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Productivity, Demographics, and Growth in Turkey: 2004-12[*]

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Abstract

Among all the OECD countries, Turkey had the second highest average annual GDP growth (measured in constant local currency) and the fifth highest average annual growth of purchasing power parity (PPP)-adjusted per capita income between 2004 and 2012. We study the sources of this high growth era, comparing Turkey with other OECD countries and breaking down GDP per capita into three components: labor productivity, the ratio of employment to the working-age population, and the ratio of the working-age population to the total population. Our findings suggest a productivity-based growth era in Turkey before the global crisis and an employment-based one in the post-crisis period. We then provide a detailed analysis of contributing factors to notable aspects of this economic expansion: the role of capital deepening and higher total factor productivity (TFP) in aggregate output per worker growth; and the rise in female employment, especially in the service sector.

JEL codes: J10, O11, O57

Keywords: Demographics, growth, productivity, Turkey

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1. Introduction

There are many aspects of long-run economic growth and development that are worth studying. The relationship between demographic change and economic development, for example, is one such aspect, one that has been marked by a degree of controversy. Economists, demographers, and social scientists have debated the effects of population size (and increase) on economic growth, i.e., whether a rising population restricts, promotes, or is independent of economic growth.[1] In recent years, the possible effects of demography on the global economy have been attracting much more attention due to changes in the age structure of the global population and the overwhelming concern with aging populations throughout the advanced countries (Appendix A.1).

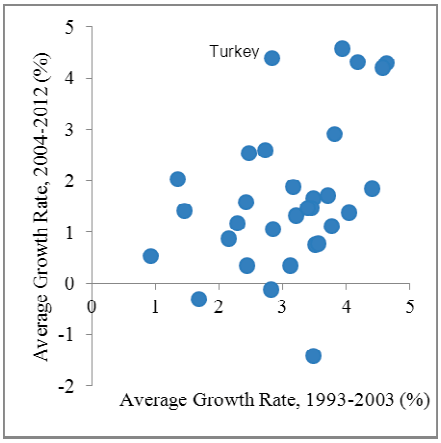
This paper focuses on the Turkish experience in the last decade. Turkey is an interesting case within the OECD, since she is one of the poorest members of the group when measured by PPP-adjusted per capita income. In fact, Turkey had the lowest (after Mexico) PPP-adjusted per capita income within the OECD as of 2012. In addition, Turkey had the worst employment to working-age population ratio (45% in 2012) among all the OECD members. Similarly, labor-force participation was only 50% in 2012; perhaps more dramatically, the female labor-force participation rate was just 29.5% in the same year. However, despite those dreary statistics, Turkey has been experiencing a remarkable transformation over the last decade as its GDP and per capita income have surged ahead. Figure 1 illustrates this phenomenon with the latest data available from the World Development Indicators Database for all of the OECD countries, starting with 1993.

Panel (a) in Figure 1 shows annual average growth rates of GDP (measured in constant local currency) for all 34 OECD member over the period 2004-12 against their counterparts in the 1993-2003 period. Turkey's GDP grew at an annual average rate of 2.83% in the 1993-2003 period, placing it in 23rd position within the OECD. On the other hand, Turkey recorded the second highest average annual growth rate of GDP in the OECD between 2004 and 2012, 4.39% (Israel was in first place, with 4.58%). Greece, Italy, and Portugal turned in the worst performances in the OECD during this time. Turkey's economic dynamism was all the more remarkable for occurring during and after the global crisis. In the period 2009-12, when most of the OECD countries were growing at a less than 2% clip, Turkey was racing ahead to claim the highest average annual growth rate of GDP in the group: more than 6.5%.

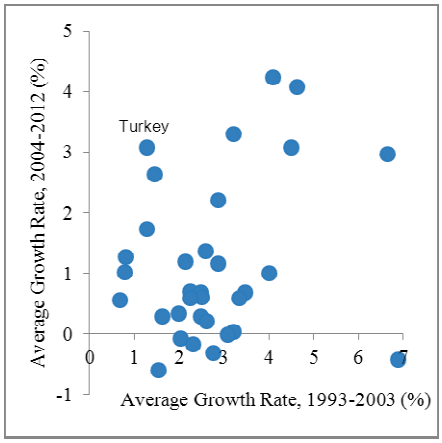
[1] It is beyond the scope of this study to examine different arguments. See Bloom and Williamson (1998) and Bloom et al. (2003) for general discussions of this issue.

Figure 1. Growth rates in the OECD

(a): GDP (in constant local currency) growth rates



(b): GDP per capita (PPP-adjusted) growth rates



Source: World Development Indicators Database (online access: May 9, 2014).

Panel (b) in Figure 1 shows annual average growth rates of GDP per capita (PPP-adjusted) in all 34 OECD members over the period 2004-12 against the same values in the 1993-2003 period. Turkey's GDP per capita expanded at an annual average rate of 1.29% in the 1993-2003 period, putting it in 30th place. On the other hand, Turkey rose to fifth place (after Slovakia, Poland, Chile, and Korea) during 2004-12, with a 3.07% average growth rate.

The objective of this study is to assess the roles of different factors (i.e., productivity, employment, and demographics) on per capita income growth in Turkey during 2004-12 in comparison with other OECD countries. Rather than trying to cover all relevant topics under the broad aegis of economic growth, we concentrate on the effects of productivity and certain changes in the labor market and national demographics on per capita income growth. We break down GDP per capita into three components: labor productivity, the ratio of employment to the working-age population, and the ratio of the working-age population to the total population. This decomposition is useful for distinguishing the overall population from the working-age population and provides insights into how shifts in the age structure of a population (in addition to improvements in labor productivity) impact economic growth.

For 2004-12, we find that of the positive movement in per capita income, output per worker accounted for 45.5%; a rise in the employment-to-working-

age population ratio constituted 39.0%; and an uptick in the ratio of the working-age population to the total population explained the remaining 15.5%. Likewise, in 2004-09, our calculations show that output per worker was the most important of the components. On the other hand, a jump in the employment-to-working-age population ratio contributed to around two-thirds of the growth in per capita output during 2009-12. In other words, our findings indicate a productivity-based growth era before the global crisis and an employment-based one in the post-crisis period.

We then provide further details to discuss our findings. Specifically, we focus on the two areas of Turkish changes in productivity and demographics. First, we examine the drivers of per capita economic growth, identifying them as capital, labor, education, and TFP. TFP growth is measured as the difference between the growth rate of output and the share-weighted growth rate of inputs. Based on the latest data from various sources, we show the quantitative importance of capital deepening and TFP growth in bringing about Turkey's economic advance during 2004-10. Second, we touch upon the issue of female employment in Turkey. In recent years, there has been greater female participation in the Turkish labor force. This matters, since major boosts in national income may occur with women entering the workforce. Interestingly, female labor-force participation in Turkey is still very low in comparison to other OECD countries (around 30% as of 2012). Indeed, the participation rate has shown a downward trend over the last 50 years.[2] We observe an emerging literature in recent years seeking to understand the link between the changes in the sectoral composition of economic activity and the variations in female participation in the labor force (Buera et al., 2013; Rendall, 2014 and the references therein). We present a decomposition exercise and note that female employment in Turkey has been particularly concentrated in the service sector.

Our paper is most closely related to the literature on the economic history of Turkey. Of special interest are highly detailed studies of the country's historical growth experience. For example, Altuğ et al. (2008) examine the determinants of long-term economic growth for Turkey over the 1880-2005 period, conducting a growth-accounting exercise across broad historical periods and policy regimes. Adamopoulos and Akyol (2009) argue that the divergence in sectoral productivity and tax policies, between Turkey on the one hand and the US and Southern Europe on the other, can account quantitatively for most of Turkey's relative underperformance between 1960 and 2003.

[2] An investigation of the reasons behind the historically low female labor-force participation in Turkey is beyond the scope of this study. See, e.g., Tunalı and Başlevent (2006); World Bank (2009).

Çiçek and Elgin (2011) use growth accounting and a dynamic general equilibrium model to profile the growth performance of Turkey between 1968 and 2004. İmrohoroğlu et al. (2014) suggest that if Turkey had managed to emulate Spanish agricultural productivity growth from 1968 to 2005, its growth in aggregate GDP per capita would have been much higher. Adamopoulos and Akyol (2009) and İmrohoroğlu et al. (2014) employ multi-sector models of sectoral change to assess the impact of inter-sectoral labor reallocation on aggregate productivity. In an econometric analysis of the role of education in economic growth, İnal and Akçabelen (2013) study the period of 1960-2009 and outline the key role played by human capital and technology transfer in determining output per worker in Turkey. Our paper complements these studies by exploring the recent growth performance of Turkey.[3] Moreover, we provide a comparison with other OECD countries during 2004-12.

In addition, our study builds on other studies investigating how macroeconomic aggregates are affected by demographic developments, such as the relationship between population age structure and labor supply, saving rates over the life cycle, or housing demand. A case in point is the research done by Ceritoğlu and Eren (2013) on the potential impact of demographic changes on labor-force participation rates in Turkey. They argue that, assuming that a change in the structure of the population will be accompanied by rises in both labor-force participation and the number of college graduates, the household saving ratio should increase by 7.6 percentage points between 2010 and 2050. Arslan et al. (2014) investigate the effects of age-structure dynamics on housing demand in Turkey, stating it may climb at a pace of around 1.5% annually on average from 2009 to 2050 (with more than two-thirds of this increase to be contributed by population growth and the rest by the changes in the age structure of the population).

The rest of the paper is organized as follows: Section 2 delivers a brief account of the Turkish experience of economic growth and demographic change. Section 3 conducts a decomposition of GDP per capita growth in Turkey and renders a comparison with other OECD countries during 2004-12. Section 4 enriches the findings with details on productivity gains and sets up an accounting framework to evaluate the contributions of various factors to the changes in output per worker. Section 5 presents a link between demographics and economic activity in Turkey, with a focus on the increasing female employment rate and its intensity in the service sector. Section 6 is the conclusion. Additional tables and figures are provided in Appendix A.

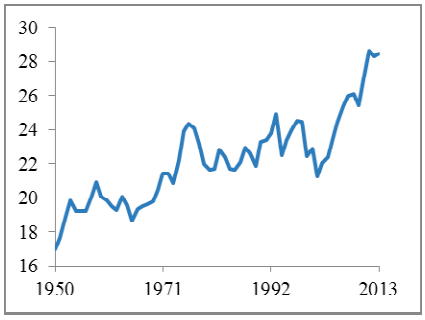
[3] For some other related studies, see Saygılı and Cihan (2008); Ismihan and Metin-Ozcan (2009); Gürsel (2011); Atiyas and Bakış (2013); Aysan et al. (2013); Üngör (2013) and the references therein.

2. Some Facts

Panel (a) in Figure 2 shows GDP per capita in Turkey relative to the US during 1950-2013.[4] The period of economic growth that began after the end of World War II reached its climax in 1976. Economic growth was volatile, and macroeconomic instability became a distinctive characteristic of the post-1980 period. GDP per capita in Turkey rose from about 22% of the American level in 1980 to about 25% in 1993. In the vulnerable economic environment of the 1990s, three major economic crises occurred, and Turkish GDP per capita shrank to 21% of the US level in 2001. However, the 2001 crisis paved the way for the introduction of structural and institutional reforms. As a result, GDP per capita relative to the US reached more than 28% in 2012.

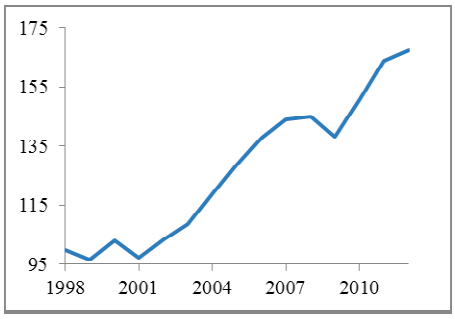
Figure 2. Growth experience of Turkey

(a): GDP per capita relative to the US (%), 1950-2013



Source: The Conference Board Total Economy Database.

(b): Real GDP in Turkey (1998=100), 1998-2012



Source: TurkStat.

Panel (b) in Figure 2 displays the time-path of GDP (at 1998 prices) during 1998-2012, where the value for 1998 is normalized to 100. The 2001 crisis resulted in a substantial output loss and a 5.7% contraction in real GDP. The Turkish economy climbed out of this hole, expanding at an average annual rate of 6.9% between 2002 and 2007. Two banner years were 2004 and 2005 (thanks in part to the global environment), when real growth hit 9.4% and

[4] Data are from the Conference Board Total Economy Database (January 2014). The level estimates are expressed in 1990 US dollars and converted at PPP to adjust for differences in relative price levels between countries. See Üngör (2013) for a recent detailed comparative study o the convergence experience of Turkey.

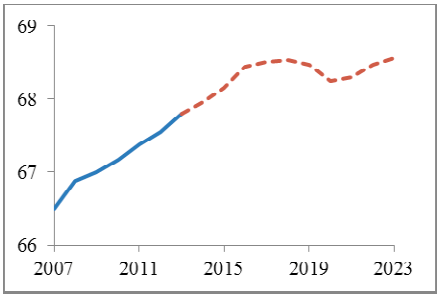
8.4%, respectively. Then, it fell to 6.9% in 2006 and 4.7% in 2007. With the advent of the global crisis, Turkish real GDP grew by a meager 0.7% in 2008, and actually contracted by 4.8% in 2009. But the following year, the Turkish economy was back on track, recording real growth of 9.2%, then 8.8% in 2011. In 2012, however, Turkey's rate of economic growth slowed to 2.2%.

Parallel to these growth rates have been demographic changes in Turkey. The panels in Figure 3 show the ratio of working-age people (15-64) to total population and the *dependency ratio* (defined as the numbers of under-15s and over-65s in the population as a proportion of those aged 15-64) for Turkey during 2007-23.[5]

The size of the working-age population not only grew in absolute terms, but also in relative terms. According to Panel (a), the ratio of the working-age population to the total population went from 66.5% in 2007 to 67.6% in 2012. The projections suggest that there will be further increases, pushing this ratio to 68.6% by 2023. The dependency ratio, calculated as the young and the elderly population divided by the working-age population, reflects how many people each working-age person has to support. Panel (b) presents this ratio as decreasing from 50.4% in 2007 to 48.0% in 2012. The projections suggest that the dependency ratio will be 45.8% in 2023.

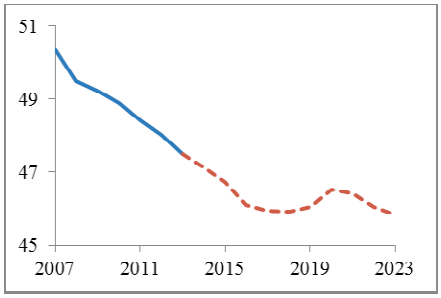
Figure 3. Demographics in Turkey, 2007-23

(a): Working-age to total population (%)



Source: TurkStat.

(b): Dependency ratio (%)



Source: TurkStat.

[5] Data for 2007-12 are based on the Address-Based Population Registration System (ABPRS), which was established in 2007, and data for 2013-23 are from the projections of TurkStat. One of the purposes of establishing the ABPRS was to establish a National Address Database (NAD) that would cover all the addresses within the boundaries of the country.

Demographic transition offers growth opportunities to countries:[6] *The first demographic dividend*, which we focus on in this paper, refers to effects arising from the higher share of working-age population within the total. The growth rate per working-age population is important from the viewpoint of the supply capacity of any economy. *The second demographic dividend*, on the other hand, refers to the permanent effects on growth. As the share of the working-age population increases (and the shares of the young and old dependents decrease), total saving in the economy may go up, which may, in turn, foster faster physical and human capital accumulation. These factors are likely to boost productive capacity in the long run (Bloom et al., 1999).

3. A GDP Decomposition

3.1. Framework

We decompose GDP per capita *(Y / P)* at time *t* into three components: labor productivity *(Y / L)*, the ratio of employment to the working-age population *(L / WP)*, and the ratio of the working-age population to the total population *(WP / P)*.[7]

$$(Y / P)_t = (Y / L)_t \; x \; (L/WP)_t \; x \; (WP/P)_t \tag{1}$$

Here, *Y* is real GDP, *P* is total population, *L* is the employed population, and *WP* denotes the working-age population. Thus, real GDP per capita can be expressed as the product of real GDP per worker (or labor productivity), employment-to-working-age population, and the ratio of working-age population to total population. We take logarithms and decompose the average annual growth rate of output per worker over a number of years, *z*, into

$$\begin{aligned} &\frac{\log\left[(Y / P)_{t+z}\right] - \log\left[(Y / P)_t\right]}{z} = \\ &\frac{\log\left[(Y / L)_{t+z}\right] - \log\left[(Y / L)_t\right]}{z} + \frac{\log\left[(L / WP)_{t+z}\right] - \log\left[(L / WP)_t\right]}{z} \\ &+ \frac{\log\left[(WP / P)_{t+z}\right] - \log\left[(WP / P)_t\right]}{z} \end{aligned} \tag{2}$$

[6] In this paper, we do not discuss the underlying factors and dynamics of demographic transition. See Lee (2003); Galor (2012) and the references therein for such issues.

[7] See, e.g., Blanchard (2004); Bloom et al. (2010); Marattin and Salotti (2011) for similar decompositions.

This formulation lets us understand the magnitude of each contribution to per capita income growth, taking the change in income per capita and splitting it into changes in output per worker (the first term on the right-hand side), changes in the ratio of employment to the working-age population (the second term on the right-hand side), and changes in the demographic ratio (the last term on the right-hand side). The last term corresponds to the first demographic dividend referred to in Section 2. In cases where growth is partly accounted for by changes in the population structure, it suggests that the country is benefiting from a demographic dividend, as its share of the working-age population within the total population is widening, i.e., fewer dependents per working-age adult. Thanks to this decomposition, we are able to measure this effect directly. This framework informs our discussions throughout the paper.

3.2 Results for Turkey

We plug the Turkish data into the accounting exercise presented in Equation (2). Our sample period is 2004-12, which incorporates recent revisions in the national accounts. Of most interest to us are the labor-market and population statistics, whose new series began in 2004 in the Turkish Statistical Institute (TurkStat) publications.[8] In addition, this period was a (relatively) high growth one for Turkey, as shown in Figure 1. GDP (at 1998 prices) data are from TurkStat. Data for population and employment are from the "Labor-Force Status by Non-Institutional Population, Years, and Sex" table of TurkStat.[9] Table 1 shows the results.[10]

During 2004-07, per capita income grew at 5.19% per year and output per worker increased 4.61% per year. In other words, the expansion in output per worker made up more than 88% of the increase in per capita income between 2004 and 2007. Additional modest contributions came from rising participation rates and an enlargement in the working-age share of the total population. Similarly, declines in labor productivity are primarily responsible for the contraction of income per capita during the global recession (in the 2007-09 period). After 2009, the role of labor productivity diminished. The key factor in

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[8] The new series of household labor-force surveys began in 2004. At the same time, a new questionnaire covering all variables requested by Eurostat has been used since 2004. In Appendix A.2, we repeat our exercise for the 1988-2003 period.

[9] We use a non-institutional population and a non-institutional working-age population. The non-institutional population comprises all the population excluding the residents of dormitories of universities, orphanages, rest homes for elderly persons, special hospitals, prisons, and military barracks, etc.; and the non-institutional working-age population indicates the population 15 years of age and over within the non-institutional population.

[10] In Appendix A.3, we extend our analysis with the data for average annual hours actually worked.

the speed-up of additions to per capita income was the observed run-up in the employment-to-working-age population ratio during 2009-2012, to the tune of 64%.

Table 1. Decomposing GDP per capita growth in Turkey (average annual changes, %)

		Contribution to output per capita of		
Period	*Y/P*	*Y/L*	*L/WP*	*WP/P*
2004-05	6.80	5.88	0.49	0.43
2005-06	5.43	4.91	0.09	0.43
2006-07	3.34	3.03	-0.12	0.43
2007-08	-0.53	-1.52	0.63	0.36
2008-09	-6.11	-5.34	-1.39	0.62
2009-10	7.63	2.76	4.37	0.51
2010-11	6.97	1.91	4.51	0.54
2011-12	0.53	-0.69	0.82	0.41
2004-07	**5.19**	**4.61**	**0.15**	**0.43**
2007-09	**-3.32**	**-3.43**	**-0.38**	**0.49**
2009-12	**5.05**	**1.33**	**3.23**	**0.49**
2004-12	**3.01**	**1.37**	**1.17**	**0.47**

Source: TurkStat, Authors' calculations.

In Turkey, job creation and the enhancement of labor and employment policies have held center stage since 2008 (World Bank, 2013). Indeed, certain pro-employment incentives may be responsible for the jump in the employment-to-population ratio in recent years. For example, OECD-ILO (2011) reports that the Turkish government's pro-business measures (such as a general reduction in social-security contributions and significant cuts in social-security and corporate-tax payments for enterprises investing in the country's less developed regions) that were put in place from 2008 onwards have led to greater recruitment of workers, more employment outside agriculture, and a drop in the level of informality.

Industrial and service employment is mainly concentrated in the big cities and in a number of fast-growing medium-sized cities, the so-called Anatolian tigers. The latter created many new jobs outside agriculture for the low-skilled segment. The OECD (2012) states that, starting from 2007 their employment rate improved; and in 2011, workers with primary education or less represented 55% of the total workers employed in Turkey.

Our findings are in line with those of Gürsel and Soybilgen (2013). They use quarterly data within a similar framework to reveal productivity dominating the per capita income growth before the global crisis, employment being the driving force since then. Now we are interested to see whether the other OECD countries show such pattern changes (in terms of the dominant factor of growth).

3.3 A Comparison within the OECD

We repeat the accounting exercise for all the other OECD countries and determine the contributions of different factors during 2004-12. Data for GDP (in constant local currency) are from the World Development Indicators Database. Data for population, working-age population (15-64), and civilian employment are from the OECD Annual Labor-Force Statistics Summary Tables (OECD, 2013b). Table 2 indicates that output per worker was the leading component of per capita income growth in Canada, the Czech Republic, Denmark, Estonia, Finland, France, Korea, the Netherlands, Portugal, Slovakia, Slovenia, the United Kingdom, and the United States before and after the crisis. On the other hand, in Australia, Austria, Belgium, Ireland, Japan, New Zealand, Norway, Poland, Spain, and Sweden, employment activity pushed up per capita income more than any other factor before the global crisis; however, productivity increments fueled the advance in per capita income after the global crisis. Thus, these countries represent the reverse cases of Turkey's experience, which we describe in Section 3.2.

Within the OECD, Greece registered the lowest average annual GDP growth rate (measured in constant local currency) and the worst average annual growth of PPP-adjusted GDP per capita over the 2004-12 period. Within that period, we see that rising output per worker accounted for 68.7% of the per capita GDP growth in Greece during 2004-07, while the corresponding figure was only 7.1% between 2009 and 2012. Declines in the employment-to-working-age Greek population ratio are primarily responsible for the significant drop in per capita income during 2009-12, accounting for 80.6% of that painful economic contraction.

3.4 A Convergence Exercise

Here, we are interested in the question of what explains the convergence experience of Turkey (relative to the US) during 2004-12 as displayed in Panel (a) in Figure 2. Following Equation (1), we see that the relative GDP per

Table 2. Sources of growth in OECD countries (average annual changes, %)

		Contribution to output per capita of					*Contribution to output per capita of*					*Contribution to output per capita of*		
Country/Period	*Y/P*	*Y/L*	*L/WP*	*WP/P*	*Country/Period*	*Y/P*	*Y/L*	*L/WP*	*WP/P*	*Country/Period*	*Y/P*	*Y/L*	*L/WP*	*WP/P*
Australia					Greece					New Zealand				
2004-2007	*1.82*	*0.36*	*1.36*	*0.10*	2004-2007	3.30	2.27	1.26	-0.22	2004-2007	1.68	0.42	1.14	0.12
2007-2009	*0.63*	*0.92*	*-0.34*	*0.06*	2007-2009	-2.10	-1.83	-0.07	-0.20	2007-2009	-1.17	0.09	-1.27	0.01
2009-2012	*1.05*	*0.97*	*0.37*	*-0.29*	2009-2012	-5.78	-0.41	-4.65	-0.71	2009-2012	0.93	1.03	0.14	-0.24
Austria					Hungary					Norway				
2004-2007	*2.68*	*0.76*	*2.20*	*-0.27*	2004-2007	2.78	2.32	0.39	0.07	2004-2007	1.64	0.06	1.25	0.33
2007-2009	*-1.62*	*-1.82*	*0.18*	*0.02*	2007-2009	-2.91	-1.30	-1.52	-0.10	2007-2009	-2.05	-2.09	-0.08	0.12
2009-2012	*1.55*	*0.91*	*0.61*	*0.02*	2009-2012	0.72	-0.60	1.41	-0.10	2009-2012	0.27	0.37	0.02	-0.12
Belgium					Iceland					Poland				
2004-2007	*1.76*	*0.51*	*1.04*	*0.20*	2004-2007	3.72	1.57	1.36	0.79	2004-2007	5.44	2.06	2.93	0.45
2007-2009	*-1.73*	*-1.39*	*-0.34*	*0.0004*	2007-2009	-4.05	-0.05	-3.97	-0.03	2007-2009	3.24	1.28	1.73	0.24
2009-2012	*0.30*	*0.54*	*-0.01*	*-0.23*	2009-2012	-0.20	-0.35	0.57	-0.43	2009-2012	3.05	3.97	-0.75	-0.17
Canada					Ireland					Portugal				
2004-2007	*1.63*	*0.84*	*0.57*	*0.22*	2004-2007	2.74	0.60	1.67	0.47	2004-2007	1.33	1.20	0.23	-0.11
2007-2009	*-2.26*	*-1.08*	*-1.16*	*-0.02*	2007-2009	-6.10	-0.46	-5.15	-0.49	2007-2009	-1.60	-0.40	-1.05	-0.15
2009-2012	*1.33*	*1.10*	*0.49*	*-0.27*	2009-2012	0.06	2.85	-1.80	-1.00	2009-2012	-0.70	2.05	-2.46	-0.29
Chile					Israel					Slovak Republic				
2004-2007	3.89	0.52	2.85	0.51	2004-2007	3.88	1.95	1.88	0.05	2004-2007	8.13	5.39	2.33	0.41
2007-2009	0.11	-0.0004	-0.33	0.44	2007-2009	0.72	0.10	0.21	0.40	2007-2009	0.16	0.09	-0.08	0.15
2009-2011	4.71	-0.34	4.82	0.23	2009-2012	2.59	-1.16	4.15	-0.41	2009-2012	2.82	3.47	-0.45	-0.20
Czech Republic					Italy					Slovenia				
2004-2007	5.92	4.74	1.05	0.13	2004-2007	0.83	0.37	0.82	-0.36	2004-2007	5.05	4.06	1.13	-0.14
2007-2009	-1.59	-0.90	-0.38	-0.31	2007-2009	-4.14	-2.98	-0.98	-0.19	2007-2009	-2.97	-2.18	-0.41	-0.38
2009-2012	1.02	1.40	0.59	-0.97	2009-2012	-0.55	0.08	0.56	-1.19	2009-2012	-0.38	1.84	-1.81	-0.41
Denmark					Japan					Spain				
2004-2007	2.09	1.70	0.49	-0.10	2004-2007	1.69	1.20	1.33	-0.84	2004-2007	1.98	-0.53	2.44	0.07
2007-2009	-3.87	-2.71	-0.92	-0.23	2007-2009	-3.26	-2.48	0.04	-0.82	2007-2009	-2.67	2.30	-4.70	-0.27
2009-2012	0.28	1.69	-0.97	-0.44	2009-2012	1.97	2.20	0.31	-0.54	2009-2012	-0.77	2.35	-2.51	-0.61
Estonia					Korea					Sweden				
2004-2007	8.78	5.27	3.61	-0.09	2004-2007	4.25	3.37	0.68	0.21	2004-2007	2.96	1.03	1.64	0.29
2007-2009	-9.58	-4.99	-4.38	-0.20	2007-2009	0.70	1.14	-0.76	0.32	2007-2009	-3.70	-2.42	-1.10	-0.18
2009-2012	5.40	3.58	2.33	-0.51	2009-2012	3.37	2.30	0.83	0.24	2009-2012	2.61	2.24	0.99	-0.62
Finland					Luxembourg					Switzerland				
2004-2007	3.74	2.37	1.47	-0.10	2004-2007	3.88	1.73	1.94	0.22	2004-2007	2.65	1.60	0.95	0.11
2007-2009	-4.79	-3.62	-1.10	-0.06	2007-2009	-5.05	-6.03	0.65	0.33	2007-2009	-1.17	-1.33	0.17	-0.01
2009-2012	1.26	1.38	0.56	-0.68	2009-2012	-0.56	-0.82	-0.12	0.38	2009-2012	0.84	0.43	0.56	-0.16
France					Mexico					United Kingdom				
2004-2007	1.50	1.16	0.30	0.04	2004-2007	1.53	1.76	-0.32	0.09	2004-2007	2.47	2.20	-0.03	0.31
2007-2009	-2.16	-1.33	-0.64	-0.19	2007-2009	-3.09	-2.29	-1.34	0.55	2007-2009	-3.69	-2.52	-0.99	-0.19
2009-2012	0.77	0.90	0.29	-0.43	2009-2012	2.97	-0.12	2.60	0.49	2009-2012	-0.48	0.31	-0.24	-0.55
Germany					Netherlands					United States				
2004-2007	2.61	0.55	2.10	-0.04	2004-2007	2.87	1.61	1.33	-0.07	2004-2007	1.62	0.98	0.46	0.19
2007-2009	-1.89	-2.78	1.09	-0.20	2007-2009	-1.43	-1.75	0.49	-0.16	2007-2009	-2.48	0.59	-2.97	-0.09
2009-2012	2.63	1.26	1.34	0.03	2009-2012	-0.05	1.07	-0.65	-0.47	2009-2012	1.58	1.74	0.04	-0.20

Source: World Development Indicators Database, OECD Annual Labor-Force Statistics Summary Tables, Authors' calculations. Note: The end year for Chile is 2011.

capita for Turkey and the US depends on the ratio of the three factors at time t:[11]

$$\frac{(Y/P)_t^{Turkey}}{(Y/P)_t^{US}} = \frac{(Y/L)_t^{Turkey}}{(Y/L)_t^{US}} \text{ x } \frac{(L/WP)_t^{Turkey}}{(L/WP)_t^{US}} \text{ x } \frac{(WP/P)_t^{Turkey}}{(WP/P)_t^{US}} \quad (3)$$

We use Equation (3) to see which of these three measurable components of data explains the evolution of GDP per capita in Turkey relative to the US. Table 3 reports real GDP per capita, real GDP per worker, the ratio of employment to the working-age population, and the ratio of the working-age population to the total population in Turkey relative to the US during 2004-12.[12]

Table 3. Sources of the convergence: Indicators relative to the US

Year	*Y / P*	*Y / L*	*L / WP*	*WP / P*
2004	0.26	0.42	0.66	0.94
2005	0.27	0.44	0.66	0.94
2006	0.28	0.46	0.66	0.94
2007	0.29	0.47	0.66	0.94
2008	0.29	0.46	0.67	0.95
2009	0.29	0.43	0.69	0.95
2010	0.31	0.43	0.74	0.96
2011	0.32	0.44	0.77	0.96
2012	0.32	0.43	0.77	0.96

Source: Economic Report of the President (2013), World Development Indicators Database, TurkStat, Authors' calculations.

In 2004, GDP per capita in Turkey relative to that of the US was around 26%. By 2012, Turkish relative GDP per capita had increased to around 32%. Output per worker had gone up both in Turkey and the US, with a relative factor of 0.43 in 2012, which is almost identical to that observed in 2004 (0.42). Similarly, the ratio of the working-age population to the total population escalated both in Turkey and the US, with a relative factor of 0.96 in 2012. This also approximates what was observed in 2004 (namely, 0.94).

Table 3 makes clear that the source of the convergence during 2004-07 was aggregate labor productivity. Later, however, during the global crisis of

[11] See Bello et al. (2011) for a similar decomposition for the growth experience of Venezuela.

[12] Data for the US are from the Economic Report of the President (2013), which are available at: http://www.gpo.gov/fdsys/pkg/ERP-2013/content-detail.html. Specifically, we use "Table B-34: Population by age group, 1940-2012" and "Table B-35: Civilian population and labor force, 1929-2012" for population and labor-market statistics. To make international comparisons valid, we use GDP at PPP in constant 2005 international dollars from the World Development Indicators database for Turkey and the US.

2007-09, declines in Turkish productivity created obstacles for convergence, despite the relative improvements in the two ratios of employment to working-age population and working-age population to total population. In fact, the average annual "growth" in Turkish labor productivity during 2007-09 was -3.37%. On the other hand, the corresponding figure for the US was 0.40% for the same period.[13] Finally, the source of the 2009-12 convergence was the positive movement in the employment-to-working-age population ratio in Turkey (and the fall of this ratio in the US). The Turkish ratio inched upward, from 0.41 in 2004 to 0.45 in 2012, while the American one slipped from 0.62 in 2004 to 0.59 in 2012.

4. Digging Deep into Productivity Gains

Here we investigate the components of the first term of the right-hand side of Equation (1), which is output per worker ($y \equiv Y / L$). Output per worker as a particular measure of productivity confounds the effects of capital accumulation and technological progress, both of which can raise output per worker. To see this, we consider the following aggregate production function:

$$Y = AK^{\alpha}(Lh)^{1-\alpha}, \quad (4)$$

where Y represents real gross domestic product (GDP), K is real physical capital, and Lh is the quality-adjusted workforce, namely the number of workers L multiplied by their average human capital h, while α and $(1 - \alpha)$ are the elasticities of output with respect to capital and labor, respectively. The term A represents total factor productivity, or TFP. TFP tells us not just how productive labor is, but how efficiently the economy uses all the factors of production. One can think of the term A as technology broadly construed, so that it also captures the nature of economic institutions critical to production. In per-worker terms, the production function can be rewritten as

$$y = Ak^{\alpha}h^{1-\alpha}, \quad (5)$$

where y is the output per worker $y \equiv Y / L$ and k is the capital-labor ratio $k \equiv K / L$. We take logarithms of this expression and decompose the average annual growth rate of output per worker over a number of years, z, (from time t to time $t + z$) as follows:

[13] It is noted that in the downturn of 2008-09, labor productivity actually rose as GDP plummeted in the US. (McGrattan and Prescott, 2012); and the financial crisis of 2008 was followed by sharp contractions in aggregate output and employment and an unusual increase in aggregate TFP in the US (Petrosky-Nadeau, 2013).

$$\frac{\log(y_{t+z})-\log(y_t)}{z}=\frac{\log(A_{t+z})-\log(A_t)}{z}+$$
$$\alpha\frac{\log(k_{t+z})-\log(k_t)}{z}+(1-\alpha)\frac{\log(h_{t+z})-\log(h_t)}{z} \quad (6)$$

The above expression decomposes the changes in output per worker into those stemming from the TFP component, those from the physical capital per worker, and those from the human capital per worker.

4.1 Data for Growth Accounting

Deciding how much of any growth in output per worker is attributable to improvements in TFP and how much to other inputs depends on the ways the input measures are constructed. We use the same data for real GDP (at 1998 prices) and employment presented in Section 3.2. The data for physical capital and human capital are central to this effort. We draw on the capital-services data (at 1998 prices) calculated by Demiroğlu (2012) for the Turkish economy. This series is a capital-services index that summarizes the productive capacity of the capital stock, composed of different types of capital, such as equipment and structures. This index properly weighs the various types of capital in accordance with their marginal product and thereby provides an appropriate measure of physical capital. Demiroğlu (2013) emphasizes the essential need for such an index for Turkish capital input, given that several previous growth-accounting studies of the Turkish economy had failed to take sufficient account of the complex nature of the national capital base.

A proper measure of labor input should account for the variability found in the human capital of the workforce. Human capital is constructed using information on the average number of years of schooling for the population over the age of 15. First, we obtain data of this type from Barro and Lee (2013). Then, we convert these data into human capital following Caselli (2005). Data in Barro and Lee (2013) are constructed at five-year intervals, from 1950 to 2010. We use a linear interpolation method to estimate missing observations, since this method does not create a major problem, given that Caselli (2005) states that the average number of years of schooling moves slowly in the short run.

It is worth noting that Barro and Lee (2013) data are widely used in economic growth and development studies for constructing human capital data,

and their estimates of educational attainment provide a reasonable proxy for the stock of human capital for a broad group of countries.[14,15]

That said, measuring human capital is not an easy task, since a nation's human-capital endowment includes the skills and capacities that reside in people and that are put to productive use (World Economic Forum, 2013). Formal education is not the only dimension of human capital. Human capital also encompasses skills and knowledge acquired by the population through on-the-job training, learning-by-experience, and the general health of the population (including physical capacities, cognitive function, and mental health).

We set the capital income share, $\alpha = 0.5$. In growth-accounting exercises, many studies set $\alpha = 0.33$ following Gollin (2002). This figure basically refers to the estimates for the rich OECD countries. Chen et al. (2010), among many other studies, use 0.5 as the labor share for emerging and developing economies, because capital is relatively scarce in most of them, and thus its return is high. On the other hand, labor is cheap there when compared to the advanced countries, leading to a lower labor share. In addition, recent studies of Turkey have argued that the value of α is around 0.5. In that regard, Altuğ et al. (2008), Ismihan and Metin-Ozcan (2009), and Tiryaki (2011) hold forth on the values of factor income shares in Turkey. Finally, TFP is calculated as the residual.

4.2 Growth-Accounting Results

Table 4 reveals the result of the decomposition presented in Equation (6) for Turkey between 2004 and 2010. Capital deepening was the dominant factor during 2005-07, while TFP growth was the leader in 2004 and 2005 and from 2007 to 2010. The global economic crisis of 2007-09 had a depressive impact on Turkish economic activity; growth accounting indicates that this fall in GDP per worker was due to a slump in TFP. Finally, TFP growth was responsible for the economic expansion seen in 2009 and 2010.

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[14] We also use the education level of the population over the age of 15 for Turkey from the National Education Statistics Database. Differing from the Barro and Lee dataset, this database does not take into consideration the educational years if the degree is not earned. The data are on an annual basis, starting from 2008, and can be reached at http://tuikapp.tuik.gov.tr/adnksdagitapp/adnks.zul?kod=2&dil=2. We compute the average years of schooling using this dataset, and the calculated value for the year 2010 almost coincides with the observation reported in the Barro and Lee dataset.

[15] Most of the research uses the average number of years of schooling in calculating human capital. Alternative proxies for human capital are mainly developed for specific purposes in different studies. For example, İnal and Akçabelen (2013) use secondary and tertiary education separately as proxies for human capital in Turkey so as to distinguish between the adoption of already existing technologies and the development of new ones.

Table 4. Sources of output per worker growth in Turkey (average annual changes, %)

Period	*Output per worker*	*Contribution to output per worker of*		
		Physical capital per worker	*Human capital per worker*	*Total Factor Productivity*
2004-05	5.9	2.4	0.4	3.1
2005-06	4.9	3.2	0.5	1.2
2006-07	3.0	2.8	0.5	-0.3
2007-08	-1.5	2.0	0.5	-4.0
2008-09	-5.3	1.0	0.5	-6.9
2009-10	2.8	-1.3	0.5	3.5

Source: Barro and Lee (2013), Demiroğlu (2012), TurkStat, Ministry of Economy, Authors' calculations.

Atiyas and Bakış (2013) find that TFP growth in the 1990s was very low; by contrast, it vastly improved in the 2000s, increasing to over 3% per annum. They find that, between 2002 and 2010, among the 98 countries for which complete data are available, Turkey ranks seventh in terms of TFP growth, calculated through the Solow residual. Üngör (2013) also claims significant TFP growth in the post-2002 period. Economic reforms and institutional changes in the last decade could have triggered this TFP movement forward. The severity of the 2001 crisis was a turning point, bringing about the introduction of a raft of economic reforms. Their objective was to establish macroeconomic and financial stability and improve the business environment. We do not aim to present a detailed overview of the major macroeconomic developments and reforms in Turkey of the last decade.[16] However, it is important to mention a few.

Among the pivotal institutional and structural reforms that were undertaken in this period were: establishing the independence of the Central Bank of Turkey, introducing a free-floating exchange-rate regime, and formally targeting the inflation rate. Other targets of economic reform were achieving fiscal discipline with the national accounts, streamlining the banking system, ameliorating the investment climate, and attracting more foreign direct investment. A related issue was the proliferation of high-tech activities in the 2000s. Noting that these sectors are more productive than their low-tech

[16] OECD (2006, 2012), Ismihan and Metin-Ozcan (2009), Gürsel (2011), Atiyas (2012), and Aysan et al. (2013) discuss the details of the reforms and their impacts on the economic performance of Turkey.

counterparts, the OECD (2012) reports that the share of medium-to-high-tech sectors in Turkey's total manufacturing exports rocketed from 30% to more than 60% in the 2002-08, period, and their share of total output rose from 23% to 30%.

5. Demographics and Female Labor-Force Participation

Let us now turn to changes in participation rates, with the focus on the rising female participation rates in Turkey. Here we investigate one specific channel, the second term on the right-hand side of Equation (1), which is the ratio of employment to working-age population (*L/WP*). In the wake of the 2008 crisis, Turkey experienced a measurable advance in both employment and labor-force participation. In Section 3.2, we found that the largest factor in per capita income growth was the improving employment-to-working-age population ratio between 2009and 2012. In fact, Turkey's total employment grew at an annual average rate of 3.7% between 2007 and 2012. This figure reflects the creation of over four million new jobs.

Turkish women's major accomplishment since the mid-2000s was upping their presence in the labor force, which coincided with this overall employment surge. For their part, Turkish men retained their rate of participation in the labor force between 2005 and 2011 (panel (c) in Figure 4), whereas the females lifted both their degree of labor-force participation and employment rates, even through the crisis (panel (d) in Figure 4).

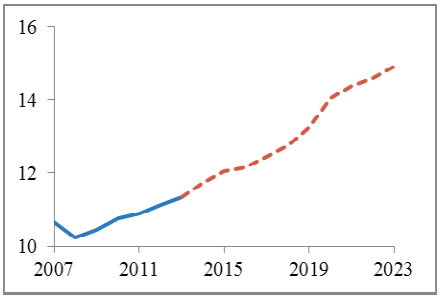
5.1 Demographics and Economic Activity

Recall that Panel (b) in Figure 3 presents the decreasing dependency ratio in Turkey. This ratio has two components: the old-age dependency and the young-age dependency. The first two panels in Figure 4 point to a drop in the dependency ratio, driven by the declines in the proportion of young dependents in the population. A fall in the dependency ratio, especially the young-dependency ratio, is likely to boost female labor-force participation. The uptrend in female participation could mean that workforce growth is outpacing the growth in the working-age population, which would push up GDP per head so long as the extra labor-force participants can find employment (Eastwood and Lipton, 2012).

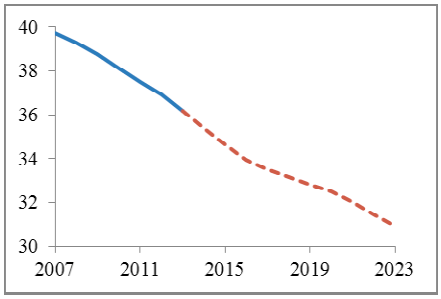
Figure 4 (c)-(d) shows the labor-force participation rates for males and females during 2004-12. Females added to their participation in the workforce, from 23.3% in 2004 to 29.5% in 2012; at the same time, a trend emerged in which many Turkish women were ending up working in the service sector.

Figure 4. Demographics and economic activity in Turkey

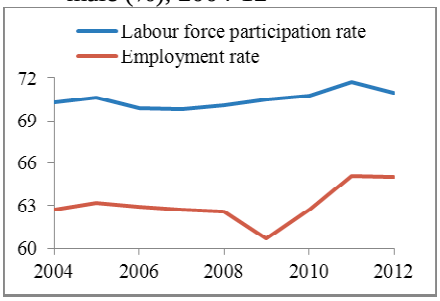
(a): Old-age dependency ratio (%), 2007-23



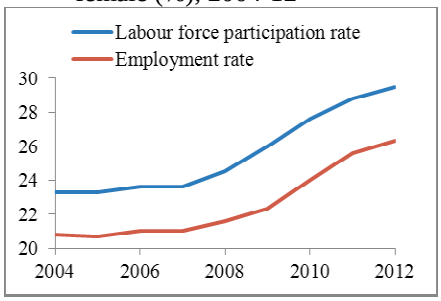
(b): Young-age dependency ratio (%), 2007-23



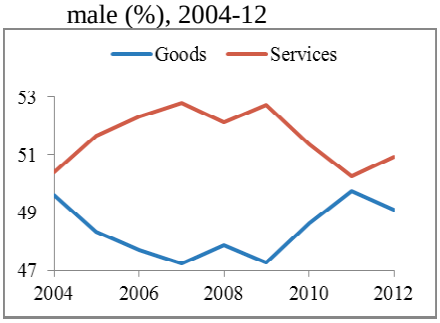
(c): Labor-force status by sex, male (%), 2004-12



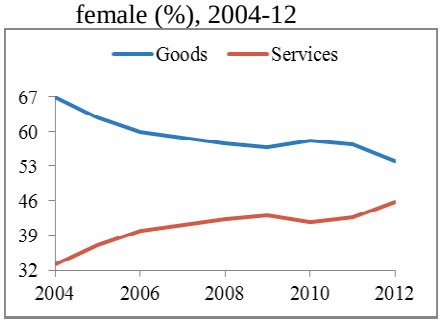
(d): Labor-force status, female (%), 2004-12



(e): Economic activity by sex, male (%), 2004-12



(f): Economic activity by sex, female (%), 2004-12



Source: TurkStat.

In Panel (e)-(f) are the sectoral employment shares for male and female workers in two broad sectors: goods and services.[17] Panel (f) clearly shows

[17] The goods sector includes agriculture, forestry, and fishing; mining and quarrying; manufacturing; electricity, gas, steam, water supply, sewerage, etc.; and construction. The service sector comprises wholesale and retail trade; transportation and storage; accommodation and food-service activities; information and communication; financial and insurance activities;

that women have been moving into the service sector. One explanation for the greater female employment is economic policy. The integration of populations with low rates of participation in the labor market has been one of the more pressing challenges that Turkey has been trying to address for several years. As stated before, Turkey implemented several labor-market policy measures during and right after the 2008 crisis. In particular, starting in July 2008, to provide incentives for employing members of disadvantaged groups, the government offered cost-reducing subsidies targeting women and youth. Balkan et al. (2014) study the impacts of these subsidies on the employment probabilities of the affected demographic groups and find that the females above 30 years of age have experienced a marked boost in their employment probability. The OECD (2013a) comments that these labor-market reforms have greatly diminished the relative labor costs of youth and women.

5.2 Female Employment Intensity

We present a decomposition exercise to demonstrate the gain in female employment and its intensity in the service sector, since is that sector that accounts for more than half of total employment in Turkey. The relationship between the rising prominence of the service sector in the economy and women's involvement in the labor market has been noted by several authors (see, e.g., Olivetti, 2013; Rendall, 2014). Countries that have large service sectors also tend to have more female employment. For example, Rogerson (2005, p.114) finds that the correlation of the change in the relative rate of employment for women with the aggregate service employment rate between 1985 and 2002 is 0.82 for a sample of 20 OECD countries.

Our analysis corroborates that of Ngai and Petrongolo (2014), who established a link between female work and structural transformation (from goods to services). It consists of showing how much of the rise in the female share of total employment took place through the expansion of the service sector. We translate the change in the share of female employment between 2004 and 2012 into two terms, one reflecting the change in the share of services, the other denoting the changes in gender intensities within either sector. The variation in female employment shares between time 0 and time *t* can be expressed as follows:

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real-estate activities; professional, scientific, and technical activities; administrative and support-service activities; public administration and defense; education; human-health and social-work activities; art, entertainment, and recreation; and social, community, and personal-service activities.

$$\frac{L_{ft}}{L_t} - \frac{L_{f0}}{L_0} = \sum\nolimits_j \alpha_{fj}\left(\frac{L_{jt}}{L_t} - \frac{L_{j0}}{L_0}\right) + \sum\nolimits_j \alpha_j\left(\frac{L_{fjt}}{L_{jt}} - \frac{L_{fj0}}{L_{j0}}\right) \quad (7)$$

Structural transformation *Female intensity*

L_m and L_f denote employment by men and women, respectively, and L indicates their sum. L_{fjt} stands for the female employment in sector j at time t. The sectoral employment is given by $L_{jt} = L_{mjt} + L_{fjt}$, , where L_{mjt} represents the male employment in sector j at time t. The first term on the right-hand side of Equation (7) represents the change in the female employment share that is attributable to structural transformation, while the second term reflects changes in the female intensity within the sector. The decomposition weights are:

$$\alpha_{fj} = \left(\frac{L_{fjt}}{L_{jt}} + \frac{L_{fj0}}{L_{j0}}\right)/2, \qquad \alpha_j = \left(\frac{L_{jt}}{L_t} + \frac{L_{j0}}{L_0}\right)/2 \quad (8)$$

The results of this decomposition for Turkey are reported in Table 5 for the 2004-12 period. The first column reports the total change in the female employment share, while the second column gives the proportion of this change that took place between sectors (*structural transformation*); the third column provides the proportion of this change that occurred within sectors (*female intensity*).

Table 5. A decomposition of female employment share

	Contributions from (%)		
Period	*Change in female employment share (%)*	*Structural transformation*	*Female Intensity*
2004-12	3.74	-8.07	108.07

Source: TurkStat, Authors' calculations.

In Table 5, we see that the female employment share moved upward, from 25.71% in 2004 to 29.45% in 2012 (3.74 = 29.45-25.71), all of which was powered by the growing female intensity (accounting for 108.07% of the

change). Sak (2014) argues that the female employment share is increasing due to the spread of shopping malls throughout central Anatolia in recent years. This could be one explanation for the female intensity in services. Our results are in line with a recent study by Gaddis and Klasen (2014), who explore the relationship between structural change as measured by disaggregated growth in employment and women's labor-force participation. For a panel of countries, they find positive effects on female labor-force participation from employment growth in trade, hotels, and restaurants as well as in other services.

Clearly, given that only 30% of Turkish women are currently employed or are looking for work, Turkey has to work hard to expand female participation in the labor force. To convey the growth ramifications of female employment, we quote the following anecdote from Norway, which is the exact opposite of Turkey as far as female employment is concerned. Labor-force participation (especially female employment) in Norway is among the highest in the OECD. The Norwegian Minister of Finance states that "…if the level of female participation in Norway were to be reduced to the OECD average, Norway's net national wealth would, all other factors being equal, fall by a value equivalent to our total petroleum wealth…" (Johnsen, 2012).

6. Concluding Remarks

In this paper, we have applied various decomposition methods to understand the sources of Turkey's growth in per capita income and their relationships with selected demographic factors. Our main findings are (i) the rise in output per worker was responsible for per capita income growth before the global crisis (2004-07); and (ii) the increases in the employment-to-population ratio underlay the per capita income advances after the crisis (between 2009 and 2012). The heightened ratios of both the employment-to-working-age population and the working-age population to total population will continue to make positive contributions to per capita income growth in Turkey if the current trends are sustained.

We have remarked on the link between the growing female employment and its intensity in the service sector. We believe that studying female participation in the workforce is of value. In fact, employment among women will be especially critical in the years to come, as an aging population may place an ever-heavier burden on public finances. The possible consequences of the unprecedented climb in the global population of those over the age of 60 are among the most highly debated topics in academic and policy circles in developed and developing countries alike. TurkStat projects the overall population of Turkey continuing to age: the elderly population, which is defined as

those 65 years of age and over, was 5.7 million in 2012 (with a proportion of 7.5%), and this segment will reach 8.6 million, or 10.2%, by 2023 (see Appendix A.1).

We are fully aware that economic growth is a long-term phenomenon, i.e., it is a long-term expansion of the productive potential of the economy. Simon Kuznets, in his Nobel Prize Lecture, states that "a country's economic growth may be defined as a long-term rise in capacity to supply increasingly diverse economic goods to its population, this growing capacity based on advancing technology and the institutional and ideological adjustments that it demands.[18]" Despite being a short period of time, the years 2004-12 provide an opportunity for further examination of the economic determinants of the growth potential of Turkey; and a systematic analysis of such a high-growth period may offer insightful lessons. One could argue that it is the cyclical factors and measurement issues that dominate any new trend over a short period.

Nevertheless, it is essential to focus on productivity improvements for long-term sustainable growth, since input-driven growth is inevitably limited (Krugman, 1994). In addition, studying selected demographic factors in an emerging country such as Turkey reinforces the work done by others in a range of Asian countries. Indeed, the historic growth "miracles" forged by some of these and the role played by their favorable demographic dynamics in their good fortune have led to demographics becoming more popular among economics researchers (see, e.g., Bloom and Williamson, 1998; Bloom et al., 1999).

We expect our findings to stimulate thought-provoking questions about productivity dynamics and demographic changes in Turkey, in keeping with the recent surge in macroeconomic research into demographic transitions' effect on economic development (see Galor, 2012 and the references therein). In particular, we urge further investigations into the links between demographics and productivity growth that will reveal cross-country productivity patterns, especially in the context of emerging markets (see, e.g, Feyrer, 2007; Ilmakunnas and Miyakoshi, 2013). For instance, what are the key determinants of the processes of demographic changes and technological advances, and how do they interact with each other?

Getting answers to such questions is vital for many developing countries in light of the so-called *middle-income trap* discussions. In that regard, future

[18] http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1971/kuznets-lecture.html

researchers should to examine the implications of demographic aging (such as increased longevity and reduced fertility) for per capita growth in developing countries in the upcoming decades (see Gonzalez-Eiras and Niepelt, 2012 for such an analysis for the rich OECD countries). Another suggestion for future investigation is to examine the relationship between shifts and variations in the age structure across sectors (see, e.g., Han and Suen, 2011). This may enhance our understanding of the leading role of the service sector in the overall economy. Finally, studying the long-term interaction between demographics and growth, which is related to the second demographic dividend, would be rewarding. In particular, the experiences of the industrialized Asian countries may shed light on the dynamics of this relationship.

Appendix A

A.1. Global Population Aging

Panel (a) in Figure A.1 shows the proportion of elderly population by selected country groups (aged 65 years and over) during 1950-2050.[19] The projections of the United Nations imply that, at the global level, the share of those 65-plus rose from 5.1% of the world population in 1950 to 7.7% in 2010, with the dramatic increase still ahead, as those 65-plus are expected to reach 15.6% by 2050. In other words, in many countries, populations will age at rapid rates over the next few decades.

This demographic transition to an older population has enormous implications for the well-being of future workforces and retirees. Moreover, the demographic developments leading to population aging and the attendant changes in the age composition of the population are likely to distort the time paths of major macroeconomic variables (see, e.g., Kenc and Sayan, 2001).

In Panel (b)-(c), we examine all of the 34 OECD countries (plus Brazil) from the ALFS Summary Tables of the OECD.[20] While aging is global, there are marked international differences in the speed and the extent of the aging process, as shown in Panel (b) and in Panel (c). Panel (b) displays the ratios for Germany, Italy, and Japan. As of 2011, these three countries have had the highest proportions of elderly population in the OECD.

Japan is the most notable case, since the percentage of elderly in its population is not only the highest among the OECD countries, but also the highest in the world. Over 20-plus years, the share of the population aged 65 years or older soared, to 24.1% in 2012 from 12.1% in 1990. The proportion of elderly population is lower in the emerging economies.

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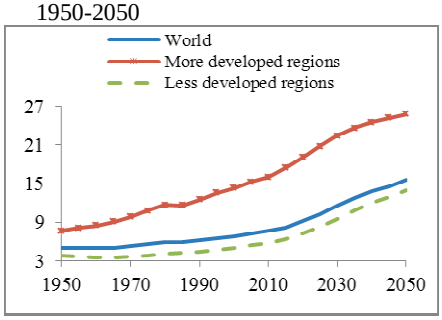
[19] Data are from the United Nations' World Population Prospects (the 2012 revision). We use the table "Percentage total population (both sexes combined) by broad age group, major area, region, and country, 1950-2100," which is available at: http://esa.un.org/unpd/wpp/Excel-Data/population.htm. Data are available for every five years, starting in 1950. We use the projections based on the medium fertility assumption of the database during 2015-50. *More developed regions* comprise Europe, North America, Australia/New Zealand, and Japan. *Less developed regions* comprise all regions of Africa, Asia (except Japan), Latin America, and the Caribbean, plus Melanesia, Micronesia, and Polynesia.

[20] The "ALFS Summary tables" dataset is a subset of the Annual Labor-Force Statistics database, which presents annual labor-force statistics and broad population series for 34 OECD member countries, plus Brazil.

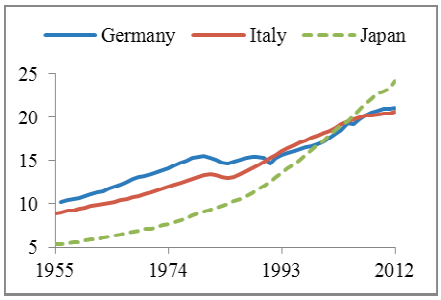
Figure A.1. Population over 65 as percentage of total population

(a): Worldwide accelaration of aging, 1950-2050



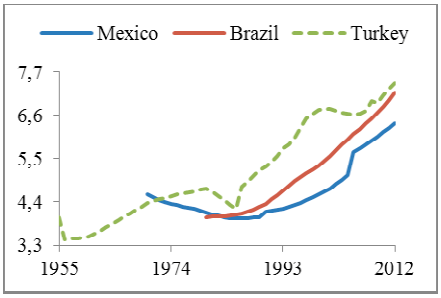
Source: United Nations, World Population Prospects (2012).

(b): The highest ratios in the OECD



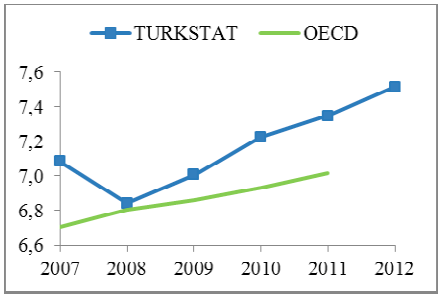
Source: OECD.

(c): The lowest ratios in the OECD



Source: OECD.

(d): Turkey, different datasets



Source: OECD, TurkStat.

Panel (c) presents the ratios for Brazil, Mexico, and Turkey. Among the OECD countries, Mexico and Turkey have the lowest proportions of elderly population as of 2010-11, with Brazil having very similar ratios. Panels (b) and (c) show that aging started earlier in the more developed regions and was beginning to take place in certain developing countries. Panel (d) compares the OECD data for Turkey with the recent updates of the Turkish population statistics based on the ABPRS during 2007-12. We calculate the population over 65 as a percentage of the total population, based on the ABPRS data. These data do not exactly match the OECD data. Nevertheless, the observation for 2012 is 7.5%.

A.2. A GDP Decomposition for the 1988-2003 Period

We repeat our accounting exercise presented in Equation (2) for the 1988-2003 period. We use the GDP (at 1998 prices) from the "Harmonized Gross Domestic Product by TurkStat" table of the Economic and Social Indicators

of the Ministry of Development, which are available at: www.mod.gov.tr/Pages/EconomicandSocialIndicators.aspx. Data for population and employment are from the "Non-institutional population by labor-force status" table of the Statistical Indicators 1923-2012, TurkStat (Table 8.1).

Table A.1 shows the results of the analysis for the period 1988-2003, decomposing GDP per capita growth into the portions associated with the size of the working-age population, the employment rate, and output per worker. During 1988-2003, per capita income grew at 1.59% per year, and output per worker went up by 2.19% per year. The negative contribution of the employment rate suggests that, had it not declined, GDP per capita growth would have been higher during 1988-2003. When the period 1998-2003 was brought under scrutiny, average aggregate employment growth was negative, at -0.6% per year.

Table A.1. Decomposing GDP per capita growth in Turkey (average annual changes, %)

		Contribution to output per capita of		
Period	*Y/P*	*Y/L*	*L/WP*	*WP/P*
1988–93	2.85	3.89	-2.05	1.01
1993–98	1.87	0.42	0.70	0.76
1998–2003	0.04	2.26	-2.57	0.34
1988–2003	**1.59**	**2.19**	**-1.31**	**0.71**

Source: T.R. Ministry of Development *Economic and Social Indicators*, TurkStat *Statistical Indicators 1923-2012*, Authors' calculations.

A.3. On the Effects of the Hours of Work

Here, we consider the possible effects of the hours worked in measuring labor productivity. We break down GDP per capita (Y / P) at time t into four components as follows:

$$(Y / P)_t = (Y / (hours * L))_t \;\; x \;\; (L / WP)_t \;\; x \;\; (WP / P)_t \;\; x \;\; hours_t \qquad (A.1)$$

The only change we introduce is incorporating the hours worked into the analysis. Now, *hours* denotes annual hours worked per worker, and $Y / (hours * L)$ is GDP per total hours. We use the OECD series of average annual hours actually worked per person in total employment for Turkey (OECD, 2013b). As before, we take logarithms and decompose the average annual growth rate of output per worker. Table A.2 provides the results of this decomposition analysis.

Table A.2. Sources of growth in Turkey (average annual changes, %)

		Contribution to output per capita of			
Period	*Y/P*	*Y/(h*L)*	*L/WP*	*WP/P*	*hours*
2004–05	6.80	4.94	0.49	0.43	0.93
2005–06	5.43	4.50	0.09	0.43	0.41
2006–07	3.34	4.74	-0.12	0.43	-1.71
2007–08	-0.53	-0.94	0.63	0.36	-0.58
2008–09	-6.11	-4.33	-1.39	0.62	-1.01
2009–10	7.63	2.97	4.37	0.51	-0.21
2010–11	6.97	2.60	4.51	0.54	-0.68
2011–12	0.53	-0.20	0.82	0.41	-0.49
2004–07	**5.19**	**4.73**	**0.15**	**0.43**	**-0.12**
2007–09	**-3.32**	**-2.64**	**-0.38**	**0.49**	**-0.79**
2009–12	**5.05**	**1.79**	**3.23**	**0.49**	**-0.46**
2004–12	**3.01**	**1.78**	**1.17**	**0.47**	**-0.42**

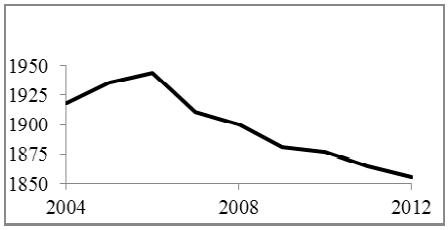
Source: TurkStat, OECD (2013b), Authors' calculations.

Our main finding does not change, and we observe a productivity-based growth era before the global crisis and an employment-based one in the post-crisis period. Notice that the analysis presented in Equation (A.1) above allows us to study the separate margins of work effort. The two principal margins of work effort are hours actually worked by employees (intensive margin) and the fraction of the working-age population that works (extensive margin). Üngör (2014) provides a detailed discussion of the labor supply in Turkey from a macroeconomic perspective. We follow Üngör (2014, Figure 2) and plot the two margins of labor supply in Turkey between 2004 and 2012.

Panel (a) in Figure A.2 shows the behavior of the intensive margin in Turkey between 2004 and 2012. According to the OECD data, an average Turkish worker worked 1,864 hours in 2011 and 1,855 hours in 2012. In a comparative perspective, Üngör (2014) states that Turkey ranked ninth among the OECD countries in 2011—after Mexico, Korea, Chile, Greece, Hungary, Poland, Estonia, and Israel. We note that the data for hours actually worked per person may not be suitable for comparisons across countries, since each country collects its own data, and their methods may not always be perfectly comparable. Panel (b) depicts the time path for the extensive margin. The employment-to-working-age population ratio in Turkey went from 41.2% in 2009 to 45.4% in 2012. Turkey has the lowest employment rate in the OECD.

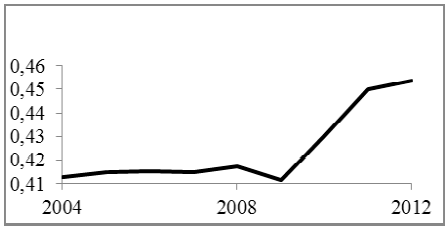
Figure A.2. Two margins of labor supply in Turkey, 2004-12

(a): Intensive margin



Source: OECD (2013b), Üngör (2014).

(b): Extensive margin



Source: TurkStat, Üngör (2014).

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