Relationship between Unemployment Rate and Real GDP in Hong Kong

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Executive Summary

- This note aims to study the impact of quarter-to-quarter (QTQ) % change in the real GDP on unemployment rate in Hong Kong as a whole and by sector especially during recession.

- The impact of % change in RGDP is highly asymmetric over different phases of the business cycle. In particular, the effect is more significant during recession. During recession, an accumulated impact of 1% fall in real GDP relative to the previous quarter would increase the overall unemployment rate by 0.36 percentage point. But during economic upswing, an 1% increase in real output would only result in a 0.15 percentage point reduction in the unemployment rate relative to the previous quarter.

- The construction sector is most responsive to the QTQ % change in real output, followed by the wholesale, retail and import/export trades, restaurants and hotels sector. The community, social and personal services sector is most insensitive. Separately, all selected sectors become much more vulnerable to the % change of real output during recession.

1. Methodology

This paper examines the average responsiveness of unemployment rate with respect to the quarter-to-quarter (QTQ) % change in real GDP in Hong Kong during 1986-2011. This study mainly follows the approach conducted in Balakrishnan, *et al.* (2010).

Impact of QTQ % change in real GDP on overall unemployment rate

The general form of the regression equation is as follows:

$$\Delta u_t = \alpha + \sum_{i=0}^{p1} \beta_i \Delta y_{t-i} + \sum_{k=1}^{q} \gamma_k \Delta u_{t-k} + \sum_{j=0}^{p2} \delta_j \times D^R \Delta y_{t-j} + \varepsilon_t \qquad (1)$$

where Δu and Δy refer, respectively, to the quarter-to-quarter (QTQ) change in unemployment rate and QTQ % change in real GDP; D^R is a dummy variable that takes on a value of 1 if the economy is in a state of recession. An economy is regarded as entering recession when there are 2 consecutive quarters of negative growth in real GDP. The use of the dummy variable allows the coefficients related to the responsiveness of changes in the unemployment rate to % change in output to take on different magnitudes depending on the state of the business cycle.[1]

Dynamic beta/Long-term effect

We then derive the long term impact of the QTQ % change in real output on the unemployment rate. For simplicity, we first use the equation for the case in which there is one lag on Δy and one lag on Δu. For this particular case, the equation is as follows:

$$\Delta u_t = \alpha + \beta_0 \Delta y_t + \beta_1 \Delta y_{t-1} + \gamma_1 \Delta u_{t-1} + \varepsilon_t \qquad (2)$$

- ✧ The short-term effect of 1% change in real output on unemployment rate in period *t* relative to *t-1* is β_0.
- ✧ The short-term effect in period *t+1* is $\gamma_1 \beta_0 + \beta_1$; in period *t+2* is

[1] One caveat is the linear specification form of the regression equation. For instance, despite real output increases continuously, it is hard for the unemployment rate to fall further when the unemployment rate has reached a low level. Thus, the responsiveness of the unemployment rate to the % change in real output also depends on its existing level.

$\gamma_1(\gamma_1\beta_0+\beta_1)$, …, in period *t*+*s* is $\gamma_1^{s-1}(\gamma_1\beta_0+\beta_1)$. As long as $|\gamma_1|<1$, the short-term effect is transitory in the latter periods and will converge to 0 eventually when time elapses.

The dynamic beta (DB) measures the long-term (accumulated) impact of 1% change in real output on unemployment rate relative to the preceding period. Under the specification above, we can write the dynamic beta for this particular case as follow:

$$\text{DB} = \beta_0+(\beta_0\gamma_1+\beta_1)+\gamma_1(\gamma_1\beta_0+\beta_1)+\ldots+\gamma_1^{s-1}(\gamma_1\beta_0+\beta_1)+\ldots$$

$$= \beta_0(1+\gamma_1+\gamma_1^2+\ldots)+\beta_1(1+\gamma_1+\gamma_1^2+\ldots)$$

So $DB=\dfrac{\beta_0+\beta_1}{1-\gamma_1}$ if $|\gamma_1|<1$

The derivation for the more general case follows the step above in an analogous manner. The resulting specification is as follows:

$$DB=\frac{\sum_{i=0}^{p1}\beta_i+\sum_{j=0}^{p2}\delta_j}{1-\sum_{k=1}^{q}\gamma_k} \tag{3}$$

Follow the practice of Balakrishnan, *et al.* (2010), the lag lengths (*p1*, *p2* and *q*) are chosen based on t-test statistics, AIC and BIC over different specification forms.

Impact of QTQ % change in real GDP on unemployment rate of each selected sector

Similarly, we estimate the coefficients of interest in each selected sector separately (See Appendix Figures 1a and b). Unfortunately, the unemployment rate data for sectors by HSIC V1.1 were available up to 2008Q4 only and thereafter the classification has switched to HSIC V2.0. The crude conversions between top level classification of HSIC V1.1 and 2.0 are shown in Appendix Table 1.

After rough inspection on time series data between March 2008 and February 2009 in which unemployment rates were available for both classifications, the changes in unemployment rate by most sectors under top level classification of HSIC V1.1 were a bit different from that of the corresponding sectors of HSIC V2.0. Only

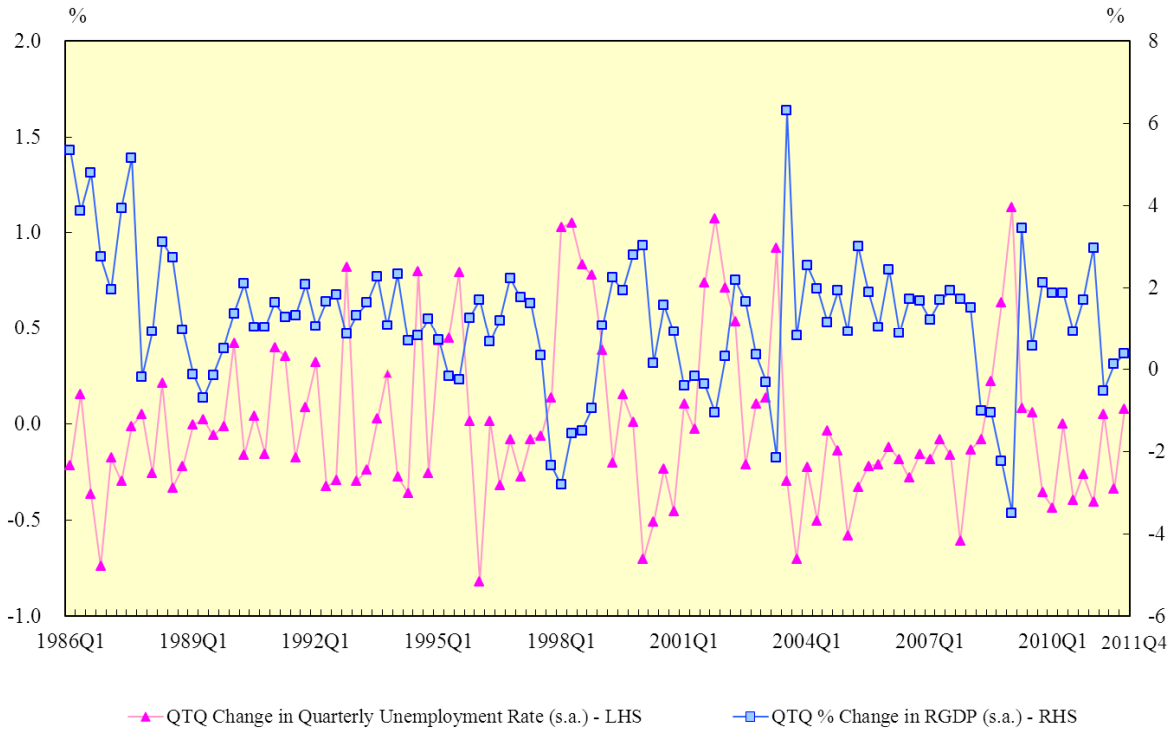
unemployment rates in the construction sector were almost the same in these two classifications over the same period. Nevertheless, to utilize the available information up to 2011, the time series data of unemployment rate by sector are being linked up based on the conversion table except the transport storage and communication sector.[2] Regressions are run on each sector based on data up to 2008Q4 and up to 2011Q4 (connected)[3]. Since the sectoral unemployment rates are not seasonally adjusted, seasonal dummies are therefore added in the regression to control for seasonality.

2. Results

2.1 QTQ % Change in Real Output on Overall Unemployment Rate

As the QTQ change in seasonally-adjusted unemployment rate and QTQ % change in seasonally-adjusted real GDP are less volatile, we use seasonally-adjusted series of unemployment rate and real GDP data to calculate Δu and Δy.

Figure 1: QTQ Change in Unemployment rate and QTQ % Change in RGDP



[2] The transport, storage and communication sector under HSIC V1.1 are unable to match with corresponding sectors in HSIC V2.0.
[3] Except the transport storage and communication sector (up to 2008Q4) and the construction sector (up to 2011Q4).

Figure 2: Plot of QTQ Change in Unemployment Rate (s.a) and QTQ % Change in RGDP (s.a)

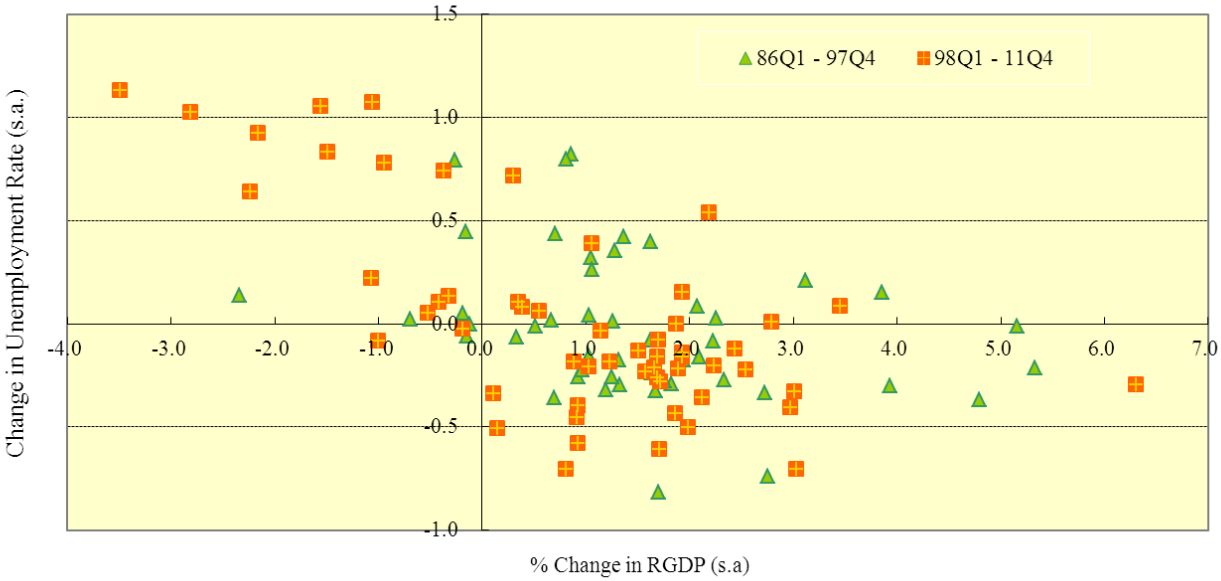


Figure 3. Cross-Correlation between QTQ Change in Unemployment Rate and QTQ % Change in RGDP

Sample: 1986Q1 2011Q4
Included observations: 104
Correlations are asymptotically consistent approximations

QC_RGDPSA,DUSA(-i)	QC_RGDPSA,DUSA(+i)	i	lag	lead
		0	-0.5557	-0.5557
		1	-0.1496	-0.5315
		2	-0.0772	-0.4024
		3	0.0538	-0.3127
		4	0.0632	-0.0279
		5	0.2070	-0.0498
		6	0.0826	0.0582
		7	0.1629	0.1291
		8	0.2294	0.1649

Figure 3 suggests that Δy not only has significant negative effect on Δu at current quarter but also has lasting effect on Δu in subsequent quarters.

Table 1: Regression Result - Overall Unemployment Rate

	(1)		(2)			
$\triangle u_{t-1}$	0.195	**	0.178	**		Dynamic Beta
	(0.089)		(0.087)		Not during Recession	-0.151
$\triangle y_t$	-0.110	***	-0.071	***		
	(0.021)		(0.026)		During Recession	-0.359
$\triangle y_{t-1}$	-0.068	***	-0.053	**		
	(0.025)		(0.025)			
$D^R * \triangle y_t$			-0.171	**		
			(0.072)			
Constant	0.211	***	0.110	*		
	(0.044)		(0.061)			
Sample Period	1986Q1 - 2011Q4					
No. of obs.	104					
Adjusted R^2	0.436		0.461			
DW Stat	2.108		2.123			

Remark: * denotes the p-value of the coefficient less than 0.1; ** for p-value<0.05, *** for p-value<0.01.

The best specification form uses Δu_{t-1}, Δy_t, Δy_{t-1} and an interaction term of recession dummy and Δy_t on RHS (See Column 2 of Table 1).[4] Intuitively, during recession, when real GDP falls 1% relative to the previous quarter, the unemployment rate will increase by 0.242 (0.071 + 0.171) percentage point in the present quarter, by 0.096 percentage point (0.242×0.178 + 0.053) in the next quarter, by 0.017 (0.096×0.178) percentage point and so on. The dynamic beta or long term effect is 0.341 percentage point. On the other hand, during economic upswing, the unemployment rate will only fall by 0.071 percentage point in the present quarter and the long-term effect on the unemployment rate is only 0.151 percentage point when real output increases by 1% relative to the preceding quarter.

2.2 QTQ % Change in Real Output on Unemployment Rate of Each Sector

As noted earlier, the time series data of sectors by HSIC V1.1 were not available after 2008. The unemployment rate of the sectors under top level of HSIC V1.1 and V2.0 are being linked up except the transport, storage and communications sector. The details of regression results are displayed in Appendix Tables 2 to 7.

[4] Other control variables such as change in real wage index, change in CPI are considered. All of them are insignificant and the presence of these variables does not affect the estimates of our interest significantly.

Table 2 below summarizes the dynamic beta (long-term effect) of an 1% decrease in RGDP on unemployment rate in each sector.

Table 2. Dynamic Beta (Long-Term Effect) by Sector

Sector	Sample Period	Dynamic Beta (Long-Term Effect)	
		Not during Recession	During Recession
Manufacturing	1986Q1-2008Q4	0.096	0.373
	1986Q1-2011Q4	0.078	0.367
Construction	1986Q1-2011Q4	0.242	0.801
Wholesale, retail and import/export trades, restaurants and hotels	1986Q1-2008Q4	0.162	0.453
	1986Q1-2011Q4	0.122	0.451
Transport, storage and communications	1986Q1-2008Q4	0.065	0.318
Financing, insurance, real estate and business services	1986Q1-2008Q4	0.045	0.288
	1986Q1-2011Q4	0.042	0.295
Community, social and personal services	1986Q1-2008Q4	0.038	0.163
	1986Q1-2011Q4	0.038	0.118

It is notably that the construction sector is the most responsive sector to the change in real output growth, with the highest estimate of dynamic beta (0.801 during recession and 0.242 in other states of economic cycle). By contrast, the unemployment rate of the community, social and personal services sector is least responsive to the % change in real output. Moreover, during recession, all selected sectors would become much more sensitive to the QTQ % change in RGDP especially the wholesale retail and import/export trades, restaurants and hotels sector.

3. Concluding Remarks

In short, this study finds that the impact of the QTQ % change in RGDP on unemployment rate is highly asymmetric over the states of business cycle, with more substantial impact during economic downswing. Moreover, the construction sector and the wholesale, retail and import/export trades, restaurants and hotels sector are more susceptible than other sectors to the % change in real output during recession.

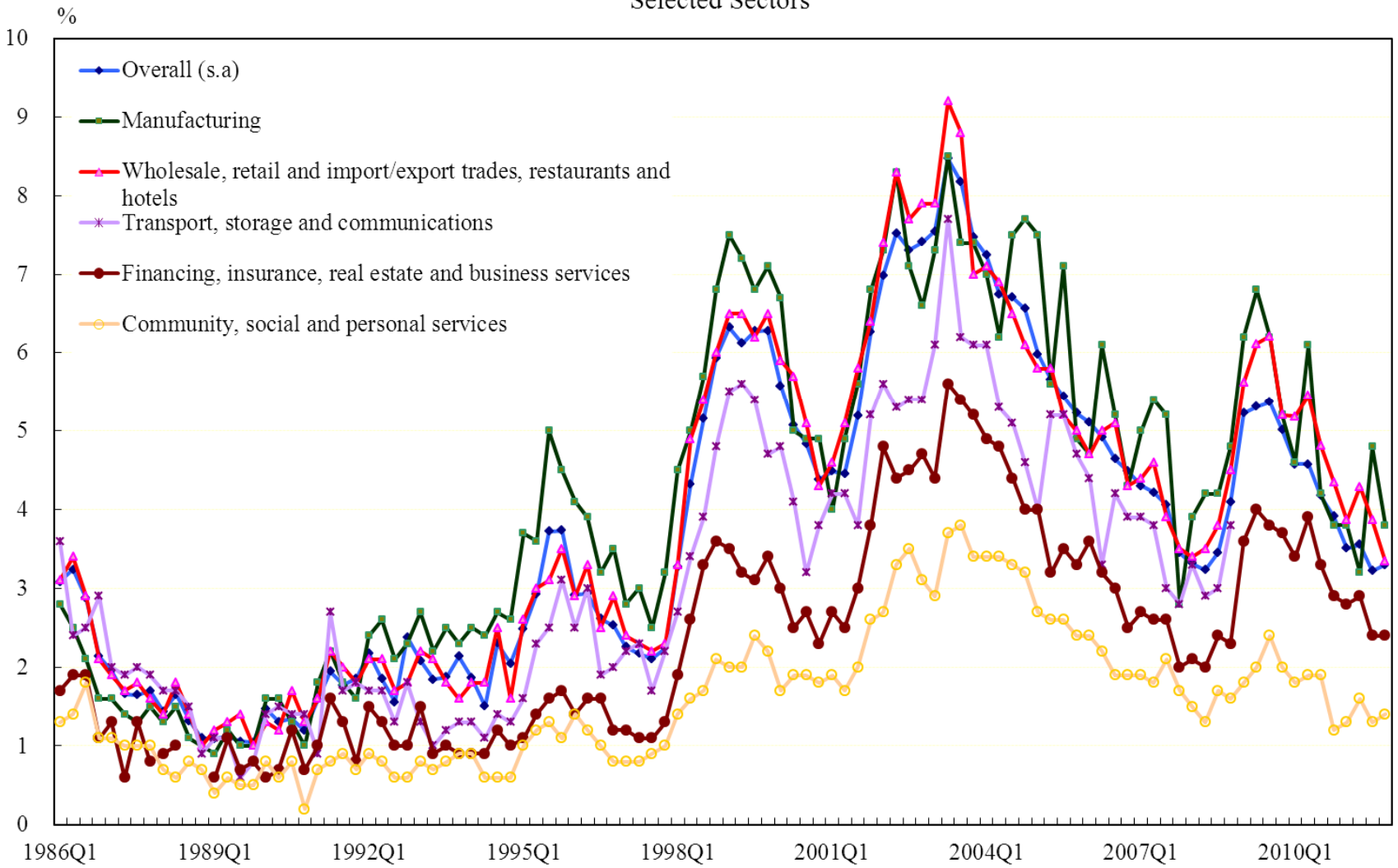
References

Balakrishnan, R., Das, M., & Kannan, P. (2010). Unemployment dynamics during recessions and recoveries: Okun's law and beyond. *World economic outlook rebalancing growth* (cha. 3). IMF.

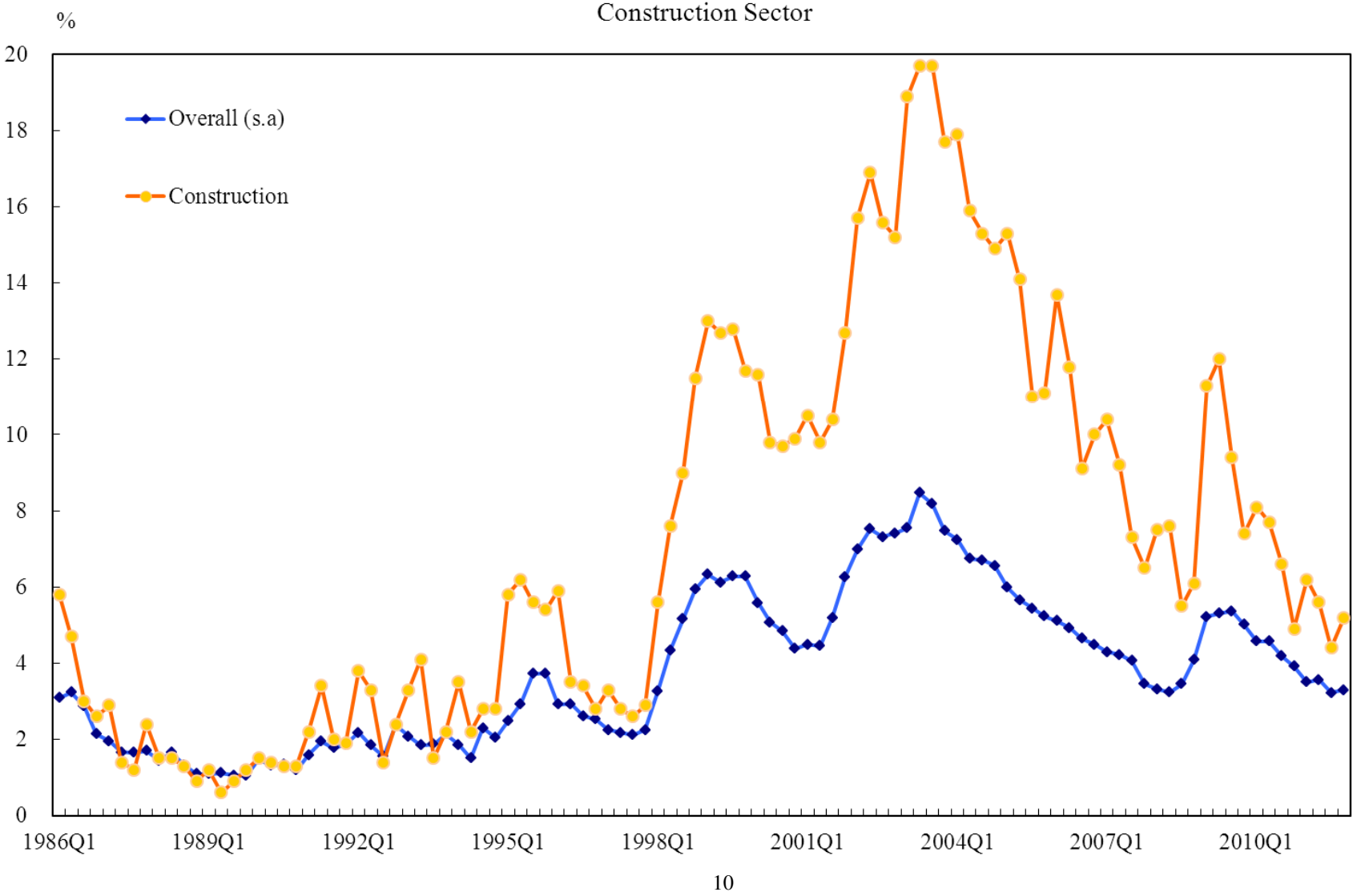
Sawtelle, B. (2007). Analyzing the link between real GDP and employment: an industry sector approach. *Business Economics, 42*, 46-54.

Steinberg, C. & Nakane, M. (2011). To fire or to hoard? Explaining Japan's labor market response in the Great Recession. IMF Working Paper NO. 11/15.

Appendix Figure 1a: Overall Unemployment Rate (s.a.) and Unemployment Rate of Selected Sectors



Appendix Figure 1b: Overall Unemployment Rate (s.a.) and Unemployment Rate of Construction Sector



Appendix Table 1: Crude Conversions between Top Level Classification of HSIC V1.1 and V2.0

HSIC V.1.1	HSIC V2.0
Manufacturing	Manufacturing
Construction	Construction
Wholesale, retail, and import/export trades, restaurants and hotels	Import/export, wholesale and retail trades Accommodation and food service activities
Transport, storage and communications Selected trades of various sectors	Transportation, storage, postal and courier services Information and communications
Financing, insurance, real estate and business services	Financing, insurance, real estate, professional and business services
Community, social and personal services	Public administration, social and personal services

Appendix Table 2: Regression Results - Manufacturing Sector

	Coefficients	S.E.	t-ratio	p-value
a.		Sample: 1986Q1 - 2008Q4		
$\triangle u_{t-1}$	-0.213	0.098	-2.171	0.033
$\triangle yt$	-0.116	0.061	-1.898	0.061
$D^R * \triangle y_t$	-0.337	0.175	-1.929	0.057
Constant	0.300	0.174	1.726	0.088
No. of obs.	92			
Adjusted R^2	0.194			
DW Stat	2.119			
b.		Sample: 1986Q1 - 2011Q4		
$\triangle u_{t-1}$	-0.246	0.092	-2.664	0.009
$\triangle yt$	-0.097	0.060	-1.611	0.110
$D^R * \triangle y_t$	-0.361	0.157	-2.295	0.024
Constant	0.214	0.176	1.217	0.227
No. of obs.	104			
Adjusted R^2	0.207			
DW Stat	2.203			

Remark: Seasonal dummies are added.

Appendix Table 3: Regression Results - Construction Sector

	Coefficients	S.E.	t-ratio	p-value
		Sample: 1986Q1 - 2011Q4		
$\triangle y_{t-1}$	-0.242	0.072	-3.380	0.001
$D^R * \triangle y_t$	-0.559	0.186	-3.006	0.003
Constant	1.314	0.224	5.876	0.000
No. of obs.	104			
Adjusted R^2	0.488			
DW Stat	2.009			

Remark: Seasonal dummies are added.

Appendix Table 4: Regression Results - Wholesale, Retail, and Import/Export Trades, Restaurants and Hotels Sector

	Coefficients	S.E.	t-ratio	p-value
a.		Sample: 1986Q1 - 2008Q4		
$\triangle u_{t-2}$	0.183	0.084	2.187	0.032
$\triangle y_{t-1}$	-0.132	0.031	-4.294	0.000
$D^R * \triangle y_t$	-0.238	0.085	-2.811	0.006
Constant	0.231	0.089	2.591	0.011
No. of obs.	92			
Adjusted R^2	0.468			
DW Stat	2.363			
b.		Sample: 1986Q1 - 2011Q4		
$\triangle u_{t-2}$	0.181	0.079	2.307	0.023
$\triangle y_{t-1}$	-0.100	0.027	-3.643	0.000
$D^R * \triangle y_t$	-0.269	0.071	-3.793	0.000
Constant	0.168	0.086	1.966	0.052
No. of obs.	104			
Adjusted R^2	0.473			
DW Stat	2.355			

Remark: Seasonal dummies are added.

Appendix Table 5: Regression Results - Transport, Storage and Communications Sector

	Coefficients	S.E.	t-ratio	p-value
		Sample: 1986Q1 - 2008Q4		
$\triangle u_{t-1}$	-0.276	0.100	-2.754	0.007
$\triangle y_{t-1}$	-0.083	0.043	-1.924	0.058
$D^R * \triangle y_t$	-0.322	0.115	-2.790	0.007
Constant	0.117	0.123	0.957	0.341
No. of obs.	92			
Adjusted R^2	0.225			
DW Stat	2.060			

Remark: Seasonal dummies are added.

Appendix Table 6: Regression Results - Financing, Insurance, Real Estate and Business Services Sector

	Coefficients	S.E.	t-ratio	p-value
a.		Sample: 1986Q1 - 2008Q4		
$\triangle u_{t-1}$	-0.206	0.098	-2.106	0.038
$\triangle y_{t-2}$	-0.054	0.025	-2.176	0.033
$D^R * \triangle y_t$	-0.294	0.066	-4.440	0.000
Constant	0.137	0.082	1.665	0.100
No. of obs.	88			
Adjusted R^2	0.296			
DW Stat	2.086			
b.		Sample: 1986Q1 - 2011Q4		
$\triangle u_{t-1}$	-0.202	0.090	-2.241	0.027
$\triangle y_{t-2}$	-0.051	0.023	-2.242	0.027
$D^R * \triangle y_t$	-0.303	0.056	-5.372	0.000
Constant	0.105	0.077	1.365	0.176
No. of obs.	100			
Adjusted R^2	0.329			
DW Stat	2.272			

Remark: Seasonal dummies are added.

Appendix Table 7: Regression Results - Community, Social and Personal Services Sector

	Coefficients	S.E.	t-ratio	p-value
a.		Sample: 1986Q1 - 2008Q4		
$\triangle u_{t-1}$	-0.160	0.096	-1.662	0.100
$\triangle u_{t-2}$	-0.185	0.096	-1.915	0.059
$\triangle y_{t-3}$	-0.051	0.016	-3.276	0.002
$D^R * \triangle y_t$	-0.168	0.043	-3.954	0.000
Constant	0.038	0.053	0.719	0.474
No. of obs.	92			
Adjusted R^2	0.268			
DW Stat	2.059			
b.		Sample: 1986Q1 - 2011Q4		
$\triangle u_{t-1}$	-0.161	0.092	-1.756	0.082
$\triangle u_{t-2}$	-0.227	0.094	-2.421	0.017
$\triangle y_{t-2}$	-0.053	0.016	-3.338	0.001
$D^R * \triangle y_t$	-0.112	0.038	-2.905	0.005
Constant	0.060	0.056	1.062	0.291
No. of obs.	104			
Adjusted R^2	0.265			
DW Stat	2.127			

Remark: Seasonal dummies are added.