

## Productivity in Cyprus

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### Abstract

The current crisis has highlighted the importance of increasing productivity for the economy to become more competitive and thereby increase its growth prospects. In this paper, we analyse the productivity path of Cyprus using various indices and compare these with the average performance in the Eurozone. We assess the performance of the Cypriot economy as a whole and also for each sector of economic activity separately. In particular, we distinguish between eight sectors, extracted using the NACE2 classification scheme. The period under study is from 1995 to 2011 for the aggregate indices and from 2002 to 2010 for the sectoral disaggregation.

**Keywords:** labour and total factor productivity, competitiveness, capital deepening, unit labour cost.

### 1. Introduction

The aftermath of the 2008 financial crisis and the current Eurozone crisis has highlighted the importance of productivity growth and competitiveness, as '... persistent losses in competitiveness and mounting external imbalances not only increase the economic and financial vulnerability of individual countries, but given the strong financial and trade interconnectedness of the euro area countries may also hinder the functioning of the euro area as a whole' (ECB, 2012, p. 8). Therefore, a key driving force for welfare and gains in income is how productive and competitive a country is.

National productivity estimates are of special importance as they are widely used in many aspects of public policy making (Diewert, 2002). For instance, the national monetary authorities consider national productivity growth estimates in making decisions about acceptable amounts of price inflation. Productivity also affects exchange rates, employment, investment and consumption. Bearing this in mind, productivity growth is an essential

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determinant for monetary policy.<sup>1</sup> There is evidence that increases in productivity are associated with low inflationary pressures and increases in competitiveness. High productivity reduces average costs and in the long term reduces product prices, therefore making the economy more competitive. Productivity measurement is also a key element in assessing standards of living (OECD, 2011). A simple example is per capita income, probably the most common measure of living standards: income per person varies directly with one measure of labour productivity, value added per hour worked. In this sense, measuring labour productivity helps to gain better understanding of the development of living standards. Nothing contributes more to the reduction of poverty, to increases in leisure and to a country's ability to finance education, public health, the environment and the arts (Blinder & Baumol, 1993, p. 778). An OECD report (2001) also states that increases in productivity are associated with higher technical change (better ways to convert resources into outputs; Griliches, 1987), higher efficiency (movements towards best practice in order to achieve the maximum amount of output that is physically achievable with current technology and given inputs; Diewert and Lawrence, 1999) and real cost savings in production (Harberger, 1998).

The two most widely used measures of productivity are total factor productivity (TFP) and labour productivity (LP). These two measures are not independent of each other. TFP, also called multi-factor productivity, captures the part of real growth in gross domestic product (GDP) that is not explained by the contributions from labour and capital. It shows how labour and capital inputs, productively combined, are used to generate GDP. TFP growth reflects phenomena such as advances in general knowledge, the advantages of particular organizational structures or management techniques, reductions in inefficiency and the reallocation of resources to more productive uses. TFP cannot be measured directly: it is a residual, often called the Solow residual, which accounts for effects in total output not caused by inputs.

Productivity (TFP) is computed using growth accounting (Solow, 1957). Growth accounting provides a useful framework for analysing observed output growth into components associated with changes in factor inputs and a residual, i.e. TFP. The growth accounting framework is empirically motivated and can be seen as a first attempt to understand the long-term growth process. The framework does not rely on the ex-ante implications of any theoretical framework and therefore does not aim to provide

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<sup>1</sup> For more details regarding productivity and monetary policy see ECB 2008 Monthly Bulletin (Jan 2008).

explanations of the underlying forces of growth, such as preferences, institutions and economic policies. It essentially implies the breaking down of observed real GDP growth into the contributions made by pertinent factors, such as labour, capital and technology.

Labour productivity is the ratio of the output of goods and services to the labour hours devoted to the production of that output. As already mentioned, at the aggregate level, labour productivity forms a direct link to a widely used measure of living standards, income per capita. 'Productivity translates directly into living standards, by adjusting for changing working hours, unemployment, labour force participation rates and demographic changes' (OECD, 2001, p. 15). From a policy perspective, labour productivity is a key reference statistic in wage bargaining. It is important to point out that a common unresolved puzzle in the literature is the source of the procyclicality of labour productivity (see Bernanke & Parkinson, 1991), i.e. the fact that labour productivity increases during booms and decreases during recessions. Real business cycle theorists argue that technology shocks are what drive labour productivity, whereas Keynesians attribute labour productivity to demand shocks.

Moreover, using labour productivity growth and the wage rate, one can evaluate the unit labour cost, which captures competitiveness with respect to labour. Unit labour cost measures the cost of labour required to produce a 'unit' of output. It is simply the rate of compensation multiplied by the quantity of labour divided by total output. It is also equal to the rate of compensation divided by productivity. That being the case, as long as compensation increases at the same rate as productivity, unit labour costs, as well as the labour share of income, will remain constant (Cashell, 2004). In this paper, we calculate both productivity indices and the unit labour cost for the Cypriot economy as a whole, as well as by sector, and compare these results with the euro area. An attempt is made to evaluate which sectors are more efficient and more competitive when compared to the average in the euro area, thus giving us a valuable indication as to which sectors would potentially assist in the future growth of the Cypriot economy. In the next section, we present the methodology for the construction of the three main indicators and describe the data used in our procedure. Section 3 presents the main results and more detailed tables and figures can be found in the Appendix. In the third section, we first discuss the results regarding the overall economy then continue with the analysis of the disaggregated sectors. In the sectoral analysis, we emphasize the unit labour cost and the competitiveness of the individual sectors. The final section concludes.

## 2. Methodology and Data

### 2.1 Model description

Productivity, also known as TFP, is computed using the growth accounting framework (Solow, 1957). Growth accounting provides a suitable framework for identifying individual factors of growth and summarizing them in a convenient way. It is useful for analysing observed output growth into components associated with changes in factor inputs and a residual, i.e. TFP. The framework dates back to 1930s and concepts developed by Paul Douglas, Tinbergen (1942) and others, but the essential attributes were presented by Solow (1957), Kendrick (1961), Denison (1962), and Jorgenson and Griliches (1967). For a historical review, see Griliches (1996). More recently, among many others, Diewert (2002) has formalized the theory by integrating index number theory, production theory and national accounting.<sup>2</sup>

The growth accounting framework is empirically driven and can be seen as a first attempt to understand the long-term growth process. It essentially implies the breaking down of observed real GDP growth into the contributions made by pertinent factors, such as labour, capital and technology. Growth accounting provides a residual measure of TFP growth, which is in fact an index number and depends on the functional form of the production function used.

Labour productivity is the ratio of the output of goods and services to the labour hours devoted to the production of that output. Labour productivity is a key determinant of living standards measured as per capita income and from this perspective is of significant policy relevance. Capital deepening is also referred to as capital intensity. If the capital stock per labour hour increases, this is an indication that the economy will expand, not indefinitely though due to diminishing returns. The ratio increases if capital grows faster than labour. If capital stock increases at the same rate as labour, the ratio is constant.

Finally, using the labour productivity measure, one can calculate the unit labour cost. This unit labour cost provides an indication of how competitive an economy is with respect to labour. If wages grow faster than labour productivity, therefore causing a higher unit labour cost, the economy is less competitive with respect to its labour. Cashell (2004)

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<sup>2</sup> For an expanded description of all the methods used for the construction of productivity, see Diewert (2002).

explains that 'as long as the contribution of output produced by the last worker hired exceeds the cost of his labor, a profit-maximizing firm will continue to add to its labor force' (p. 1). This will increase the demand for labour and 'an increase in the demand for labor will tend to push up the wage rate' (Cashell, 2004, p. 2). Maybe this will not be the case and the benefits will pass to consumers or just to the profits of the firm. Unit labour cost is a way of assessing whether labour is reaping the benefits of increasing productivity. Unit labour cost is basically the rate of compensation divided by productivity and 'as long as compensation increases at the same rate as productivity, unit labor costs ... should remain constant' (Cashell, 2004, p. 7). For a description of the model, see the Appendix.

## 2.2 Data description

In order to use the growth accounting methodology, data on the prices and quantities of both the output and the inputs are required. We obtained data from several Eurostat and European Commission publications. The data cover the period 1995 to 2011 for the aggregate economy and the period 2000 to 2011 for the sectoral analysis. The variables used are the gross value added in current prices and constant prices, the number of employees (total and self-employed), the total hours worked (man hours, for total employees and the self-employed), investment in current and constant prices, and the compensation of employees. All price data are expressed in euros at constant 2000 prices.

Data for Cyprus and the rest of the 16 euro area countries were collected. The respective variables for the euro area as a whole were created by aggregating all 17 countries.<sup>3</sup> The compiled dataset includes some of the sectors from Eurostat's NACE2 classification, which classifies economic activities into 21 branches. In particular, data were collected for the sectors of manufacturing, construction, the wholesale and retail trade, transport and storage, electricity, gas and water, accommodation and food services, financial services and insurance, information and communication, real estate, education, health, and finally the services sector.<sup>4</sup> In the sectoral analysis section of this paper, we present the results for eight of the aforementioned sectors: manufacturing; construction; transport and storage; electricity, gas and water; accommodation and food services;

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<sup>3</sup> Malta and Ireland are excluded from the sectoral analysis due to data limitations.

<sup>4</sup> The services sector includes professional, scientific and technical activities, administrative and support service activities, arts, entertainment and recreation, and other service activities.

financial services and insurance; education; health. We focus our analysis primarily on the period 2002–2011, which we also separate into two sub-periods: from 2002 to 2008, before the crisis, and the crisis period from 2008 onwards.

For the construction of all output variables, we used the value added in current prices as the value of output, together with the value added in constant prices considered as the quantity of output. To obtain the price of each output, we divided current prices by constant prices. Regarding labour, the compensation of employees was used as the value of labour, adjusted to include those who are self-employed, a procedure also followed by the European Central Bank. Having obtained the value of labour and hours worked, the price of labour was calculated and expressed in 2000 prices. Using the data for the price and value of labour, one can then calculate the quantity of labour.

The capital stock was constructed using investment data in current and constant prices. The value of capital was obtained using the value added in current prices together with the value of labour. The perpetual inventory method was followed with a constant depreciation rate of 5% to construct the quantity of capital. For the initial value, i.e. the value in the initial period  $t = 0$ , of the quantity of capital, we used the initial investment in the respective period divided by the depreciation rate plus the growth rate of output.

Using the above inputs and outputs, we construct indices of TFP and labour productivity. TFP, also known as multi-factor productivity or MFP, is measured as output growth minus a weighted sum of the growth of all inputs and is considered a better measure than others as it reflects more exactly the efficiency of an economy. In this paper, we refer to TFP as productivity. Together with TFP and labour productivity, two other measures of economic performance are calculated. These measures are the unit labour cost and capital deepening.

### 3. Results

#### 3.1 Analysis of the overall economy

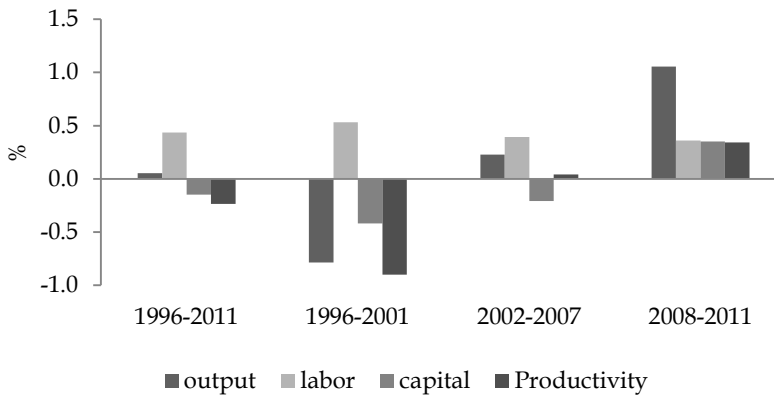
##### 3.1.1 Total factor productivity

TFP shows the efficiency of an economy, or the level of competitiveness with respect to both labour and capital inputs. The overall productivity growth for Cyprus was 1.67% throughout the period 1995–2011. In the period 1996–2001 the average productivity growth rate was 2.7%, whereas in the period 2002–2007 it declined to 1.7%. After 2008, the productivity growth for Cyprus was nearly zero, with a value of 0.06%. In 2003 and 2009 we observe that productivity growth is negative, whereas the period 2004–2008 is characterized by stable productivity growth.

Changes in output growth can be explained in relation to capital and labour contributions and productivity changes. During the period 1996–2011, productivity growth was the most important contributor to output growth, explaining more than half of the period's growth rate. Labour also made a significant contribution, while the remainder was accounted for the capital. Period 2002–2007, is characterized by a slowdown in productivity while both capital and labour growth increased their contribution to the overall output growth. Finally, in 2008–2011 a decline in both labour and productivity contributions took place while capital growth was positive and capital appeared to have a slight acceleration.

Comparing productivity growth between Cyprus and the euro area, Cyprus was slightly below the euro area average but both remained positive throughout the entire sample with the euro area average being 1.9%. This indicates that Cyprus is less competitive compared to the average country in the euro area. Higher productivity growth would be necessary in order for Cyprus to catch up with the rest of the euro area. Analytically, in the period 1996–2001 productivity growth in Cyprus was 2.7%, which is lower than the average of 3.6% in the euro area. The differences between Cyprus and the Eurozone are depicted in Figure 1, which shows deviations of Cyprus from the euro area.

FIGURE 1  
*Output growth and components (deviations of Cyprus from euro area)*



In Figure 1, a positive number indicates that values in Cyprus are higher than in the euro area, while a negative number indicates the opposite. In the period 1996–2001, Cyprus appears to be less competitive than the euro area. The period 1996–2001 is worse in terms of productivity growth when compared with the euro area, with a difference in productivity of -0.9%. Output growth is also lower, with Cyprus showing a growth of 3.8%, while growth in the rest of the euro area is 4.5% on average. The capital contribution is very small in Cyprus, suggesting that this period is characterized by low capital intensity (0.1% in Cyprus; 0.5% in the euro area). Investment also seems to be lacking when compared to the euro area, or it is directed at low productive capital sectors such as construction and the public sector. On the other hand, the labour contribution is higher in Cyprus than in the euro area overall (0.9% in Cyprus; 0.4% in the euro area). The low capital and higher labour contribution in Cyprus indicates a substitution of capital with labour.

The period 2002–2007 is characterized by a slowdown in the growth of productivity in both Cyprus and the euro area (1.7% in Cyprus; 1.7% in the euro area). In the euro area, we observe a reduction of 1.2% in output growth, whereas the contributions of labour and capital increase. In Cyprus, we observe that output growth decreased slightly at a rate of 0.3%, whereas the contributions of labour and capital increased. This increase is attributed to the increase in the number of employees, wages and investment. In particular, labour growth was 1.75% in the period 2002–2007, while in 1996–2001 it was 2.63%; the wage growth rate was 5% in comparison to 4.8% in the same periods; finally, the capital stock growth rate was 1.8% in comparison to 0.23% in these periods.



Finally, after 2008, the euro area sees a slightly negative productivity growth rate (-0.3%), while Cyprus has a slightly positive growth rate of approximately 0.1%. This is explained by the fact that the crisis reached the majority of the euro area before Cyprus, so we cannot yet conclude that Cyprus appears to be more competitive. Future work when more recent data become available will provide this information, but it is expected that due to the recent developments in Cyprus, productivity will reach even lower levels than in the euro area. In the euro area, we saw a dramatic decline in the output growth, namely a deceleration of 3.49%, together with a deceleration of both capital and labour contributions. The contribution of labour was negative, pointing to the large unemployment level in the euro area, which reached 10.1% in 2011, while the contribution of capital was positive, although capital decelerated from 0.9% in the pre-crisis period to 0.5% in the period after 2008. Moreover, during the same period, the average output growth in Cyprus was 0.8%, but decelerated by 2.7% from the earlier period.

### 3.1.2 Labour productivity and wages

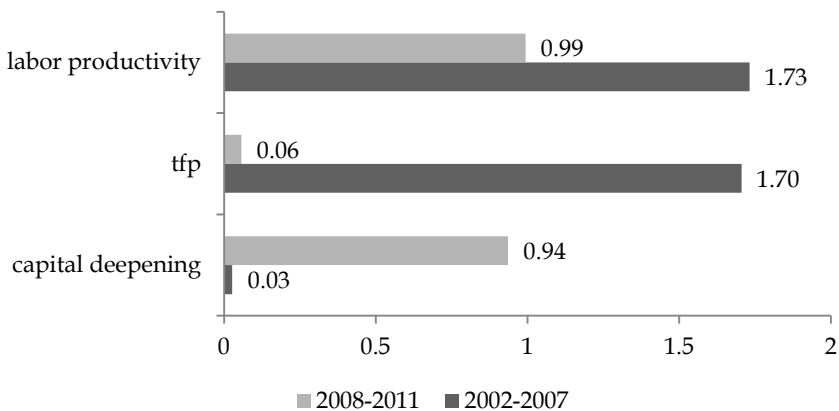
In Cyprus, labour productivity growth during the period 1996–2011 was 1.7% on average. In the period 1996–2001, the average labour productivity growth was 2.1%, while between 2002 and 2007 it was only 1.7%. This was mainly driven by a large decrease that took place in 2003, when labour productivity growth became negative. Various factors and incidents that occurred during 2003 may have caused this decrease in productivity. The 2003 annual report of the Central bank of Cyprus indicates that during that year there was a fall in both the arrivals and revenues of the tourism sector, a decline in domestic demand, a slowdown in manufacturing, electricity, gas and water, and a drop in local construction activities to a lesser extent. Moreover, imports and exports also shrank during that period. At the same time, these overall reductions in economic activity were accompanied by an increase in employment and in real earnings. After 2003 the share of labour in total output started a downward trend which lasted until 2007. Specifically, in 2003 the share of labour was 0.63 and reached 0.57 in 2007.

After 2008 labour productivity rates in Cyprus dropped to close to zero (0.9%). This can be attributed to the fact that both labour and output growth decelerated. There was an overall contraction in major sectors of the economy during 2009 as is documented in the annual report of the Central Bank of Cyprus. In particular, wholesale and retail trade, hotels and restaurants, transport, storage and communications were among the major sectors that contracted in 2009. During the same period,

employment together with the share of labour saw a decrease. Specifically, employment recorded a drop of 0.6%. The rate of unemployment increased drastically from 3.8% in 2008 to reach 7.9% in 2011, while the number of registered unemployed increased by 51.7% in 2009.

Figure 2 below shows labour productivity and its main components for Cyprus. As noted above and as shown in equation 4 (see Appendix), labour productivity growth is equal to TFP plus capital deepening. Capital deepening is defined as the ratio of capital services to hours worked. If capital services increase faster than labour hours, the ratio increases, indicating a substitution of capital for labour.

FIGURE 2  
*Labour productivity, Total productivity and capital deepening, Cyprus*

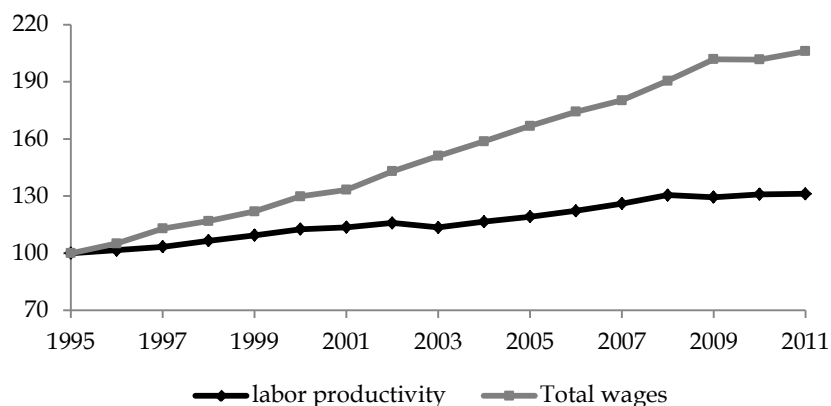


Regarding the period 2002–2007, Figure 2 shows that the main contributor to labour productivity is TFP, while capital deepening is almost zero. This period is characterized by low capital intensity, indicating that investment is low or directed into low productive capital. Therefore, this translates to the fact that labour productivity is explained predominantly by technological improvements for this time span. After 2008, both labour productivity and TFP drop, with the latter coming close to 0%. However, capital deepening increases and therefore contributes to the fact that the labour productivity growth is higher than TFP. These figures suggest that during 2008–2011 there has been some substitution between capital and labour. The data suggest that in this period capital growth is positive as capital appears to show a small acceleration, implying investment in productive projects.

Taking the respective growth rates, we constructed indices of labour productivity and total wages. The resulting indices are presented in Figure 3.

FIGURE 3

*Labour productivity and wage indices, Cyprus*



In Figure 3, we observe a gap between labour productivity and total wages, with the total wage index being above labour productivity throughout the period covered, and the divergence between the two constantly increasing. As noted earlier, one can evaluate the unit labour cost by using labour productivity growth and the wage rate. The unit labour cost captures the competitiveness of a unit, i.e. industry, sector or country, with respect to labour. Based on Figure 3, we can conclude that the unit labour cost increases throughout the period, indicating a loss in the competitiveness of the Cypriot economy. The gap between the two indices appears to be larger during the period 2009–2011. Considering the whole sample, from 1996 to 2011, wages increase by 4.4% annually and labour productivity by 1.6%, resulting in a gap of approximately 3%. This increase is rather stable throughout the whole period under study. In particular, from 1996 to 2001, the growth rate in wages was 4.8%, while that of labour productivity was 2.1%, providing a unit labour cost of 2.7%. Similarly, the unit labour cost for the period 2002–2007 was 3.3%, which is the highest value of unit labour cost among the periods under investigation, and 2.4% during the period 2008–2011 (see also Figure 4).

FIGURE 4

*Labour productivity, real unit labour cost and real wages (growth rates)*

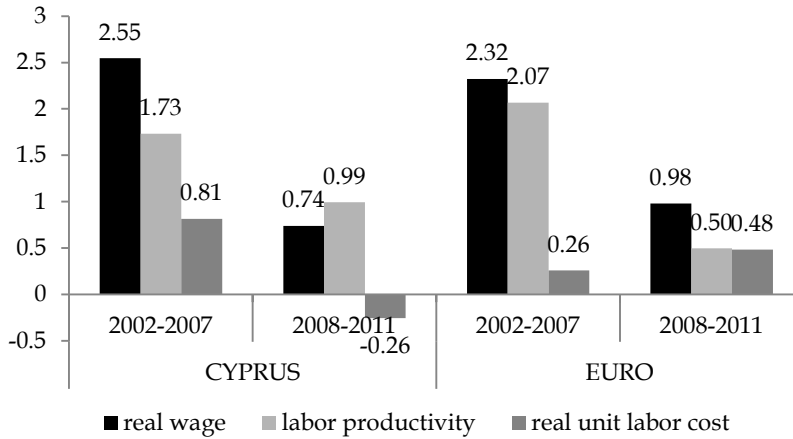


Figure 4 reveals that there is a gap between labour productivity and total wages in both Cyprus and the euro area. The total real wage growth rate is above the labour productivity in the sub-period 2002–2007 in Cyprus and therefore the unit labour cost appears to be positive. The picture in the euro area is similar. There is an obvious reduction in all growth rates between the periods 2002–2007 and 2008–2011 for both Cyprus and the euro area as a whole. In the period 2002–2007, the unit labour cost in Cyprus was higher compared to that of the euro area. Based on this observation, we can conclude that there is a loss of competitiveness for the Cypriot economy during that period. Regarding the succeeding period, 2008–2011, the unit labour cost in Cyprus is lower and negative, suggesting higher labour productivity than real wages. In the euro area the unit labour cost shows growth, with a decrease in both labour productivity and real wage growth rates. A clearer picture is provided in Figure 5.

Dean and Sherwood (1994) note that the costs of inputs used by a country's industries and sectors can be used as important indicators of competitiveness. They further explain that if these costs are less in one country, then the country's trade situation is improving relative to another and that the unit labour costs can be used for comparisons between countries with respect to labour competitiveness.

FIGURE 5  
*Real unit labour cost*

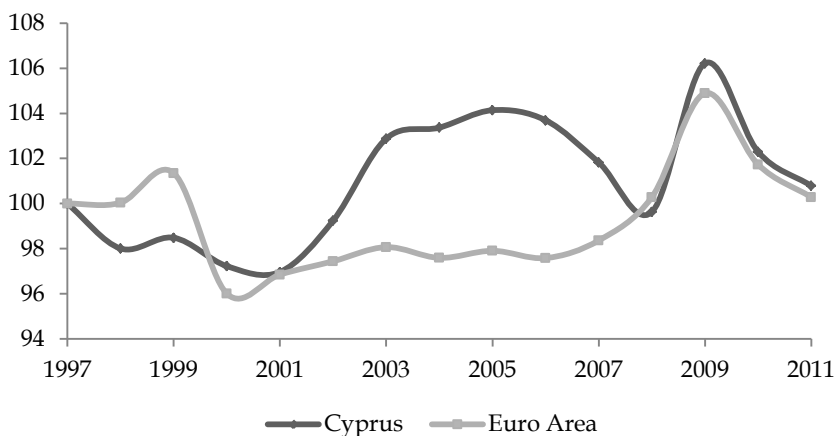


Figure 5 provides an illustration of the real unit labour cost (RULC) index (1997=100) for Cyprus against that of the euro area. The unit labour cost has been converted to real terms using the consumer price index to enable more robust country comparisons, ensuring that changes in the unit labour cost do not reflect changes in inflation. The graph reveals a large gap between the unit cost of labour in Cyprus and the euro area starting in 2002 and lasting until 2007, with the Cypriot economy having a higher unit labour cost compared to the euro area. During this period, the compensation of employees and wages increased, while output decreased and employment was relatively stable in Cyprus. This could explain why there is such a difference between Cyprus and the euro average in terms of competitiveness during the aforementioned period, with Cyprus lacking in terms of labour competitiveness. In 2006, the gap started to close, reaching zero in 2008. After 2008 the two indices move together, with Cyprus staying just above the euro area. After reaching a peak in 2009, the real unit costs for both countries then decrease. The period after 2009 is one of high unemployment rates and decreasing outputs in both Cyprus and the euro area.

## 3.2 Sectoral analysis

### 3.2.1 Overview of sectors

The five largest sectors in Cyprus, ranked with respect to their share in GDP in 2011, are the wholesale and retail trade with a share of 12.1%, followed by the financial services and insurance sector with 9.0%, then the construction sector with 7.9%, accommodation with 6.5%, and finally the

manufacturing sector with a share of 6.2%.<sup>5</sup> The sectors with the smallest shares in GDP are the health sector with a share of 1.8%, electricity, gas and water with 2.8%, education with 4.2%, and finally transport with a share of 4.7%.

The ranking among the various sectors in Cyprus has not changed greatly over the years. In particular, from 1996 to 2011, the whole period covered in this study, there was no change in the relative shares of the smallest four sectors in Cyprus. Slight reallocations were seen between the five largest sectors, especially after 2008 and as a result of the financial crisis, which predominantly had an impact on the production of durable goods in the secondary sector of the economy. Namely, in the aftermath of the crisis, during the period 2008–2011, the manufacturing and accommodation sectors shrank by over 3%. On the other hand, the financial services and insurance sector experienced an expansion of almost 2% to become the second largest sector in Cyprus, having initially ranked as the fifth largest below manufacturing and construction sectors in the late 90s. In this section, we focus on the following sectors: manufacturing; electricity, gas and water; construction; transport and storage; accommodation and food services; financial services and insurance; education; health. We highlight the performance of these sectors in terms of their unit labour cost movements to infer useful conclusions regarding their competitiveness.

The graphs (Figure 6) in the Appendix, present the differences in RULCs, labour productivity, and real wages between Cyprus and the euro area for the period 2002–2010. Prior to calculating the country differences for each of the three measures – RULC, labour productivity and real wages – we converted these measures into indices, taking 2002 as the reference year. Therefore, for 2002, the difference between Cyprus and the euro area will be zero for each of the three measures as they have all been set to take the same value for comparison purposes. Converting into indices allows us to compare proportional changes rather than changes in the level of each measure between Cyprus and the euro area. A positive figure means that the growth rate of that measure in Cyprus rose faster than the respective measure in the euro area. Of course, it might be the case that Cyprus remained constant and the euro area decelerated. A flat curve would illustrate that the respective measure increased or decreased proportionally at the same rate in Cyprus and the euro area throughout the period covered in the sample. Moreover, as the growth rate of the RULC is

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<sup>5</sup> For brevity we refer to some composite sectors using the first sector in their designation. For instance we refer to the ‘accommodation and food services’ sector, as the ‘accommodation’ sector. The detailed designation is according to Eurostat’s NACE2 classification of sectors and can be seen in the sectoral graphs.

defined as the difference between the growth rates of real wages and labour productivity, from each individual graph we can therefore infer whether the difference in the RULC originates from a gap in the growth rate of real wages or from a gap in the labour productivity growth rate. As noted above, when the RULC decreases, it is interpreted as increasing competitiveness in a country. In our case, a negative RULC figure in the graphs below would represent an improvement in the competitiveness in Cyprus as it would mean that the growth rate of the RULC in Cyprus was lower than that of the euro area. Note, however, that this does not imply that competitiveness in the euro area did not grow; it only implies that it grew faster in Cyprus than in the euro area.

If labour productivity increases, pressure is exerted through increased wage bargaining for wage increases. If, on the other hand, labour productivity decreases, it is a signal that wages should be reduced. When the RULC in a specific sector increases above that of another country, this translates into loss in the competitiveness of that country's sector with respect to its labour, as compared to the other country's competitiveness. The RULC is reduced if either real wages are reduced or labour productivity increases.

Similarly in Figure 7 of the Appendix, we observe the difference between the productivity and capital-labour ratio for Cyprus and corresponding euro area sectors. A negative number here suggests that the Cypriot sector is worse with respect to productivity and has a lower capital-labour ratio (capital intensity) compared to the euro area.

With respect to TFP, we observe that in the period 2002–2007, most sectors experienced positive productivity growth. The sectors with the highest contribution of productivity to output growth were the financial services sector followed by the transport sector. Two sectors experienced negative productivity rates, causing a reduction in their output and therefore loss of efficiency and competitiveness. These were the manufacturing sector, which had negative output growth from 1996, and the accommodation sector, which saw a drop in its output growth due to negative productivity. Finally, the education sector had a negative but almost zero productivity growth.

In the period 2008–2011, the effects of the crisis become apparent in the Cypriot economy. A drop occurred in the productivity of all sectors causing the aggregate measures of productivity and output growth to decrease further, except in education, health and accommodation in which productivity increased, as did output growth. Negative productivity

growth rates can be observed in the construction, electricity, gas and water, and transport sectors. In construction and transport, the negative productivity pushes the output growth downwards to negative rates. The financial services sector also experienced a decrease in productivity, but the rates remained at positive levels, as was also the case for output growth. In the period 2008-2011, capital deepening increased in most sectors except accommodation, financial services and insurance, and education, in which it was basically 0%. These are therefore sectors that experienced no investment or no new investment.

### 3.2.2 Sector disaggregation

Prior to discussing the individual sectors presented in this report, it is important to point out various economic developments and some key facts retrospectively that may have been the main driving forces behind changes in the RULC and therefore the competitiveness of the overall economy, or even of specific sectors of the Cypriot economy.

On 1 May 2004, Cyprus entered the European Union, followed by the adoption of the euro in 2008, which replaced the national currency, the Cypriot pound. The integration of Cyprus within the European Union was accompanied by the liberalization of various professions and increased labour mobility from and mostly towards Cyprus. A considerable amount of both skilled and unskilled labour started to flow into the local market. This flow had an immediate impact on the prices of services, as greater competition in the labour market due to the increased labour supply exerted contractionary pressures, forcing real wages in specific professions to go down. In terms of figures, in 2010 more than 74% of employees from abroad were employed in the services sector, 21% in the production and construction sectors, and the remaining 5% in the primary sector.<sup>6</sup>

According to Soumeli (2008), in 2006 the proportion of employees that belonged to labour unions in Cyprus was 58%. It should be noted that not all sectors in Cyprus are represented by a labour union. However, it is notable that the highest participation ratios are usually found in the public sector. Furthermore, those employees in sectors that have not formed labour unions are also protected through legislation related to employment that defines minimum wages, levels of working hours and redundancy payments. Both the existence of labour unions and the employee protection legislation are intended to retain a smooth working environment between the two parties, employers and employees, in the

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<sup>6</sup> Source: Central Bank of Cyprus.



labour market. However, sometimes these measures have been criticized for working against the proper allocation of efficient human resources and therefore the productivity of labour as they may prompt workers to exert less effort due to the inability of employers to react. Moreover, labour unions and employment protection measures can prove harmful for the overall economy, not only for the aforementioned reason but also because public and private sector wages as well as employment cannot be adjusted accordingly during economic meltdowns.

The participation of employees in labour unions, especially in the private sector, has been declining over the years. One of the causes is the fact that immigrant workers are usually not interested in registering with unions, probably in an effort to avoid any immediate financial burden. The percentage of foreign employees in the labour force reached 21.1% in 2010, from only 9.5 in 2002.<sup>7</sup> As mentioned above, this increase can be partly attributed to the entry of Cyprus to the European Union in 2004. In particular, the percentage change in the overall labour force of Cyprus was around 4.2% in 2004, with over 3.1% being workers from abroad and the rest 1.1% being Cypriot citizens.

Below we go into more detail and give possible explanations for the movements in the RULC and its components for each of the individual sectors examined in this study. As we saw in Figure 4, which illustrates the level of the overall unit cost in Cyprus against that of the euro area, the average real labour cost in Cyprus increased vastly after 2001 and retained its relatively high level until 2005, at which point it started a downward path to converge to the euro area average in 2008. In 2008 it reached a trough and started increasing again, but this time following closely the levels seen in the Eurozone. The individual sectors, though, reveal a different picture with heterogeneous movements, attributed to the different structures of each of the specific sectors. Overall, four of the sectors could be said to be performing better compared to the euro area for all or the majority of the period covered, from 2002 to 2010. Those sectors are construction, transport, financial services and health. On the other hand, manufacturing, accommodation, electricity, gas and water, and education underperformed compared to the euro area average. An overperforming sector is one that is constantly becoming more competitive than the respective sector in the euro area, whereas underperforming indicates the opposite. In a cross-sector comparison for Cyprus, health, accommodation and electricity, gas and water are the sectors with the largest changes in their levels of competitiveness as opposed to

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<sup>7</sup> Source: Central Bank of Cyprus.

manufacturing, financial services and education; these latter sectors were the most stable, at least when compared to each other.

### **Manufacturing**

Overall, the RULC in the manufacturing sector increased until 2009. The sector in Cyprus can be characterized as underperforming when compared to the average RULC of the euro area countries. In contrast to Cyprus, the labour cost in the euro area decreased until 2007. Both indices, however, reached a peak in 2009 before starting to decline. The increasing path of the RULC in Cyprus from 2002 until the peak in 2009 can be attributed to the increase in real wages. Real wages in the manufacturing sector in Cyprus increased from 2004 and peaked in 2008; indeed, they increased by a total of more than 12% during the four years prior to the peak in the RULC.

Regarding the second component of the RULC, labour productivity decreased from the beginning of the sample period until 2007. Labour productivity declined mainly due to decreases in the sectoral output for the period 2004–2006 and due to increases in labour in 2007. It is noteworthy that manufacturing is one of the sectors with a high participation rate of employees in labour unions. This could potentially explain why wages remained high even though labour productivity decreased during that period.

The manufacturing sector is essentially in a worse position with respect to productivity throughout the whole period. The TFP of the sector decreased from 2003, becoming rather more stable after 2009. It experienced a small increase in 2008, which caused a shift in the difference, but this was again followed by a fall. The difference in the capital–labour ratio is relatively stable at around zero.

### **Electricity, gas and water**

The composite sector of electricity, gas and water, which comprises goods and services mainly produced under the administration of the government, is another of the four underperforming sectors in Cyprus. Also, it is important to bear in mind that the highest participation ratios in labour unions are usually found in the public sector. The overall picture reveals an increasing trend in the RULC in Cyprus, with a peak in 2010. It is notable that this sector is that with the greatest loss in competitiveness as the RULC increases to more than 75% in the period covered in our sample. The path of labour productivity has been rather stable, showing a moderate decreasing trend over the years, meaning that the explosive path in the RULC must have been driven by real wages. Real wages increased

by almost 70% in eight years, with the greatest increase happening between 2009 and 2010.<sup>8</sup> It is also notable that there was almost no gap in the RULC between Cyprus and the euro area average until 2003.

The electricity, gas and water sector appears to be less competitive with respect to TFP after 2007. While there was no significant difference until then, we see a drop in the figure, suggesting that the sector became less competitive especially in the period 2008–2010. Both productivity and labour productivity in the sector move together; however, after 2008 TFP drops even further. The growth rate of capital stock of the sector shows an increase from 2006 to 2010 and is higher when compared to the growth of labour and this is the reason for the increase in the capital–labour ratio, causing the difference between Cyprus and the euro area and even reaching positive levels after 2009.

### **Construction**

The competitiveness of the construction sector in Cyprus increased until 2008 when it reached its peak. The picture in the construction sector in the euro area is somewhat similar. On average, labour productivity increased and real wages decreased from 2002 to 2008, when both reversed their direction. The decreasing path of real wages that is especially notable after 2005 can be attributed to the large number of unskilled workers who migrated to the country after it opened its borders in 2004. As explained at the beginning of this section, the entry of foreign workers has probably weakened labour unions and their activity, allowing wages to adjust to lower levels. After 2008, slight increases in real wages were recorded. This is probably due to the outflow of mostly foreign workers observed after the worsening of the economy and the negative expectations that were formed regarding the housing construction market. Moreover, in the last three years of our sample, output in the sector has declined faster than labour, forcing labour productivity to decline over 22% during that period.

The upward path of labour productivity in Cyprus before 2008 was primarily due to capital deepening, especially after 2007 as TFP declined from then on. Capital deepening during that period was positive, suggesting a substitution of capital for labour, and thus causing the improvement in labour productivity. New productive investment

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<sup>8</sup> Data for the compensation of employees reveal that all three sub-sectors (electricity, gas, and water) faced large increases after 2009. Specifically, in the water sector, compensation rose from €27.8 million to €49 million and in the electricity and gas sector from €42 to €74 million. Moreover, in 2010 gross wages and salaries in the electricity and gas sector increased from €23.1 million to €38, and in the water sector from €35 to €57.4 million, retaining high levels thereafter.

probably took place during this period in various projects. The growth rate of capital stock of the Cypriot sector increased between 2006 and 2008 by around 10%, but dropped in 2009 to almost 0%. The decrease in labour productivity after 2008 was due to both a fall in total productivity and capital intensity, which could either mean no new investment or investment in low productive capital.

### **Transport and storage**

The transport and storage sector saw considerable improvement in terms of competitiveness and even exceeded the performance of the same sector in the euro area, which can be said to have been relatively stable throughout the period. The share of air transport-related services, which includes airport activities to a large extent, was 64% of the total sectoral output on average. Therefore, the privatization of the administration of the national airports in 2006 can potentially explain the majority of improvements made in the sector that are reflected in the decrease in the RULC seen after 2005 and up until 2009. Labour productivity saw positive growth from the beginning of the sample; however, the peak in the RULC was primarily due to real wage decreases that started in 2005 and continued until 2010. From 2009, the sectoral output declined faster than labour, resulting in a peak and a downward trend in labour productivity from 2009 onwards. Furthermore, between 2008 and 2009, the RULC line in the graph crosses the horizontal line, meaning that real wage growth in Cyprus was lower compared to that of the euro area from then on.

The slight shift in the constantly improving labour productivity after 2009 is due to a drop in both TFP and capital intensity. The transport and storage sector seems competitive when compared to the euro area. The difference in the productivity is positive and increasing, with a small drop in 2009. Similarly, after 2007 the capital-labour ratio of the sector is higher than the corresponding ratio for the euro area. Both productivity measures in this sector show an increase throughout the period, with small drops after 2009. The capital stock of the sector provides a different picture. The capital stock starts growing after 2005 until 2008 to reach 12%. After that we observe a drop in the growth rate of the capital stock which becomes zero in 2010 and negative in 2011. The capital-labour ratio shows an increase.

### **Accommodation and food service**

The accommodation and food service sector includes most tourism-related activities and services. The sector had been experiencing huge increases in real wages until 2005. From then on, real wages decreased at rate of over

3% annually on average. Given that labour productivity remained relatively constant, especially after 2005, the contraction in real wages forced the RULC down, closing the gap that existed between Cyprus and the average level in the euro area. Similarly to the construction sector, wage depletion can be attributed to the inflow of unskilled workers as a result of the integration of Cyprus within the European Union in 2004.

The slight improvement in the labour productivity after 2005 can be attributed to TFP increases. Capital intensity in the sector is found to be close to zero, suggesting no new investment or simply that the sector used its capital only for maintenance. The capital-labour ratio of the sector decreases and the growth rate of capital shows negative levels from 2007. The difference in the capital-labour ratio is around zero, but sees a positive value in 2009 and 2010. Finally, emphasis should be placed on improving the competitiveness of this sector as it is one of the five largest sectors of the Cypriot economy and was among the two largest during the late 90s.

### **Financial services and insurance**

In the financial services sector, the gap between the RULC of Cyprus and that of the euro area shows an increase, with Cyprus becoming constantly more competitive especially after 2004. Even though real wages in Cyprus grew slightly faster on average than in the euro area, the gap in the real labour cost can be attributed to the faster growth of labour productivity in Cyprus. There is an upward trend in labour productivity in Cyprus from 2003, with labour productivity becoming more stable after 2010. Labour increased annually at an almost constant rate of 2% from 2004. Four years after the financial crisis of 2000, the sectoral output experienced an almost 10% annual increase, with later changes also remaining at high positive values.

The contribution of the capital deepening factor is almost zero, as is the growth rate of capital, translating to no new investment. As a result, the main contributor to labour productivity increases is TFP. The financial sector is the second sector that seems to be performing better than the euro area. The difference in productivity is positive and shows an increasing trend. The difference in the capital-labour ratio is decreasing and negative, suggesting that the corresponding euro area sector has a higher capital-labour ratio.

It is crucial here to point out that due to the nature of the output of financial services and other service sectors, possible mis-measurement issues may lead to bias in productivity and sectoral output assessment.

This is an issue which remains unresolved and is highlighted by Gallouj and Savona (2009), amongst others.

### **Education**

The gap in the competitiveness of the education sector between Cyprus and the euro area shows an increase from 2005, with the Cypriot RULC increasing constantly until 2009 and that of the euro area remaining relatively constant. Labour productivity in the education sector in Cyprus is the most stable across all sectors. Therefore, it seems that wages are almost entirely responsible for the increasing loss of competitiveness in the education sector in Cyprus. Approximately 90% of the total expenditure in the education sector is distributed to primary and secondary education and only the remaining 10% to higher education.

As with the other sectors, it is important here to point out that most sectors comprise many different sub-sectors, thus, in most cases, to gain a deeper understanding, it would be necessary to be study these separately. Further disaggregation of each sector needs to be undertaken and productivity analysis applied to be able to extract robust information and also to be able to utilize these results in the policy decision-making process.

With respect to productivity, there is no apparent difference between the education sector in Cyprus and the euro area. Based on the graph, the difference fluctuates around zero. The difference in the capital-labour ratio starts to decrease after 2003, becoming zero in 2007 and going negative afterwards. The capital-labour ratio in the euro area shows an increase throughout the period, whereas the Cypriot ratio is rather stable, so the difference between the two is widening.

### **Human health and social work**

Competitiveness in the health sector of Cyprus shows an improvement from the beginning of our sample period. Given the stable RULC in the euro area, the gap between Cyprus and the rest of the euro area increased over the period. The gap in real wages is negative and decreasing throughout the entire sample, suggesting that real wages in Cyprus decreased faster compared to the average in the euro area. Increased competition in the health services as a result of the liberalization of most professions in 2004 could potentially explain what drove real wages down. On the other hand, labour productivity in Cyprus saw huge increases from 2005, while the downward trend in the euro area contributed to the widening of the gap between Cyprus and the euro area. The increases in

labour productivity of the health sector in Cyprus after 2005 are due to increasing sectoral outputs but also negative growth rates in labour.

Moreover, both capital intensity and TFP are found to contribute to the observed increase in labour productivity. The growth rate of capital stock and TFP show an increase, so the increase in labour productivity can be attributed to both technological improvements and high investment.

#### **4. Conclusion**

In this paper, we have examined various indicators in order to assess the performance of the Cypriot economy as a whole and also for each sector of economic activity separately. In particular, we distinguished between and therefore assessed the performance of eight sectors, extracted using the NACE2 classification scheme. First, we calculated total factor productivity (TFP), also known just as productivity, employing growth accounting methodology. Then, we used these results to calculate labour productivity growth and finally the real unit labour cost (RULC). All three indicators are interrelated as one depends on the other; however, they comprise separate tools, thereby giving us the ability to infer results for different aspects of the economy and sectors. The TFP measure of productivity shows how effectively combined labour and capital inputs are used to generate GDP. TFP is usually referred to as 'technology' as it reflects phenomena such as advances in general knowledge, reductions in inefficiency and generally anything that would affect output production levels other than the inputs used, i.e. labour and capital. On the other hand, labour productivity shows the value of the additional goods and services produced per hour of work. Finally, the RULC measures the cost of labour required to produce a 'unit' of output. In this sense, this measure captures the competitiveness of a country or a sector with respect to labour. A country is said to be gaining competitiveness in when its productivity increases at a rate faster than that of its trading partners.

After May 2004, when Cyprus became a full member of the European Union, the labour supply increased due to an inflow of labour mostly from Eastern Europe. The increased labour supply exerted downward pressure on wages, resulting in an increase in labour productivity. Although labour productivity increased in Cyprus by 1.7% on average in the period 2002–2007 and 0.9% for 2008–2010, our results suggest that the cost of labour per unit of output during the period 2002–2010 was higher compared to the Eurozone average, resulting in Cyprus becoming constantly less competitive.

Furthermore, regarding sectoral developments, the sectors that underperformed compared to their Eurozone counterparts were manufacturing, accommodation and food, electricity, gas and water, and education; on the other hand, the best productivity performers were the construction, transport and storage, financial services and insurance, and health sectors. These findings may highlight the fact that sectors controlled by trade unions are more prone to loss of competitiveness than other sectors of the economy, especially those with a large public sector component. Labour market distortions are therefore largely responsible for the loss of competitiveness of the Cypriot economy and taking urgent steps to re-align pay to productivity is a pre-requisite for economic recovery. Improvements in overall productivity and competitiveness will only be achieved when we address the waste from paying people for output with a value below their remuneration, even when this remuneration is considered low in absolute terms.



## Appendix

### Model description and results

#### A.1 Model description

Solow's (1957) seminal paper provides a useful context for introducing the basics of growth accounting, which has influenced numerous subsequent growth accounting studies. Following his notion, we define a production function as:

$$Y = F(K, L, t)$$

where  $Y$  is the quantity of output,  $K$  is the capital input,  $L$  is the labour input and  $t$  the level of technology (TFP). Differentiating with respect to time and dividing by  $Y$  (rearranging in terms of growth rates):

$$\hat{y} = \frac{\partial F}{\partial K} \frac{K}{Y} \hat{k} + \frac{\partial F}{\partial L} \frac{L}{Y} \hat{l} + \frac{\partial F}{\partial t} \frac{1}{Y} \quad (1)$$

where  $\hat{(\ )}$  stands for the growth rate, e.g.  $\hat{x} = \frac{\partial x}{\partial t} / X$ . Then, the rate of TFP change  $\hat{T}$  is calculated as a residual:

$$\hat{T} = \frac{\partial F}{\partial t} \frac{1}{Y} = \hat{y} - \frac{\partial F}{\partial K} \frac{K}{Y} \hat{k} - \frac{\partial F}{\partial L} \frac{L}{Y} \hat{l} \quad (2)$$

However, equation (2) is impractical as the marginal products of capital,  $\frac{\partial F}{\partial K}$  and labour,  $\frac{\partial F}{\partial L}$ , inputs are unobservable. Assuming that firms maximize their profits, the social marginal products must be equal to the observed factor prices. Therefore, equation (2) becomes:

$$\hat{T} = \hat{y} - s_K \hat{k} - s_L \hat{l} \quad (3)$$

where  $\hat{(\ )}$  again denotes the growth rate and  $s$  indicates the output shares of capital and labour. This framework grew phenomenally between 1957 and Diewert's (2002) paper. The methodology was extended and applied in various empirical studies.

When production exhibits constant returns to scale, we can link the labour productivity to TFP growth. Labour productivity growth depends on TFP growth plus capital deepening, where capital deepening refers to the growth rate of per capita capital, measuring the substitution between capital and labour. Labour productivity can therefore be written as:

$$\hat{\ell} = \hat{T} + s_K (\hat{k} - \hat{l}) \quad (4)$$

Finally, using the labour productivity measure, one can calculate the unit labour

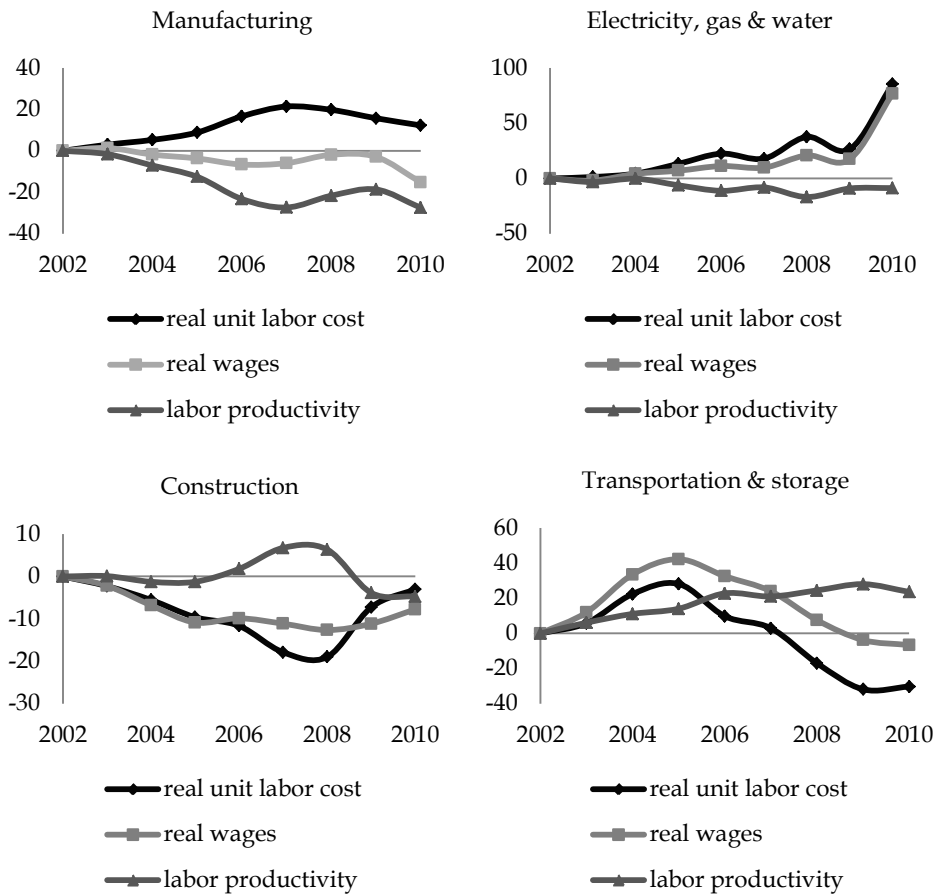
cost as the difference between the wage growth rate and the labour productivity growth rate:

$$\hat{u} = \hat{w} - \hat{\ell} \quad (5)$$

where  $\hat{w}$  is the growth rate of wages and  $\hat{u}$  is the unit labour cost, or the RULC when  $\hat{w}$  is measured in real rather than nominal terms.

**A.2 Graphs and tables**

FIGURE 6  
*Real unit labour cost, real wages, labour productivity  
 (differences of Cyprus from euro area)*



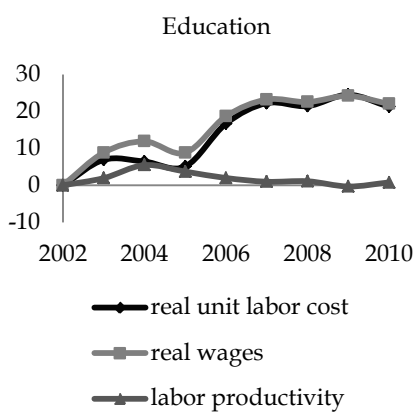
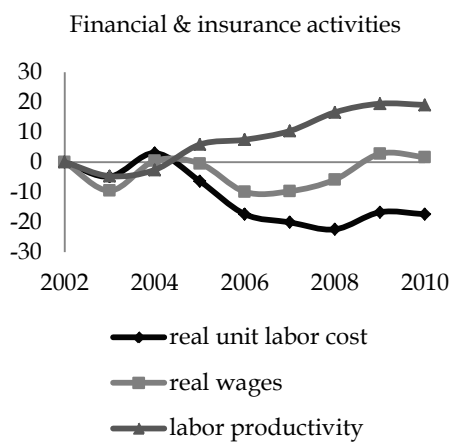
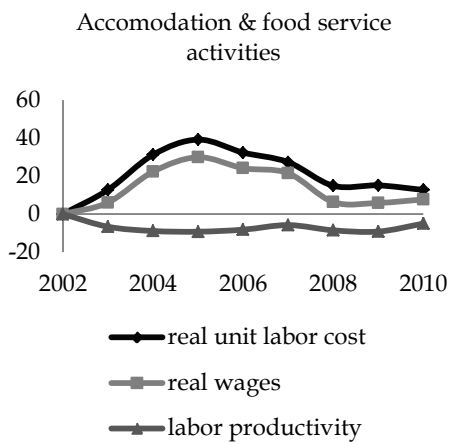


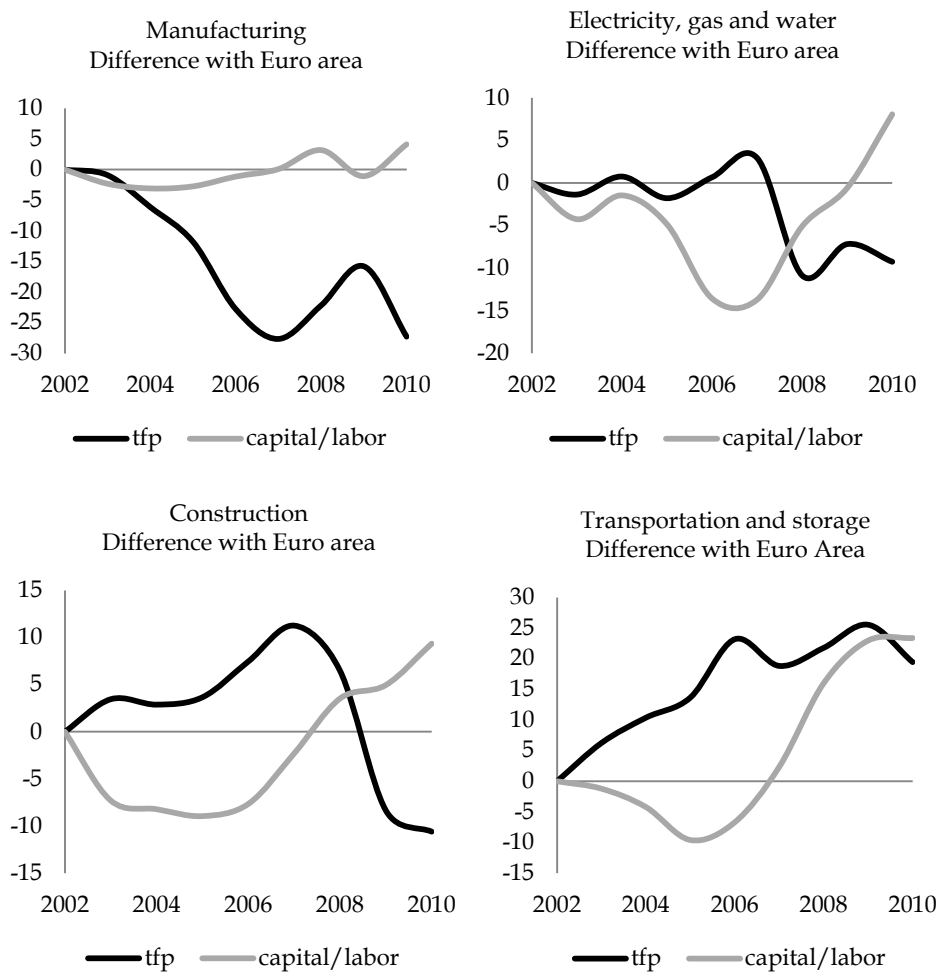
TABLE 1  
*Output growth and components*

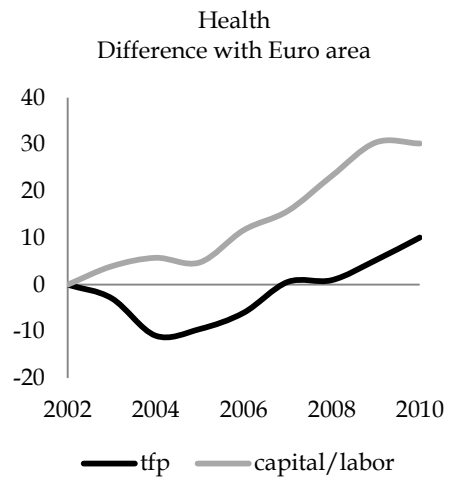
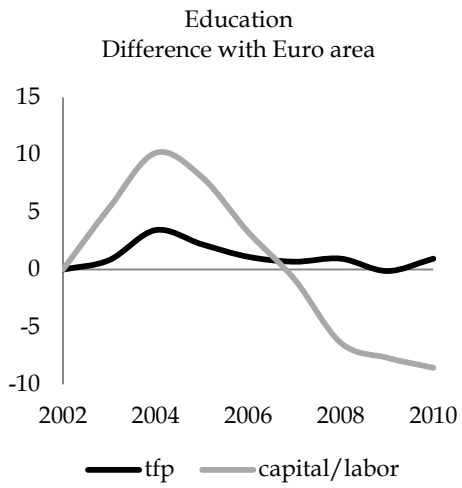
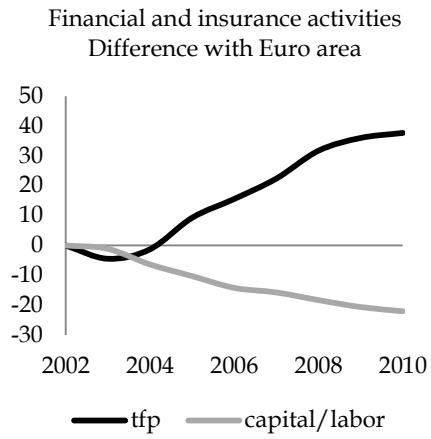
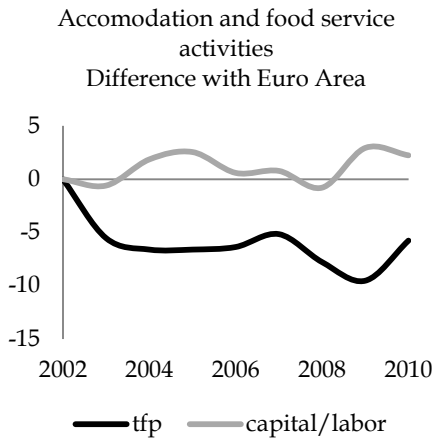
	Output	Productivity	Inputs
<u>Manufacturing</u>			
2002-2011	-0.84	-0.81	-0.03
2002-2007	-0.15	-0.85	0.70
2008-2011	-1.89	-0.75	-1.13
<u>Electricity, gas and water</u>			
2002-2011	3.88	-1.21	5.09
2002-2007	5.83	2.24	3.59
2008-2011	0.96	-6.38	7.34
<u>Construction</u>			
2002-2011	0.37	-1.94	2.31
2002-2007	7.00	2.65	4.35
2008-2011	-9.56	-8.83	-0.74
<u>Transportation and storage</u>			
2002-2011	2.30	1.01	1.29
2002-2007	5.07	3.45	1.62
2008-2011	-1.87	-2.65	0.78
<u>Accommodation and food service activities</u>			
2002-2011	-0.92	-1.06	0.14
2002-2007	-1.50	-2.37	0.87
2008-2011	-0.05	0.92	-0.97
<u>Financial and insurance activities</u>			
2002-2011	4.90	4.39	0.51
2002-2007	5.44	5.41	0.02
2008-2011	4.08	2.85	1.23
<u>Education</u>			
2002-2011	2.75	0.06	2.69
2002-2007	2.47	-0.10	2.57
2008-2011	3.17	0.30	2.87
<u>Health</u>			
2002-2011	3.94	2.11	1.84
2002-2007	2.53	0.89	1.64
2008-2011	6.06	3.93	2.14

TABLE 2  
*Labour productivity, TFP and capital intensity*

	Labour productivity	Productivity	Capital deepening
<u>Manufacturing</u>			
2002-2011	-0.02	-0.81	0.80
2002-2007	-0.41	-0.85	0.44
2008-2011	0.58	-0.75	1.33
<u>Electricity, gas and water</u>			
2002-2011	0.33	-1.21	1.54
2002-2007	1.00	2.24	-1.24
2008-2011	-0.68	-6.38	5.70
<u>Construction</u>			
2002-2011	-1.22	-1.94	0.72
2002-2007	1.59	2.65	-1.06
2008-2011	-5.44	-8.83	3.39
<u>Transportation and storage</u>			
2002-2011	2.98	1.01	1.97
2002-2007	4.64	3.45	1.19
2008-2011	0.49	-2.65	3.14
<u>Accommodation and food service activities</u>			
2002-2011	-1.21	-1.06	-0.15
2002-2007	-2.51	-2.37	-0.14
2008-2011	0.74	0.92	-0.18
<u>Financial and insurance activities</u>			
2002-2011	4.22	4.39	-0.17
2002-2007	5.33	5.41	-0.08
2008-2011	2.54	2.85	-0.31
<u>Education</u>			
2002-2011	0.10	0.06	0.04
2002-2007	0.04	-0.10	0.15
2008-2011	0.17	0.30	-0.12
<u>Health</u>			
2002-2011	3.77	2.11	1.67
2002-2007	2.35	0.89	1.46
2008-2011	5.90	3.93	1.98

FIGURE 7  
*Productivity and capital/labour Ratio (differences of Cyprus from euro area)*





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