Sectoral Okun's Law and Cross-Country Cyclical Differences*

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Abstract

We estimate Okun's law at the sectoral level for the US, the UK, Japan, and Switzerland to test several hypotheses that may explain why the aggregate Okun's coefficients are different across countries. Specifically, we show that the sectoral composition is not a driver and find that the sectoral coefficients are proportional to the aggregate in all four countries. We also show that the standard deviation of unemployment is the main driver of the cross-country differences. This is consistent with labor market policies being crucial to explain the cross-country cyclical differences in the aggregate Okun's coefficient.

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1 Introduction

This paper examines whether the differences in the aggregate Okun's coefficients between four countries are largely driven by factors that affect every sector in the same way or by factors that affect each sector differently. Okun's law is the empirical negative relationship between GDP growth and the unemployment rate. The four countries we investigate are the US, the UK, Japan, and Switzerland.

The literature on drivers of cross-country differences in the cyclical behaviour beyond the Okun's coefficient can broadly be split into two categories. The first category attributes the differences to factors that affect the overall economy (e.g. Ohanian et al., 2018; Scarpetta, 1996; and Ilzetzki et al., 2013). Such a factor would affect every sector in a similar way and the cross-country differences of sectoral Okun's coefficients should be proportional to the differences at the aggregate level. For example, different labor market policies regarding hiring and firing would fall in this category, as all sectors are affected in the same way.

This contrasts to the second strain of the literature, which finds that cross-country cyclical differences are largely driven by factors that affect firms or sectors differently across countries (e.g. Bartelsman et al., 2013; Hsieh and Klenow, 2009; Alfaro et al., 2008; Harrigan, 1999; and Haltiwanger et al., 2014). Such factors would affect different sectors heterogeneously and the aggregate differences could be explained by this heterogeneity. One such factor could be differences in the production functions. Some sectors are more capital intensive than others, causing them to behave differently along a business cycle and the sectoral composition would drive cross-country differences.

We contribute to the literature on cyclical differences by determining which category the Okun's coefficient falls in. Specifically, we test whether the aggregate differences disappear if the sector sizes are the same across countries (e.g. if manufacturing has the same share of GDP for all countries) and we find that this can be rejected. We also examine whether all of the sectoral coefficients are proportional and we find that we cannot reject this. Next, we inspect whether any sector's coefficient is the same as the aggregate's and we find that this can also be rejected. Lastly, we decompose the Okun's coefficient to determine whether the correlation between unemployment or the standard deviations of unemployment or GDP are driving the differences. We find that the standard deviation of unemployment is the main driver.

It is well documented that the aggregate Okun's coefficients are different across countries (e.g. Ball et al., 2017; Lee, 2000; and Moosa, 1997). However, while there are several studies that look at sub-national Okun's law (e.g. regional in Porras-Arena and Martín-Román, 2019; Guisinger et al., 2018; Durech et al., 2014; Freeman, 2000; Villaverde and Maza, 2009 and demographics in Evans, 2018), sectoral breakdowns are scarce and only focus on a single country.[1] Our contributions to the literature include documenting the cross-country estimates at both the aggregate and sectoral levels. This can be very helpful in forecasting as shown in Ball et al. (2015) with regards to the aggregate level. In addition, we are able to refine the determinants of the aggregate cross-country differences in Okun's coefficients relative to the previous literature by taking advantage of the properties of the sectoral estimates.

This analysis is also important for monetary policy. An extensive amount of literature has linked monetary policy actions to sectoral output (e.g. Dale and Haldane, 1995; Ganley and Salmon, 1997; Dedola and Lippi, 2005; Ibrahim, 2005; Alam and Waheed, 2006; Ghosh, 2009; Hayo and Uhlenbrock, 2000; and many others). A common finding in this literature is that construction is the most responsive sector to monetary policy shocks. We contribute to this literature by documenting the links of sectoral output to sectoral unemployment. Given the full employment mandate of the Federal Reserve, it is very important to know not only how responsive output is to monetary policy but also how responsive unemployment in each sector is to output. For example, even though US output in retail might be more responsive to monetary policy shocks than in manufacturing, the output-unemployment relationship in retail might be weaker than in manufacturing. As a result, unemployment might actually be more responsive to monetary policy in manufacturing. By providing estimates for the sectoral Okun's coefficients, we make a valuable contribution to the sectoral monetary policy literature as well. However, we do not test monetary shocks on (un)employment directly. This might be a topic for future research.

Similar to monetary policy, fiscal policy impacts on sectoral output have been studied previously (e.g. Bénétrix and Lane, 2010 and Monacelli and Perotti, 2008). Specifically, it was found that the

[1] However, Abe and Ohta (2001) investigate Japan and Hartwig (2014) study Switzerland at the sectoral level and found large differences across sectors.

sectoral impact of fiscal policy shocks is not the same as monetary policy shocks. As with monetary policy, we contribute to this literature by estimating the output-unemployment relationship.

We also contribute to the literature with regards to other shocks as well. For example, Vukotic (2017) looks at the impact news shocks have on sectoral output. Similarly to the monetary policy and fiscal policy, addressing the sectoral output-unemployment relationship can have important implications there as well.

Last but not least, we also contribute to the literature on panel data and pooled estimates (e.g. Freeman, 2001 and Lee, 2000). By decomposing the Okun's coefficient into the correlation and standard deviations, we are able to assess where the heterogeneity across countries comes from. We show that, at least for the Okun's coefficient, standardizing the variables can substantially alter the heterogeneity in the coefficients. We also show that, while the correlation between unemployment and GDP is rather similar across countries, the Okun's coefficient is not.

The remainder of the paper is structured as follows: The next two sections explain our empirical strategy and the data sources. The following sections report the sectoral Okun's coefficients, and different tests to determine the drivers of these differences. The last section concludes.

2 Empirical Strategy

In line with Ball et al. (2017) and Okun (1963), we estimate the Okun's coefficient with unemployment as the dependent variable and output as the independent variable.[2]

For our estimation, we mainly use the first difference format:

$$\Delta u_t = \alpha + \beta[100\Delta Y_t] + \varepsilon_t \tag{1}$$

where Δu_t is the change in the unemployment rate from the previous period and ΔY_t is the log change in output from the previous period. Here, α is a constant term and β is the Okun's coefficient that captured the cyclical co-movement of change in the unemployment rate and changes in value added. Finally, ε_t is the error term.[3]

[2]Sometimes, it is estimated with the reverse roles, where output is the dependent variable and unemployment the independent variable. This does not change the significance of the results.

[3]The constant term is included in the regression but not reported in the results as in Ball et al. (2017)

In addition, we also estimate the Okun's coefficient using the Hodrick-Prescott (HP) filter of the form:

$$u_t - u_t^* = \beta[100(Y_t - Y_t^*)] + \varepsilon_t \tag{2}$$

where u_t is the unemployment rate at the national level and Y_t is the log real value added at the national level. Y_t^* and u_t^* correspond to the log potential output and the natural rate of unemployment, respectively. β is the Okun's coefficient capturing the cyclical co-movement in the deviation of the unemployment rate with the deviations of output from their respective long run trends. We mainly present the first difference results due to some of the shortcomings of filtering the series (e.g. see Hamilton, 2018) and the results utilizing either method are very similar to each other.

In order to estimate this equation at the sectoral level, it is necessary to obtain sectoral output and unemployment data. While output data is readily available, there are some conceptional issues regarding unemployment.

At the national level, the unemployment rate is simply people looking for jobs divided by the labor force (the sum of the number of people employed or unemployed) times 100. Based on this definition, there is no simple way to allocate the unemployed to the different sectors. We opt for the same approach taken in the previous literature (e.g. Abe and Ohta, 2001; and Hartwig, 2014) and choose the sector of the previous occupation. While there is likely some leakage from one sector to another (e.g. an administrator can move easily from one sector to another) and the unemployed without previous occupations are ignored, we expect that large economic swings in a sector are still being captured.

Berman and Pfleeger (1997) calculated the correlations between GDP and industry employment for 183 industries in the US. We expect to find similarities to this study in our paper. Specifically, we expect a large variation across sectors and that sectors that produce goods and services that consumers or firms can postpone their purchases of are sensitive to business cycle, such as the manufacturing and construction sectors. On the other hand, we expect that sectors that produce necessity or public goods do not show an apparent correlation, such as the health, education services, and government sectors.

3 Data

We collected annual sector level data for the US, the UK, Switzerland, and Japan. The output data was taken from the Bureau of Economic Analysis for the US, the Office for National Statistics for the UK, the Swiss National Statistical Office for Switzerland, and the Cabinet Office, Government of Japan for Japan. Unemployment rate series are retrieved from the Bureau of Labor Statistics for the US, the Office for National Statistics for the UK, the State Secretariat for Economic Affairs for Switzerland, and the Ministry of Internal Affairs and Communications for Japan.

The data sets cover the years 1997-2016 for the US, 1995-2017 for the UK, 2002-2016 for Switzerland, and 2000-2016 for Japan at the four sectoral level (agriculture, manufacturing, services, and government). Tables 1 and 2 show the average GVA and employment compositions for these economies over the corresponding sample periods. All of these four economies are service economies as the service sector accounts for about 60-70% in each of them. Additionally, the agriculture sector and the government account for less than 15% in the economies. Although, there are some differences. For example, the manufacturing sector accounts for less than 20% for the US and UK based on GVA, while it is more than 25% for Switzerland and Japan. Given the substantial differences in Okun's coefficients and some differences in sectoral composition, this should allow us to make some inference about the impact of the sectoral composition.

For the most disaggregated level available, we lose some years due to definition changes. Specifically, the samples for the US and Japan are shortened to the years 2000-2016 and 2002-2016, respectively.

The sectoral definitions do not match perfectly across countries. Some countries have more disaggregated data for some sectors than others (e.g. Switzerland breaks down insurance services separately from financial services), or employ different definitions (e.g. different levels of ISIC), making it difficult to match the sectoral definitions across countries. Where necessary, GDP and unemployment are aggregated into the common sector. The most disaggregated definitions we use can be found on table 5.

In addition to the annual data, we also collected quarterly data for the US and UK.

4 Sectoral Okun's Coefficient

First, we estimate the Okun's coefficient based on equations (1) and (2) at the national level to observe if our estimation procedure is in line with the literature. Our results are estimated with standard errors robust to heteroskedastic and auto-correlated errors (HAC errors) and are reported in Tables 3 and 4 for the first difference and HP filtered results, respectively. All of the coefficients are negative and statistically significant, confirming that Okun's law holds in all four economies at the national level. In absolute value, the coefficients are largest in the US, followed by the UK, Switzerland, and Japan. The first difference specification gave us somewhat smaller coefficients than with the HP filter. However, this difference does not change the order of countries or the significance. The aggregate economy coefficients are in line with Ball et al. (2017), showing that the relationship is relatively stable over time even though the estimation time periods are not exactly aligned. At the quarterly level, there appears to be a weaker output-unemployment relationship than at the annual level, but it is still highly significant.

Next, we estimate the coefficients for the four sectors (agriculture, manufacturing, services, and the government) for each country and report the results in Tables 3 and 4 for the first difference and HP filtered regression, respectively. The sector level results are broadly similar across countries with agriculture and government having no cyclical relationship between unemployment and output, while manufacturing and services exhibit a strong negative relationship. In terms of magnitudes, the Okun's coefficients for the latter two sectors are also broadly in line with the aggregate results. Similar to the aggregate results the results remain broadly unchanged, independent from taking first differences or HP filtering the series. Due to this, we only report the results from the first differenced method in equation (1) with annual frequency data and leave the results from HP filter method or quarterly data in the Appendix.

For the detailed sectoral estimation, we use the following eleven sectors: agriculture; manufacturing, mining, and utility; construction; wholesale and retail trade; transportation and information; financial activity; accommodation; education and health; professional and business (excluding Japan); other services; government.[4] The results are presented in Table 5. As with the results

[4]Business services for Japan are categorized into other services

in the previous tables, the coefficients broadly have a similar pattern to the aggregate with the US and UK having the strongest negative relationship while Switzerland and Japan have a much weaker relationship. As with the less disaggregated sectoral results, manufacturing and some service sectors appear to have the strongest relationship. Aside from the sectors already discussed above (agriculture and government), education and financial services appear to not have a strong output-unemployment relationship. This consistent sectoral pattern across countries shows that the sectoral output-unemployment relationship is similar across countries. It also appears that the relationship is actually strongest for the aggregate and relatively weaker for the disaggregated data, as very few sectoral relationships are more negative than the aggregate. One interesting pattern that can be directly observed is the similarity of the sectoral pattern across countries.

5 What Drives the Differences?

To get back to the initial question of what is driving the international differences in cyclical correlations, there are several aspects to test based on the results. One driver could be the sectoral composition of the economies. As shown in tables 1 and 2, while all four economies are service economies, their sectors have different shares. For example, the US and UK have a manufacturing sector of less than 20% while Japan and Siwtzerland both have more than 25% based on GVA. In terms of employment, they are a bit more similar, but there are still clear differences, be it in the government or manufacturing sectors.

Another possibility is that the differences are caused by factors affecting all sectors in the same way. While there is heterogeneity among sectors, the tables from the previous section also show that within sectors and across countries, the pattern found in the aggregate is somewhat repeated. Note, that this case does not fully exclude the case of one sector driving the results.

Given that several manufacturing and service sectors are close to the aggregate coefficient, it could be that the aggregate coefficients are the same as a single sector of the countries. Or put differently, is it possible that one sector has the same coefficient as the aggregate?

5.1 Sectoral Compositions

The cross-country differences in the Okun's coefficients can be driven by the differences in the sectoral composition. For example, it could be the case that the reason why the US has a larger coefficient than Switzerland is due to the US economy having a larger retail sector. To test this, we re-weight the sectors in each country to match the US sector sizes. Specifically for output, we use the following equation:

$$GDP_{i,US,t} = \sum_s \frac{\alpha_{s,US}}{\alpha_{s,i}} GVA_{i,s,t} \tag{3}$$

where $GDP_{i,US,t}$ represents country i's GDP at period t with the US sectoral composition, $\alpha_{s,US} = \frac{Y_{US,s}}{\sum_s Y_{US,s}}$ represents the GDP share of sector s in the US, $\alpha_{s,i} = \frac{Y_{i,s}}{\sum_s Y_{i,s}}$ represents the GDP share of sector s in country i, and $GVA_{i,s,t}$ represents sector s's GVA in country i at period t. Thus the equation transforms country i's sectoral composition into the US sectoral composition. The US shares are the four sectoral shares averaged for the years 1997-2017.

The unemployment rate in country i matched to the US economy at period t is similarly defined by:

$$u_{i,US,t} = \frac{\sum_s \frac{\alpha_{s,US}}{\alpha_{s,i}} U_{i,s,t}}{\sum_s \frac{\alpha_{s,US}}{\alpha_{s,i}} (U_{i,s,t} + E_{i,s,t})} \tag{4}$$

where $U_{i,s,t}$ is the number of unemployed in country i, sector s at period t and $E_{i,s,t}$ is the number of employed in country i, sector s at period t. Note this specification does not change the sectoral unemployment rate. Before estimating Okun's coefficient, the resulting aggregate unemployment rate and output are either differenced or transformed using the HP filter. Since the sectoral definitions are different across countries and professional service sector is missing in Japan, we only tested this for four sectors.

Table 6 reports the national Okun's coefficient for each country for the reweighted variables. Compared to the original national level estimates on table 3, the differences in coefficients are small and those estimates are within the one standard error of the original estimates. We repeat the analysis by replacing the weights based on US GVA shares by the US employment shares. As table 7 reports, the differences in coefficients compared to table 3 are are within the one standard error of the estimates (except in Japan with two standard errors).

Together, this shows, that changing the sectoral proportions of the economies does not have much impact on the aggregate Okun's coefficient. Indeed at least for these four countries, it can be rejected that the sectoral composition is the driver of the cross-country differences in the aggregate coefficient.

5.2 Are Sectors Proportional to the Aggregate?

Another test is to check if sectoral differences have the same proportions across countries. That is, if the US and Japan have a country level coefficient of -0.5 and -0.1 respectively, will the sectoral coefficients of the US divided by five be close to the sectoral coefficients of Japan.

To test this, we create ratios of sectoral coefficients and test, for example, if the ratio of the agricultural sector to the manufacturing sector for the US is equal to the ratio for Japan. Specifically, we test the non-linear null hypothesis

$$\frac{\beta_{i,US}}{\beta_{j,US}} = \frac{\beta_{i,k}}{\beta_{j,k}} \tag{5}$$

That is, we analyze if the ratio between the US coefficient for sector i and sector j is equal to the ratio between the country k coefficient for sector i and sector j. Because we only have annual data, it is unfortunately not possible to jointly estimate all sectors for all countries in one equation.

We only run this test for the four sector economy and run the US vis-a-vis the other countries in separate system OLS. Next we test, if the ratio of agriculture to each of the other sectors is the same using a joint Chi-squared test. For example, we examine if the three US ratios are each equal to the respective UK ratios jointly. The results are reported in Table 8 in the row "joint" for each country.

The results show that the ratios do not differ significantly across countries. We repeat the test for the ratio between the manufacturing and services coefficients, as these are the two that are significantly different from zero based on the results in Table 3. Again, the results presented show that there is no significant difference between the countries.

Therefore, it is not possible to reject the possibility that all sectoral coefficients are proportional across countries. Thus, it is probable that the aggregate coefficient could be inferred for all countries if the aggregate coefficient for one country and the manufacturing coefficients for all countries are known. While sectors have different coefficients, it appears that they are all affected in the same way for a country. That is, dividing the US sectoral coefficients by the Japan coefficients will lead to a similar value for all sectors.

5.3 Is any sector coefficient close to the aggregate?

In the previous section, it was shown that the sectors are broadly proportionate to the aggregate and this proportion is stable across countries. Therefore it should be possible to infer the aggregate differences across countries by analyzing a single sector across countries. Though there are some sectors in which this proportion is more stable across countries than others. This being said, we now wish to find whether there exist a sector that is closest to the aggregate for all countries.

To determine if any sectoral coefficient is close to the aggregate for all of the countries we conduct a t-test with the null hypothesis that the sectoral coefficient is equal to the aggregate coefficient. The t-statistics for the broad and narrow sectors are presented in tables 9 and 10, respectively.

Both tables show that for the US and UK the manufacturing sector's coefficients are closest to the aggregate. However, this is not true for Switzerland and Japan. For Switzerland, professional services and accommodation (both services) are closest to the aggregate coefficient. For Japan, the government and to some extent services are the closest.

Overall, there does not appear to be a single sector that has the same coefficient as the aggregate for all of the countries. As shown in the previous section, however, it cannot be rejected that the coefficients are proportional and it is possible to multiply the sectoral coefficient by a constant to get close to the aggregate coefficients.

6 Decomposing the Coefficient

Based on the results in the previous section, it appears that the cross-country differences in Okun's coefficients have a driver that affects all sectors the same way. To further determine what this driver is we can run simple regressions. It is thus possible to decompose the Okun's coefficient into the correlation between the following two variables and their respective standard deviations:

$$\hat{\beta} = corr(\bar{u}_t, \bar{y}_t)\frac{sd(\bar{u}_t)}{sd(\bar{y}_t)}, \tag{6}$$

where $\bar{u}_t$ denotes either the change in the unemployment rate or the deviation from trend, $\bar{y}_t$ is the log change in output or the deviation from trend, $sd()$ represents the standard deviation of the variable, and $corr()$ is the correlation between the two variables.

This decomposition will allow us to determine if any of the three components is driving the cross-country differences or if perhaps all are contributors. In turn, this can help determine if there is a specific channel through which the difference across countries is determined. For example, if the variance of output is driving the results, then macro or micro factors affecting output are most likely causing the differences. If instead the variance of unemployment is a strong driver, this would suggest that labor market factors are the main driver of these differences.

Tables 11, 13, and 15 report for four sectors, the standard deviation for the output gap, the standard deviation for the unemployment rate gap, and the correlation of the two, respectively. Tables 12, 14, and 16 report these for 11 sectors. The tables show that there is some heterogeneity across sectors, however there is less volatility for output than for unemployment in line with Loayza et al. (2007) and Sala et al. (2012). For example, for the service numbers, the standard deviations range from 1.30-1.75 for output and 0.35-0.85 for unemployment. In addition, for unemployment, the standard deviations for the US are the highest, followed by the UK, Switzerland and Japan, which is aligned with the Okun's coefficients. For output, there is no such pattern as the variability across countries does not match the Okun's coefficients: Switzerland has the lowest standard deviation for output for the aggregate, which would imply a high Okun's coefficient. The pattern of the correlations also does not align with the pattern of Okun's coefficients: there are no clear ranking of the which country has the highest correlation across sectors. Indeed, the aggregate correlation between output and unemployment appears to be quite close across countries.

Motivated by the finding that the standard deviation of unemployment is aligned with the Okun's coefficients, we estimate the equation (1) but first divide the change in the unemployment rate by its standard deviation:

$$u_{t,adjusted} = \frac{\Delta u_t}{\sigma_{\Delta u}} \tag{7}$$

This specification normalizes the unemployment rate so that the differences in variations of changes in unemployment is eliminated across countries.[5] Therefore based on equation (6), the only remaining factors that can potentially explain the cross-country differences in Okun's coefficients are the standard deviation of changes in output and the correlation between changes in output and the unemployment rate. However, as shown above, these two measurements do not provide systematic patterns that match the pattern of the Okun's coefficients. Thus, with the normalization we expect that the Okun's coefficients are close to each other across countries, but not necessarily across sectors.

Tables 17 and 18 show the regression results after normalizing the unemployment rate. The last column in both tables show the Chi squared test results with the null hypothesis that all coefficients in the same row are equal. With regards to the national results, the coefficients are now not significantly different from each other. Indeed, the specific pattern found previously that the US had the most negative Okun's coefficient followed by the UK, Switzerland, and Japan is now gone. This pattern was also present in the sectoral coefficients and it also vanishes once the unemployment rate is normalized. Indeed, except for manufacturing and other services, the hypothesis that all Okun's coefficients are the same cannot be rejected. With regards to manufacturing and services, it is rejected because one of the countries has a very different coefficient from the others. Therefore, our results suggest that the national coefficients are mainly driven by the volatility of the unemployment rate.

The finding that the standard deviation matters also has important implications for cross-country studies more generally. In particular, while the significance of the results should not be affected, the actual coefficient and thus the economic interpretation might change. Furthermore, this can impact the decision of whether to pool the data across countries or not. If the coefficients appear to be very different without standardizing variables, a panel setup like Freeman (2001) might be rejected, even if the standardized variables would lead to very similar coefficients. At least for (un-)employment, this can be very important.

The pattern of the standard deviations as well as the pattern of the correlation suggests that the volatility of unemployment is able to explain a large portion of the variation in Okun's coefficients

[5] Note that since we use first differences across the two variables, the mean is close to 0.

across countries. We further test this hypothesis by using OECD data for aggregate GDP and Unemployment rate and estimate Okun's coefficients using equation 1 across the entire available sample of annual data. As Figure 1 shows, there is a strong positive correlation between the absolute value of the Okun's coefficient and the standard deviation of unemployment that explains around 40% of the variance in Okun's coefficients.[6] This is in line with labor market policies being relevant for the difference in Okun's coefficient and thus the cyclical correlation between output and unemployment.

7 Conclusion

This paper investigated several potential drivers for the cyclical differences between unemployment and GDP as measured by cross-country differences in Okun's law. The results presented suggest that the differences stem from factors affecting the economies as a whole, be it macroeconomic policies or some other factors. More specifically, it appears that the difference in coefficients is, to a large extent, driven by labor market factors.

The sectoral composition appears not to be significant. Thus, factors affecting sectors differently, such as having different production functions, appear to have minimal effects. In addition, the sectoral pattern in cyclical correlation between output and unemployment appears to be very similar across the four countries studied.

In the broader context of empirical cross-country studies, we showed that it is critical to check the importance of the variances of the variables for the estimates. Especially for studies that include employment, it could be helpful to check if the coefficients become more similar when standardizing the variables.

An important topic for future research would be to further narrow down the exact driver. While labor market factors appear to be significant, we were not able to distinguish whether it is macro policy factors or micro factors. Also, we did not investigate drivers for sectoral differences in the coefficients which could also be another topic for future research.

[6] The reversal of the positions of Japan and Switzerland in the two data sets is likely due to the shorter sample for Switzerland in the OECD data, which only starts in 2010 and does not include any full business cycles.

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Figures

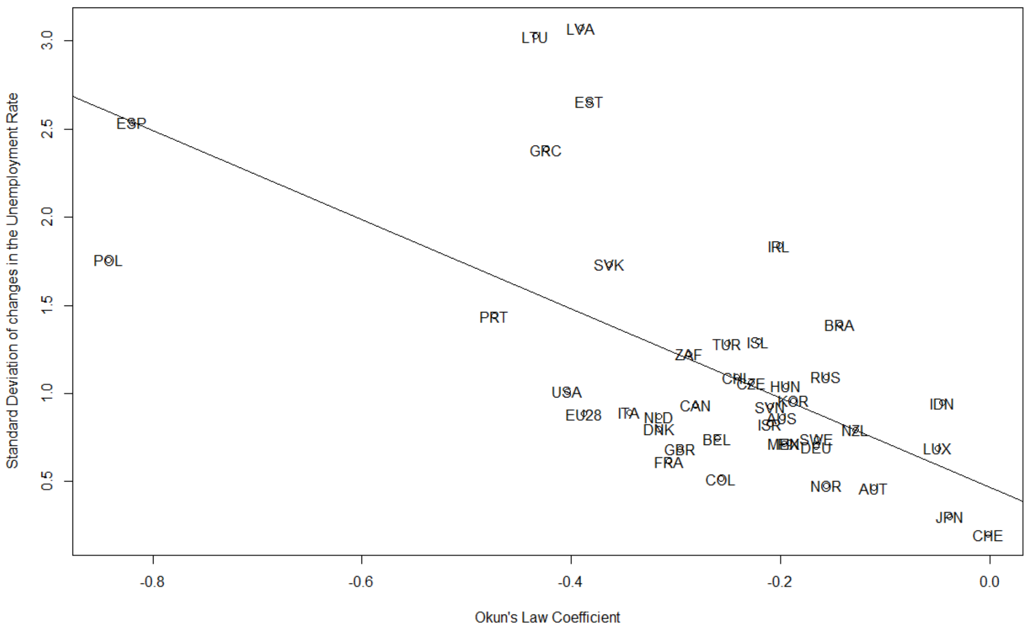

Figure 1: Unemployment Volatility Drives Differences in Cyclical Correlations

Tables

Table 1: Average Sectoral GVA Shares in Overall GVA per Country

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Agriculture	0.86%	5.74%	0.74%	1.13%
	(0.8%,0.91%)	(7.13%,4.36%)	(0.86%,0.63%)	(1.45%,0.83%)
Manufacturing	18.88%	18.14%	26.75%	27.71%
	(20.13%,17.69%)	(21.65%,16.31%)	(27.11%,26.53%)	(29.05%,28.08%)
Service	66.29%	70.13%	62%	65.86%
	(63.26%,69.01%)	(63.77%,74.72%)	(60.91%,62.78%)	(64.14%,66.01%)
Government	13.96%	5.99%	10.51%	5.3%
	(15.81%,12.38%)	(7.44%,4.61%)	(11.12%,10.06%)	(5.36%,5.08%)

Parenthesis: (initial period, last period) for each sector.

Table 2: Average Sectoral Employment Shares in Overall Employment per Country

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Agriculture	1.07%	2.82%	3.56%	4.26%
	(1.59%,1.09%)	(3.54%,2.86%)	(3.95%,3.15%)	(5.29%,3.5%)
Manufacturing	18.9%	20.8%	21.98%	27.35%
	(22.76%,17.06%)	(25.8%,16.54%)	(23.64%,20.53%)	(32.68%,24.71%)
Service	64.65%	69.95%	69.5%	64.79%
	(60.3%,67.56%)	(64.63%,74.39%)	(67.22%,71.61%)	(58.55%,68.16%)
Government	15.39%	6.43%	4.96%	3.59%
	(15.35%,14.28%)	(6.03%,6.22%)	(5.19%,4.71%)	(3.47%,3.63%)

Parenthesis: (initial period, last period) for each sector.

Table 3: First Difference Sectoral Results

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Frequency	Yearly			
$100 * \Delta Y_t$	Dependent variable: Δu_t			
Total	-0.450***	-0.267***	-0.251***	-0.125***
	(0.120)	(0.025)	(0.040)	(0.029)
R^2	0.57	0.68	0.59	0.48
Agriculture	0.038	-0.090	-0.010	-0.001
	(0.050)	(0.056)	(0.008)	(0.008)
R^2	0.033	0.175	0.092	0
Manufacturing	-0.555***	-0.260***	-0.161***	-0.061***
	(0.141)	(0.041)	(0.026)	(0.021)
R^2	0.63	0.72	0.73	0.44
Service	-0.380***	-0.206***	-0.192**	-0.150**
	(0.092)	(0.036)	(0.083)	(0.069)
R^2	0.58	0.52	0.38	0.28
Government	0.186*	0.007	0.189	-0.099
	(0.097)	(0.044)	(0.101)	(0.112)
R^2	0.082	0.002	0.142	0.058
N	20	22	15	16

HAC standard errors in parenthesis. $*p < 0.1$; $**p < 0.5$; $***p < 0.01$.

Table 4: HP Filter Sectoral Results

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Frequency	Yearly			
$100 * (Y_t - Y_t^*)$	Dependent variable: $u_t - u_t^*$			
Total	-0.599***	-0.293***	-0.248***	-0.160***
	(0.063)	(0.045)	(0.029)	(0.015)
R^2	0.83	0.66	0.62	0.72
Agriculture	0.017	-0.141***	-0.014	-0.002
	(0.084)	(0.025)	(0.008)	(0.007)
R^2	0.003	0.448	0.065	0.006
Manufacturing	-0.634***	-0.305***	-0.191***	-0.095***
	(0.086)	(0.030)	(0.033)	(0.014)
R^2	0.83	0.69	0.82	0.7
Service	-0.507***	-0.251***	-0.169***	-0.162***
	(0.053)	(0.046)	(0.042)	(0.041)
R^2	0.84	0.57	0.44	0.56
Government	0.301	0.065**	0.172	-0.105
	(0.205)	(0.026)	(0.113)	(0.103)
R^2	0.115	0.135	0.06	0.051
N	21	23	16	17

HAC standard errors in parenthesis. $^*p < 0.1$; $^{**}p < 0.5$; $^{***}p < 0.01$.

Table 5: First Difference Disaggregated Sectoral Results

Country	The US	The UK	Switzerland	Japan
Period	2000-2017	1995-2017	2002-2017	2002-2016
Frequency	Yearly			
$100 * \Delta Y_t$	Dependent variable: Δu_t			
Total	-0.627***	-0.267***	-0.251***	-0.120***
	(0.107)	(0.025)	(0.040)	(0.036)
R^2	0.71	0.68	0.60	0.51
Agriculture	0.036	-0.090	-0.010	-0.008
	(0.059)	(0.056)	(0.008)	(0.010)
R^2	0.03	0.17	0.09	0.04
Manufacturing, Mining & Utilities	-0.530***	-0.282***	-0.139***	-0.051**
	(0.171)	(0.027)	(0.020)	(0.020)
R^2	0.58	0.76	0.75	0.5
Construction	-0.501***	-0.170**	0.068	-0.029**
	(0.078)	(0.069)	(0.100)	(0.014)
R^2	0.74	0.4	0.05	0.07
Wholesale & Retail Trade	-0.266***	-0.148***	-0.060	-0.031
	(0.036)	(0.055)	(0.075)	(0.027)
R^2	0.64	0.32	0.06	0.12
Transportation & Information	-0.247***	-0.115***	-0.092*	-0.027
	(0.088)	(0.025)	(0.053)	(0.034)
R^2	0.45	0.48	0.19	0.03
Financial Activities	-0.035	-0.059	-0.031	0.026
	(0.088)	(0.052)	(0.026)	(0.044)
R^2	0.01	0.06	0.09	0.01
Accommodation	-0.290***	-0.112	-0.256***	-0.028
	(0.059)	(0.084)	(0.053)	(0.031)
R^2	0.58	0.11	0.63	0.05
Education & Health	0.055	-0.015	-0.041	0.076
	(0.086)	(0.039)	(0.031)	(0.061)
R^2	0.01	0	0.11	0.04
Professional and Business	-0.441***	-0.132***	-0.325***	
	(0.050)	(0.031)	(0.070)	
R^2	0.6	0.61	0.44	
Other Services	-0.141	-0.110**	-0.006	-0.171
	(0.086)	(0.053)	(0.005)	(0.112)
R^2	0.23	0.2	0.02	0.24
Government	0.227**	0.007	0.189*	-0.105
	(0.099)	(0.044)	(0.101)	(0.130)
R^2	0.12	0	0.14	0.06
N	17	22	15	14

HAC standard errors in parenthesis. $^*p < 0.1$; $^{**}p < 0.5$; $^{***}p < 0.01$.

Table 6: National Results with the US Sectoral GVA Shares

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Frequency	Yearly			
$100 * \Delta Y_{i,US,t}$	Dependent variable: $\Delta u_{i,US,t}$			
Total	-0.450***	-0.272***	-0.253***	-0.128***
	(0.120)	(0.037)	(0.042)	(0.022)
R^2	0.568	0.602	0.600	0.512
N	20	22	15	16

This table shows the aggregate coefficients when the 4 sectors are scaled to match the US GVA shares before aggregating them. HAC standard errors are in parenthesis. $*p < 0.1$; $**p < 0.5$; $***p < 0.01$.

Table 7: National Results with the US Sectoral Employment Shares

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Frequency	Yearly			
$100 * \Delta Y_{i,US,t}$	Dependent variable: $\Delta u_{i,US,t}$			
Total	-0.450***	-0.266***	-0.278***	-0.160***
	(0.120)	(0.037)	(0.048)	(0.028)
R^2	0.568	0.592	0.567	0.491
N	20	22	15	16

This table shows the aggregate coefficients when the 4 sectors are scaled to match the US employment shares before aggregating them. HAC standard errors in parenthesis. $^{*}p < 0.1$; $^{**}p < 0.5$; $^{***}p < 0.01$.

Table 8: Are Cross-Country Coefficients Proportional?

UK	Chi Squared	df	P-value
Joint	4.43	3	0.22
Manufacturing and Services	0.06	1	0.81
Japan	**Chi Squared**	**df**	**P-value**
Joint	0.21	3	0.98
Manufacturing and Services	1.68	1	0.20
Switzerland	**Chi Squared**	**df**	**P-value**
Joint	1.90	3	0.59
Manufacturing and Services	0.69	1	0.40

All test statistics relate to the re-estimation of Okun's coefficients in Tables 3 in system OLS. The Joint rows test the null hypothesis that the ratio of the US agriculture/US sector i is equal to j agriculture/j sector i for country j for all sectors i, jointly. The Manufacturing and Services rows test the null hypothesis that US manufacturing/US services is equal to j manufacturing/j services for country j.

Table 9: Is One Sector's Coefficient Equal to the Aggregate?

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Frequency	Yearly			
T statistic				
Agriculture	7.09***	6.91***	18.22***	7.71***
Manufacturing	-1.16	0.24	3.84**	2.74***
Service	1.09	2.76***	0.88	-0.84
Government	15.9***	16.1***	10.86***	0.79
N	20	22	15	16

This table reports the T-statistic for the null hypothesis that the sectoral coefficient is equal to the aggregate coefficient for the same country from Table 3. $*p < 0.1$; $**p < 0.5$; $***p < 0.01$.

Table 10: Is One Sector's Coefficient Equal to the Aggregate?

Country	The US	The UK	Switzerland	Japan
Period	2000-2017	1995-2017	2002-2017	2002-2016
Frequency	Yearly			
T statistic				
Agriculture	7.54***	6.91***	18.22***	6.06***
Manufacturing, Mining & Utilities	0.8	-0.72	4.83***	2.53**
Construction	1.48*	1.55	6.51***	2.81***
Wholesale & Retail Trade	10.06***	3.58***	2.12*	4.47***
Transportation & Information	4***	5.27***	4.13***	2.75***
Financial Activities	11.16***	4.5***	6.53***	3.65***
Accommodation	7.61***	2.66***	-0.10	3.18***
Education	9.63***	12.61***	6.81***	4.49***
Professional and Business	3.54***	3.58***	-1.43	
Other Services	9.28***	6.29***	12.86***	-0.71
Government	20.05***	16.1***	10.86***	0.37
N	17	22	15	14

This table reports the T-statistic for the null hypothesis that the sectoral coefficient is equal to the aggregate coefficient for the same country from Table 5. $*p < 0.1$; $**p < 0.5$; $***p < 0.01$.

Table 11: Standard Deviation of Output, $\sigma_{\Delta y}$, for 4 Sectors

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Frequency	Yearly			
	$\sigma_{\Delta y}$			
Total	1.664	1.739	1.530	2.051
Agriculture	8.258	2.667	6.125	6.426
Manufacture	2.937	3.419	3.414	5.453
Service	1.67	1.712	1.449	1.307
Government	0.736	1.971	0.451	0.729
N	20	22	15	16

Table 12: Standard Deviation of Output, $\sigma_{\Delta y}$, for Disaggregated Sectors

Country	The US	The UK	Switzerland	Japan
Period	2000-2017	1995-2017	2002-2017	2002-2016
Frequency	Yearly			
	$\sigma_{\Delta y}$			
Total	1.51	1.739	1.520	2.192
Agriculture	8.363	2.667	6.125	6.297
Manufacturing, Mining & Utilities	2.827	2.854	4.216	7.209
Construction	4.923	5.023	1.954	4.446
Wholesale & Retail Trade	3.137	2.81	2.388	3.056
Transportation & Information	3.458	3.705	2.060	2.859
Financial Activities	2.323	2.183	4.728	1.644
Accommodation	2.933	2.856	3.756	3.654
Education & Health	1.237	1.29	1.479	0.861
Professional and Business	2.559	4.134	1.479	
Other Services	3.407	2.533	6.270	2.499
Government	0.717	1.971	0.451	0.742
N	17	22	15	14

Table 13: Standard Deviation of Unemployment Rate, $\sigma_{\Delta u}$, for 4 Sectors

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Frequency	Yearly			
	$\sigma_{\Delta u}$			
Total	0.992	0.563	0.497	0.372
Agriculture	1.722	0.577	0.209	0.25
Manufacture	2.053	1.047	0.641	0.5
Service	0.834	0.49	0.448	0.371
Government	0.479	0.338	0.226	0.301
N	20	22	15	16

Table 14: Standard Deviation of Unemployment Rate, $\sigma_{\Delta u}$, for Disaggregated Sectors

Country	The US	The UK	Switzerland	Japan
Period	2000-2017	1995-2017	2002-2017	2002-2016
Frequency	Yearly			
	$\sigma_{\Delta u}$			
Total	1.127	0.563	0.497	0.368
Agriculture	1.859	0.577	0.209	0.278
Manufacturing, Mining & Utilities	1.969	0.925	0.68	0.519
Construction	2.866	1.346	0.596	0.491
Wholesale & Retail Trade	1.044	0.727	0.569	0.281
Transportation & Information	1.275	0.618	0.424	0.471
Financial Activities	0.907	0.519	0.473	0.572
Accommodation	1.112	0.974	1.208	0.451
Education & Health	0.605	0.297	0.184	0.349
Professional and Business	1.462	0.7	0.748	
Other Services	0.996	0.625	0.299	0.871
Government	0.478	0.338	0.226	0.323
N	17	22	15	14

Table 15: Correlation Between Unemployment and Output

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Frequency	Yearly			
Corr(Δu_t,ΔY_t)				
Total	-0.754	-0.823	-0.772	-0.69
Agriculture	0.181	-0.418	-0.304	-0.016
Manufacture	-0.794	-0.849	-0.856	-0.664
Service	-0.761	-0.719	-0.619	-0.53
Government	0.286	0.043	0.377	-0.24
N	20	22	15	16

Table 16: Correlation Between Unemployment and Output - Disaggregated Sectors

Country	The US	The UK	Switzerland	Japan
Period	2000-2017	1995-2017	2002-2017	2002-2016
Frequency	Yearly			
Corr(Δu_t,ΔY_t)				
Total	-0.841	-0.823	-0.772	-0.716
Agriculture	0.162	-0.418	-0.304	-0.189
Manufacturing, Mining & Utilities	-0.76	-0.869	-0.864	-0.707
Construction	-0.861	-0.633	0.223	-0.258
Wholesale & Retail Trade	-0.798	-0.57	-0.252	-0.339
Transportation & Information	-0.669	-0.691	-0.446	-0.161
Financial Activities	-0.091	-0.247	-0.307	0.075
Accommodation	-0.764	-0.329	-0.796	-0.23
Education & Health	0.113	-0.065	-0.332	0.187
Professional and Business	-0.772	-0.782	-0.666	
Other Services	-0.484	-0.446	-0.131	-0.49
Government	0.341	0.043	0.377	-0.243
N	17	22	15	14

Table 17: Sectoral Results from $\sigma_{u,FD}$ Adjusted Unemployment Rate

Country	The US	The UK	Switzerland	Japan	Test
Period	1997-2017	1995-2017	2002-2017	2000-2016	
Frequency	Yearly				
$100 * \Delta Y_t$	Dependent variable: $\Delta u_{t,adjusted}$				
Total	-0.453***	-0.473***	-0.504***	-0.430***	χ^2_3=3.72
	(0.121)	(0.044)	(0.081)	(0.078)	P-value = 0.293
R^2	0.568	0.678	0.596	0.475	
Agriculture	0.022	-0.157	-0.050	-0.009	χ^2_3= 4.05
	(0.029)	(0.098)	(0.040)	(0.032)	P-value = 0.256
R^2	0.033	0.175	0.092	0	
Manufacturing	-0.270***	-0.248***	-0.251***	-0.190***	χ^2_3= 11.15
	(0.069)	(0.039)	(0.040)	(0.042)	P-value = 0.011
R^2	0.631	0.720	0.732	0.441	
Service	-0.455***	-0.420***	-0.427**	-0.436**	χ^2_3= 1.35
	(0.11)	(0.073)	(0.184)	(0.187)	P-value = 0.718
R^2	0.578	0.517	0.383	0.281	
Government	0.389*	0.022	0.837*	-0.348	χ^2_3= 4.28
	(0.203)	(0.129)	(0.445)	(0.373)	P-value = 0.233
R^2	0.082	0.002	0.142	0.058	
N	20	22	15	16	

Compared with table 3, the change in the unemployment rate was normalized by the standard deviation ($\Delta u_{t,adjusted} = \frac{u_t - u_{t-1}}{\sigma_{\Delta u}}$). The regressions for each country are run in system OLS with HAC robust standard errors in parenthesis. The last column shows the joint hypothesis test that the Okun's coefficients are the same across countries within a row. $*p < 0.1$; $**p < 0.5$; $***p < 0.01$.

Table 18: Disaggregated Sectoral Results from $\sigma_{u,FD}$ Adjusted Unemployment Rate

Country	The US	The UK	Switzerland	Japan	Test
Period	2000-2017	1995-2017	2002-2017	2002-2016	
Frequency	Yearly				
$100 * \Delta Y_t$	Dependent variable: $\Delta u_{t,adjusted}$				
Total	-0.557***	-0.473***	-0.504***	-0.327***	χ^2_3=2.88
	(0.095)	(0.044)	(0.081)	(0.097)	P-value = 0.410
R^2	0.707	0.678	0.596	0.513	
Agriculture	0.019	-0.157	-0.050	-0.03	χ^2_3= 4.27
	(0.032)	(0.098)	(0.039)	(0.037)	P-value = 0.233
R^2	0.026	0.175	0.092	0.036	
Manufacturing, Mining & Utilities	-0.269***	-0.305***	-0.205***	-0.098**	χ^2_3= 18.63
	(0.087)	(0.03)	(0.029)	(0.038)	P-value = 0.000
R^2	0.578	0.756	0.746	0.499	
Construction	-0.175***	-0.126**	0.114	-0.058**	χ^2_3= 6.32
	(0.027)	(0.051)	(0.163)	(0.028)	P-value = 0.097
R^2	0.741	0.4	0.050	0.067	
Wholesale & Retail Trade	-0.254***	-0.203***	-0.105	-0.111	χ^2_3= 3.12
	(0.035)	(0.075)	(0.132)	(0.095)	P-value = 0.373
R^2	0.637	0.325	0.063	0.115	
Transportation & Information	-0.193***	-0.186***	-0.217*	-0.056	χ^2_3= 3.10
	(0.069)	(0.041)	(0.125)	(0.073)	P-value = 0.376
R^2	0.447	0.477	0.199	0.026	
Financial Activities	-0.039	-0.113	-0.065	0.045	χ^2_3= 0.84
	(0.097)	(0.101)	(0.054)	(0.077)	P-value = 0.840
R^2	0.008	0.061	0.094	0.006	
Accommodation	-0.261***	-0.115	-0.212***	-0.063	χ^2_3= 5.32
	(0.053)	(0.086)	(0.044)	(0.069)	P-value = 0.150
R^2	0.584	0.108	0.633	0.053	
Education & Health	0.091	-0.05	-0.224	0.218	χ^2_3= 1.77
	(0.142)	(0.131)	(0.168)	(0.175)	P-value = 0.622
R^2	0.013	0.004	0.11	0.035	
Professional and Business	-0.302***	-0.189***	-0.434***		χ^2_2= 4.05
	(0.034)	(0.044)	(0.093)		P-value = 0.132
R^2	0.596	0.611	0.444		
Other Services	-0.142	-0.176**	-0.02	-0.196	χ^2_2= 17.14
	(0.087)	(0.084)	(0.016)	(0.129)	P-value = 0.001
R^2	0.234	0.199	0.017	0.24	
Government	0.475**	0.022	0.837*	-0.327	χ^2_2= 3.91
	(0.207)	(0.129)	(0.445)	(0.401)	P-value = 0.272
R^2	0.116	0.002	0.142	0.059	
N	17	22	15	14	

Compared with table 5, the change in the unemployment rate was normalized by the standard deviation ($\Delta u_{t,adjusted} = \frac{u_t - u_{t-1}}{\sigma_{\Delta u}}$). The regressions for each sector are run in system OLS with HAC robust standard errors in parenthesis. The last column shows the joint hypothesis test that the Okun's coefficients in that row are the same for all countries. $*p < 0.1$; $**p < 0.5$; $***p < 0.01$.

A Appendix

Table A.1: Sectoral Results from Quarterly Data

Country	The US		The UK	
Period	2005Q1-2018Q2		1995Q1-2018Q1	
Frequency	Quarterly			
$100\Delta Y_t$ or $100(Y_t - Y_t^*)$	Dependent variable: Δu_t or $u_t - u_t^*$			
Total	-0.351***	-0.286***	-0.179***	-0.106***
	(0.088)	(0.031)	(0.029)	(0.017)
R^2	0.39	0.71	0.38	0.36
Agriculture	0.018	0.049	0.002	-0.022
	(0.039)	(0.026)	(0.044)	(0.026)
R^2	0.005	0.086	0	0.006
Manufacturing	-0.285***	-0.280***	-0.172***	-0.153***
	(0.096)	(0.049)	(0.026)	(0.020)
R^2	0.28	0.49	0.32	0.59
Service	-0.264***	-0.242***	-0.111***	-0.063***
	(0.058)	(0.027)	(0.027)	(0.016)
R^2	0.32	0.72	0.23	0.2
Government	-0.029	0.021	0.015	0.009
	(0.134)	(0.058)	(0.047)	(0.019)
R^2	0.001	0.003	0.002	0.002
First Difference	Yes	No	Yes	No
HP Filter	No	Yes	No	Yes
N	53	54	92	93

HAC standard errors in parenthesis. $^*p < 0.1$; $^{**}p < 0.5$; $^{***}p < 0.01$.

Table A.2: Disaggregated Sectoral Results from the HP Filter Method or Quarterly Data

Country	The US	The UK	Switzerland	Japan	The US		The UK	
Period	2000-2017	1995-2017	2002-2017	2002-2016	2005Q1-2018Q2		1995Q1-2018Q1	
Frequency	Yearly				Quarterly			
$100\Delta Y_t$ or $100(Y_t - Y_t^*)$	Dependent variable: Δu_t or $u_t - u_t^*$							
Total	-0.650***	-0.293***	-0.248***	-0.159***	-0.351***	-0.286***	-0.179***	-0.106***
	(0.068)	(0.045)	(0.029)	(0.014)	(0.088)	(0.031)	(0.029)	(0.017)
R^2	0.83	0.66	0.62	0.8	0.39	0.71	0.38	0.36
Agriculture	0.006	-0.141***	-0.014	-0.007	0.018	0.049*	0.002	-0.022
	(0.091)	(0.025)	(0.008)	(0.006)	(0.039)	(0.026)	(0.044)	(0.026)
R^2	0	0.45	0.07	0.06	0	0.090	0	0.01
Manufacturing, Mining & Utilities	-0.593***	-0.300***	-0.158***	-0.085***	-0.247**	-0.259***	-0.175***	-0.152***
	(0.110)	(0.032)	(0.019)	(0.011)	(0.112)	(0.052)	(0.032)	(0.023)
R^2	0.71	0.7	0.83	0.72	0.25	0.46	0.23	0.47
Construction	-0.445***	-0.193***	0.077	-0.039*	-0.311***	-0.238***	-0.109***	-0.094***
	(0.055)	(0.041)	(0.054)	(0.022)	(0.068)	(0.044)	(0.029)	(0.020)
R^2	0.83	0.39	0.08	0.2	0.39	0.46	0.16	0.32
Wholesale & Retail Trade	-0.261***	-0.182***	-0.040	-0.038**	-0.145**	-0.139***	-0.041	-0.039**
	(0.034)	(0.039)	(0.043)	(0.017)	(0.064)	(0.022)	(0.027)	(0.016)
R^2	0.75	0.52	0.04	0.26	0.19	0.58	0.03	0.07
Transportation & Information	-0.314***	-0.139***	-0.117	-0.073***	-0.061	-0.156***	-0.049**	-0.056***
	(0.064)	(0.029)	(0.070)	(0.023)	(0.049)	(0.030)	(0.021)	(0.020)
R^2	0.47	0.47	0.24	0.25	0.04	0.39	0.04	0.15
Financial Activities	-0.246**	-0.117*	-0.048***	-0.096	-0.045	-0.048	-0.042	-0.023
	(0.117)	(0.060)	(0.017)	(0.088)	(0.101)	(0.033)	(0.030)	(0.024)
R^2	0.16	0.12	0.31	0.1	0.02	0.04	0.02	0.01
Accommodation	-0.348***	-0.192***	-0.236***	-0.074***	-0.183***	-0.135***	-0.011	-0.016
	(0.054)	(0.068)	(0.050)	(0.019)	(0.055)	(0.017)	(0.032)	(0.021)
R^2	0.71	0.24	0.64	0.35	0.15	0.4	0	0.01
Education & Health	-0.056	-0.040	-0.017	-0.010	0.016	0.030	0.003	-0.004
	(0.181)	(0.045)	(0.032)	(0.092)	(0.067)	(0.049)	(0.019)	(0.010)
R^2	0.01	0.02	0.02	0	0	0.01	0	0
Professional and Business	-0.658***	-0.138***	-0.223***		-0.246***	-0.236***	-0.049**	-0.054***
	(0.102)	(0.028)	(0.076)		(0.059)	(0.030)	(0.024)	(0.012)
R^2	0.79	0.49	0.24		0.31	0.66	0.07	0.29
Other Services	-0.290***	-0.246***	-0.019	-0.097**	-0.311***	-0.161***	-0.006	-0.024
	(0.076)	(0.048)	(0.015)	(0.041)	(0.079)	(0.043)	(0.018)	(0.016)
R^2	0.6	0.49	0.06	0.11	0.24	0.26	0	0.02
Government	0.231	0.065**	0.172	-0.117	-0.029	0.021	0.015	0.009
	(0.195)	(0.026)	(0.113)	(0.105)	(0.134)	(0.058)	(0.047)	(0.019)
R^2	0.09	0.13	0.06	0.05	0	0	0	0
N	18	23	16	15	53	54	92	93
First Difference	No	No	No	No	Yes	No	Yes	No
HP Filter	Yes	Yes	Yes	Yes	No	Yes	No	Yes

HAC standard errors in parenthesis. $^*p < 0.1$; $^{**}p < 0.5$; $^{***}p < 0.01$.

Table A.3: National Results with the US Sectoral GVA Composition (HP Filter)

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Frequency	Yearly			
$100 * (Y_{i,US,t} - Y^*_{i,US,t})$	Dependent variable: $u_{i,US,t} - u^*_{i,US,t}$			
Total	-0.599***	-0.274***	-0.241***	-0.149***
	(0.063)	(0.049)	(0.034)	(0.015)
R^2	0.834	0.522	0.608	0.758
N	21	23	16	17

HAC standard errors in parenthesis. $^*p < 0.1$; $^{**}p < 0.5$; $^{***}p < 0.01$.

Table A.4: National Results with the US Sectoral Employment-Labor Force Ratio (HP Filter)

Country	The US	The UK	Switzerland	Japan
Period	1997-2017	1995-2017	2002-2017	2000-2016
Frequency	Yearly			
$100 * (Y_{i,US,t} - Y^*_{i,US,t})$	Dependent variable: $u_{i,US,t} - u^*_{i,US,t}$			
Total	-0.599***	-0.274***	-0.269***	-0.176***
	(0.063)	(0.049)	(0.043)	(0.021)
R^2	0.834	0.529	0.565	0.734
N	21	23	16	17

This table shows the aggregate coefficients when the 11 sectors are scaled to match the US employment shares before aggregating them. HAC standard errors in parenthesis. $^*p < 0.1$; $^{**}p < 0.5$; $^{***}p < 0.01$.

Table A.5: Is One Sector Driving the Aggregate (HP Filter or Quarterly Data)?

Country	The US	The UK	Switzerland	Japan	The US		The UK	
Period	1997-2017	1995-2017	2002-2017	2000-2016	2005Q1-2018Q2		1995Q1-2018Q1	
Frequency	Yearly				Quarterly			
	T statistic							
Agriculture	26.23***	14.08***	29.79***	37.69***	13.97***	60.23***	24.17***	26.2***
Manufacturing	-1.46*	-1.03	4.97***	12.81***	3.32***	0.72	1.46*	-17.08***
Service	4.98***	3.09***	5.93***	-0.15	7.71***	7.74**	17.67***	17.62***
Government	18.74***	32.5***	13.87***	2.13*	16.61***	33.58***	32.6***	43.07***
N	21	23	16	17	53	54	92	93
First Difference	No	No	No	No	Yes	No	Yes	No
HP Filter	Yes	Yes	Yes	Yes	No	Yes	No	Yes

This table reports the T-statistic for the null hypothesis that the sectoral coefficient is equal to the aggregate coefficient for the same country from Table 5. $*p < 0.1$; $**p < 0.5$; $***p < 0.01$.

Table A.6: Is One Sector Driving the Aggregate (HP Filter or Quarterly data)?

Country	The US	The UK	Switzerland	Japan	The US		The UK	
Period	2000-2017	1995-2017	2002-2017	2002-2016	2005Q1-2018Q2		1995Q1-2018Q1	
Frequency	Yearly				Quarterly			
	T statistic							
Agriculture	23.73***	14.08***	29.79***	37.76***	13.97***	60.23***	24.17***	26.2***
Manufacturing, Mining & Utilities	1.84*	-0.54	9.97***	15.76***	4.57***	3.31***	0.73	-15.39***
Construction	9.62***	7.79***	20.45***	17.59***	2.32**	6.56***	10.81***	4.31***
Wholesale & Retail Trade	21.02***	8.9***	15.34***	20.95***	16.53***	28.25***	29.55***	27.52***
Transportation & Information	14.83***	13.66***	6.69***	11.87***	20.28***	21.95***	27.37***	18.25***
Financial Activities	12.28***	11.07***	23.02***	2.67***	17.95***	38.46***	23.26***	27.25***
Accommodation	14.31***	5.82***	0.80	13.56***	13.98***	30.88***	23.33***	31.21***
Education	12.68***	18.87***	20.68***	5.98***	30.44***	39.74***	67.18***	48.87***
Professional and Business	-0.24	13.9***	1.19		7.74***	8.47***	22.38***	24.06***
Other Services	14.53***	3.41***	27.14***	5.37***	2.73***	17.07***	32.21***	33***
Government	17.62***	32.5***	13.87***	1.48	16.61***	33.58***	32.6***	43.07***
N	18	23	16	15	53	54	92	93
First Difference	No	No	No	No	Yes	No	Yes	No
HP Filter	Yes	Yes	Yes	Yes	No	Yes	No	Yes

This table reports the T-statistic for the null hypothesis that the sectoral coefficient is equal to the aggregate coefficient for the same country from Table 5. $*p < 0.1$; $**p < 0.5$; $***p < 0.01$.

Table A.7: Standard Deviation of Unemployment Rate, σ_{u-u^*} or $\sigma_{\Delta u}$, for 4 Sectors (HP Filter or Quarterly Data)

Country	The US	The UK	Switzerland	Japan	The US		The UK	
Period	1997-2017	1995-2017	2002-2017	2000-2016	2005Q1-2018Q2		1995Q1-2018Q1	
Frequency	Yearly				Quarterly			
σ_{u-u^*} or $\sigma_{\Delta u}$								
Total	1.114	0.649	0.401	0.329	0.339	0.367	0.181	0.198
Agriculture	1.785	0.561	0.195	0.169	1.389	1.117	0.55	0.418
Manufacture	2.16	1.085	0.508	0.477	0.788	0.901	0.391	0.444
Service	0.954	0.584	0.372	0.298	0.31	0.322	0.159	0.166
Government	0.586	0.373	0.284	0.247	0.265	0.183	0.305	0.209
N	21	23	16	17	53	54	92	93
First Difference	No	No	No	No	Yes	No	Yes	No
HP Filter	Yes	Yes	Yes	Yes	No	Yes	No	Yes

Table A.8: Standard Deviation of Unemployment Rate, σ_{u-u^*} or $\sigma_{\Delta u}$, for Disaggregated Sectors

Country	The US	The UK	Switzerland	Japan	The US		The UK	
Period	2000-2017	1995-2017	2002-2017	2002-2016	2005Q1-2018Q2		1995Q1-2018Q1	
Frequency	Yearly				Quarterly			
σ_{u-u^*} or $\sigma_{\Delta u}$								
Total	1.237	0.649	0.401	0.332	0.339	0.367	0.181	0.198
Agriculture	1.92	0.561	0.195	0.177	1.389	1.117	0.55	0.418
Manufacturing, Mining & Utilities	1.881	0.843	0.534	0.527	0.758	0.866	0.418	0.452
Construction	3.237	1.5	0.505	0.433	1.029	1.057	0.542	0.53
Wholesale & Retail Trade	1.175	0.569	0.482	0.227	0.442	0.397	0.319	0.304
Transportation & Information	1.342	0.664	0.352	0.382	0.572	0.548	0.365	0.308
Financial Activities	1.02	0.512	0.427	0.416	0.461	0.374	0.38	0.319
Accommodation	1.248	1.043	1.012	0.405	0.517	0.426	0.555	0.484
Education & Health	0.7	0.337	0.164	0.226	0.274	0.232	0.149	0.135
Professional and Business	1.525	0.73	0.606		0.558	0.561	0.336	0.318
Other Services	1.104	0.707	0.262	0.75	0.554	0.424	0.46	0.357
Government	0.579	0.373	0.284	0.264	0.265	0.183	0.305	0.209
N	18	23	16	15	53	54	92	93
First Difference	No	No	No	No	Yes	No	Yes	No
HP Filter	Yes	Yes	Yes	Yes	No	Yes	No	Yes

Table A.9: Standard Deviation of Unemployment Rate, σ_{Y-Y^*} or $\sigma_{\Delta Y}$, for 4 Sectors (HP Filter or Quarterly Data)

Country	The US	The UK	Switzerland	Japan	The US		The UK	
Period	1997-2017	1995-2017	2002-2017	2000-2016	2005Q1-2018Q2		1995Q1-2018Q1	
Frequency	Yearly				Quarterly			
	σ_{Y-Y^*} or $\sigma_{\Delta Y}$							
Total	1.697	1.798	1.278	1.746	0.607	1.085	0.627	1.12
Agriculture	5.814	2.665	3.598	5.657	5.248	6.718	1.433	1.504
Manufacture	3.099	2.953	2.411	4.201	1.454	2.257	1.276	2.225
Service	1.721	1.754	1.456	1.379	0.664	1.13	0.681	1.167
Government	0.66	2.091	0.414	0.537	0.278	0.481	0.77	1.083
N	21	23	16	17	53	54	92	93
First Difference	No	No	No	No	Yes	No	Yes	No
HP Filter	Yes	Yes	Yes	Yes	No	Yes	No	Yes

Table A.10: Standard Deviation of Unemployment Rate, σ_{Y-Y^*} or $\sigma_{\Delta Y}$, for Disaggregated Sectors

Country	The US	The UK	Switzerland	Japan	The US		The UK	
Period	2000-2017	1995-2017	2002-2017	2002-2016	2005Q1-2018Q2		1995Q1-2018Q1	
Frequency	Yearly				Quarterly			
	σ_{Y-Y^*} or $\sigma_{\Delta Y}$							
Total	1.738	1.798	1.278	1.866	0.607	1.085	0.627	1.12
Agriculture	6.02	2.665	3.598	5.9	5.248	6.718	1.433	1.504
Manufacturing, Mining & Utilities	2.667	2.357	3.079	5.249	1.548	2.276	1.146	2.051
Construction	6.617	4.84	1.889	5.01	2.08	3.004	2.011	3.175
Wholesale & Retail Trade	3.89	3.277	2.231	3.013	1.327	2.165	1.288	2.091
Transportation & Information	2.923	3.286	1.486	2.61	1.87	2.211	1.48	2.134
Financial Activities	1.633	1.544	5.001	1.378	1.308	1.525	1.171	1.24
Accommodation	3.017	2.66	3.421	3.241	1.081	1.999	1.778	2.226
Education & Health	0.919	1.252	1.382	0.619	0.583	0.81	0.717	0.989
Professional and Business	2.061	3.717	1.337		1.273	1.929	1.858	3.148
Other Services	2.95	2.024	3.508	2.586	0.875	1.354	2.423	2.149
Government	0.738	2.091	0.415	0.52	0.278	0.481	0.77	1.083
N	18	23	16	15	53	54	92	93
First Difference	No	No	No	No	Yes	No	Yes	No
HP Filter	Yes	Yes	Yes	Yes	No	Yes	No	Yes

Table A.11: Standard Deviation Ratios, $\sigma_{u-u^*}/\sigma_{y-y^*}$ or $\sigma_{\Delta u}/\sigma_{\Delta Y}$, for 4 Sectors

Country	The US		The US		The UK		The UK		Switzerland		Japan		Japan	
Period	1997-2017		2005Q1-2018Q2		1995-2017		1995Q1-2018Q1		2002-2017		1994-2016		2000-2016	
Frequency	Yearly		Quarterly		Yearly		Quarterly		Yearly		Yearly		Yearly	
						$\sigma_{u-u^*}/\sigma_{y-y^*}$ or $\sigma_{\Delta u}/\sigma_{\Delta Y}$								
Total	0.597	0.657	0.559	0.339	0.324	0.361	0.29	0.177	0.325	0.314	0.203	0.196	0.181	0.188
Agriculture	0.208	0.307	0.265	0.166	0.216	0.21	0.384	0.278	0.034	0.054	0.051	0.04	0.039	0.03
Manufacture	0.699	0.697	0.542	0.399	0.306	0.367	0.307	0.2	0.188	0.211	0.104	0.124	0.092	0.113
Service	0.5	0.554	0.468	0.285	0.286	0.333	0.233	0.142	0.309	0.255	0.362	0.268	0.284	0.216
Government	0.651	0.888	0.953	0.38	0.171	0.178	0.396	0.193	0.501	0.684			0.412	0.461
First Difference	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
HP Filter	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	20	21	53	54	22	23	92	93	15	16	22	23	16	17

Table A.12: Sectoral Results from $\sigma_{u,FD}$ Adjusted Unemployment Rate (HP Filter or Quarterly Data)

Country	The US	The UK
Period	2005Q1-2018Q2	1995Q1-2018Q1
Frequency	Quarterly	
$100 * \Delta Y_t$	Dependent variable: $\Delta u_{t,adjusted}$	
Total	-1.034***	-0.986***
	(0.261)	(0.162)
R^2	0.395	0.381
Agriculture	0.013	0.004
	(0.028)	(0.080)
R^2	0.005	0
Manufacturing	-0.362***	-0.440***
	(0.122)	(0.066)
R^2	0.277	0.315
Service	-0.852***	-0.700***
	(0.187)	(0.173)
R^2	0.32	0.227
Government	-0.109	0.050
	(0.507)	(0.155)
R^2	0.001	0.002
N	53	92

The change in the unemployment rate was normalized by the standard deviation ($\Delta u_{t,adjusted} = \frac{u_t - u_{t-1}}{\sigma_{\Delta u}}$). The regressions for each country are run in system OLS with HAC robust standard errors in parenthesis. *$p < 0.1$; **$p < 0.5$; ***$p < 0.01$.

Table A.13: Disaggregated Sectoral Results from $\sigma_{u,FD}$ Adjusted Unemployment Rate

Country	The US	The UK
Period	2005Q1-2018Q2	1995Q1-2018Q1
Frequency	Quarterly	
$100 * \Delta Y_t$	Dependent variable: $\Delta u_{t,adjusted}$	
Total	-1.034***	-0.986***
	(0.261)	(0.162)
R^2	0.395	0.381
Agriculture	0.013	0.004
	(0.028)	(0.08)
R^2	0.005	0
Manufacturing, Mining & Utilities	-0.325**	-0.418***
	(0.148)	(0.077)
R^2	0.254	0.23
Construction	-0.302***	-0.201***
	(0.066)	(0.053)
R^2	0.394	0.164
Wholesale & Retail Trade	-0.327**	-0.127
	(0.146)	(0.083)
R^2	0.189	0.027
Transportation & Information	-0.106	-0.134**
	(0.086)	(0.056)
R^2	0.039	0.039
Financial Activities	-0.098	-0.112
	(0.219)	(0.078)
R^2	0.016	0.017
Accommodation	-0.353***	-0.02
	(0.107)	(0.058)
R^2	0.145	0.001
Education & Health	0.058	0.017
	(0.244)	(0.129)
R^2	0.001	0
Professional and Business	-0.44***	-0.424***
	(0.106)	(0.072)
R^2	0.314	0.072
Other Services	-0.562***	-0.012
	(0.143)	(0.038)
R^2	0.242	0.001
Government	-0.109	0.05
	(0.507)	(0.155)
R^2	0.001	0.002
N	53	92

The change in the unemployment rate was normalized by the standard deviation ($\Delta u_{t,adjusted} = \frac{u_t - u_{t-1}}{\sigma_{\Delta u}}$) and the HP filtered series as well ($u_{t,adjusted} - u^*_{t,adjusted} = \frac{u_{t,adjusted} - u^*_{t,adjusted}}{\sigma_{u_t - u^*_t}}$). The regressions for each country are run in system OLS with HAC robust standard errors in parenthesis. $^*p < 0.1$; $^{**}p < 0.5$; $^{***}p < 0.01$.

Table A.14: Sectoral Results from $\sigma_{u,HP}$ Adjusted Unemployment Rate

Country	The US		The UK		Switzerland	Japan
Period	1997-2017	2005Q1-2018Q2	1995-2017	1995Q1-2018Q1	2002-2017	2000-2016
Frequency	Yearly	Quarterly	Yearly	Quarterly	Yearly	
$100 * (Y_t - Y_t^*)$	Dependent variable: $u_{t,adjusted} - u^*_{t,adjusted}$					
Total	-0.538***	-0.779***	-0.452***	-0.535***	-0.618***	-0.487***
	(0.057)	(0.083)	(0.069)	(0.087)	(0.073)	(0.046)
R^2	0.834	0.715	0.661	0.36	0.624	0.722
Agriculture	0.009	0.044*	-0.251***	-0.052	-0.071*	-0.013
	(0.047)	(0.023)	(0.044)	(0.061)	(0.042)	(0.042)
R^2	0.003	0.086	0.448	0.006	0.066	0.006
Manufacturing	-0.294***	-0.311***	-0.281***	-0.344***	-0.376***	-0.199***
	(0.04)	(0.055)	(0.028)	(0.044)	(0.066)	(0.029)
R^2	0.828	0.494	0.691	0.586	0.820	0.699
Service	-0.532***	-0.752***	-0.430***	-0.382***	-0.455***	-0.542***
	(0.056)	(0.084)	(0.079)	(0.094)	(0.113)	(0.137)
R^2	0.839	0.723	0.568	0.198	0.440	0.559
Government	0.514	0.115	0.175**	0.045	0.605	-0.423
	(0.35)	(0.32)	(0.071)	(0.091)	(0.399)	(0.417)
R^2	0.115	0.003	0.135	0.002	0.063	0.051
N	21	54	23	93	16	17

The unemployment rate gap was normalized by the standard deviation ($u_{t,adjusted} - u^*_{t,adjusted} = \frac{u_{t,adjusted} - u^*_{t,adjusted}}{\sigma_{u_t - u_t^*}}$). The regressions for each country are run in system OLS with HAC robust standard errors in parenthesis. $*p < 0.1$; $**p < 0.5$; $***p < 0.01$.

Table A.15: Disaggregated Sectoral Results from $\sigma_{u,HP}$ Adjusted Unemployment Rate

Country	The US		The UK		Switzerland	Japan
Period	2000-2017	2005Q1-2018Q1	1995-2017	1995Q1-2018Q1	2002-2017	2002-2016
Frequency	Yearly	Quarterly	Yearly	Quarterly	Yearly	
$100 * (Y_t - Y_t^*)$	Dependent variable: $u_{t,adjusted} - u^*_{t,adjusted}$					
Total	-0.526***	-0.779***	-0.452***	-0.535***	-0.601***	-0.479***
	(0.055)	(0.083)	(0.069)	(0.087)	(0.073)	(0.041)
R^2	0.835	0.715	0.661	0.36	0.624	0.799
Agriculture	0.003	0.044*	-0.251***	-0.052	-0.071*	-0.042
	(0.048)	(0.023)	(0.044)	(0.061)	(0.042)	(0.034)
R^2	0	0.086	0.448	0.006	0.066	0.062
Manufacturing, Mining & Utilities	-0.315***	-0.298***	-0.355***	-0.336***	-0.297***	-0.161***
	(0.058)	(0.06)	(0.038)	(0.05)	(0.035)	(0.021)
R^2	0.706	0.461	0.702	0.474	0.834	0.718
Construction	-0.137***	-0.225***	-0.129***	-0.178***	0.153	-0.09*
	(0.017)	(0.041)	(0.027)	(0.037)	(0.107)	(0.05)
R^2	0.83	0.458	0.388	0.32	0.084	0.203
Wholesale & Retail Trade	-0.222***	-0.351***	-0.221***	-0.128**	-0.083	-0.168**
	(0.029)	(0.054)	(0.047)	(0.052)	(0.090)	(0.073)
R^2	0.747	0.577	0.523	0.071	0.037	0.256
Transportation & Information	-0.234***	-0.284***	-0.209***	-0.183***	-0.332*	-0.192***
	(0.047)	(0.055)	(0.043)	(0.064)	(0.198)	(0.061)
R^2	0.469	0.395	0.474	0.152	0.244	0.252
Financial Activities	-0.241**	-0.128	-0.229*	-0.071	-0.112***	-0.23
	(0.115)	(0.087)	(0.117)	(0.075)	(0.039)	(0.211)
R^2	0.155	0.038	0.125	0.008	0.314	0.101
Accommodation	-0.279***	-0.318***	-0.185***	-0.034	-0.233***	-0.182***
	(0.043)	(0.041)	(0.065)	(0.044)	(0.050)	(0.047)
R^2	0.709	0.403	0.241	0.006	0.635	0.349
Education & Health	-0.079	0.131	-0.119	-0.029	-0.105	-0.045
	(0.258)	(0.21)	(0.132)	(0.075)	(0.193)	(0.408)
R^2	0.005	0.011	0.022	0.001	0.021	0.001
Professional and Business	-0.431***	-0.421***	-0.189***	-0.17***	-0.368***	
	(0.067)	(0.054)	(0.038)	(0.036)	(0.125)	
R^2	0.789	0.659	0.495	0.287	0.242	
Other Services	-0.262***	-0.38***	-0.348***	-0.068	-0.072	-0.13**
	(0.069)	(0.102)	(0.068)	(0.046)	(0.056)	(0.055)
R^2	0.6	0.265	0.495	0.021	0.063	0.112
Government	0.399	0.115	0.175**	0.045	0.605	-0.443
	(0.336)	(0.32)	(0.071)	(0.091)	(0.399)	(0.398)
R^2	0.087	0.003	0.135	0.002	0.063	0.053
N	18	54	23	93	16	15

The unemployment rate gap was normalized by the standard deviation ($u_{t,adjusted} - u^*_{t,adjusted} = \frac{u_{t,adjusted} - u^*_{t,adjusted}}{\sigma_{u_t - u_t^*}}$). The regressions for each country are run in system OLS with HAC robust standard errors in parenthesis. $*p < 0.1$; $**p < 0.5$; $***p < 0.01$.

Table A.16: Correlation Between Unemployment and Output

Country	The US	The UK	Switzerland	Japan	The US		The UK	
Period	1997-2017	1995-2017	2002-2017	2002-2016	2005Q1-2018Q2		1995Q1-2018Q1	
Frequency	Yearly				Quarterly			
Corr(Δu_t,ΔY_t) or Corr($u_t - u_t^*$,$Y_t - Y_t^*$)								
Total	-0.913	-0.813	-0.79	-0.85	-0.628	-0.845	-0.617	-0.6
Agriculture	0.055	-0.669	-0.256	-0.075	0.069	0.293	0.006	-0.078
Manufacture	-0.91	-0.831	-0.906	-0.836	-0.526	-0.703	-0.561	-0.765
Service	-0.916	-0.754	-0.663	-0.748	-0.566	-0.85	-0.476	-0.445
Government	0.339	0.367	0.251	-0.227	-0.03	0.056	0.039	0.048
N	21	23	16	17	53	54	92	93
First Difference	No	No	No	No	Yes	No	Yes	No
HP Filter	Yes	Yes	Yes	Yes	No	Yes	No	Yes

Table A.17: Correlation Between Unemployment and Output - Disaggregated Sectors

Country	The US	The UK	Switzerland	Japan	The US		The UK	
Period	2000-2017	1995-2017	2002-2017	2002-2016	2005Q1-2018Q2		1995Q1-2018Q1	
Frequency	Yearly				Quarterly			
Corr(Δu_t,ΔY_t) or Corr($u_t - u_t^*$,$Y_t - Y_t^*$)								
Total	-0.914	-0.813	-0.79	-0.894	-0.628	-0.845	-0.617	-0.6
Agriculture	0.02	-0.669	-0.256	-0.25	0.069	0.293	0.006	-0.078
Manufacturing, Mining & Utilities	-0.841	-0.689	-0.913	-0.848	-0.504	-0.679	-0.838	-0.479
Construction	-0.912	-0.623	0.29	-0.451	-0.627	-0.677	-0.404	-0.566
Wholesale & Retail Trade	-0.865	-0.267	-0.506	-0.76	-0.57	-0.723	-0.252	-0.192
Transportation & Information	-0.685	-0.689	-0.494	-0.502	-0.199	-0.628	-0.199	-0.39
Financial Activities	-0.394	-0.354	-0.561	-0.317	-0.128	-0.195	-0.131	-0.088
Accommodation	-0.842	-0.491	-0.797	-0.591	-0.381	-0.635	-0.035	-0.076
Education & Health	-0.073	-0.149	-0.146	-0.028	0.034	0.106	0.012	-0.029
Professional and Business	-0.888	-0.704	-0.492		-0.56	-0.812	-0.269	-0.536
Other Services	-0.775	-0.704	-0.252	-0.335	-0.492	-0.515	-0.03	-0.146
Government	0.294	0.367*	0.251	-0.231	-0.03	0.056	0.039	0.048
N	18	23	16	15	53	54	92	93
First Difference	No	No	No	No	Yes	No	Yes	No
HP Filter	Yes	Yes	Yes	Yes	No	Yes	No	Yes