A Sectoral Approach to Okun's Law*

Wayne Apap[a,†] and Daniel Gravino[b]

[a] *Economic Policy Department, Ministry for Finance, Malta*
[b] *Department of Economics, University of Malta, Malta*

Abstract

The study adds to the existing literature on the relationship between output and unemployment by using a sectoral specification of Okun's Law to capture the differential sensitivity of the unemployment rate to output developments in the services and manufacturing sectors. Using quarterly data for the period between 2000 and 2012, we show that Malta's unemployment rate has been more sensitive to output developments in the services sector than to those in the manufacturing sector. We use different equation specifications and the youth unemployment rate to show that the impact resulting from developments in the manufacturing sector occurs mainly via layoffs while developments in the services sector affect the unemployment rate via the hiring of new entrants into the labour market.

Keywords: Okun's law, manufacturing, services, unemployment
JEL Classification: E24, E32

*The authors are grateful to Brian Camilleri, Gilmour Camilleri, Gevit Duca, Marianne Grima, Brian Micallef, Godwin Mifsud, Kevin Vella, Melchior Vella and participants in the seminars held at the Economic Policy Department and the University of Malta for helpful comments and suggestions. The views expressed in this article are solely those of the authors.

†Corresponding author: Wayne Apap; E-mail: wayne.apap@gov.mt; Address: Economic Policy Department, Ministry for Finance, Valletta, Malta

1 Introduction

The social and economic impacts of the global financial crisis which started in the United States in 2007 have led many governments to look for ways of boosting aggregate demand, which, in turn, would be expected to bring unemployment rates back to 'normal' levels. These developments have spurred a number of empirical studies on the short-run relationship between output and unemployment; what is generally referred to as Okun's Law. Many, such as Gordon (2011) and Burgen, Meyer and Tasci (2012), have questioned the stability of the relationship since the start of the crisis as unemployment increased by substantially more (or less) than expected in various economies. Others, such as Ball *et al.* (2013), have claimed that 'the relationship is strong and stable by the standards of macroeconomics'. These studies, however, overlook one important aspect: they do not consider the differential sensitivity of the unemployment rate to output developments in the manufacturing and services sectors. This may be one reason for the observed instability of estimates of the Okun coefficient, particularly in light of past and on-going deindustrialization in a number of countries worldwide.

Within this context, we use data for the Maltese economy for the period between 2000 and 2012 in an attempt to gauge the sensitivity of the unemployment rate to output developments in the manufacturing and services sectors. We find that the unemployment rate has been more sensitive to output developments in the services sector than to those in the manufacturing sector, and we use different equation specifications to show that the impact of developments in the manufacturing sector on the unemployment rate occurred mainly via layoffs while developments in the services sector affected the unemployment rate via the hiring of new entrants into the labour market.

The remainder of the article is structured as follows: Section 2 presents standard estimates of the Okun coefficient that relate the country's *aggregate* output to the unemployment rate; Section 3 presents estimates of the sensitivity of the unemployment rate to developments in the output of the manufacturing and services sectors; and Section 4 concludes.

2 Aggregate Output-Unemployment Relationship

Using a quarterly data set which includes 52 observations for the period between 2000 and 2012, Figure 1 presents a scatter plot of GDP growth against percentage point changes in the unemployment rate.[1] A simple line of best fit suggests that there exists a negative relationship between the two variables of interest: the unemployment rate tends to increase when output growth is relatively low and vice versa.

We generate estimates of the strength of this relationship using the difference version of Okun's law:[2]

$$\Delta U_t = \alpha + \beta \Delta Y_t + \varepsilon_t \tag{1}$$

where ΔU_t is the change in the unemployment rate when period t is compared to $t-4$ and ΔY_t is real output growth when period t is compared to period $t-4$. The parameter β (what is referred to as the Okun coefficient) is a measure of the elasticity of the unemployment rate with respect to output while the parameter α shows the change in the unemployment rate when there is no change in real output.

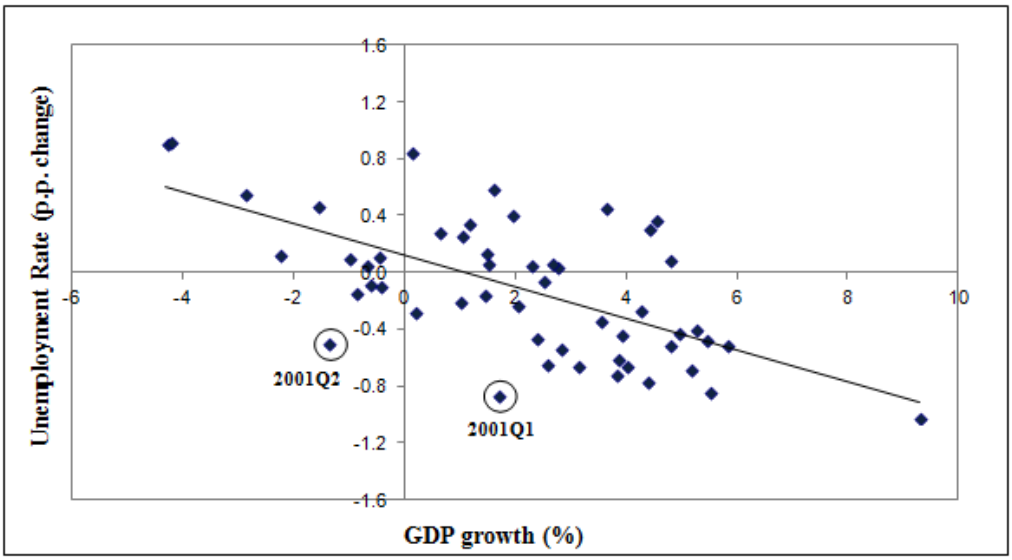
Estimates of equation (1) yield the following results:

$$\begin{array}{rcccccc} \Delta U_t & = & 0.12 & - & 0.11 & \Delta Y_t & + \varepsilon_t \\ & & (0.075) & & (0.000) & & \end{array} \qquad R^2 = 0.41$$

[1] We measure the unemployment rate as the share of unemployed in the country's labour force while output is measured by GDP. Both labour market and GDP data were obtained from the National Statistics Office (NSO), with the former based on the administrative records of the Employment and Training Corporation (ETC).

[2] Okun (1962) originally estimated two versions of the relationship: a difference version (which relates aggregate output growth to changes in the unemployment rate) and a gap version (which relates the gap between the actual and natural rate of unemployment to the gap between actual and potential output). Experiments along these lines have led us to believe that using the gap version as an alternative to the difference version should not alter the conclusions of this paper.

Figure 1: GDP growth against changes in the unemployment rate



These confirm the existence of a negative and significant relationship between Malta's output growth and its unemployment rate. Specifically, the unemployment rate would be expected to increase by around 0.1 percentage point for every 1% decrease in annual real GDP growth.[3] This is broadly consistent with other estimates of the Okun coefficient for Malta found in the literature (see, for example, ECB, 2012; Micallef, 2013).

However, we observe (and also confirm using studentized residuals) two outliers.[4] In the first quarter of 2001, the unemployment rate decreased significantly in spite relatively low output growth, whilst in the second quarter of the same year the unemployment rate decreased further even as the economy contracted. These seemingly contradicting developments were largely the result of contrasting developments in the manufacturing and services sectors. While the demand for goods produced by the domestic semiconductors industry deteriorated, the impact on aggregate employment was contained by: (i) the positive growth rate recorded by the services sector; and (ii) the hoarding of labour by the manufacturing industry

[3]We also considered an equation specification with lagged GDP growth based on the assumption that that firms may react to changes in output growth with some lag. However, the estimates yielded similar results.

[4]There were other observations which exceeded the ±2 threshold for studentized residuals. However, we focus on the two observations with the highest values.

itself. Noting these exceptional circumstances, and in an attempt to abstract from mixing cyclical with structural adjustments, the analysis presented in Section 3 attempts to uncover important information about the relationship between the unemployment rate and sectoral growth developments.

3 Sectoral Output-Unemployment Relationship

The differing performances of the services and manufacturing sectors are shown in Figure 2. Figure 2(c) shows that the services sector generally enjoyed positive output growth (with the exception of 2009), while Figure 2(b) shows that the manufacturing sector was characterized by several periods of negative growth. A *priori* this may suggest that increases in unemployment during recessionary periods (presented in Figure 2(a)) were largely the result of developments in the manufacturing (rather than in the services) sector. However, a more rigorous analysis reveals otherwise.

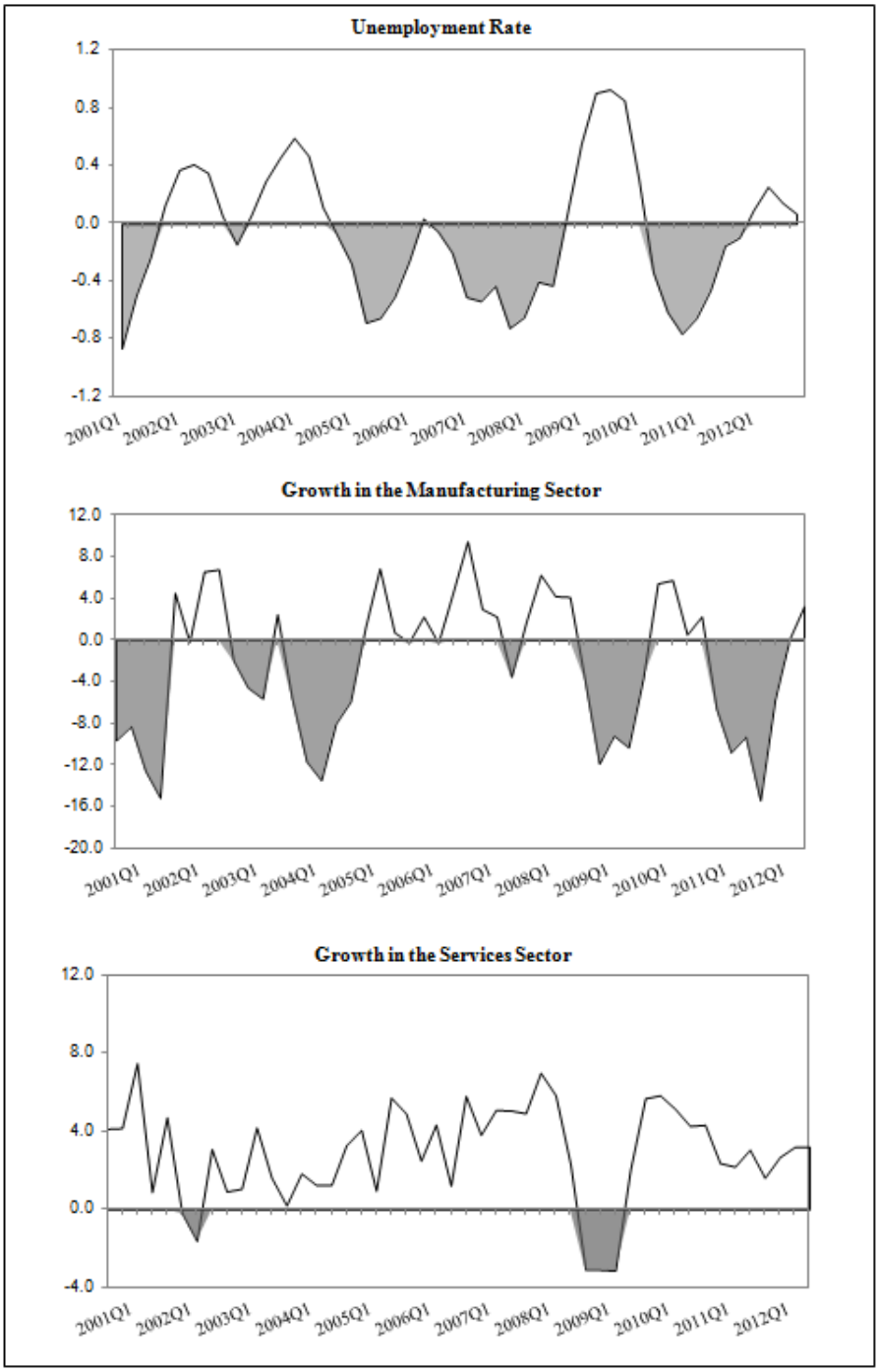
We analyse how the heterogeneous developments in these two sectors are associated with changes in the unemployment rate by estimating a slightly modified version of Okun's law. Following a growth rate disaggregation method used in Anderton *et al.* (2014), we re-specify equation (1) in terms of the various sub-sectors of the economy by using the following approximation:[5]

$$\Delta Y = \Delta \sum_i Y_i \approx \sum_i \frac{Y_i}{\sum_i Y_i} \Delta Y_i \tag{2}$$

where i represents either the manufacturing sector (m) or the services sector (s) and Y_i is the output of sector i; noting that $\frac{Y_i}{\sum_i Y_i}$ are moving (rather than constant) shares to ensure the accuracy of the approximation. Equation (1) can then be rewritten as:

[5]Whereas Anderton et al. (2014) disaggregate GDP by its expenditure components, we use their method to disaggregate GDP by sector.

Figure 2: Unemployment rate and setoral output growth



$$\Delta U_t = \alpha + \sum_i \beta_i \lambda_{it} \Delta Y_{it} + \varepsilon_t \tag{3}$$

where β_i represents the responsiveness of the unemployment rate to sector i's output growth, $\lambda_i = \frac{Y_i}{\sum_i Y_i}$ represents the weight of sector i's contribution to the country's total output, and ΔY_i represents real output growth in sector i.

The results are presented in Table 1. Columns (i), (ii) and (iii) show the elasticity of the unemployment rate with respect to output developments in each of the two sectors, $\beta_i \lambda_i$, while columns (v), (vi) and (vii) show estimates of the weighted β-coefficients, β_i.[6] Thus, we are able to isolate the differential unemployment responsiveness (what Anderton *et al.* [2014] term as 'unemployment intensity'), β_i, for each sector rather than simply estimating the composite term, $\beta_i \lambda_i$. However, the product of $\beta_i \lambda_i$ is useful in that it yields the differential 'component elasticities', i.e. the proportional responsiveness of unemployment to developments in each sectors' output.[7]

In line with the results presented in Section 2, the regression estimates show that there is a negative and significant relationship between changes in the unemployment rate and sectoral output growth. However, these results also show that there exist some important differences between the two sectors. Indeed, column (i) suggests that the manufacturing industry has a relatively low impact on the unemployment rate when compared to the services sector.[8] In part, this is the result of the manufacturing sector's relatively small share in total output ($\lambda_m \approx 0.25$). However, even after accounting for the effect of each sector's market size, the weighted β-coefficient for services is greater than that for manufacturing (see column (v)). Specifically, it is estimated that the unemployment intensity associated with the manufacturing sector is 0.09 compared to 0.12 associated with

[6] The $\beta_i \lambda_i$ estimates are obtained by multiplying the weighted β-coefficients with the respective sector's weights in GDP (λ_i) which are presented in column (iv).

[7] The $\beta_i \lambda_i$ estimates show the change in the unemployment rate that is associated with a 1% increase in output of sector i.

[8] Along the lines explained in Anderton, et all (2014), the sum of the 'component elasticities' approximately adds up to -0.11; in line with the Okun coefficient estimates in the aggregate version of the Okun equation.

Table 1: Estimates of β_i and $\beta_i\lambda_i$ in the modified version of Okun's Law

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
		$\beta_i\,\lambda_i$		λ_i		β_i	
constant	**0.098**	**0.083**	**0.215*****		**0.126**	**0.113**	**0.223*****
	(0.215)	(0.279)	(0.008)		(0.106)	(0.133)	(0.004)
$\Delta Y_{s,t}$	**-0.084*****		**-0.067*****	0.754	**-0.118*****		**-0.092*****
	(0.000)		(0.001)		(0.000)		(0.000)
$\Delta Y_{m,t}$	**-0.024*****		**-0.010**	0.246	**-0.091*****		**-0.041***
	(0.001)		(0.151)		(0.000)		(0.088)
$\Delta Y_{s,t-1}$		**-0.079*****	**-0.059*****	0.754		**-0.113*****	**-0.073*****
		(0.000)	(0.003)			(0.000)	(0.004)
$\Delta Y_{m,t-1}$		**-0.026*****	**-0.026*****	0.246		**-0.102*****	**-0.082*****
		(0.000)	(0.000)			(0.000)	(0.001)
R^2	0.411	0.429	0.567		0.418	0.444	0.591
Adj R^2	0.387	0.405	0.530		0.394	0.422	0.556

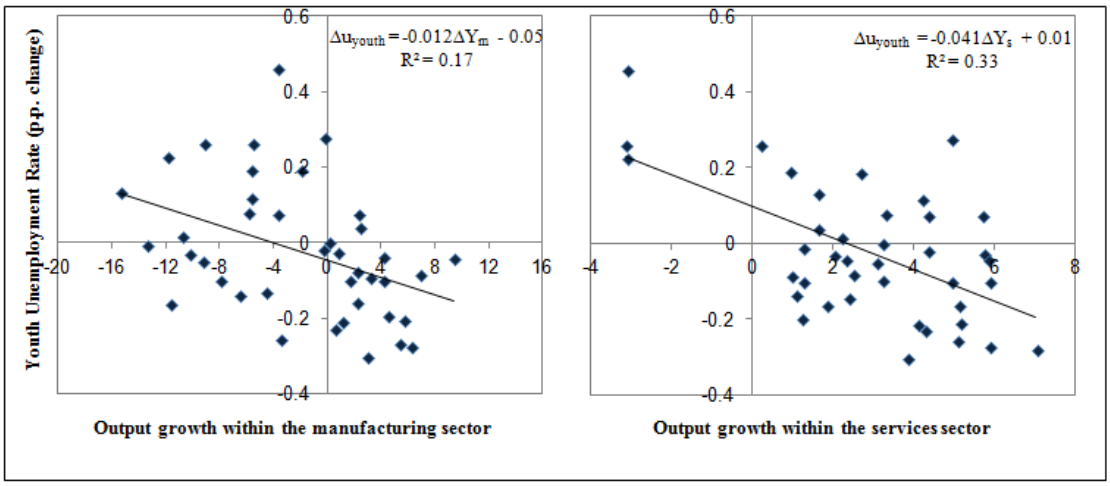
*,**,*** represent the 90, 95 and 99 percent level of significance respectively
The values in brackets represent p-values.

the services sector.[9]

The reasons underlying the seemingly stronger unemployment intensity of the services sector are two. The first is the labour-hoarding behaviour that is typical of manufacturing firms and encouraged by government through subsidies in times of deficient demand. Indeed, the Malta Employers Association (2009) reports that during the 2009 recession, a large number of manufacturing firms did not resort to redundancies in the hope that the situation improves in the medium term. The second factor is the services sector's crucial role in absorbing new entrants into the labour market. Indeed, a closer look at the data shows that the larger share of new entrants into the labour force tend to find employment within the services

[9]The stronger unemployment intensity of the services sector suggests that we should observe a stronger Okun coefficient as the share of the services sector in total output increases. Although this is beyond the scope of this paper, we note that rolling regression estimates presented in Micallef (2013) indicate a strengthening of the Okun coefficient which coincided with a gradual and significant rise in the share of services in total output. Specifically, as the share of services in output increased from 73% in 2001 to 81% in 2012, the estimates suggest that the Okun coefficient increased from -0.08 during the first 20 quarters of the period under observation to -0.15 during the last 20 quarters. However, we note that the strengthening of the Okun coefficient may reflect changes in other factors (such as productivity) rather than just the increasing share of services; and while the cross-sector productivity differences would be captured by our specification, the within-sector productivity changes go unaccounted for.

Figure 3: Sectoral output growth against changes in the unemployment rate



sector. Consequently, when the growth rate of the services sector slows down, a number of new entrants – who would have alternatively found employment in the services sector – might end up unemployed.

Along these lines, we hypothesize that the manufacturing sector affects the unemployment rate via layoffs (which typically occurs with a lag) while the services sector affects the unemployment rate via hiring of new entrants into the labour market (the impact of which is 'felt' immediately). To test this hypothesis, we make use of lagged explanatory variables and find that developments in the services sector have a stronger *immediate* impact on the unemployment rate while developments in the manufacturing sector affect the unemployment rate with a lag of one quarter. This is evident by comparing column (i) to column (ii) and column (v) to column (vi) in Table 1, and is further confirmed by the results in columns (iii) and (vii) which represent a specification of equation (2) that includes both current and lagged output growth for the two sectors. In both cases, the estimates obtained support the arguments that the services sector has a greater impact in the current period while the manufacturing sector has a greater impact with a lag of one quarter.

To confirm the hypothesis that growth slowdowns in the services sector are important contributors to increases in the unemployment rate, we also make use of

youth unemployment rate data.[10] Because youths constitute a large share of new entrants into the labour market, and if slowdowns in the growth of the services sector are indeed a major cause of a higher unemployment rate, then we should observe a stronger relationship between the youth unemployment rate and output growth in the services sector relative to that with the manufacturing sector. Figure 3 suggests that this is indeed the case: a simple line of best fit reveals that the relationship between the youth unemployment rate and output growth in the services sector is stronger than the relationship between the youth unemployment rate and growth in the manufacturing sector. Specifically, a 1% increase in output growth of the services sector is associated with a 0.04 percentage points decline in the youth unemployment rate while a 1% increase in the growth of the manufacturing sector is associated with only a 0.01 percentage points decline in the youth unemployment rate. The null hypothesis that the two coefficients are not statistically different from each other was rejected with 99% level of confidence. In addition, the R-squared is also higher for the services sector, suggesting that more of the variation in the youth unemployment rate is explained by developments in the services sector.

4 Concluding Remarks

In line with existing literature, we show that there exists a significant and negative relationship between output and unemployment. However, we also show that the relationship between the unemployment rate and developments in the services sector is stronger than that with developments in the manufacturing sector. In part, this is the result of the larger share of the services sector in the country's total output. However, our estimates suggest that the stronger relationship with the services sector is true even after accounting for the sectoral size asymmetry.

One of two main reasons underlying this important result is labour hoarding, which is known to be predominantly practiced in the manufacturing sector. This

[10]The youth unemployment rate is defined as the number of unemployed persons that are 16-24 years old. Data was obtained from NSO and is based on the administrative records of the ETC.

suggests that labour hoarding may have helped mitigate the impact of negative developments in the manufacturing sector on the unemployment rate. Thus, the findings of the study support Government's past strategy to deal with the potential firing of workers in the manufacturing sector during times of distress by offering firm-targeted financial support. This is particularly important because these are often workers whose skills are not easily transferable to other sectors of the Maltese economy and would therefore risk becoming long-term unemployed.

A second reason underlying the stronger relationship between the unemployment rate and developments in the services sector is the sector's crucial role in absorbing new entrants into the labour market. When the growth rate of the services sector slows down (as is typical during recessionary periods), a number of new entrants – who would have alternatively found employment in the services sector – might end up registering for employment. Thus, despite the less frequent firing observed in the services sector, it accounts for a significant portion of the observed changes in the unemployment rate. This suggest that, during recessionary periods, government may fight rising unemployment by helping new entrants in the labour market to find employment *sooner* so as to limit the negative and permanent impact of recessions on the country's long-run potential output.

Finally, we note that the findings of this study suggest that any significant changes in Malta's economic structure would have an effect on the magnitude of the output-unemployment relationship. Individual and cross-country studies that analyse the effects of changes in economic structure on the size and stability of the Okun coefficient using the sectoral version of the Okun equation proposed in this study are left for future research.

References

[1] Anderton, R., Aranki, T., Bonthuis, B. and Jarvis, V. (2014) "Disaggregating Okun's Law: Decomposing the Impact of the Expenditure Components of GDP on Euro Area Unemployment." *ECB Working Paper* 1747.

[2] Ball, L.A., Leigh, D. and Lougani, P. (2013) "Okun's Law: Fit at Fifty?" *NBER Working Paper Series*, WP 18668.

[3] Burgen, E., Meyer, B.H. and Tasci, M. (2012) "An Elusive Relation between Unemployment and GDP Growth: Okun's Law." *Cleveland Federal Reserve Economic Trends*.

[4] European Central Bank. (2012) "Recent Developments in the Okun Relationship in the Euro Area," *ECB Monthly Bulletin* (July).

[5] Gordon, R.J. (2010) "Okun's Law and Productivity Innovations." *American Economic Review: Papers and Proceedings* 10 (2): 11-15.

[6] Malta Employers Association. (2009) "Malta: Impact of COLA on Employers in Times of Recessions."

[7] Micallef, B. (2013) ""Estimating Okun's Law for Malta." Report published in the *Central Bank of Malta Quarterly Review* 2013:3.

[8] Okun, A. (1962) "Potential GNP: its Measurement and Significance," reprinted as *Cowles Foundation Paper* 190.