8044389
Manufacturing share	82,613	.27785	.1516396	0	.8100514
Total Employment	83,864	166245.1	665370	0	1.04e+08
Change in Employment	82,613	.0068799	.0630647	-2.237226	4.286279
Population	83,864	234408.2	665370	0	1.31e+07

Table 1: *CBSA data used in our baseline estimation. Not seasonally adjusted. Source: QCEW.*

The number of observations reflects the number of CBSAs times each quarter for which data are available for a given CBSA. The primary explanatory variables in our analysis are employment shares in the manufacturing and service industries while the main outcome variable is the change in total employment. We use the standard deviations and means shown in the table to standardize explanatory variables in our analysis.

As we are interested to estimate how structural transformation affects the efficacy of monetary policy on aggregate employment, we use population weights in our estimation. This approach ensures that the highly populated CBSAs have a stronger role in determining our estimated parameters.

Applying population weights also helps to address the issue that, due to the disclosure protection scheme of the BLS, both employment and population sometimes equal zero (as shown in table 1) in the smaller CBSAs. In addition to using population weights, we apply provide several techniques to deal with these zeros. First, we interpolate population and total employment using adjacent values. Second, if there are still zeroes in the sample, we delete such observations from the main estimation. Finally, we trim the top and bottom 0.5% values of the change in employment variable to take into account extreme outliers (for example, increases of 428 %). Trimming these outliers, however, does not change our main results.

	Service share	Manufacturing share	Change in Employment
Service share			
Manufacturing share	-0.6459		
Change in Employment	0.0236	-0.0095	
Population	0.2726	-0.1299	0.0008

Table 2: *Correlations among the key variables of interest in our sample.*

To conclude the description of our dataset, table 2 provides correlations between the main variables of interest. In particular, the table shows that our two main regressors are negatively and strongly correlated, with a correlation coefficient of -0.6459.

The table also shows that population and service share are positively correlated while the opposite is true for population and the manufacturing share. Yet, both of these correlations are small in magnitude, indicating that using population weights does not over-represent counties with higher service shares.

2.3 Monetary Policy Shock Series

Our baseline estimation uses the monetary policy shock series provided by Coibion, Gorodnichenko, Kueng, and Silvia (2017) who extended the narrative shocks measured by Romer and Romer (2004) to more recent years. We construct a quarterly series, ε_t^{MP}, from these high-frequency monetary policy shocks by summing up all shocks within any quarter t. Figure 4 presents the resulting monetary policy shock series, measured in interest rate basis points.[4]

[4] As is common in the literature, we set the extreme realization in the second quarter of 1980 to zero in our baseline estimations to avoid contaminating our findings by this outlier.

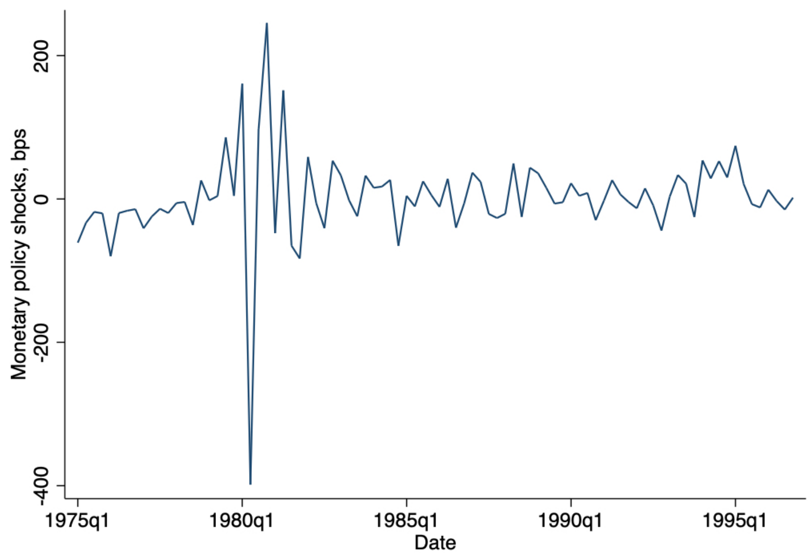

Figure 4: *Quarterly monetary policy shocks series*

3 Estimation and Results

3.1 Monetary Policy and Aggregate (Average) Total and Industry Employment

Before beginning our analysis at the CBSA level, we estimate the response of US aggregate and average total employment as well as industry employment to our baseline monetary policy shocks. Specifically, we estimate local projections a la Jordà (2005) using the following specification:

$$y_{t+h,t} = log(y_{t+h}) - log(y_{t-1}) = \alpha^h + \nu_q^h + \sum_{j=0}^{12} \beta^{h,j} e_{t-j}^{MP} + \sum_{j=1}^{2} \phi^{h,j} y_{t-j} + \gamma^h X_{t-1} + \varepsilon_t \qquad (1)$$

where y_t is the outcome variable at time t and we choose an estimation horizon of $h = 0, ..., 20$ as our employment data are quarterly. α^h is an estimation horizon specific intercept, ν_q is a quarter fixed effect, e_{t-j}^{MP} is the monetary policy shock series (where we use shocks at quarter t and add lags j to capture lagged effects) and y_{t-j} are lags in the change of the outcome variable. Finally, X_t denotes a vector of controls which include lagged changes in GDP, the inflation rate (as measured by changes in the CPI) and the unemployment rate. Standard errors are Newey-West which take into account serial correlation. We use three lags. In this specification, the estimated coefficients β^h captures the average effect of monetary policy shocks e_{t-j}^{MP} on the outcome variable y_t.

To estimate the average effect at the CBSA level, we modify equation (1) as follows:

$$y_{t+h,t,i} = \alpha_i^h + \nu_q^h + \sum_{j=0}^{12} \beta^{h,j} e_{t-j}^{MP} + \sum_{j=1}^{2} \phi^{h,j} y_{t-j,i} + \gamma^h X_{t-1} + \varepsilon_{t,i} \tag{2}$$

where $y_{t+h,t,i}$ is employment in different industries in CBSA i. α_i^h is a CBSA fixed effect. In X we retain the same aggregate controls as before.

As shown in Figure 5, we find that aggregate and average total employment decline in response to a contractionary monetary policy shock and recover after about four years. More specifically, our estimation finds that an unexpected increase in the policy interest rate by one percentage point decreases employment by about 1.5-2%. The effect is largest after about three years following the shock.

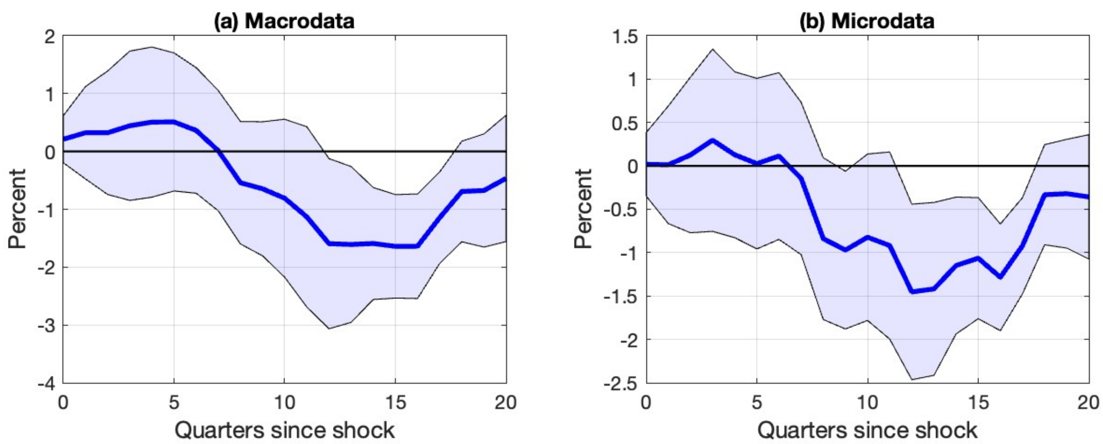

Figure 5: *Aggregate and population weighted average effect of a contractionary monetary policy shock on cumulative change in total employment. Left (a): US aggregate. Right (b): CBSA level. Impulse responses at quarterly frequency on time series and panel data respectively, based on the local projection specification shown in (1) and (2). Shaded areas show 95 percent confidence intervals constructed using Newey and West (1987) and Driscoll and Kraay (1998) standard errors, for a) and b), respectively.*

Next, we investigate industry employment responses and estimate equation (1) using aggregate industry employment as outcome variables, focusing on industries which employ at least 5% of the total labor force. We present our findings in figure 6. We find that a contractionary monetary policy shock decreases employment across all industries, and, consistent with our earlier results, the trough is reached after about three years following the shock. Moreover, we find that, out of all SIC industry classifications, service employment is one of the least responsive; it declines by a maximum of about 1% while employment in the manufacturing industry declines by 3-4 % and employment in the construction industry by 5%.

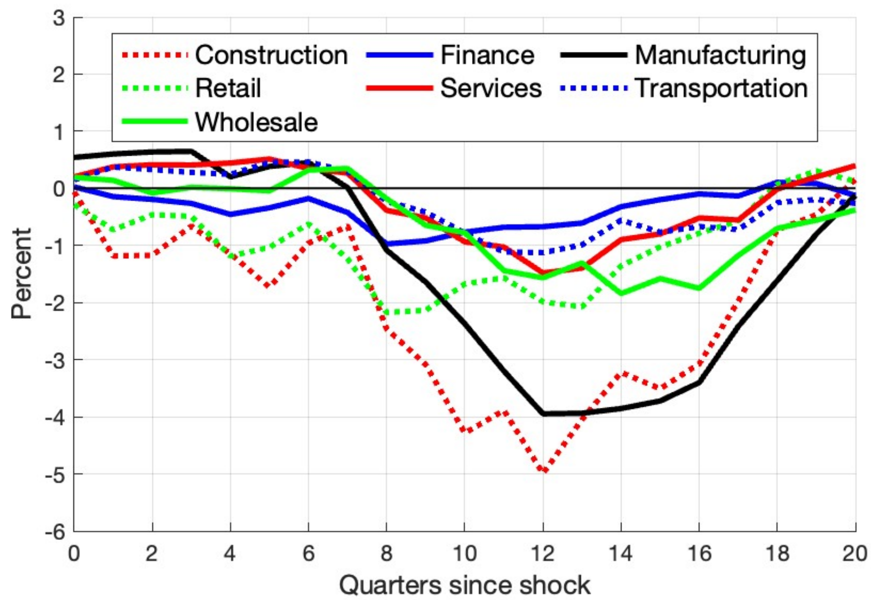

Figure 6: *Population weighted average effect of a contractionary monetary policy shock on cumulative change in total employment across different industries at the US aggregate level. Estimation is implemented on aggregate data separately for each industry and based on the local projection specification shown in (1).*

We now use the CBSA level panel data to estimate (2) separately for each industry. Our results, presented in figure 7, are consistent with the aggregate level results shown in figure 6. Again, employment in services is one of the least affected with a decline of about 1% while employment in construction is the most affected with a decline of about 5%. Also, the trough is again reached about three years following the shock.

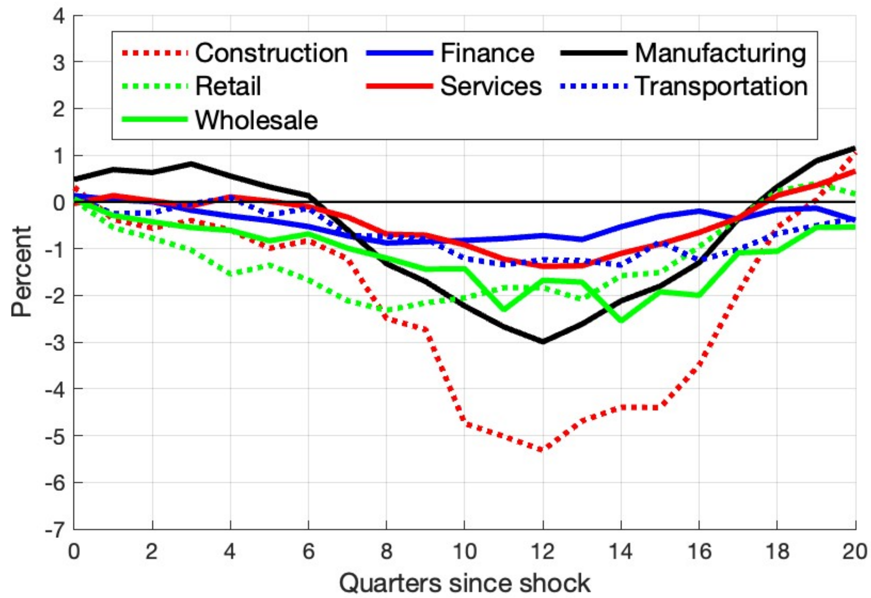

Figure 7: *Population weighted average effect of a contractionary monetary policy shock on cumulative change in total employment across different industries at the CBSA level. Estimation is provided on panel data separately for each industry and based on the local projection specification shown in (2).*

3.2 Monetary Policy Efficacy with Heterogeneous Service and Manufacturing Shares

Our main research objective is to estimate the role of the service and manufacturing industry share in determining the efficacy of monetary policy. Hence, we now use our CBSA panel dataset to investigate the role of industry employment share differences in determining the response of total employment to a monetary policy shock.

Specifically, we calculate percentiles of the CBSA level service employment shares, Z_i, and generate dummy variables for each percentile, $\mathbb{1}[Z_{t-1,i} \in g]$, as well as an interaction between dummy variables and monetary policy shocks. Hence, our coefficient of interest is $\beta^{h,g}$, i.e. the interaction between the service employment shares and the monetary policy shocks.[5]

$$y_{t+h,t,i} = \alpha_i^h + \eta_{qt}^h + \sum_{j=1}^{G} \beta^{h,g} \mathbb{1}[Z_{t-1,i} \in g] \, e_t^{MP} + \sum_{j=1}^{G} \theta^{h,g} \mathbb{1}[Z_{t-1,i} \in g] + \phi^h y_{t-1,i} + \gamma^h X_{t-1,i} + \varepsilon_{t,i} \quad (3)$$

η_{qt}^h is a time fixed effect, and $X_{t-1,i}$ includes such covariates as CBSA level income per capita and shares of industry employment in industries other than services or manufacturing.

[5]This specification is similar to Herreno and Pedemonte (2022), Cloyne, Ferreira, Froemel, and Surico (2018) and Holm, Paul, and Tischbirek (2021).

To provide a comprehensive description of the statistical differences between our estimates of $\beta^{h,g}$, we show the results of estimating the difference in means between the 10th and 90th percentiles of the service and manufacturing share distribution in figure 8. In this estimation, we also include time fixed effects in (3) to account for aggregate changes in the economy. We find that CBSAs which have lower service shares (higher manufacturing share) are more affected by monetary policy as employment in these CBSAs decreases by about 1.5 (2) percentage points more, as shown by the results in figure 8. Moreover, the difference we estimate is statistically significant at the 5 % level.

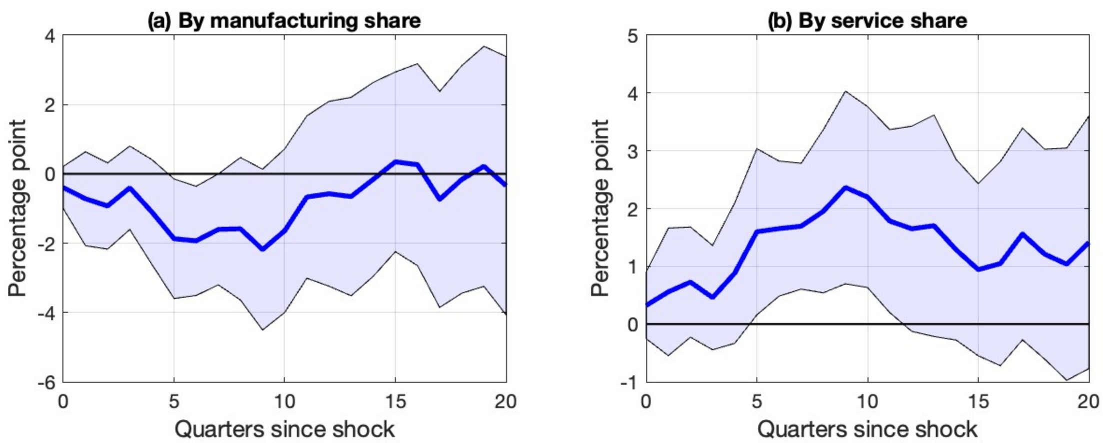

Figure 8: *Manufacturing and service employment share: 10th vs 90th percentile. Difference in population weighted means: Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3). Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.*

3.3 Do CBSAs with high manufacturing shares decrease service or total (excluding manufacturing) employment by more than CBSAs with high service shares?

In this section, we show that the effect of monetary policy on employment stems not only from manufacturing employment in the CBSAs that have high share of manufacturing employees. Rather, such CBSAs also decrease their employment in sectors other than manufacturing by more. We arrive at this finding by conducting a similar analysis as in the previous section but our dependent variable is now total employment minus employment in manufacturing.

As shown by figure 9, CBSAs that have high shares of manufacturing decrease their total employment by more than CBSA that have high share of services. This results is mainly driven by employment changes in the service industry in CBSAs having high shares of manufacturing.

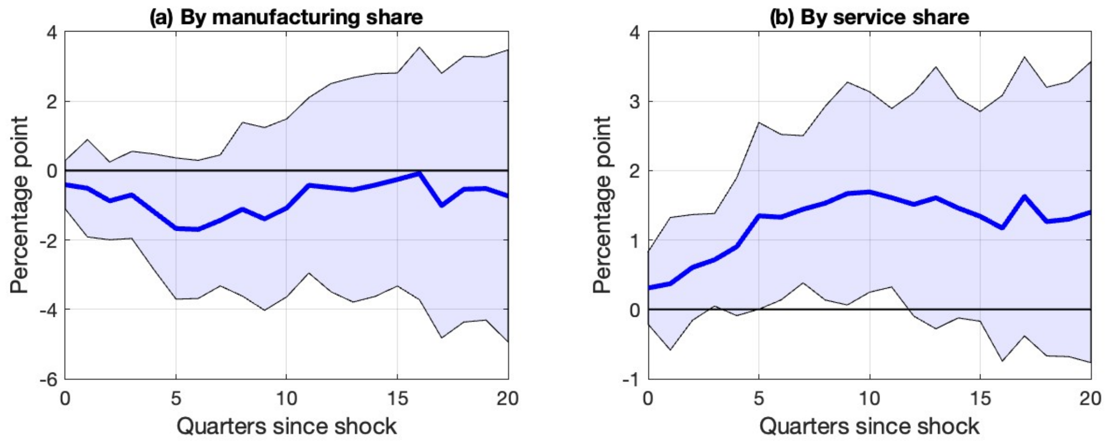

Figure 9: *Manufacturing and service employment share: 10th vs 90th percentile. Difference in population weighted means: Impulse responses of cumulative change in (total - manufacturing) employees to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3). Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.*

A plausible explanation for this finding is a spillover effect; as employees in manufacturing lose their jobs, they demand fewer services provided by service workers. As services are generally non-tradeable, this effect exacerbates the reduction in total employment in the local labor market.

4 Robustness

In this section, we summarize the findings of several robustness exercises. Details and full results of these exercises are presented in section 6, the appendix.

By how much has the efficacy of monetary policy declined in the past decades? Appendix 6.1 investigates the degree by which monetary policy has become less effective. We conduct this investigation using data on aggregate employment at quarterly frequency, obtained from the FRED databse. We subdivide our dataset into two samples, before and after 1990. Figure 11 shows that the effect of monetary policy was stronger before 1990 than after 1990.

This results could also be caused by differences in the identified monetary policy shocks before and after 1990. Figure 10 shows that shocks before 1990 were more volatile. An addition, after 1994, when FOMC minutes started to become publicly available, the Romer-Romer shock series might be more predictable. To account for the difference in volatility of the shocks, we run a regression using Market based shocks for the period of 1990-2007. The results are displayed in figure 13. They show larger coefficients for the period of 1990-2007. However, the coefficients are still smaller than for the period of 1968-1990 for which we used the Romer-Romer shocks. Note that while there is a statistically significant difference in the effect of monetary policy for the samples using Romer-Romer shocks, this difference is not due to the Volcker disinflation, but for the period preceding disinflation, 1968-1980.

Does using narrative monetary policy shocks (Romer-Romer) change our main results? Appendix 6.2 investigates the effect of monetary policy on aggregate employment for different industries during the period of interest 1970-1997 using Romer-Romer shocks and data at yearly frequency. Figure 14 shows the aggregate employment response at yearly frequency to a contractionary monetary policy shock. The figure shows that increasing the interest rate by 1 percentage point decreases employment by about 2.5%. Figure 15 shows impulse responses to the 1 percentage point contractionary monetary policy shock for different sectors. The figure shows that construction, finance and real estate, and manufacturing are the most affected. In particular, employment in the construction, finance and real estate and manufacturing industry decreases by about 3%, while employment in the service industry decreases only by about 1.2% and is the least affected.

How does employment in different sectors within service and manufacturing respond to monetary policy shocks? Figure 16 shows impulse response functions for employment in durable vs. non-durable manufactured goods production. Employment in durable good production is more responsive to the monetary policy shocks by about 1 percentage point. Figure 17 shows impulse responses by sectors within durable and non-durable goods industries and figure 18 shows impulse responses by sectors within the service industry. These figures document that, while the service industry is less affected by monetary policy on average, there is a heterogeneity to the monetary policy shocks within industries. In particular, within the service industry, such sectors as education, business services, and motion pictures are the least affected by monetary policy, while such sectors as auto-repair, legal, and miscellaneous are the most affected.

Does controlling for labor force characteristics change our main results? For the years from 1977 onwards, the ASEC dataset provides representative person level information for each US state. From this dataset, we construct measures for each state's labor force characteristics, such as shares of different age and education groups, as well as the racial breakdown. We merge these measures with our main dataset by aggregating the CBSA level to the state level. Appendix 6.3 contains the results we produce using the state level data.

Appendix 6.3.1 shows the results of estimating the effect of monetary policy on total employment at the state level for the yearly frequency. Figure 19 displays the population weighted average effect of a contractionary monetary policy shock. It implies that a 1 percentage point unexpected increase in the interest rate decreases employment by about 2.6%. Figure 20 shows the importance of manufacturing and service shares for transmission of the monetary policy after controlling for income, race, and education as additional state level characteristics.

For different manufacturing shares (left panel), the figure shows that a one percentage point increase in the interest rate decreases employment in the states that are within the 90th percentile of the manufacturing share distribution by about 3 percentage points more than in states that are within the 10th percentile of this distribution. Notably, the income, race, and education measures of each state's labor force are being held constant during this estimation. The right panel of the figure shows the importance of the service share for monetary policy transmission. In particular, the panel implies that a one percentage point increase in the interest rate decreases employment in the states that are within the 90th percentile of the service share distribution by about 2 percentage points less than states that are within the 10th percentile of this distribution, again keeping income, race, and education constant. All of these results are economically and statistically significant.

Finally, figure 21 repeats our estimates of the spillover effect discussed in section 3.3, this time using state level data which allow us to control for difference in labor force characteristics. As the figure shows, we obtain estimates which are similar to the onces we produced at the CBSA level.

Appendix 6.3.2 repeats the robustness estimations at the state level but uses quarterly instead of annual frequency data. The results are very similar to those obtained at annual frequency.

Does using counties instead of CBSAs change our findings? Appendix 6.4 shows the results of implementing our baseline estimations using county level data instead of aggregating it into CBSAs. Figure 28 shows average (panel a) and population weighted average (panel b) estimates of the effect of monetary policy on employment growth. Both the average and population weighted average effect is similar to our previous estimates and implies that one percentage point unexpected increase in policy interest rates decreases total employment within the county by about 2%.

5 Conclusion

Does the structural transformation of the US economy limit the capacity of the Federal Reserve to stimulate or dampen labor market activity and influence total employment? In this paper, we answer this question using longitudinal and geographical variation in the employment shares of different industries, the service and manufacturing industries in particular. For the time period from 1975 to 2000, we find that employment in CBSAs with a larger share of workers in the service industry reacts least to monetary policy shocks. The effect difference between CBSAs with low and high shares is about 2%. We find the opposite for CBSAs with high manufacturing shares. Our findings are robust across a range of econometric controls and specifications as well as at different levels of geographic aggregation. They show that the transformation of the US towards a service oriented economy decreases the capacity of the Federal Reserve to influence the trajectory of employment.

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6 Appendix

6.1 Has the efficacy of monetary policy declined over time?

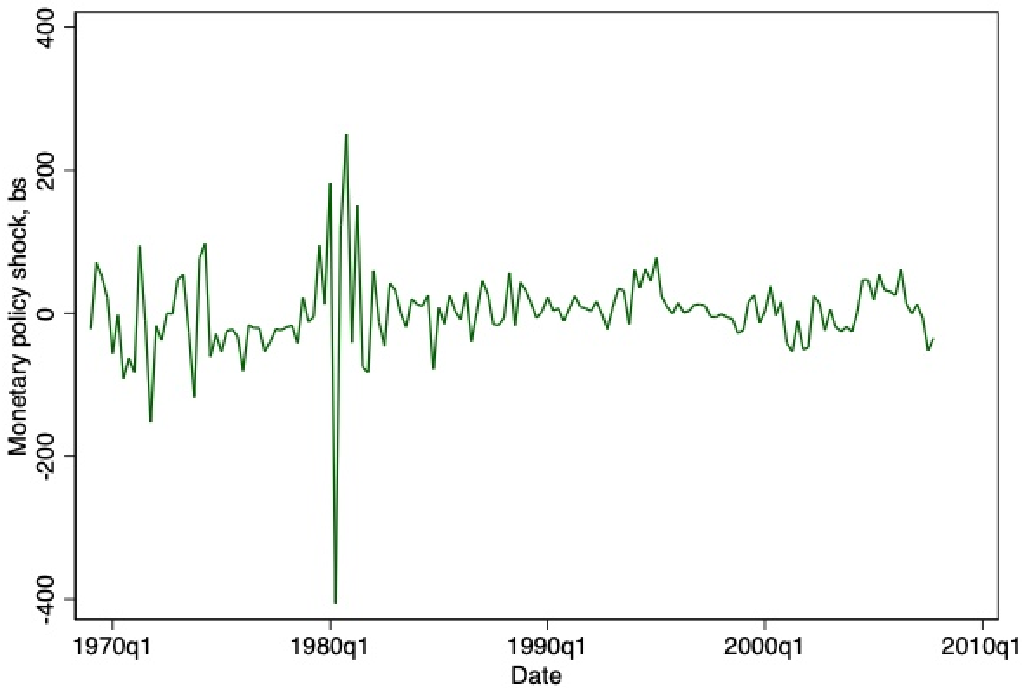

Figure 10: Updated Romer-Romer monetary policy shocks

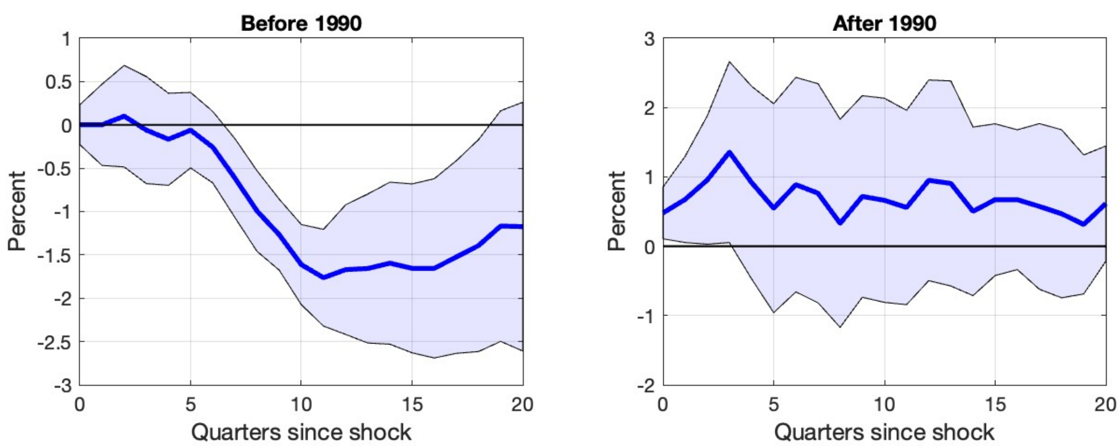

Figure 11: Employment impulse responses to a contractionary monetary policy shock at yearly frequency, based on the local projection specification shown in (1). Shaded areas show 95 percent confidence intervals constructed using Newey and West (1987) standard errors.

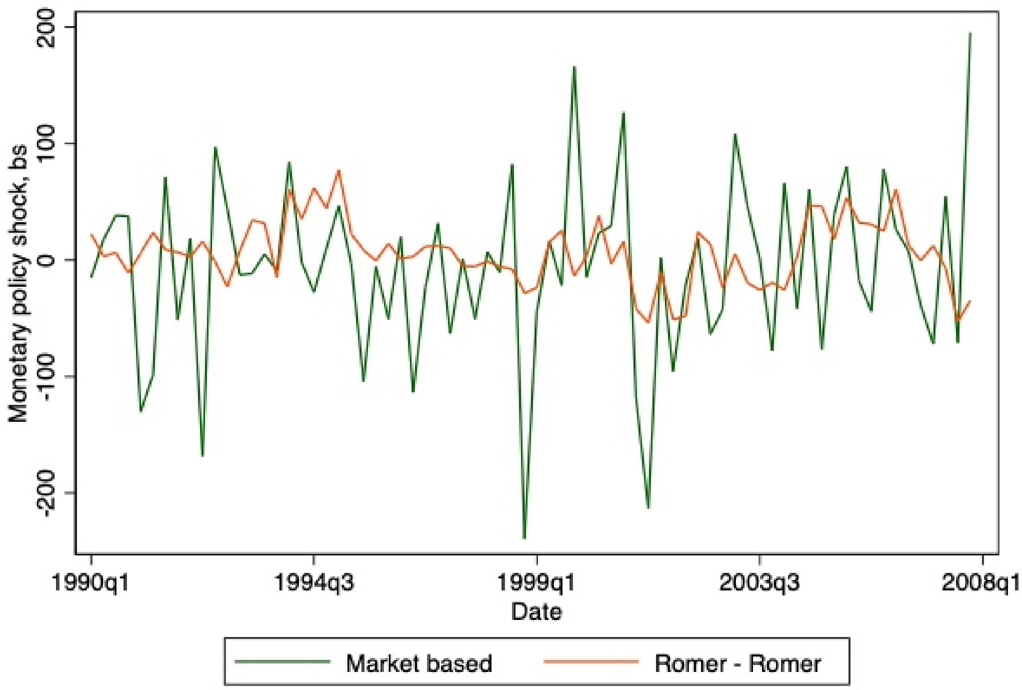

Figure 12: Market based vs Romer-Romer shocks

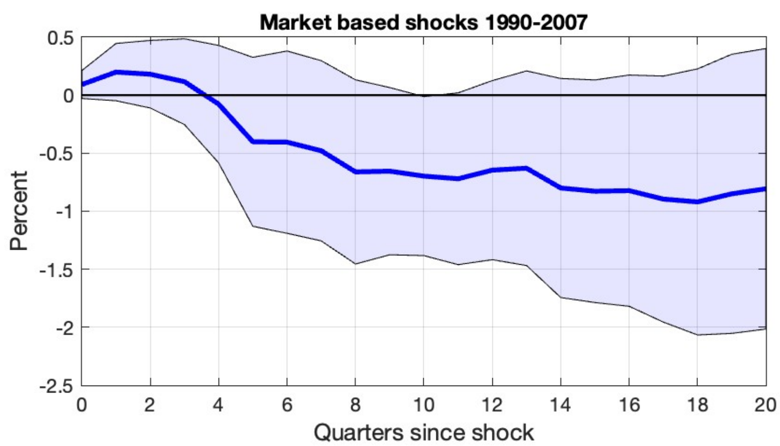

Figure 13: Employment impulse responses to a contractionary monetary policy shock at yearly frequency, based on the local projection specification shown in (1). Shaded areas show 95 percent confidence intervals constructed using Newey and West (1987) standard errors.

6.2 Using Romer-Romer shocks and annual aggregate data

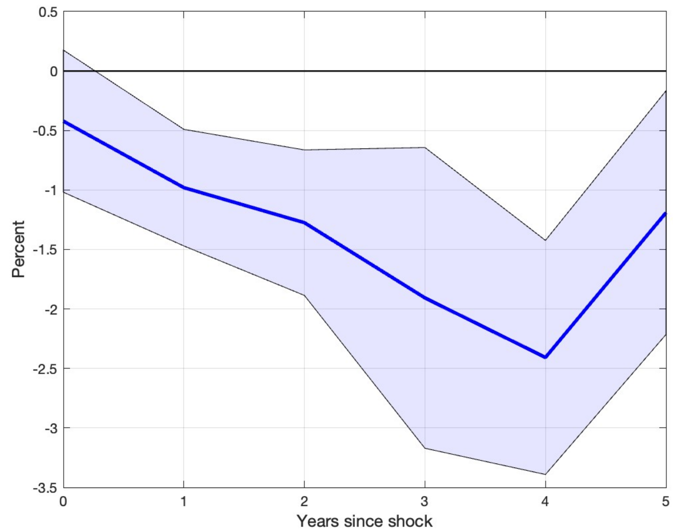

Figure 14: Employment impulse responses to a contractionary monetary policy shock at yearly frequency, based on the local projection specification shown in (1). Shaded areas show 95 percent confidence intervals constructed using Newey and West (1987) standard errors.

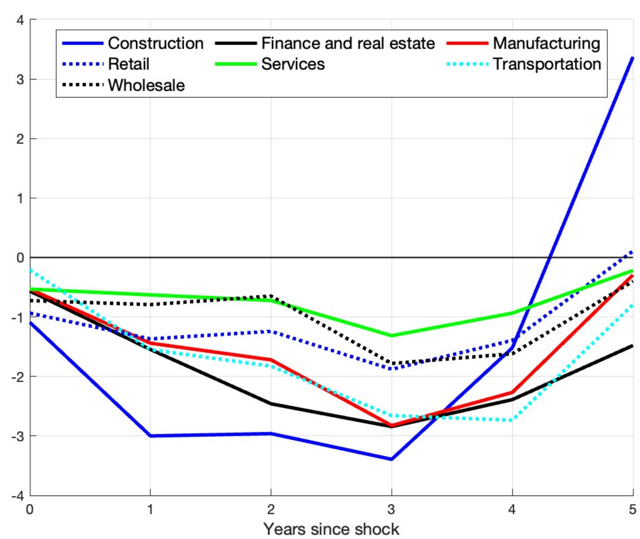

Figure 15: Industry employment impulse responses to a contractionary monetary policy shock at yearly frequency, based on the local projection specification shown in (1).

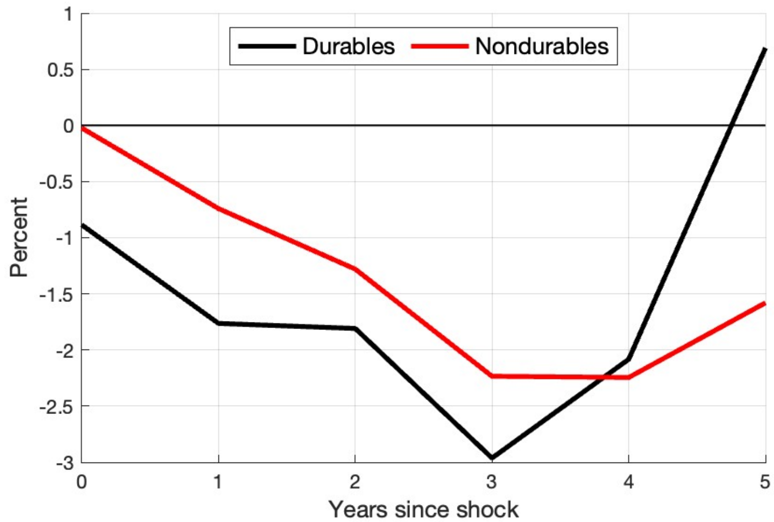

Figure 16: Industry employment impulse responses to a contractionary monetary policy shock at yearly frequency, based on the local projection specification shown in (1).

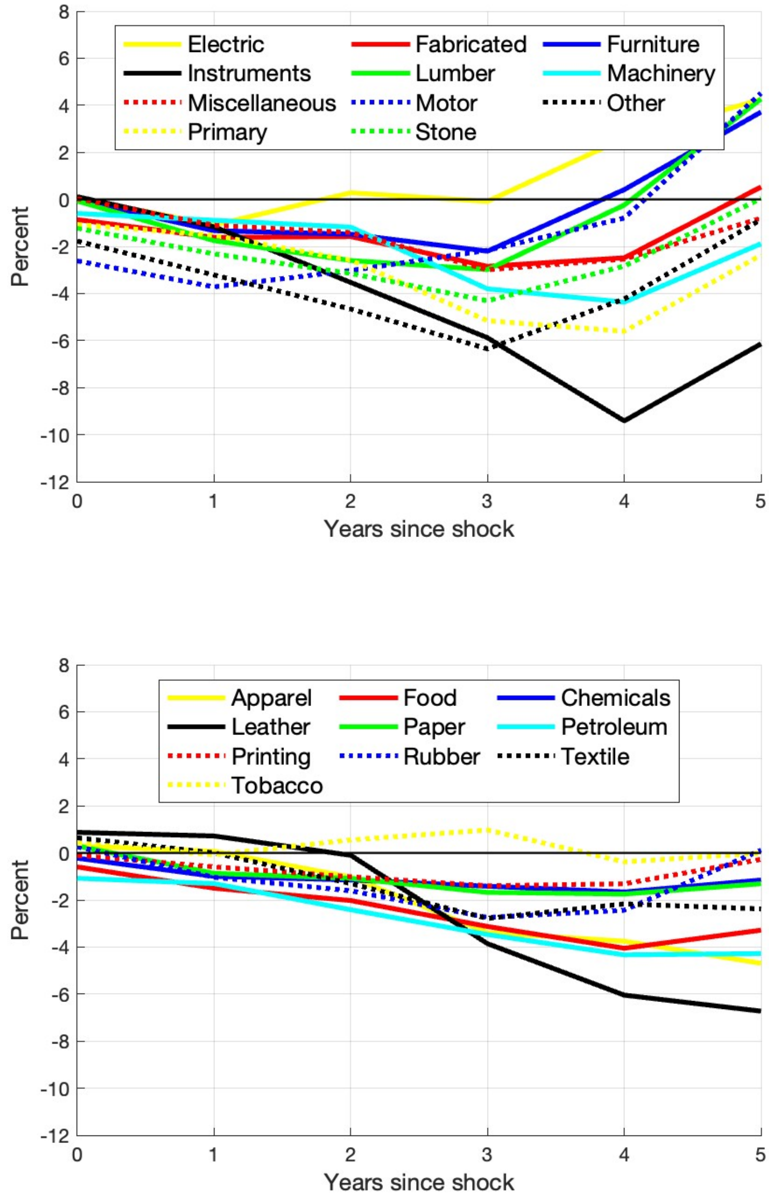

Figure 17: Industry employment impulse responses to a contractionary monetary policy shock at yearly frequency, based on the local projection specification shown in (1).

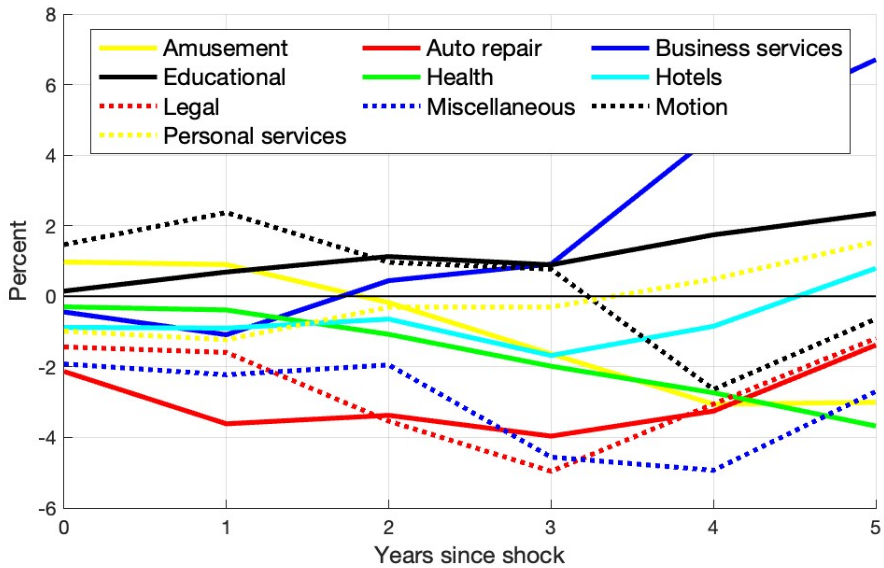

Figure 18: Industry employment impulse responses to a contractionary monetary policy shock at yearly frequency, based on the local projection specification shown in (1).

6.3 State data

6.3.1 Annual

	NT	Mean	Median	Std dev
Service share	1,428	.2804722	.2688662	.0958764
Manufacturing share	1,428	.2253078	.2241784	.0708018
Total Employment	1,479	1595302	1009648	1788327

Table 3: Descriptive statistics

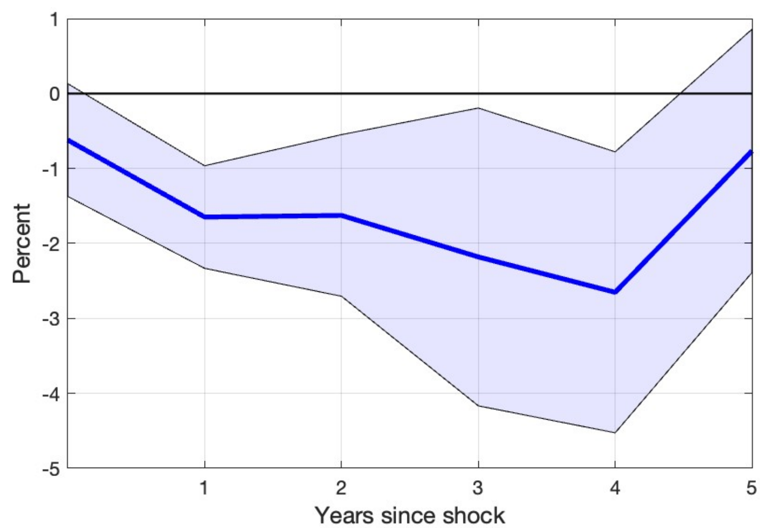

Figure 19: Employment impulse responses to a contractionary monetary policy shock at yearly frequency, based on the local projection specification shown in (3) (estimates are population weighted). Shaded areas show 95 percent confidence intervals constructed using Driscoll and Kraay (1998) standard errors.

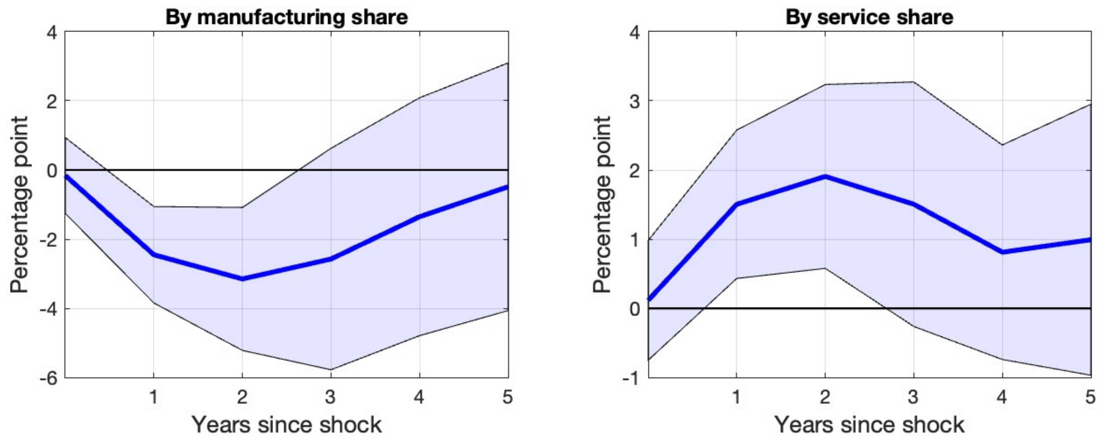

Figure 20: Total employment responses to monetary policy shocks by manufacturing and service employment share: 10th vs 90th percentile. Impulse responses to a contractionary monetary policy shock at yearly frequency, based on the local projection approach in (3) including income, race, and education as additional characteristics and using population weights. Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.

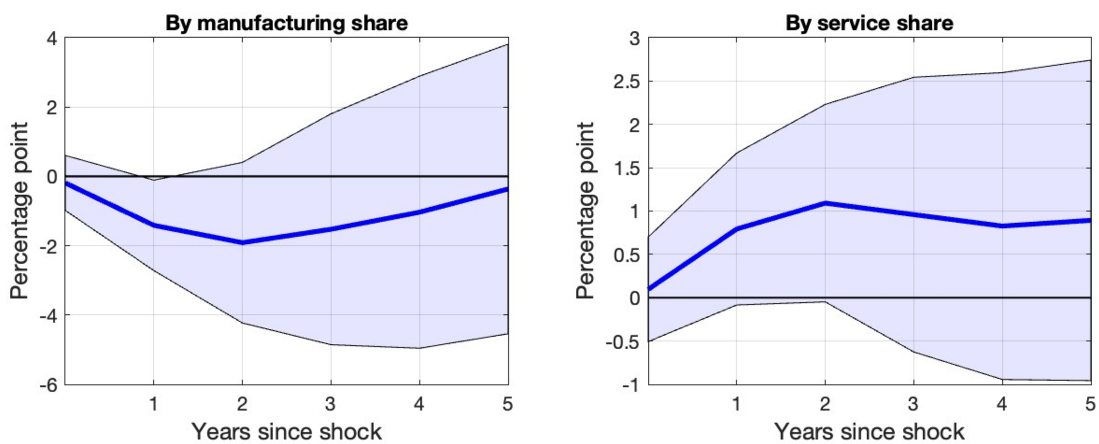

Figure 21: (Total employment - manufacturing) responses to monetary policy shocks by manufacturing and service employment share: 10th vs 90th percentile. Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3) including income, race, and education as additional characteristics and using population weights. Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.

6.3.2 Quarterly

	NT	Mean	Median	Std dev
Service share	4,732	.2656671	.2542487	.0765379
Manufacturing share	4,732	.2229529	.2259539	.0927988
Total Employment	4,732	3139168	1070442	1.15e+07

Table 4: Descriptive statistics

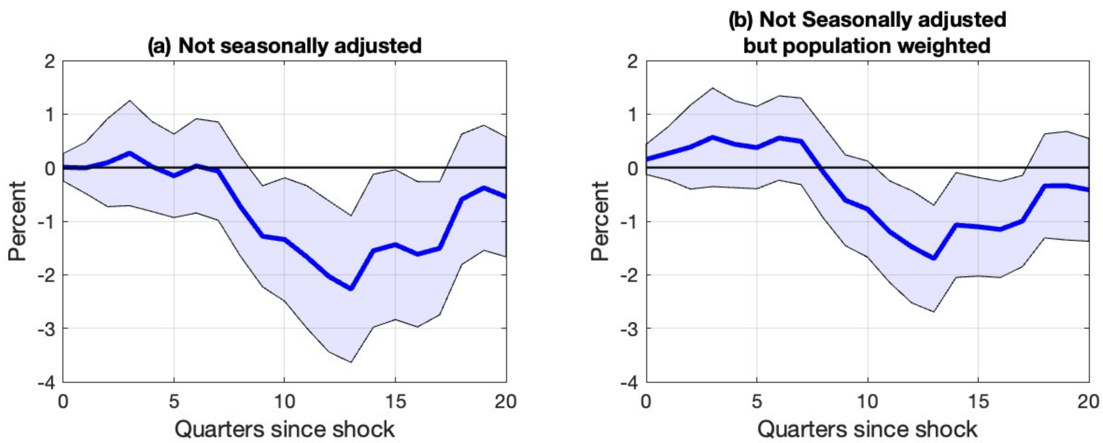

Figure 22: Average effect: Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection specification shown in (2). Shaded areas show 95 percent confidence intervals constructed using Driscoll and Kraay (1998) standard errors.

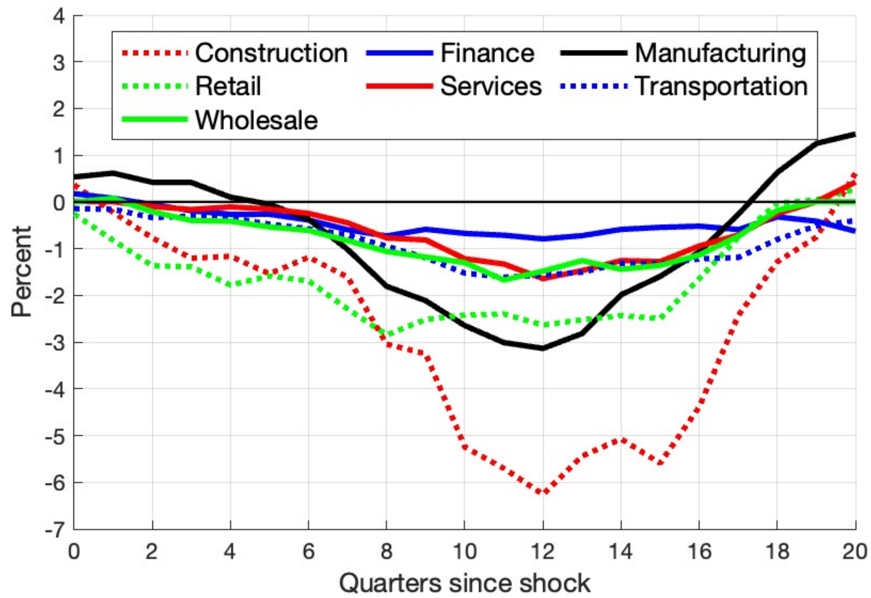

Figure 23: Population weighted average effect of contractory monetary policy on cumulative change in total employment across different industries. Estimation is provided separately for each industry and based on the local projection specification shown in (2).

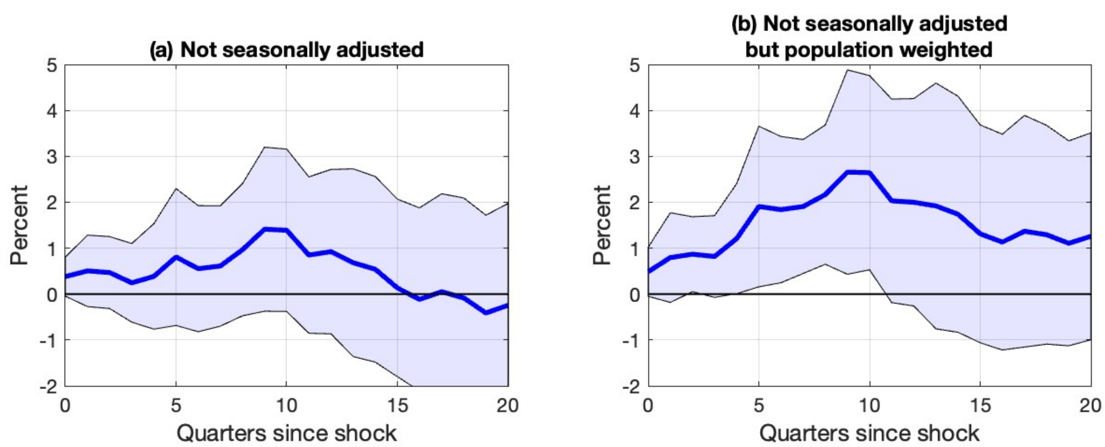

Figure 24: Total employment responses to monetary policy shocks by service employment share: 10th vs 90th percentile. Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3). Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.

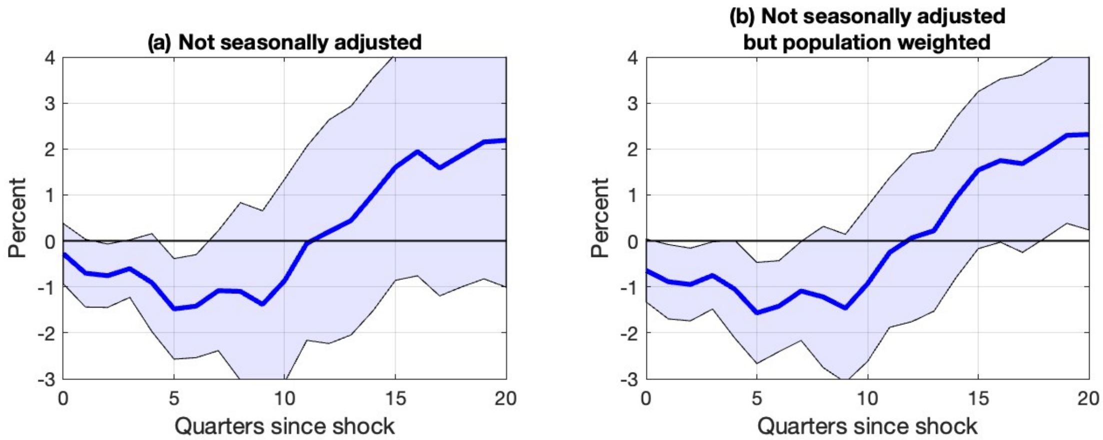

Figure 25: Total employment responses to monetary policy shocks by manufacturing employment share: 10th vs 90th percentile. Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3). Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.

Spillover Spillover on data (total - manufacturing)

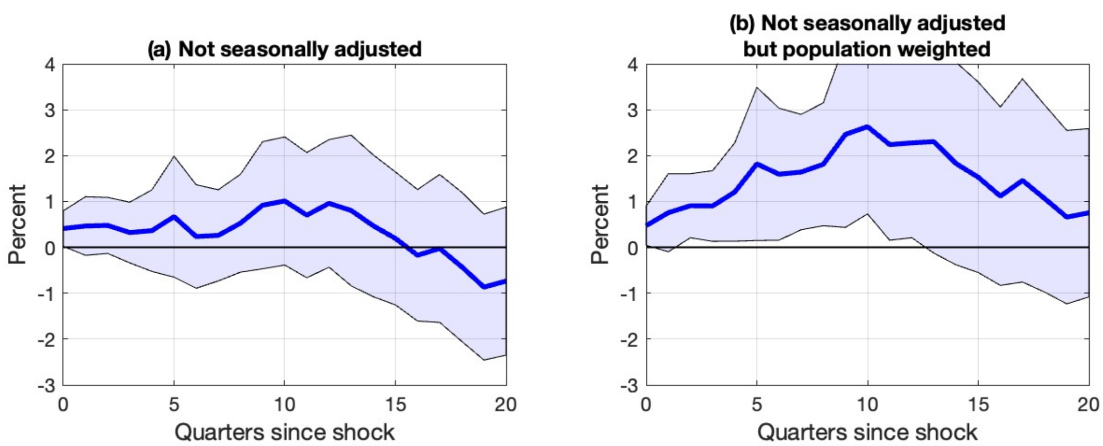

Figure 26: Total employment responses to monetary policy shocks by service employment share: Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3). Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.

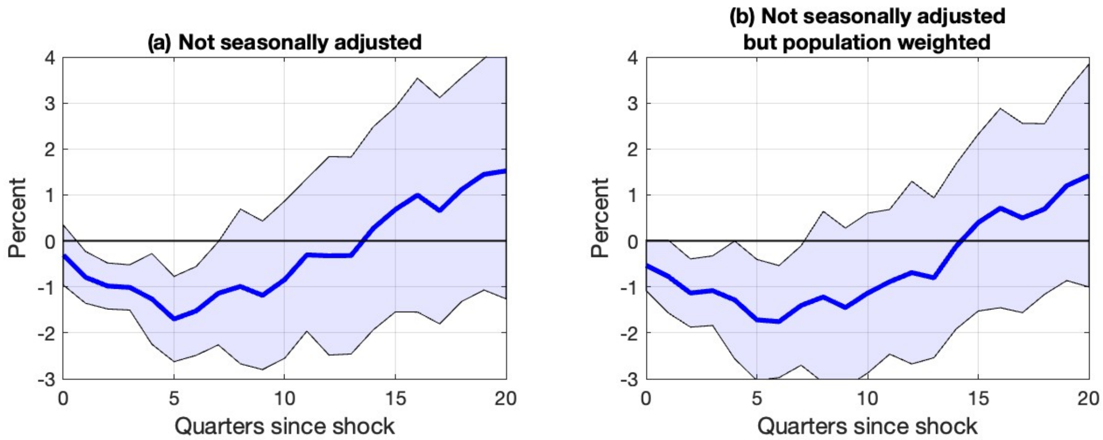

Figure 27: Total employment responses to monetary policy shocks by service employment share: Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3). Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.

6.4 County data

	N	Mean	Median	Std dev
Service share	1,479	22.09366	21.15746	5.216684
Manufacturing share	1,479	17.82337	17.81942	8.023278
Total Employment	1,479	1991476	1312846	2185150

Table 5: Descriptive statistics

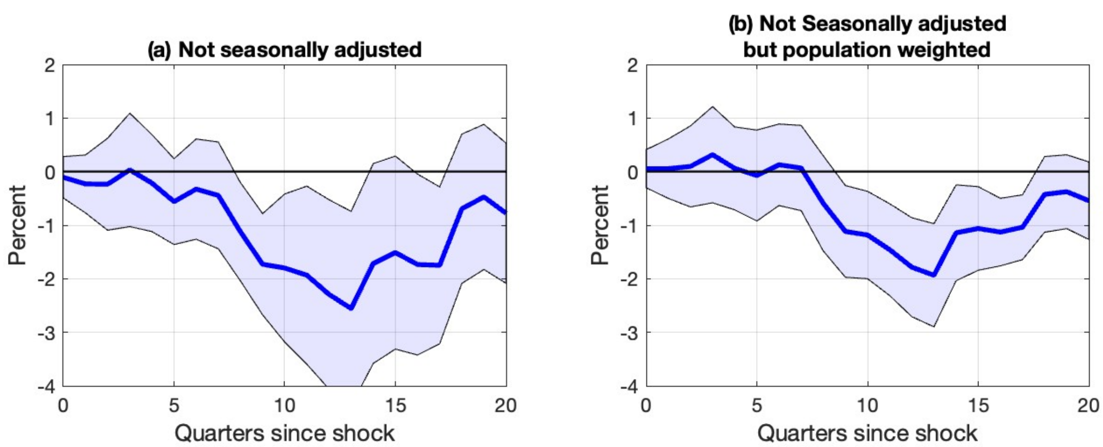

Figure 28: Average effect: Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection specification shown in (2). Shaded areas show 95 percent confidence intervals constructed using Driscoll and Kraay (1998) standard errors.

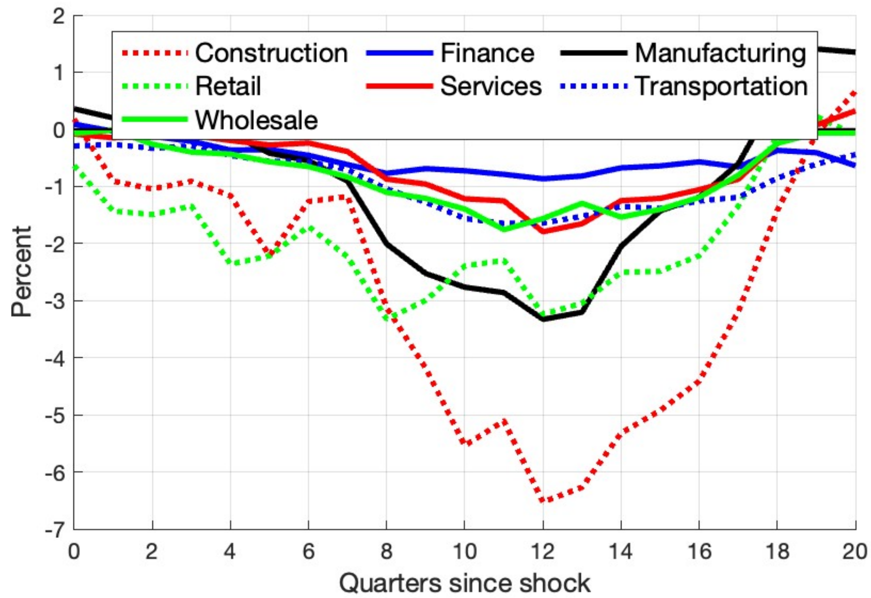

Figure 29: Average industry employment impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection specification shown in (2).

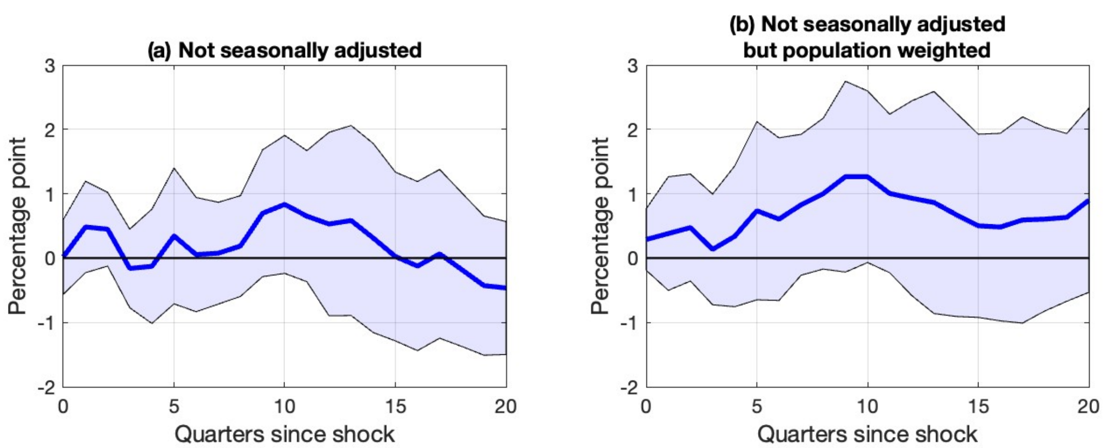

Figure 30: Service employment share: 10th vs 90th percentile. Difference in mean: Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3). Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.

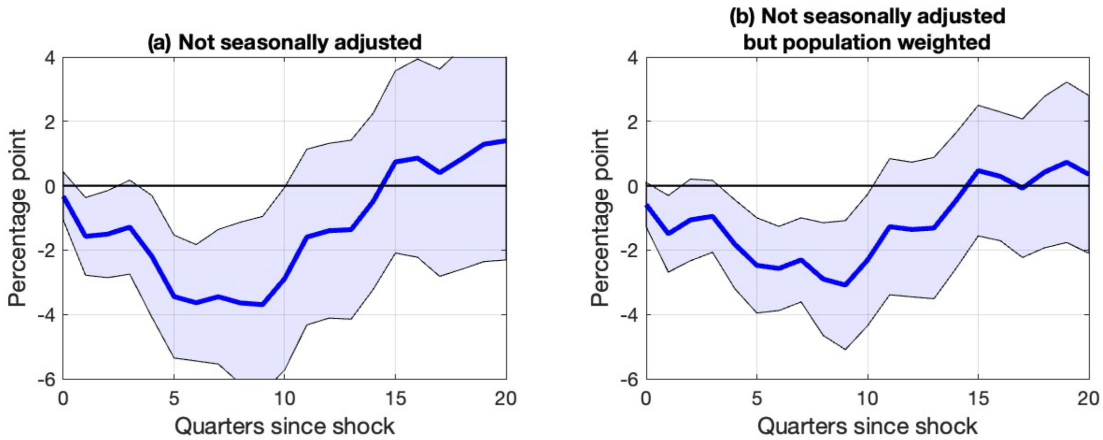

Figure 31: Manufacturing employment share: 10th vs 90th percentile. Difference in mean: Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3). Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.

Spillover Spillover on data (total - manufacturing)

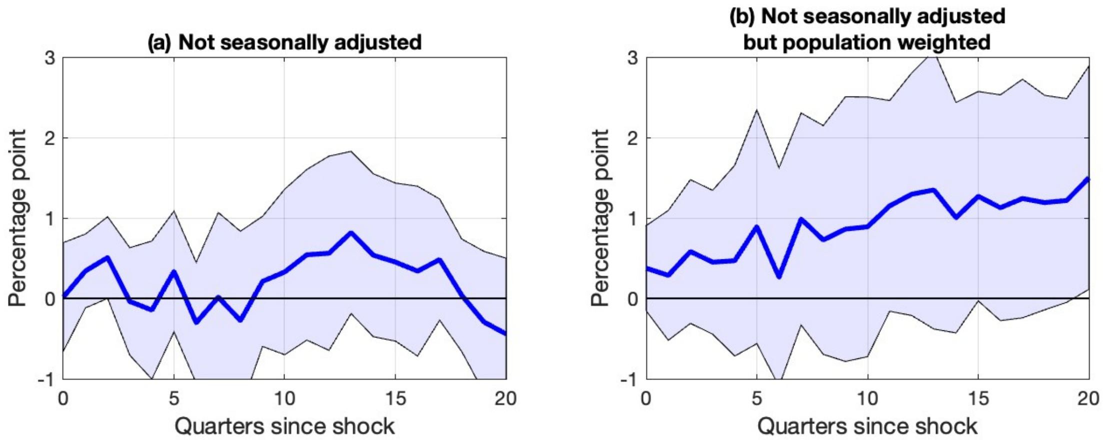

Figure 32: Total employment responses to monetary policy shocks by manufacturing relative to service employment share: Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3). Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.

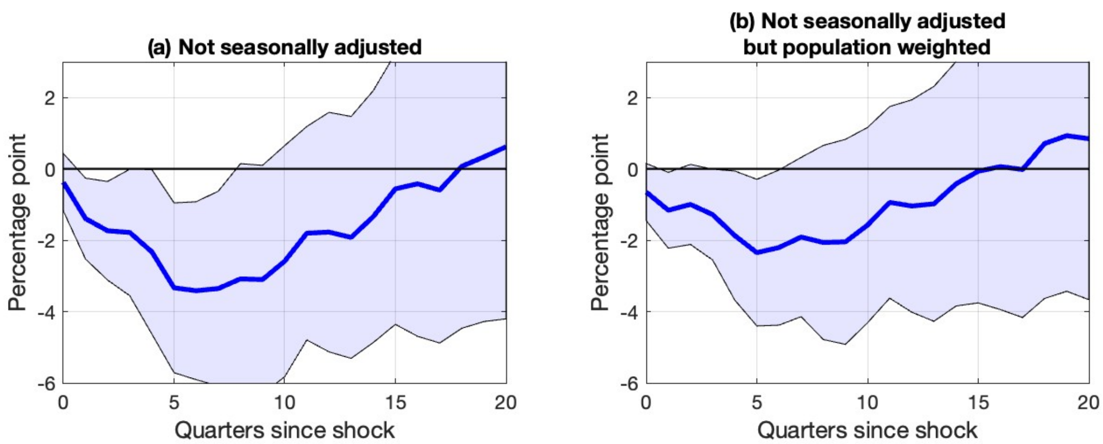

Figure 33: Total employment responses to monetary policy shocks by manufacturing relative to service employment share: Impulse responses to a contractionary monetary policy shock at quarterly frequency, based on the local projection approach in (3). Shaded area shows 95 percent confidence interval constructed using Driscoll and Kraay (1998) standard errors.