Productivity, reallocation and structural change: an assessment

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3.1) Introduction

The basic narrative of the Turkish economy up until mid-2000s was one of successful structural change. After a decade of macroeconomic instability and highly volatile growth that characterized most of the 1990s, and following the adoption of a wide-ranging economic program in 2001, Turkey exhibited respectable economic growth in the 2000's, at least until the global financial crisis. Further, growth in that period was accompanied by rapid increase in total factor productivity (TFP) (Atiyas and Bakis, 2014) as well as successful performance in structural change, i.e. reallocation of labor from low productivity agriculture to higher productivity services and industry (Rodrik, 2010; Atiyas and Bakis 2014, 2015). Further, this period was characterized by significant improvements in both political and economic institutions (Acemoglu and Ucer, 2015; and Chapter 2 by the same authors in this volume). By contrast, there is widespread agreement that Turkey's economic performance has deteriorated in the last few years. With the loss of the EU anchor, and increase in authoritarian tendencies there is also widespread concern about institutional degradation, including in areas such as independence of the judiciary, freedom of the press, and the overall quality of governance (See chapters 2, 7 and 8). The purpose of this chapter is to evaluate how the narrative of successful structural change needs to be modified to accommodate the developments of the last 4 decades.

The chapter makes several contributions: First it will update the growth accounting exercise presented in Atiyas and Bakis (2014) and examine the contribution of total factor productivity to aggregate growth. Second, the growth accounting exercise will be extended to the construction industry. The construction industry is believed to have played a significant role in recent years and to our knowledge the present chapter is the first to examine the characteristics of growth in this industry in an accounting framework. It is also worthy to note that the recent severe depression in this sector played a crucial role in the recession of 2018. Third, to assess whether structural change has continued to play a positive role, the chapter will examine the contribution of reallocation of labor to the growth of aggregate labor productivity. Finally, based on the premise that structural transformation and technological upgrading eventually shows up in increase in international competitiveness, the chapter will provide evidence on slowdown in the improvement of the quality of Turkey's exports.

Throughout the chapter we try to follow a uniform scheme of periodization of the last 4 decades. The period 1981-1989 covers the period of economic liberalization and reform under Ozal governments up to capital account liberalization that took place in 1989. The period 1990-2002 covers the "lost years" of 1990s when Turkey struggled with macroeconomic instability, high inflation, large budget deficits made worse by off-budget expenditures. The excesses of the 1990s culminated in a financial crisis in 2000-2001, and an economic reform program supported by the IMF and the World Bank, launched in 2001-2002. The year 2002 is a year of high growth, reflecting a "rebound" effect of a severe contraction experienced in 2001. We include the year 2002 in the "lost years" segment both because the contraction and the rebound growth cancel each other out and also because the Justice and Development Party (AK Party) government was formed on November 2002 and Recep Tayyip Erdogan became Prime Minister in March 2003.

We will refer to the years 2003-2013 as the "first AK Party period". We further subdivided this period into three: The years 2003-2007 correspond to a period of intensive economic and political reform as well as an orientation towards accession to the European Union. These are years when, overall, institutions of economic policy making were more rule-based than traditionally has been the case in Turkey (Chapter 7). While a new business class was supported by the government, the prospect of EU accession and the adoption of EU regulations provided the traditional elite with security. The years 2008-2010 correspond to the period of global economic crisis, causing a substantial drop in GDP in 2009, followed by a rebound in 2010. Even though growth was high in 2010, it reflected a rebound from a low base. We therefore include the year 2010 in the same period as 2008-2009, and call the whole cycle "the crisis period". The period 2014-2018 corresponds to what we call the "second AK Party period" when a fundamental change the mode of governance is clearly visible: Following the Gezi protests in 2013, successive AK Party governments turned increasingly authoritarian, a tendency that peaked following the 2016 failed coup attempt. When exactly the change occurred is a matter of controversy. Some observers underline the year 2012 as the year when the rift between AK Party and the Gulen movement became visible.[1]

An important contribution of this chapter is that we carry out the growth accounting exercise in 4 sectors: Agriculture, industry (comprising mining, manufacturing, electricity, water and gas), construction and the services. We include construction as a separate industry because its role in the economy has been important and controversial, especially in the last decade and a half. There is a widespread view that economic growth in the last few years has relied too heavily on growth in the construction industry. The construction sector has been promoted both because it generates jobs, and because it is a sector where generation and allocation of rents to politically connected firms is relatively easy. Rents can be generated both through changes in regulations (e.g. changing zoning regulations can generate significant rents in construction of buildings) especially in construction of and through public procurement (e.g. building of motorways or projects with private sector participation). Moreover, many of the new business groups associated with the ruling AK Party, are in the construction business (Buğra and Savaşkan, 2014). Gurakar (2016) examines public procurement data and finds that "In the AK Party period, …, the majority government has used public procurement as an influential tool both to increase its electoral success and build its own, loyal elites." (p. 107). At the same time, the role of politics in the development of the construction industry is nothing new. For example, granting titles to illegal urban settlements in exchange for political support has always been an important dimension of political clientelism in Turkey. These considerations make it worthwhile to examine the characteristics of growth in this sector in some detail.

[1] In February 2012 prosecutors allegedly associated with the Gulen movement revealed an investigation against the president of the National Intelligence Organization who was closely associated with the leadership of the Justice and Development Party (AK Party).

The chapter is organized as follows: The next section presents our data and methodology. The third section discusses the results of the growth accounting exercise at the aggregate level. Section 4 examines the role of factor accumulation and total factor productivity growth in agriculture, industry, construction and services. Section 5 investigates the role of reallocation in aggregate growth of labor productivity. Section 6 provides a brief analysis of the quality of Turkey's exports. Section 7 concludes.

3.2) Data and methodology

a) Methodology:

The starting point for total factor productivity (TFP) estimation is the assumption of a production function. Almost all past studies estimating TFP start with the basic production function $Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$. Then, from this function TFP growth is derived as follows

$$\ln(A_{t+1}/A_t) = \ln(Y_{t+1}/Y_t) - \alpha\ln(K_{t+1}/K_t) - (1-\alpha)\ln(L_{t+1}/L_t) \quad \ldots(1)$$

where α is the share of capital in GDP. So, TFP growth is measured as a residual, and usually it is called Solow's residual. The reason for this labeling is that Solow (1957) was the first paper to compute TFP in this way. Once α is estimated or assumed we need time series data on Y, K, L to estimate TFP growth. One common problem is lack of capital data. And typical solution is using investment data and perpetual inventory equation

$$K_{t+1} = (1-\delta)K_t + I_t \quad \ldots(2)$$

to obtain a time series of capital data. This equation requires the initial level of capital, which is not available unfortunately. Again, the common practice is to assume that the economy is in a steady state so that GDP and capital grows at the same constant rate (g) so that we have the following equation that pins down the initial capital stock

$$K_0 = \frac{I_0}{g+\delta} \quad \ldots(3)$$

Here, I_0 is usually the first observation of investment data, g is the average growth rate for the period we want to compute capital stock and finally δ is the depreciation rate for capital stock.

For sectoral TFP growth we use the following variant of equation 1

$$\ln\left(A_{t+1}^{i}/A_{t}^{i}\right) = \ln\left(Y_{t+1}^{i}/Y_{t}^{i}\right) - \alpha^{i}\ln\left(K_{t+1}^{i}/K_{t}^{i}\right) - \left(1-\alpha^{i}\right)\ln\left(L_{t+1}^{i}/L_{t}^{i}\right) \quad \dots(4)$$

where superscript i refers to sector. In this paper these are agriculture, industry, construction and services. We are allowing sectors to have different capital shares.

b) Data

Before presenting details of our data we should expose our sectoral classification. For TFP analysis we present both aggregate results and sectorial results where sectors are agriculture, industry (mining, manufacturing and public utilities), construction, and services. The main constraint for TFP analysis, as we will see below, is the construction of a long capital stock series which is only feasible for 4 sectors given above. Since we do not need capital stock data for labor productivity analysis, we enlarge the number of sectors to 9: agriculture; mining; public utilities (electricity, water and gas); manufacturing; construction; wholesale and retail trade; financial institutions, insurance and real estate; transport, storage and communications; and community, social, personal and government services.

i. Setting parameters

To estimate equation 2 (which also requires estimation of equation 3) we need to determine parameters α and δ, along with GDP, investment and employment series both at aggregate and sectoral level. Following the literature, we set depreciation rate to 6 percent for aggregate analysis. For sectoral depreciation, we let agriculture have a lower depreciation rate, 3 percent in the baseline specification and the same depreciation rate for all sectors as a robustness check (6 percent). For capital share, our main specification uses a value of 1/3 for capital share when we analyze aggregate TFP as most of the literature respectively. Another reason why we prefer 1/3 is that Atiyas and Bakis (2014) show that aggregate labor share adjusted for self-employment is around 2/3, which is widely used by TFP literature.

However, starting from December 2016 TurkStat made an important revision to national accounts. Both composition and level GDP change in important ways. One wonders whether the finding by Atiyas and Bakis (2014) on adjusted labor share still holds in the new GDP series.

One disadvantage of the new series of “GDP by income approach” released by TurkStat is that it covers only 2009-2018 period. Nevertheless, if we compute aggregate labor share adjusted for self-employment from this more recent is around 2/3, actually 64.3 percent to be precise (see Bakis and Acar, 2020, for details). For sectoral TFP analysis there is no such consensus on factor shares. However, different sectors are expected to have different factor shares. For sectoral factor shares we rely on Valentinyi and Herrendorf (2008), who measure sectoral income shares for USA, we use capital share, $\alpha = 0.55$ for agriculture, $\alpha = 1/3$ for industry and services and finally $\alpha = 0.21$ for construction. A hasty reaction to these numbers may be that the capital share for agriculture is too high. But given that land is part of the capital stock for agriculture and for many farmers land is the principal input in production it seems more convincing than it looks.

The concerns about a constant depreciation rate that is common to all sectors are well known, however given lack of convincing data most of the literature stick with 6 percent of constant depreciation rate. Part of the problem is unavoidable. There is an inherent problem in calculating a unique and constant depreciation rate when capital is made, in varying proportions, of communication technology equipment, machinery as well as buildings, land, animals and office equipment. Studies by Jorgensohn (1996) and Hulten and Wykoff (1981) show that depreciation rate is lowest in agriculture, highest for construction, and in between for manufacturing and services. This is why we prefer a depreciation rate of 6 percent for aggregate analysis, but for sectoral analysis we favor 4 percent for agriculture, 8 percent for construction, and 6 percent for both industry and services.

In addition to other data problems, we want to construct a time series that goes back as far as possible. This is necessary to have reliable TFP numbers. Since our oldest observation for aggregate investment goes back to 1948, we construct GDP and employment series going back to 1948 as well. For aggregate GDP we easily find series going back to 1948. For investment and employment, it is relatively more difficult but still feasible. The most difficult task was finding sectorial investment series going back to 1948. In the following sections, we provide a detailed discussion of how each variable used in the TFP analysis is constructed.

ii. GDP

We use real GDP as a measure of output from the Turkish Statistical Institute (TurkStat). One major difficulty in construction "real GDP" data for Turkey is changes in activity classification. Looking at Turksat data we see that different classifications are used through time. First, we have the International Standard Industrial Classification of all Economic Activities (ISIC) rev. 2, which covers years 1948-2006. Then, we have NACE rev.2 which covers years 1998-2018. Actually, in practice we had other classifications such as NACE rev.1 which covered years 1998-2011.

But when TurtStat updated activity classification it extrapolated to earlier years so that between 1948 and 2018 we have only two classifications for GDP. Meanwhile, when TurkStat switched to chain-linking technology, the activity classification, NACE rev. 2, did not change, but the treatment of "Financial intermediation services indirectly measured" changed in new series. Before, in 1998 based GDP it was a separate item that needs to be added to sectorial total along with taxes and subsidies to get GDP at purchaser's prices. But with new chain-linked series taking 2009 as reference year it is distributed to individual sectors so that we need to add only taxes and subsidies to sectorial total to get GDP at purchaser's prices. To be consistent across time we are assuming that whatever is common to all sectors (such as FISIM or taxes and subsidies) are distributed across sectors following their share of value added in sectorial total. Once the problem regarding FISIM and taxes and subsidies is solved it is not difficult to construct sectorial employment for 9 sectors. For details and conversion table we use for different classifications see Bakis and Acar (2020).

iii. Capital

We use the Gross Fixed Capital Formation (GFCF) and the perpetual inventory method (PIM) to derive capital stock. Since we rely on steady state assumption to compute initial capital stock, it is better to compute it as early as possible so that any error we are doing in initial estimate disappears in the long run. In this paper we calculate the aggregate capital stock in 1948 and we report TFP results for 1980 and later years. So, we have a 32 years of gap between time we calculate TFP and initial capital stock estimation. Since by iterating perpetual inventory equation

$$K_t = K_0(1-\delta)^t + \sum_{i=0}^{t-1} I_i(1-\delta)^{t-1-i}$$

We see that any error made in the estimation of initial capital stock disappears exponentially with a growth rate of -δ percent. Therefore, we tried to go back as far as possible to estimate initial capital. Since our first observation of investment is in 1948, we estimated initial capital stock in 1948. Assuming a depreciation rate of 6 percent, only a small portion of initial capital (as much as $(1-\delta)^{32} = 13.8$ percent) is rest for year t. So, 86.2 percent of any error we made in estimation of initial capital disappears by 1980.

Our major difficulty in this paper, regarding data, was the construction of sectoral capital stock for Turkish economy. The reason is that DPT published investment series using "housing" as a sector instead of "construction". Since it is difficult to disentangle housing from other construction investments previous literature avoided sectoral TFP beyond 3 sectors (agriculture, industry and services where construction is put either in industry or services). But as we discussed in Introduction, construction is an important sector both for understanding dynamics of Turkish economy and political economy related issues in Turkey. Consequently, we tried our best to come up with a capital stock for construction sector. Unfortunately, it is not possible to build reliable capital series for 9 sectors as it is the case for GDP and employment[2]. Thus, we restrict the number of sectors to 4 (agriculture, industry, construction and services). Also, publicly available data that can be used to separate housing investment from other construction is available for the 1992-2015 period, with 3 different economic activity classifications (ISIC, NACE rev.1, and NACE rev.2). For details and conversion table that we use see Bakis and Acar (forthcoming).

Once a deprecation rate is decided, we compute initial level of capital in 1948 using equation 3 as, $K_0 = I_0/(\bar{g} + \delta)$ where $\bar{g}$ is theoretically the growth rate of capital and output in the steady state. In practice, we use the average growth rate of GDP over 10 years following year

[2] The sectors are: agriculture; mining; public utilities (electricity, water and gas); manufacturing; construction; wholesale and retail trade; financial institutions, insurance and real estate; transport, storage and communications; and community, social, personal and government services.

1948. Equation 3 is commonly used in the literature and it assumes that economy is in a steady state in 1948. For investment, we use the gross fixed capital formation (GFCF), again as does literature. Once we have an estimate for initial capital stock, we assume a 6 percent depreciation rate and add new investment in year t to the next year's capital stock to obtain aggregate stock of capital for Turkish economy.

There is another problem when one builds sectoral physical capital series. Knowing the aggregate level of capital does not help in determining how much of it goes to each sector. Following Caselli (2005), we use the non-arbitrage condition between sectors. The idea is that the marginal firm (or investment) should earn the same rate of returns in each sector. Assuming a Cobb-Douglas production function where we allow capital share to be sector dependent (below a is used for agriculture, i for industry, c for construction and s for services)

$$Y_j = A_j K_j^{\alpha_j} L_j^{1-\alpha_j}, j = a, i, c, s$$

The non-arbitrage condition can be written as (where P_i denotes prices of sector i and $P_i Y_i$ is the sectoral GDP in current prices for sector i)

$$\frac{\alpha_a P_a Y_a}{K_a} = \frac{\alpha_i P_i Y_i}{K_i} = \frac{\alpha_c P_c Y_c}{K_c} = \frac{\alpha_s P_s Y_s}{K_s} \quad \ldots (5)$$

Alternatively, these equations can be written in terms of sectoral shares of GDP (v_j) and sectoral capital as well

$$K_a = K_s \frac{\alpha_a v_a}{\alpha_s v_s}; \;\; K_i = K_s \frac{\alpha_i v_i}{\alpha_s v_s}; \; K_c = K_s \frac{\alpha_c v_i}{\alpha_s v_s} \quad \ldots (6)$$

Instead of sectoral shares of GDP in a single year (v_{jt}) we use the average sectoral shares over first 5 years ($\bar{v}_j, j = a, i, s$ over 1948-1952) to minimize the risk of measurement error, or an outlier year. Combining the above equations with the fact that the sum of the sectoral physical capital is equal to the aggregate level of capital, $K = K_a + K_i + K_c + K_s$, we can obtain initial capital levels for year 1948 once we have aggregate physical capital for Turkish economy.

iv. Employment

There are two problems regarding generation of consistent employment data that goes back to 1980s. The first one is the change in total employment because of update made to Turkish population due to the Address Based Population Registration System (ABPR hereafter, “ADNKS” in Turkish). This creates a break in employment in 2004, where only 2004 and following years are based on ABPR data. In the old series we have an employment of 21.7 million while in the updated ones we have only 19.6 million implying a difference more than 2 million employees in 2004. The second problem is changes in activity classification. Even if like GDP, many classifications (ISIC rev2, NACE rev.1 and NACE rev.2) are used it is not difficult to construct sectoral employment for 9 sectors. For both aggregate and sectoral employment we use employment figures published by TurkStat for 2004-2018 period. For earlier years we use growth rates found in TurkStat (2007) which uses old series before ABPR update.

3.3) Trends in overall productivity and basic growth accounting

Table 3.1 presents the basic data for growth accounting. The first panel shows the growth rates of aggregate GDP and the second panel shows the percentage contributions of capital, labor and aggregate total factor productivity to overall GDP growth. GDP growth is highest in the 2002-2013 period, reaching 5.7 percent. In fact, if one were to disregard the crisis (and rebound) years of 2008-10, GDP growth surpassed 7 percent in that period. The period 1990-2002 exhibits lower average GDP growth compared to the other periods.

The first panel of the Table shows that TFP growth (represented by A in the table) has been especially high in the 1980s, and in the 2003-2007 and 2011-2013 periods. The very high growth rate of TFP in the 2003-2007 period (4.0 percent) is especially noteworthy, corroborating earlier findings in Atiyas and Bakis (2014). Growth in TFP is substantially lower in 1990-2002 period, but especially in 2014-2018. TFP growth has been negative during the period of the global economic crisis. Another important observation is that the growth rate of capital stock increased substantially in the 2000s, from below 5 percent in the 1980s and 1990s, to above 6 percent in the 2000s, reaching a high of 7.2 percent per annum in 2014-2018.

Table 3.1: Basic accounting of overall GDP growth in Turkey 1981-2018 (%)

	Y	K	L	A	LP
Growth rate (%)					
1981-1989	4,7	3,8	1,1	2,7	2,3
1990-2002	3,4	4,9	1,2	1,0	1,9
2003-2013	5,7	6,3	2,6	1,9	3,2
2003-2007	*7,0*	*6,2*	*1,5*	*4,0*	5,6
2008-2010	*1,4*	*6,4*	*2,9*	*-2,7*	-1,4
2011-2013	*7,8*	*6,5*	*4,1*	*2,9*	3,8
2014-2018	4,8	7,2	2,4	0,8	2,5
Contribution (%)					
1981-1989		27,1	15,6	57,4	
1990-2002		47,0	23,6	29,4	
2003-2013		37,1	30,1	32,8	
2003-2007		*29,3*	*14,3*	*56,4*	
2008-2010		*154,1*	*137,1*	*-191,2*	
2011-2013		*27,9*	*34,8*	*37,3*	
2014-2018		49,6	32,9	17,5	

Note: Y: GDP, K: Capital, L: Labor, A: TFP, LP: Labor productivity. The second panel shows the percentage contribution K, L and A to overall growth.

The second panel of Table 3.1 shows the contribution of factor accumulation and TFP growth to overall GDP growth in Turkey. As expected, the percentage contribution of TFP growth is especially high in the 1981-1989 and 2003-2007 periods. In both periods, over one half of overall growth in GDP is accounted for by the growth of TFP. TFP growth is especially low in the 2014-2018 period. Periods with low contribution of TFP growth are also characterized by high contributions of accumulation of capital, moving above 47 percent in 1990-2002 and almost 50 percent in 2014-2018.

In that regard, a comparison of the 1980s and the 2014-2018 period is telling: Average annual growth in aggregate GDP in these two periods is very similar, 4.7 and 4.8, respectively. However, as indicated above, in the former period, which corresponds to a period of fundamental reforms, more than half of high GDP growth is accounted for by growth in productivity (57.4 percent). By contrast, in the 2014-2018 period, when the reform momentum was all but lost, the contribution of TFP growth is very low, about 18 percent on an average annual basis. As discussed in detail in Chapter 2, the period 2014-2018 also witnessed significant deterioration in both political and economic institutions.

The last column of the first panel of the table shows growth in labor productivity (LP). It is easy to observe that growth in LP mimics growth in GDP quite closely: periods of high GDP growth also exhibit relatively high growth in LP. A casual observation also suggests a high degree of correlation between growth in TFP and LP as well, except for the period 2014-2018. In this period, growth in LP is still relatively high (on average about 2.5 per annum) whereas growth in TFP is quite low, suggesting that relatively high LP growth is mainly due to increase in the capital-labor ratio rather than increase in TFP. This is consistent with high contribution of growth of capital (49.6 percent) to overall GDP growth mentioned above.

Overall, one has to submit that economic growth in the 2014-2018 period was quite respectable, but, compared to all earlier periods investigated in this chapter, was driven more strongly by capital accumulation rather than efficiency in resource use.

3.4) Trends in sectoral productivity

In this section we examine productivity trends in four sectors: Agriculture, industry, construction and services. We start with a comparison of growth in TFP in the four industries. The data is presented in Table 3.2. The first column presents the data for growth in aggregate TFP and the rest of the columns present growth in sectoral TFP.

Table 3.2: Growth in sectoral TFP

	g	g_agr	g_ind	g_con	g_ser
1981-1989	2.7	-0.9	4.5	5.2	-0.6
1990-2002	1.0	1.0	0.9	0.2	-1.6
2003-2013	1.9	1.1	3.1	4.5	-0.4
2003-2007	4.0	1.3	4.7	9.8	0.1
2008-2010	-2.7	2.3	-1.7	-6.7	-2.5
2011-2013	2.9	-0.2	5.3	7.1	0.8
2014-2018	0.8	2.2	1.6	0.5	-0.1

Note: g_X: growth in TFP sector X where X takes the following values: agr= agriculture, ind= industry, con=construction, ser= services.

One can make several observations: First, TFP growth is much higher in industry and construction relative to both agriculture and services. TFP growth in construction is very high in high growth years, but very low in the low-growth 1990s and highly negative during the crisis years. TFP growth in construction remains quite low in the 2014-2018 period. By contrast, TFP growth in industry is less volatile. The drop in the TFP of industry during the crisis years of 2008-2010 is much smaller than the drop in the TFP of the construction sector. TFP growth in industry Is also higher than that in construction in the 2014-2018 period. TFP growth in agriculture is quite low. Interestingly, it is highest in the 2014-2018 period. Finally, TFP growth in services is negative in all periods. We should note that low (or even negative) TFP growth in services is not specific to Turkey. Other studies find similar findings for OECD countries and USA (see among others Kets and Lejour, 2003; Foerster et al., 2019).

It will be interesting to examine TFP growth in individual industries in some detail. Table 3.3 presents the results for agriculture. Average annual growth in the capital stock of agriculture is of the order of 2-3 percent throughout the period. Growth in agricultural TFP is relatively high in the 2003-2007 and 2014-2018 periods (1.3 and 2.2, respectively). In both periods employment growth is negative (-3.4 and – 2.5, respectively). As in Atiyas and Bakis (2014), we conjecture that higher TFP growth in agriculture during these periods mainly reflects the decline in hidden unemployment in agriculture.[3] Given that agriculture has historically been laden with low productivity and overemployment, an increase in productivity through a reduction of hidden unemployment is a welcome development.

[3] One may note that TFP growth in agriculture during the 2003-2007 period in the current chapter (2.2 per annum) is substantially lower than that for 2002-2006 reported in Atiyas and Bakis (above 6 percent per annum). The difference is partly due to different periodization and partly due to differences in the calculated growth of capital stock (2.6 vs 0.7 in Atiyas and Bakis, 2014).

Table 3.3: Factor accumulation and TFP growth in agriculture

	Y	K	L	A
1981-1989	0,8	2,9	0,4	-0,9
1990-2002	1,8	2,4	-1,1	1,0
2003-2013	2,7	2,6	0,4	1,1
2003-2007	*1,2*	*2,6*	*-3,4*	*1,3*
2008-2010	*5,5*	*1,6*	*5,2*	*2,3*
2011-2013	*2,6*	*3,6*	*1,9*	*-0,2*
2014-2018	2,6	2,7	-2,5	2,2

Note: Y: GDP, K: Capital, L: Labor, A: TFP.

Table 3.4: Factor accumulation and TFP growth in industry

	Y	K	L	A
1981-1989	6,9	2,5	2,4	4,5
1990-2002	3,5	2,6	2,5	0,9
2003-2013	6,7	6,2	2,2	3,1
2003-2007	*8,6*	*7,5*	*2,1*	*4,7*
2008-2010	*0,7*	*4,4*	*1,4*	*-1,7*
2011-2013	*9,3*	*5,7*	*3,2*	*5,3*
2014-2018	4,8	4,4	2,7	1,6

Note: Y: GDP, K: Capital, L: Labor, A: TFP.

Table 3.4 provides the details of growth in GDP, capital, labor and TFP in industry. One important observation is the increase in the growth rate of capital stock in the 2000s relative to the earlier two periods. While the rate of increase in the capital stock was around 2.5 percent in 1981-1989 and 1990-2002, it increased to 6.2 percent in 2002-2013 and 4.4 percent in 2014-2018. Increase in capital stock was high even in the crisis (and rebound) years of 2008-2010, about 4.4 percent. Growth in labor was between 2-3 percent in most of periods. Growth in TFP industry was high in the 1981-1989 period (about 4.5 percent per annum) and surpassed 5 percent in the non—crisis years of the 2003-2013 period. It dropped to 1.6 percent in 2014-2018. As with overall GDP growth, GDP growth in industry was mostly driven by increase in capital stock in the 2014-2018 period, and the contribution of TFP was low. The drop in TFP growth in the 2014-2018 period reflects a serious slowdown in technology upgrading and should probably be interpreted as a distress signal for the future of industry in Turkey.

Table 3.5: Factor accumulation and GDP growth in construction

	Y	K	L	A
1981-1989	6,6	4,7	0,5	5,2
1990-2002	1,3	4,7	0,1	0,2
2003-2013	10,7	5,8	6,2	4,5
2003-2007	*16,0*	*5,8*	*6,3*	*9,8*
2008-2010	*-1,9*	*4,2*	*5,0*	*-6,7*
2011-2013	*14,4*	*7,3*	*7,3*	*7,1*
2014-2018	4,2	8,9	2,2	0,5

Table 3.5 provides similar data for construction. GDP growth in the construction industry has been high in 1981-1989 (about 6.6 percent), dropped to 1.3 percent in the 1990s, and reached a peak of 10.7 percent per annum in 2003-2013. In 2014-2018 it was relatively moderate, about 4.2 percent on average. The construction industry has attracted high levels of investment in all periods, with the rate of growth of capital stock close to 5 percent in the 1980s and 1990s, 5.6 percent in the 2000s and reaching a peak of 8.6 percent in the 2014-2018 period. This relatively high rate of growth in the capital stock was accompanied by relatively high TFP growth in the 1980s and non-crisis years of the 2000s. As observed above, by contrast TFP growth has been highly negative during the crisis years and very low in the 2014-2018 period. The period 2014-2018 is noteworthy in that regard, when GDP growth in the construction industry is driven by very high growth rates in capital stock but very low rates in productivity growth. Another interesting aspect of the construction industry is relatively high growth rates in labor in the 2000s, especially relative to the rest of the sectors: Construction has been an important generator of employment during the 2003-2013 period (see Chapter 5).

We report similar data for services in Table 3.6. Services is also characterized by high growth rates in capital as well as labor. Growth in capital stock was lowest in the 1980 but still high at an average of 6 percent per annum. It was much higher in the rest of the periods, reaching a peak annual average of 10 percent in the 2002-2007 period. The rate of growth in labor, although lower than that in construction in the 2000s, has also been quite high. These high rates of factor accumulation have been associated with very low or negative growth in TFP throughout the last four decades.

It is well known there is much heterogeneity in productivity and productivity growth among service industries. In their analysis of structural change in advanced countries, Jorgenson and Timmer (2011 draw attention to this heterogeneity and underline the need for better measurement as well as better understanding of drivers of technical change in service industries. In the case of Turkey as well, one needs a more detailed breakdown of services to understand the dynamics of low TFP growth in services. Nevertheless, persistent low TFP growth suggests that Turkey has not yet benefitted from the expansion of those service industries that are characterized by a higher intensive use of information and communication technologies and thereby enjoy higher productivity growth.

Table 3.6: Factor accumulation and GDP growth in services

	Y	K	L	A
1981-1989	3,9	6,0	3,7	-0,6
1990-2002	3,5	8,6	3,4	-1,6
2003-2013	5,0	9,4	3,5	-0,4
2003-2007	*5,8*	*10,2*	*3,5*	*0,1*
2008-2010	*1,6*	*8,3*	*2,1*	*-2,5*
2011-2013	*7,2*	*9,2*	*5,0*	*0,8*
2014-2018	5,2	7,4	4,2	-0,1

It is important to remember that the share of services in total GDP of Turkey has remained above 60 percent. Its share in total employment has increased from about 30 percent in 1980 to about 55 percent in 2018. It has also attracted high levels of investment throughout the period with growth rates of capital higher than those in industry. Hence services make up a significant portion of overall economic activity in Turkey. If Turkey is stuck in a middle income trap, part of the explanation probably lies in the fact that productivity growth has been so low in such an important part of the economy.

3.5) Trends in structural change

Overall productivity growth can be achieved through two main mechanisms. First, productivity growth can be achieved within individual firms through investments in better technology, employment of higher skilled labor, research and development, innovation activities etc. Second, an increase in overall productivity can be achieved by the reallocation of factors of production from low to high productivity firms. The same is true at the level of industries: Growth in aggregate productivity can be achieved by productivity growth within industries, and by reallocation of inputs from low to high productivity industries. At the level of an industry, the former captures both productivity growth within firms and reallocation between firms. At the level of industries, the latter is often called structural change. While one would expect that that structural change would make a positive contribution to productivity growth, this is not always the case. In particular, McMillan et. al. (2014) has shown that in 1990-2005, the contribution of structural change to overall growth in LP in fact has been negative in Latin America and Africa. In other words, in these regions, labor has moved from high to low productivity industries.[4]

In this section contributions we concentrate on labor productivity and decompose growth in aggregate labor productivity into two components: a component that reflects productivity growth within industries and the second reflecting the effects of reallocation of labor between industries. Specifically, we undertake the decomposition proposed by McMillan et. al. (2014):

$$\Delta P_t = \sum_i \bar{s}\Delta p_{i,t} + \sum_i \bar{p}\Delta s_{i,t}$$

Here the Δ stands for the difference between time t and t-k, *P* and p_i stand for productivity of the overall economy and of sector *i*, respectively, and s_i stands for the employment share of sector *i*.[5] Finally, the formula relies on average employment share and average productivity level of each sector where average is defined with respect to $\bar{s} = (s_{i,t-1} + s_{i,t})/2$ and $\bar{p} = (p_{i,t-1} + p_{i,t})/2$. Hence the equation decomposes labor productivity growth in period $t-1$ and t into two parts: the first part of the equation captures productivity growth within each sector, weighted by the beginning of period employment shares. The second part term is the sum of changes in employment shares of each industry, weighted by the end of period sectoral productivity levels. The second part reflects structural change.

[4] For more on the relation between sectoral productivity and changes in sectoral employment shares see Chapter 5.

[5] As mentioned above, we use the following sectors for this analysis: agriculture; mining; public utilities (electricity, water and gas); manufacturing; construction; wholesale and retail trade; financial institutions, insurance and real estate; transport, storage and communications; and community, social, personal and government services.

The results of the exercise are presented in Table 3.7. The first panel reports growth in aggregate labor productivity (column 1), and the within and between components as reflected in the equation above (where within plus between equals growth in aggregate LP). The lower panel reports the percentage contribution of the within and between components to growth in aggregate LP (where the numbers of the two components add up to 100).

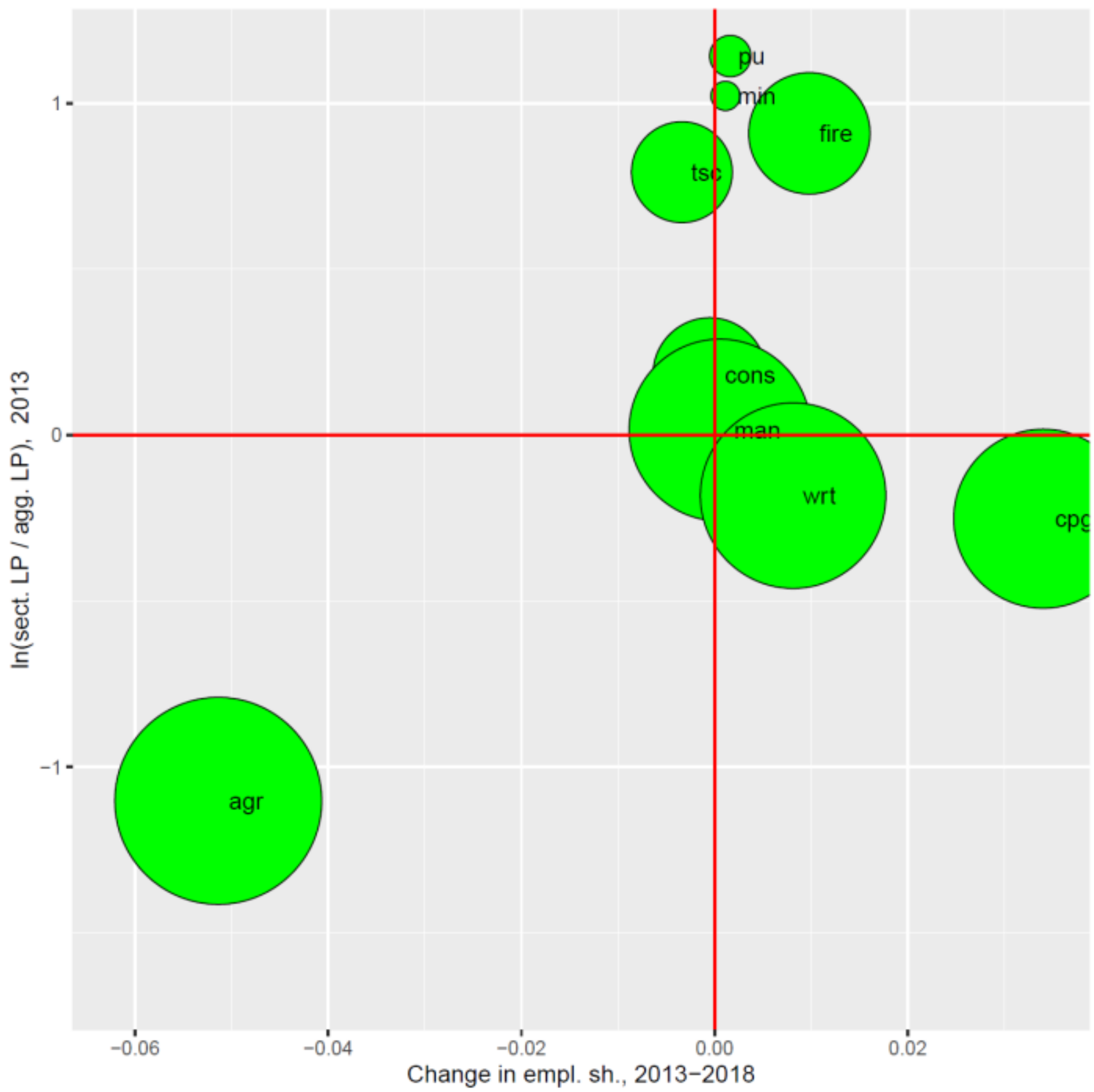
Previous studies (Rodrik, 2010; Atiyas and Bakis 2015) have shown that overall, the contribution of structural change to growth in aggregate labor productivity has been positive in Turkey. Table 3.7 confirms the earlier findings. It also shows, however, the positive contribution of structural change to aggregate growth in labor productivity has diminished in recent years. The "between" component of labor productivity growth has been above 1 percentage points in all of the post 1990 periods, reaching 1.9 percentage points in the 2003-2007 period and 1.6 percentage points in the 2003-2013 period. Importantly, the between component has been positive (about 1.4 percentage points) even during the crisis years. However, it has dropped to 0.7 percent in the 2014-2018 period. In other words, in recent years, reallocation has played a much diminished role in promoting growth in aggregate LP.

Table 3.7: Decomposing growth in labor productivity

Growth rate (%)	LP	Within	Between
1981-1989	2,3%	1,7%	0,6%
1990-2002	1,9%	0,7%	1,2%
2003-2013	3,2%	1,6%	1,6%
2003-2007	*5,6%*	*3,7%*	*1,9%*
2008-2010	*-1,4%*	*-2,8%*	*1,4%*
2011-2013	*3,8%*	*2,6%*	*1,2%*
2014-2018	2,5%	1,8%	0,7%
Contribution (%)			
1981-1989		73,4	26,6
1990-2002		39,3	60,7
2003-2013		50,7	49,3
2003-2007		*66,0*	*34,0*
2008-2010		*200,4*	*-100,4*
2011-2013		*68,6*	*31,4*
2014-2018		71,0	29,0

Figure 3.1 helps explain why this has been the case. The y-axis of the figure is the log of the ratio of sectoral to aggregate LP in 2013. This ratio is equal to zero when sectoral labor productivity is equal to aggregate labor productivity. The x-axis shows the change in sectoral employment shares between 2013-2018. The size of the circles represents the share of sectoral employment in 2013. The figure shows that between 2013-2018 a significant amount of employment growth happened in industries whose labor productivity in 2013 were lower than aggregate labor productivity, namely wholesale and retail trade (wrt) and especially community, social, personal and government services (cpg). Moreover, these are industries with high employment shares to start with.

Figure 3.1: Sectoral productivity and changes in employment share: 2013-2018



Note: agr: agriculture; min: mining; pu: public utilities (electricity, water and gas); man: manufacturing; cons: construction; wrt: wholesale and retail trade; fire: financial institutions, insurance and real estate; tsc: transport, storage and communications; cpg: community, social, personal and government services.

Figure 3.2: Evolution of LP components: within and between

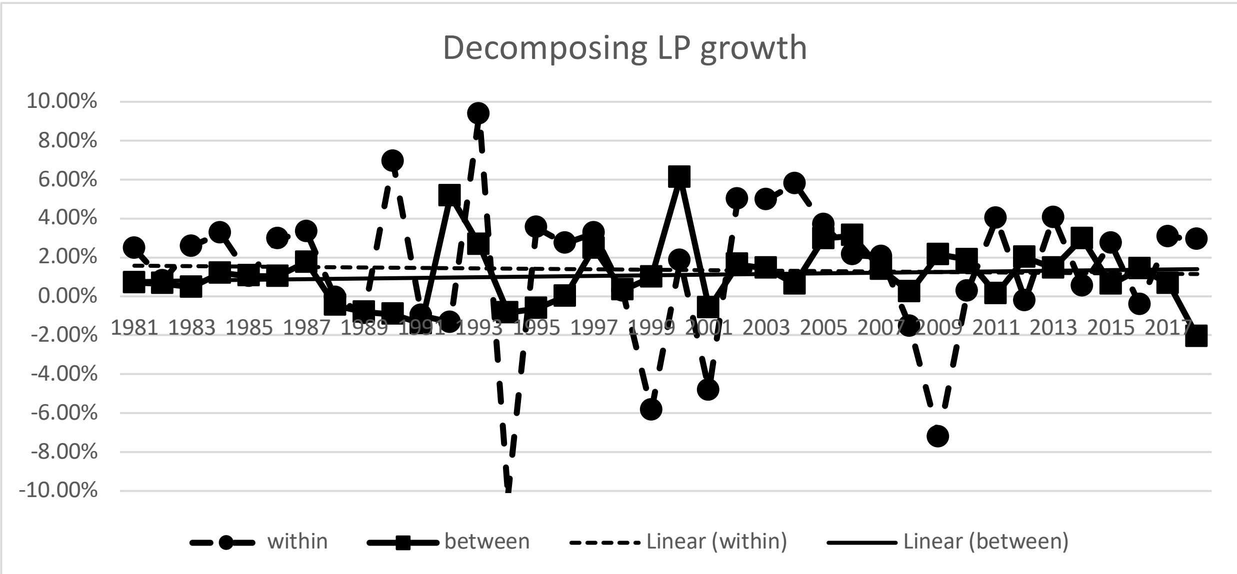
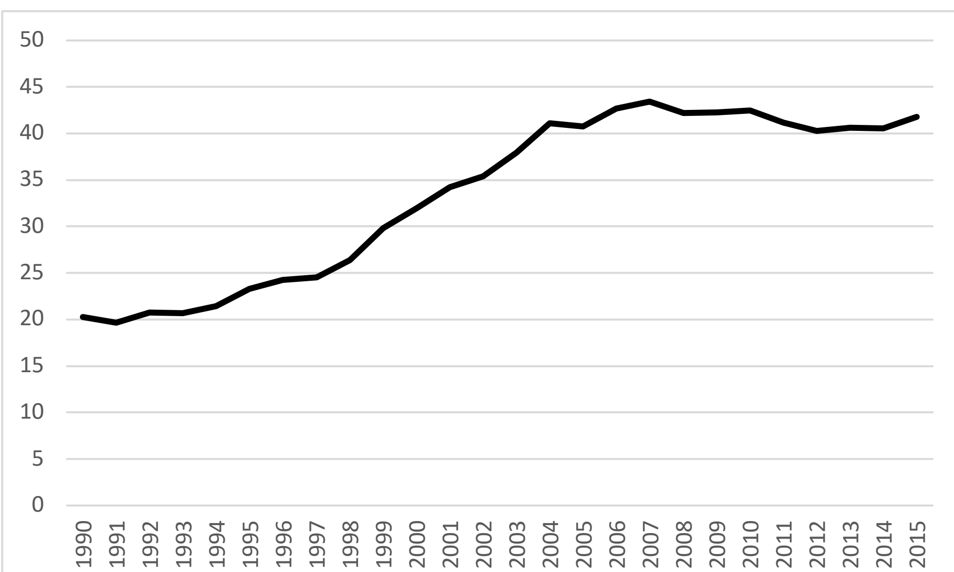


Figure 3.2 shows the evolution of between and within components over time. Even if the average growth is almost the same for each component, we see clearly that the within component is much more volatile. Since within component refers to the economic efficiency and capital deepening, the sharp falls in within component in crisis and low growth years (1994, 1999, 2001, 2009, 2016) is likely to imply a decline in economic efficiency in these particular years, since there are no strong declines in physical capital stock that could justify such drops in within component. A usual explanation for large losses in labor productivity (and within component) during economic crisis and strong increases in expansion period following recession is labor hoarding. Since adjusting labor input level in line with demand for products is costly for firms, they prefer to respond to these fluctuations by adjusting the utilization rate of their employment. In practice labor hoarding may happen through a decrease in hours worked and (partially) paid or unpaid temporary leaves during crisis. The claim is that when economic conditions are better hoarded workers (that are supposed to be qualified and experienced) provide an extra effort to meet the hike in demand which increases labor (within) productivity. To get further insight into why within component is so volatile in the Turkish economy one needs to work with firm level data and closely track firms with declining productivity. If we can find common characteristics or patterns for such firms, this could help in understanding (labor) productivity dynamics in Turkey.

3.6) Structural change and sophistication of Turkish exports

One of the consequences of structural transformation is changes in the structure of exports. One would expect that in an open economy as resources are successfully shifted to higher productivity industries, and as firms engage in technological upgrading, research and development and innovation, these changes would eventually enable firms to be competitive in international markets, and export more sophisticated products with higher technology content. In this section we make a very brief assessment of changes in the structure of Turkish exports in the last 2-3 decades. We look at two indicators. The first is the share of goods with medium and high technology content in total manufactured exports. As shown in Figure 3.3 this share increased substantially from about 20 percent in mid-1990s to about 45 in 2007. This increase was mainly due to increases in the share of medium technology products, especially in the automotive industry and domestic appliances (Albaladejo, 2006). The share of medium and high technology products remained stagnant after 2007, vacillating between 40 and 45 percent. In other words, in the last decade Turkish exports did not register any improvements in terms of technology content. One might add that the share of high-technology products in manufactured exports remained very low throughout the period, at below 3 percent.

Figure 3.3: The share of medium and high tech exports in manufacturing exports (%)

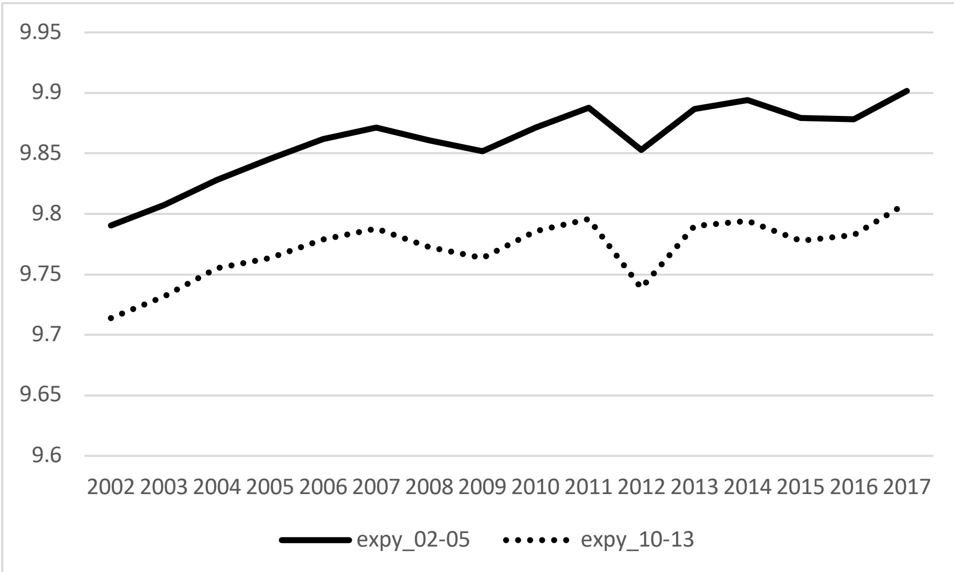


Source: World Development Indicators

The second indicator reflects the "sophistication of exports", labelled as EXPY in the literature (Hausman et. al. 2007). Essentially, EXPY is a measure of the degree to which a country's export basket resembles those of rich countries. It is calculated in the following way: For each product (at the level of 6-digit Harmonized System), the weighted average of per capita incomes of countries that export that product is calculated. This is called PRODY. Then, EXPY of a country is calculated as the export-share-weighted sum of the PRDOYs of the products it exports. EXPY or Turkey is presented in Figure 3.4. Because the EXPY may be sensitive to the years for which PRODYs are calculated two indicators have been calculated. For the first one, PRODYs are calculated as the average of 2002-2005 (beginning of period). For the second one, PRODYs are calculated as the average of 2010-2013. The figure shows the log of EXPY between 2002-2017. Even though the levels of the two indicators are different, their behavior over time are very similar. In both cases, EXPY increases relatively fast between 2002-2007, but slows down after 2007. For example, the difference in log EXPY (which approximates percentage growth) is about 7-8 percent between the years 2002-2007 but only 3-4 percent between 2008-2017.

These findings suggest a sharp contrast in the evolution of the sophistication of Turkish exports in the period 2002-2007 and 2008-2018. As emphasized above, and discussed in detail in Chapter 2, the period of 2002-2007 was a period of significant economic and political reforms, improvements in institutions and high productivity growth. It seems these developments had a clear positive effect on the degree of sophistication of Turkish exports. Similarly, in the more recent period, the slowdown in economic reforms the deterioration in both political and economic institutions, as well as the slowdown in TFP growth seems to be associated with a slowdown in the improvements of the sophistication of Turkish exports.

Figure 3.4:The sophistication of Turkish exports



Source: UN-Comtrade

3.7) Conclusion

This chapter has presented the results of a growth accounting exercise both of the aggregate economy and in agriculture, industry, construction and services. We find that while productivity growth has made a major contribution to economic growth, especially until the global recession thanks to institutional improvements, its contribution to growth has diminished substantially in the 2014-2018 period. Growth in the latter period has been driven primarily by factor accumulation, especially accumulation of capital. The slowdown in productivity gains constitutes certainly one of the main challenges that Turkish economy faces in the future.

On the other hand this finding suggests that various programs initiated by the government to encourage the banking system to provide credit to the private sector, and the various subsidy mechanisms designed as instruments of industrial policy in order to get out of recession since 2018 have not been able, at least so far, to generate productivity increases. Our results show that these policies have most likely helped the continuation of economic growth by promoting capital investment. A corollary is that the efficiency of recent investment initiatives may be questionable.[6]

Growth accounting at the level of individual sectors reveals that TFP growth in construction has been high but also highly volatile, contracting much faster than that in industry during periods of economic slowdown and contraction. TFP growth in construction has been especially low in 2014-18, but relative to previous periods and relative to industry. By contrast, the growth of the capital stock in construction has been much faster in construction relative to industry in this period.

Services are an important part of the Turkish economy, both in terms of share in GDP and employment. The analysis presented above suggests that productivity growth in services has remained poor throughout the period. This seems to present an important barrier to the growth of productivity in the future.

Our analysis of the role of reallocation of labor in aggregate LP growth suggests that the contribution of reallocation to aggregate productivity has also diminished in the 2014-2018 period. It seems that the main reason for this is that employment has increased particularly in industries with lower-than-average productivity.

Overall, our analysis suggests that Turkey has missed an important opportunity to upgrade its productive capacity during the periods of high economic growth. In particular, after successfully moving from industries with relatively low technology into those with medium technology since the 1990s, transformation has not progressed any further. Interestingly, Turkey's experience especially in the earlier part of the 2000s suggests a blueprint about how to move ahead. However, the overall orientation of economic policy and performance in recent years does not provide much hope that such a blueprint will be followed.

[6] The recent contraction in private investments and the parallel slowdown in economic growth may be signaling that this way of sustaining growth may have reached its limits. See Sonmez (2019) and Bakis and Mutluay (2019).

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APPENDIX

Robustness checks for TFP analysis

Since there is no consensus on the method one needs to use to estimate initial capital stock, or sectoral depreciation rate, or factor shares, we want to test whether our results are sensitive to small changes in one or both of them.

Table 3.8 shows the sensitivity of aggregate and sectoral TFP growth rates to assumptions about capital share and depreciation rate. We compare our baseline specification (the first row in the table) with two others (second and third rows). It appears that capital share has more effect on results compared to depreciation rate. Since we are modifying these parameters for agriculture and construction these two sectors are the only affected ones. When capital share goes from 0.55 to 0.33 for agriculture, the TFP growth increases considerably. For instance, in the 2014-2018 period the average TFP growth goes from 2.2 percent to 3.4 percent. This is the highest change but in all other periods we see positive effects. The intuition is that for a given GDP and capital growth a lower capital elasticity makes room for a larger TFP contribution. When capital share goes from 0.21 to 0.33 for construction, the TFP growth is reduces considerably. For instance, in the 2014-2018 period the average TFP growth goes from 0.5 percent to minus 0.3 percent. This is the highest change but in all other periods we see a similar negative effect. Again, the intuition is that for a given GDP and capital growth a higher capital elasticity makes room for a lower TFP contribution. The effect of the change in deprecation rate is relatively unimportant.

Table 3.9 shows different approaches for estimating capital stock and the resulting aggregate and sectoral TFP growth rates. As we see in that table, despite some minor differences, they do not change the story of productivity for Turkish economy. Our preferred approach ("aggregate ss") consists of estimating initial capital by combining the assumption of steady state and perpetual inventory equation. Then, to find how much of the K is distributed among different sector we follow Caselli (2005) and use non-arbitrage condition between sectors. A second alternative would be applying the steady state assumption of steady state and perpetual inventory equation at sectoral level as it each sector is a separate economy. A third one is assuming $K_0 = kY_0$ where k is the constant. Feenstra et al. (2015) compares this approach to the steady-state one and claim this one being superior: "*we argue that this method actually leads to superior results, in particular in early years of the sample and in transition economies, where the data is available for a limited period of time and where the early years were particularly turbulent* (p.12 in Online Appendix)". This approach goes back to Harrod-Domar growth model where we GDP is proportional to capital stock. In economic planning literature k is called ICOR (incremental capital output ratio), and has been frequently in 60s and 70s (see for instance Sato, 1971). Using the low of motion for capital we can rewrite the ICOR equation as

$$k = \frac{\Delta K}{\Delta Y} = \frac{I - \delta K}{\Delta Y}$$

So, the ratio of net investment to change in GDP is constant. Since the above function depends on capital and the knowledge of depreciation rate it is not easy to apply. Instead of using the above one, we followed a report made for government of India (GoI, 2012) and for Turkish economy we compute the ratio of gross investment to GDP change ($I/\Delta Y$) for 1949-1979 period and took the median value as ICOR. Once we know k it is easy to calculate initial capital stock. First, we compute initial capital stock for 1948 (ICOR-1948). This is OK for aggregate economy. But, since data reliability is of concern for years for sectoral investment data before year 1980, we compute initial capital stock in 1980 and check whether there are significant changes in TFP growth (ICOR-1980). As can be seen from Table 3.9, despite some minor differences all approaches yield similar results. The only visible differences are when we compute initial capital in 1980 using ICOR approach. While the level of capital stock generated in the three first approaches is very close to each other in 1980, the fourth approach (ICOR-1980) generates relatively a higher stock of capital, except agriculture. As a result, given investment series, the growth rate of capital stays relatively low. Accordingly, given GDP and employment growth numbers, this increases the growth rate of TFP, except agriculture. These differences tend to vanish as time passes, naturally, as the effect of initial capital weakens as time passes. This is why we prefer to estimate initial capital as early as possible so that any error in measurement is largely compensated by exponential decay.

Table 3.8. Sensitivity of TFP growth to capital share and depreciation rate

diff alpha, diff depr

	alpha = 0,55		depr = 0,04			alpha = 0,33		depr = 0,06			alpha = 0,21		depr = 0,08			alpha = 0,33		depr = 0,06	
AGR	Y	K	L	A	IND	Y	K	L	A	CON	Y	K	L	A	SER	Y	K	L	A
1981-1989	0,8	2,9	0,4	-0,9	1981-1989	6,9	2,5	2,4	4,5	1981-1989	6,6	4,7	0,5	5,2	1981-1989	3,9	6,0	3,7	-0,6
1990-2002	1,8	2,4	-1,1	1,0	1990-2002	3,5	2,6	2,5	0,9	1990-2002	1,3	4,7	0,1	0,2	1990-2002	3,5	8,6	3,4	-1,6
2003-2013	2,7	2,6	0,4	1,1	2003-2013	6,7	6,2	2,2	3,1	2003-2013	10,7	5,8	6,2	4,5	2003-2013	5,0	9,4	3,5	-0,4
2003-2007	*1,2*	*2,6*	*-3,4*	*1,3*	*2003-2007*	*8,6*	*7,5*	*2,1*	*4,7*	*2003-2007*	*16,0*	*5,8*	*6,3*	*9,8*	*2003-2007*	*5,8*	*10,2*	*3,5*	*0,1*
2008-2010	*5,5*	*1,6*	*5,2*	*2,3*	*2008-2010*	*0,7*	*4,4*	*1,4*	*-1,7*	*2008-2010*	*-1,9*	*4,2*	*5,0*	*-6,7*	*2008-2010*	*1,6*	*8,3*	*2,1*	*-2,5*
2011-2013	*2,6*	*3,6*	*1,9*	*-0,2*	*2011-2013*	*9,3*	*5,7*	*3,2*	*5,3*	*2011-2013*	*14,4*	*7,3*	*7,3*	*7,1*	*2011-2013*	*7,2*	*9,2*	*5,0*	*0,8*
2014-2018	2,6	2,7	-2,5	2,2	2014-2018	4,8	4,4	2,7	1,6	2014-2018	4,2	8,9	2,2	0,5	2014-2018	5,2	7,4	4,2	-0,1

same alpha, diff depr

	alpha = 0,33		depr = 0,04			alpha = 0,33		depr = 0,06			alpha = 0,33		depr = 0,08			alpha = 0,33		depr = 0,06	
AGR	Y	K	L	A	IND	Y	K	L	A	CON	Y	K	L	A	SER	Y	K	L	A
1981-1989	0,8	3,0	0,4	-0,4	1981-1989	6,9	2,5	2,4	4,5	1981-1989	6,6	4,7	0,5	4,6	1981-1989	3,9	5,9	3,7	-0,6
1990-2002	1,8	2,4	-1,1	1,7	1990-2002	3,5	2,6	2,5	0,9	1990-2002	1,3	4,7	0,1	-0,4	1990-2002	3,5	8,5	3,4	-1,6
2003-2013	2,7	2,6	0,4	1,6	2003-2013	6,7	6,2	2,2	3,1	2003-2013	10,7	5,8	6,2	4,6	2003-2013	5,0	9,4	3,5	-0,4
2003-2007	*1,2*	*2,7*	*-3,4*	*2,6*	*2003-2007*	*8,6*	*7,5*	*2,1*	*4,7*	*2003-2007*	*16,0*	*5,8*	*6,3*	*9,9*	*2003-2007*	*5,8*	*10,1*	*3,5*	*0,1*
2008-2010	*5,5*	*1,6*	*5,2*	*1,5*	*2008-2010*	*0,7*	*4,4*	*1,4*	*-1,7*	*2008-2010*	*-1,9*	*4,2*	*5,0*	*-6,6*	*2008-2010*	*1,6*	*8,3*	*2,1*	*-2,5*
2011-2013	*2,6*	*3,6*	*1,9*	*0,1*	*2011-2013*	*9,3*	*5,7*	*3,2*	*5,3*	*2011-2013*	*14,4*	*7,3*	*7,3*	*7,1*	*2011-2013*	*7,2*	*9,2*	*5,0*	*0,8*
2014-2018	2,6	2,7	-2,5	3,4	2014-2018	4,8	4,4	2,7	1,6	2014-2018	4,2	8,9	2,2	-0,3	2014-2018	5,2	7,4	4,2	-0,1

same alpha, same depr

	alpha = 0,33		depr = 0,06			alpha = 0,33		depr = 0,06			alpha = 0,33		depr = 0,06			alpha = 0,33		depr = 0,06	
AGR	Y	K	L	A	IND	Y	K	L	A	CON	Y	K	L	A	SER	Y	K	L	A
1981-1989	0,8	2,7	0,4	-0,3	1981-1989	6,9	2,5	2,4	4,5	1981-1989	6,6	4,8	0,5	4,6	1981-1989	3,9	5,9	3,7	-0,6
1990-2002	1,8	2,2	-1,1	1,8	1990-2002	3,5	2,6	2,5	0,9	1990-2002	1,3	4,9	0,1	-0,4	1990-2002	3,5	8,5	3,4	-1,6
2003-2013	2,7	2,6	0,4	1,6	2003-2013	6,7	6,2	2,2	3,1	2003-2013	10,7	5,6	6,2	4,7	2003-2013	5,0	9,4	3,5	-0,4
2003-2007	*1,2*	*2,7*	*-3,4*	*2,5*	*2003-2007*	*8,6*	*7,5*	*2,1*	*4,7*	*2003-2007*	*16,0*	*5,5*	*6,3*	*10,0*	*2003-2007*	*5,8*	*10,1*	*3,5*	*0,1*
2008-2010	*5,5*	*1,3*	*5,2*	*1,6*	*2008-2010*	*0,7*	*4,4*	*1,4*	*-1,7*	*2008-2010*	*-1,9*	*4,3*	*5,0*	*-6,7*	*2008-2010*	*1,6*	*8,3*	*2,1*	*-2,5*
2011-2013	*2,6*	*3,9*	*1,9*	*0,0*	*2011-2013*	*9,3*	*5,7*	*3,2*	*5,3*	*2011-2013*	*14,4*	*6,9*	*7,3*	*7,2*	*2011-2013*	*7,2*	*9,2*	*5,0*	*0,8*
2014-2018	2,6	2,8	-2,5	3,4	2014-2018	4,8	4,4	2,7	1,6	2014-2018	4,2	8,6	2,2	-0,2	2014-2018	5,2	7,4	4,2	-0,1

Table 3.9. The effect of different approaches to estimate initial capital stock

Aggregate ss	g	g_agr	g_ind	g_con	g_ser
1981-1989	2,7	-0,9	4,5	5,2	-0,6
1990-2002	1,0	1,0	0,9	0,2	-1,6
2003-2013	1,9	1,1	3,1	4,5	-0,4
2003-2007	4,0	1,3	4,7	9,8	0,1
2008-2010	-2,7	2,3	-1,7	-6,7	-2,5
2011-2013	2,9	-0,2	5,3	7,1	0,8
2014-2018	0,8	2,2	1,6	0,5	-0,1

Sectoral ss	g	g_agr	g_ind	g_con	g_ser
1981-1989	2,7	-1,3	4,3	5,3	-0,5
1990-2002	1,0	0,8	1,0	0,0	-1,5
2003-2013	1,9	1,2	3,2	4,7	-0,3
2003-2007	4,0	1,5	5,1	10,2	0,2
2008-2010	-2,7	2,1	-2,1	-7,2	-2,5
2011-2013	2,9	0,0	5,3	7,5	0,9
2014-2018	0,8	2,2	1,6	0,4	-0,4

ICOR-1948	g	g_agr	g_ind	g_con	g_ser
1981-1989	2,7	-1,1	4,5	5,2	-0,5
1990-2002	1,0	0,9	0,9	0,2	-1,6
2003-2013	1,9	1,1	3,1	4,5	-0,4
2003-2007	4,0	1,2	4,7	9,8	0,1
2008-2010	-2,7	2,2	-1,7	-6,7	-2,5
2011-2013	2,9	-0,3	5,3	7,1	0,8
2014-2018	0,8	2,2	1,6	0,5	-0,1

ICOR - 1980	g	g_agr	g_ind	g_con	g_ser
1981-1989	3,4	-3,7	4,7	5,1	0,7
1990-2002	1,3	0,1	1,0	0,2	-1,1
2003-2013	2,0	0,8	3,2	4,5	-0,4
2003-2007	4,1	0,8	4,8	9,8	0,2
2008-2010	-2,6	2,0	-1,7	-6,7	-2,5
2011-2013	3,0	-0,5	5,3	7,1	0,8
2014-2018	0,9	2,0	1,6	0,5	-0,1