Productivity, Demographics and Growth in Turkey: 2004-2012[1]

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Abstract

Turkey has the second highest average annual growth rate of GDP (measured in constant local currency) and the fifth highest average annual growth rate of purchasing power parity (PPP)-adjusted per capita income among all the OECD countries between 2004 and 2012. We study the sources of this high growth era, in comparison with other OECD countries, decomposing GDP per capita into three components: labor productivity, the ratio of employment to working-age population, and the ratio of working-age population to total population. Our findings suggest a productivity-based growth era before the global crisis and an employment-based growth era in the post-crisis period for Turkey. We then provide a detailed analysis on contributing factors (i) discussing the role of capital deepening and total factor productivity (TFP) growth for aggregate output per worker growth; and (ii) presenting a link between the female intensity in the service sector and the rise in female employment.

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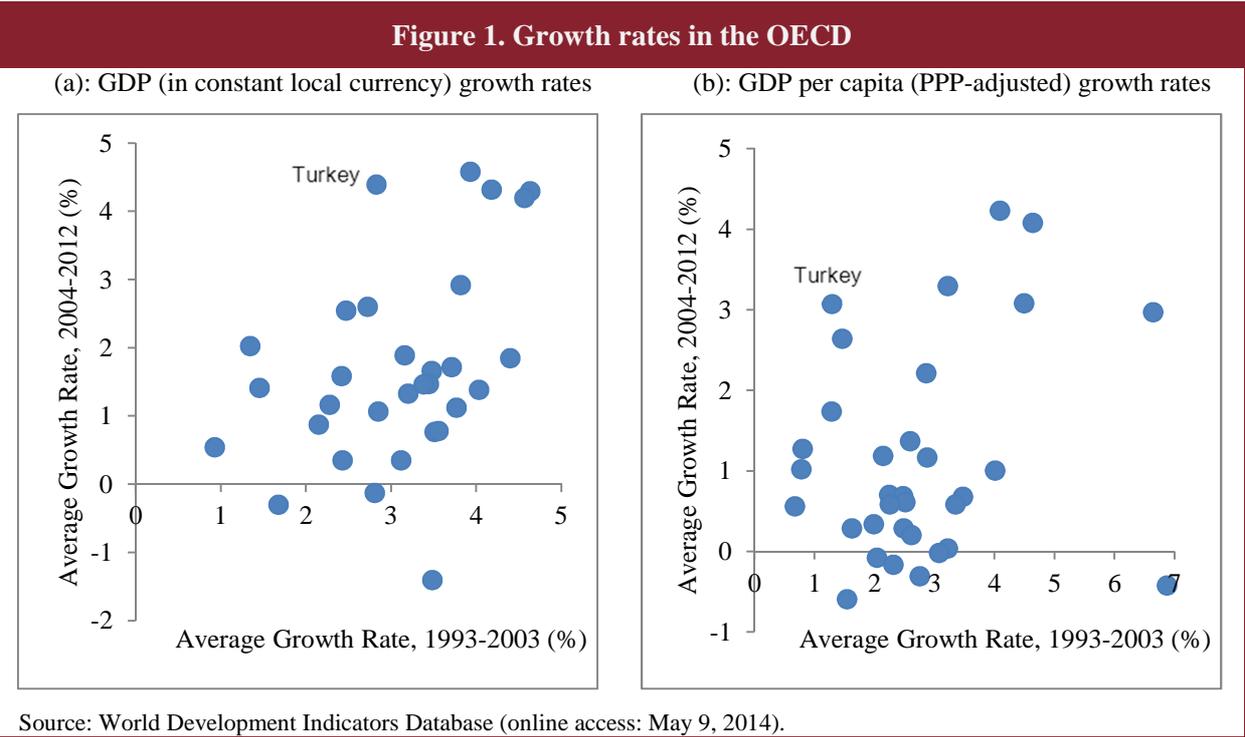
1. Introduction

There are many aspects of long-run growth and development. The relationship between demographic change and economic development, for example, is one particular aspect; and there has been a debate among economists, demographers and social scientists over the effects of population size (and growth) on economic growth, i.e., whether population growth restricts, promotes or is independent of economic growth.[4] In recent years, 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 population aging across 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 OECD using the PPP-adjusted per capita income measure. In fact, Turkey (after Mexico) had the lowest PPP-adjusted per capita income within the OECD as of 2012. In addition, Turkey had the lowest employment to working-age population ratio (with 45% in 2012) among all the OECD countries. Similarly, labor force participation rate was only 50% in 2012 and perhaps more dramatically, female labor force participation rate was 29.5% as of 2012. Having these figures in mind, Turkey has been experiencing a transformation in the last decade with a surge in GDP and per capita income. Figure 1 illustrates this point using 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) over the period 2004-2012 against annual average growth rates over the period 1993-2003 for all 34 countries in the OECD. Turkey's GDP grew at an annual average rate of 2.83% in the 1993-2003 period; and Turkey ranked twenty-third in the OECD with this growth rate. On the other hand, Turkey had the second highest average annual growth rate of GDP between 2004 and 2012 in the OECD, with a 4.39% growth rate. Israel had the highest average annual growth rate of GDP between 2004 and 2012, with a 4.58% growth rate.

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[4] 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 on this issue.

Greece, Italy, and Portugal had the worst performances in the OECD. Especially, the growth performance after the global crisis was remarkable in Turkey. In the period 2009-2012, most of the OECD countries had growth rates of less than 2%. On the other hand, Turkey had the highest average annual growth rate of GDP during 2009-2012 in the OECD, with more than 6.5% growth rate.

Figure 1. Growth rates in the OECD

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) over the period 2004-2012 against annual average growth rates over the period 1993-2003 for all 34 countries in the OECD. Turkey's GDP per capita grew at an annual average rate of 1.29% in the 1993-2003 period; and Turkey ranked thirtieth in the OECD with this growth rate. On the other hand, Turkey had the fifth (after Slovak Republic, Poland, Chile, and Korea) highest average annual growth rate of GDP per capita in the OECD during 2004-2012, with a 3.07% growth rate.

Our objective in this study is to assess the roles of different factors (such as productivity, employment and demographics) on per capita income growth in Turkey during 2004-2012 in comparison with other OECD countries. Rather than trying to cover all relevant topics under

the theme of economic growth, we study the effects of productivity and some of the changes in labor market and demographics on per capita income growth. We decompose GDP per capita into three components: labor productivity, the ratio of employment to working-age population, and the ratio of working-age population to total population. This decomposition is useful to distinguish the overall population from the working-age population and provides insights for the implications of the changes in the age structure of the population (in addition to the changes in labor productivity) for economic growth.

We find that growth in output per worker accounted for 45.5%; growth in the employment-to-working-age population ratio constituted 39.0%; and growth in the ratio of working-age population to total population explained the remaining 15.5% of growth in per capita output in Turkey between 2004 and 2012. Our calculations show that output per worker was the most important component of per capita income growth for the 2004-2009 period. On the other hand, growth in employment-to-working-age population ratio made up around two-thirds of growth in per capita output during 2009-2012. In other words, our findings indicate a productivity-based growth era before the global crisis and an employment-based growth era in the post-crisis period.

We then provide further details to discuss our findings. Specifically, we focus on two extensions in regard to changes in productivity and demographics in Turkey. First, we examine the sources of growth and decompose changes in output per worker into different components, calculating the contributions of capital, labor, education, and TFP to growth. TFP growth is measured as the difference between the growth rate of output and the share-weighted growth rate of inputs. Based on the new and updated data from different sources, we show the quantitative importance of capital deepening and TFP growth for aggregate output per worker growth during 2004-2010. Second, we touch upon the issue of female employment in Turkey. One aspect of the demographic changes in Turkey is linked to the labor market via increased female labor force participation rates and elevated employment rates in recent years. This issue is important, since significant increases in national income may occur with women entering the workforce. Although increased in recent years, female labor force participation rates are still very low in a comparative perspective (around 30% as of 2012). Turkey is a

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particularly important case as, unlike in many other countries, female labor force participation has shown a downward trend over the last 50 years.[5] There has been an emerging literature in recent years to understand the link between the changes in the sectoral composition of economic activity and the changes in female labor force participation rates (Buera et al., 2013; Rendall, 2014 and the references therein). We present a decomposition exercise and show that female employment has been concentrated particularly in the service sector in Turkey.

Our paper is most closely related to the literature that seeks to understand the economic growth experience of Turkey. There are some very detailed studies to understand the historical growth experience of Turkey. For example, Altuğ et al. (2008) examine the determinants of long-term economic growth for Turkey over the period 1880–2005, conducting a growth-accounting exercise across broad historical periods and policy regimes for the Turkish economy. Adamopoulos and Akyol (2009) argue that the evolution of differences in sectoral productivity and taxes, between Turkey and the U.S., as well as Southern Europe, can account quantitatively for most of Turkey's relative underperformance to these regions between 1960 and 2003. Çiçek and Elgin (2011) use growth accounting and a dynamic general equilibrium model to study the growth performance of Turkey between 1968 and 2004. İmrohoroğlu et al. (2014) discuss that if Turkey had inherited Spanish agricultural productivity growth from 1968 to 2005, the growth rate of aggregate GDP per capita would have been much higher in Turkey. Adamopoulos and Akyol (2009) and İmrohoroğlu et al. (2014) employ multi-sector models of sectoral change and they are interested in the impact of inter-sectoral labour 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 show the importance of human capital and technology transfer in determining the output per worker in Turkey. Our paper complements these studies by exploring the recent growth performance of Turkey.[6] Moreover, we provide a comparison with other OECD countries during 2004-2012.

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[5] An investigation of the reasons behind the historically low female labor force participation rates in Turkey is beyond the scope of this study. See, e.g., Tunalı and Başlevent, 2006; World Bank, 2009.
[6] 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.

In addition, our study complements the 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. For example, Ceritoğlu and Eren (2013) study the potential impact of demographic changes on labor force participation rates in Turkey. They argue that under the assumption that the change in the structure of population will be accompanied with rising labor force participation rates and the number of college graduates, household saving ratio is projected to increase by 7.6 percentage points during 2010-2050. Arslan et al. (2014) study the effects of age structure dynamics of population on housing demand in Turkey and argue that housing demand may increase 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 age structure of the population).
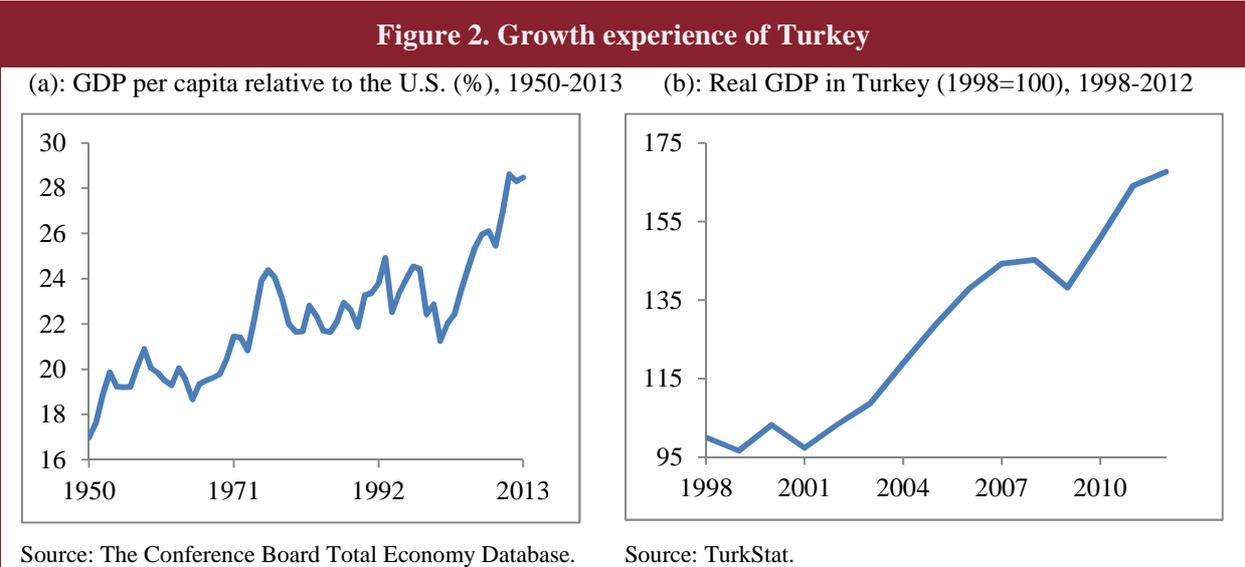
The rest of the paper is organized as follows: Section 2 delivers a brief account of the Turkish experience of economic growth and demographic change. Section 3 conducts a decomposition of GDP per capita growth in Turkey and renders a comparison with other OECD countries during 2004-2012. Section 4 enriches 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 on demographics and economic activity in Turkey with a focus on the increasing female employment rate and its intensity in the service sector. Section 6 concludes. Additional tables and figures are provided in Appendix A.

2. Some Facts

Panel (a) in Figure 2 shows GDP per capita in Turkey relative to the U.S. during 1950-2013.[7] The period of economic growth that had begun after the end of the 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 increased from about 22% of the U.S. level in 1980 to about 25% in 1993. In the vulnerable economic

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

environment of the 1990s, three major economic crises occurred and GDP per capita shrank to 21% of the U.S. level in 2001. The 2001 crisis paved the way for the introduction of structural and institutional reforms. GDP per capita relative to the U.S. reached more than 28% in 2012.

Figure 2. Growth experience of Turkey

(a): GDP per capita relative to the U.S. (%), 1950-2013	(b): Real GDP in Turkey (1998=100), 1998-2012

Source: The Conference Board Total Economy Database.   Source: TurkStat.
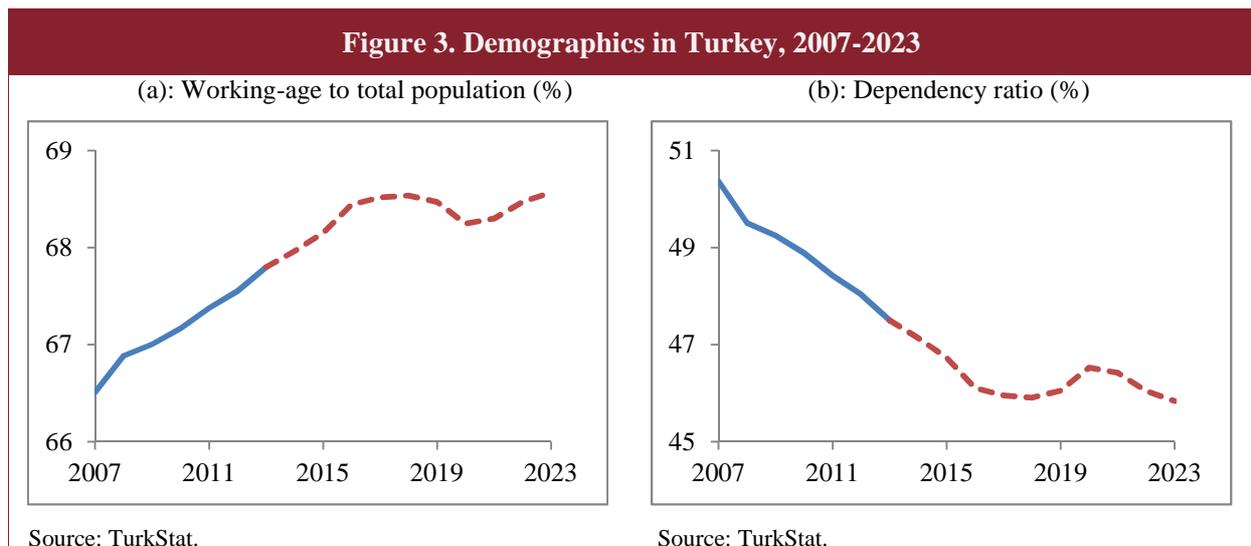
Panel (b) in Figure 2 displays the time-path of GDP (at 1998 prices) during 1998-2012, where the value for 1998 is normalized to 100. The 2001 crisis resulted in a substantial output loss and a 5.7% decline in real GDP. The economy came back from this deep growing at an average annual rate of 6.9% between 2002 and 2007. Especially, very strong growth performances were observed in 2004 and 2005 (thanks in part to the global environment); and the economy recorded a real growth of 9.4% in 2004 and 8.4% in 2005. Real GDP growth rate was 6.9% in 2006 and it was 4.7% in 2007. There were declines in growth rates in 2008 and 2009 due to the global crisis. Real GDP grew by only 0.7% in 2008, and contracted by 4.8% in 2009. Then, the Turkish economy recorded a real growth of 9.2% in 2010 and 8.8% in 2011. Turkey's rate of economic growth slowed to 2.2% in 2012.

In addition to these growth rates, there 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 2007-2023.[8]

The size of 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 total population increased from 66.5% in 2007 to 67.6% in 2012. The projections suggest that there will be further increases and this ratio will be 68.6% in 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) depicts that this ratio decreased 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, 2007-2023

(a): Working-age to total population (%)   (b): Dependency ratio (%)

Source: TurkStat.   Source: TurkStat.

Demographic transition offers growth opportunities to countries:[9] *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 a viewpoint of the supply capacity of any economy. *Second demographic*

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[8] Data for 2007-2012 are based on the Address Based Population Registration System (ABPRS), which was established in 2007, and data for 2013-2023 are from the projections of the TurkStat. One of the purposes of establishing the ABPRS is to establish National Address Database (NAD) that covers all addresses within the boundaries of the country.

[9] 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.

dividend, on the other hand, refers to permanent effects on growth. As the share of working-age population increases (and the shares of the young and old dependents decrease) total saving in the economy may increase, which may pave the way for 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 working-age population (L/WP), and the ratio of working-age population to total population (WP/P).[10]

$$(Y/P)_t = (Y/L)_t \times (L/WP)_t \times (WP/P)_t. \tag{1}$$

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

$$\frac{log[(Y/P)_{t+z}] - log[(Y/P)_t]}{z}$$

$$= \frac{log[(Y/L)_{t+z}] - log[(Y/L)_t]}{z} + \frac{log[(L/WP)_{t+z}] - log[(L/WP)_t]}{z}$$

$$+ \frac{log[(WP/P)_{t+z}] - log[(WP/P)_t]}{z}. \tag{2}$$

This formulation lets us to understand the magnitude of each contribution to per capita income growth, decomposing changes in output per capita into changes in output per worker (the first term on the right hand side), changes in the ratio of employment to working-age

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

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 we have discussed 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 working-age population in total population is increasing, i.e., less dependents per working-age adult. Thanks to this decomposition we are able to measure this effect directly. This framework provides guidance to our discussions throughout the paper.

3.2 Results for Turkey

We use the Turkish data to apply the accounting exercise presented in Equation (2). Our sample period is 2004-2012. This period incorporates the recent revisions for national accounts, labor market and population statistics. Especially, labor market and population data have been revised and new series are reported starting with 2004 in the Turkish Statistical Institute (TurkStat) publications.[11] In addition, this period is a (relatively) high growth period for Turkey as shown in Figure 1. GDP (at 1998 prices) data is from the TurkStat. Data for population and employment are from the "Labour Force Status by Non-Institutional Population, Years and Sex" table of the TurkStat.[12] Table 1 shows the results.[13]

During 2004-2007, per capita income grew at 5.19% per year and output per worker grew at 4.61% per year. In other words, growth in output per worker made up more than 88% of growth in per capita output between 2004 and 2007. This means that growth in output per worker accounted for most of the speed up in Turkey's GDP per capita growth during 2004-2007, with modest contributions from rising participation rates and increases in the working-age share of the total population. Similarly, declines in labor productivity are primarily responsible for the contraction of output per capita during the global recession (in the 2007-

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[11] The new series of household labour force survey began to be applied from 2004. In that regard, 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.

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

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

2009 period). The role of the labor productivity growth diminished in the post-2009 era. The most important factor for per capita income growth was the observed increases in employment-to-working-age population ratio during 2009-2012, i.e., growth in employment-to-working-age population ratio built up 64% of growth in per capita output.

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*
2004-2005	6.80	5.88	0.49	0.43
2005-2006	5.43	4.91	0.09	0.43
2006-2007	3.34	3.03	-0.12	0.43
2007-2008	-0.53	-1.52	0.63	0.36
2008-2009	-6.11	-5.34	-1.39	0.62
2009-2010	7.63	2.76	4.37	0.51
2010-2011	6.97	1.91	4.51	0.54
2011-2012	0.53	-0.69	0.82	0.41
2004-2007	**5.19**	**4.61**	**0.15**	**0.43**
2007-2009	**-3.32**	**-3.43**	**-0.38**	**0.49**
2009-2012	**5.05**	**1.33**	**3.23**	**0.49**
2004-2012	**3.01**	**1.37**	**1.17**	**0.47**
Source: TurkStat, Authors' calculations.				

Job creation and the enhancement of labor and employment policies have been at the center stage since 2008 (World Bank, 2013). A set of pro-employment incentives may be responsible for the increases in employment-to-population ratio in recent years. For example, OECD-ILO (2011) reports that measures, such as a general reduction of social security contributions, significant social security and corporate tax reductions for enterprises investing in less developed regions, taken to reduce non-wage labor costs and introduced from 2008 onwards have encouraged the recruitment of workers, increased employment outside agriculture and helped reducing informality. Industry and service employment is mainly concentrated in big cities and in a number of fast growing medium-sized cities, the so-called *Anatolian tigers*. These medium-sized cities created many new jobs for the low-skilled, outside traditional agriculture. OECD (2012) reports that starting from 2007 their employment rate increased; and in 2011, workers with primary education or less represented 55% of total workers employed.

Our findings are in line with the discussion provided by Gürsel and Soybilgen (2013). They use quarterly data within a similar framework to our analysis and underline the findings that a productivity-based growth dominated the per capita income growth before the global crisis; and the growth in the post-crisis period has been an employment-based one. 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 other OECD countries and report the contributions of different factors during 2004-2012. 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 displays that output per worker was the most important component of per capita GDP growth in Canada, Czech Republic, Denmark, Estonia, Finland, France, Korea, the Netherlands, Portugal, the Slovak Republic, Slovenia, the United Kingdom, and the Unites States before and after the crisis. On the other hand, in Australia, Austria, Belgium, Ireland, Japan, New Zealand, Norway, Poland, Spain, and Sweden, employment-based growth dominated the per capita income growth before the global crisis; and productivity-based growth dominated the per capita income growth after the global crisis. In that regard, these countries are the reverse cases of Turkey's experience we depict in Section 3.2.

Greece had the lowest average annual growth rate of GDP (measured in constant local currency) and the lowest average annual growth rate of PPP-adjusted GDP per capita in the 2004-2012 period in the OECD. Our findings show that growth in output per worker accounted for 68.7% of per capita GDP growth during 2004-2007, while the corresponding figure was only 7.1% between 2009 and 2012 in Greece. Declines in the employment-to-working-age population ratio are primarily responsible for the significant drop in per capita income during 2009-2012, accounting for 80.6% of that negative growth in Greece.

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

Country/Period	Contribution to output per capita of			
	Y/P	Y/L	L/WP	WP/P
Australia				
2004-2007	*1.82*	*0.36*	*1.36*	*0.10*
2007-2009	*0.63*	*0.92*	*-0.34*	*0.06*
2009-2012	*1.05*	*0.97*	*0.37*	*-0.29*
Austria				
2004-2007	*2.68*	*0.76*	*2.20*	*-0.27*
2007-2009	*-1.62*	*-1.82*	*0.18*	*0.02*
2009-2012	*1.55*	*0.91*	*0.61*	*0.02*
Belgium				
2004-2007	*1.76*	*0.51*	*1.04*	*0.20*
2007-2009	*-1.73*	*-1.39*	*-0.34*	*0.0004*
2009-2012	*0.30*	*0.54*	*-0.01*	*-0.23*
Canada				
2004-2007	*1.63*	*0.84*	*0.57*	*0.22*
2007-2009	*-2.26*	*-1.08*	*-1.16*	*-0.02*
2009-2012	*1.33*	*1.10*	*0.49*	*-0.27*
Chile				
2004-2007	3.89	0.52	2.85	0.51
2007-2009	0.11	-0.0004	-0.33	0.44
2009-2011	4.71	-0.34	4.82	0.23
Czech Republic				
2004-2007	5.92	4.74	1.05	0.13
2007-2009	-1.59	-0.90	-0.38	-0.31
2009-2012	1.02	1.40	0.59	-0.97
Denmark				
2004-2007	2.09	1.70	0.49	-0.10
2007-2009	-3.87	-2.71	-0.92	-0.23
2009-2012	0.28	1.69	-0.97	-0.44
Estonia				
2004-2007	8.78	5.27	3.61	-0.09
2007-2009	-9.58	-4.99	-4.38	-0.20
2009-2012	5.40	3.58	2.33	-0.51
Finland				
2004-2007	3.74	2.37	1.47	-0.10
2007-2009	-4.79	-3.62	-1.10	-0.06
2009-2012	1.26	1.38	0.56	-0.68
France				
2004-2007	1.50	1.16	0.30	0.04
2007-2009	-2.16	-1.33	-0.64	-0.19
2009-2012	0.77	0.90	0.29	-0.43
Germany				
2004-2007	2.61	0.55	2.10	-0.04
2007-2009	-1.89	-2.78	1.09	-0.20
2009-2012	2.63	1.26	1.34	0.03

Country/Period	Contribution to output per capita of			
	Y/P	Y/L	L/WP	WP/P
Greece				
2004-2007	3.30	2.27	1.26	-0.22
2007-2009	-2.10	-1.83	-0.07	-0.20
2009-2012	-5.78	-0.41	-4.65	-0.71
Hungary				
2004-2007	2.78	2.32	0.39	0.07
2007-2009	-2.91	-1.30	-1.52	-0.10
2009-2012	0.72	-0.60	1.41	-0.10
Iceland				
2004-2007	3.72	1.57	1.36	0.79
2007-2009	-4.05	-0.05	-3.97	-0.03
2009-2012	-0.20	-0.35	0.57	-0.43
Ireland				
2004-2007	2.74	0.60	1.67	0.47
2007-2009	-6.10	-0.46	-5.15	-0.49
2009-2012	0.06	2.85	-1.80	-1.00
Israel				
2004-2007	3.88	1.95	1.88	0.05
2007-2009	0.72	0.10	0.21	0.40
2009-2012	2.59	-1.16	4.15	-0.41
Italy				
2004-2007	0.83	0.37	0.82	-0.36
2007-2009	-4.14	-2.98	-0.98	-0.19
2009-2012	-0.55	0.08	0.56	-1.19
Japan				
2004-2007	1.69	1.20	1.33	-0.84
2007-2009	-3.26	-2.48	0.04	-0.82
2009-2012	1.97	2.20	0.31	-0.54
Korea				
2004-2007	4.25	3.37	0.68	0.21
2007-2009	0.70	1.14	-0.76	0.32
2009-2012	3.37	2.30	0.83	0.24
Luxembourg				
2004-2007	3.88	1.73	1.94	0.22
2007-2009	-5.05	-6.03	0.65	0.33
2009-2012	-0.56	-0.82	-0.12	0.38
Mexico				
2004-2007	1.53	1.76	-0.32	0.09
2007-2009	-3.09	-2.29	-1.34	0.55
2009-2012	2.97	-0.12	2.60	0.49
Netherlands				
2004-2007	2.87	1.61	1.33	-0.07
2007-2009	-1.43	-1.75	0.49	-0.16
2009-2012	-0.05	1.07	-0.65	-0.47

Country/Period	Contribution to output per capita of			
	Y/P	Y/L	L/WP	WP/P
New Zealand				
2004-2007	1.68	0.42	1.14	0.12
2007-2009	-1.17	0.09	-1.27	0.01
2009-2012	0.93	1.03	0.14	-0.24
Norway				
2004-2007	1.64	0.06	1.25	0.33
2007-2009	-2.05	-2.09	-0.08	0.12
2009-2012	0.27	0.37	0.02	-0.12
Poland				
2004-2007	5.44	2.06	2.93	0.45
2007-2009	3.24	1.28	1.73	0.24
2009-2012	3.05	3.97	-0.75	-0.17
Portugal				
2004-2007	1.33	1.20	0.23	-0.11
2007-2009	-1.60	-0.40	-1.05	-0.15
2009-2012	-0.70	2.05	-2.46	-0.29
Slovak Republic				
2004-2007	8.13	5.39	2.33	0.41
2007-2009	0.16	0.09	-0.08	0.15
2009-2012	2.82	3.47	-0.45	-0.20
Slovenia				
2004-2007	5.05	4.06	1.13	-0.14
2007-2009	-2.97	-2.18	-0.41	-0.38
2009-2012	-0.38	1.84	-1.81	-0.41
Spain				
2004-2007	1.98	-0.53	2.44	0.07
2007-2009	-2.67	2.30	-4.70	-0.27
2009-2012	-0.77	2.35	-2.51	-0.61
Sweden				
2004-2007	2.96	1.03	1.64	0.29
2007-2009	-3.70	-2.42	-1.10	-0.18
2009-2012	2.61	2.24	0.99	-0.62
Switzerland				
2004-2007	2.65	1.60	0.95	0.11
2007-2009	-1.17	-1.33	0.17	-0.01
2009-2012	0.84	0.43	0.56	-0.16
United Kingdom				
2004-2007	2.47	2.20	-0.03	0.31
2007-2009	-3.69	-2.52	-0.99	-0.19
2009-2012	-0.48	0.31	-0.24	-0.55
United States				
2004-2007	1.62	0.98	0.46	0.19
2007-2009	-2.48	0.59	-2.97	-0.09
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.

3.4 A Convergence Exercise

Here, we are interested in the question of what explains the convergence experience of Turkey (relative to the U.S.) during 2004-2012 as shown in Panel (a) in Figure 2. Following Equation (1), the relative GDP per capita for Turkey and the U.S. depends on the ratio of the three factors at time t:[14]

$$\frac{(Y/P)_t^{Turkey}}{(Y/P)_t^{US}} = \frac{(Y/L)_t^{Turkey}}{(Y/L)_t^{US}} \times \frac{(L/WP)_t^{Turkey}}{(L/WP)_t^{US}} \times \frac{(WP/P)_t^{Turkey}}{(WP/P)_t^{US}}. \tag{3}$$

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 U.S. Table 3 reports real GDP per capita, real GDP per worker, the ratio of employment to working-age population, and the ratio of working-age population to total population in Turkey relative to the U.S. during 2004-2012.[15]

Table 3. Sources of the convergence: Indicators relative to the U.S.				
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 U.S. was around 26%. By 2012, relative GDP per capita increased to around 32%. Output per worker increased both in Turkey

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[14] See Bello et al. (2011) for a similar decomposition for the growth experience of Venezuela.
[15] Data for the U.S. 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 available, we use GDP at PPP in constant 2005 international dollars from the World Development Indicators database for Turkey and the U.S.

and the U.S. with the relative factor of 0.43 in 2012. This factor is very similar to that observed in 2004 (that is 0.42). Similarly, the ratio of working-age population to total population escalated both in Turkey and the U.S. with the relative factor of 0.96 in 2012. This also is very similar to that observed in 2004 (that is 0.94).

Table 3 displays that the source of the convergence during 2004-2007 was aggregate labor productivity. During the global crisis of 2007-2009, declines in productivity gains in Turkey created obstacles for convergence, despite the relative improvements in the ratio of employment to working-age population and the ratio of working-age population to total population. In fact, average annual growth of labor productivity in Turkey during 2007-2009 was -3.37%. On the other hand, the corresponding figure for the U.S. was 0.40% in the same period.[16] Finally, the source of the convergence during 2009-2012 was the increases in the employment-to-working-age population ratio in Turkey (and the declines of this ratio in the U.S.). This ratio increased from 0.41 in 2004 to 0.45 in 2012 in Turkey; while it decreased from 0.62 in 2004 to 0.59 in 2012 in the U.S.

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

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

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

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[16] It is noted that in the downturn of 2008–2009, labor productivity actually rose as GDP plummeted in the U.S. (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 U.S. (Petrosky-Nadeau, 2013).

human capital h, while α and $(1 - \alpha)$ are the elasticities of output with respect to capital and labor, respectively. The term A is called total factor productivity, or TFP. TFP tells us not just how productive labour is, but how efficiently the economy uses all 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

$$y = Ak^{\alpha}h^{1-\alpha}, \tag{5}$$

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:

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

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

4.1 Data for Growth Accounting

How much output per worker growth is attributed by growth accounting to improvements in TFP and how much to the growth of 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. It is especially important to discuss the data for physical capital and human capital. We use the capital services data (at 1998 prices) calculated by Demiroğlu (2012) for the Turkish economy. The Demiroğlu (2012) 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. That index properly weighs different types of capital in accordance with their marginal product, and thereby provides an appropriate measure of physical capital. Demiroğlu (2013) emphasizes the importance of using such an index for the capital input,

given that some previous growth accounting studies on the Turkish economy fail to take sufficient account of the differences in the nature of different types of capital.

A proper measure of the growth of labor input should account for differences in the human capital of the workforce. Human capital is constructed using information on average years of schooling in the population over the age of 15. First, we obtain data on average years of schooling 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 5-year intervals from 1950 to 2010. We use a linear interpolation method to estimate missing observations. Linear interpolation does not create a major problem as Caselli (2005) states that average years of schooling moves slowly in the short-run. It is important to note 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.[17,18]

That being 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). Education is not the only dimension of human capital. Human capital includes skills and knowledge acquired by the population through formal education, on-the-job training, learning-by-experience as well as 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

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[17] We also use the education level in 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 is on annual basis, starts 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 data set and the calculated value for the year 2010 do almost coincide with the observation reported in the Barro and Lee dataset.

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

emerging and developing economies, because capital is relatively scarce in most of those remaining economies and thus its return is high. On the other hand, labor is cheap compared to advanced countries, leading to a lower labor share. In addition, recent studies for Turkey argue that the value of α is around 0.5. In that regard, Altuğ et al. (2008), Ismihan and Metin-Ozcan (2009), and Tiryaki (2011) provide discussions 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. Table 4 shows that capital deepening was the dominant factor during 2005-2007; and TFP growth was the dominant factor during 2004-2005 and during 2007-2010. The global economic crisis of 2007-2009 had a negative impact on economic activity; and growth accounting indicates that this fall in GDP per worker was due to a fall in TFP. Finally, TFP growth was responsible for the growth during 2009-2010.

Table 4. Sources of output per worker growth in Turkey (average annual changes, %)				
		Contribution to output per worker of		
Period	Output per worker	Physical capital per worker	Human capital per worker	Total factor Productivity
2004-2005	5.9	2.4	0.4	3.1
2005-2006	4.9	3.2	0.5	1.2
2006-2007	3.0	2.8	0.5	-0.3
2007-2008	-1.5	2.0	0.5	-4.0
2008-2009	-5.3	1.0	0.5	-6.9
2009-2010	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; and by contrast, it vastly improved in the 2000s, increasing to over 3% per annum. They find that, in the period 2002-2010, among the 98 countries for which complete data is available, Turkey ranks 7th in terms of TFP growth calculated through the Solow residual. Üngör (2013) also finds significant TFP growth in the post-2002 period. Economic reforms and institutional changes in the last decade could have triggered the TFP growth. The severity of the 2001 crisis was a turning point bringing about the introduction of different economic reforms. The objective of

these reforms was to establish macroeconomic and financial stability and improve the business environment. We do not aim to present a detailed overview of major macroeconomic developments and reforms in Turkey in the last decade.[19] However, it is important to mention some of the developments.

Among the institutional and structural reforms were the independence of the Central Bank of Turkey, the introduction of free-floating exchange rate regime, and the introduction of the inflation-targeting regime. In addition, there were economic reform programs to achieve fiscal discipline and improve the banking system; to meliorate the investment climate and speed up the privatization; to attract foreign direct investment and maintain a floating exchange rate regime. A related issue is the growth of higher-tech activities in the 2000s. Noting that these sectors are more productive than the low-tech sectors, OECD (2012) reports that the share of medium-to-high-tech sectors in Turkey's total manufacturing exports climbed from 30% to more than 60% during 2002-2008, and their share in total output rose from 23% to 30%.

5. Demographics and Female Labor Force Participation

We have discussed changes in output per worker in the preceding section; let us now turn to changes in participation rates, with a focus on rising female participation rates in Turkey. Here we investigate one specific channel regarding the second term of the right-hand side of Equation (1), which is the ratio of employment to working-age population (L/WP). In the period after the 2008 crisis, Turkey experienced a measurable increase in both employment and labor force participation. In Section 3.2, we have found that the most important factor for per capita income growth was the observed increases in employment-to-working-age population ratio during 2009-2012. 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. Turkey's significant improvement in female labor force participation since the mid-2000s came at a time of this significant employment growth. The labor force participation rates of men remained stable between 2005 and 2011 (panel (c) in Figure 4). On

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

the other hand, female labor force participation and employment rates increased even through the crisis (panel (d) in Figure 4).

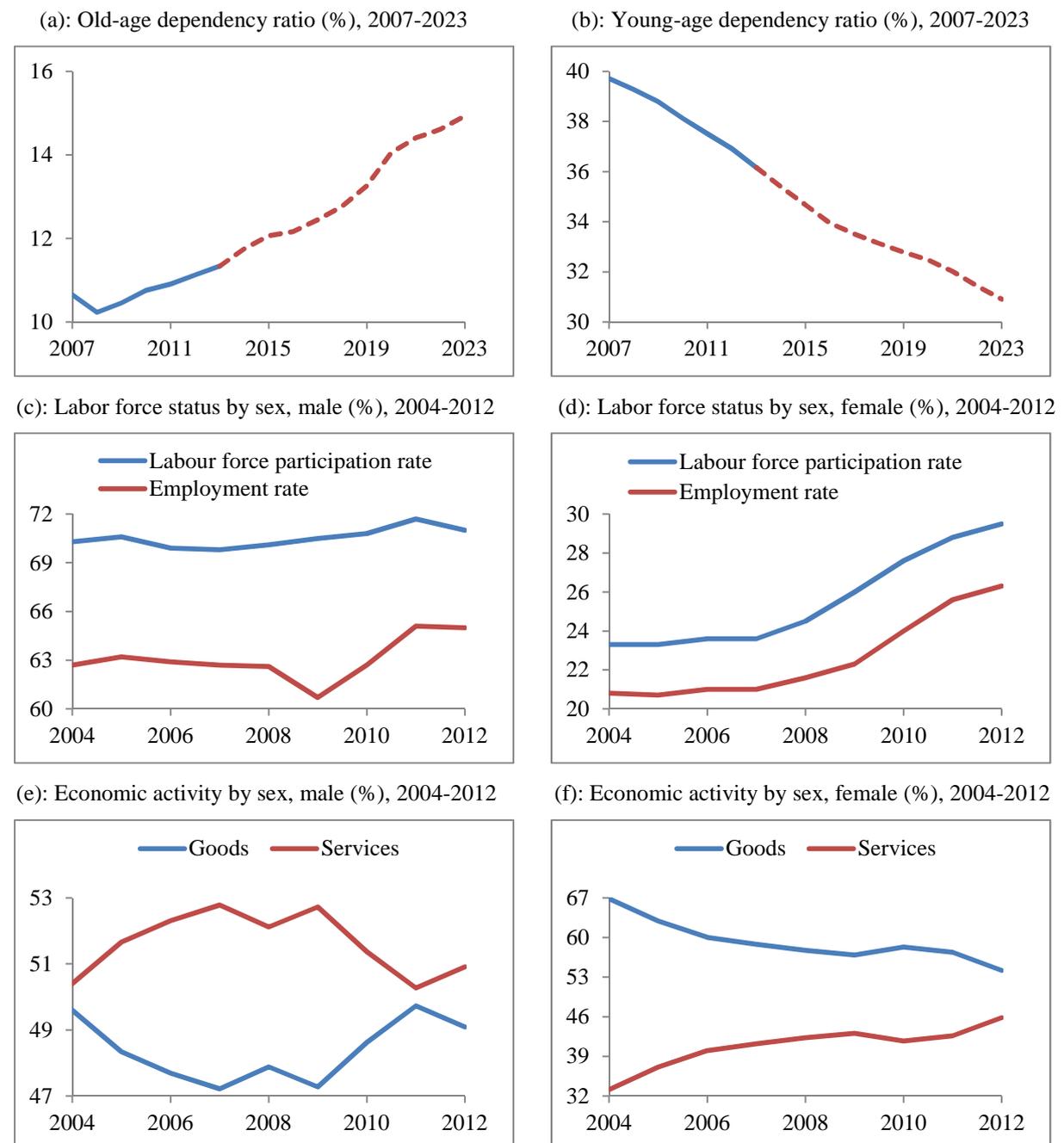## 5.1 Demographics and Economic Activity

Recall that Panel (b) in Figure 3 shows the decreasing dependency ratio for Turkey. This ratio has two components: the old-age dependency and the young-age dependency. The first two panels in Figure 4 display that the dependency ratio has been declining, 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 faster than growth in the working age population, which would push up growth of 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 2004-2012. Female labor force participation rate increased from 23.3% in 2004 to 29.5% in 2012 and a related issue is the service sector employment of women entering the labor force in recent years.

Panel (e)-(f) shows the sectoral employment shares for male and female workers in two broad sectors: goods and services.[20] Panel (f) clearly shows that women have been moving into the service sector. One aspect of the increased female employment rate is the economic policy. The integration of populations with low rates of participation in the labor market has been one of the prominent challenges that Turkey has been making a great effort to address. As stated before, Turkey implemented several labor market policy measures during and right after the 2008 crisis. In particular, to support the employment outcomes of the disadvantaged groups in the labor market, cost reducing subsidies targeting women and youth employment became effective in July 2008. Balkan et al. (2014) study impacts of the employment subsidies introduced in 2008 on the employment probabilities by demographic groups and find that the

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

females above 30 years of age have experienced a significant increase in their employment probability. OECD (2013a) comments that these labor market reforms have significantly reduced relative labor costs for youth and women.

Figure 4. Demographics and economic activity in Turkey

(a): Old-age dependency ratio (%), 2007-2023

(b): Young-age dependency ratio (%), 2007-2023

(c): Labor force status by sex, male (%), 2004-2012

(d): Labor force status by sex, female (%), 2004-2012

(e): Economic activity by sex, male (%), 2004-2012

(f): Economic activity by sex, female (%), 2004-2012

Source: TurkStat.

5.2 Female Employment Intensity

We present a decomposition exercise to show the increasing female employment rate and its intensity in the service sector, since the service sector accounts for more than half of the total employment in Turkey. The relationship between the increasing importance 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 and the aggregate service employment rate between 1985 and 2002 is 0.82 for a sample of 20 OECD countries.

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

$$\frac{L_{ft}}{L_t} - \frac{L_{f0}}{L_0} = \underbrace{\sum_j \alpha_{fj}\left(\frac{L_{jt}}{L_t} - \frac{L_{j0}}{L_0}\right)}_{\textit{Structural transformation}} + \underbrace{\sum_j \alpha_j\left(\frac{L_{fjt}}{L_{jt}} - \frac{L_{fj0}}{L_{j0}}\right)}_{\textit{Female intensity}}. \tag{7}$$

L_m and L_f denote employment by men and women, respectively, and L denotes their sum. L_{fjt} denotes female employment in sector j at time t. The sectoral employment is given by $L_{jt} = L_{mjt} + L_{fjt}$, where L_{mjt} denotes 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:

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

The results of this decomposition for Turkey are reported in Table 5 for the 2004-2012 period. The first column reports the total change in the female employment share, while the second column reports the proportion of this change that took place between sectors (*structural transformation*) and the third column reports the proportion of this change that took place within sectors (*female intensity*).

Table 5. A decomposition of female employment share			
		Contributions from (%)	
	Change in female	*Structural*	*Female*
Period	*employment share (%)*	*transformation*	*Intensity*
2004-2012	3.74	-8.07	108.07
Source: TurkStat, Authors' calculations.			

Table 5 shows that the female employment share increased from 25.71% in 2004 to 29.45% in 2012 (3.74=29.45-25.71) and the growing female intensity is explaining all of this increase (with explaining 108.07% of the change). Sak (2014) argues that female employment share is increasing due to the spread of shopping malls all around the Anatolian plateau in recent years. This provides 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. They find positive effects on female labor force participation from employment growth in trade, hotels, and restaurants and from employment growth in other services for a panel of countries.

We argue that the fact that only 30% of Turkish women are currently employed or are looking for work indicates that Turkey has to work hard to increase female labor force participation. To understand the growth impacts of female employment, we quote the following anecdote from Norway. Norway is the exact opposite case of Turkey in female employment figures. Labor force participation (and in particular female employment) in Norway is among the highest in the OECD. 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 factor being equal, fall by a value equivalent to our total petroleum wealth…" (Johnsen, 2012).

6. Concluding Remarks

In this paper, we have studied simple decomposition methods to understand the sources of the per capita income growth and their relations with selected demographic factors in Turkey. Our main findings are (i) growth in output per worker was responsible for per capita income growth before the global crisis (during 2004-2007); and (ii) the increases in the employment-to-population ratio were responsible for per capita income growth after the crisis (during 2009-2012). Increasing employment-to-working-age population ratio and the ratio of working-age population to total population will have positive contributions to per capita income growth in Turkey if the current trends are preserved.

In this paper, we have stated the link between the increasing female employment and its intensity in the service sector. We believe that studying female participation is important. In fact, employment among women will be especially critical in the years to come, as an aging population may place an increasingly severe burden on public finances. The possible consequences of the unprecedented increase in global population over the age of 60/65 are among the highly debated topics in academic and policy circles in both developed and developing countries. Population projections from the TurkStat show that the population of Turkey will continue aging: elderly population, which is the population at 65 years of age and over, was 5.7 million in 2012 (with a proportion of 7.5%) and this population will reach 8.6 million people with a proportion of 10.2% in 2023 (see Appendix A.1).

We are fully aware of the fact 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.[21]" Although a short period of time, the 2004-2012 era provides 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 important lessons. One can argue that cyclical factors and measurement issues may well dominate any trend change over a short period. Having this in mind, it is important to have productivity growth for long-term sustainable growth, since input-driven growth is inevitably limited (Krugman, 1994). In addition, focusing on selected demographic factors in an emerging country such as Turkey complements the previous studies on Asian countries. Growth miracles of some Asian countries and the close interaction of favorable demographic dynamics with their high-growth periods have been one of the reasons why demographics became popular among researchers (see, e.g., Bloom and Williamson, 1998; Bloom et al., 1999).

We suppose that our findings may stimulate thought-provoking questions for productivity dynamics and demographic changes in Turkey, considering that there has been an increase in research relating the demographic transition and economic development among macroeconomists (see Galor, 2012 and the references therein). Obviously a lot more research needs to be done on the topics we discuss in this paper. We argue that further research investigating the links between demographics and productivity growth may provide insight into cross-country productivity patterns, especially in the context of emerging markets (see, e.g, Feyrer, 2007; Ilmakunnas and Miyakoshi, 2013). For example, what are the key determinants of the processes of demographic changes and technological change and how do they interact with each other?

Getting answers to such questions are important for many developing countries in light of the so-called *middle-income trap* discussions. In that regard, it would be important for future research to examine the effects of demographic aging (such as increased longevity and reduced fertility) on 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 research 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

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

understanding of the dominance of the service sector in the overall economy. Finally, studying long-run interaction between demographics and growth, which is related to the second demographic dividend, would be rewarding. In particular, experiences of the industrialized Asian countries may shed light on the dynamics of this interaction.

Appendix A
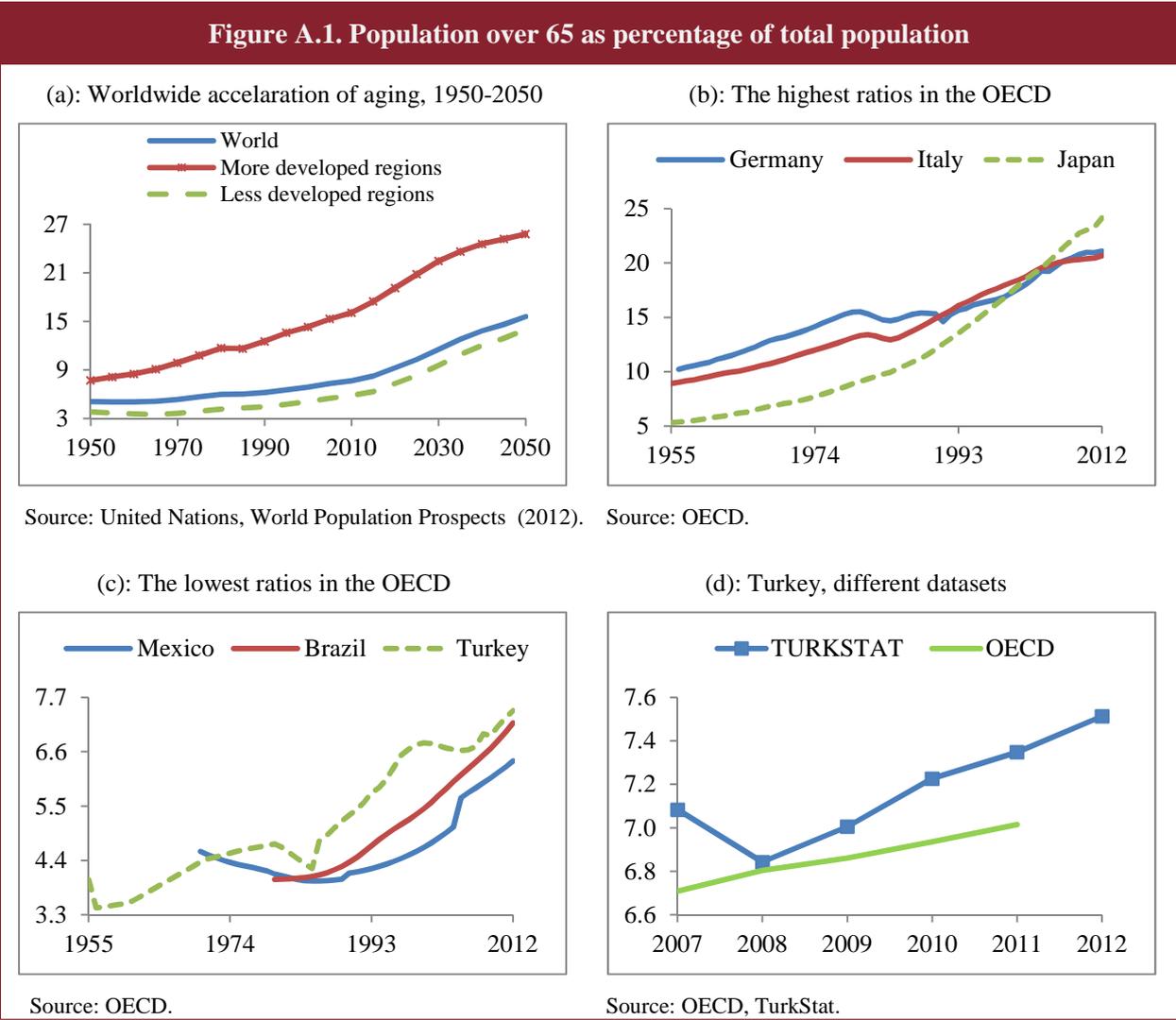
A.1. Global Population Aging

Panel (a) in Figure A.1 shows the proportion of elderly population by selected country groups (aged 65 years and over) during 1950-2050.[22] The projections of the United Nations imply that, at the global level, the share of those 65-plus rose from 5.1% of 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 other 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 work force and retirees. Moreover, the demographic developments leading to population aging and changes in age composition of the population are likely to affect the time paths of major macroeconomic variables significantly (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.[23] While aging is global, there are marked international differences in the speed and the extent of the aging processes, as shown in panel (b) and in panel (c). Panel (b) displays the ratios for Germany, Italy, and Japan. These three countries have the highest proportions of elderly population as of 2011 in the OECD. Japan is the most notable case, since the percentage of elderly in the population is not only highest among the

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[22] 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 in every five years, starting in 1950. We use the projections based on the medium fertility assumption of the database during 2015-2050. *More developed regions* comprise Europe, Northern 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.

[23] 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.

OECD countries but highest in the world. The share of the population aged 65 years or older rose rapidly to 24.1% in 2012 from 12.1% in 1990. The proportion of elderly population is lower in the emerging economies.

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) depicts the ratios for Brazil, Mexico, and Turkey. Mexico and Turkey have the lowest proportions of elderly population as of 2010/2011 among the OECD countries and Brazil has very similar ratios. Panel (b) and (c) show that aging had started earlier in the more developed regions and was beginning to take place in some developing countries. Panel (d) compares the OECD data for Turkey with the recent updates of the Turkish population statistics based on the ABPRS during 2007-2012. We calculate the population over 65 as

percentage of 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: http://www.mod.gov.tr/Pages/EconomicandSocialIndicators.aspx. Data for population and employment are from the "Non-institutional population by labour 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 of 1988-2003, decomposing GDP per capita growth into growth associated with changes in 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 grew at 2.19% per year. A negative contribution of the employment rate suggests that, had the employment rate 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 is negative at 0.6% per year.

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

| Period | Y/P | Contribution to output per capita of | | |
		Y/L	L/WP	WP/P
1988–1993	2.85	3.89	-2.05	1.01
1993–1998	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 decompose GDP per capita (Y/P) at time *t* into four components as follows:

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

The only change we introduce is incorporating the hours of worked into the analysis. Now, *hours* denotes annual hours worked per worker and $Y/(hours*L)$ denotes 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
2004–2005	6.80	4.94	0.49	0.43	0.93
2005–2006	5.43	4.50	0.09	0.43	0.41
2006–2007	3.34	4.74	-0.12	0.43	-1.71
2007–2008	-0.53	-0.94	0.63	0.36	-0.58
2008–2009	-6.11	-4.33	-1.39	0.62	-1.01
2009–2010	7.63	2.97	4.37	0.51	-0.21
2010–2011	6.97	2.60	4.51	0.54	-0.68
2011–2012	0.53	-0.20	0.82	0.41	-0.49
2004–2007	**5.19**	**4.73**	**0.15**	**0.43**	**-0.12**
2007–2009	**-3.32**	**-2.64**	**-0.38**	**0.49**	**-0.79**
2009–2012	**5.05**	**1.79**	**3.23**	**0.49**	**-0.46**
2004–2012	**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 growth era in the post-crisis period. Notice that the decomposition presented in Equation (A.1) allows us to analyze 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 on 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 1864 hours in 2011 and 1855 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. Employment to working-age population ratio in Turkey increased 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, 2004-2012

(a): Intensive margin (b): Extensive margin

Source: OECD (2013b), Üngör (2014). Source: TurkStat, Üngör (2014).
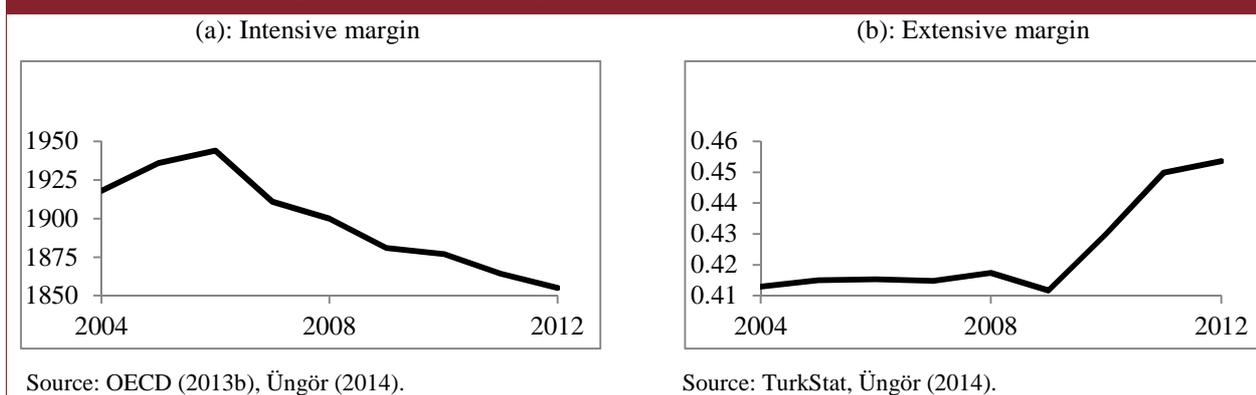
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