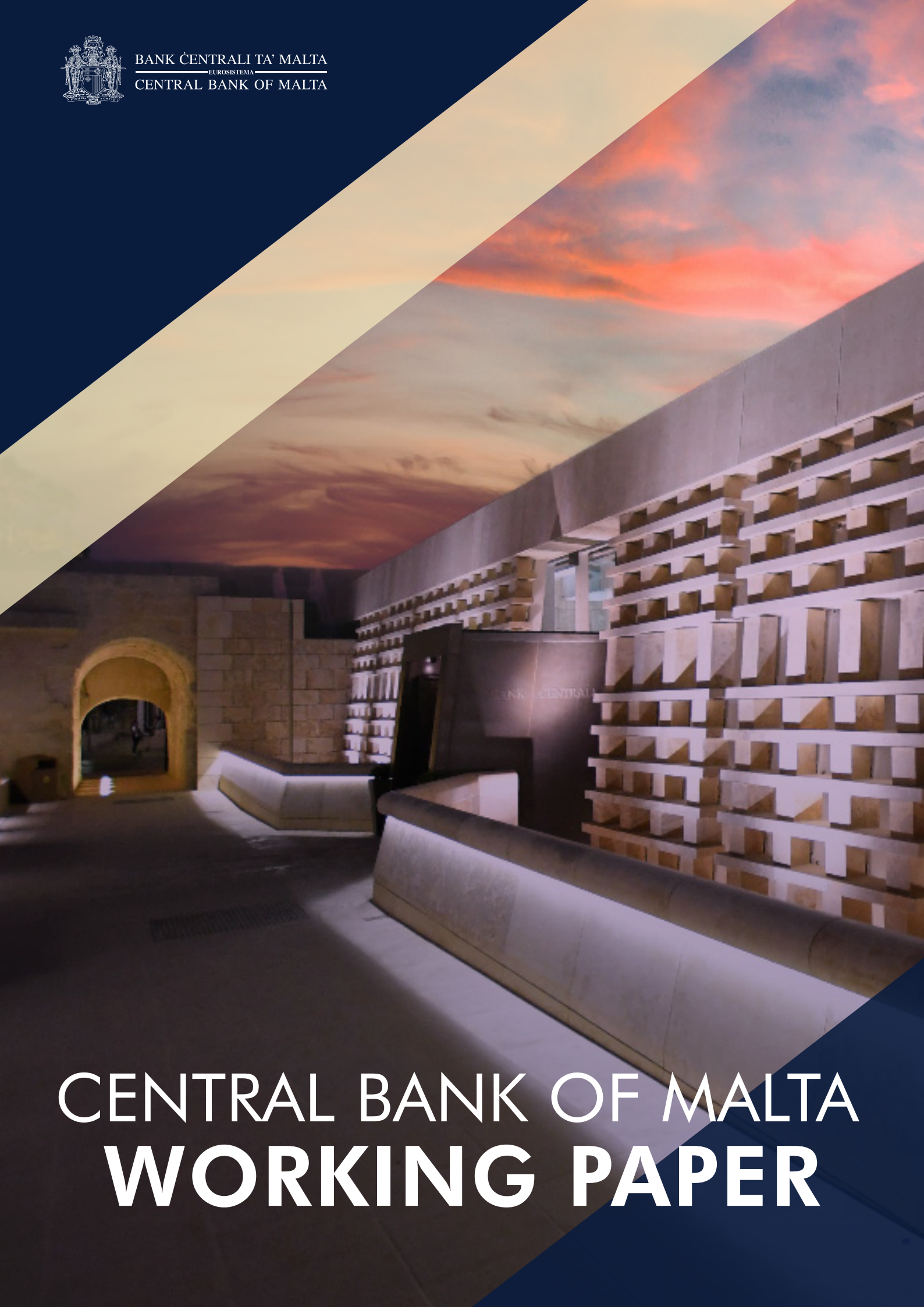

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LABOUR PRODUCTIVITY GROWTH IN MALTA: A SECTORAL DECOMPOSITION ANALYSIS

Roberta Montebello & Jude Darmanin[1]

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[1] Roberta Montebello and Jude Darmanin work in the Economic Analysis Department of the Central Bank of Malta.

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Correspondence: publicrelations@centralbankmalta.org

Abstract

This paper computes sectoral contributions to real labour productivity growth in Malta during the two decades since 2000. The aim is to give an account of the sectoral developments affecting Malta's productivity growth in the twenty years since 2000, in the context of significant structural change. To this end, this study employs the exactly additive GEAD technique developed by Tang and Wang (2004), which allows for the decomposition of sectoral productivity growth into efficiency gains and resource reallocation.

Real labour productivity growth in Malta averaged 1.2% between 2000 and 2019, double that registered in the euro area. This divergence in growth rates was driven by a consistently positive reallocation level effect in each of the sample subperiods, as a result of the large structural shifts and reforms that have occurred since 2000. On the other hand, the contribution of within-sector efficiency gains in Malta was below that observed in the euro area on average and was the main driver of cyclical fluctuations in Malta's productivity growth since 2000. Distortions such as government assistance and labour hoarding during recessions magnified these fluctuations. Across sectors, the results suggest that productivity developments were quite heterogenous, with services industries generally recording positive contributions to productivity growth. On the other hand, the manufacturing sector mainly registered negative contributions, as efficiency gains were offset by an outflow of resources towards other sectors.

Keywords: *Labour productivity growth, exactly-additive decomposition, sectoral contributions, structural changes, services, Malta, euro area.*

JEL Classification: *E24, J24, J21; 052.*

Table of Contents

Introduction

Labour productivity growth is a fundamental factor determining the long-term growth potential of an economy, and is a necessary precondition for sustainable economic growth, higher living standards, and improved competitiveness (Dumagan, 2013). In view of its socio-economic implications, substantial attention is being devoted to monitoring productivity levels and implementing productivity-enhancing policies. In September 2016, the European Council recommended the establishment of productivity boards across the European Union (EU). Consequently, the Malta National Productivity Board was set up in 2019, with the aim of identifying the main competitiveness and productivity challenges facing Malta and the policy responses required to meet them (European Central Bank, 2017; National Productivity Board, 2020).

To better understand aggregate labour productivity growth, it is essential to delve into productivity developments at a sectoral level, which can exhibit a lot of heterogeneity both in the level of labour productivity as well as in growth. The objective of this study is to compute sectoral contributions to aggregate labour productivity growth in Malta using data for 2000-2020. The main results are presented for the 2000-2019 sample period, with 2020 being analysed separately owing to the distortionary impact of the COVID-19 pandemic on the average productivity growth estimates.

This decomposition of productivity growth will serve two main purposes. Firstly, a sectoral decomposition will enable the identification of the predominant sectoral contributors to aggregate productivity growth over time. Secondly, the applied decomposition technique will enable us to decompose productivity growth into within-sector efficiency and resource reallocation effects. To this aim, this study employs an exactly additive decomposition technique developed by Tang and Wang (2004).

This paper extends the literature on productivity growth in Malta in various directions. Following the first publication of chain-linked data in 2020, this study computes sectoral contributions to *real* labour productivity growth in Malta. This contrasts with prior studies, which analysed productivity growth using nominal output data. Indeed, Micallef (2015) noted that the absence of sectoral price deflators for Malta at the time rendered in depth analysis of sectoral productivity challenging. This study also provides a comparison of sectoral productivity contributions in Malta and in the euro area, in light of the significant structural change undergone by the Maltese economy relatively to other European countries since 2000 (Darmanin et al., 2021). This comparison will enable us to identify whether this structural change enabled Malta to bridge its observed productivity gap with the euro area.

This paper starts with a review of the productivity literature, outlining the sources of productivity growth and providing an economic and historical background to productivity developments in Malta since 2000. We then provide a description of the dataset and an overview of the decomposition technique used. The subsequent chapter presents the sectoral contributions to labour productivity growth for Malta, along with a comparison to the euro area. In turn, each sectoral contribution is decomposed to isolate the impact of efficiency gains on productivity growth from the reallocation

effect. We also take a closer look at the impact of the Great Recession of 2009 and the COVID-19 pandemic of 2020 on productivity growth in Malta. The final chapter summarises the main conclusions of this study and identifies areas for further research.

Literature Review

The sources of productivity growth

The economic literature typically decomposes productivity growth into two main sources (Isaksson, 2009). The first source is within-sector productivity; that is, firms within a sector becoming more efficient in producing their output given a specific level of inputs. This incorporates factors such as technological progress, improved internal processes, and the training and upskilling of labour. The second source is resource reallocation. This captures structural change within an economy, emanating from the movement of labour and other resources towards more productive sectors and/or changes in industry composition through the entry and exit of firms. Impediments to the reallocation of resources, such as regulation and labour immobility, play an important role in determining the magnitude of the reallocation effect to aggregate productivity growth (Bartelsman et al., 2004).

The importance of these sources can vary considerably across countries and across time. In a meta-review of this strand of productivity literature, Isaksson (2009) concluded that industrialized countries generally source their productivity growth from within-sector gains, rather than the reallocation effect. This conclusion was based on earlier studies such as Bartelsman et al. (2004), Giannangeli and Gomez-Salvador (2008), and Pagés et al. (2009). According to Brown and Earle (2008), the scope for reallocation in liberalised economies is low as inefficient firms are regularly “cleansed” by the market.

Conversely, Van Beveren and Vanormelingen (2014) and Van den Bosch and Vanormelingen (2017) both showed that in Belgium resource reallocation is an important contributor to productivity growth. However, while its impact is generally stable, that of within-sector productivity tends to be more volatile, thereby making the latter the main source of cyclical variation in productivity growth. In another study, Disney et al. (2000) found that external restructuring accounted for 50% of labour productivity growth in UK manufacturing between 1980 and 1992.

These contrasting findings could reflect differences in methodology and dataset disaggregation. Mitsukuni et al. (2014) suggested that the observed weakness of the reallocation effect could be a result of differing productivity measurements. Furthermore, the level of sectoral disaggregation may affect the degree to which the reallocation effect is captured, since not all structural change occurs between sectors (Isaksson, 2009; Sharpe, 2010). If firms shift their productive processes but remain within the same broadly-defined sector, such as manufacturing, the resulting productivity improvements will still be recorded as within-productivity. Furthermore, structural change is a slow process that may take decades to show up in data, unless very disaggregated sectoral data is used (Isakkson, 2009).

Van Beveren and Vanormelingen (2014) also argue that the source of productivity growth is likely to vary across sectors, so an analysis at aggregate level is likely to mask these effects. For example, Baldwin and Gu (2011) found that in the Canadian manufacturing sector, within-sector productivity growth and reallocation are equally as important, while in the retail sector reallocation accounted for the bulk of productivity growth. This is because making productivity-enhancing investments is necessary to compete in the manufacturing sector. On the other hand, potential efficiency gains in the retail sector are limited, and hence productivity growth typically occurs through changes in industry composition (Foster et al., 2006).

At the same time, the relative importance of reallocation and efficiency gains can depend on the economy's business cycle position. During downturns, low efficiency firms are forced to exit the market while surviving firms attempt to engage in more effective processes, leading to an increase in aggregate productivity (Isaksson, 2009). Van den Bosch and Vanormelingen (2017) found that the reallocation effect in Belgium was substantially larger during and right after recession periods, while Brown and Earle (2008) concluded that the reallocation effect was strong in Eastern European economies that were in a state of transition. This cleansing effect is more prominent within sectors, though it also takes place between different industries. On the other hand, economic booms can lead to a misallocation of resources toward lower-productivity sectors supported by artificially high prices and credit. This can explain the sluggish recovery in many advanced economies following the credit boom and financial crisis in the late 2000s (Borio et al., 2015).

Nevertheless, Van den Bosch and Vanormelingen (2017) suggested that the cleansing mechanism of recessions might be offset by labour hoarding and government support to failing industries, as firms naturally seek to retain their workforce in spite of falling production. Recessions could also slow down the matching of newly unemployed workers with higher productivity jobs (Barlevy, 2002). An additional factor that might distort the productivity-enhancing effects of recessions is scarring (Ouyang, 2009). This occurs when recessions lead to high exit rates among new firms that would have survived in non-recession periods and become high-productivity firms later in their life. Indeed, Foster et al. (2016) and Lopez-Garcia et al. (2016) found that the impact of the Great Recession in 2009 on productivity-enhancing reallocation was negative, due to its significant impact on job creation, trade flows, and credit availability.

Productivity literature in Malta

In a recent study, Darmanin et al. (2021) showed that real productivity levels in Malta had increased between 2000 and 2019, particularly in the manufacturing sector and in high-skilled services activities. However, sectoral productivity levels in Malta generally remained below those observed in the euro area between 2014 and 2020. Other studies, such as Grech (2015a), Micallef (2015), and Micallef (2016) also analysed productivity growth in Malta and its determinants, though from a different perspective when compared to this study and that in Darmanin et al. (2021).

Darmanin et al. (2021) also reviewed changes in the Maltese economic structure between 2000 and 2019 using chain-linked national accounts data at a sectoral level. During this period, services sectors accounted for an increasing share of output and employment. Grech (2015a) noted that these changes mainly stemmed from the development of higher-value services sectors, such as IT, gaming, professional services and financial services, as well as the commercialisation of services that were previously conducted informally, such as care services, office administration, support services, and security. These developments in turn led to the increased diversification of the Maltese economy (Cassar, 2017). Nevertheless, Micallef (2016) called for caution in the interpretation of changes in the share of certain sectors, since a proportion of this change could be the result of outsourcing of certain activities to other sectors, such as cleaning or security activities.

Structural change and productivity growth in Malta since 2000 have been significantly influenced by government reforms and by major political and economic events. The liberalisation of markets and the removal of state aid and subsidies prior to EU accession in 2004 affected traditionally protected sectors, such as manufacturing (Grech, 2015b). Along with a better-trained labour force and a targeted strategy to attract foreign direct investment, this opened the door to growth in higher value-added services sectors such as financial services, maritime, logistics, professional services, back-office administration, information technology, and gaming. At the same time, the composition of the manufacturing sector shifted from labour-intensive industries, such as the manufacture of textiles, wearing apparel & leather products, toward higher skilled sectors, such as the manufacturing of chemicals and pharmaceuticals (Borg Caruana, 2018).

Other productivity-enhancing reforms included the restructuring of the energy sector (Rapa, 2017), the introduction of low-cost airlines in the late 2000s (Attard, 2020), and numerous labour market reforms (Micallef, 2017). The latter consisted of policies aimed at increasing the labour supply, such as tax incentives, pension reforms, and free child-care centres, and initiatives to strengthen the employability of certain target groups, such as training schemes and the gradual tapering of social benefits for the long-term unemployed. These labour market reforms were vital in facilitating the participation of female and older workers, as well as the inflow of foreign workers (Grech, 2017), into the domestic labour force, thereby addressing the labour and skill shortages brought about by the rapid development of new industries (Micallef, 2019). Furthermore, the recent establishment of the Malta Development Bank should improve access to credit, particularly for SMEs (Micallef, 2017). Micallef (2019) concluded that the structural reforms enacted over the past two decades, as well as the process of economic diversification, led to a sharp improvement in the economy's potential.

Methodology

Data description

This study analyses sectoral productivity growth in Malta and its sources using annual national accounts data obtained from Eurostat (2021) for the 2000-2020 period. The sample period captures significant changes in the sectoral structure of the Maltese economy, which was particularly notable after accession into the EU in 2004 (Grech & Zerafa, 2015; Cassar, 2017; Darmanin et al., 2021). The main results are presented for the 2000-2019 period, with estimates for 2020 analysed individually due to the significant distortionary impact of the COVID-19 restrictions on output and productivity levels. Furthermore, the impact of the economic downturn on productivity in 2020 is compared to the impact of the recession observed in 2009.

Productivity levels are measured as the ratio of chain-linked sectoral gross value added per person employed. This differs from previous studies on productivity growth in Malta, which made use of nominal output data. Benchmark revisions to national accounts data (NSO, 2020) might also result in differing conclusions to earlier studies.

The use of a productivity per head measure as opposed to productivity per hour worked was constrained by the unavailability of sectoral hours worked data. We acknowledge that measuring labour input in hours worked could be a more appropriate measure to capture the impact of economic shocks on productivity, particularly during temporary downturns when labour adjustments are mainly made to working hours. Hence, as a robustness check, we decompose labour productivity growth in hours worked for periods of economic downturn in Malta, though at a more aggregated level than the main results. This hours worked decomposition combines average employment hours from the Labour Force Survey (LFS) and employment level data from the national accounts.

Sectors are split according to the NACE Rev. 2 classification, though some sectors have been grouped owing to their relatively small share.[2] Additionally, the sectoral contributions to productivity growth for the main sample period of 2000-2019 are further divided into three subperiods: 2000-2007, 2008-2012, and 2013-2019. We begin by observing the developments in productivity growth in the subperiod prior to the financial crisis (2000-2007), which incorporates Malta's accession into the EU in 2004, followed by the subperiod marked by the global financial crisis (2008-2012), and the high growth years of 2013-2019.

For comparison purposes, this study also calculates and decomposes sectoral contributions to labour productivity growth in the euro area. Given the significant restructuring of the Maltese economy that has taken place since 2000 relative to the euro area, and the lower starting point of Malta's productivity levels when compared with the euro area (Darmanin et al., 2021), the results are

[2] We merge NACE sectors S-U, consisting of other service activities, activities of households as employers, and activities of extraterritorial organisations and bodies, into a '*Miscellaneous Services*' category. We also group NACE sectors B (mining and quarrying), D (electricity, gas, steam and air conditioning supply), and E (water supply; sewerage, waste management and remediation activities).

expected to identify an ongoing convergence process between productivity in Malta and in the euro area.

Decomposition

The aim of a productivity decomposition is primarily to identify the sources of productivity growth. There are several productivity decomposition methods in the literature, depending on the level of disaggregation of the dataset and whether productivity is defined as total factor or labour productivity. According to Isaksson (2009), the choice of productivity definition does not matter if the ultimate objective is to identify sources of productivity change, as changes in total factor productivity should ultimately lead to changes in labour productivity. The only disadvantage in working with a labour productivity definition is that one is unable to distinguish between the driving forces behind efficiency gains, such as technological progress or improved internal processes.

The productivity decomposition derived by Tang and Wang (2004), commonly referred to as the generalised exactly additive decomposition (GEAD), is used in this study to estimate sectoral contributions to aggregate labour productivity growth. This method decomposes labour productivity growth into three components, corresponding to the three terms in equation 1 below.[3] The GEAD equation defines growth in aggregate labour productivity (G_t) as a function of each *i* sector's labour productivity growth (G^i), its share of employment (l^i), and its relative price level compared with the overall economy (p^i).

$$G_t = \sum \left[\frac{Y^i_{t-1}}{Y_{t-1}} G^i_t + \frac{Z^i_{t-1}}{Z_{t-1}} \left(p^i_t l^i_t - p^i_{t-1} l^i_{t-1} \right) + \frac{Z^i_{t-1}}{Z_{t-1}} \left(p^i_t l^i_t - p^i_{t-1} l^i_{t-1} \right) G^i_t \right] \qquad \textit{(eq.1)}$$

The first term corresponds to the *pure productivity effect* (PPE). This captures a sector's contribution to aggregate growth due to within-sector effects, weighted by its share in aggregate nominal output in the previous period (Y_{t-1}). This isolation of pure productivity growth is necessary, since it captures the effect of productivity changes independent of non-efficiency factors, such as changes in the relative size of a sector (Tang & Wang, 2004). This effect captures sectoral efficiency gains, including technological progress, automation, and an upskilling of the workforce.

The second and third terms of the GEAD together capture the impact of resource reallocation and structural change on aggregate labour productivity growth, scaled by each sector's productivity level (Z^i) relative to the aggregate (*Z*). The second term was described by Avillez (2012) as the (*static*) *reallocation level effect* (RLE). In essence, this effect captures the impact of resource reallocation between sectors through changes in the relative size of each sector, which in turn is determined by sectoral labour shares and relative price levels.

[3] A full derivation of the GEAD is provided in Appendix I.

As shown in Denison (1962), aggregate labour productivity can increase even when within-sector productivity remains constant if labour moves towards sectors with relatively higher labour productivity. For instance, a shift in labour towards an above-average productivity sector from a below-average productivity sector will have a positive effect on the former sector's contribution and a negative effect on the latter's contribution. Since this effect is scaled by a sector's relative productivity level to the aggregate, the positive impact on the above-average productivity sector will be larger than the negative impact on the below-average productivity sector, such that aggregate labour productivity will increase.

The third term is the *(dynamic) reallocation growth effect* (RGE). While the RLE captures the clean reallocation effect (since it holds productivity growth constant), the RGE is a covariance term containing both growth in real productivity and the reallocation effect. According to Nordhaus (2001) and de Avillez (2012), the RGE reveals whether the economy is subject to Baumol's cost disease; that is, whether resources are moving towards sectors where productivity is stagnant or declining. When resources move toward an industry with declining labour productivity growth, even if its relative productivity is above-average (which is usually the case with established industries), the positive impact on aggregate productivity through the RLE effect will be dampened by a negative RGE effect (Dumagan, 2013).

The inclusion of relative prices in the GEAD captures resource reallocation from more intensive use of non-labour inputs, since changes in prices could induce movements in non-labour resources towards higher-value sectors (Dumagan, 2013). When the relative value of an industry's output changes, this will translate into a higher contribution to aggregate output and hence to aggregate labour productivity growth (Tang & Wang, 2004).

In order to disentangle the impact of labour shares and relative prices on productivity growth, Diewert (2010) proposed an extension to the GEAD, the three-component GEAD. In this decomposition, shown in equation 2, the first three terms correspond to the individual impacts of sectoral productivity (G^i), growth in relative prices (γ^i), and growth in labour shares (σ^i), with the first term being mathematically equivalent to the PPE effect in the GEAD.[4] The last four terms represent the interaction terms, and are generally small in magnitude (Diewert, 2014). Each effect is weighted by sector *i*'s share of nominal output in the preceding period (y_{t-1}^i).

$$G_t = \sum(y_{t-1}^i)(G_t^i) + \sum(y_{t-1}^i)(\gamma_t^i) + \sum(y_{t-1}^i)(\sigma_t^i) + \sum(y_{t-1}^i)(\gamma^i)(\sigma_t^i) + \sum(y_{t-1}^i)(G_t^i)(\gamma_t^i) + \sum(y_{t-1}^i)(G_t^i)(\sigma_t^i) + \sum(y_{t-1}^i)(G_t^i)(\sigma_t^i)(\gamma_t^i) \qquad \textit{(eq.2)}$$

Equations 1 and 2 are both exactly additive expressions for aggregate labour productivity growth and ultimately provide the same sectoral contributions, with the only difference being that equation 2

[4] A full derivation of the three-component GEAD is provided in Appendix II.

provides a more disaggregated decomposition of the reallocation effect. Indeed, the sum of the individual impacts of growth in relative prices (γ^i) and in labour shares (σ^i) and of the interaction term between the two is equal to the second term (the RLE effect) in equation 1.

In a review of different sectoral decomposition techniques, Dumagan (2013) suggests that the GEAD outperforms other decomposition techniques, such as the commonly used traditional aggregate labour productivity decomposition (TRAD) and its variant developed by Centre for the Study of Living Standards (Sharpe, 2010).[5] A similar conclusion was reached in Reinsdorf (2015). Although the GEAD and the TRAD share many similarities, they differ in two vital aspects.

Firstly, within-sector effects in the TRAD are weighted according to sectors' real output (X_{t-1}) shares, as opposed to nominal output (Y_{t-1}) shares as seen in the GEAD. This is because the TRAD is built on the assumption that sectoral real outputs are additive to aggregate output, which can only hold true if real output is measured in constant prices. However, when a fixed-weight, constant price index is used, the importance of industries whose prices have declined in the intervening period is overestimated, making output and productivity estimates highly dependent on the base year selected (Tang & Wang, 2004). Secondly, the TRAD does not take relative price changes into account when measuring the reallocation effect, thereby ignoring movements in non-labour resources. Because of these two features, sectoral contributions calculated via the TRAD approach will not be exactly additive to aggregate labour productivity growth when output is measured in chain-linked volumes, rather than in constant prices. On the other hand, the GEAD decomposition does away with this issue entirely by assuming additivity in nominal, rather than real output. This also allows for the calculation of exactly additive contributions even when output is not measured using additive methods, such as in chain-linked volumes.

Results

Decomposition of aggregate labour productivity growth

This subsection provides a brief overview of labour productivity growth and its sources in Malta and in the euro area at an aggregate level. The results are provided in *Table 1* for the main sample period 2000-2019 and are also divided into three smaller subperiods.[6]

During the 2000-2019 period, real labour productivity in Malta increased by an average of 1.2%, outpacing productivity growth in the euro area, which registered an average growth rate of 0.6%. This divergence was primarily driven by a higher reallocation level effect in Malta, reflecting the significant restructuring of the Maltese economy during the period under review. On the other hand, the

[5] As given in de Avillez (2012), the TRAD equation is: $G_t = \sum_i \left[\frac{X^i_{t-1}}{X_{t-1}} G^i_t + \frac{Z^i_{t-1}}{Z_{t-1}}\left(l^i_t - l^i_{t-1}\right) + \frac{Z^i_{t-1}}{Z_{t-1}}\left(l^i_t - l^i_{t-1}\right)G^i_t\right]$.

[6] Calculations based on national accounts 2020Q4 vintage.

contribution of the pure productivity effect in Malta was lower on average than that registered in the euro area (0.3 percentage points compared with 0.7 percentage points). At the same time, the reallocation growth effect in Malta was negative, which could indicate that resources shifted towards sectors whose productivity levels were declining, akin to Baumol's cost disease (Avillez, 2012). However, a closer analysis will suggest that this was due to sector-specific factors rather than an economy-wide phenomenon.

The higher aggregate productivity growth rate observed in Malta could in part be explained by a convergence process towards productivity levels in the euro area, given that productivity in most Maltese sectors during the reviewed period were below those registered in the euro area (Darmanin et al., 2021). However, as is clearly shown in *Table 1*, this convergence is mainly due to structural change rather than sectoral efficiency gains. Since sectoral reallocation is temporary and is likely to slow down in the future, increased investment in efficiency-improving production processes is necessary to sustain these higher productivity growth rates.

When divided into subperiods, the results suggest that the reallocation level effect remained significantly positive throughout the period under review, particularly during the subperiod characterised by the global financial crisis (2008–2012). On the other hand, the pure productivity effect exhibited more volatility, turning negative in the 2008-2012 subperiod but supporting productivity growth during the 2000-2007 and the 2013-2019 subperiods. In particular, the pure productivity effect rose sharply during the high-growth subperiod of 2013-2019. This is consistent with Van Beveren and Vanormelingen (2014) and Van den Bosch and Vanormelingen (2017), which found that the pure productivity effect was the main contributor to cyclical movements in productivity growth.

Table 1: Decomposition of aggregate labour productivity growth in Malta & the euro area

(subperiod averages; annual percentage change (where indicated); percentage point contribution)

	2000-2019		**2000-2007**		**2008-2012**		**2013-2019**	
	MT	**EA**	**MT**	**EA**	**MT**	**EA**	**MT**	**EA**
Aggregate labour productivity growth (%)	***1.2***	***0.6***	***1.1***	***0.9***	***0.7***	***0.2***	***1.6***	***0.5***
Pure productivity effect	0.3	0.7	0.4	1.0	-0.6	0.3	0.9	0.6
Reallocation level effect	1.2	0.0	0.7	0.0	1.7	-0.1	1.3	0.0
Reallocation growth effect	-0.4	0.0	-0.1	0.0	-0.4	0.0	-0.6	0.0

Source: Eurostat (2021); authors' calculations.

Decomposition of labour productivity growth by broad economic sector

This subsection discusses the sectoral distribution of labour productivity growth in Malta. Aggregate labour productivity growth rates are decomposed by broad economic sector for both Malta and the euro area during 2000-2019, as well as for the three subperiods under analysis, as shown in *Table 2*.

Over the entire sample period, the services sector was the driver of productivity growth in Malta. In contrast, the manufacturing sector had the largest negative contribution. Although similar sectoral developments were observed in the euro area, the absolute magnitude of these contributions was greater in Malta. In particular, the positive contribution of the services sector (1.9 percentage points) was significantly larger than that registered in the euro area (0.6 percentage points). On the other hand, productivity within the Maltese manufacturing sector stood at a negative 0.6 percentage points on average, compared with a negative 0.1 percentage points in the euro area. The contributions of the primary and trade sectors to productivity growth in both Malta and the euro area were minor on average between 2000 and 2019.

Although this observation relating to the manufacturing and services sectors holds for most of the subperiods under analysis, the magnitude of their respective contributions varies over time. The manufacturing sector in Malta registered its largest negative contribution to productivity growth during the 2000-2007 subperiod, particularly in the initial years, following a sharp drop in the output of electronic components due to the bursting of the information technology bubble (Borg Caruana, 2018). Additionally, the manufacturing sector went through a period of restructuring following developments ahead of EU accession and in the immediate years after. These primarily included the removal of government subsidies and other state aid (Grech, 2015b) and exposure to an increased level of competition from EU counterparts (Borg Caruana, 2018).

The sizeable negative contribution from the manufacturing sector during 2000-2007 persisted during the following subperiods (2008-2012; 2013-2019), albeit to a lesser extent. In particular, the contribution of this sector dropped to -2.6 percentage points during the global financial crisis in 2009, albeit not as low as in the 2001 recession. This was offset by a positive contribution from the services sector, which was significantly higher than that observed in the euro area and suggests that Malta's convergence toward euro area productivity levels was mainly driven by this sector.

When compared with the euro area, developments in the contribution of the services sector generally followed same trend during the 2000-2007 and 2008-2012 subperiods, albeit to a larger magnitude in Malta. Developments diverged in the 2013-2019 subperiod, in line with the sharp rise in economic activity and continued flow of resources towards the sector in Malta, which was not mirrored in the euro area. With regards to the manufacturing sector, while weakness in its contribution to productivity growth was observed in both economies, Malta registered a significantly larger negative contribution during 2000-2007 and 2013-2019. The former relates to the sector's downsizing around the time of EU accession, while the latter occurred due to strong activity in the services sector, leading to a shift in labour resources.

Table 2: Broad sectoral decomposition of aggregate labour productivity growth in Malta & the euro area

(subperiod averages; annual percentage change (where indicated); percentage point contribution)

	2000-2019		2000-2007		2008-2012		2013-2019	
	MT	EA	MT	EA	MT	EA	MT	EA
Aggregate labour productivity growth (%)	***1.2***	***0.6***	***1.1***	***0.9***	***0.7***	***0.2***	***1.6***	***0.5***
Primary	-0.1	0.0	0.0	-0.1	-0.2	0.0	0.0	0.0
Industry	-0.6	-0.1	-1.1	0.1	-0.6	-0.4	-0.2	0.1
of which:								
Manufacturing	-0.6	-0.1	-0.9	-0.1	-0.3	-0.3	-0.5	0.1
Construction	0.0	0.0	-0.1	0.1	-0.1	-0.2	0.1	0.0
Trade	-0.1	0.0	-0.1	0.1	-0.1	0.0	0.0	0.1
Services	1.9	0.6	2.2	0.8	1.7	0.6	1.8	0.4

Source: Eurostat (2021); authors' calculations.

Notes: Industry refers to NACE sectors B-F, while the trade and services sectors refer to NACE sectors G and H-U, respectively.

Sectoral decomposition of labour productivity growth in Malta

The decomposition of broadly defined economic sectors in the previous subsection sets the foundation for a more disaggregated sectoral analysis. *Table 3* decomposes labour productivity growth in Malta by NACE sector for the full sample period, while also providing a sectoral decomposition for the 2000-2007, 2008-2012, and the 2013-2019 subperiods.

The positive contribution of the services sector, the driver of productivity growth in Malta during 2000-2019, was largely driven by the arts, entertainment & recreation sector, professional, scientific & technical activities, administrative & support services, and financial & insurance activities. The contribution of most services sectors was supported by a positive reallocation effect. Meanwhile, as observed in *Table 1*, the pure productivity effect was positive but weak during the period under review. The sectors observing the largest efficiency gains were the information & communication sector and industrial sectors such as manufacturing. The latter probably reflected the restructuring of the manufacturing sector following EU accession in 2004, partly offsetting the negative contribution of the reallocation of resources away from the downsized sector.

In the subperiod dominated by accession into the EU (2000-2007), improvements in Malta's productivity growth rate were largely driven by shifts in the structure of the Maltese economy towards services, evidenced through the reallocation level effect. Financial & insurance activities, the arts, entertainment & recreation sector, and to a lesser extent professional, scientific & technical activities registered the largest positive contributions to aggregate productivity growth during this subperiod. On the other hand, the manufacturing sector registered a substantial negative contribution to productivity growth, following a period of restructuring and the complete removal of levies upon EU accession. Thus, as resources shifted from the manufacturing sector towards services, the overall

impact on the aggregate reallocation level effect was positive due to the relatively higher productivity level of services sectors.[7]

Apart from the reallocation level effect, the pure productivity growth effect also had a positive contribution to overall productivity growth during the 2000-2007 subperiod, albeit to a lesser extent. Efficiency improvements largely emanated from financial & insurance activities and the arts, entertainment, & recreation sector, as growth in output outpaced employment growth. The manufacturing sector also registered efficiency gains as the sector downsized, leading to a faster decline in employment when compared with output. These developments could also be explained by the development of new, higher productivity subsectors, notably the pharmaceutical products & preparations subsector. However, this improvement was partially dampened by developments in the subsector relating to the manufacturing of computers & electronics, following the bursting of the information technology bubble at the start of the subperiod.

On the other hand, efficiency losses were registered in sectors such as construction and real estate during the 2000-2007 subperiod, dampening the overall pure productivity growth effect. Following a strong increase in output at the start of this subperiod due to public sector health and other infrastructural projects occurring at the time (Central Bank of Malta, 2003), the construction sector registered a large decline in output once these projects were completed. Despite this, employment in the sector continued to increase, possibly due to the buoyant residential property market at the time and leading to a drop in output per worker (Central Bank of Malta, 2005; Gatt & Grech, 2016).

During the following 2008-2012 subperiod, the changing structure of the Maltese economy continued to favourably impact total productivity growth. Specifically, the reallocation effect in favour of the services sectors was stronger than that observed in the previous subperiod, particularly in above-average productivity sectors such as arts, entertainment & recreation, real estate activities, and financial & insurance activities. However, the overall contribution of services sectors in general declined during this subperiod, mainly resulting from the adverse impact of the global financial crisis on the pure productivity growth effect. This negative impact of the 2009 downturn is analysed further in the following subsection. Overall, the arts, entertainment & recreation sector, consisting primarily of gambling & betting activities, together with the professional, scientific & technical activities and the financial & insurance sectors continued to record the largest positive contributions to productivity growth in Malta during this subperiod.

Productivity growth accelerated during the 2013-2019 subperiod, averaging 1.6%. These were years characterised by significant economic growth. Consistent with previous subperiods, services sectors led this growth in productivity levels. The professional, scientific & technical activities sector continued to record one of the largest positive contributions to growth, followed by the administrative & support services sector and the information & communication sector. The arts, entertainment & recreation sector also registered a significant contribution to growth, albeit to a relatively lesser extent.

[7] Sectoral macroeconomic indicators are given in Appendix III.

Contrary to the developments recorded during 2008-2012, the 2013-2019 subperiod was characterised by a positive pure productivity growth effect, larger than that observed in previous subperiods. In particular, the industrial sector comprising utilities & quarrying and the information & communication services sector recorded a pure productivity growth effect significantly above that in other sectors. The former was partially a result of reforms in the energy sector (Rapa, 2017) and the strong economic growth during this subperiod, leading to a sharp increase in its contribution to productivity growth in spite of its small share in nominal output. The wholesale & retail trade sector also registered a notable increase in efficiency gains, as growth in real output surpassed employment growth.

On the other hand, the arts, entertainment & recreation sector and the real estate sector recorded negative pure productivity effects, following larger increases in employment relative to output. These results, particularly the weakness in output growth in the arts, entertainment & recreation sector, is likely a statistical artefact and should be treated with caution, as anecdotal evidence suggests that this sector was among the highest performing during the 2013-2019 growth years. This is also evidenced by the continued growth in employment within the sector. According to Grech (2018), statistical revisions to output data tend to be sizeable and biased upwards, which could indicate that future revisions to the data might lead to an increase in output growth, which in turn would raise the contribution of the PPE effect.

At the same time, reallocation towards above-average productivity sectors continued during the 2013-2019 subperiod, leading to a further positive reallocation level effect at an aggregate level. In particular, the arts, entertainment & recreational sector, administrative & support services, and the professional, scientific & technical activities sector, together with real estate activities, recorded the largest positive reallocation level effects.

This positive reallocation level effect was partly dampened by a negative reallocation growth effect. A closer analysis of the data suggests that this negative effect was mainly due to developments in the energy sector, where the share of employment declined as productivity levels were increasing. This drop in employment is however a statistical effect, owing to a reclassification of employment in the energy sector to the administrative and support services sector during this subperiod (NSO, 2015). Hence, the negative reallocation growth effect observed during this subperiod is mainly a result of employment reclassifications between sectors, rather than to a wider-economy phenomenon of resources moving towards sectors with declining productivity levels.

Table 3: Sectoral decomposition of aggregate labour productivity growth in Malta

*(subperiod averages; *annual percentage change; percentage point contribution)*

	2000-2019				2000-2007				2008-2012				2013-2019			
	Total	PPE	RLE	RGE	**Total**	PPE	RLE	RGE	**Total**	PPE	RLE	RGE	**Total**	PPE	RLE	RGE
Aggregate labour productivity growth	**1.2***	**0.3**	**1.2**	**-0.4**	**1.1***	**0.4**	**0.7**	**-0.1**	**0.7***	**-0.6**	**1.7**	**-0.4**	**1.6***	**0.9**	**1.3**	**-0.6**
Agriculture, forestry and fishing	**-0.1**	0.0	-0.1	0.0	**0.0**	0.1	-0.1	0.0	**-0.2**	-0.1	0.0	0.0	**0.0**	0.0	-0.1	0.0
Quarrying and utilities	**0.0**	0.2	0.0	-0.1	**0.0**	0.0	-0.1	0.0	**-0.3**	-0.4	0.2	-0.1	**0.2**	0.7	-0.2	-0.3
Manufacturing	**-0.6**	0.3	-0.8	0.0	**-0.9**	0.2	-1.1	0.0	**-0.3**	0.9	-1.0	-0.1	**-0.5**	0.0	-0.5	0.0
Construction	**0.0**	0.0	0.0	0.0	**-0.1**	-0.3	0.2	0.0	**-0.1**	0.1	-0.1	0.0	**0.1**	0.1	-0.1	0.0
Wholesale and retail trade; repair of motor vehicles and motorcycles	**-0.1**	0.1	-0.2	0.0	**-0.1**	-0.1	0.0	0.0	**-0.1**	0.2	-0.3	0.0	**0.0**	0.3	-0.3	0.0
Transportation and storage	**0.0**	0.0	0.0	0.0	**-0.1**	0.0	0.0	0.0	**-0.1**	-0.2	0.1	0.0	**0.1**	0.1	-0.1	0.0
Accommodation and food service activities	**0.0**	0.0	0.0	0.0	**-0.1**	-0.2	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.1**	0.1	0.0	0.0
Information and communication	**0.2**	0.3	0.0	0.0	**0.2**	0.1	0.0	0.0	**0.1**	0.2	0.0	0.0	**0.4**	0.5	-0.1	0.0
Financial and insurance activities	**0.3**	0.1	0.2	0.0	**0.7**	0.3	0.3	0.0	**0.3**	-0.1	0.4	0.0	**-0.1**	0.0	-0.1	0.0
Real estate activities	**0.1**	-0.3	0.5	-0.1	**0.1**	-0.2	0.3	0.0	**0.0**	-0.6	0.7	-0.1	**0.1**	-0.3	0.5	-0.1
Professional, scientific and technical activities	**0.4**	0.1	0.3	0.0	**0.3**	0.0	0.3	0.0	**0.3**	0.1	0.2	0.0	**0.6**	0.2	0.4	0.0
Administrative and support service activities	**0.3**	0.0	0.3	0.0	**0.1**	-0.1	0.2	0.0	**0.2**	0.0	0.1	0.0	**0.6**	0.1	0.5	0.0
Public administration and defence; compulsory social security	**0.0**	0.1	-0.1	0.0	**0.1**	0.1	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**	0.1	-0.1	0.0
Education	**0.1**	-0.1	0.2	0.0	**0.1**	0.0	0.2	0.0	**0.1**	-0.2	0.3	0.0	**0.0**	-0.1	0.1	0.0
Human health and social work activities	**0.1**	0.0	0.1	0.0	**0.2**	0.1	0.1	0.0	**0.2**	0.0	0.2	0.0	**0.1**	0.0	0.1	0.0
Arts, entertainment, and recreation	**0.4**	-0.3	0.8	-0.1	**0.6**	0.3	0.3	0.0	**0.5**	-0.3	0.9	-0.1	**0.2**	-0.9	1.2	-0.1
Miscellaneous services	**0.0**	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0

Source: Eurostat (2021); authors' calculations.

Notes: The acronyms PPE, RLE and RGE stand for the pure productivity effect, reallocation level effect, and reallocation growth effect, respectively.

The subperiod results depicted in *Table 3* point to the reallocation level effect as being the main driver of aggregate labour productivity growth in Malta. On this note, *Table 4* further disaggregates the reallocation level effect into sectoral employment shares and relative price changes, enabling us to identify the main source of resource reallocation in Malta. In each of the subperiods, it is evident that resource reallocation mainly occurred through shifts in labour. Labour movements toward higher productivity sectors contributed 0.7 percentage points to aggregate productivity growth during the 2000-2007 subperiod, before intensifying to 1.5 and 1.2 percentage points during 2008-2012 and 2013-2019, respectively.

At a sectoral level, the results suggest that over the full sample period, labour shifted away from industrial sectors, such as manufacturing, but also from public services, albeit to a lesser extent. A closer analysis suggests that employment fell strongly in manufacturing subsectors such as the manufacturing of furniture, clothing, food & beverages, and rubber & plastic products. On the other hand, it was mainly services sectors that saw the largest increases in labour contribution. These include real estate activities, information & communication services, the arts, entertainment, & recreation sector and, more recently, sectors such as professional, scientific, & technical activities, and administrative & support services.[8] The increase in labour share within the administrative & support services sector, particularly in the last subperiod, could be due to an ongoing increase in employment outsourcing by firms in several sectors (Micallef, 2016). This outsourcing could also be partly behind falling or weak labour reallocation contributions in other sectors, such as manufacturing and accommodation & food services.

In contrast, the impact of changes in relative prices on aggregate productivity growth was negligible when compared with the contribution of shifts in labour resources. Within sectors, it was mainly the manufacturing and the information & communication sectors which saw the largest declines in the contribution of relative prices, the former as a result of downsizing and restructuring around the time of EU accession, and the latter due to the nature of the industry. These negative contributions were generally offset by increasing relative prices in other sectors, such as the arts, entertainment & recreation sector, and education.

[8] The labour contribution of real estate activities sector is significantly amplified by the high relative productivity of the sector, as argued by Nordhaus (2001). The above-average productivity level of this sector, which includes buying and selling own real estate, renting to third parties, and operating real estate, mainly reflects the inclusion of imputed rent of owner-occupied dwellings in chain-linked gross value added.

Table 4: Reallocation level effect by employment share & relative prices in Malta

(subperiod averages; percentage point contribution)

	2000-2019			2000-2007			2008-2012			2013-2019		
	RLE	**Labour share**	**Relative prices**	**RLE**	**Labour share**	**Relative prices**	**RLE**	**Labour share**	**Relative prices**	**RLE**	**Labour share**	**Relative prices**
Aggregate labour productivity growth	**1.2**	**1.1**	**0.0**	**0.7**	**0.7**	**-0.1**	**1.7**	**1.5**	**0.2**	**1.3**	**1.2**	**0.0**
Agriculture, forestry and fishing	**-0.1**	0.0	0.0	**-0.1**	0.0	-0.1	**0.0**	0.0	0.0	**-0.1**	-0.1	0.0
Quarrying and utilities	**0.0**	-0.1	0.1	**-0.1**	-0.1	0.0	**0.2**	-0.1	0.3	**-0.2**	-0.1	-0.1
Manufacturing	**-0.8**	-0.6	-0.3	**-1.1**	-0.7	-0.4	**-1.0**	-0.7	-0.3	**-0.5**	-0.4	-0.1
Construction	**0.0**	0.0	0.0	**0.2**	0.1	0.0	**-0.1**	-0.1	0.0	**-0.1**	0.0	0.0
Wholesale and retail trade; repair of motor vehicles and motorcycles	**-0.2**	0.0	-0.1	**0.0**	0.1	-0.1	**-0.3**	-0.1	-0.1	**-0.3**	-0.1	-0.2
Transportation and storage	**0.0**	0.0	0.0	**0.0**	-0.1	0.0	**0.1**	0.1	0.1	**-0.1**	0.0	-0.1
Accommodation and food service activities	**0.0**	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.1	**0.0**	0.1	-0.1
Information and communication	**0.0**	0.1	-0.2	**0.0**	0.0	0.0	**0.0**	0.3	-0.3	**-0.1**	0.1	-0.2
Financial and insurance activities	**0.2**	0.1	0.1	**0.3**	0.2	0.1	**0.4**	0.2	0.1	**-0.1**	-0.1	0.0
Real estate activities	**0.5**	0.5	0.0	**0.3**	0.4	-0.1	**0.7**	0.7	0.0	**0.5**	0.4	0.0
Professional, scientific and technical activities	**0.3**	0.3	0.0	**0.3**	0.2	0.0	**0.2**	0.2	0.0	**0.4**	0.4	0.0
Administrative and support service activities	**0.3**	0.3	0.0	**0.2**	0.2	0.0	**0.1**	0.1	0.0	**0.5**	0.5	0.0
Public administration and defence; compulsory social security	**-0.1**	-0.1	0.0	**0.0**	-0.1	0.1	**0.0**	-0.1	0.0	**-0.1**	-0.2	0.0
Education	**0.2**	0.0	0.2	**0.2**	0.1	0.1	**0.3**	0.1	0.2	**0.1**	-0.1	0.2
Human health and social work activities	**0.1**	0.1	0.0	**0.1**	0.1	0.0	**0.2**	0.2	0.0	**0.1**	0.0	0.0
Arts, entertainment, and recreation	**0.8**	0.5	0.3	**0.3**	0.2	0.1	**0.9**	0.6	0.2	**1.2**	0.7	0.5
Miscellaneous services	**0.0**	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0

Source: Eurostat (2021); authors' calculations.

Notes: The reallocation level effect (RLE) also includes an interaction term which is negligible in magnitude and has therefore been omitted from this table.

The impact of economic downturns on productivity growth

The analysis conducted in the previous subsections suggests that labour productivity growth tends to have a pro-cyclical element, particularly the pure productivity effect. This is in line with results from similar studies in the literature (Van Beveren & Vanormelingen, 2014; Van den Bosch & Vanormelingen, 2017).

Historically, Malta has recorded five years of economic downturn since 2000, mainly in 2001, 2004, 2009, 2011 (Ellul, 2021), and more recently, in 2020. While the impact of 2001 and 2004 and their effect on the manufacturing sector has already been discussed, this subsection will focus on productivity developments during the 2009 (Great Recession) and 2020 (COVID-19 pandemic) downturns. Since the economic literature on the impact of recessions on productivity growth is ambiguous, due to the trade-off between the cleansing effect and distorting factors such as labour hoarding, government aid, and scarring, the aim here is to identify which of these opposing factors was dominant in determining the immediate effect of these downturns on Malta's productivity growth. In this light, *Table 5* provides a sectoral decomposition of productivity growth during 2009 and 2020.

In line with developments in output growth, aggregate labour productivity growth declined in 2009 and 2020. Labour productivity fell by 1.1% in 2009, mirroring a similar decline in real output while aggregate employment remained largely unchanged. In contrast, productivity declined at an unprecedented annual rate of 8.2% in 2020, due to a sharp drop in output without a corresponding decline in total employment. These declines emanated entirely through the pure productivity growth effect. The overall decline in productivity levels during 2020 was much larger than that registered in 2009, mainly due to the partial lockdown measures which severely restricted activity and production in several sectors.

Table 5: Sectoral developments in productivity, output, and employment during 2009 and 2020

*(*annual percentage change; percentage point contribution)*

	2009					2020				
	Labour Productivity					Labour Productivity				
	Total	PPE	RE	Output*	Employment*	**Total**	PPE	RE	Output*	Employment*
Aggregate	**-1.1***	**-3.1**	**1.9**	**-1.1**	**0.0**	**-8.2***	**-8.2**	**0.0**	**-5.8**	**2.6**
Agriculture, forestry and fishing	**0.4**	0.5	0.0	40.7	2.0	**-0.1**	-0.1	-0.1	-10.7	-0.8
Quarrying and utilities	**0.8**	0.3	0.5	13.1	-3.0	**-0.2**	-0.2	0.0	-4.9	7.3
Manufacturing	**-2.6**	-1.3	-1.4	-15.6	-8.0	**-0.3**	0.0	-0.3	-0.1	0.3
Construction	**-0.3**	-0.2	-0.1	-6.3	-2.9	**0.0**	-0.3	0.3	2.9	10.7
Wholesale and retail trade; repair of motor vehicles and motorcycles	**-0.6**	-0.6	-0.1	-4.2	0.9	**-1.3**	-1.0	-0.3	-9.9	1.2
Transportation and storage	**0.0**	-0.3	0.3	-1.5	3.3	**-2.6**	-2.6	-0.1	-43.1	1.5
Accommodation and food service activities	**-0.4**	-0.2	-0.2	-8.6	-4.8	**-3.2**	-3.2	0.0	-64.7	2.4
Information and communication	**-0.1**	-0.2	0.1	0.9	4.9	**0.8**	1.2	-0.4	13.6	-1.7
Financial and insurance activities	**1.3**	0.8	0.5	15.8	4.2	**0.1**	0.3	-0.2	3.9	0.5
Real estate activities	**0.5**	-0.6	1.1	5.6	16.0	**-0.3**	-0.7	0.4	-4.8	6.7
Professional, scientific and technical activities	**0.1**	-0.5	0.7	0.6	13.5	**-0.4**	-0.6	0.3	-1.5	5.5
Administrative and support service activities	**0.1**	-0.1	0.1	-0.2	2.2	**-1.1**	-1.2	0.2	-10.8	5.2
Public administration and defence; compulsory social security	**0.3**	0.1	0.1	2.0	0.2	**0.2**	0.4	-0.2	5.5	-1.4
Education	**0.2**	-0.1	0.3	-0.5	1.4	**-0.2**	-0.1	0.0	-2.2	0.5
Human health and social work activities	**0.4**	0.1	0.3	5.1	3.2	**-0.1**	-0.3	0.2	-0.7	5.1
Arts, entertainment, and recreation	**-1.1**	-0.8	-0.2	-2.4	8.5	**0.5**	0.4	0.1	10.0	4.4
Miscellaneous services	**-0.1**	0.0	0.0	-4.2	-2.3	**-0.1**	-0.1	0.0	-7.7	2.0

Source: Eurostat (2021); authors' calculations.

Notes: The acronyms PPE and RE stand for the pure productivity effect and the total reallocation effect (sum of the reallocation level effect and the reallocation growth effect), respectively. Output is defined as chain-linked GVA.

The 2009 downturn was particularly pronounced in the manufacturing sector, trade, and the tourism-reliant sector of accommodation & food services. However, the sharp drop in output in these sectors was not mirrored to the same extent by employment, indicating the presence of labour hoarding. Indeed, during this downturn labour adjustments were largely made to hours worked, such as by introducing four-day weeks or reducing overtime hours (Central Bank of Malta, 2009).

On the other hand, reallocation continued to contribute positively to growth during 2009, suggesting that productivity-enhancing structural change was not dented by the recession. Indeed, *Table 6* shows that resource reallocation actually accelerated in the immediate period during and after the recession. The RLE effect, after having contributed 1.8 percentage points in 2009, accelerated to 2.5 percentage points in 2010. It also registered a strong contribution in the following years, standing at 1.0 points in 2011 and 1.5 points in 2012. Disaggregating the reallocation effect using the three-component GEAD, we find that the labour component accounted for all of the RLE effect in 2009, at least 70% in 2010 and 2011, and around 57% in 2012. While part of these movements could have been driven by the continued impact of restructuring following EU accession (the RLE averaged 1.4 percentage points in the pre-crisis years 2005-2008), the results suggest that these movements were accelerated, rather than hampered, by the recession in 2009.

Table 6: Reallocation level effect in Malta during and immediately after the 2009 recession
(percentage point contribution to aggregate labour productivity growth)

	2009	2010	2011	2012
Reallocation level effect	***1.8***	***2.5***	***1.0***	***1.5***
Labour contribution (%)	100	77	73	57

Source: Eurostat (2021); authors' calculations.

Similar to developments in 2009, the pure productivity effect was negative across most sectors in 2020, reflecting the exceptional negative shock to output. The sectors which registered the largest (negative) PPE effect where those which are reliant on tourism, such as accommodation & food services and transportation & storage. This was mainly because the economy absorbed this shock through a temporary decline in hours worked, rather than through changes in employment levels, largely aided by the government wage supplement scheme. Meanwhile, unlike in 2009, the reallocation effect during the COVID-19 pandemic was zero – this can probably be explained by the impact on labour mobility from the pandemic restrictions and the overall economic uncertainty, as well as the cushioning of existing jobs by government aid and the belief that the crisis would be transitory. Whether the medium-term impact of the pandemic on reallocation and productivity growth is positive or negative remains to be seen. However, the pandemic has highlighted the importance of the economic diversification witnessed over the past two decades, limiting the adverse

impact of this shock on economic activity and on productivity growth in a time when labour movements were limited.

To account for the presence of labour hoarding in 2009 and 2020 and the fact that temporary adjustments to hours worked are more common during recessions, *Table 7* re-estimates the sectoral contributions to productivity growth using an hours worked definition for labour input. As expected, the results suggest that the decline in labour productivity was relatively lower using this definition, as hours worked declined to a much larger extent than employment levels. Nevertheless, the main sectoral sources of the decline in productivity, namely manufacturing and tourism-reliant sectors, remained unchanged, though the composition of the sectoral contributions alters slightly as the adjustment in hours feeds into the reallocation effect.

Table 7: Sectoral developments in hourly productivity during 2009 and 2020 (selected sectors)
*(*annual percentage change; percentage point contribution)*

	2009			2020		
	Total	PPE	RE	**Total**	PPE	RE
Aggregate labour productivity growth	**-0.4***	-2.7	2.3	**-5.7***	-5.3	-0.4
of which:						
Manufacturing	**-2.5**	-0.9	-1.7	**-0.1**	0.3	-0.4
Wholesale and retail trade; repair of motor vehicles and motorcycles	**-0.6**	-0.7	0.1	**-1.1**	-0.9	-0.2
Transportation and storage	**0.0**	-0.1	0.2	**-2.5**	-2.3	-0.2
Accommodation and food services	**-0.4**	-0.1	-0.3	**-3.2**	-3.1	-0.1

Source: Eurostat (2021); authors' calculations.

Notes: The acronyms PPE and RE stand for the pure productivity effect and the total reallocation effect (sum of the reallocation level effect and the reallocation growth effect), respectively. Output is defined as chain-linked GVA.

Conclusion

Using the GEAD method developed by Tang and Wang (2004) and its extension (Diewert, 2010), this study decomposed real labour productivity growth in Malta into exactly additive sectoral contributions. Furthermore, productivity growth within each sector was further decomposed between within-sector efficiency gains and a resource reallocation effect. This was made possible by the first publication of chain-linked sectoral output data in mid-2020.

The results suggest that average labour productivity growth in Malta was double that observed in the euro area for the main sample period 2000-2019. Annual growth in Malta averaged 1.2%, compared with 0.6% in the euro area. This divergence was driven wholly by the reallocation effect, with overall sectoral efficiency gains lower in Malta compared with the euro area. The structural changes observed in Malta from 2000 onwards, relating to EU accession in 2004, the restructuring of the manufacturing sector, and the shift of resources toward higher value-added services sectors, all contributed to this

divergence. It is also suggested that these developments may reflect a convergence in Malta's productivity levels to the euro area, though reliance on sectoral reallocation rather than efficiency gains could hamper this process in the long run.

Over the entire period, the services sector was the driver of productivity growth in Malta, with the manufacturing sector registering a negative contribution and other sectors, such as trade and construction, registering minimal impacts. The magnitude of the positive contribution of services and the negative contribution of manufacturing was significantly higher than those observed in the euro area, further supporting the conclusion of a structural shift towards higher-value services driving Malta's productivity growth since 2000.

The results are more heterogenous when divided into subperiods, suggesting that the factors influencing Malta's labour productivity growth changed over time. Productivity growth was robust in the pre-financial crisis subperiod (2000–2007), driven by a reallocation of resources toward higher productivity sectors from the manufacturing sector, which underwent a period of restructuring owing to EU accession in 2004. Productivity growth moderated but remained positive during the 2008-2012 subperiod. This mainly reflected a contraction in within-sector efficiency, possibly as a result of the impact of the Great Recession on output per worker within some sectors. At the same time, the impact of resource reallocation strengthened, in favour of sectors such as arts, entertainment & recreation, financial & insurance activities, and real estate. Aggregate productivity growth accelerated once more during the 2013-2019 subperiod, driven by continued resource reallocation and a rebound in sectoral efficiency gains as economic activity accelerated.

We also provide a more in-depth review of productivity developments during the Great Recession of 2009 and the COVID-19 pandemic in 2020, in order to assess the impact of negative output shocks on productivity growth in Malta. During both years, productivity growth declined owing to a relatively smaller drop in employment when compared with the contraction in output, suggesting an element of labour hoarding. However, the 2009 Great Recession did not halt the productivity-enhancing reallocation of resources that was ongoing. In the case of the 2020 COVID-19 pandemic, the reallocation effect dropped to zero owing to the impact of the pandemic restrictions and government aid. Since labour adjustments to economic shocks tend to initially be made in hours worked, we also show that the decline in labour productivity during these periods of economic downturn was relatively less with a productivity definition based on hours worked.

Understanding the sources of productivity growth can help policy-makers identify the measures needed to boost future productivity and uncover new channels of growth. Overall, the results suggest that while productivity levels in Malta remain below those observed in the euro area, convergence is ongoing. These findings should provide impetus to policy makers to continue encouraging increased efficiencies within the manufacturing sector, particularly through grants encouraging investment in new technologies and in research and development, as well as the continued development of high-value industries such as pharmaceuticals. At the same time, while traditional sectors such as tourism remain vital to the economy, the recent COVID-19 pandemic has highlighted the increased importance

of diversifying the economy further into high growth services industries. In order to be sustainable and productivity-enhancing, it is vital that such growth be accompanied by a rise in value added, which can only be achieved through continued investment, training of labour, and a competitive playing field.

The potential limitations of this study should be kept in mind. In particular, the GEAD, like other decomposition methods, is sensitive to the level of disaggregation of sectoral data. In particular, less disaggregated decompositions fail to pick up the reallocation of resources within subsectors in the same industry, thereby overstating the contribution of within-sector efficiency gains and understating the impact of structural change. Given that this study, for data availability reasons, only employs a 1-digit NACE disaggregation of sectors, the actual impact of reallocation on Malta's productivity growth might be even higher than given in the results. Therefore, scope for further research in this area exists should sectoral NACE data at 2-digit level for Malta become publicly available.

Another limitation that must be mentioned is the frequency of revisions to national accounts data. These revisions can sometimes be quite large in magnitude (particularly during benchmark revisions), which might affect the accuracy of the published results. Given that sectoral price deflators were published relatively recently, revisions to chainlinked data are even more likely. Moreover, the data for Malta may be prone to statistical artefacts, leading to anomalies such as the decline in output observed in the arts, entertainment & recreation sector during the 2013-2019 subperiod. These data anomalies might in turn affect the results of the presented productivity estimates.

At the same time, measurement of productivity in terms of heads rather than hours worked might lead to an overestimation of the contraction in productivity levels during economic downturns, especially during periods when companies are hoarding labour but adjusting total hours worked. Theoretically, the reverse could also occur during periods of rising output; in this case, if increases in demand are met with longer working hours for existing workers (such as increased overtime) rather than an increase in employment, productivity gains would be overstated if productivity is measured in output per head.

This study and the newly available chain-linked national accounts data by sector provides opportunities for further research into productivity and competitiveness in Malta. A natural next step would be to use these estimates to study developments in Malta's wage competitiveness compared with trading partners and other euro area countries. In turn, this would further enable analysis of the observed divergences in Malta's unit labour costs compared with the euro area. Another potential area of research is a detailed study of the reallocation effect through micro data on sectoral employment transitions, which would reveal the direction of movement of labour between sectors over time. This study could also be expanded through the decomposition of total factor productivity, as opposed to labour productivity. This would enable the identification of the factors behind observed efficiency gains within sectors, such as technological progress and the upskilling of labour.

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Appendix I: The GEAD decomposition

The following is a derivation of the GEAD decomposition, originally devised by Tang and Wang (2004).

Aggregate labour productivity is defined as the ratio of aggregate value added to total employment (see equation 3), where Z_t is aggregate labour productivity in period t, X_t is aggregate value added measured in real volumes, and L_t is aggregate employment.

$$Z_t = \frac{X_t}{L_t} \qquad \textit{(eq.3)}$$

Using the fact that output (X_t) is the aggregate nominal output (Y_t) deflated by the economy-wide price deflator (P_t) i.e. $X_t = \frac{Y_t}{P_t}$, and that nominal output is the aggregate sum of the individual sector (*i*) outputs (so $Y_t = \sum Y_t^i$) then:

$$Z_t = \frac{\sum Y_t^i}{P_t L_t} = \frac{\sum P_t^i X_t^i}{P_t L_t} \qquad \textit{(eq.4)}$$

Multiplying and dividing equation 4 with L_t^i:

$$Z_t = \sum \frac{P_t^i}{P_t} \frac{L_t^i}{L_t} \frac{X_t^i}{L_t^i} = \sum p_t^i l_t^i Z_t^i \qquad \textit{(eq.5)}$$

where p_t^i is the relative price level of sector i (P_t^i) compared with the economy-wide price level (P_t), l_t^i is the labour share of sector *i* (L_t^i) in total employment (L_t), and Z_t^i is the labour productivity of sector *i*.

Given equation 5, it is now possible to obtain an identity for growth in aggregate labour productivity in terms of output, prices, and employment, which shall be defined as G_t.

$$G_t = \frac{Z_t - Z_{t-1}}{Z_{t-1}} = \sum \frac{(p_t^i l_t^i Z_t^i - p_{t-1}^i l_{t-1}^i Z_{t-1}^i)}{Z_{t-1}} \qquad \textit{(eq.6)}$$

Adding and subtracting $p_t^i l_t^i Z_{t-1}^i$ to the numerator of equation 6:

$$\begin{aligned} G_t &= \sum \frac{(p_t^i l_t^i Z_t^i - p_{t-1}^i l_{t-1}^i Z_{t-1}^i + p_t^i l_t^i Z_{t-1}^i - p_t^i l_t^i Z_{t-1}^i)}{Z_{t-1}} \\ &= \sum \frac{1}{Z_{t-1}} \left[p_t^i l_t^i (Z_t^i - Z_{t-1}^i) + Z_{t-1}^i (p_t^i l_t^i - p_{t-1}^i l_{t-1}^i) \right] \\ &= \sum \frac{Z_{t-1}^i}{Z_{t-1}} \left[p_t^i \, l_t^i \left(\frac{Z_t^i - Z_{t-1}^i}{Z_{t-1}^i} \right) + (p_t^i l_t^i - p_{t-1}^i l_{t-1}^i) \right] \end{aligned} \qquad \textit{(eq.7)}$$

Now note that by equation 4:

$$\frac{Z_{t-1}^{i}}{Z_{t-1}} = \left[\frac{Y_{t-1}^{i}}{P_{t-1}^{i} L_{t-1}^{i}}\right] * \left[\frac{Y_{t-1}}{P_{t-1} L_{t-1}}\right]^{-1} \qquad \textit{(eq.8)}$$

Adding and subtracting $\frac{Z_{t-1}^{i}}{Z_{t-1}} p_{t-1}^{i} l_{t-1}^{i} G_{t}^{i}$ to equation 7, noting that $\frac{Z_{t}^{i} - Z_{t-1}^{i}}{Z_{t-1}^{i}}$ is the growth in labour productivity of sector i (G_{t}^{i}), and that by equation 8, $\frac{Z_{t-1}^{i}}{Z_{t-1}} p_{t-1}^{i} l_{t-1}^{i}$ reduces down to $\frac{Y_{t-1}^{i}}{Y_{t-1}}$, we obtain the GEAD decomposition (equation 9).

$$\begin{aligned} G_t &= \sum \frac{Z_{t-1}^{i}}{Z_{t-1}} \left[p_t^i l_t^i G_t^i + \left(p_t^i l_t^i - p_{t-1}^i l_{t-1}^i\right) + \left(p_{t-1}^i l_{t-1}^i G_t^i\right) - \left(p_{t-1}^i l_{t-1}^i G_t^i\right)\right] \\ &= \sum \left[\frac{Y_{t-1}^{i}}{Y_{t-1}} G_t^i + \frac{Z_{t-1}^{i}}{Z_{t-1}} \left(p_t^i l_t^i - p_{t-1}^i l_{t-1}^i\right) + \frac{Z_{t-1}^{i}}{Z_{t-1}} \left(p_t^i l_t^i - p_{t-1}^i l_{t-1}^i\right) G_t^i\right] \qquad \textit{(eq.9)} \end{aligned}$$

Appendix II: The three-component GEAD

The following is the derivation of the three-component GEAD as devised by Diewert (2010), which builds on the GEAD decomposition devised by Tang and Wang (2004) and derived in Appendix I.

Using equation 5 from Appendix I, the growth factor of aggregate productivity (Z_t) is:

$$\frac{Z_t}{Z_{t-1}} = \sum \frac{p_t^i l_t^i Z_t^i}{p_{t-1}^i l_{t-1}^i Z_{t-1}^i} \qquad \textit{(eq.10)}$$

Multiplying and dividing equation 10 by $\sum \frac{p_{t-1}^i X_{t-1}^i}{L_{t-1}}$:

$$\frac{Z_t}{Z_{t-1}} = \left[\sum \frac{p_t^i l_t^i Z_t^i (p_{t-1}^i X_{t-1}^i)}{p_{t-1}^i l_{t-1}^i Z_{t-1}^i L_{t-1}}\right] * \left[\sum \frac{p_{t-1}^i X_{t-1}^i}{L_{t-1}}\right]^{-1} \qquad \textit{(eq.11)}$$

Recognising that, from equation 4 in Appendix I, $\frac{p_{t-1}^i X_{t-1}^i}{L_{t-1}} * \left[\sum \frac{p_{t-1}^i X_{t-1}^i}{L_{t-1}}\right]^{-1} = \frac{Y_{t-1}^i}{\sum Y_{t-1}^i} = y_{t-1}^i$, where y_{t-1}^i is the share of sector *i* in aggregate nominal output, equation 11 becomes:

$$\frac{Z_t}{Z_{t-1}} = \sum \left[\frac{p_t^i}{p_{t-1}^i}\right]\left[\frac{l_t^i}{l_{t-1}^i}\right]\left[\frac{Z_t^i}{Z_{t-1}^i}\right](y_{t-1}^i) \qquad \textit{(eq.12)}$$

Equation 12 decomposes the growth factor of aggregate productivity. Recognising that the growth rate of a variable is its growth factor minus one, equation 12 can be written as:

$$\begin{aligned} G_t &= \left[\sum(\gamma_t^i + 1)(\sigma_t^i + 1)(G_t^i + 1)(y_{t-1}^i)\right] - 1 \\ &= \sum(y_{t-1}^i)\left[(\gamma_t^i + 1)(\sigma_t^i + 1)(G_t^i + 1) - 1\right] \qquad \textit{(eq.13)} \end{aligned}$$

Where $\gamma_t^i = \frac{p_t^i}{p_{t-1}^i} - 1$ (growth rate of sector *i*'s relative prices), $\sigma_t^i = \frac{l_t^i}{l_{t-1}^i} - 1$ (growth rate of sector *i*'s labour share), $G_t^i = \frac{Z_t^i}{Z_{t-1}^i} - 1$ (growth rate of sector *i*'s productivity, and $\sum(y_{t-1}^i) = 1$. Expanding, we obtain the three-component GEAD (equation 14):

$$\begin{aligned} G_t = \sum(y_{t-1}^i)(G_t^i) + \sum(y_{t-1}^i)(\gamma_t^i) + \sum(y_{t-1}^i)(\sigma_t^i) + \sum(y_{t-1}^i)(\gamma^i)(\sigma_t^i) + \sum(y_{t-1}^i)(G_t^i)(\gamma_t^i) + \\ \sum(y_{t-1}^i)(G_t^i)(\sigma_t^i) + \sum(y_{t-1}^i)(G_t^i)(\sigma_t^i)(\gamma_t^i) \qquad \textit{(eq.14)} \end{aligned}$$

Appendix III – Sectoral macroeconomic indicators in Malta by sub-period

Table A: Sectoral macroeconomic indicators in Malta.

(subperiod averages; annual percentage change)

	2001-2007		2008-2012		2013-2019	
	Output	Employment	Output	Employment	Output	Employment
Total economy	**2.1**	**1.0**	**2.8**	**2.0**	**7.1**	**5.5**
Agriculture, forestry and fishing	6.8	1.8	-4.1	0.6	3.0	0.5
Quarrying and utilities	-2.1	-3.3	-25.7	-2.5	84.0	-3.7
Manufacturing	-1.3	-3.2	3.3	-3.0	2.4	1.2
Construction	-1.3	2.7	1.2	-0.6	8.2	4.2
Wholesale and retail trade; repair of motor vehicles and motorcycles	1.3	1.7	2.6	0.8	6.7	4.0
Transportation and storage	-0.2	0.1	-0.7	3.0	7.6	5.3
Accommodation and food service activities	-1.5	1.1	1.0	1.2	9.0	7.1
Information and communication	4.4	1.3	11.0	7.3	16.4	7.5
Financial and insurance activities	11.6	4.8	4.9	5.1	3.7	3.8
Real estate activities	3.7	7.4	2.8	13.5	6.3	13.2
Professional, scientific and technical activities	7.2	7.1	8.2	6.5	13.7	11.1
Administrative and support service activities	4.0	6.3	6.3	5.6	17.0	14.6
Public administration and defence; compulsory social security	1.6	-0.1	1.2	1.1	4.3	2.5
Education	1.4	1.9	0.4	3.4	1.8	3.7
Human health and social work activities	4.0	2.7	5.2	5.4	5.8	6.3
Arts, entertainment, and recreation	21.4	8.5	8.4	11.1	3.4	12.5
Miscellaneous services	2.5	2.9	1.4	4.6	5.2	5.6

Source: Eurostat (2021); authors' calculations.

Notes: Output is defined as chainlinked GVA. Employment is from national accounts data. Prices represent sectoral deflators.

Table B: Nominal gross value added share & relative productivity levels in Malta.

(subperiod averages; ratio to aggregate)

	2000-2007		2008-2012		2013-2019	
	GVA share	Relative productivity	GVA share	Relative productivity	GVA share	Relative productivity
Agriculture, forestry and fishing	2.2	1.2	1.3	0.8	1.0	0.9
Quarrying and utilities	2.3	0.9	1.8	0.7	1.7	1.7
Manufacturing	16.7	0.7	13.3	0.9	8.8	0.8
Construction	6.9	1.0	4.5	0.6	3.9	0.7
Wholesale and retail trade; repair of motor vehicles and motorcycles	12.5	0.7	10.8	0.6	10.2	0.7
Transportation and storage	7.0	1.3	5.9	1.0	5.9	1.0
Accommodation and food service activities	5.9	0.9	4.9	0.7	5.0	0.8
Information and communication	5.0	1.4	5.5	1.4	6.8	1.9
Financial and insurance activities	5.3	1.5	8.5	1.6	8.3	1.5
Real estate activities	6.3	18.5	6.5	10.9	6.1	7.8
Professional, scientific and technical activities	4.1	1.3	5.4	1.2	7.9	1.3
Administrative and support service activities	3.7	0.9	4.1	0.7	6.4	0.8
Public administration and defence; compulsory social security	7.1	0.8	6.6	0.8	5.7	0.7
Education	5.9	0.9	5.9	0.8	5.5	0.6
Human health and social work activities	5.0	0.9	6.0	0.9	6.0	0.8
Arts, entertainment, and recreation	2.8	3.7	7.7	5.0	9.7	3.2
Miscellaneous services	1.4	0.6	1.3	0.5	1.1	0.4

Source: Eurostat (2021); authors' calculations.

Notes: A relative productivity level of above (below) one indicates an above (below) average productivity level.