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Productivity, structural change and skills dynamics: Evidence from a half century analysis in Tunisia and Turkey

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Abstract

This article explores the contribution of structural change and the skill upgrading of the labor force to productivity in Tunisia and Turkey in the institutional context of the post-World War II period. Our growth decomposition shows that productivity is mainly explained by intra-industry changes for both countries during the import substitution period. Structural change played an important role in Turkey for a longer period of time than in Tunisia. Based on an instrumental variable regression setting, we find evidence that overall, the change in the share of high-educated workers had a causal impact on productivity levels in Turkey, but no such relation was found in Tunisia. Secondly, we show that this productivity increase has mainly been driven by the reallocation of higher educated labor between sectors rather than the absorption of highly educated workers within sectors. In Tunisia we do not find evidence of links between education demand and productivity. Moreover, the evidence from the instrumental variable regressions show that when we exclude the government sector in Tunisia, the overall skills upgrading is negatively associated with productivity growth, suggesting a downward return to educated labor demand over time.

Keywords: Productivity, Skills, Structural change, Tunisia, Turkey, MENA
JEL Classifications: J24, L16, 047, 053, 055, 057, N15, N17

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1 Introduction

This paper examines the respective contributions of reallocation and upgrading of skills to productivity. In most developing countries educational attainment has increased spectacularly in the recent decades. In the past, education had been often reserved to foreigners and the elite, in particular in countries with a colonial heritage. Its spread became widely considered as a vector for modernization during the first half of the twentieth century. Nevertheless, Pritchett (2001), in his contribution "Where has all the education gone?", shows that education does not always foster growth. One possible reason is the low quality of education supply which has been well documents. On the other hand, the roots of the stagnation of skills demand in many countries has yet to be understood.

A stagnation of skilled labor demand can result from low skill-biased structural change (a sectoral reallocation phenomenon) or the absence of within-sector skill upgrading. According to Hendricks (2010) within-industry gaps play a much higher role than structural change in explaining differences in education across countries. However, much of the development literature also shows the crucial role of structural change in explaining differences in incomes across countries (Restuccia et al., 2008). In the past half-century, the largest trend in structural change has been the reallocation out of the agricultural sector into more productive sectors. In the US, Caselli and Coleman II (2001) find that agricultural employment explains a large part of the different regional productivity rates. On a cross-country level, Duarte and Restuccia (2010) similarly find that there are large differences between countries in agricultural productivity, while Herrendorf and Valentinyi (2012) find that there is a larger gap between developing countries and the US in food, equipment and construction sectors. They find that the catch-up is higher in manufacturing than in others. Finally, McMillan and Rodrik (2011) find that that Asian countries caught-up faster over the long run while growth enhancing structural changes did not necessarily lead to the same impacts in Africa. McMillan et al. (2014) find that structural change contributed positively to growth in Africa since 2000 primarily due to increasing agricultural productivity and rising food and commodity prices.

Within sector changes are also an important predictor of productivity. In a cross-country analysis, Teixeira and Queirós (2016) found that human capital and product specialization are important determinants of economic growth. As countries move into more specialized goods and into more knowledge-intensive industries, the role of human capital becomes more prevalent. However, the interaction between human capital and structural change depends on the level of development of the country. Highly-developed (OECD) countries have a positive correlations between human capital and structural change over the longer period (1960-2011). While Mediterranean countries also demonstrate a positive correlation over the shorter term (1990-2011), the overall effect of human capital via specialization in high tech and knowledge intensive activities is negative. Their analysis suggests that pure resource reallocation to knowledge intensive industries does not increase growth for all countries. Buera et al. (2015) likewise find a correlation between demand for high-skilled labor and a compositional shift of value-added to sectors that are intensive in high-skilled labor.

It is, however, difficult to untangle the direction of causality because of the endogeneity of key variables. While Ngai and Pissarides (2007) argue that different rates of productivity explain structural change, Bárány and Siegel (2018) show that polarization, in terms of employment and average wage growth, resulted mainly from structural change from manufacturing to services .

Moreover, there is no clear pattern on the relative contributions of structural change and skill-biased technological change to total productivity in most countries. A case study in Germany, Schimmelpfennig (1998) shows that the contribution of structural change is higher than found by previous studies, which overstate the role of skill-biased technological change, while for Swiecki (2017), skill-biased technological change explains 43 percent of labor reallocation for the median country.

Our article first explores the contribution of structural change and skill upgrading of the labor force to productivity by looking into the post-World War II data in Tunisia and Turkey. The reason we choose these two countries is because both countries are labor rich developing countries, where the weak absorption of college graduate job seekers is identified as a particularly acute problem. In more recent years, the research shows that the 2011 Tunisian uprising, was motivated by frustration of thousands of unemployed educated youth (Gatti et al. 2013, Rijkers et al. 2014, Angel-Urdinola et al. 2015).

Following McMillan and Rodrik (2011) we decompose the overall productivity into within and between components, to see if labor productivity resulted from workers moving out of lower productivity sectors, like agriculture, to higher productivity sectors, like manufacturing, or, if productivity increased mainly because of changes within each sector. Using a similar method from Berman et al. (1998), we decompose the overall contributions to total skills upgrading to movement of high skilled workers between sectors and increased concentration of high-skilled employment within sectors. The next step consists of regressing labor productivity on the various indices computed. Because of the endogenous nature of the relationship between skills and productivity growth, our most convincing methodology relies on instrumental variables.

We find that the total skill upgrading has a causal impact on productivity in Turkey and its main driver is the skills upgrading between sectors, and not skills upgrading within sectors. In Turkey, we show that a one point increase in total skill upgrading increases sectoral productivity by 0.12 percentage points. More specifically, a one point increase in the reallocation of the share of highest skill between sectors increases productivity by the order of .26 percentage points. On the other hand, we do not find a similar effect for Tunisia. In fact, there does not seem to be a statistically meaningful association between total skill upgrading and productivity or productivity growth in Tunisia, except when excluding the public sector. This is similar to the literature on the broader low productivity findings in post-colonial states by Richards and et.al (2013). In this scenario, there is a negative impact of total skills upgrading on productivity growth due primarily to upgrading within sectors - this is likely a result of skills mismatching within sectors. The difference between results with and without the public sector is likely due to a concentration of skilled employment in the public administration.[1]

[1] Historically, this last phenomenon is due to the consensus of post-colonial elites to replace the colonial foreign elite with high-skilled workers in post-independence policy

2 Historical background

Overall, Turkey and Tunisia present a suitable point of comparison due to a number of similarities. They are both non-oil economies, with sizable domestic markets, on the European periphery. The macro policy framework in both countries went through a similar shift from the import substitution industrialization (ISI) period with a heavily planned economy roughly between 1960-1980 to the liberalization thereafter. The ISI period also involved reallocating labor away from traditional sectors, primarily agriculture. Finally, the human capital composition improved significantly between and within sectors over the course of policy shifts since the 1960s.[2]

However, there were significant differences between these two countries as well. Even though nation-state building, the modernization of the state, and late industrialization overlapped in both countries, the process started much earlier in Turkey, than in Tunisia. Turkey came out of the disintegration of Ottoman Empire as a nation-state in the 1920s, when most of institution building occurred. By the early 1930s, the nationalization of economy, effectively meaning the removal of non-Muslim elements, was almost complete. Concurrently, the Great Depression and disintegration of the world economy stimulated import substituting industrialization and state-entrepreneurship. Therefore, by 1960, Turkey had reached the end of the first stage of import substitution, producing most of non-durable consumer goods (processed food and textiles) domestically. Not least, the pre-1960 period did not see structural change, as Turkey was still a frontier country, as Hansen (1991) called, in the sense that the open land frontier prevented a large scale migration from rural areas and agriculture until the 1950s.

In Tunisia, we observe a similar process, but with a time lag. We can see the implementation of a mix of ISI and nationalization policies, starting from after the independence in the 1950s. Prior to this, Tunisia had a predominantly agricultural economy. Furthermore, the urban centers, trade and small scale manufacturing were controlled by the Europeans, who had settled in the country in the late nineteenth century. Indeed, the first industrialization experience was launched by the French in the 1930s to promote local manufacturing (tax exemptions, guaranteed credit, etc.) during World War II. However this industrialization period did not last long. Trade with Europe stopped abruptly and only resumed after the end of the war, quickly dismantling the burgeoning manufacturing sector (Bellin, 2002). The national census conducted in 1951 shows that Tunisian owned less than 10% of the largest manufacturing firms, as the local bourgeoisie preferred investing in land and commerce instead of manufacturing.

Between 1960-80, right after the early stages of the ISI period, Turkey started to produce consumer durables and intermediate goods. Even though there was a sizable public sector activity in manufacturing, more than half of the value added was created by the private sector. State interventions and government planning was complementary to the interests of state enterprises, which were large in scale and mostly invested in intermediate goods, and the private sector, which focused on the consumer good markets. The sharp policy reversal towards market liberalization, reduction of state intervention and export promotion took place in 1980 at the height of the political turmoil and the crisis of the ISI period. The swing was severe, requiring a comprehensive readjustment of prices and wages. Real wages dwindled; the prices significantly moved in favor of manufacturing and the agricultural subsidies were reduced. The combined

[2]See Karakoç et al. (2017) for a brief evaluation of industrialization over the whole 20th century. Chapters 11 and 12 of Hansen (1991) also provide a detailed evaluation of import substitution and liberalization after 1980.

result was the reinforcement of rural-urban migration. The symbiotic relationship between the large scale public enterprises and private sector also changed structurally. Small and medium scale manufacturing enterprises revived in the Anatolian cities, which had not been industrial centers previously, thus changing notably the spatial distribution of industry.[3].

Since the 1960s, the large sectoral shifts in employment coincided with significant improvement in skills acquisition in Turkey. In 1960, the average literacy rate was 38 percent. It steadily increased up to 95 percent in 2013 (TIUK, 2014). The literacy rate was twice as much for male as for female in 1960, yet the gap narrowed to negligible levels over time. As for the quality of education, while the student-teacher ratio in primary schools was 46 in 1960, it came down to 20 in 2013, indicating an increase in school quality.[4] The gross enrollment ratio in primary and secondary education increased from about 60 percent to 90 percent between 1960-2013, and even more remarkably, the rise in tertiary education gross enrollment rate increased from 5 to 95 percent over the same period. Therefore, the average education status over the long run was characterized by a steady increase in primary school enrollment and a much faster participation in secondary and tertiary schools. Unlike primary and secondary schooling, college enrollment picked up only after 1990s. The most important reform affecting enrollment was that the compulsory education requirement was increased from 5 to 8 years in 1997. However, despite this improvement, the education system has failed to produce a workforce with skills necessary for a diversified and technologically advanced industrial sector, which still produces basic goods without a high level of technological sophistication.

Tunisia faced similar barriers to developing its economy and workforce. After Tunisian independence in 1956, the government was preoccupied by the transfer public administration to Tunisians and the creation of sovereign institutions such as a central bank and a national currency. The post colonial period started off with a liberal economic model (1956-1961), but private investment did not take-off right away (Bellin, 2002). Starting from 1962, this period was followed by the adoption of a socialist agenda. As part of the new paradigm, in 1964 the government seized the 450,000 hectares of land of French settlers and collectivized the land of small-holders. However, the land seizure and collectivization policy ended in 1969 after its failure to deliver significant improvements, internal opposition of large landowners and the refusal of international donors, such as the World Bank, to continue financing the government. The absence of productivity gains, impeded any structural change away the agricultural sector during this period. Subsequently, liberalization coupled to a large-scale export promotion program "*Loi 1972*" was implemented at the beginning of 1970s and marked the beginning of the development of a manufacturing sector. Not coincidentally, this development was often spearheaded by former civil servants who became entrepreneurs benefiting from Government incentives.

Tunisia witnessed a deep economic crisis in the 1980s and a severe balance of payments crisis in 1986. These jointly led to the adoption of a structural adjustment plan, whose main purpose was to ensure macroeconomic stability. The plan required a strong devaluation of the local currency and tight monetary and fiscal policies (Naccache, 2009), as well as increased trade

[3]Filiztekin and Tunalı (1999) shows that the so-called "Anatolian tigers" heavily depended on low wages to be able to compete domestically and globally

[4]However, the student/teacher ratio did not change much in high schools. Also the doubling of the ratio for college level indicates the huge increase in college enrollment particularly after the 1990s.

integration and the gradual removal of price controls. The stabilization period was followed by an adjustment period, marked mainly by the liberalization of foreign trade[5]. Nevertheless, trade liberalization was not rampant in the mid to late 1990s. This was primarily because of preoccupations with social stability and protecting Tunisian firms from international competitors. Tunisia undertook labor reforms with the goal of increasing labor market flexibility while maintaining some form of protection to workers. The main reforms of the labor code took place in 1994 and 1996, but had a limited impact according to Angel-Urdinola et al. (2015). A competition law and a new investment code were established respectively in 1991 and 1993. Although several reforms took place with the aim of accelerating growth in jobs and productivity, the practice of cronyism, corruption, and rent extraction continued to foster to unequal access to business opportunities and limited competition (Rijkers et al., 2017).

However, the educational attainment was relatively high in Tunisia as compared to Turkey (Figure 3). Tunisia has a longer history of high and medium skilled workers than Turkey. While today, the literacy rate in Tunisia is 79 percent for adults and 97 percent for youth aged between 15 and 24 in 2014, in the 1970s and 1980s this was around 48 and 74 percent, respectively. Compared to other North African and Middle Eastern countries, this was also relatively high.[6] In 1991, mandatory schooling was extended from 6 to 9 years in 1991, increasing average schooling years for most students. As a result, while in 1984 the literacy rate for the working-age population was 37 percent, in 2014, the literacy rate increased to 81 percent.

In addition, the quality of schooling, particularly for younger students, improved substantially over the past few decades. According to UNESCO data, student-teacher ratios for pre-primary schools dropped by half from the 80's where the rate was around 30 school students per teacher, to 15.8 students per teacher in 2016. The trend for student-teacher ratios in primary, secondary, and tertiary schools was similar. In primary schools, the student-teacher ratios dropped from 47.5 in the beginning of the 1970s to 16.2 in 2016; in secondary school the ratios dropped from 27.8 in 1971 to 13.6 in 2011; in tertiary school the ratios dropped from 17.6 in 1972 to 15.9 in 2012. Although the effects on society are not easily measurable, the economic effects are yet to materialize. Contrarily to countries like Malaysia, which were able to quickly absorb the massive increase of educated workers produced by the public education system (Marouani and Mouelhi, 2015), in Tunisia the increase in education was accompanied by a massive unemployment of young graduates (30 percent on average and 40 percent for women)[7].

Based on this long run view, one can argue that by the time both economies embarked on structural change in the 1950s, Turkey had a solid manufacturing base, a large private sector, a policy experience and established institutions. The ISI policy in Turkey was more pro-business than Tunisia's socialist stance, adopted in the 1960s. While in Tunisia, the large public sector employment emerged as a result of Tunisia's unique post-colonial development, in Turkey, where nationalization, the emergence of Muslim economic elites, industrialization, and state-making all overlapped, we find a workforce that is primarily employed in productive private sector activities.

Historically, the development of the large public sector was a defining characteristics of the

[5]Including GATT (1989), the WTO (1994) and the free-trade agreement with the European Union (1995)
[6]According to statistics from UNESCO, accessible here : http://data.uis.unesco.org/
[7]Data extracted from INS website, available here: http://www.ins.tn/fr

post-war economies in the MENA. Owen and Pamuk (1998, 99-100) point out that this was typical of ISI strategy in the decolonizing developing countries, yet in the Middle East the state assumed an even bigger role. They identify three possible explanations: The absence of a strong private sector due to the departure or expulsion of the existing bourgeoisie, the nature of Arab socialist regimes, and the rapprochement with the Soviet Union. Issawi (1982, 7-8) emphasizes the importance of a peculiar ethnic division of labor in domestic economies in the long nineteenth century, which would later be destroyed by the economic nationalism, first in Turkey and then in Arab countries in the post-war years. While the non-Muslim minorities came to assume a large role in trade and manufacturing in Turkey, Syria and Iraq, the Europeans in North Africa played a similar role as a result of a long historical processes. Typically, at the top of this division of labor were Europeans, whose position was secured via a number of legal and economic privileges. The minorities provided administrative and occupational skills, constituting the skeleton of the local bourgeoisie. Then came the local Muslims cultivating land, and supplying unskilled labor. After World War I, this economic hierarchy was increasingly challenged by political and economic nationalism, which eventually led to the elimination or expulsion of the Europeans and minorities. Therefore, we can argue that the bigger the foreign influence in the economy, the more passive the nineteenth century state was, and the more likely the transitional state played bigger role. Along similar lines, Richards and et.al (2013, chapter 7) also argue that the caretaker states of the colonial era logically evoked their opposites during decolonization.

Reflecting the trends above, described in the historical context Figure 1 shows the sectoral composition of GDP since 1960s for both countries. Turkey seems to have witnessed a more clear-cut case of overall structural change: the share of agriculture steadily decreased from 33 to 10 percent, while manufacturing and services share increased structurally and significantly. Meanwhile, the share of public sector remained small, and in fact declined after the 1980s. In Tunisia, the composition of GDP shows two periods: one between before 1980 (mostly socialist period) where agriculture expanded and manufacturing grew perhaps marginally, and one after 1980 where markets more rapidly liberalized. In a certain sense, structural change was negligible before the beginning of the liberal period (1970s), when the share of agricultural productivity declined from 20 to 10 percent in favor of manufacturing and government sector. Overall, services interestingly remained stagnant.

Judging from employment shares in Figure 2, Turkey's trends are similar to Tunisia's but more marked. There was a sectoral shift from agriculture to manufacturing and services since the 1960s, and more pronounced employment trends after 1980. However, in Tunisia, before 1980, the share of government employment decline briefly, while the share of employment in manufacturing increased. Since the 1980s, agriculture declined in favor of services and government. Finally, Figure 3 shows that the Tunisian workforce was better educated in the 1960s than in Turkey, if measured by the percentage of employees with at least a medium level education. Since then, the number of those with higher than medium education steadily increased. Interestingly, there is a time lag between Tunisia and Turkey in the diffusion of education. We can see that Turkey's education attainment made a leap forward in the 1980s, one decade later than Tunisia. However, since 1980s, the average attainment level has increased exponentially.

3 Data and methodology

The decomposition analysis requires data on value-added by country and sector. Critically, to understand skills contributions, we also need to gather data on employment both by country, sector and by education level. There are several international databases with information on value-added per sector. Many contemporaries use data from the Groningen database for internationally comparable value-added data. Studies focusing on employment by sector can use sources such as the UNIDO data on employment by sector. However, matching between the two sources for employment by sector and education for both our countries was not possible. Instead, in a laborious effort, we returned to original data sources to extract data, reclassify and harmonize between the two countries. The end result is a 5-sector database that includes information on value-added by sector, and employment by education and sector.

For Turkey, the data on the educational status of employees for each sector is obtained from Turkish population censuses.[8] GDP per sector was used to proxy for value-added data and were gathered from official statistical yearbooks provided by the Turkish Statistical Agency (Turkstat). The national sources for the Tunisia data have been gathered through two main national surveys. The value-added per sector data was obtained through annual statistical books from the Development Plans and Institute of Statistics. Data on employment by education level and sector was gathered from periodic censuses and labor force surveys. Both value-added and employment by education statistics were cross-checked with the data from the Tunisian Institute for Competitiveness and Quantitative Studies (*Institut Tunisien de la Competitivité et des Études Quantitatives (ITCEQ)*.[9] Data on trade flows were gathered from CEPII-CHELEM database that includes several world trade statistics and calculated indicators (CEPII and de Saint Vaulry, 2008).[10] Further data used for macroeconomic controls were gathered from the World Penn Tables database (Feenstra et al., 2015) and the World Bank's Climate Change Knowledge Portal.

3.1 Decomposition analysis

There have been previous attempts to measure the contribution of TFP to growth in Turkey. Altug et al. (2008) finds that TFP contribution to growth remained at between 3-18 percent between 1950-1979, under different growth accounting specifications, and strikingly TFP growth was even negative in the agricultural sector. In contrast, its contribution increased up to around 30 percent between 1980-2005, most of which came from non-agricultural sector. They also decompose labor productivity into within and between-sectors components, finding that the sectoral shift component of labor productivity decreased over time (from 55 to 3 percent). Overall, it seems that during the transition from low-to-high productivity path, the importance of sectoral shifts declined, as the non-agricultural sectors dominate the overall picture with high productivity within sectors. Filiztekin (2000) furthermore finds that the improvement in the manufacturing productivity explains half of the value added growth. The nexus is particularly relevant for the sectors with higher trade exposure, as he documents that trade share within manufacturing Granger-causes productivity growth.

[8] Data is reported in census results for every five years from 1960 to 1990 and 2000. The years 2010 and 2015 can be found in the employment statistics in the database Turkish Statistical Agency.

[9] We are indebted to Monji Ben Chaabene for having shared his work with us.

[10] CEPII-CHELEM uses data from UNCOMTRADE. The advantage of using CEPII-CHELEM over UNCOMTRADE is that CEPII applies a harmonization strategy to improve the quality and representativeness of the data and creates useful indicators.

In Tunisia, there have been attempts to measure the decomposition of productivity in more recent decades. According to Marouani and Mouelhi (2015), productivity in Tunisia has more than doubled in the post-1995 period [11]. This suggests that the reforms implemented may have had a positive effect on productivity. However, during the years of this study, (1983-2995) the change was concentrated on the within sector component of productivity. Structural change was very low during the period before 1995 and nil since, while we would have expected trade liberalization and labor market reforms to enhance the inter-sectoral movement of resources.

In our paper, we followed the decomposition methodology employed by McMillan and Rodrik (2011) and Berman et al. (1998) to understand the respective contributions of within sector and structural change components to the overall productivity and skills upgrading in each sector and on the aggregate level. The two decompositions follow the same logic and are as follows:

- Productivity Decomposition, McMillan and Rodrik (2011)

$$\Delta P_t = \sum_{i=1}^{n} \Theta_{i,t-k} \Delta P_{i,t} + \sum_{i=1}^{n} P_{i,t} \Delta \Theta_{i,t} \tag{1}$$

- Skill Upgrading Decomposition, Berman et al. (1998)

$$\Delta Sk_t = \sum_{i=1}^{n} \Delta sk_{i,t} \Theta_{i,t} + \sum_{i=1}^{n} \Delta \Theta_{i,t} sk_{i,t} \tag{2}$$

where P_t is aggregate productivity, $P_{i,t}$ is sectoral productivity, $\Theta_{i,t}$ is the share of sector i in total employment, Sk_t is the share of highly educated labor in total labor and $sk_{i,t}$ is the share of highly educated labor by sector.

The workforce in Tunisia and Turkey showed improvements in levels of education from the 1960s to the 2010s (see Figure 3). Tunisia started the 1960s with a higher percentage of secondary degree educated workforce and relatively less percentage of individuals with no, primary or only *khitab* (or religious schooling) education than Turkey. However, in the 2010s the profile of the workforce in Turkey matched that of Tunisia, suggesting a rapid catch up in the skills base of the workforce.

Productivity Decomposition The trends in the evolution of productivity for Tunisia and Turkey demonstrated stark differences over the past half a decade (see Figure 4). For Tunisia, overall productivity after independence was relatively large but fluctuated in the following years. The within component explained most growth from the 1960's to 2015, except from the time between 1994 and 2000 where the between component explained more of productivity increases. The trend for Turkey is quite different. While the within component explained much of the change from the 1960s to 1975, reallocation of resources explained the lion's share of

[11] This is in comparison to the 1983-1995 period.

productivity from 1975 to 2000. It was only until the period of 2000 to 2006 that the within component became a dominant factor of productivity growth. In addition, while overall growth in productivity doubled from 1975 to 2006, it sharply dropped thereafter. In the years capturing productivity trends between 1975 and 2000, the between component explained over half of productivity growth, but from 2000 onwards, much of productivity was explained by the within component.

There has been quite a bit of volatility in the composition of productivity over the past 50 years in Tunisia. The results of the percentage shares of the productivity decomposition in Figure 5 (Panel Tunisia) show us that from the 60s to the 70s the total productivity primarily composed of a large change of within sector productivity, and a negative contribution from the reallocation across sectors. The relationship changed in the 80s, when Tunisia's productivity became more determined by reallocation of across industries. The first period saw the end of restrictive regulations on ownership and investment, and the beginning of windfall tax incentives for foreign investors in the investment law of 1972 (*la Loi 1972*), bringing Tunisian industry towards a more export-oriented activities in the decades to follow. The next few decades corresponds to the structural adjustment period which cut agricultural subsidies and led to a switch from import-substitution to export-orientation. The relationship changed again in the 2000s on-wards where we observe the resurgence of productivity within sectors as the main (and almost the sole) driver of productivity, as in the findings of Marouani and Mouelhi (2015).

In Turkey, the story is a bit more marked (Figure 5, Panel Turkey). Like Tunisia, the productivity in Turkey in the 1960's was dominated by the within component of productivity decomposition. In the 1980s, the reallocation of resources had a dominant role in productivity. From the 1980s to 2000s, reallocation between sectors was still an important component of productivity but gradually lost ground to the within component. This occurred at the same time as the periods of ISI policies and the initial phase of opening up to global markets. From the 1990s onward, productivity within sectors gained ground. The timing of this change coincides with a reversal of political openness to global markets, a reduction of state interventionism and export promotion. It also coincides with the changes in educational reforms.

In Tunisia and Turkey, the between and within trends in productivity vary by sector (Figures 6 and 7). In Tunisia's agriculture sector, and to some extent in manufacturing sector, most of the productivity is driven by within changes, while in services, productivity is equally about reallocation of labor. Productivity in Tunisia's agricultural sector is dominated by within changes for most of the periods in the last 50 years, while the other sectors do not demonstrate any notable patterns except for in government where changes within sectors explain productivity more in later years. In Turkey, the agricultural sector plays less of an important role, but manufacturing and services are rather important sectors and both structural change and within sector upgrading are important determinants of overall productivity. Like in Tunisia, the Turkish service sector, is growing in productivity. It is also mostly dominated by the between component of the productivity decomposition in earlier years, but it is overpowered by the within component in later years.

On sectoral level, we observe that both countries have growth in the share of employment in the agricultural sector and services. In Tunisia, we observe mostly stable and low levels of productivity per sector but steady changes in the share of employment across most sectors

(Figure 8). As expected, the employment share in agriculture dropped substantially, while the share of employment in services increased. While we observe some increase in the share of employment in government, the share of employment in construction remained minimal, and the share of employment in manufacturing stayed more or less constant over time. In Turkey, the trends were similar, with a sharp drop in the share of employment in agriculture over the 50 year period, and a large increase in the share of employment in the services sector (Figure 9). Like Tunisia, the share of employment in the services sector rose. However, unlike in Tunisia, the share of employment in the Turkish manufacturing sector also steadily rose. This suggests that while in Tunisia, the low productivity government sector employment may have expanded and obstructed the contribution of skills to sectoral productivity, in Turkey this is was not the case.

Skills Decomposition The evolution for skills decomposition for Tunisia is more or less continuously positive over the entire period (Figure 10). There was only a marginally negative contribution that came from changes within sectors in 1989 and in 2015, and a negative contribution of structural change to productivity in our first period from 1967 to 1975. In Tunisia, skill upgrading (or the change in the overall share of high skilled employment) from the 1960s to 2015 was primarily due to the reallocation of skills to different sectors. Once we approach the 90's to 2010, total skills-upgrading starts becoming due, to a larger part, to each sector containing a larger share of high skilled workers. The swell of high-skills within sectors that does not coincide with an economy shifting towards more productive activities (c.f. Figure 12 and 5), set the background for the 2011 Jasmine revolution, and provides fuel for frustration among unemployed, high-skilled youth. At the same time, jobs for high-skilled workers in the government services and public sector (Figure 8), with low to no tangible productivity, still accounted for a relatively high share of employment at that time.

In Turkey, the skills composition of employment was more volatile than in Tunisia. In the period after ISI and a more command-led economy, substantial growth of educated labor force working within sectors was an important component of overall skills-upgrading. In the later period (1970-1975), moving high-skilled workers between sectors actually negatively contributed to overall skills-upgrading. In the following periods until 1990, skills-upgrading within sectors had an overall negative contribution to overall skills upgrading. Like Tunisia, the between component of skills upgrading, capturing the increase of employment in sectors requiring high skilled workers had an important rol in most of the periods from the 1970s. The remarkable negative contribution of the within component of skills upgrading from 1980 to 1985, suggests a loss of relative education levels of workers within sectors. This may have been a temporary result of the gradual opening of the economy to global economy, at the same time as the sharp improvement of the mandatory years of education keeping some workers temporarily out of the labor market.

4 Modeling productivity decomposition for regression analysis

The rest of the paper aims to document the relevance of skill-biased structural change on sectoral productivity in Turkey and Tunisia. As documented in the previous sections, reforms and modernization since the 1960s resulted in rapid structural change and productivity in both countries. Moreover, as in many other parts of the world, average years of schooling, as well as the share of university graduates in total labor force increased significantly in both countries, and yet the contribution of skills upgrading to productivity is largely overlooked in the literature. We aim to fill this gap by quantifying the impact of skill upgrading on productivity in this comparative case study.

Our main aim in this section is to estimate the contribution of each of the following measures of skill upgrading to productivity growth:

- **Total skill upgrading:** increase in the share of the highest skilled category of labor in total employment,
- **Skill upgrading within sectors:** increase in the share of the highest skilled category of labor in total employment due to the within sector component,
- **Skill upgrading between sectors:** increase in the share of the highest skilled category of labor in total employment due to the between sector component. This is also known as Skill Biased Structural Change (SBSC).

Estimating the causal impact of skill upgrading on productivity is admittedly a very difficult task given limited data availability and the endogenous nature of relationship between productivity and skills. In our attempt to establish a sound empirical link between the two, we face the following challenges. First, structural change is a long run phenomena, whereas the data on sectoral employment by education starts only from 1965 for Turkey and 1967 for Tunisia. Education data is based on censuses for Turkey and it is available for every 5 years with the exception of 1995. In order to maximize the number of observations, we rely on decompositions at the sectoral level rather than using economy wide productivity growth.

The sectors that are commonly available in the official statistics of both countries are agriculture, manufacturing, construction, services and public administration. This leaves us a total of 50 observations by five sectors on skill upgrading for Turkey for the years: 1965, 1970, 1975, 1980, 1985, 1990, 2000, 2006, 2010 and 2015. For the upskilling decomposition variables, each year refers to the span between that year and the previous year. The first year off data in Turkey is 1960, and therefore the upskilling variables for the data point 1965 refers to the span from 1960 to 1965. The data for Tunisia is more abundant and yet more irregular spanning the years: 1967, 1975, 1984, 1989, 1994, 1997, annually between 2000 and 2007, and again for all years between 2010 and 2015, all of which provide 95 potential observations. Using annualized data, we choose to keep similar period gaps between the years in Turkey as in Tunisia to avoid too much noise in regressions. The years used in Tunisia are 1975, 1984, 1989, 1994, 2000, 2006, 2010, and 2015. The first year of available data in Tunisia is 1967. Since years in which data is available for both countries do not perfectly overlap (especially for the period before 2000) we prefer to run separate regressions for both countries to maximize the observations per country.[12] We acknowledge, however, that the small sample size is an important problem which may cast doubt on our estimations. Hence our results should be interpreted with caution.

The second challenge is that skills and productivity are highly endogenous and it is notoriously difficult to isolate the independent effects of the two. Our main variables of interest are

[12]More specifically, pooling the data results in a total of 70 observations of country-year pairs, 35 for each.

the total skill upgrading, skill upgrading within sectors and skill upgrading between sectors and we use each of them one at a time. Given the nature of endogenous relationship between skills and productivity growth, it is ideal to use Arellano-Bond type system GMM estimators. However, there are reasons why that is not possible in the case of Turkey. First, we have only 50 observations for a total 5 sectors in Turkey, which can lead to problems of over-fitting and instrument proliferation taking into account the fact that the time dimension is larger than the cross section, i.e. $T = 10$ versus $N = 5$. Pooling the Turkish and Tunisian data does not solve the problem, as in that case we would need to drop the sectors and use the overall decomposition results for the two countries.[13] Doing that would reduce the sample size even further without providing any added benefit for a sounder estimation strategy. Instead, our empirical strategy relies on first documenting the correlations based on OLS estimations, and then with the available data at hand, trying to investigate whether skill upgrading has a causal impact on productivity growth using three different sets of instrumental variables for Turkey. For Tunisia, we follow the same procedure.

Our first set of instruments is the lagged values of skill upgrading for each of the three measures that we defined above, plus the lagged values of share of university graduates in each sector as a percent of the total economy wide employment. In later specifications, we also include the lag of the share of university graduates in all other sectors, excluding the sector in question. Since the data is available for every five years for Turkey, the instruments that we use are the fifth lags. For Tunisia, since the data is irregular, we use the first lagged value available if there are more than 1 year apart between two observations (such as using skill upgrading between 1967-1975 for predicting skill upgrading between 1975-1984) and lag $n - 5$ when observations allow (such as using skill upgrading from 2005 to 2010 to predict upgrading from 2010-2015). Our identifying assumption is that the lagged values of skill upgrading and the sectoral share of university graduates in economy-wide employment affect productivity only through their impact on current skill upgrading and there is no direct association between current productivity and the lagged values of our instruments. Although our instruments pass commonly used identification tests in most specifications, these are admittedly strong assumptions which may, in fact, not hold. Hence we relax these assumptions one by one and try other instruments as explained below.

In our second set of specifications we replace the lagged values of skill upgrading with an indicator that proxies the technology intensity of European Union exports to the rest of the world. The instrument that we use to predict skill upgrading comes from the CEPII-CHELEM database and it measures the degree to which the goods are processed by sectors. This variables captures the competitiveness of European goods in international markets by weighing the value of net trade flows from European countries to the rest of the world with the value of all trade. They refer to this indicator as the revealed comparative advantage (RCA). [14] Using 2010 as the base year, our indicator is estimated through the following method:

$$RCA_{i,k} = 1000 * \frac{W_k}{YPPA_i}\left[\frac{X_{i,k} - M_{i,k}}{W_k} - \frac{X_i - M_i}{W}\right] \quad (3)$$

[13]More specifically, pooling the data means year-sector pairs would not be unique any more as there are two pairs for each year and sector when Turkey and Tunisia are combined.

[14]We use the second version of this indicator. The advantage of using the second version over the first is because the later version is weighed by total world exports (rather than just all other exports), measured in current USD PPPs and includes trade in services. In addition, we also control for the RCA of exports from each country to the rest of the world.

where W represents world exports; $YPPA$ is GDP measured in thousands; X represents exports; and M represents imports for each good k and country i. The indicator is later classified into categories of goods that correspond to their place in global value chains as determined by CEPII. The data is grouped in 6 different levels of goods, including primary, basic manufacturing, intermediary goods, equipment, mixed products and consumption goods. To give a more concrete example of how this works, a car is classified as a final consumption good, but the parts that make up the car, such as the wheels, are classified as intermediate manufacturing goods, and the rubber (from the rubber tree) that makes the wheels as a primary good. Further description of the type of goods in each category is available in Table 1.

This classification can be viewed as an approximation for the technological content of the goods. If we consider technology from a more historical view, the development of rubber into a wheel is the next step on the value chain and technologically more advanced than the extraction of the rubber from the tree itself. It can therefore proxy an increase (or simply any change) in the demand for types of goods. However, we acknowledge that this classification does not capture advances in the quality of the final goods. For example, cobalt, a mineral extracted from the ground, is classified as a primary good. The use of cobalt to produce batteries involves intermediate manufacturing processes, but with a few screws, metals and glass, the batteries become a part of a final good, a cell phone. While one can argue that there is technological advancement that is captured by the use of raw material for a final product, this does not capture the difference between a basic (yet sturdy) Nokia phone and an i-phone type smart phone.

In using this measure, we rely on the assumptions that *i*) both Turkey and Tunisia are small, price-taker countries whose supply of goods do not significantly impact world demand, or significantly pose any dumping or anti-competitive risks, and *ii*) that world trends are exogenously determined outside of Turkish and Tunisian internal industrial and educational trends. We then make the critical identifying assumption that an increase in the technology intensity of European exports to the rest of the world has a direct impact on skills demand and incentives for skill upgrading in Turkey and in Tunisia, but otherwise have no direct impact on the sectoral productivity. In other words, we assume that sophistication of EU exports to the rest of the world affects sectoral productivity in Turkey and Tunisia only by changing the incentives to whether or not to employ high skilled labor in Turkey and Tunisia due to export competition. This might be a strong assumption to make however, as explained above, we argue that Turkey and Tunisia are small open economies for which the technology intensity of EU exports to the rest of the world should be exogenous and it should have an impact on productivity in our countries only by realigning the sectoral allocation of skilled labor.[15]

We are aware that there may also be an impact of increasing technological intensity of European goods on the demand for more technologically advanced equipment and processes, that may then directly impact productivity. However, given that the indicator is calculated in relative terms, technological catch up should theoretically remain the same for global economies keeping the place of Tunisia and Turkey in terms of the race to the technological frontier, stable. For example, if the absolute value of competitiveness of European cars increases (prices drop) due to advancements in the production process or innovation adoption, the relative competitiveness would only change if there was no transfer (diffusion or use) of technology. In reality, some

[15] As will be explained below our instrument passes the basic identification tests, at least for Turkey.

firms may have a first mover advantage, but this does not last for long, and we do not expect this to have long term impacts. Secondly, for countries not on the limit of the technological frontier, we do not expect innovation to be a confounding factor, nor do we expect increasing technology in other countries to improve the *rate of innovation* in our countries.[16] Lastly, we use this instrument as one of many different instrumental regressions, so that the reader can decide on which instrumental variable may be more credible.[17]

Relying on these assumptions, we construct our instrument as follows: we create a new variable where we assign CHELEM's *i*) technology intensity of EU agricultural exports for predicting skill upgrading in agricultural sector in Turkey and Tunisia, *ii*) technology intensity of EU intermediary goods exports for predicting skill upgrading in manufacturing sector in Turkey and Tunisia, *iii*) technology intensity of EU equipment exports for predicting skill upgrading in construction sector in Turkey and Tunisia, *iv*) technology intensity of EU consumption goods exports for predicting skill upgrading in services sector in Turkey and Tunisia, and finally we assign 0 in predicting skill upgrading in for government services in Turkey and Tunisia.

In the third set of instruments, we drop the sectoral share of university graduates in total employment all together and use CHELEM's technology intensity of EU exports to the rest of the world, its square and the interaction of the intensity measure with old age dependency ratio (elder individuals as a % of working age population) for Turkey and Tunisia. Old age dependency captures the empirical regularity of quantity-quality trade off in fertility decisions which should directly affect the incentives for skill upgrading. However, old age dependency ratio does not vary by sectors. Hence by creating the interaction term, we hope to capture how the change in demographics in Turkey and Tunisia interplay with technological sophistication of rival exports for different sectors.[18]

In the fourth and final set of instruments, we include the sectoral share of university graduates in total employment as well as the share of university graduates in employment in all other sectors except for the sector at hand. The logic of this is twofold. The level of education demand in other sectors has a direct impact on education demand in each sector, via labor market clearing channels and competition for limited supplies of highly educated workers, such that the instrument is likely valid. Secondly, it descriptively satisfies the exclusion restriction as it is not credible that it would have any direct effect on sectoral productivity estimates except through its impact on skills demand within the excluded sector.

Using OLS and 2SLS, we estimate the following equation for each country:

$$\Delta y_{i,t} = \beta_0 + \beta_1 \Delta Skill_{i,t} + \beta_2 \Delta X_{i,t} + \beta_3 \rho_t + \Delta W_t' \gamma + \lambda_i + \tau_t + \epsilon_{i,t} \quad (4)$$

where $y_{i,t}$ is the log of productivity and productivity growth (percentage change in value added per worker) in sector i between $t-1$ and t; $\Delta Skill_{i,t}$ is either *i*.) total skill upgrading, or, *ii*.) between skill upgrading, or *iii*.) within skill upgrading in sector i between $t-1$ and t; $\Delta X_{i,t}$ denotes the change in relative comparative advantage (RCA) of Turkish or Tunisian exports which we extract from CEPII and de Saint Vaulry (2008) database. We are able to match CHELEM's

[16]This can be checked with additional robustness tests on patenting in Tunisian and Turkish economics.

[17]In any case, all regressions point towards the same outcomes.

[18]The rationale for including the square of technology intensity of EU exports is twofold; first we contemplate that sophistication of rival exports might have second order effects on skill upgrading in countries in question. And second, Dieterle and Snell (2016) suggest that using only linear first stages may miss important information about effect heterogeneity and instrument validity and recommend including a quadratic in the instrument in the first stage.

relative comparative advantage data with agriculture, manufacturing and services properly, however since there is no comparable RCA for construction and public administration sectors, we assign zero for the two sectors. In OLS specifications, we also control for EU comparative advantage using the same methodology, but not in 2SLS. ρ_t is the average rainfall provided by the World Bank's Climate Change Knowledge Portal.[19] ΔW_t denotes real capital stock growth (at constant 2011 national prices) and change in human capital index between $t-1$ and t, both of which we take from the Penn dataset.[20] And finally λ_i denotes sector effects and τ_t year effects.

We start with baseline OLS estimations for Turkey and Tunisia in Tables 2 and 3. Columns (1), (4) and (7) shows the raw correlations between productivity and *i*) total skill upgrading, *ii*) skill upgrading between sectors, and *iii*) skill upgrading within sectors when only the year effects, sector effects and sector specific linear trends are controlled. The basic estimations show that there is a negative and but not statistically significant association between total skill upgrading and productivity growth for Turkey and a negative and significant association for Tunisia. When we look at the association between productivity and skill upgrading between sectors and within sectors separately, we see that skill upgrading between sectors, i.e. skilled biased structural change in column (4) is positively but not statistically significantly associated with productivity growth with a coefficient of 0.09 percentage points for Turkey. In Tunisia it is again, negatively and significantly associated with productivity with a magnitude of 26 percentage points. [21] Likewise, in Turkey, upgrading skills within sectors is positively associated with productivity (and to a higher magnitude than upgrading of skills in sectors through reallocation), while it is negatively, but not significantly significantly associated with productivity in Tunisia.

In columns (2), (5) and (8), we include rainfall, real capital and human capital stock growth and in columns (3), (6) and (9) we also include the change in the relative comparative advantage of national exports and EU exports as two additional controls. Our estimations show that with additional controls, skill upgrading between sectors is still positive and not significantly associated with productivity for Turkey and that total skills, within sector and between sector skill upgrading is negative but either weakly or not significantly associated with productivity in Tunisia. In terms of magnitude, both columns (8) and (9) show that a percentage point increase in skill upgrading between sectors is on average associated with 0.07 point increase in productivity for Turkey. The change in real exchange rates was negatively associated with productivity in Turkey, but not in Tunisia. This may be due to the fact that in Turkey, exchange rates were fixed over most of the period of analysis, and used as a tool to improve competitiveness. While this was also the case in the earlier periods in Tunisia, exchange rates were floated at an earlier period. Interestingly, average rainfall negatively affects productivity in Turkey, whereas it has a positive impact in Tunisia. This could be due to the fact that agriculture is still a prominent

[19]Since Turkish data is available for every 5 years, we take 5 years average of the rainfall data for Turkey, however since the data is irregular, we use the annual rainfall data for Tunisia.

[20]The Penn dataset from **?**, uses a measure of human capital from **?** that captures the average years of schooling in 5 year intervals by age group for the working age population. Their variables provides a yearly stock of the overall years of schooling as an aggregate. We acknowledge that there may be some multi-colinearity between our main skills upgrading variables and human capital stocks (supply of skills), but our skills variables include the number of employed individuals in each education category by sector. This is an estimate of the demand of skilled workers per sector, rather than a supply of educated individuals in the entire country. Furthermore, the primary goal of our paper is to estimate the causal effect of skill upgrading on productivity using employed skills (demand of skills) rather than the causal impact of skills itself. Lastly, we do not directly use human capital stock but the change in the human capital index.

[21]The differences in magnitude of estimates in Turkey and Tunisia is also reflective of the different total levels of productivity within each country.

sector in Tunisia for which there could be a boost in productivity after heavier rainfall, lifting the overall productivity whereas it is the opposite in Turkey. Our results also show capital accumulation is positively and significantly associated with productivity for Turkey, but negatively associated in Tunisia. The percentage change in human capital stock is negatively and significantly associated with productivity in Turkey and negatively but not significantly associated with productivity in Tunisia. In Turkey, this may be explained in particular by education supply reforms in Turkey that sharply lifted the supply of educated workers in the economy but did not react to the economy's demand for skills. In our baseline OLS estimations, the comparative advantage for EU exports and the comparative advantage of Tunisian and Turkish exports measures are not significantly correlated with productivity.

If we now look at how good our estimations were at predicting actual productivity levels for Tunisia and Turkey in Tables 11 and12, we see that in both cases fitted values of productivity are quite close to the estimated values for both Tunisia and Turkey. In both cases, the fitted regressions marginally overestimated productivity in the agricultural, manufacturing and services sector – all trade-able sectors. On the other hand, they very precisely estimated outcomes in the construction sector. Lastly, in Turkey, the fitted regression estimates also underestimated productivity in the government sector. However, in Tunisia, the fitted regression estimates over estimated productivity in the government sector. In a following section, we will explore estimated causal effects of skills on productivity without the government sector in Tunisia.

So far, our estimations aimed to document the basic correlations between measures of skill upgrading and productivity without attributing any causal interpretation. In what follows below, we rely on 2SLS estimations, which we hope will allow to document the causal effect of skill upgrading on productivity. Because productivity estimates are a first order outcome, we additionally include the growth of productivity (value added per worker) to help understand direct impacts of skills reallocation and upgrading. Tables 4 and 5 show the results of our first set of 2SLS estimations, where we use the lagged values of skill upgrading and the share of university graduates in economy-wide employment as instruments. For Turkey, estimates in columns (1)-(3) show that there is a positive and significant impact of total skills upgrading and reallocation of skills between sectors on the current level of productivity. More specifically, our results confirm that total skill upgrading and productivity are positively related and statistically significant for Turkey (Table 4), but there is no meaningful association for Tunisia (Table 5). Moreover, as before, our results suggest that the impact, on average, comes from the movement of skilled labor between sectors, rather than the upgrading of skills within sectors for Turkey.

First stage results indicate that our instruments perform fairly well for Turkey but weakly for Tunisia. In all specifications in Tables 4 and 5, Hansen's J Statistics show that the instruments are uncorrelated with the error term and satisfy the over-identification requirements. F statistics for the first stage for Turkey are above 10 with the exception of skill upgrading within sectors. Moreover, first stage coefficients of instruments for Turkey are highly significant with the exception of fifth lag of skill upgrading within sectors in column (3) and (6). The negative coefficients for the two instruments reflect base effects, as larger changes in the past period, on average led to lower increases in the current period. Overall, based on the instrument validity tests in the first stage, we can at least confidently argue that for the period between 1970-2015, the effect of skill reallocation between sectors on productivity was on average positive for Turkey. While this first set of instruments had a measurable impact on productivity, it had no impact on productivity growth. As for Tunisia, although the instruments perform relatively poorly and it is harder to argue based on poor instruments, there is no convincing evidence of impact of skill upgrading on productivity growth whatsoever.

In our second set of estimations, we employ the technology intensity of EU exports to the rest of the world as an instrument along with the lagged share of college graduates. Like our OLS estimations, results in Tables 6 and 7 show that total skill upgrading increases productivity in Turkey (but not in Tunisia). While the F-tests shows strong relevance of the instruments for the total skills and the reallocation of skills variables, the causal impact is only significant for overall skills upgrading. We do not know if the positive impact of overall skills upgrading was due to reallocation of skills or skill upgrading, and this relationship is weakly significant. A percentage point increase in total skill upgrading on average increases sectoral productivity by 11 percentage points. However, in terms of productivity growth, there is a negative and strongly significant impact of reallocation of skills between sectors on productivity growth. The combined results suggest a downward curving curb of the marginal impact of skills on productivity. First stage results at the lower panel of Tables 6 and 7 show that the coefficients of technology intensity of EU exports are positive and highly significant in predicting total skill upgrading and skill upgrading within sectors for Turkey, but it is insignificant for Tunisia. All of the first stage estimations passes the over-identification tests for Turkey, but not for Tunisia and Sanderson Windmeijer F statistics suggests that in Turkey we reject the null hypothesis that our skill upgrading measures are unidentified (except for skill upgrading within sectors, Column (3) of Table 6). Overall, our second set of estimations in Tables 6 and 7 confirm the earlier findings that overall skill upgrading positively affected sectoral productivity growth in Turkey. As for Tunisia, the impact of skill upgrading on productivity growth is again, null.

In our third set of estimations, we employ the technology intensity of EU exports to the world, its square and its interaction with national countries' old age dependency ratio as instruments to predict skill upgrading for Turkey and Tunisia. Although these instruments do a better job in predicting skill upgrading within sectors for Turkey, they are weaker instruments. Column (3) and (6) of Table 8 suggest that all the coefficients of instruments are highly significant, the instruments pass the Hansen's over-identification test, but we can not comfortably reject the Sanderson Windmeijer weak identification test, for which the null hypothesis is that the endogenous regressors in question is unidentified. Technology intensity of EU exports has a positive coefficient suggesting that within skill upgrading in Turkey increases with the improvement in the sophistication of EU goods. The coefficient of the squared IV is also statistically significant but negative, providing evidence of a nonlinear first stage. The interaction between the technology intensity of EU exports and old age dependency ratio of Turkey is negative, suggesting that the positive effects of technology spillovers are dampened with aging population per working age population. A recent study by Acemoglu and Restrepo (2018) shows that aging leads to greater industrial automation, and in particular, to more intensive use and development of robots. The study also provides evidence of more rapid development of automation technologies in countries undergoing greater demographic change. The study shows that given its pace of aging population, Turkey had an above average imports of industrial robots between 1996 and 2015, when compared with other OECD countries (Acemoglu and Restrepo (2018), page 39, Figure 8). Hence, the negative coefficient of the interaction term might be capturing, *ceteris paribus*, the impact of relatively fast robotization of the manufacturing and the rise of services sector in light of aging population, that replaces middle and low skilled employment in Turkey. In other words, as the share of labor in manufacturing sector declines, aging population with lower rates of high skills and automation might limit the incentives for skill upgrading on average across sectors, holding all else constant. Table 9 confirms that in Tunisia, the technological level of exports has a limited affect on skills, even if old age dependence seems to be at least negatively correlated with upgrading of skills within sectors.

In the final set of estimations in Table 10 and 11, we use the lagged values of the share of college graduates in the total economy, and separately, the share of college graduates in all other sectors. For Turkey, these estimators are jointly strong predictors of reallocation of skills and reasonably good predictors of the total skill upgrading, easily passing the over-identification test. For Tunisia, unfortunately, these instruments are still only weakly relevant. In Turkey, while there are no measurable, significant impacts of skills using these instruments on productivity, we are able to find negative and significant impacts of skills upgrading and the reallocation of skills between sectors on productivity growth, which corresponds to a downward curving return of skills on productivity found in our first set of regressions.

Lastly, the absorption of high skilled workers in the governments sector in Tunisia was identified as a factor that may potentially be disturbing the relationship between skills and productivity in Tunisia. To test this supposition, in Table 12 we recalculated the skills decomposition without the government sector and re-estimated the instrumental variable estimation using the lagged shares of college graduates, the lagged share of college graduates in other sectors and the square of the technology intensity of EU Exports to the world. While this limited the number of firms included in the analysis, it can give us an idea of whether a causal relation may exist between the two. While the combination of all three instruments was a strong predictor and it passed the over-identification restrictions, there was still no impact on current level of productivity. However, there is evidence to suggest that there is a negative relationship between productivity growth and both total skills upgrading and skills upgrading within sectors, as we saw in Turkey.

Overall, both the OLS and the 2SLS estimations point to the same empirical finding, that for the period between 1970-2015 *i*) total skill upgrading has been a positive determinant of productivity for Turkey, but not for Tunisia, *ii*) Skill reallocation between sectors was the main driver of productivity increases in Turkey, and *iii*) for the entire sample in Turkey and the Tunisian private (no government) sector, there is a negative association between total skills upgrading and growth of productivity. In Turkey, the negative association between total skills upgrading and productivity growth is due to mis-allocation of skills between sectors, while in Tunisia, it is due to limited growth of skills within productive (private) sectors.

5 Conclusion

This article aimed at understanding the links between skill demand and productivity using a structural change perspective. We relied on decomposition techniques and regressions using Tunisian and Turkish postwar sectoral data.

The productivity decomposition results showed that structural change played a big role during the last 40 years in Turkey and Tunisia, but that productivity upgrading within sectors plays a more important role in explaining overall productivity decomposition in more recent years. The skills decomposition results shows us that concurrently, overall skills upgrading is characterized by the reallocation of skills across sectors in Tunisia and Turkey.

Our regression results show that skill upgrading has a causal impact on productivity in Turkey. The main driver of productivity is the the reallocation of skilled labor between sectors and not the increase of the share of highly educated workers within sectors. We do not find a similar effect for Tunisia. In both cases, however, we find evidence for a downward curving return to skills due to negative causal impacts of reallocation of skills between sectors to productivity growth.

The policy implications of the outcomes are important. In Tunisia, weak instruments may be limiting further causal inferences, however, descriptively, the reallocation of skilled labor and reallocation of resources (structural change) do not seem to have a strong positive impact on productivity, while it is evident that from the productivity decomposition analysis there seems to be a swelling of resources contributing to productivity within sectors. This suggests that there is a need for jobs that can accommodate and efficiently gain the benefits of higher skilled workers, and that jobs are skills are not well matched in the economy. In Turkey, the measurably positive impact of skill reallocation, and the concurrent higher levels of productivity being explained by the growth of sectors (the increases in the within component of the productivity decomposition) in more recent years, suggests productivity improved by the reallocation of high skills into sectors that are more productive and on the verge of expansion.

Secondly, total skills changes in both Turkey and Tunisia negatively effect productivity growth. In Turkey this is due to high skilled workers not being re-allocated into high growth sectors. In Tunisia, this is due to high-skilled workers within sectors that are not contributing to a greater share of growth. As a second order outcome, this suggests a decreasing return of skills overtime, albeit for different reasons. In both cases, the policy implications of such results suggest that the contribution of a skilled workforce to the economy can be improved. In the case of Tunisia, skills can better contribute to productivity growth if the supply of skills can better anticipate the demand of skills within the growing private sector.

The historical context and institutions of both countries were essential in how the skills contributed to productivity in the economy. In Turkey the private sector was more dynamic at an earlier stage. It experienced growth enhancing reforms, concurrently with education reforms creating an institutional environment where skills contributed to productivity. On the other hand, a strong statist tradition, in a post-colonial institutional setting, that absorbed high skills into the government sector to build the modern state. Access to education in Tunisia may have been historically higher, but its economy was not moving fast enough to appropriately absorb them. In response to the Lant Pritchett, the education went more to productive activities in Turkey, while in Tunisia, high skilled education continued to be channeled to the public sector in absence of sufficient opportunities in the formal private sector.

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Table 1: Classification of goods in value chains from CEPII-CHELEM

Level in Supply Chain	**Types of Goods**
Primary Goods	Agricultural,products; all types of extractive resources (minerals; carbon, gas and, petrol, etc)
Basic Manufacturing	Cement, ceramics, and glass; Iron and metal; Basic and organic chemicals
Intermediate Goods	Transformed iron,goods; Textiles; Wood work and paper; Metal work, wood work, motors, electronic work, car parts; Fertilizer, paint, plastics and rubber articles
Equipment	Agricultural, material, machines, building material, telecommunication material, transport equipment, etc.
Mixed Goods	Leather; Furniture; Printed goods; Plastic articles; Refined petroleum and electricity; Meat,fish and edible greasy substances
Consumption Goods	Clothing, garments,and carpets; Manufactured articles (like toys, etc); Watches, clockwork, cameras and optical and electronic equipment for public consumption; Household appliances, cars and automobiles; Sanitary and pharmaceutical, goods; Cereal-based products, animal products, vegetable products, drinks and, tobacco.

Figure 1: Sectoral Composition of Value Added

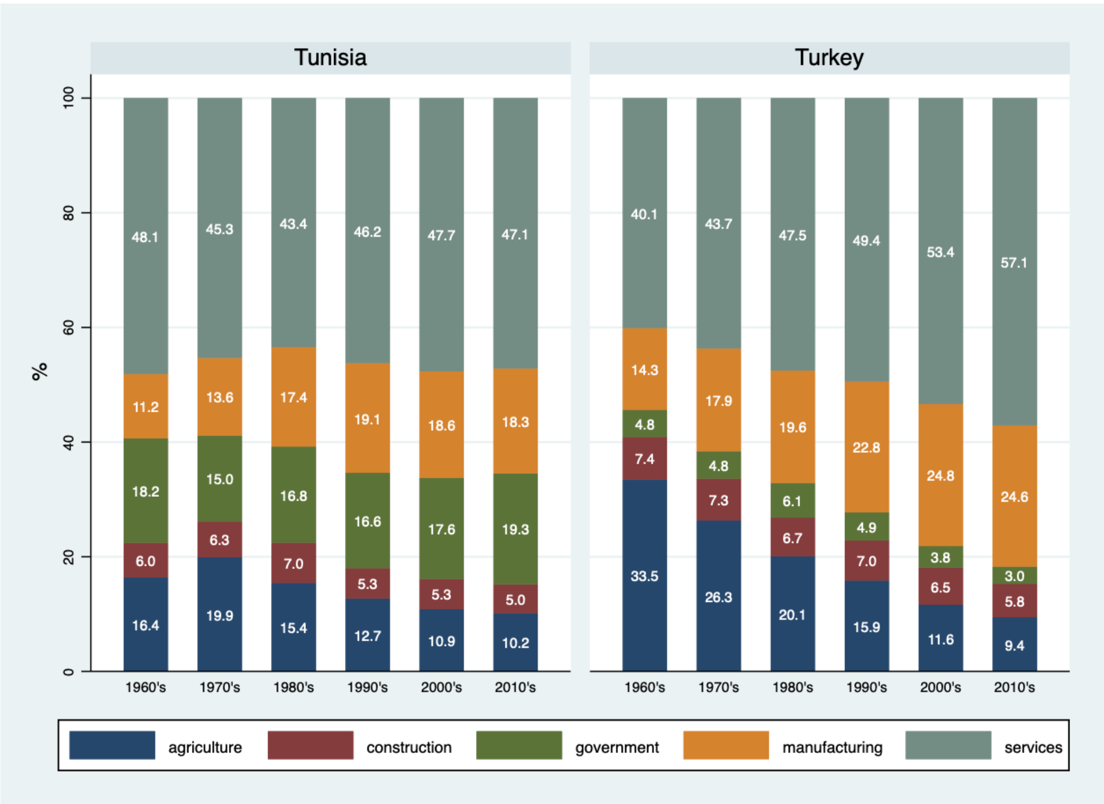


Figure 2: Sectoral Composition of Employment

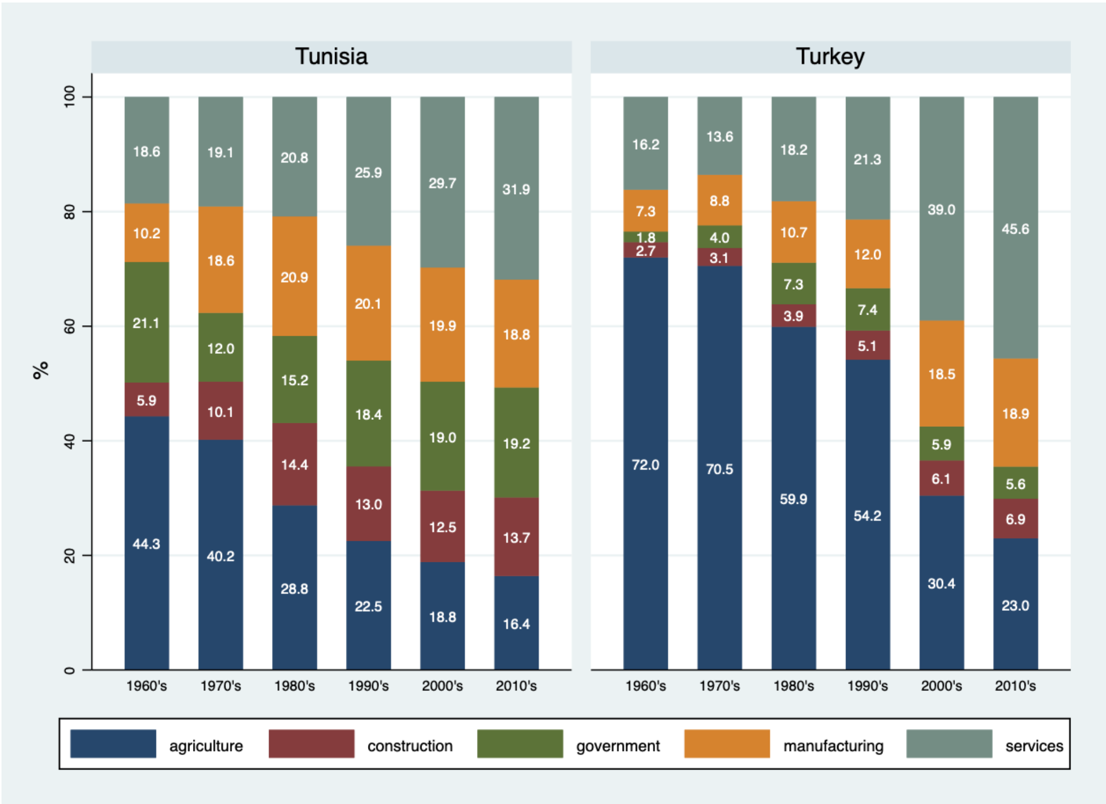


Figure 3: Composition of Education

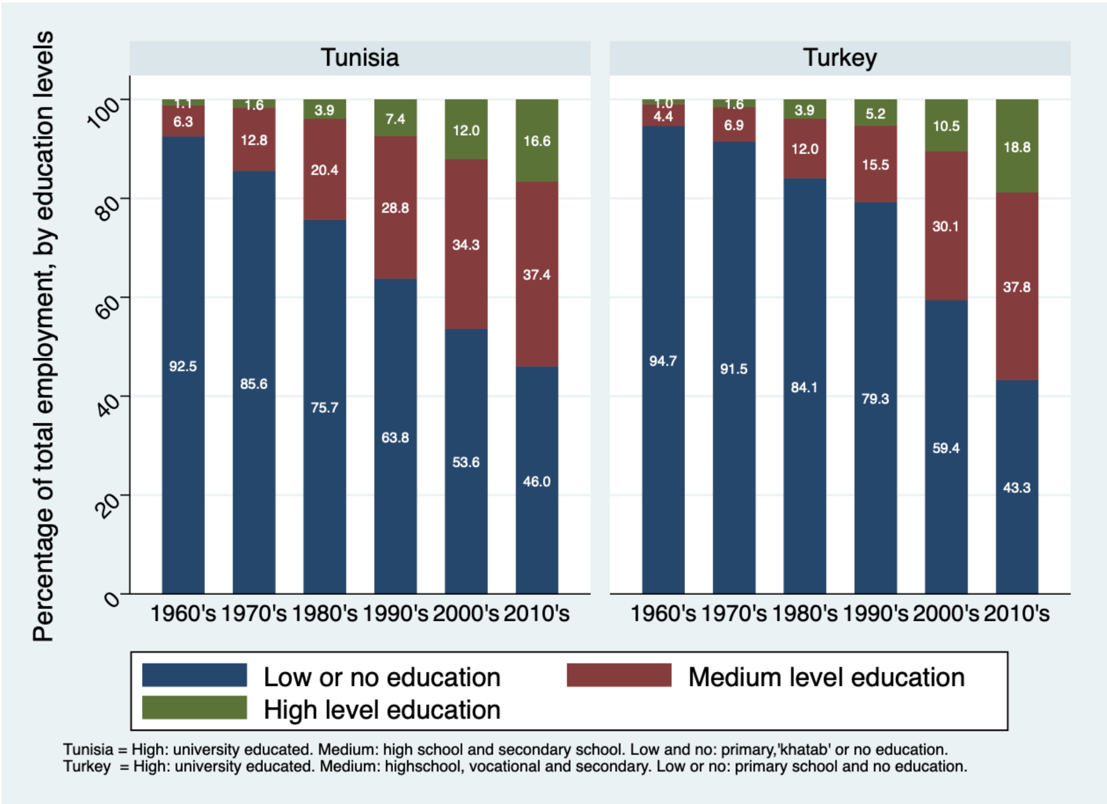
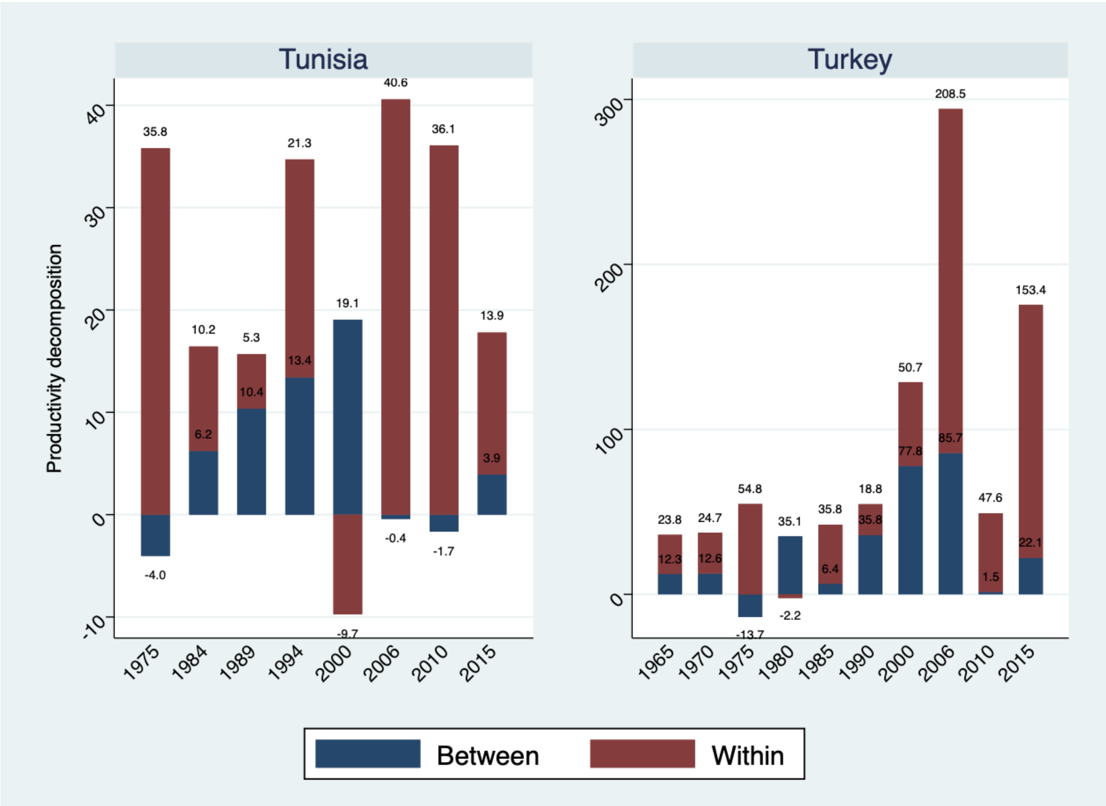
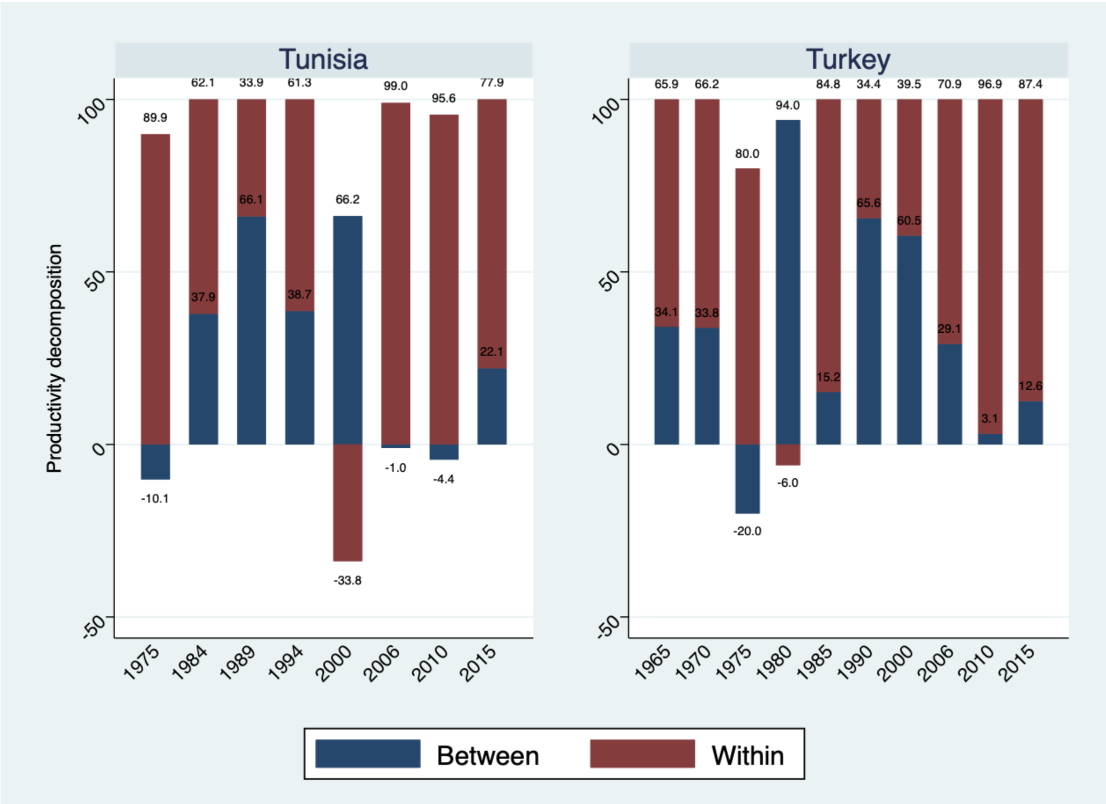


Figure 4: Total Productivity Decomposition



Note: The bars should be interpreted as representing the change between the current year and the prior year (annualized). For Tunisia, the prior year for 1975 is 1967. For Turkey, the prior year is 1960.

Figure 5: Structural Change and Within Component (as a % of total skills upgrading)



Note: The bars should be interpreted as representing the change between the current year and the prior year (annualized). For Tunisia, the prior year for 1975 is 1967. For Turkey, the prior year is 1960.

Figure 6: Productivity in Tunisia

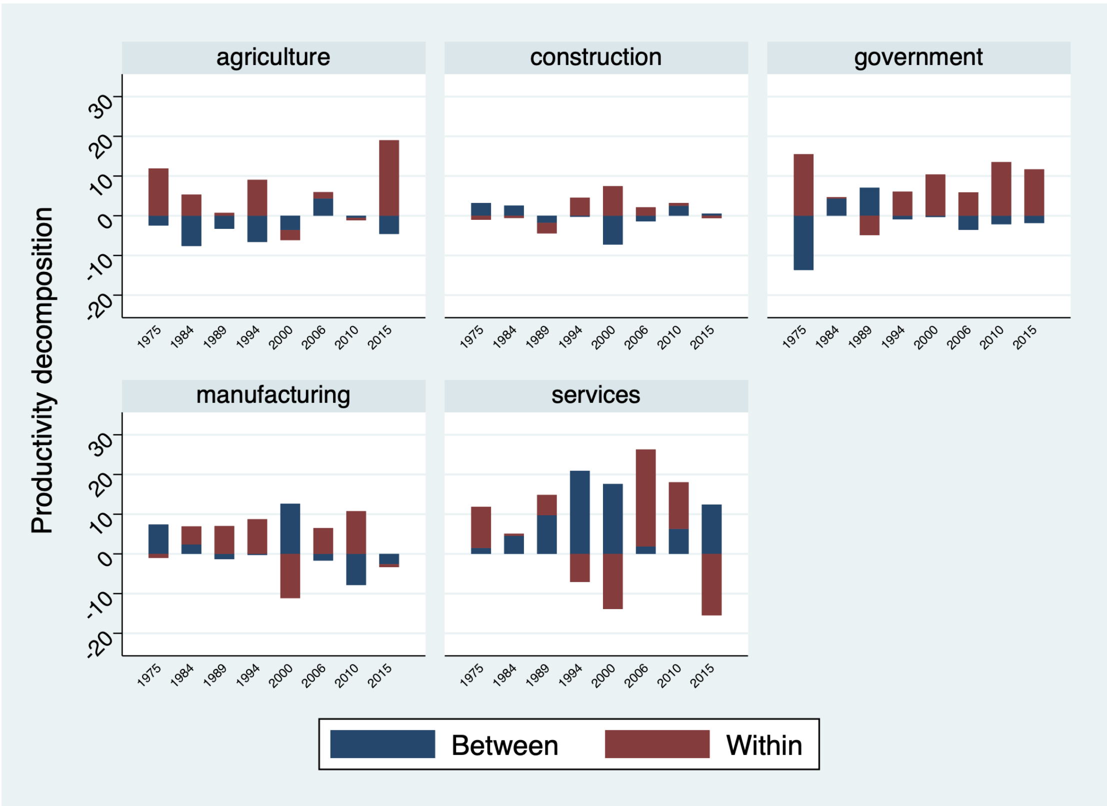


Figure 7: Productivity in Turkey

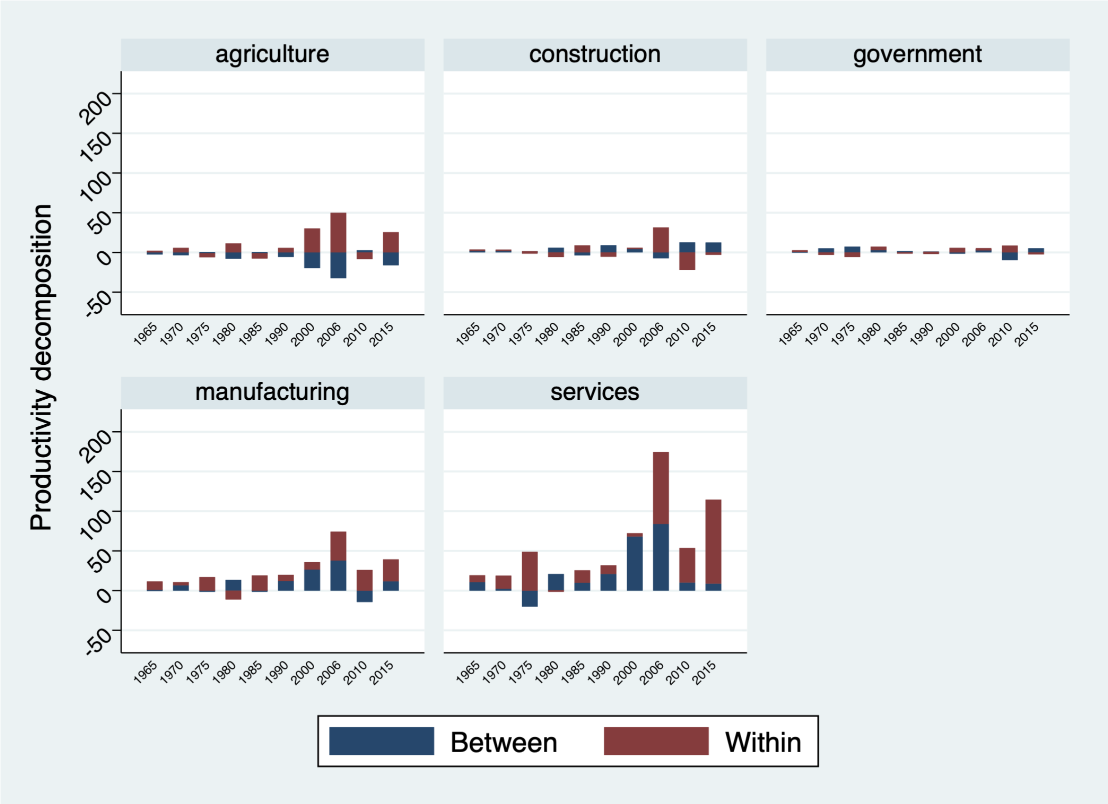


Figure 8: Productivity (levels) and Share of Employment (Tunisia)

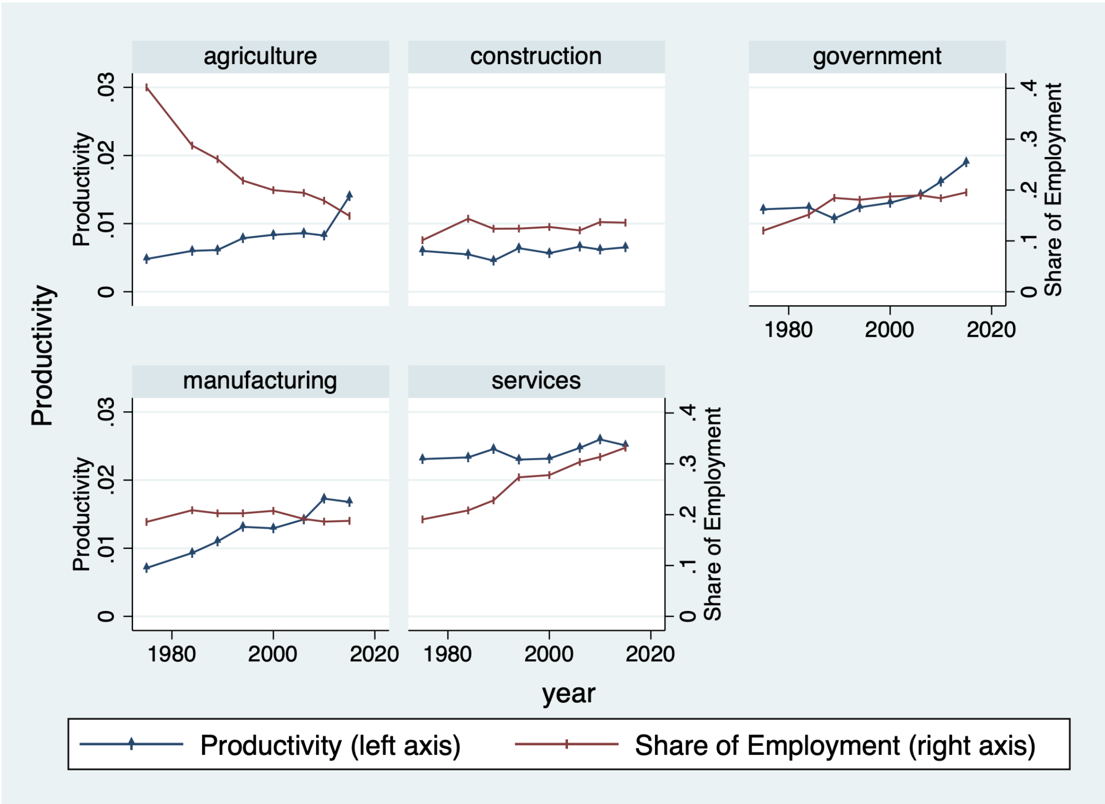


Figure 9: Share of Productivity (levels) and Share of Employment (Turkey)

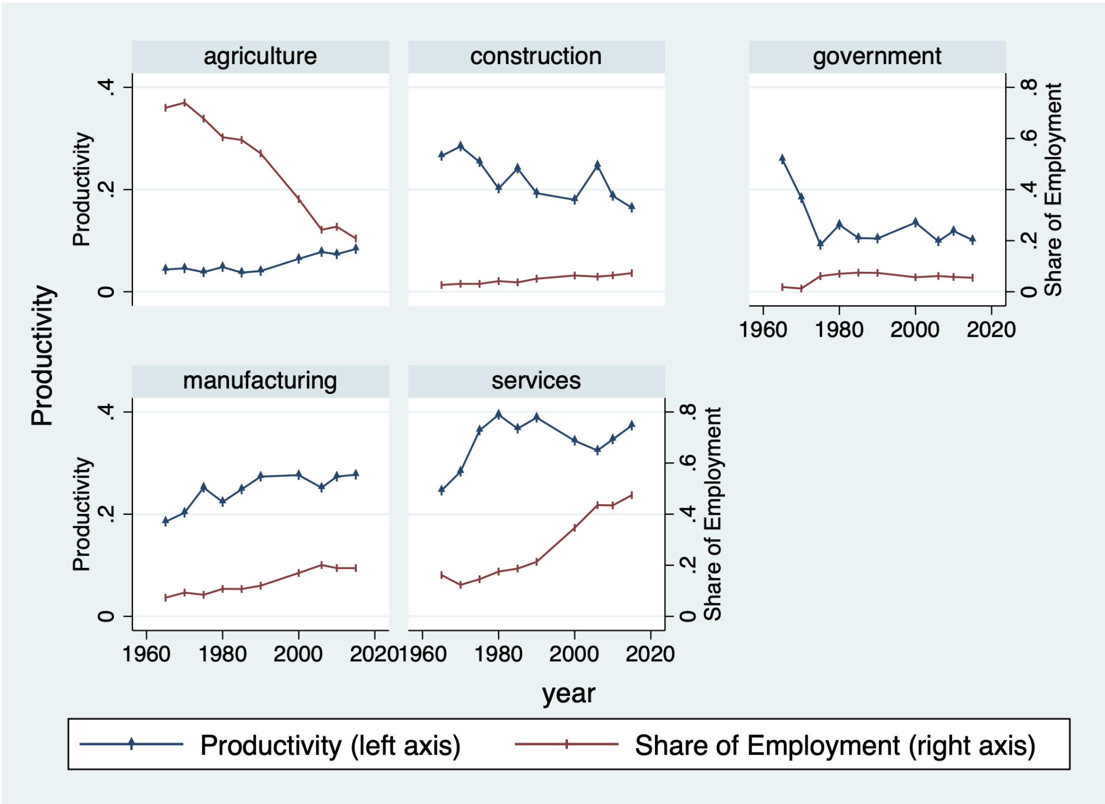


Figure 10: Skills Decomposition

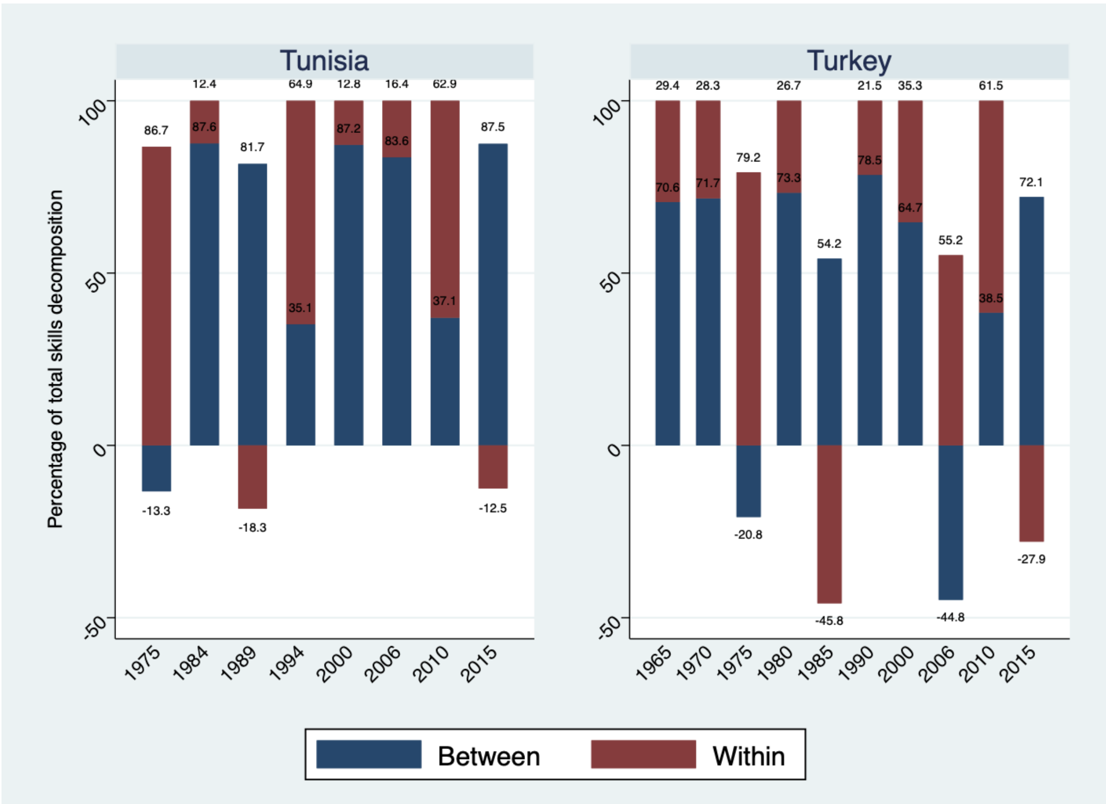


Figure 11: Turkey: Fitted versus Actual Productivity Estimates

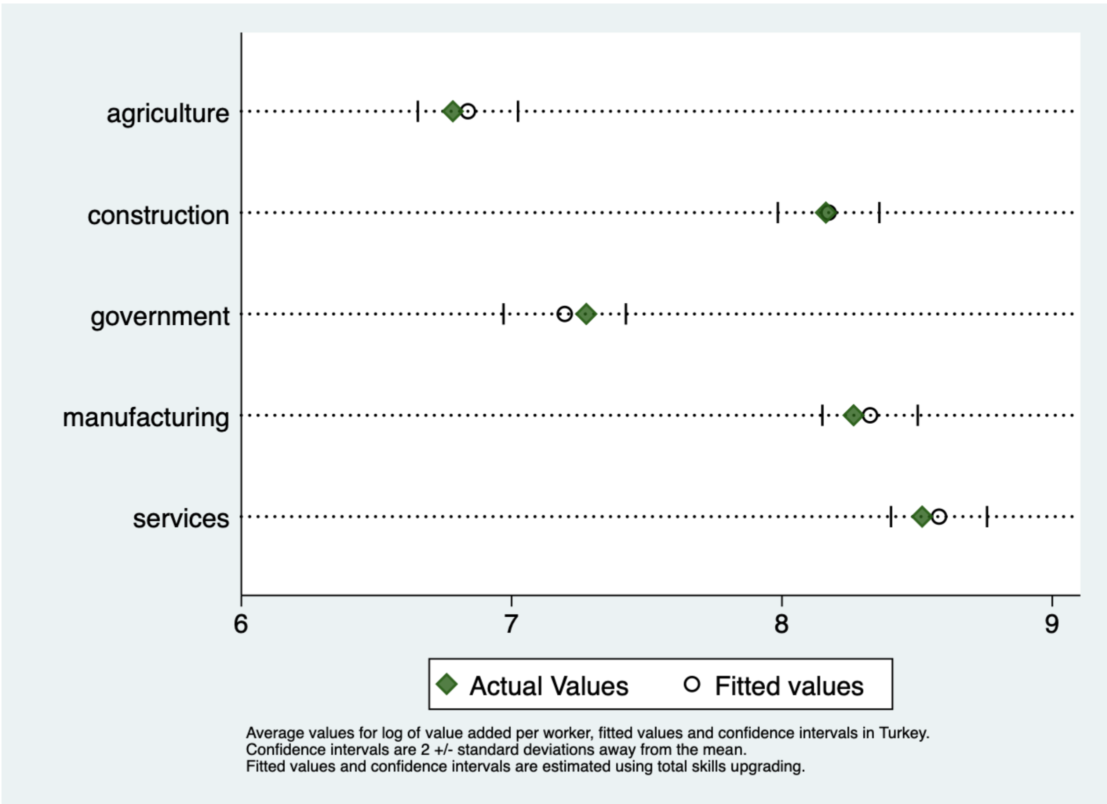


Figure 12: Tunisia: Fitted versus Actual Productivity Estimates

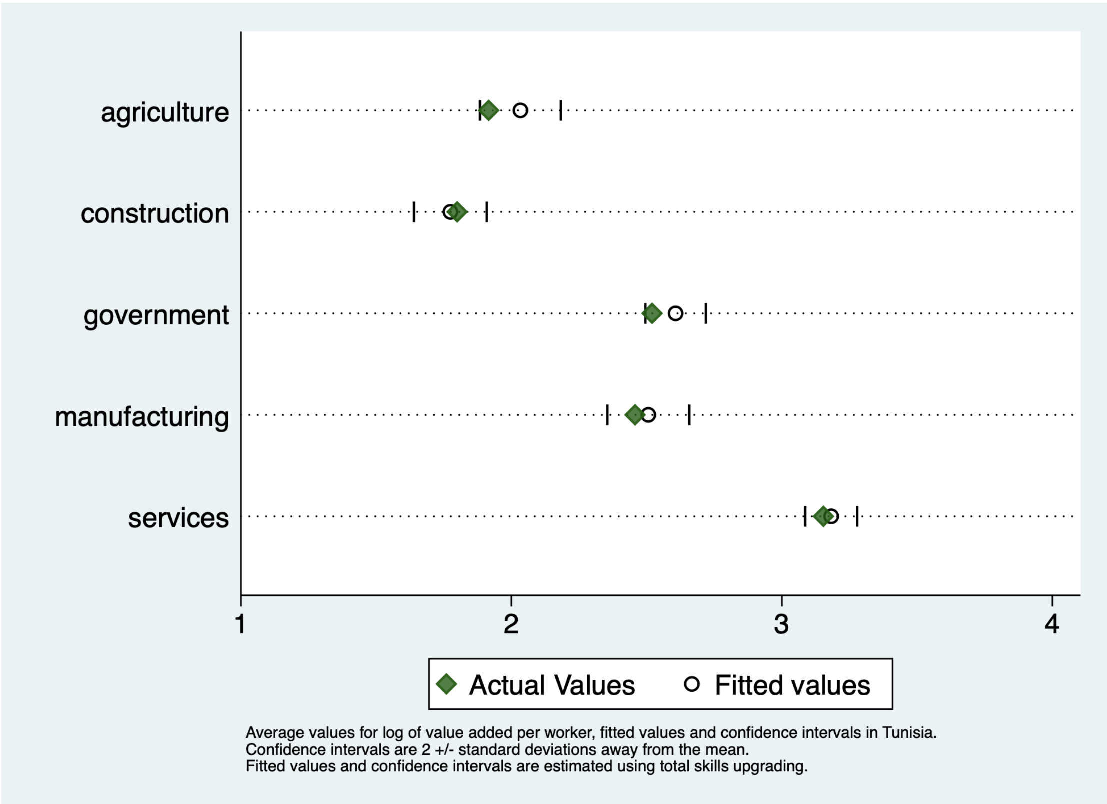


Table 2: OLS Estimations for Sectoral Productivity (Value-Added per worker), Turkey

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) OLS
Skill Upgrading	-0.011	0.077	0.074						
	[0.096]	[0.093]	[0.095]						
Skill Upgrading Between				-0.095	0.008	0.007			
				[0.172]	[0.167]	[0.173]			
Skill Upgrading Within							0.022	0.162	0.162
							[0.132]	[0.131]	[0.134]
Real exchange rate (% change)		-0.235**	-0.236**		-0.250**	-0.247**		-0.245***	-0.251**
		[0.092]	[0.109]		[0.091]	[0.108]		[0.088]	[0.102]
Average rainfall (mm)		-2.133**	-2.133**		-2.265**	-2.235**		-2.226***	-2.277**
		[0.839]	[0.994]		[0.829]	[0.994]		[0.801]	[0.936]
Capital stock growth (2011 national prices, in logs)		8.354**	8.324**		8.867***	8.731**		8.677***	8.821**
		[3.035]	[3.534]		[3.003]	[3.533]		[2.931]	[3.353]
Human capital stock (% change)		-18.083***	-18.004**		-19.059***	-18.770**		-18.596***	-18.860**
		[6.161]	[7.143]		[6.033]	[7.061]		[5.996]	[6.825]
Comparative advantage of EU exports (% change)			-0.010			-0.012			-0.007
			[0.022]			[0.023]			[0.021]
Comparative advantage of TR exports (% change)			-0.004			-0.004			-0.004
			[0.005]			[0.005]			[0.005]
Constant	-84.776***	18.307	18.272	-85.066***	26.223	24.590	-85.148***	20.439	22.994
	[9.868]	[39.906]	[48.459]	[9.492]	[38.886]	[47.874]	[10.393]	[37.356]	[44.731]
Observations	50	45	45	50	45	45	50	45	45
R-squared	0.970	0.977	0.977	0.970	0.976	0.976	0.970	0.977	0.978
Sector specific Time Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sector Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Productivity growth refers to annualized growth of value-added per worker.

Table 3: OLS Estimations for Sectoral Productivity (Value-Added per worker), Tunisia

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Skill Upgrading	-21.224**	-21.224**	-18.707*						
	[8.412]	[8.412]	[9.189]						
Skill Upgrading Between				-26.243**	-26.243**	-23.711*			
				[10.906]	[10.906]	[12.434]			
Skill Upgrading Within							-56.091*	-56.091*	-49.819
							[32.662]	[32.662]	[41.033]
Real x-rate growth		0.007	0.007		0.007	0.006		0.008	0.008
		[0.005]	[0.005]		[0.005]	[0.005]		[0.005]	[0.006]
Rainfall (mm)		0.025**	0.024*		0.024**	0.022		0.028**	0.026*
		[0.011]	[0.013]		[0.011]	[0.013]		[0.012]	[0.015]
Capital stock growth (2011 national prices, in logs)		-1.476***	-1.464**		-1.492***	-1.481***		-1.372**	-1.375**
		[0.504]	[0.523]		[0.498]	[0.510]		[0.539]	[0.558]
Human capital stock (% change)		-0.206	-0.252		-0.170	-0.204		-0.327	-0.400
		[0.857]	[0.861]		[0.845]	[0.834]		[0.908]	[0.965]
Comparative advantage of EU exports (% change)			0.008			0.010			0.006
			[0.015]			[0.014]			[0.018]
Comparative advantage of TN exports (% change)			0.001			0.001			0.001
			[0.001]			[0.001]			[0.001]
Constant	-17.034*	-16.844*	-16.484*	-17.478*	-17.268*	-16.770*	-17.147*	-17.040*	-16.594*
	[8.591]	[8.669]	[8.841]	[8.511]	[8.596]	[8.643]	[8.852]	[8.920]	[9.211]
Observations	40	40	40	40	40	40	40	40	40
R-squared	0.981	0.981	0.982	0.981	0.981	0.982	0.980	0.980	0.981
Sector specific Time Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sector Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Productivity growth refers to annualized growth of value-added per worker.

Table 4: 2SLS Estimations of Sectoral Productivity and Productivity Growth-1, Turkey

	(A) Log of value added per worker			(B) Growth of value added per worker		
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Total Skill Upgrading	Between Upgrading	Within Upgrading	Total Skill Upgrading	Between Upgrading	Within Upgrading
Skill Upgrading	0.122*			-0.021		
	[0.074]			[0.020]		
Skill Upgrading Between		0.259*			-0.043	
		[0.144]			[0.028]	
Skill Upgrading Within			0.163			-0.029
			[0.169]			[0.049]
Real x-rate growth	-0.237***	-0.214**	-0.259***	-0.088***	-0.092***	-0.084***
	[0.077]	[0.086]	[0.070]	[0.027]	[0.027]	[0.026]
Average rainfall (mm)	-2.150***	-1.939**	-2.348***	-0.803***	-0.837***	-0.769***
	[0.699]	[0.782]	[0.637]	[0.242]	[0.245]	[0.238]
Capital stock growth (2011 national prices, in logs)	8.354***	7.617***	9.073***	2.818***	2.937***	2.697***
	[2.505]	[2.787]	[2.297]	[0.859]	[0.871]	[0.843]
Human capital stock (% change)	-18.099***	-16.858***	-19.363***	-5.269***	-5.469***	-5.058***
	[5.082]	[5.597]	[4.694]	[1.674]	[1.685]	[1.654]
Comp. advantage of TR exports (% change)	-0.003	-0.002	-0.004	-0.003*	-0.003*	-0.003*
	[0.004]	[0.005]	[0.004]	[0.002]	[0.002]	[0.002]
Constant	18.500	11.696	26.634	37.979***	39.056***	36.645***
	[33.352]	[36.837]	[30.326]	[11.936]	[11.880]	[11.912]
Observations	45	45	45	45	45	45
R-squared	0.976	0.974	0.977	0.469	0.488	0.450
Controls	YES	YES	YES	YES	YES	YES
FIRST STAGE AND IDENTIFICATION						
Coefficients of Instruments						
L5. Share of College Grad. in Tot. Emp.	-38.420***	-24.410***	-14.145**	-38.420***	-24.410***	-14.145**
	[7.606]	[3.760]	[6.370]	[7.606]	[3.760]	[6.370]
L5. Total Skill Upgrading	-0.372			-0.372**		
	[0.138]			[0.138]		
L5. Between Skill Upgrading		-0.390***			-0.390***	
		[0.130]			[0.130]	
L5. Within Skill Upgrading			-0.342			-0.342
			[0.212]			[0.212]
Sanderson-Windmeijer F Statistic	13.04	22.92	2.74	13.04	22.92	2.74
	pval(0.000)	pval(0.000)	pval(0.0837)	pval(0.000)	pval(0.000)	pval(0.0837)
Hansen J Statistic	0.003	0.708	0.913	1.034	0.759	1.917
	pval(0.955)	pval(0.400)	pval(0.339)	pval(0.309)	pval(0.384)	pval(0.166)

(1) Newey West standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2) Null hypothesis for S.-Windmeijer weak identification test is that *the particular endogenous regressor in question is unidentified*.

(3) Null for Hansen's J statistic is that the *instruments are uncorrelated with the error term.*

Table 5: 2SLS Estimations of Sectoral Productivity and Productivity Growth-1, Tunisia

	(A) Log of value added per worker			(B) Growth of value added per worker		
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Total Skill Upgrading	Between Upgrading	Within Upgrading	Total Skill Upgrading	Between Upgrading	Within Upgrading
Skill Upgrading	-3.731			-11.223		
	[23.909]			[8.923]		
Skill Upgrading Between		-23.826			-26.611	
		[55.082]			[20.612]	
Skill Upgrading Within			58.986			6.567
			[51.740]			[18.896]
Real x-rate growth	0.019***	0.017***	0.019***	0.002	0.001	0.003
	[0.005]	[0.006]	[0.005]	[0.002]	[0.002]	[0.002]
Average rainfall (mm)	0.221	0.254	0.184	0.100	0.121	0.071
	[0.329]	[0.331]	[0.312]	[0.108]	[0.111]	[0.110]
Capital stock growth (2011 national prices, in logs)	0.051***	0.045**	0.054***	0.004	0.001	0.008*
	[0.014]	[0.018]	[0.013]	[0.004]	[0.006]	[0.005]
Human capital stock (% change)	-0.900	-0.670	-0.990	0.053	0.222	-0.090
	[0.906]	[1.056]	[0.820]	[0.281]	[0.323]	[0.274]
Comp. advantage of TN exports (% change)	-0.003***	-0.004**	-0.004**	-0.001**	-0.001**	-0.001*
	[0.001]	[0.002]	[0.002]	[0.000]	[0.001]	[0.001]
Observations	35	35	35	35	35	35
R-squared	0.983	0.984	0.979	0.549	0.521	0.424
Controls	YES	YES	YES	YES	YES	YES
FIRST STAGE AND IDENTIFICATION						
Coefficients of Instruments						
Lagged Share of College Graduates in Tot. Emp.	-0.121**	-0.059	-0.080***	-0.121**	-0.059	-0.080***
	[0.047]	[0.044]	[0.026]	[0.047]	[0.044]	[0.026]
Lagged Total Skill Upgrading	0.009			0.009		
	[0.123]			[0.123]		
Lagged Between Skill Upgrading		0.019			0.019	
		[0.150]			[0.150]	
Lagged Within Skill Upgrading			-0.115			-0.115
			[0.110]			[0.110]
Sanderson-Windmeijer F Statistic	3.42	1.05	6.34	3.42	1.05	6.34
	pval(0.056)	pval(0.373)	pval(0.009)	pval(0.056)	pval(0.373)	pval(0.009)
Hansen J Statistic	7.080	6.84	2.65	5.685	3.831	3.081
	pval(0.008)	pval(0.009)	pval(0.104)	pval(0.017)	pval(0.050)	pval(0.079)

(1) Newey West standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2) Null hypothesis for S.-Windmeijer weak identification test is that *the particular endogenous regressor in question is unidentified*.

(3) Null for Hansen's J statistic is that the *instruments are uncorrelated with the error term*.

Table 6: 2SLS Estimations of Sectoral Sectoral Productivity and Productivity Growth-2, Turkey

	(A) Log of value added per worker			(B) Growth of value added per worker		
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Total Skill Upgrading	Between Upgrading	Within Upgrading	Total Skill Upgrading	Between Upgrading	Within Upgrading
Skill Upgrading	0.115*			-0.027		
	[0.065]			[0.019]		
Skill Upgrading Between		0.223			-0.061**	
		[0.157]			[0.027]	
Skill Upgrading Within			0.177			-0.035
			[0.109]			[0.037]
Real x-rate growth	-0.239***	-0.221***	-0.259***	-0.089***	-0.095***	-0.084***
	[0.077]	[0.084]	[0.070]	[0.026]	[0.027]	[0.026]
Average rainfall (mm)	-2.163***	-1.998***	-2.346***	-0.813***	-0.868***	-0.770***
	[0.700]	[0.768]	[0.640]	[0.235]	[0.243]	[0.237]
Capital stock growth (2011 national prices, in logs)	8.407***	7.836***	9.061***	2.859***	3.050***	2.702***
	[2.522]	[2.741]	[2.318]	[0.832]	[0.859]	[0.835]
Human capital stock (% change)	-18.199***	-17.251***	-19.333***	-5.347***	-5.673***	-5.070***
	[5.121]	[5.491]	[4.750]	[1.622]	[1.660]	[1.634]
Comp. advantage of TR exports (% change)	-0.003	-0.002	-0.004	-0.003*	-0.003*	-0.003
	[0.004]	[0.004]	[0.004]	[0.002]	[0.002]	[0.002]
Constant	19.299	14.413	26.233	38.599***	40.467***	36.809***
	[33.188]	[36.174]	[30.079]	[11.581]	[11.811]	[11.655]
Observations	45	45	45	45	45	45
R-squared	0.977	0.975	0.977	0.469	0.493	0.446
Controls	YES	YES	YES	YES	YES	YES
FIRST STAGE AND IDENTIFICATION						
Coefficients of Instruments						
Technology Intensity of EU Exports to World	0.115***	0.023	0.202**	0.115***	0.023	0.202**
	[.032]	[0.014]	[.074]	[.032]	[0.014]	[.074]
L5. Share of College Grad. in Tot. Emp.	-43.642***	-23.667***	-11.663**	-43.642***	-23.667***	-11.663**
	[7.642]	[5.099]	[4.469]	[7.642]	[5.099]	[4.469]
Sanderson-Windmeijer F Statistic	16.57	11.03	5.04	16.57	11.03	5.04
	pval(0.000)	pval(0.000)	pval(0.014)	pval(0.000)	pval(0.000)	pval(0.014)
Hansen J Statistic	0.007	0.300	0.491	0.518	0.000	1.86
	pval(0.931)	pval(0.584)	pval(0.483)	pval(0.4715)	pval(0.9993)	pval(0.173)

(1) Newey West standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2) Null hypothesis for S.-Windmeijer weak identification test is that *the particular endogenous regressor in question is unidentified*.

(3) Null for Hansen's J statistic is that the *instruments are uncorrelated with the error term*.

Table 7: 2SLS Estimations of Sectoral Productivity and Productivity Growth-2, Tunisia

	(A) Log of value added per worker			(B) Growth of value added per worker		
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Total Skill Upgrading	Between Upgrading	Within Upgrading	Total Skill Upgrading	Between Upgrading	Within Upgrading
Skill Upgrading	3.268			-9.045**		
	[15.124]			[4.217]		
Skill Upgrading Between		4.428			-12.328**	
		[20.620]			[5.663]	
Skill Upgrading Within			12.472			-33.966*
			[56.846]			[18.849]
Real x-rate growth	0.007**	0.007**	0.007*	0.002	0.002	0.002
	[0.004]	[0.004]	[0.004]	[0.001]	[0.001]	[0.001]
Average rainfall (mm)	-1.321***	-1.316***	-1.334***	0.165	0.152	0.202
	[0.453]	[0.454]	[0.455]	[0.132]	[0.131]	[0.145]
Capital stock growth (2011 national prices, in logs)	0.027***	0.027***	0.026***	0.004	0.004	0.006*
	[0.009]	[0.009]	[0.009]	[0.003]	[0.003]	[0.003]
Human capital stock (% change)	-0.398	-0.408	-0.371	-0.049	-0.021	-0.125
	[0.718]	[0.731]	[0.699]	[0.208]	[0.205]	[0.222]
Comp. advantage of TN exports (% change)	0.001	0.001	0.001	0.000	0.000	0.001*
	[0.001]	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]
Observations	40	40	40	40	40	40
R-squared	0.978	0.978	0.978	0.540	0.540	0.482
Controls	YES	YES	YES	YES	YES	YES
FIRST STAGE AND IDENTIFICATION						
Coefficients of Instruments						
Technology Intensity of EU Exports to World	0.000	0.000	0.000	0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Lagged Share of College Graduates in Tot. Emp.	-0.216**	-0.158**	-0.057***	-0.216**	-0.158**	-0.057***
	[0.080]	[0.070]	[0.020]	[0.080]	[0.070]	[0.020]
Sanderson-Windmeijer F Statistic	3.85	2.79	4.16	3.85	2.79	4.16
	pval(0.037)	pval(0.084)	pval(0.030)	pval(0.037)	pval(0.084)	pval(0.030)
Hansen J Statistic	1.110	1.111	1.106	0.430	0.415	0.428
	pval(0.292)	pval(0.292)	pval(0.293)	pval(0.512)	pval(0.519)	pval(0.513)

(1) Newey West standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2) Null hypothesis for S.-Windmeijer weak identification test is that *the particular endogenous regressor in question is unidentified*.

(3) Null for Hansen's J statistic is that the *instruments are uncorrelated with the error term*.

Table 8: 2SLS Estimations of Sectoral Productivity and Productivity Growth-3, Turkey

	(A) Log of value added per worker			(B) Growth of value added per worker		
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Total Skill Upgrading	Between Upgrading	Within Upgrading	Total Skill Upgrading	Between Upgrading	Within Upgrading
Skill Upgrading	0.139			0.030		
	[0.095]			[0.030]		
Skill Upgrading Between		-0.221			0.053	
		[0.442]			[0.102]	
Skill Upgrading Within			0.224**			0.036
			[0.109]			[0.034]
Real x-rate growth	-0.234***	-0.302***	-0.258***	-0.078***	-0.074**	-0.083***
	[0.080]	[0.098]	[0.071]	[0.028]	[0.031]	[0.027]
Average rainfall (mm)	-2.120***	-2.738***	-2.340***	-0.712***	-0.677**	-0.760***
	[0.726]	[0.895]	[0.646]	[0.256]	[0.278]	[0.243]
Capital stock growth (2011 national prices, in logs)	8.239***	10.577***	9.021***	2.463***	2.345**	2.640***
	[2.624]	[3.260]	[2.349]	[0.899]	[0.979]	[0.854]
Human capital stock (% change)	-17.882***	-22.173***	-19.229***	-4.599***	-4.406**	-4.912***
	[5.308]	[6.134]	[4.821]	[1.740]	[1.855]	[1.658]
Comp. advantage of TR exports (% change)	-0.003	-0.004	-0.004	-0.003	-0.003	-0.003*
	[0.004]	[0.004]	[0.004]	[0.002]	[0.002]	[0.002]
Constant	16.761	48.426	24.836	32.617**	31.711**	34.683***
	[35.081]	[41.086]	[30.436]	[12.893]	[13.936]	[11.968]
Observations	45	45	45	45	45	45
R-squared	0.976	0.974	0.977	0.384	0.372	0.424
Controls	YES	YES	YES	YES	YES	YES
FIRST STAGE AND IDENTIFICATION						
Coefficients of Instruments						
Technology Intensity of EU Exports to World	0.116	-0.099*	0.214**	0.116	-0.099*	0.214**
	[0.121]	[0.057]	[0.077]	[0.121]	[0.057]	[0.077]
Technology Intensity of EU Exports to World ^{2}	-0.007***	-0.003*	-0.006***	-0.007***	-0.003*	-0.006***
	[0.003]	[0.002]	[0.002]	[0.003]	[0.002]	[0.002]
TI EU Exports*Old Age Dependancy TR	-0.013	0.008	-0.021**	-0.013	0.008	-0.021**
	[0.013]	[0.007]	0.008	[0.013]	[0.007]	0.008
Sanderson-Windmeijer F Statistic	4.19	2.16	7.262	4.19	2.16	7.262
	pval(0.0162)	pval(0.119)	pval(0.001)	pval(0.0162)	pval(0.119)	pval(0.001)
Hansen J Statistic	4.51	3.98	4.14	1.517	1.828	1.713
	pval(0.110)	pval(0.137)	pval(0.130)	pval(0.468)	pval(0.401)	pval(0.425)

(1) Newey West standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2) Null hypothesis for S.-Windmeijer weak identification test is that *the particular endogenous regressor in question is unidentified*.

(3) Null for Hansen's J statistic is that the *instruments are uncorrelated with the error term*.

Table 9: 2SLS Estimations of Sectoral Productivity and Productivity Growth-3, Tunisia

	(A) Log of value added per worker			(B) Growth of value added per worker		
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Total Skill Upgrading	Between Upgrading	Within Upgrading	Total Skill Upgrading	Between Upgrading	Within Upgrading
Skill Upgrading	2.897			-8.416**		
	[15.451]			[4.272]		
Skill Upgrading Between		3.091			-9.660*	
		[20.384]			[5.722]	
Skill Upgrading Within			12.314			-30.682*
			[47.240]			[16.356]
Real x-rate growth	0.007**	0.007**	0.007*	0.002	0.002	0.002
	[0.004]	[0.004]	[0.004]	[0.001]	[0.001]	[0.001]
Average rainfall (mm)	-1.323***	-1.324***	-1.334***	0.169	0.167	0.204
	[0.449]	[0.446]	[0.458]	[0.134]	[0.137]	[0.148]
Capital stock growth (2011 national prices, in logs)	0.027***	0.027***	0.026***	0.004	0.004	0.005*
	[0.009]	[0.009]	[0.009]	[0.003]	[0.003]	[0.003]
Human capital stock (% change)	-0.396	-0.399	-0.371	-0.052	-0.039	-0.123
	[0.721]	[0.736]	[0.702]	[0.210]	[0.213]	[0.223]
Comp. advantage of TN exports (% change)	0.001	0.001	0.001	0.000	0.000	0.001*
	[0.001]	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]
Observations	40	40	40	40	40	40
R-squared	0.978	0.979	0.978	0.537	0.528	0.485
Controls	YES	YES	YES	YES	YES	YES
FIRST STAGE AND IDENTIFICATION						
Coefficients of Instruments						
Technology Intensity of EU Exports to World	0.000	0.000	0.000	0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Technology Intensity of EU Exports to World ^{2}	0.000	0.000	-0.000	0.000	0.000	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
TI EU Exports*Old Age Dependancy TN	-0.201**	-0.135*	-0.066***	-0.201**	-0.135*	-0.066***
	[0.078]	[0.066]	[0.021]	[0.078]	[0.066]	[0.021]
Sanderson-Windmeijer F Statistic	2.58	2.24	3.76	2.58	2.24	3.76
	pval(0.082)	pval(0.115)	pval(0.027)	pval(0.082)	pval(0.115)	pval(0.027)
Hansen J Statistic	1.274	1.251	1.261	0.898	1.659	0.646
	pval(0.529)	pval(0.535)	pval(0.532)	pval(0.638)	pval(0.436)	pval(0.724)

(1) Newey West standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2) Null hypothesis for S.-Windmeijer weak identification test is that *the particular endogenous regressor in question is unidentified*.

(3) Null for Hansen's J statistic is that the *instruments are uncorrelated with the error term*.

Table 10: 2SLS Estimations of Sectoral Sectoral Productivity and Productivity Growth-4, Turkey

	(A) Log of value added per worker			(B) Growth of value added per worker		
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Total Skill	Between	Within	Total Skill	Between	Within
	Upgrading	Upgrading	Upgrading	Upgrading	Upgrading	Upgrading
Skill Upgrading	0.089			-0.044*		
	[0.098]			[0.025]		
Skill Upgrading Between		0.178			-0.071**	
		[0.169]			[0.032]	
Skill Upgrading Within			0.150			-0.101
			[0.236]			[0.071]
Real x-rate growth	-0.244***	-0.229***	-0.259***	-0.093***	-0.097***	-0.086***
	[0.075]	[0.081]	[0.070]	[0.026]	[0.027]	[0.026]
Average rainfall (mm)	-2.210***	-2.073***	-2.350***	-0.845***	-0.884***	-0.779***
	[0.685]	[0.745]	[0.635]	[0.241]	[0.248]	[0.235]
Capital stock growth (2011 national prices, in logs)	8.590***	8.113***	9.085***	2.983***	3.113***	2.759***
	[2.444]	[2.646]	[2.285]	[0.859]	[0.879]	[0.839]
Human capital stock (% change)	-18.545***	-17.748***	-19.393***	-5.582***	-5.784***	-5.216***
	[4.947]	[5.291]	[4.666]	[1.676]	[1.699]	[1.661]
Comp. advantage of TR exports (% change)	-0.003	-0.002	-0.004	-0.003*	-0.003*	-0.002
	[0.004]	[0.004]	[0.004]	[0.002]	[0.002]	[0.001]
Constant	22.067	17.848	27.046	40.481***	41.239***	38.770***
	[33.371]	[35.515]	[30.844]	[11.964]	[12.041]	[11.980]
Observations	45	45	45	45	45	45
R-squared	0.977	0.975	0.977	0.452	0.493	0.331
Controls	YES	YES	YES	YES	YES	YES
FIRST STAGE AND IDENTIFICATION						
Coefficients of Instruments						
L5. Share of College Grad. in Tot. Emp.	-32.860***	-21.09***	-11.76*	-32.860***	-21.09***	-11.76*
	[9.607]	[5.927]	[6.201]	[9.607]	[5.927]	[6.201]
L5. Share of College Grad. in all other sectors	1.326***	0 .403**	0.923**	1.326***	0 .403**	0.923**
	[0.440]	[0.185]	[0.402]	[0.440]	[0.185]	[0.402]
Sanderson-Windmeijer F Statistic	10.84	22.74	3.72	10.84	22.74	3.72
	pval(0.000)	pval(0.000)	pval(0.039)	pval(0.000)	pval(0.000)	pval(0.039)
Hansen J Statistic	0.454	0.182	1.09	0.273	0.549	0.021
	pval(0.500)	pval(0.670)	pval(0.300)	pval(0.601)	pval(0.459)	pval(0.886)

(1) Newey West standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2) Null hypothesis for S.-Windmeijer weak identification test is that *the particular endogenous regressor in question is unidentified*.

(3) Null for Hansen's J statistic is that the *instruments are uncorrelated with the error term*.

Table 11: 2SLS Estimations of Sectoral Productivity and Productivity Growth-4, Tunisia

	(A) Log of value added per worker			(B) Growth of value added per worker		
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Total Skill Upgrading	Between Upgrading	Within Upgrading	Total Skill Upgrading	Between Upgrading	Within Upgrading
Skill Upgrading	-7.792			-7.848		
	[13.714]			[5.198]		
Skill Upgrading Between		-13.231			-10.022	
		[18.199]			[7.229]	
Skill Upgrading Within			-0.239			-29.687
			[52.870]			[19.576]
Real x-rate growth	0.007**	0.007*	0.007*	0.002	0.002	0.002
	[0.004]	[0.004]	[0.004]	[0.001]	[0.001]	[0.001]
Average rainfall (mm)	-1.392***	-1.419***	-1.342***	0.173	0.165	0.204
	[0.404]	[0.399]	[0.441]	[0.143]	[0.147]	[0.149]
Capital stock growth (2011 national prices, in logs)	0.026***	0.025***	0.026***	0.004	0.004	0.005*
	[0.009]	[0.009]	[0.009]	[0.003]	[0.003]	[0.003]
Human capital stock (% change)	-0.331	-0.289	-0.379	-0.056	-0.037	-0.122
	[0.707]	[0.711]	[0.701]	[0.212]	[0.213]	[0.223]
Comp. advantage of TN exports (% change)	0.001	0.001	0.001	0.000	0.000	0.001*
	[0.001]	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]
Observations	40	40	40	40	40	40
R-squared	0.981	0.981	0.979	0.533	0.530	0.486
Controls	YES	YES	YES	YES	YES	YES
FIRST STAGE AND IDENTIFICATION						
Coefficients of Instruments						
Lagged Share of College Graduates in Tot. Emp.	-0.164**	-.0105*	-0.058**	-0.164**	-.0105*	-0.058**
	[0.071]	[0.061]	[0.022]	[0.071]	[0.061]	[0.022]
Lagged Share of College Graduates in all other sectors	0.059	0.064	-0.005	0.059	0.064	-0.005
	[0.071]	[0.058]	[0.019]	[0.071]	[0.058]	[0.019]
Sanderson-Windmeijer F Statistic	3.58	2.71	4.13	3.58	2.71	4.13
	pval(0.046)	pval(0.089)	pval(0.031)	pval(0.046)	pval(0.089)	pval(0.031)
Hansen J Statistic	1.681	1.632	1.674	0.024	0.126	0.098
	pval(0.195)	pval(0.201)	pval(0.196)	pval(0.876)	pval(0.722)	pval(0.754)

(1) Newey West standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2) Null hypothesis for S.-Windmeijer weak identification test is that *the particular endogenous regressor*

(2) *in question is unidentified*.

(3) Null for Hansen's J statistic is that the *instruments are uncorrelated with the error term*.

Table 12: 2SLS Estimations of Sectoral Productivity and Productivity Growth (Private Sector Only), Tunisia

	(A) Log of value added per worker			(B) Growth of value added per worker		
	2SLS - No Gov Total Skill Upgrading	2SLS - No Gov Between Upgrading	2SLS - No Gov Within Upgrading	2SLS - No Gov Total Skill Upgrading	2SLS - No Gov Between Upgrading	2SLS - No Gov Within Upgrading
Skill Upgrading	-7.619			-5.941**		
	[7.197]			[2.709]		
Skill Upgrading Between		-8.323			-6.630	
		[11.502]			[4.668]	
Skill Upgrading Within			-24.239			-18.541**
			[18.929]			[7.390]
Real x-rate growth	0.003	0.003	0.004	0.002	0.001	0.002
	[0.004]	[0.004]	[0.005]	[0.002]	[0.002]	[0.002]
Average rainfall (mm)	-0.135	-0.066	-0.289	0.083	0.137	-0.034
	[0.464]	[0.446]	[0.521]	[0.153]	[0.149]	[0.170]
Capital stock growth (2011 national prices, in logs)	0.008	0.007	0.010	0.003	0.003	0.005
	[0.010]	[0.010]	[0.011]	[0.004]	[0.004]	[0.004]
Human capital stock (% change)	0.202	0.223	0.080	0.045	0.063	-0.050
	[0.819]	[0.814]	[0.885]	[0.234]	[0.234]	[0.265]
Comp. advantage of TN exports (% change)	0.001	0.001	0.001	0.000	0.000	0.000
	[0.001]	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]
Observations	32	32	32	32	32	32
R-squared	0.983	0.983	0.983	0.440	0.421	0.421
Controls	YES	YES	YES	YES	YES	YES
FIRST STAGE AND IDENTIFICATION						
Coefficients of Instruments						
Technology Intensity of EU Exports to World [2]	0.000	0.000	0.000	0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Lagged Share of College Graduates in Tot. Emp.	-1.228***	-0.740***	-0.489***	-1.228***	-0.740***	-0.489***
	[0.223]	[0.123]	[0.124]	[0.223]	[0.123]	[0.124]
Lagged Share of College Graduates in all other sectors	-0.461***	-0.254***	-0.207***	-0.461***	-0.254***	-0.207***
	[0.089]	[0.064]	[0.039]	[0.089]	[0.064]	[0.039]
Sanderson-Windmeijer F Statistic	12.56	23.16	12.36	12.56	23.16	12.36
	pval(0.000)	pval(0.000)	pval(0.000)	pval(0.000)	pval(0.000)	pval(0.000)
Hansen J Statistic	0.828	1.228	0.271	2.323	3.604	0.837
	pval(0.661)	pval(0.541)	pval(0.874)	pval(0.313)	pval(0.165)	pval(0.658)

(1) Newey West standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2) Null hypothesis for S.-Windmeijer weak identification test is that *the particular endogenous regressorin question is unidentified*.

(3) Null for Hansen's J statistic is that the *instruments are uncorrelated with the error term*.