

Asik, Gunes; Karakoc, Ulas; Marouani, Mohamed Ali; Marshalian, Michelle

Working Paper

Productivity, structural change, and skills dynamics: Evidence from a half-century analysis

WIDER Working Paper, No. 2020/18

Provided in Cooperation with:

United Nations University (UNU), World Institute for Development Economics Research (WIDER)

Suggested Citation: Asik, Gunes; Karakoc, Ulas; Marouani, Mohamed Ali; Marshalian, Michelle (2020) : Productivity, structural change, and skills dynamics: Evidence from a half-century analysis, WIDER Working Paper, No. 2020/18, ISBN 978-92-9256-775-0, The United Nations University World Institute for Development Economics Research (UNU-WIDER), Helsinki, <https://doi.org/10.35188/UNU-WIDER/2020/775-0>

This Version is available at:

<https://hdl.handle.net/10419/229242>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



WIDER Working Paper 2020/18

Productivity, structural change, and skills dynamics

Evidence from a half-century analysis

Gunes Asik,¹ Ulas Karakoc,² Mohamed Ali Marouani,³ and Michelle Marshalian⁴

March 2020

Abstract: This paper explores the contribution of structural change and the skill upgrading of the labour force to productivity. Our growth decomposition based on an original database we built for Tunisia and Turkey shows that productivity is mainly explained by intra-industry changes during the import substitution period. Second, we show that this productivity increase has been driven by the reallocation of higher-educated labour between sectors rather than the absorption of highly educated workers within sectors. Based on an instrumental variable regression setting, we also find evidence that the change in the share of high-educated workers had a causal impact on productivity levels. Moreover, when we exclude the government sector, the overall skills upgrading is negatively associated with productivity growth, suggesting a downward sloping return to educated labour demand over time.

Keywords: MENA, productivity, skills, structural change, Tunisia, Turkey

JEL classification: J24, L16, O47, O57

Acknowledgements: The authors kindly thank Leila Bagdadi, Stijn Broecke, Philippe DeVreyer, Ishac Diwan, Stefan Hertog, Adeel Malik, and El Mouhoub Mouhoud, the discussant and participants at the 2019 WIDER Development Conference, Transforming economies—for better jobs, the 2019 Dial Development Economics Conference in Paris, the referees from the Economic Research Forum, participants of the 2018 ERF Workshop in Luxor, and the Journées doctorales du développement (CERDI- LEO- DIAL- FSJES) in Casablanca for valuable feedback. The authors gratefully acknowledge the financial support from the ERF, and acknowledge the publication of the previous version of this paper as part of the ERF working paper series (Asik et al. 2018). All opinions and errors are our own.

¹Tobb University of Economics and Technology, Ankara, Turkey; ²Humboldt University Berlin, Berlin, Germany; ³UMR Développement et sociétés, IRD, Paris, France; Paris 1 Pantheon-Sorbonne University, Paris, France; Economic Research Forum, Tunis, Tunisia; ⁴University of Paris, Dauphine (PSL), Paris, France; Paris 1 Pantheon-Sorbonne University, Paris, France; DIAL, Paris, France; corresponding author: Michelle-lisa.Marshalian@univ-paris1.fr

This study has been prepared within the UNU-WIDER project on [Varieties of structural transformation](#).

Copyright © The Authors 2020

Information and requests: publications@wider.unu.edu

ISSN 1798-7237 ISBN 978-92-9256-775-0

<https://doi.org/10.35188/UNU-WIDER/2020/775-0>

Typescript prepared by Gary Smith.

The United Nations University World Institute for Development Economics Research provides economic analysis and policy advice with the aim of promoting sustainable and equitable development. The Institute began operations in 1985 in Helsinki, Finland, as the first research and training centre of the United Nations University. Today it is a unique blend of think tank, research institute, and UN agency—providing a range of services from policy advice to governments as well as freely available original research.

The Institute is funded through income from an endowment fund with additional contributions to its work programme from Finland, Sweden, and the United Kingdom as well as earmarked contributions for specific projects from a variety of donors.

Katajanokanlaituri 6 B, 00160 Helsinki, Finland

The views expressed in this paper are those of the author(s), and do not necessarily reflect the views of the Institute or the United Nations University, nor the programme/project donors.

1 Introduction

This paper examines the respective contributions of labour reallocation and skill upgrading to productivity variation. In most developing countries, educational attainment has increased spectacularly in recent decades. In the past, education was often reserved for foreigners and the elite, especially 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) showed that education did not always foster growth. Among the explanations, the low quality of education and skill mismatch have been widely cited. For the latter, low levels of structural change, particularly from basic manufacturing to high-value-added industries and services, contributed to the lack of demand for high-skilled workers. However, education as a social mobility vector and anti-poverty mechanism continues to be encouraged even when the demand for skilled workers is not high. A stagnation of skilled labour demand can also result from the absence of within-sector skill upgrading. According to Hendricks (2010), within-industry gaps play a much greater role than structural change in explaining differences in education across countries. In contrast, much of the development literature highlights the role of structural change in income differences between countries (Restuccia et al. 2008).

In the past half-century, the most significant trend in structural change has been the reallocation out of the agricultural sector into more productive sectors (Caselli and Coleman II 2001). On a cross-country level, the catch-up between the USA and other countries is higher in manufacturing than in other sectors (Herrendorf and Valentinyi 2012). While there are substantial differences between countries in services productivity (Duarte and Restuccia 2010), cross-country aggregate productivity gaps are in larger part due to the agricultural sector (Gollin et al. 2013). Since 2000, structural change has contributed positively to growth in Africa, primarily due to increasing agricultural productivity and rising food and commodity prices (McMillan et al. 2014). This paper is related to this strand of the literature, which tries to understand the contribution of structural change, among other factors, in productivity growth. Previous authors have argued that competitive exchange rates and labour market flexibility are among the most important determinants of growth-enhancing structural change (McMillan and Rodrik 2011). There is also literature arguing that productivity growth increases after the implementation of pro-competition trade reforms, in particular when sectors were previously import-competing or faced onerous domestic regulations (Topalova and Khandelwal 2011).

Our paper is also related to the literature on the growing impact of skills on productivity with structural change. In a cross-country analysis, human capital and product specialization are essential determinants of economic growth. As countries move into more specialized goods and more knowledge-intensive industries, the role of human capital becomes more important.¹ However, the interaction between human capital and structural change depends on the level of development of the country. Furthermore, there is a correlation between demand for high-skilled labour and a compositional shift of value-added to sectors that are intensive in high-skilled labour (Buera et al. 2015).

It is difficult to untangle the direction of causality between productivity and growth within and between sectors because of the endogeneity of key variables. Different rates of productivity can explain structural change (Ngai and Pissarides 2007), and increases to productivity have a positive impact on the skill premia (Dix-Carneiro and Kovak 2015). But skilled workers contribute to productivity, with the observed polarization of skills and wages resulting mainly from structural change from manufacturing to services (Bárány and Siegel 2018).

¹ Hanushek and Woessmann (2008) consider that cognitive skills are even more relevant in determining growth than just human capital as measured by years of education, but limitations in the historical availability of these data make the investigation through this angle more difficult.

We first explore the contribution of structural change and skill upgrading of the labour force to productivity by taking a comparative historical approach to the post-World War II trends and data in Tunisia and Turkey.² We develop an original database on the two countries beginning in the 1960s, and use it to decompose the overall productivity change into within and between components. This decomposition allows us to assess whether labour productivity resulted from workers moving out of lower-productivity sectors (e.g. agriculture) into higher-productivity sectors (e.g. manufacturing), or if productivity increased mainly because of changes within each sector (McMillan and Rodrik 2011). Using a similar method from Berman et al. (1998), we decompose the overall contributions to total skills upgrading to the movement of high-skilled workers between sectors and increased concentration of high-skilled employment within sectors. The next step consists of regressing labour 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 and its primary driver is the reallocation of skilled workers between sectors, and not skills upgrading within sectors. 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 the highest skill between sectors increases productivity by order of 0.26 percentage points. The instrument used did not allow us to identify the causal relationship for Tunisia.

2 Historical setting

This section sets out to identify the differences and similarities between Turkey and Tunisia in terms of industrial development and structural change, the relative role of the public sector in transitional periods, and the evolution of education and skills from the 1960s to the 2010s.

The short historical narrative seeks to demonstrate that, while in the 1960s Turkey had a sizeable private sector, particularly in manufacturing, Tunisia came right out of the decolonization processes where the state and public sector played a more pivotal role. Therefore, it is likely that this environment created a path dependency in which the state continued to play a significant role in economic institutions in Tunisia. Turkey's dynamic business classes outperformed the role of the Turkish public sector in the economy. Structural change played a less significant role in the allocation of labour resources to the public sector in Turkey, and productivity gains were more strongly realized in the private sector. Even though both countries showed significant improvements in educational attainment, the utilization of the more skilled labour force remains more limited in Tunisia, in particular, due to the vast size of the public sector.

Turkey and Tunisia present a suitable point of comparison as two non-oil economies with sizeable domestic markets in the European periphery. Furthermore, the Tunisian economic model took several examples from the post-war Turkish model. 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 and 1980, to liberalization thereafter. The ISI period also involved reallocating labour away from traditional sectors, primarily agriculture in both countries. Finally, the human cap-

² The reason we choose these two countries is that both are labour-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 the frustration of thousands of unemployed educated youth (Angel-Urdinola et al. 2015; Gatti et al. 2013; Rijkers et al. 2014). Furthermore, some aspects of the Tunisian economic post-colonial institutions were modelled after the post-war Turkish state's model.

ital composition improved significantly between and within sectors throughout policy shifts since the 1960s.³

However, there were significant differences as well. Even though nation-state building and industrialization overlapped in both countries, the process started much later in Tunisia. In Turkey, most institution-building occurred in the 1920s, and by the early 1930s the nationalization of the economy, effectively meaning the removal of non-Muslim elements, was almost complete. ISI with substantial state entrepreneurship proceeded after the Great Depression, and by 1960 the country had reached the end of the first stage of import substitution, producing most of its non-durable consumer goods domestically. However, the pre-1960 period did not see structural change. Turkey was still a ‘frontier country’ (Hansen 1991) and the open land frontier prevented large-scale migration from rural areas and agriculture until the 1950s.

Between 1960 and 1980, Turkey started to produce consumer durables and intermediate goods. Even though there was significant public sector activity in manufacturing, more than half of the value-added was created by the private sector. 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. Real wages dwindled; the prices significantly moved in favour of manufacturing, and agricultural subsidies were reduced. The combined result was the reinforcement of rural–urban migration.⁴

The large sectoral shifts in employment coincided with significant improvement in skills acquisition. In 1960, the average literacy rate was 38 per cent. It steadily increased to 95 per cent in 2013 (TIUK 2014). In terms of the quality of education, while the student:teacher ratio in primary schools was 46:1 in 1960, it came down to 20:1 in 2013.⁵ The gross enrolment ratio in primary and secondary education increased from about 60 per cent to 90 per cent between 1960 and 2013, and even more remarkably the rise in tertiary education gross enrolment rate increased from 5 to 95 per cent over the same period. The most critical reform affecting enrolment was that of 1997, which increased compulsory education from five to eight years.

In Tunisia, we observe the implementation of a mix of ISI and nationalization policies, starting after independence. Before independence, Tunisia had a predominantly agricultural economy, where the urban centres, trade, and small-scale manufacturing were controlled by the Europeans who had settled in the country in the late nineteenth century.⁶ The national census conducted in 1951 shows that Tunisians owned less than 10 per cent of the largest manufacturing firms, as the local bourgeoisie preferred investing in land and commerce instead of manufacturing. After independence in 1956, the government was preoccupied with transferring the administration to Tunisians and the creation of sovereign institutions. The post-colonial period started with a liberal economic model (1956–61) failing in private investment (Bellin 2002), but switched to a socialist agenda after 1962 with the expropriation of 450,000 hectares of

³ See Karakoç et al. (2017) for a brief evaluation of industrialization over the whole twentieth century. Chapters 11 and 12 of Hansen (1991) also provide a detailed evaluation of import substitution and liberalization after 1980.

⁴ The symbiotic relationship between large-scale public enterprises and the private sector also changed structurally. Small- and medium-scale manufacturing enterprises revived in the Anatolian cities, which had not been industrial centres previously, thus changing notably the spatial distribution of industry. Filiztekin and Tunalı (1999) show that the so-called ‘Anatolian tigers’ depended heavily on low wages to be able to compete domestically and globally.

⁵ However, the student:teacher ratio did not change much in high schools. Also, the doubling of the ratio at the college level indicates the massive increase in college enrolment particularly after the 1990s.

⁶ Indeed, the first industrialization experience was launched by the French in the 1930s to promote local manufacturing (tax exemptions and guaranteed credit, among others) 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).

land from French settlers, and collectivizing the land of smallholders. The land seizure and collectivization policy ended in 1969 due to its failure to deliver significant improvements, alongside opposition from large landowners and international donors. Subsequently, liberalization coupled with a large-scale export promotion programme, ‘*Loi 1972*’ at the beginning of the 1970s, marked the beginning of the development of the manufacturing sector.⁷

A severe economic crisis and balance of payments problems in the 1980s jointly led to the adoption of a structural adjustment plan (Naccache 2009), which was followed by the liberalization of foreign trade.⁸ Shortly after that, Tunisia undertook labour reforms intending to increase labour market flexibility while maintaining some form of protection for workers, but these had a limited impact on labour flexibility and reallocation (Angel-Urdinola et al. 2015). Lastly, competition law and a new investment code were established in 1991 and 1993 respectively. All these reforms aimed to accelerate the growth in jobs and productivity, but cronyism, corruption, and rent extraction continued to foster unequal access to business opportunities, and limited competition (Rijkers et al. 2017).

Historically, educational attainment is relatively high in Tunisia compared to Turkey, as well as in most other MENA countries (Middle East, North Africa, Afghanistan; Figure 1). However, in the 2010s, the profile of the workforce in Turkey matched that of Tunisia, suggesting a rapid catch-up in the employed skills base. Interestingly, there is a time lag between Tunisia and Turkey in the diffusion of education (Turkey’s education attainment leapt forward in the 1980s). In Tunisia, we observe a trend that supports the implementation of a statist post-transitional model, with a relatively high level of public sector employment and a relatively high level of medium and highly educated workers in public employment (Figures 2 and 3). In 1991, mandatory schooling was extended from six to nine years, increasing average schooling years for most students. In addition, there is some evidence to suggest that the quality of schooling improved. According to UNESCO data, student:teacher ratios for pre-primary schools dropped by half after the 1980s. Contrary to countries that were able to quickly absorb a massive increase of educated workers (Marouani and Mouelhi 2015), in Tunisia, the increase in education was accompanied by massive unemployment of young graduates (30 per cent on average and 40 per cent for women).⁹

Therefore, by the time both economies embarked on structural change in the 1950s, Turkey had a solid manufacturing base, a large private sector, and an ISI policy that was still more pro-business than Tunisia’s nascent socialist institutions. Reflecting on the trends described so far, Figure 4 shows the sectoral composition of gross domestic product (GDP) since the 1960s.¹⁰ Turkey witnessed a more clear-cut increase in the share of productivity originating from the services industry. The share of agriculture steadily decreased from 33 to 10 per cent, while manufacturing and services share increased structurally and significantly. Meanwhile, the share of the public sector remained small, and in fact declined after the 1980s. In Tunisia, the composition of GDP shows two periods: one before 1980 (mostly socialist period) in which agriculture expanded, and manufacturing grew perhaps marginally, and one after 1980 in which markets more rapidly liberalized.

Overall, services interestingly remained stagnant.

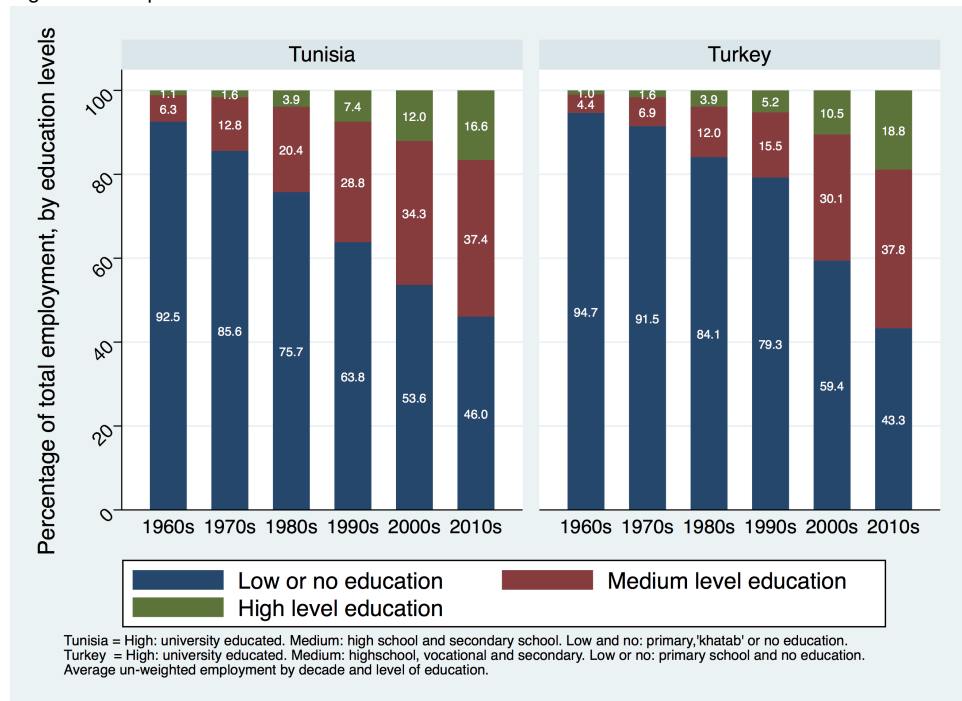
⁷ Not coincidentally, this development was often spearheaded by former civil servants who became entrepreneurs benefiting from government incentives.

⁸ This included the General Agreement on Tariffs and Trade (GATT; 1989), the World Trade Organization (WTO; 1994), and the free-trade agreement with the European Union (1995). Nevertheless, trade liberalization was not rampant in the mid- to late 1990s, primarily because of preoccupations with social stability and protecting Tunisian firms from international competitors.

⁹ Data extracted from the National Institute of Statistics (INS) website, available at: www.ins.tn/fr.

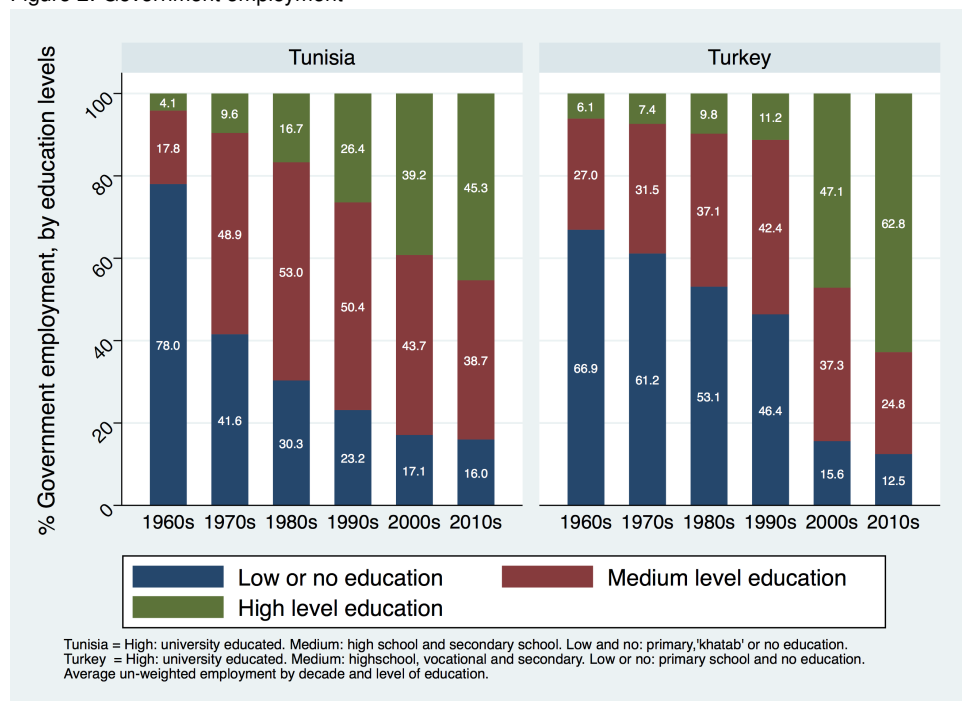
¹⁰ For reference, Figure A1 demonstrates the change in employment shares by sector over time.

Figure 1: Composition of education



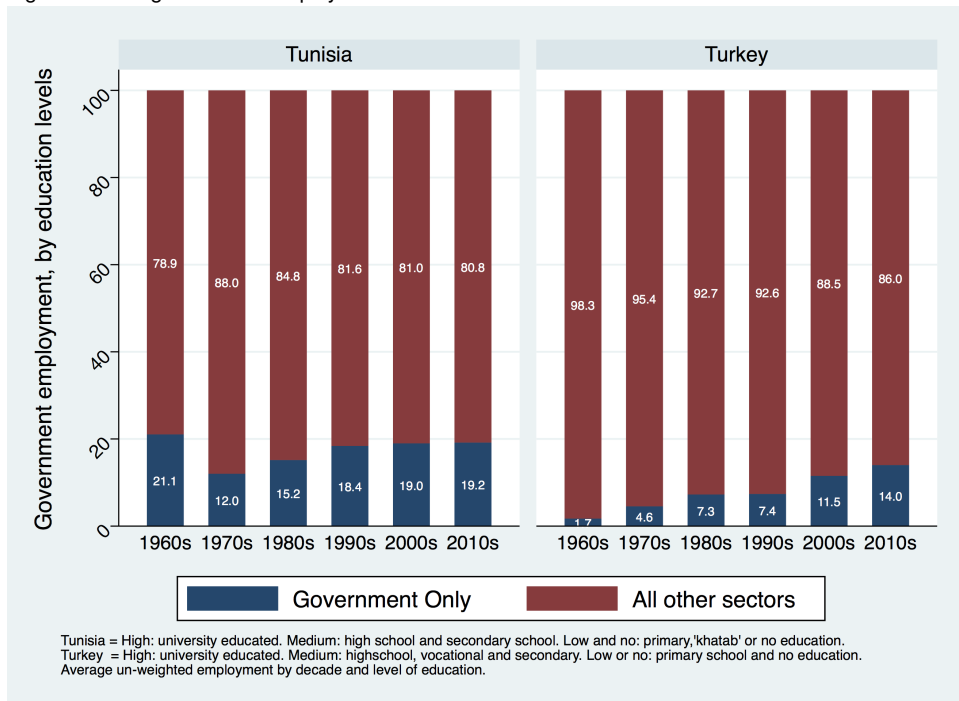
Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ (Institut Tunisien de la Compétitivité et des Etudes Quantitatives) data for Tunisia.

Figure 2: Government employment



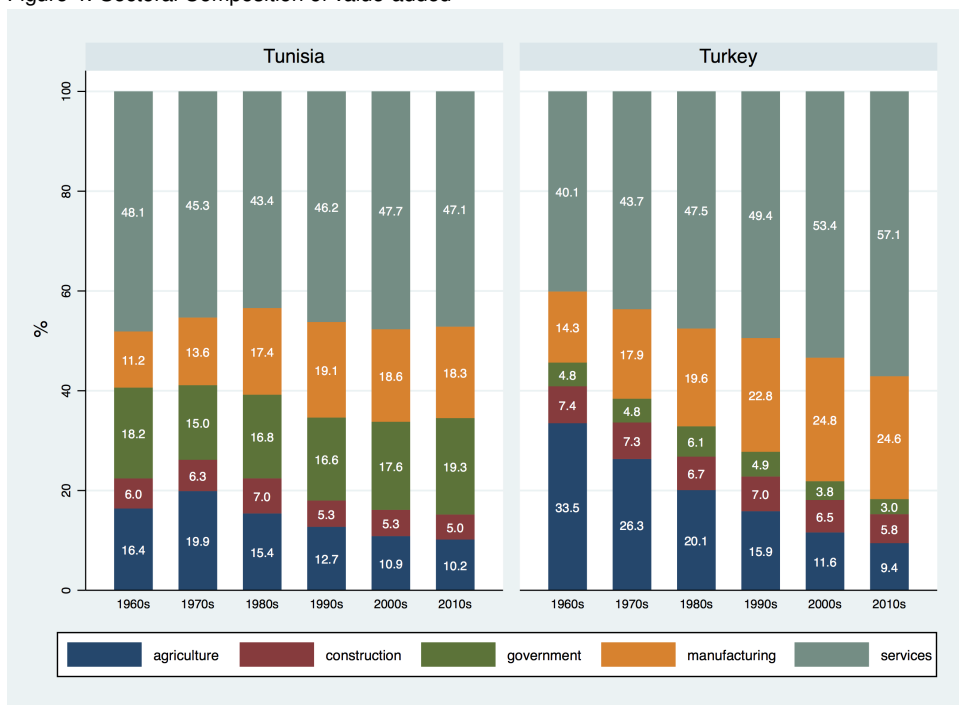
Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 3: Total government employment



Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 4: Sectoral Composition of value-added



Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

3 Decomposing productivity and skills demand: data and methodology

We now take a macroeconomic approach that decomposes the components of changes in productivity and skills from the 1960s to 2010. 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 by country, sector, and 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 countries was not possible. Instead, in a laborious effort, we returned to the original data sources to extract the data, reclassify it, and harmonize between the two countries. The result is a five-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 are obtained from the Turkish population censuses.¹¹ GDP per sector was used to proxy for value-added data and was gathered from official statistical yearbooks provided by the Turkish Statistical Agency (Turkstat). The sources for the Tunisian data are two main national surveys. The value-added per sector data was obtained through annual statistical books from the Development Plans and INS. Data on employment by education level and sector were gathered from periodic censuses and labour force surveys. Both value-added and employment by education statistics were cross-checked with the data from the ITCEQ.¹² Data on trade flows were gathered from the CEPII-CHELEM database that includes several world trade statistics and calculated indicators (CEPII and de Saint Vaulry 2008).¹³ 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

We follow 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):

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

- Skill upgrading decomposition (Berman et al. 1998):

$$\Delta S k_t = \sum_{i=1}^n \Delta s k_{i,t} \Theta_{i,t} + \sum_{i=1}^n \Delta \Theta_{i,t} s k_{i,t} \quad (2)$$

where P_t is aggregate productivity, $P_{i,t}$ is sectoral productivity, $\Theta_{i,t}$ is the share of sector i in total employment, $S k_t$ is the share of highly educated labour in total labour, and $s k_{i,t}$ is the share of highly educated labour by sector.

¹¹ Data are reported in census results for every five years from 1960 to 1990 and in 2000. The years 2010 and 2015 can be found in the employment statistics in the database of the Turkish Statistical Agency.

¹² We are indebted to Monji Ben Chaabene for sharing his work with us.

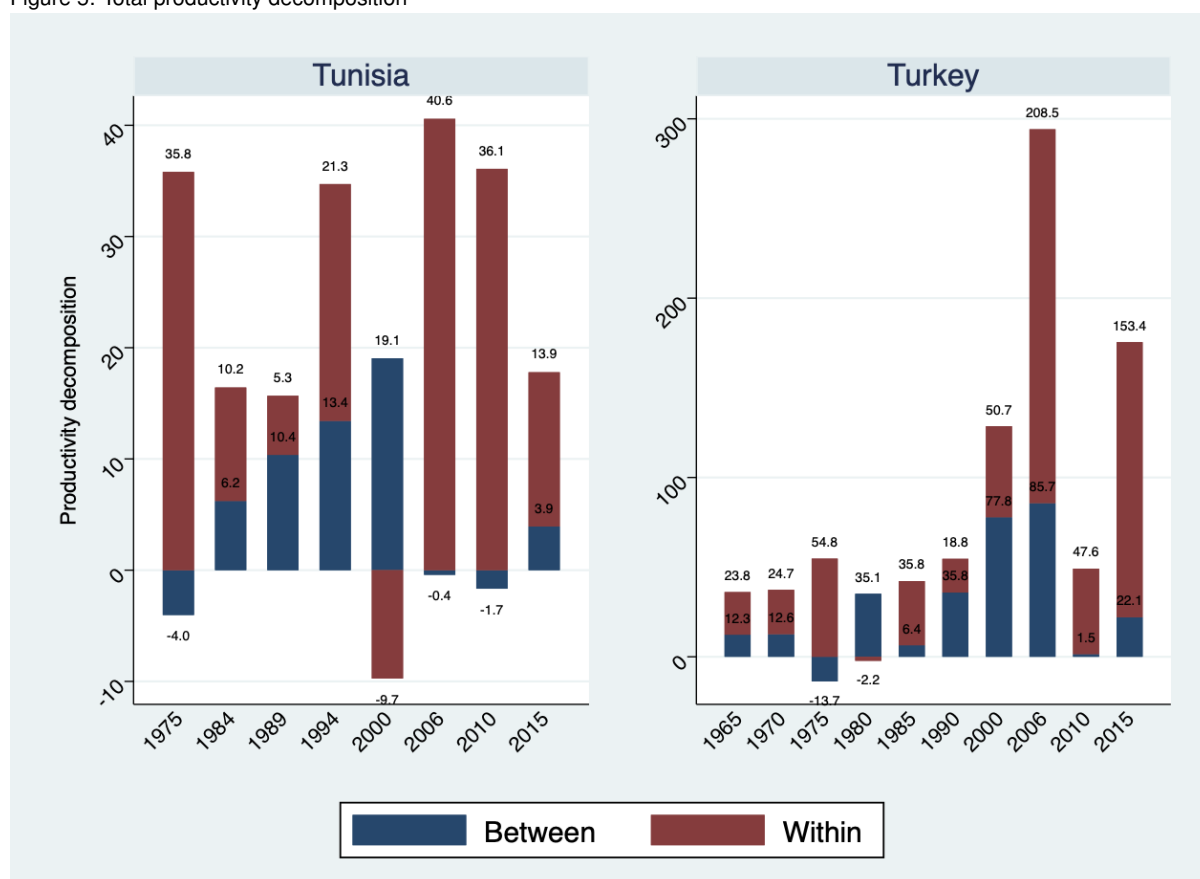
¹³ CEPII-CHELEM uses data from UN COMTRADE. The advantage of using CEPII-CHELEM over UN COMTRADE is that CEPII applies a harmonization strategy to improve the quality and representativeness of the data and creates useful indicators.

Productivity decomposition

The trends in the evolution of productivity for Tunisia and Turkey demonstrated differences over the past half-decade (Figures 5 and 6). For Tunisia, overall productivity after independence was relatively large but fluctuated in the following years. While the within-sector component explained much of the change from the 1960s to 1975, reallocation of resources explained the lion's share of productivity from 1975 to 2000.

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 (*Loi 1972*), bringing the Tunisian industry towards more export-oriented activities in the decades to follow. The next few decades correspond to the structural adjustment period, which cut agricultural subsidies and led to a switch from import substitution to export orientation. The relationship changed again from the 2000s onwards, where we observe the resurgence of productivity within sectors as the primary (and almost the sole) driver of productivity, similar to Marouani and Mouelhi (2015).

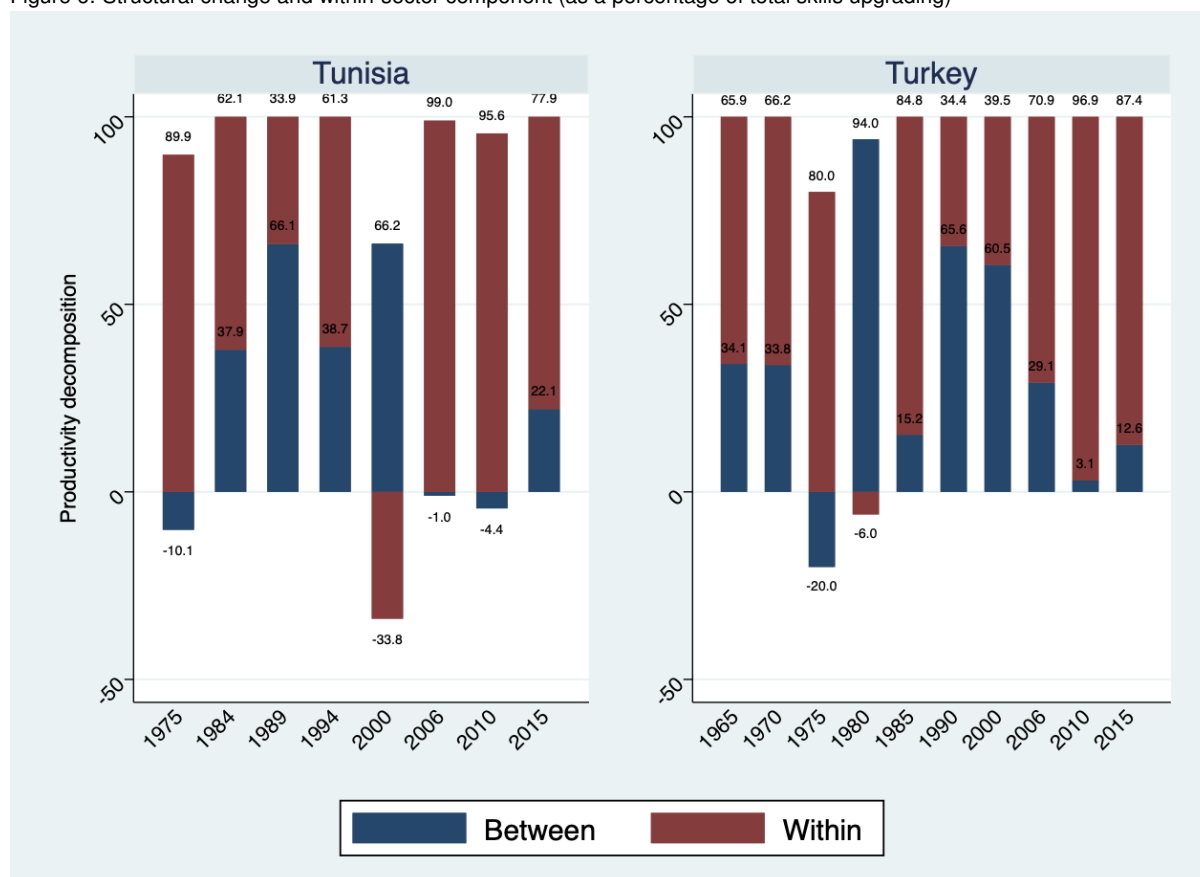
Figure 5: Total productivity decomposition



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.

Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 6: Structural change and within-sector component (as a percentage 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.

Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

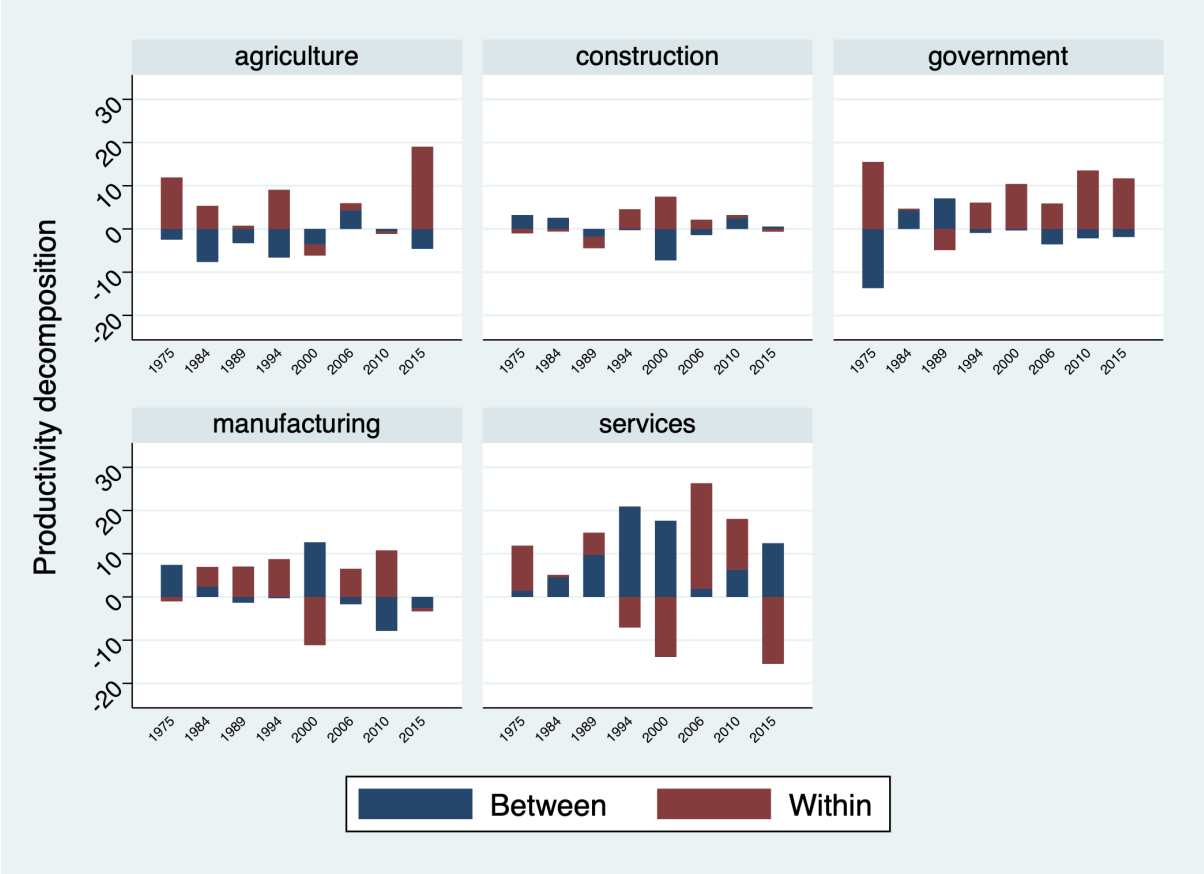
In Turkey, the story is a bit more marked (Figure 6, Panel Turkey). Like Tunisia, the productivity in Turkey in the 1960s was dominated by the within-sector component of the productivity decomposition. In the 1980s, the reallocation of resources had a dominant role in productivity. From the 1980s to 2000s, reallocation between sectors was still an important component of productivity but gradually lost ground to the within-sector component. This observation 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 both Tunisia and Turkey, the between- and within-sector trends in productivity vary by sector (Figures 7 and 8). In Tunisia's agriculture sector, and to some extent in the manufacturing sector, most of the productivity is driven by within-sector changes, while in services, productivity is equally about reallocation of labour. Productivity in Tunisia's agricultural sector is dominated by within-sector changes for most of the periods in the last 50 years, while the other sectors do not demonstrate any unusual 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-sector component of the productivity decomposition in earlier years, but it is overpowered by the within-sector component in later years. Overall, there is no clear correlation

between the components of between- and within-sector productivity over time for either country (see Figures 11 and 12).¹⁴

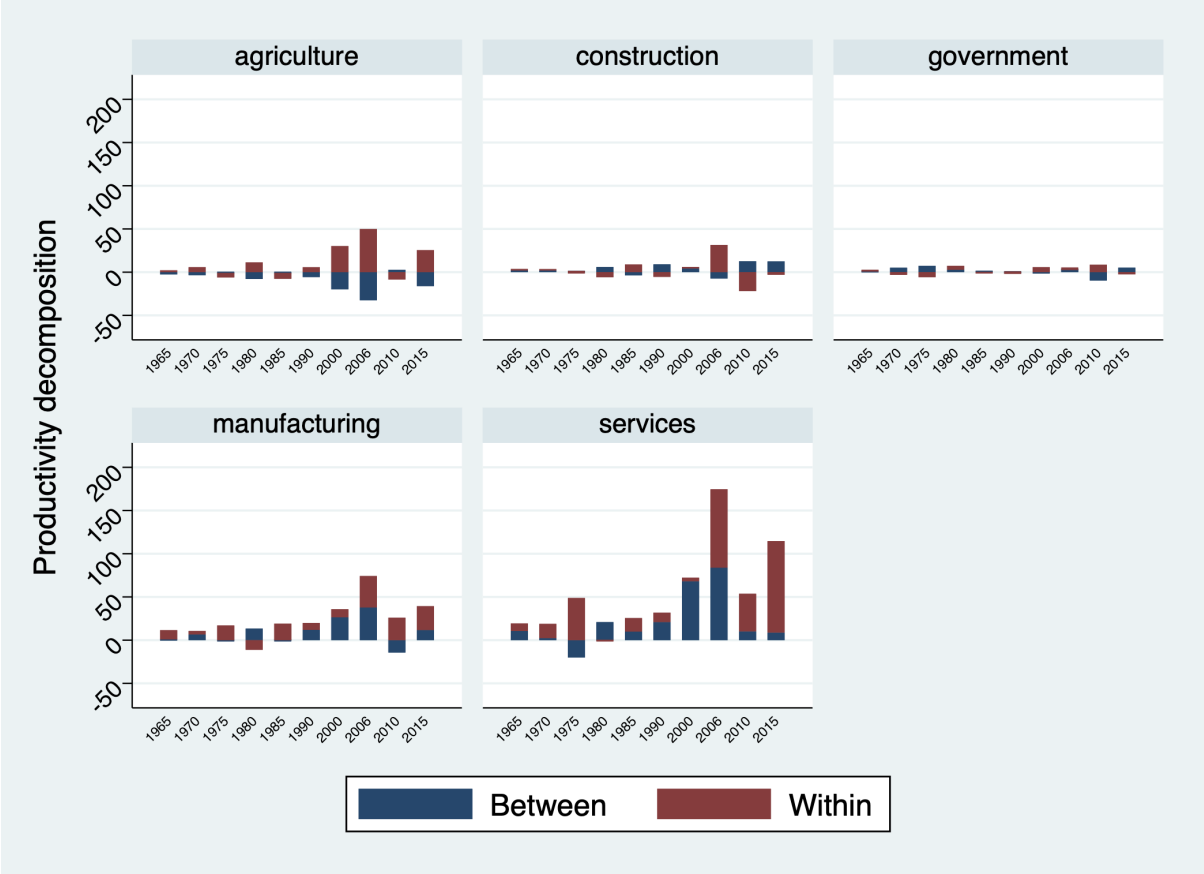
¹⁴ On the sectoral level, we observe that both countries have grown in the share of employment in the agricultural sector and services. In Tunisia, we observe mostly stable and low levels of productivity per sector, but steady changes in the share of employment across most sectors (Figure 9). As expected, 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 years, and a large increase in the share of employment in the services sector (Figure 10). 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 trend 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 was not the case.

Figure 7: Productivity in Tunisia



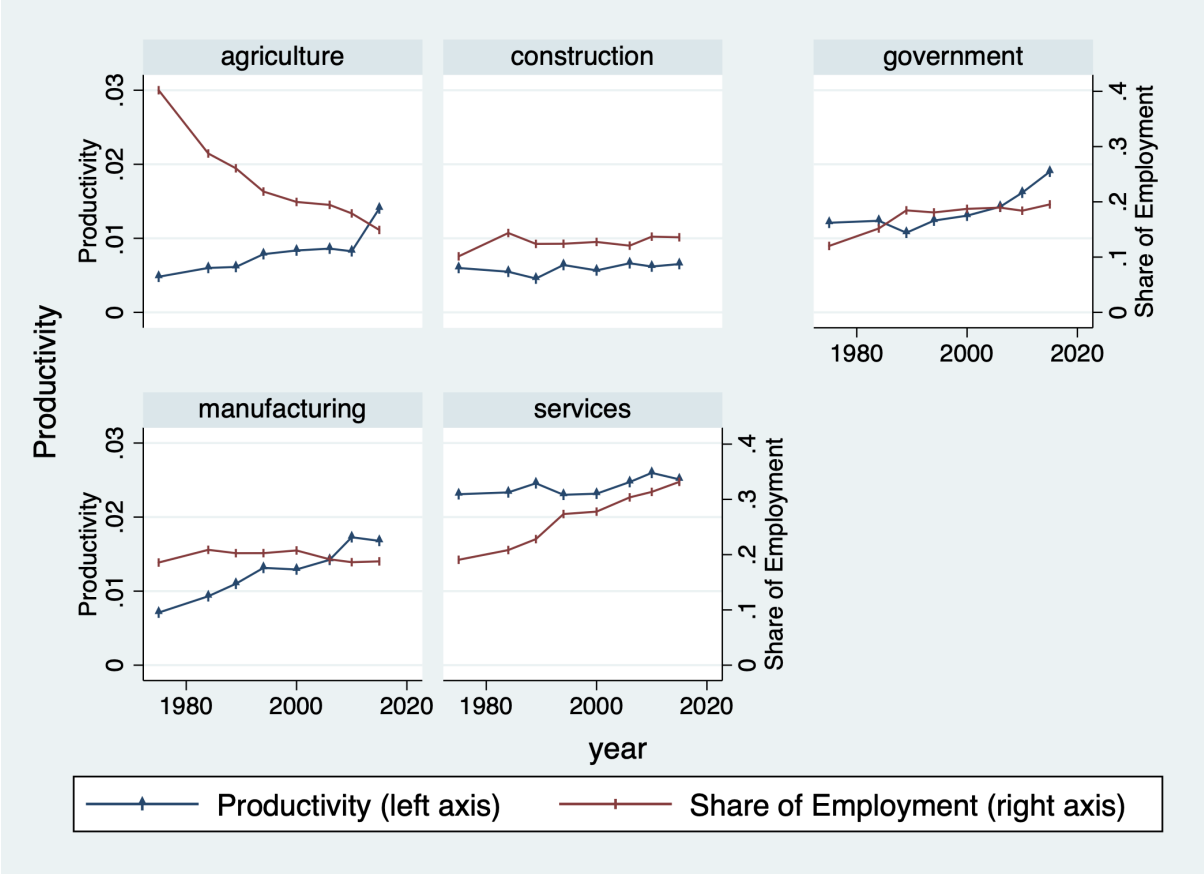
Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 8: Productivity in Turkey



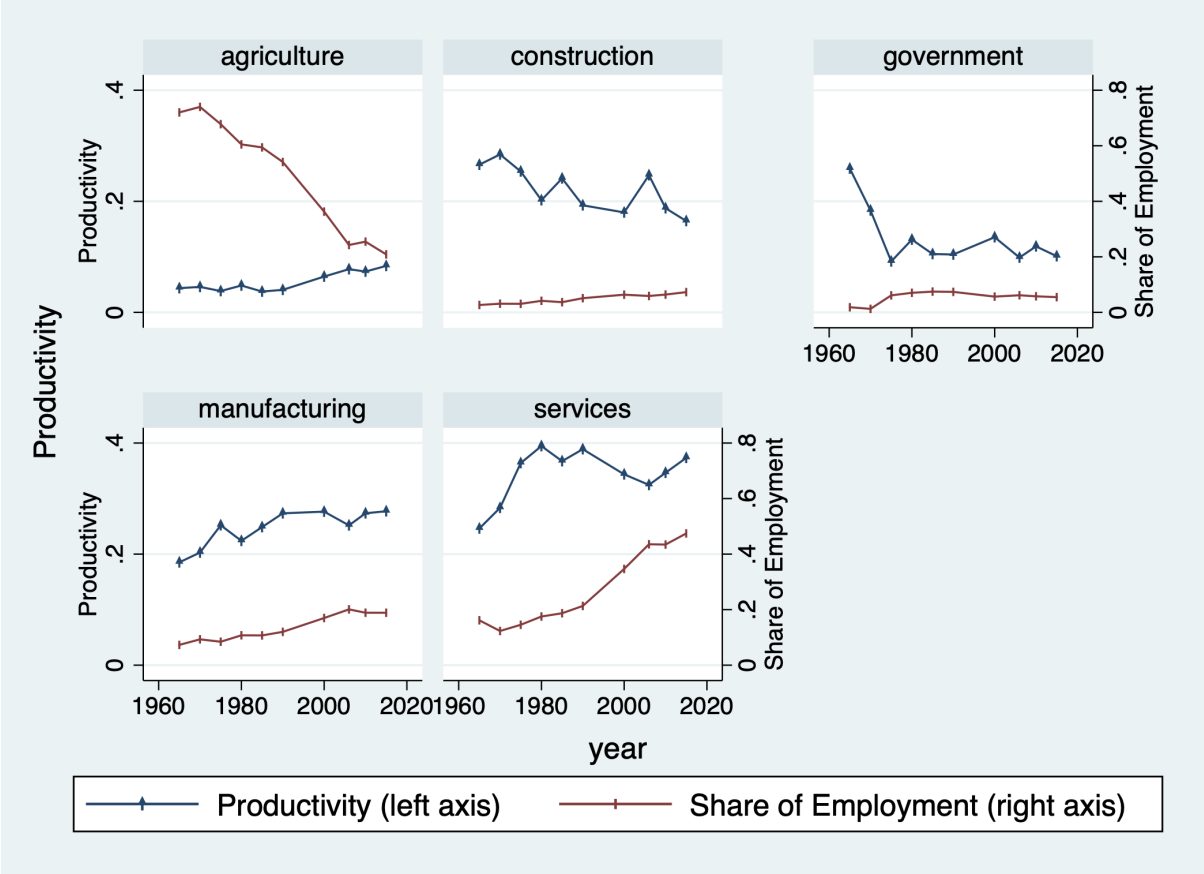
Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 9: Productivity (levels) and share of employment (Tunisia)



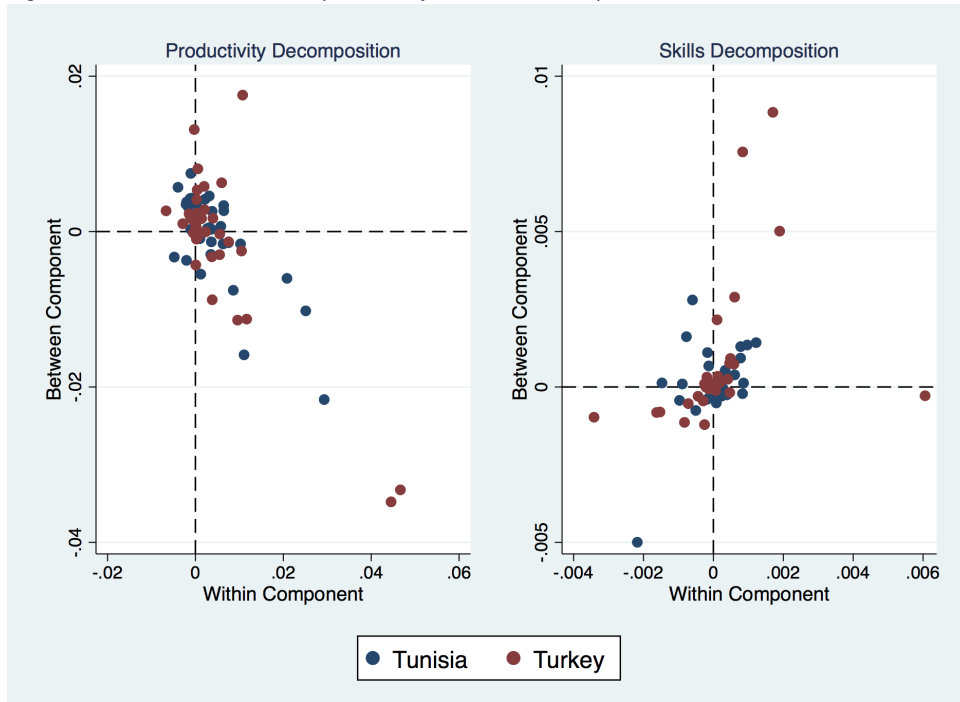
Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 10: Share of productivity (levels) and share of employment (Turkey)



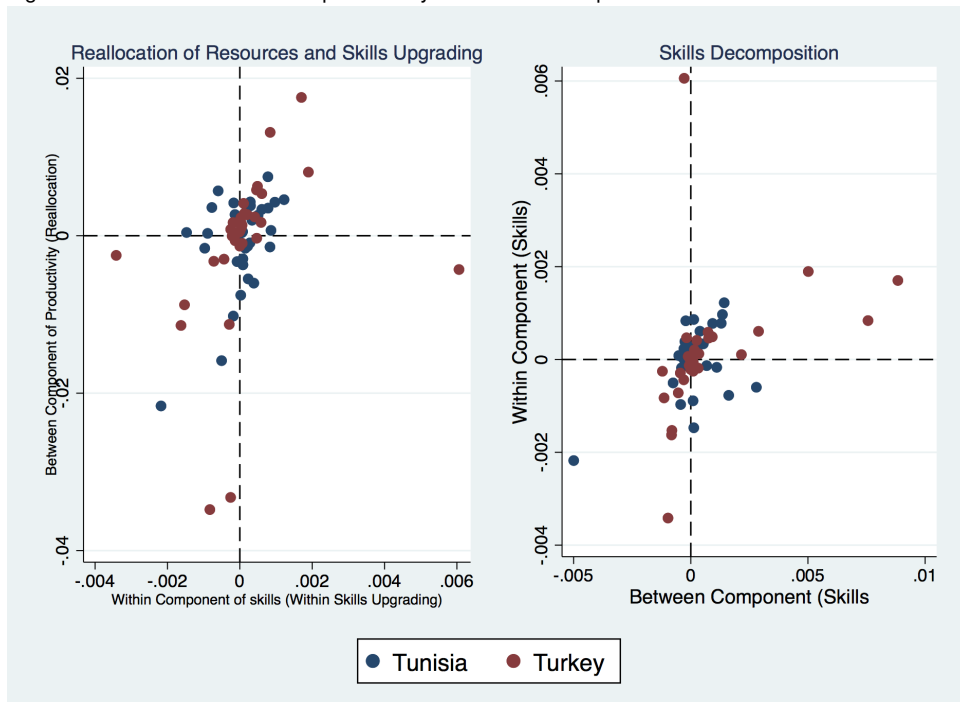
Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 11: Cross-correlations for productivity and skills decomposition



Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 12: Cross-correlations for productivity and skills decomposition



Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Skills decomposition

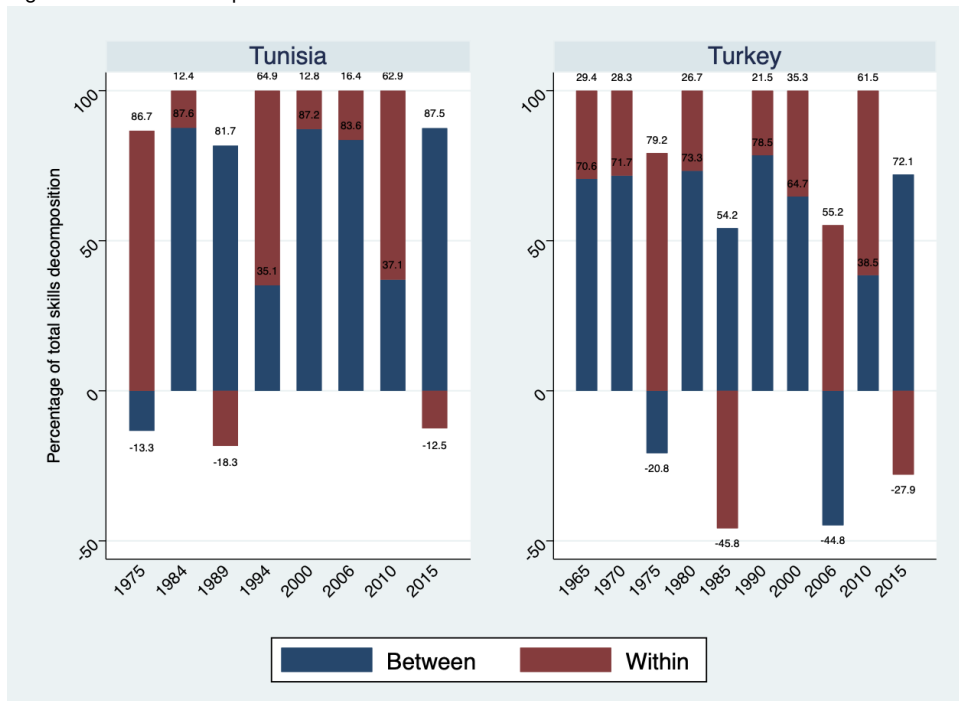
The evolution for skills decomposition for Tunisia is more or less continuously positive over the entire period (Figure 13). There was only a marginally negative contribution that came from changes within sectors in 1989 and in 2015, and a negative contribution of structural change to productivity in our first period from 1967 to 1975. In Tunisia, skill upgrading (or the change in the overall share of high-skill employment) from the 1960s to 2015 was primarily due to the reallocation of skills to different sectors. Once we approach the 1990s to 2010, total skills upgrading starts becoming due—to a larger part—to each sector containing a larger share of high-skill workers. The swell of high-skill workers within sectors that does not coincide with an economy shifting towards more productive activities (cf. Figures 14 and 6) set the background for the 2011 Jasmine revolution, and provides fuel for frustration among unemployed, high-skill youth. At the same time, jobs for high-skill workers in the government services and public sector (Figure 9), 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 the educated labour force working within sectors was an important component of overall skills upgrading. In the later period (1970–75), moving high-skill 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-sector component of skills upgrading, capturing the increase of employment in sectors requiring high-skill workers, had an important role in most of the periods from the 1970s. The remarkable negative contribution of the within-sector 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 the global economy, at the same time as the sharp improvement in the mandatory years of education kept some workers temporarily out of the labour market.

Finally, while there is little correlation of the between- and within-sector estimates (see Figures 11 and 12), there is a positive correlation between the between-sector component of productivity and the between-sector component of skills, especially in Turkey (see Figure 15). This suggests that there is a potential link between productivity and skills reallocation that may be occurring due to the reallocation of resources between sectors rather than within-sector upgrading. If we look at the sectoral components of this correlation, for both Turkey and Tunisia, there is a positive association between skills reallocation and resource reallocation, and its contributions are productivity-enhancing in the services sector, while it is productivity-reducing in the agricultural sector (see Figure 16).¹⁵ This is even more evident in the correlation between the structural change (between) component of the productivity decomposition and the reallocation of skilled workers component of skills decomposition in Turkey (see Figure 17).

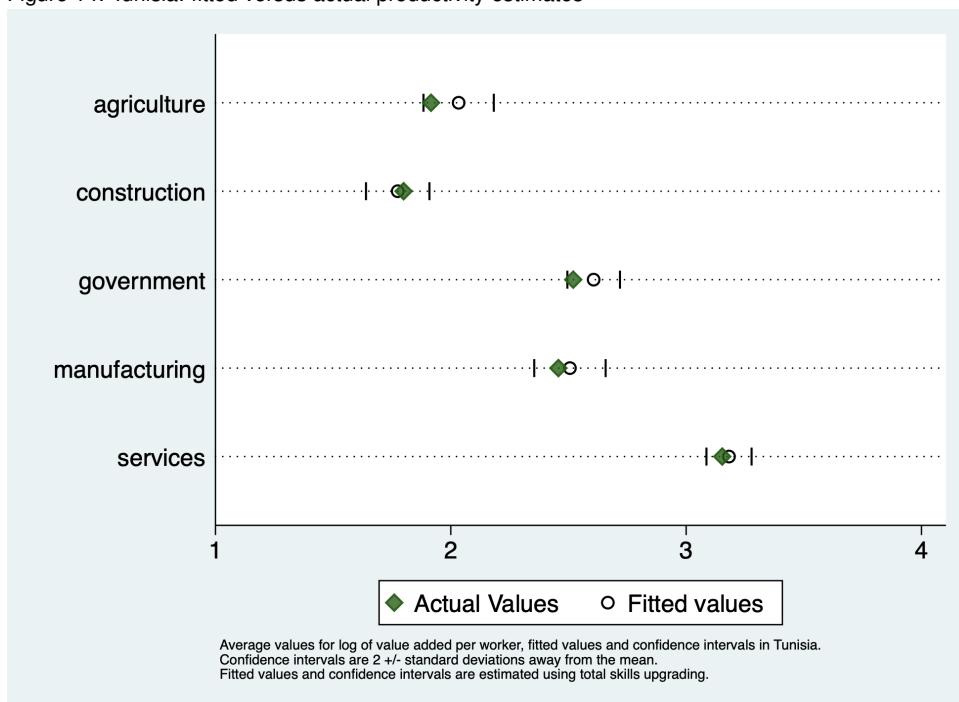
¹⁵ A positive between-component value suggests that the reallocation is productivity-enhancing, while a negative component value suggests that the reallocation results in a net decrease in productivity.

Figure 13: Skills decomposition



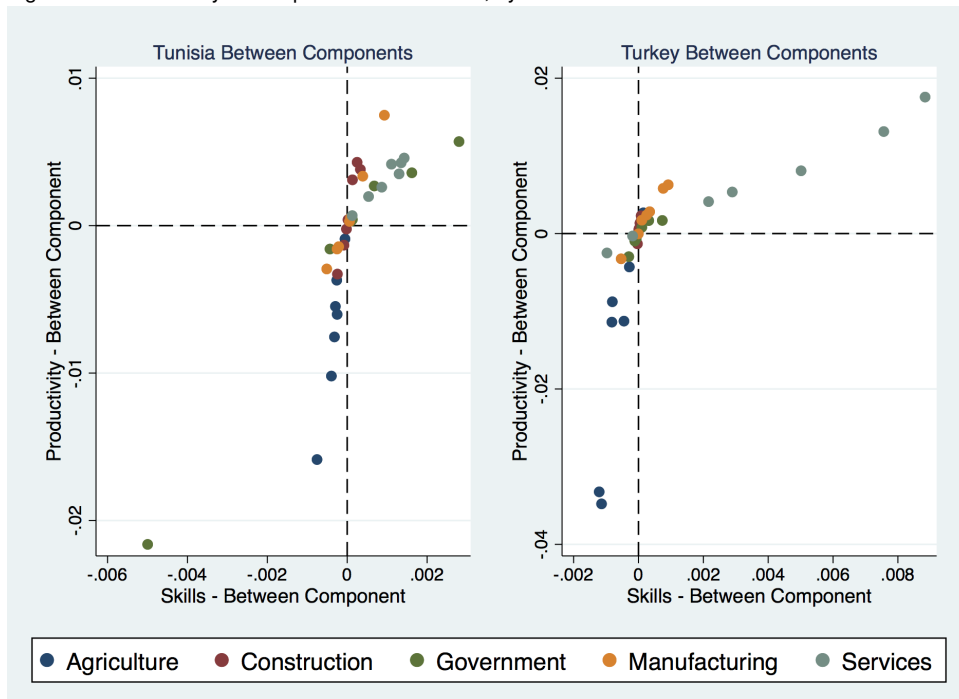
Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 14: Tunisia: fitted versus actual productivity estimates



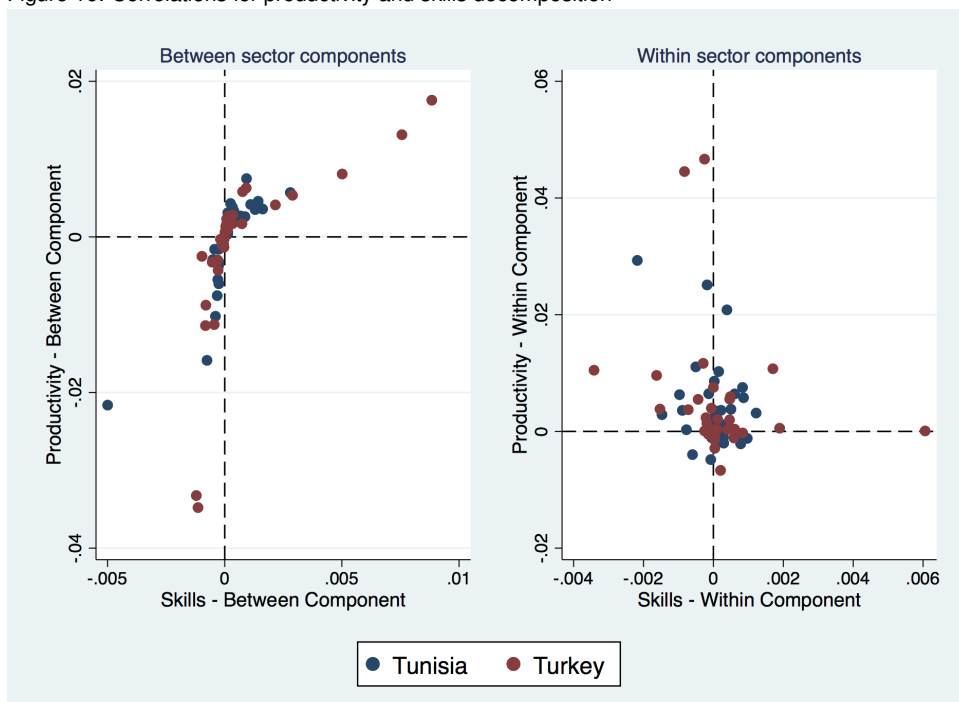
Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 15: Productivity decomposition correlations, by sector



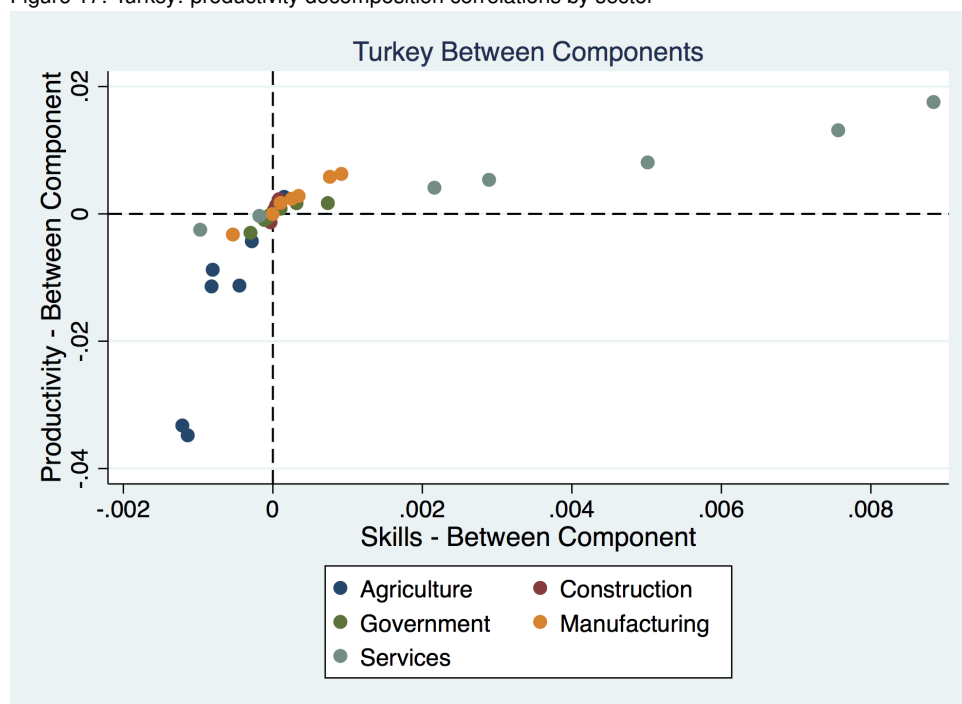
Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 16: Correlations for productivity and skills decomposition



Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure 17: Turkey: productivity decomposition correlations by sector



Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

4 Modelling productivity and skill upgrading

Average years of schooling increased significantly in both countries, and yet the contribution of skills upgrading to productivity is largely overlooked in the literature. This section aims to explore whether there is support for the causal inference of the impact of skill-biased structural change on sectoral productivity in Turkey and Tunisia. Our main aim in this section is to estimate the contribution of each of the following measures of skills upgrading to productivity growth:

- **Total skill upgrading:** the increase in the share of the highest skilled category of labour in total employment.
- **Skill upgrading within sectors:** the increase in the share of the highest skilled category of labour in total employment due to the within-sector component.
- **Skill upgrading between sectors:** the increase in the share of the highest skilled category of labour in total employment due to the between-sector component. This type of increase is also known as skill-biased structural change (SBSC).

Estimating the causal impact of skills upgrading on productivity is admittedly a difficult task, given limited data availability and the endogenous nature of the relationship between productivity and skills. In our attempt to establish a sound empirical link between the two, we face the following challenges. First, data on sectoral employment by education starts only from 1965 for Turkey and 1967 for Tunisia, with 5–10-year gaps, limiting a more long-term and data-rich approach. Second, sectors are not consistent across time or between the two countries. The sectors that are commonly available in the official statistics of both countries are agriculture, manufacturing, construction, services, and public administration. This collection of data leaves us a total of 50 observations by five sectors on skills 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 of data for Turkey is 1960, and therefore the upskilling variables for the data point 1965 refer to

the span from 1960 to 1965. The first year of available data in Tunisia is 1967, and the first data point refers to the span of years from 1967 to 1975.¹⁶ We acknowledge, however, that the small sample size is a significant problem that 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 the total skill upgrading, skill upgrading within sectors, and skill upgrading between sectors; we use each of these independently (one at a time) because the sum of the within- and between-sector components is equal to total skill upgrading. Given the nature of the endogenous relationship between skills and productivity growth, it is ideal to use the Arellano–Bond type system GMM (generalized method of moments) estimators. However, there are reasons why this is not possible. We have only 50 observations for a total of five 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.¹⁷ 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 (ordinary least squares) 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. We follow the same procedure for Tunisia.

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 the share of university graduates in each sector as a percentage of the total economy-wide employment. Since the data are available for every five years for Turkey, the instruments that we use are the fifth lags. For Tunisia, since the data are irregular, we use the first lagged value available between two observations (such as using skill upgrading between 1967 and 1975 to predict skill upgrading between 1975 and 1984) and lag $n - 5$ when observations allow (such as using skill upgrading from 2005 to 2010 to predict upgrading from 2010 to 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.

Using OLS and 2SLS (two-Stage least squares), we estimate the following equation for each country:

$$y_{i,t} = \beta_0 + \beta_1 Skill_{i,t} + \beta_2 X_{i,t} + \beta_3 \rho_t + \Delta W_t' \gamma + \lambda_i + \tau_t + \varepsilon_{i,t} \quad (3)$$

where $y_{i,t}$ is the log of productivity in sector i between $t - 1$ and t ; $Skill_{i,t}$ is either (1) total skill upgrading, (2) between-skill upgrading, or (3) within-skill upgrading in sector i between $t - 1$ and t . Following the work of McMillan and Rodrik (2011), McMillan et al. (2014), and Topalova and Khandelwal

¹⁶ The data for Tunisia are more abundant than those for Turkey 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. Since years in which data are available for both countries do not entirely overlap (especially for the period before 2000), we prefer to run separate regressions for both countries to maximize the observations per country. More specifically, pooling the data results in a total of 70 observations of country–year pairs, 35 for each.

¹⁷ More specifically, pooling the data means year–sector pairs would not be unique anymore as there are two pairs for each year and sector when Turkey and Tunisia are combined.

(2011), who identify commodity prices and trading trends as important factors impacting productivity, we control for the relative comparative advantage (RCA) of Turkish or Tunisian exported commodities on global markets, with $X_{i,t}$, which we extract from the CEPII and de Saint Vaulry (2008) database.¹⁸ In OLS specifications, we also control for the comparative advantage of EU commodities on global markets. Consistent with the literature on agricultural development (Gollin et al. 2013), we use average rainfall, ρ_t , as a control for agricultural output trends. These values are provided by the World Bank’s Climate Change Knowledge Portal.¹⁹ We include controls for real capital stock growth (at constant 2011 national prices) to control for capital flows. Lastly, following the literature on human capital and productivity (Bárány and Siegel 2018; Teixeira and Queirós 2016), we include a variable to control for the change in human capital index between $t - 1$ and t , ΔW_t . Both the financial and human capital values are taken from the Penn dataset²⁰ And finally, to follow standard cross-sectional analysis protocols, we control for λ_i sector and τ_t year fixed effects.

We start with baseline OLS estimations for Turkey and Tunisia in Tables 1 and 2. Columns (1), (4), and (7) shows the raw correlations between productivity and (1) total skill upgrading, (2) skill upgrading between sectors, and (3) 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 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—that is, SBSC 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 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 and within- and between-sector skill upgrading are negative but either weakly or not significantly associated with productivity in Tunisia. In terms of magnitude, both columns (8) and (9) show that a 1 percentage point increase in skill upgrading between sectors is, on average, associated with a 0.07 point increase in productivity for Turkey. The change in real exchange rates was

¹⁸We are able to match CHELEM’s 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 these two sectors. This variable is used as a proxy for country export activity and competitiveness. More details on this variable are given in the Appendix.

¹⁹Since Turkish data are available for every five years, we take five-year averages of the rainfall data for Turkey; since the data for Tunisia are irregular, we use the annual rainfall data for Tunisia.

²⁰The Penn dataset from Feenstra et al. (2015) uses a measure of human capital from Barrow and Lee (2013) that captures the average years of schooling in five-year intervals by age group for the working-age population. Their variables provide a yearly stock of the overall years of schooling as an aggregate. We acknowledge that there may be some multi-collinearity 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. The employment values are, therefore, based on the demand for 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 for 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.

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

negatively associated with productivity in Turkey, but not in Tunisia. This outcome 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 on Tunisia. This correlation could be due to the fact that agriculture is still a prominent sector in Tunisia for which there could be a boost in productivity after more substantial rainfall, lifting the overall productivity, whereas it is the opposite in Turkey. Our results also show that capital accumulation is positively and significantly associated with productivity for Turkey but negatively associated for 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 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 export measures are not significantly correlated with productivity.

Table 1: OLS Estimations for sectoral productivity (value-added per worker), Turkey

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

Notes: 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.

Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Table 2: 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	-0.212**	-0.212**	-0.187*						
	[0.084]	[0.084]	[0.092]						
Skill upgrading between sectors				-0.262**	-0.262**	-0.237*			
				[0.109]	[0.109]	[0.124]			
Skill upgrading within sectors							-0.561*	-0.561*	-0.498
							[0.327]	[0.327]	[0.410]
Real exchange 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

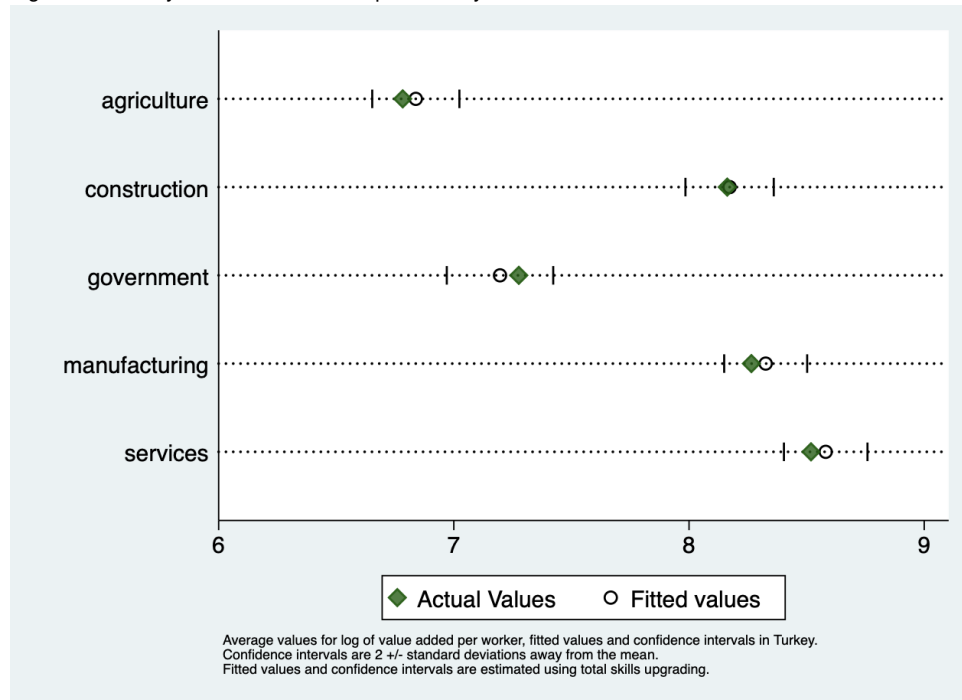
Notes: Robust standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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

Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

If we now look at how good our estimations were at predicting actual productivity levels for Tunisia and Turkey in Figures 18 and 14, 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 sectors—all tradeable 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 overestimated productivity in the government sector.

Figure 18: Turkey: fitted versus actual productivity estimates



Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

So far, our estimations have aimed to document the basic correlations between measures of skill upgrading and productivity without attributing any causal interpretation. In the macroeconomic literature, finding instruments to push towards causal inference for aggregate values is notoriously difficult. When possible, most authors use GMM methods or lagged values of key variables as instruments. We have discussed why a panel GMM is not possible due to over-fitting, but we can still attempt to follow others in the literature by using lagged values of variables that are closely related to and directly impact key right-hand side values. Following the review on aggregate productivity and education trends by Sianesi and Reenen (2003), one potential instrument for a macroeconomic study is the lagged values of skill upgrading and the share of university graduates in economy-wide employment as instruments. In what follows below, we rely on 2SLS estimations, which we hope will allow us to document the causal effect of skill upgrading on productivity. Tables 3 and 4 show the results of the OLS estimations compared to our set of 2SLS estimations. For Turkey, estimates in the last three columns show that there is a positive and significant impact of total skills upgrading and reallocation of skills between sectors on productivity. More specifically, our results confirm that total skill upgrading and productivity are positively related and statistically significant for Turkey (Table 3), but there is no meaningful association captured in the last three columns for Tunisia (Table 4). Moreover, as in the decomposition analysis, our results suggest that the impact, on average, comes from the movement of skilled labour between sectors, rather than the upgrading of skills within sectors for Turkey.

Table 3: OLS and 2SLS estimations of sectoral productivity, Turkey

	(A) OLS: log of value-added per worker			(B) 2SLS: log of value-added per worker		
	Total skill upgrading	Between upgrading	Within upgrading	Total skill upgrading	Between upgrading	Within upgrading
Skill upgrading	0.074 [0.095]			0.122* [0.074]		
Skill upgrading between		0.007 [0.173]			0.259* [0.144]	
Skill upgrading within			0.162 [0.134]			0.163 [0.169]
Real exchange rate growth	-0.236** [0.109]	-0.247** [0.108]	-0.251** [0.102]	-0.237*** [0.077]	-0.214** [0.086]	-0.259*** [0.070]
Average rainfall (mm)	-2.133** [0.994]	-2.235** [0.994]	-2.277** [0.936]	-2.150*** [0.699]	-1.939** [0.782]	-2.348*** [0.637]
Capital stock growth (2011 national prices, in logs)	8.324** [3.534]	8.731** [3.533]	8.821** [3.353]	8.354*** [2.505]	7.617*** [2.787]	9.073*** [2.297]
Human capital stock (% change)	-18.004** [7.143]	-18.770** [7.061]	-18.860** [6.825]	-18.099*** [5.082]	-16.858*** [5.597]	-19.363*** [4.694]
Comp. advantage of TR exports (% change)	-0.004 [0.005]	-0.004 [0.005]	-0.004 [0.005]	-0.003 [0.004]	-0.002 [0.005]	-0.004 [0.004]
Constant	18.272 [48.459]	24.590 [47.874]	22.994 [44.731]	18.5 [33.352]	11.696 [36.837]	26.634 [30.326]
Observations	45	45	45	45	45	45
R-squared	0.977	0.976	0.978	0.976	0.974	0.977
Controls	Yes	Yes	Yes	Yes	Yes	Yes
First stage and identification for 2SLS estimations						
Coefficients of instruments						
L5. Share of college grad. in tot. emp.				-38.420*** [7.606]	-24.410*** [3.760]	-14.145** [6.370]
L5. Total skill upgrading				-0.372 [0.138]		
L5. Between skill upgrading					-0.390*** [0.130]	
L5. Within skill upgrading						-0.342 [0.212]
Sanderson–Windmeijer F Statistic				13.04 pval(0.000)	22.92 pval(0.000)	2.74 pval(0.0837)
Hansen's J statistic				0.003 pval(0.955)	0.708 pval(0.400)	0.913 pval(0.339)

Notes: (1) Newey West standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (2) Null hypothesis for Sanderson–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*.

Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Table 4: OLS 2SLS estimations of sectoral productivity, Tunisia

	(A) OLS: log of value-added per worker			(B) 2SLS: log of value-added per worker		
	Total skill upgrading	Between upgrading	Within upgrading	Total skill upgrading	Between upgrading	Within upgrading
Skill upgrading	-0.187*			-0.037		
	[0.092]			[0.239]		
Skill upgrading between		-0.237*			-0.238	
		[0.124]			[0.551]	
Skill upgrading within			-0.498			0.590
			[0.410]			[0.517]
Real exchange rate growth	0.007	0.006	0.008	0.019***	0.017***	0.019***
	[0.005]	[0.005]	[0.006]	[0.005]	[0.006]	[0.005]
Average rainfall (mm)	0.024*	0.022	0.026*	0.051***	0.045**	0.054***
	[0.013]	[0.013]	[0.015]	[0.014]	[0.018]	[0.013]
Capital stock growth (2011 national prices, in logs)	-1.464**	-1.481***	-1.375**	0.221	0.254	0.184
	[0.523]	[0.510]	[0.558]	[0.329]	[0.331]	[0.312]
Human capital stock (% change)	-0.252	-0.204	-0.400	-0.900	-0.670	-0.990
	[0.861]	[0.834]	[0.965]	[0.906]	[1.056]	[0.820]
Comp. advantage of TN exports (% change)	0.001	0.001	0.001	-0.003***	-0.004**	-0.004**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]
Observations	40	40	40	35	35	35
R-squared	0.982	0.982	0.981	0.983	0.984	0.979
Controls	YES	YES	YES	YES	YES	YES
First stage and identification for 2SLS estimations						
Coefficients of instruments						
Lagged share of college graduates in tot. emp.				-12.2**	-5.89	-8.051***
				[4.71]	[4.39]	[2.690]
Lagged total skill upgrading				0.009		
				[0.123]		
Lagged between skill upgrading					0.019	
					[0.150]	
Lagged within skill upgrading						-0.115
						[0.110]
Sanderson–Windmeijer F Statistic				3.42	1.05	6.34
				pval(0.056)	pval(0.373)	pval(0.009)
Hansen’s J Statistic				7.08	6.84	2.65
				pval(0.008)	pval(0.009)	pval(0.104)

Notes: (1) Newey West standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (2) Null hypothesis for Sanderson–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*.

Source: Authors’ compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

The first-stage results indicate that our instruments perform reasonably well for Turkey but weakly for Tunisia. In all specifications in Tables 3 and 4, 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, except for skill upgrading within sectors. Moreover, the first-stage coefficients of instruments for Turkey are highly significant, with the exception of the fifth lag of skill upgrading within sectors in columns (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 and 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, using this method and these instruments with the available data, of the impact of skill upgrading on productivity growth whatsoever.

Overall, both the OLS and the 2SLS estimations point to the same empirical finding, that for the period between 1970 and 2015: (1) total skill upgrading has been a positive determinant of productivity for Turkey; (2) skill reallocation between sectors was the main driver of productivity increases in Turkey; and, however (3) there were no robust findings for Tunisia.

5 Conclusion

This paper 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 post-war sectoral data.

The productivity decomposition results showed that structural change played a significant role during the last 40 years, but that productivity upgrading within sectors plays a more critical role in explaining overall productivity decomposition only in more recent years. The skills decomposition results show us that, concurrently, overall skills upgrading is characterized by the reallocation of skills across sectors. Furthermore, historically there were more high- and medium-skill workers occupying more jobs in the government sector in Tunisia than in Turkey, which may have been explained by post-colonial path dependency in the 1960s.

Our regression results show that skill upgrading has a causal impact on productivity. The main driver of productivity is the reallocation of skilled labour between sectors and not the increase of the share of highly educated workers within sectors.

The policy implications of the outcomes are essential. In Tunisia, weak instruments may be limiting further causal inferences; however, descriptively, the reallocation of skilled labour 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. The relatively higher allocation of educated skilled labour into the public sector may be impeding a more productive contribution of such skills to the economy. In Turkey, the measurable positive impact of skill reallocation, and the concurrent higher levels of productivity, are explained by the growth of sectors (the increases in the within-sector component of the productivity decomposition) in more recent years. This finding suggests that productivity increased by the reallocation of high skills into sectors that are more productive and on the verge of expansion.

The historical context and institutions of both countries are essential for understanding how skills can contribute to productivity in the economy. Historically 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 in which skills contributed to productivity. On the other hand, there was 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 absorb high-skill workers appropriately. To respond to Lant Pritchett, education went more to productive activities in Turkey, while in Tunisia high-skill, educated workers continued to be channelled to the public sector in the absence of sufficient opportunities in the formal private sector. This final result means that the contribution of education to productivity growth depends on the historical institutional setting of the country.

References

- Angel-Urdinola, D.F., A. Nucifora, and D. Robalino (2015). ‘Labor Policy to Promote Good Jobs in Tunisia: Revisiting Labor Regulation, Social Security, and Active Labor Market Programs’. Report 92871. Washington, DC: World Bank.
- Asik, G., M.A. Marouani, M. Marshalian, and U.Karakoc (2018). ‘Productivity, Structural Change and Skills Dynamics in Tunisia and Turkey’. Working Paper 1269. Giza: Economic Research Forum.
- Barro, R.J., and J.W. Lee (2013). ‘A new data set of educational attainment in the world, 1950–2010’. *Journal of Development Economics*, 104: 184–98.
- Bellin, E.R. (2002). *Stalled Democracy: Capital, Labor, and the Paradox of State-Sponsored Development*. New York: Cornell University Press.
- Berman, E., J. Bound, and S. Machin (1998). ‘Implications of Skill-Biased Technological Change: International Evidence’. *Quarterly Journal of Economics*, 113(4): 1245–79.
- Buera, F.J., J.P. Kaboski, and R. Rogerson (2015). ‘Skill Biased Structural Change’. Working Paper 21165. Cambridge, MA: National Bureau of Economic Research.
- Bárány, Z.L., and C. Siegel (2018). ‘Job Polarization and Structural Change’. *American Economic Journal: Macroeconomics*, 10(1): 57–89.
- Caselli, F., and W.J. Coleman II (2001). ‘The US Structural Transformation and Regional Convergence: A Reinterpretation’. *Journal of Political Economy*, 109(3): 584–616.
- CEPII, and A. de Saint Vaulry (2008). *Base de données CHELEM-commerce international du CEPII*. CEPII. [Database]
- Dix-Carneiro, R., and B.K. Kovak (2015). ‘Trade Liberalization and the Skill Premium: A Local Labor Markets Approach’. *American Economic Review*, 105(5): 551–57.
- Duarte, M., and D. Restuccia (2010). ‘The Role of the Structural Transformation in Aggregate Productivity’. *Quarterly Journal of Economics*, 125(1): 129–73.
- Feenstra, R.C., R. Inklaar, and M.P. Timmer (2015). ‘The Next Generation of the Penn World Table’. *American Economic Review*, 105(10): 3150–82.
- Filiztekin, A., and I. Tunali (1999). ‘Anatolian Tigers: Are They for Real?’. *New Perspectives on Turkey*, 20: 77–106.
- Gatti, R., M. Morgandi, R. Grun, S. Brodmann, D. Angel-Urdinola, J.M. Moreno, D. Marotta, M. Schiffbauer, and E.M. Lorenzo (2013). *Jobs for Shared Prosperity: Time for Action in the Middle East and North Africa*. Washington, DC: World Bank.

- Gollin, D., D. Lagakos, and M.E. Waugh (2013). 'The Agricultural Productivity Gap'. *Quarterly Journal of Economics*, 129(2): 939–93.
- Hansen, B. (1991). *Egypt and Turkey: Political Economy of Poverty, Equity and Growth*. Washington, DC: World Bank.
- Hanushek, E.A., and L. Woessmann (2008). 'The Role of Cognitive Skills in Economic Development'. *Journal of Economic Literature*, 46(3): 607–68.
- Hendricks, L. (2010). 'Cross-Country Variation in Educational Attainment: Structural Change or Within-Industry Skill Upgrading?'. *Journal of Economic Growth*, 15(3): 205–33.
- Herrendorf, B., and A. Valentinyi (2012). 'Which Sectors Make Poor Countries so Unproductive?'. *Journal of the European Economic Association*, 10(2): 323–41.
- Karakoç, U., S. Pamuk, and L. Panza (2017). 'Industrialization in Egypt and Turkey, 1870–2010'. In K.H. O'Rourke and J.G. Williamson (eds), *The Spread of Modern Industry to the Periphery since 1871*. Oxford: Oxford University Press.
- Marouani, M.A., and R. Mouelhi (2015). 'Contribution of Structural Change to Productivity Growth: Evidence from Tunisia'. *Journal of African Economies*, 25(1): 110–32.
- McMillan, M., and D. Rodrik (2011). 'Globalization, Structural Change and Productivity Growth'. Working Paper 17143. Cambridge, MA: National Bureau of Economic Research.
- McMillan, M., D. Rodrik, and I. Verduzco-Gallo (2014). 'Globalization, Structural Change, and Productivity Growth, with an Update on Africa'. *World Development*, 63: 11–32.
- Naccache, S. (2009). 'The Political Economy of Trade Policy in Tunisia'. *Middle East Development Journal*, 1(1): 31–58.
- Ngai, L.R., and C.A. Pissarides (2007). 'Structural Change in a Multisector Model of Growth'. *American Economic Review*, 97(1): 429–43.
- Pritchett, L. (2001). 'Where Has All the Education Gone?'. *The World Bank Economic Review*, 15(3): 367–91.
- Restuccia, D., D.T. Yang, and X. Zhu (2008). 'Agriculture and Aggregate Productivity: A Quantitative Cross-Country Analysis'. *Journal of Monetary Economics*, 55(2): 234–50.
- Rijkers, B., H. Arouri, C. Freund, and A. Nucifora (2014). 'Which Firms Create the Most Jobs in Developing Countries? Evidence from Tunisia'. *Labour Economics*, 31: 84–102.
- Rijkers, B., C. Freund, and A. Nucifora (2017). 'All in the Family: State Capture in Tunisia'. *Journal of Development Economics*, 124: 41–59.
- Sianesi, B., and J.V. Reenen (2003). 'The Returns to Education: Macroeconomics'. *Journal of Economic Surveys*, 17(2): 157–200.
- Teixeira, A.A., and A.S. Queirós (2016). 'Economic Growth, Human Capital and Structural Change: A Dynamic Panel Data Analysis'. *Research Policy*, 45(8): 1636–48.
- TIUK (2014). 'Statistical Indicators 1923–2013'. Technical Report. Available at: http://www.turkstat.gov.tr/Kitap.do?metod=KitapDetay&KT_ID=0&KITAP_ID=160.
- Topalova, P., and A. Khandelwal (2011). 'Trade Liberalization and Firm Productivity: The Case of India'. *Review of Economics and Statistics*, 93(3): 995–1009.

Appendix: description of revealed comparative advantage

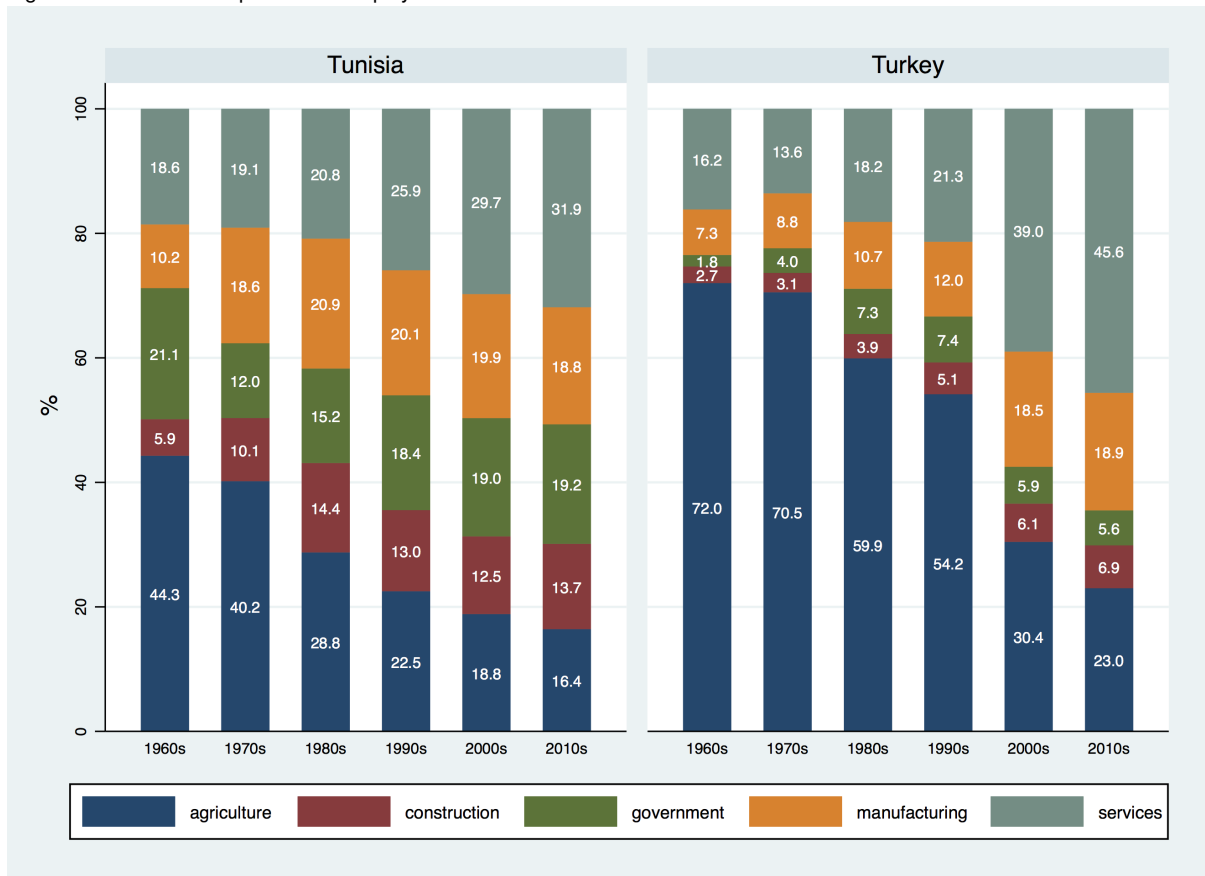
The revealed comparative advantage of exports from Tunisia and Turkey to the rest of the world, in 2010 US dollars:

$$RCA_{i,k} = 1000 \times \frac{W_k}{YPPA_i} \left[\frac{X_{i,k} - M_{i,k}}{W_k} - \frac{X_i - M_i}{W} \right] \quad (4)$$

where W represents world exports; $YPPA_i$ is GDP measured in thousands; X represents exports; and M represents imports for each good k and country i (either Turkey or Tunisia).

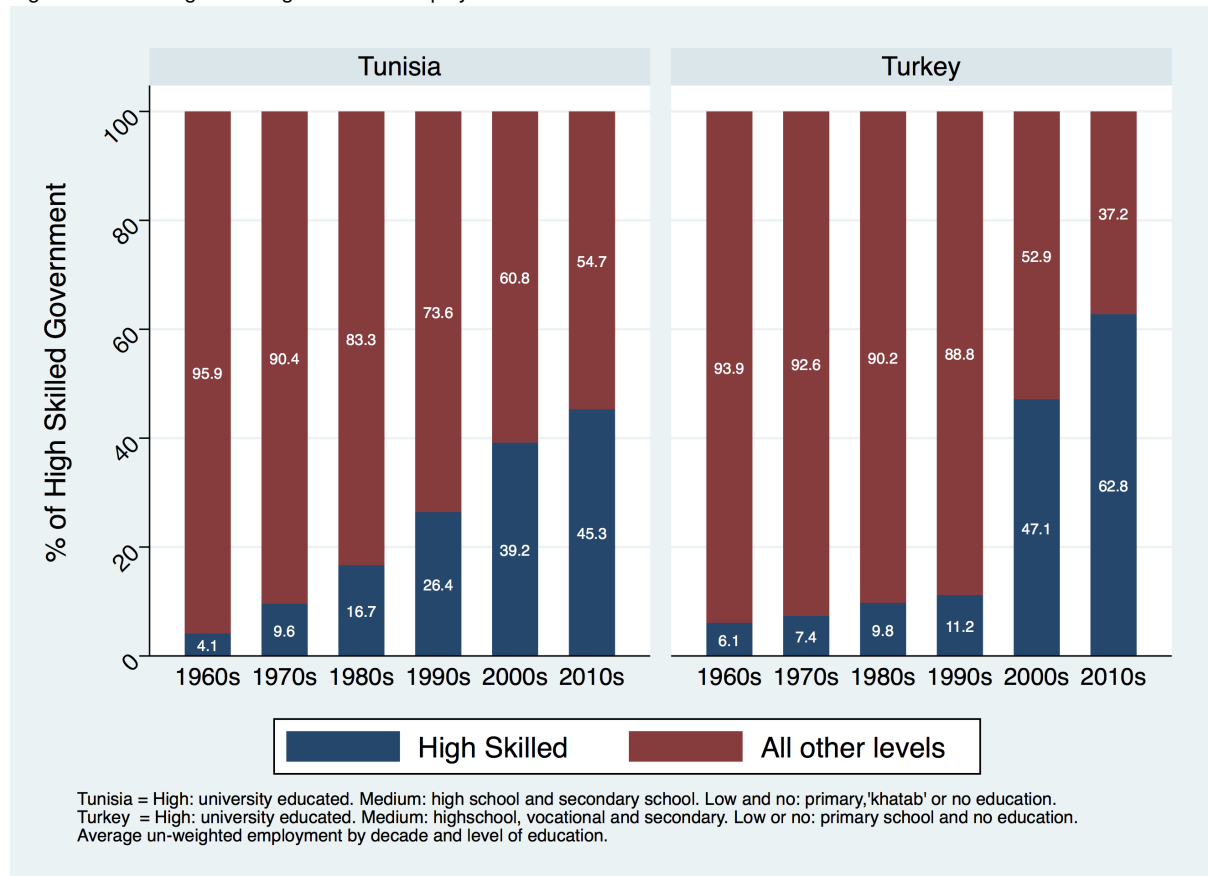
In using this measure, we rely on the assumptions that (1) both Turkey and Tunisia are small, price-taker countries whose supply of goods does not significantly impact world demand, or significantly pose any dumping or anti-competitive risks; and (2) that world trends are exogenously determined outside of Turkish and Tunisian internal industrial and educational trends.

Figure A1: Sectoral composition of employment



Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.

Figure A2: Total high-skilled government employment



Source: Authors' compilation based on Turkstat data for Turkey and INS and ITCEQ data for Tunisia.