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SECTORAL CONTRIBUTIONS TO AGGREGATE LABOUR PRODUCTIVITY AND ULC GROWTH

BOX 3: SECTORAL CONTRIBUTIONS TO AGGREGATE LABOUR PRODUCTIVITY AND ULC GROWTH¹

In August 2020, the NSO carried out benchmark revisions to national accounts data and published, for the first time, data on chainlinked GVA by sector.² This additional information allows for the analysis of sectoral developments in labour productivity and ULCs, while accounting for the impact of price changes.

This box looks at sectoral contributions to total labour productivity and real ULC growth during 2020 using national accounts data. In order to ensure the additivity of sectoral productivity contributions, the analysis utilises the generalised exactly additive decomposition (GEAD) of productivity growth first developed by Tang and Wang (2004).³ In the first section, an overview of the GEAD decomposition of productivity growth is presented. This decomposition is then used to analyse sectoral contributions to labour productivity growth in Malta during 2020, using GVA output data measured in chainlinked volumes. The final section then assesses sectoral contributions to growth in real ULCs during 2020.

Overview of the GEAD

Unlike other productivity decompositions, the GEAD proposed by Tang and Wang (2004) has the desirable property of estimating exactly additive sectoral contributions to aggregate labour productivity growth, even when output is measured in chainlinked volumes.⁴ According to this approach, each sector's contribution to aggregate labour productivity growth can be decomposed into three effects, commonly identified as the pure productivity effect, the reallocation level effect, and the reallocation growth effect.⁵

The pure productivity effect for a sector captures its contribution to aggregate productivity growth that is solely due to changes in its labour productivity, weighted by its share in nominal aggregate output. Aside from growth in sectoral productivity, a sector's contribution to aggregate productivity growth is influenced by changes in its relative size, which can be due to either a change in its share of total employment or in real output prices, or both. For instance, even when sectoral labour productivity levels remain unchanged, labour productivity can increase at an aggregate level if labour shifts from sectors with below-average labour productivity levels towards sectors with above-average labour productivity levels (Denison, 1962).⁶ Furthermore, the importance of a sector for aggregate labour productivity changes when the relative value of its output changes. Thus, an increase in a sector's prices compared with the economy-wide price level will increase the sector's contribution to aggregate labour productivity growth, even in the absence of a shift in labour inputs.

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² See "The 2020 National Accounts Benchmark Revision" QR 2021_1.

³ Tang, J., & Wang, W. (2004) "Sources of aggregate labour productivity growth in Canada and the United States", *Canadian Journal of Economics*, 37(2), pp. 421-444.

⁴ The GEAD is one type of decomposition method used in this field of literature. Although other decomposition methods may give different results, the GEAD is the only decomposition to give exactly additive sectoral contributions when output is measured in chainlinked volumes.

⁵ The GEAD equation is shown below, where G_t is growth in aggregate labour productivity measured on the basis of GVA, G_t^i is growth in labour productivity of sector i , Z_t is the labour productivity level in period t , Z_t^i is labour productivity of sector i in period t , Y_t is aggregate nominal value added, p_t^i is the relative price of sector i to economy-wide prices and l_t^i is sector i 's share of total employment.

$$G_t = \sum_i \left[\frac{Y_t^i}{Y_{t-1}} G_t^i + \frac{Z_{t-1}^i}{Z_{t-1}} (p_t^i l_t^i - p_{t-1}^i l_{t-1}^i) + \frac{Z_{t-1}^i}{Z_{t-1}} (p_t^i l_t^i - p_{t-1}^i l_{t-1}^i) G_t^i \right]$$

⁶ Denison, E. (1962). "The sources of economic growth in the United States and the alternatives before us", New York: Committee for Economic Development.

In the GEAD decomposition, this reallocation effect is split into a static (level) effect and a dynamic (growth) effect. The static reallocation level effect captures the impact of absolute changes in labour shares and/or relative prices, scaled by the ratio of the respective sector's labour productivity level to the economy-wide productivity level. The dynamic reallocation growth effect takes into account whether these changes are occurring within a growing or a declining productivity industry. An increase in the relative size of an above-average productivity sector and a simultaneous decrease in the relative size of a below-average productivity sector will have a positive reallocation effect on the former sector's contribution and a negative effect on the latter's. Because the reallocation effect is weighted by a sector's relative productivity level to the overall economy, the positive impact on the above-average productivity sector will more than offset the negative impact on the below-average productivity sector, positively impacting aggregate labour productivity.

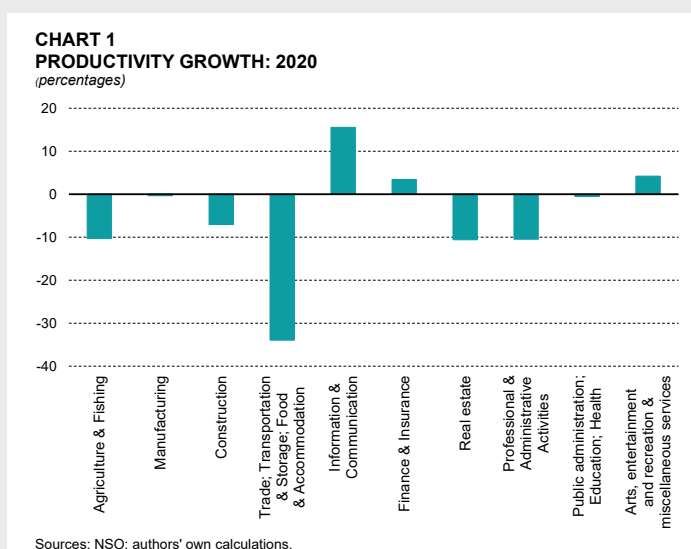
Sectoral contributions to aggregate labour productivity growth

In 2020, aggregate labour productivity in Malta – measured as chainlinked GVA per person employed – declined by 8.2% over the levels recorded in 2019.⁷ This reflects the fact that despite the sharp contraction in GVA, employment increased on an annual basis. Almost all sectors registered a decline in their productivity levels, except for the sectors comprising information and communication, finance and insurance activities, and arts, entertainment and related services (see Chart 1).

The largest decline in productivity growth during 2020 can be observed in the group of sectors comprising trade, transportation, accommodation and food services. Productivity in these sectors collectively decreased by around a third in 2020. These sectors were particularly impacted by the containment measures enacted to limit the spread of COVID-19, especially the travel ban and the closure of non-essential outlets. Such containment measures lead to a sharp drop in output within these sectors, which was not mirrored in employment levels.

In 2020, productivity also declined sharply in the real estate sector, as well as in the sectors comprising professional, scientific and technical activities, and administrative and support services – which includes travel agency services. In each of these sectors, the decline in productivity was driven by a contraction in GVA and an increase in employment.

Table 1 shows the sectoral contributions to aggregate labour productivity growth derived using the GEAD decomposition. In line with its sharp drop in productivity, the sector comprising trade, transportation, accommodation and food services had the largest negative contribution to aggregate productivity growth in 2020. It contributed -7.2 percentage



⁷ This analysis is based on GVA rather than GDP per person employed, as sectoral data are only available for GVA. Aggregate productivity and ULC may thus deviate from those reported in the section of this Report on costs and competitiveness where aggregate productivity and ULC are derived using GDP.

Table 1
SECTORAL CONTRIBUTIONS TO AGGREGATE LABOUR PRODUCTIVITY GROWTH

Percentage points; chainlinked

	2015	2016	2017	2018	2019	2020
Agriculture, forestry & fishing	0.0	0.0	-0.3	0.1	0.0	-0.1
Industry (excl. construction)	-0.2	0.1	-0.5	0.2	-0.2	-0.5
of which: Manufacturing	-0.7	-0.3	0.0	0.2	-0.2	-0.3
Construction	0.2	0.0	0.2	0.1	0.3	0.0
Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities	1.5	-1.0	-0.1	-0.2	-0.5	-7.2
Information & communication	0.5	0.9	0.2	0.2	0.3	0.8
Finance & insurance activities	0.5	0.1	-0.4	-0.2	0.0	0.1
Real estate activities	0.4	0.4	-0.1	0.1	0.0	-0.3
Professional, scientific and technical activities; administrative and support service activities	2.0	1.8	1.7	1.0	0.5	-1.4
Public administration and defence; education, health and social work activities	-0.1	0.1	-0.5	-0.1	0.0	-0.1
Arts, entertainment and recreation, repair of household goods and other services	1.8	-2.2	-0.1	-2.2	-0.5	0.4
Aggregate labour productivity growth (%; GVA-based)	6.6	0.1	0.2	-1.0	-0.2	-8.2

Sources: NSO; authors' own calculations.

points to overall productivity growth, accounting for most of the registered contraction in aggregate labour productivity.

The sectors comprising professional and administrative activities also had a sizeable negative contribution to aggregate productivity developments in 2020, with a joint contribution of -1.4 percentage points. Although the decline in productivity levels is similar to that suffered in the real estate and construction sector, the professional and administrative activities sectors recorded the second largest negative contribution to aggregate productivity growth because of relatively higher share in nominal GVA, thereby amplifying the contribution of the pure productivity effect.

Using the GEAD approach, Table 2 decomposes the contribution of each sector to aggregate productivity growth into the three effects, namely the pure productivity effect, the reallocation level effect and the reallocation growth effect. On an aggregate level, the pure productivity effect – which captures the change in productivity within sectors – was the main contributor to the drop in labour productivity in Malta during the year under review. This effect was negative in most sectors, reflecting the exceptional developments in output in 2020. However, a few sectors did record positive pure productivity effects, such as the information and communication sector, and the arts, entertainment, and related services sector.

Conversely, reallocation effects had a negligible impact on aggregate productivity during the year under review, albeit with a mixed picture across sectors. This reflects the unique nature of the shock experienced during 2020, in which large parts of the economy were forced to shut down or limit production simultaneously, while fiscal support curtailed the number of layoffs. As a result, it is likely that the economy mostly absorbed the COVID-19 shock through a temporary decline in productivity, rather than a change in employment or prices. Furthermore, reallocation effects are normally more visible over longer periods of time.⁸

⁸ A forthcoming working paper by Montebello, R. and Darmanin, J. will analyse longer-term sectoral contributions to productivity growth in Malta, using the method described above.

Table 2
SECTORAL CONTRIBUTIONS TO PRODUCTIVITY GROWTH DECOMPOSED

Percentage points; chainlinked

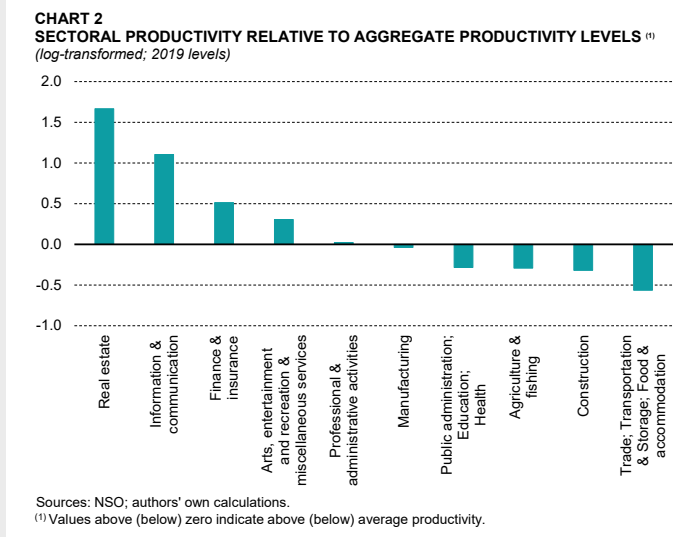
	2020				
	Total contribution	Pure productivity effect	Total reallocation effect	Reallocation effect	
				Reallocation level effect	Reallocation growth effect
Agriculture, forestry & fishing	-0.1	-0.1	-0.1	-0.1	0.0
Industry (excl. construction)	-0.5	-0.2	-0.3	-0.3	0.0
of which: Manufacturing	-0.3	0.0	-0.3	-0.3	0.0
Construction	0.0	-0.3	0.3	0.3	0.0
Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities	-7.2	-6.8	-0.4	-0.5	0.2
Information & communication	0.8	1.2	-0.4	-0.3	-0.1
Finance & insurance activities	0.1	0.3	-0.2	-0.2	0.0
Real estate activities	-0.3	-0.7	0.4	0.4	0.0
Professional, scientific and technical activities; administrative and support service activities	-1.4	-1.9	0.4	0.5	-0.1
Public administration and defence; education, health and social work activities	-0.1	-0.1	0.0	0.0	0.0
Arts, entertainment and recreation, repair of household goods and other services	0.4	0.4	0.1	0.1	0.0
Total economy	-8.2	-8.1	-0.1	-0.1	0.0

Sources: NSO; authors' own calculations.

While the pure productivity effect was the main driver behind overall productivity growth at the aggregate level, the reallocation effect did have an impact on the individual contributions of several sectors. In the GEAD approach, these reallocation effects are weighted by the ratio of a sector's productivity level to the aggregate level in the previous period. Chart 2 provides a picture of sectoral relative productivity levels in 2019.⁹

The total reallocation effects in professional and administrative activities and in the real estate sector in 2020 were positive, as these sectors experienced an increase in their relative size. In particular, the former registered one of the largest increases in its employment share during the year. On the other hand, the positive reallocation effect in the real estate sector was driven by a marginal increase in relative prices, which was significantly amplified by its relatively high productivity levels compared with economy-wide productivity.

Conversely, the reallocation effects of the sector comprising finance and insurance activities, and



⁹ The values have been log-transformed to scale down the values of outlier sectors. The high relative productivity level of the real estate sector, which includes buying and selling own real estate, renting to third parties and operating real estate, mainly reflects the high intensity of non-labour inputs in the sector, specifically capital and imputed rents. As a result, output requires less labour input than in other sectors.

the information and communication sector were negative, reflecting a decrease in their employment share, with the former also registering a marginal fall in relative prices. At the same time, the reallocation effects of the manufacturing sector and the sector comprising trade, transportation, storage, accommodation and food services were negative due to a fall in their employment shares, though this effect was muted by the sectors' below-average productivity.

Sectoral contributions to growth in real compensation per employee and real ULC¹⁰

Real compensation per employee decreased by 1.6% in 2020 (see Table 3). The largest contributor to this drop was the sector comprising trade, transportation, accommodation and food services, reflecting the impact of the coronavirus pandemic on the tourism industry and the high take up of the wage supplement scheme. The sector comprising professional, scientific and technical activities along with administrative and support services also registered a significantly negative contribution. Most other industries had a minor contribution to aggregate compensation per employee growth, suggesting little or no growth. Only the sector comprising public administration, education and health registered a significant positive contribution during the period under review.

Aggregate real ULC increased by 7.2% during 2020 (see Table 4). This was mainly due to the sharp decline in aggregate productivity, shown in Table 1, which offset the aforementioned drop in compensation per employee.

As observed for contributions to productivity growth, the main driver behind the increase in ULC was the trade, transportation, accommodation and food services sector. This was followed by the sector comprising professional and administrative activities. These were the two groups of sectors whose output and productivity levels were mostly impacted by the pandemic, mainly as a result of their links

Table 3
SECTORAL CONTRIBUTIONS TO GROWTH IN REAL COMPENSATION PER EMPLOYEE⁽¹⁾

Percentage points

	2015	2016	2017	2018	2019	2020
Agriculture, forestry & fishing	0.0	0.0	0.0	0.0	0.0	0.0
Industry (excl. construction)	0.3	0.5	-0.1	0.1	0.2	-0.3
of which: Manufacturing	0.1	0.4	-0.1	0.1	0.2	-0.3
Construction	0.1	0.3	-0.1	0.0	-0.4	-0.3
Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities	1.9	1.2	-1.3	0.0	-1.0	-1.4
Information & communication	-0.1	0.5	0.7	0.9	0.2	0.1
Finance & insurance activities	0.7	0.2	0.1	0.0	0.4	0.1
Real estate activities	0.1	0.0	-0.1	0.0	-0.1	0.0
Professional, scientific and technical activities; administrative and support service activities	0.2	0.5	-0.9	0.1	-0.3	-0.7
Public administration and defence; education, health and social work activities	0.1	0.6	-0.4	0.1	0.8	0.8
Arts, entertainment and recreation, repair of household goods and other services	-0.2	1.2	0.3	0.3	0.2	0.1
Growth in compensation per employee (total economy) (%)	2.9	4.8	-2.1	1.4	0.5	-1.6

Sources: NSO; authors' own calculations.

⁽¹⁾ Sum of sectoral contributions may not exactly match aggregate CPE growth due to chainlinking.

¹⁰ Using the GEAD decomposition of productivity, it is possible to calculate approximate sectoral contributions to real ULC growth as the log difference of sectoral contributions to compensation per employee growth and aggregate productivity growth.

Table 4
SECTORAL CONTRIBUTIONS TO GROWTH IN REAL ULCs⁽¹⁾

Percentage points

	2015	2016	2017	2018	2019	2020
Agriculture, forestry & fishing	0.0	0.0	0.3	-0.1	0.0	0.1
Industry (excl. construction)	0.4	0.4	0.4	-0.1	0.4	0.1
of which: Manufacturing	0.9	0.7	-0.1	-0.1	0.3	0.0
Construction	-0.1	0.3	-0.4	-0.2	-0.7	-0.3
Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities	0.4	2.2	-1.2	0.2	-0.5	5.8
Information & communication	-0.6	-0.3	0.4	0.6	0.0	-0.8
Finance & insurance activities	0.2	0.1	0.5	0.1	0.4	0.1
Real estate activities	-0.3	-0.4	0.0	-0.1	-0.1	0.3
Professional, scientific and technical activities; administrative and support service activities	-1.8	-1.2	-2.6	-0.8	-0.8	0.7
Public administration and defence; education, health and social work activities	0.2	0.5	0.1	0.1	0.8	0.8
Arts, entertainment and recreation, repair of household goods and other services	-2.0	3.4	0.4	2.5	0.7	-0.3
ULC growth (total economy) (%)	-3.5	4.8	-1.9	2.4	0.3	7.2

Sources: NSO; authors' own calculations.

⁽¹⁾ Sum of sectoral contributions may not exactly match aggregate ULC growth due to chainlinking.

to the tourism industry. The sector comprising public administration, education and health also registered an increase in ULC, mainly reflecting the increase in compensation per employee within the sector. On the other hand, some sectors recorded declines in ULC growth, including information and communication, the sector comprising arts, entertainment and recreation, and construction. Developments in the former two mainly reflected increased productivity levels within the sectors, which are mostly digital based and hence were not as heavily impacted by the COVID-19 restrictions as other sectors.

When interpreting the above results, the following points must be noted. Firstly, this analysis was conducted in a year when the economy was hit by a large (negative) shock. The sudden nature of the economic shock, as well as government schemes intended to reduce redundancies during the pandemic period, meant that the normal reallocation among sectors was limited. Indeed, as highlighted in Table 2, the pure productivity effect significantly outweighed the reallocation effect during 2020. One would expect that, as the economy starts to recover from the deep economic shock in 2020 and government schemes are gradually phased out, sectoral reallocation might become more prevalent, as underperforming sectors would lose resources in favour of more productive ones.

Secondly, for the purposes of this box, productivity levels are calculated based on the number of persons employed, rather than employment hours. The latter would have been a better indicator of changes to sectoral productivities during 2020, since hours worked responded more sharply to the decline in economic activity than employment levels. Nevertheless, sectoral data for hours worked are not as yet available.