*Macroeconomic Dynamics*, **18**, 2014, 998–1017. Printed in the United States of America.
doi:10.1017/S1365100512000727

# AGRICULTURAL PRODUCTIVITY AND GROWTH IN TURKEY

**AYŞE İMROHOROĞLU AND SELAHATTİN İMROHOROĞLU**
*University of Southern California*

**MURAT ÜNGÖR**
*Central Bank of the Republic of Turkey*

This paper investigates the growth experience of one country in detail in order to enhance our understanding of important factors that affect economic growth. Using a two-sector model, we identify low productivity growth in the agricultural sector as the main reason for the divergence of income per capita between Turkey and its peer countries between 1968 and 2005. An extended model that incorporates distortions in the use of intermediate goods in producing agricultural output indicates that policies that have different effects across sectors and across time may be important in explaining the growth experience of countries.

**Keywords:** Sectoral Productivity Differences, International Comparisons, Turkey, Agriculture, Two-Sector Model

## 1. INTRODUCTION

In 1960, GDP per capita in Turkey was 73% of GDP per capita in Greece, Portugal, and Spain. By 1977, this ratio had fallen to around 50%, and it remained at this level until very recently. In this paper we investigate the reasons behind this relative stagnation and inquire whether we can isolate particular policies or features that may have been responsible.

Many authors have focused on the role of institutions, human capital, and macroeconomic policies in affecting economic growth in developing countries. For example, Hall and Jones (1999) attributed most of the differences in output per worker to differences in institutions and government policies across countries. Acemoğlu et al. (2001) estimated large effects of institutions on income per capita. Barro (1999) and Glaeser et al. (2004), among others, have focused on the role of human capital.

We would like to thank the Editor, two anonymous referees, the participants at the 2008 Economic Research Forum Conference organized by TUSIAD and Koç University, the University of Hawaii, the Society of Economic Dynamics annual meetings (2009), the Federal Reserve Bank of New York, New York University, the University of Tokyo, and Arizona State University. We also thank the Economic Policy Research Foundation of Turkey (TEPAV) and the Merih Celasun family for granting this paper the 2011 Merih Celasun award. The views expressed herein are those of the authors and not necessarily those of the Central Bank of the Republic of Turkey. Address correspondence to: Murat Üngör, Research and Monetary Policy Department, Central Bank of the Republic of Turkey, İstiklal Caddesi 10, Ulus, 06100 Ankara, Turkey; e-mail: murat.ungor@tcmb.gov.tr.

 1365-1005/13 

Recently, models of sectoral transformation have been emphasized in providing an alternative insight into these differences. For example, Gollin et al. (2002) and Restuccia et al. (2008) discuss the importance of the agricultural sector in accounting for the differences in income per capita, whereas Duarte and Restuccia (2010) conclude that low productivity in services explains the lack of convergence across a large set of countries.

Our investigation of the historical data for Turkey reveals that the divergence of income per capita between Turkey and its peer countries took place in a period when some of the fiscal and monetary policy indicators, such as the share of government consumption in GDP and the inflation rate, were not significantly different between them. In addition, none of the peer countries was a member of the European Union. A striking difference, however, was present in their sectoral employment shares and sectoral productivities. Turkey had a much larger share of employment in agriculture in 1960, and the decline in this share was much slower than for its peers.

These observations steered us toward examining the growth experience of Turkey through the lens of a multisectoral model. Our results indicate that the main reason for Turkey's relative stagnation was its low agricultural productivity growth. Although this result may not be surprising, given the large differences in agricultural productivity levels across these countries, it changes the focus of the investigation, for Turkey, to policies that have different effects across sectors and across time. We provide some evidence that policies that discriminated against agriculture deserve special attention for understanding the low productivity growth in the Turkish agricultural sector.

Figure 1 shows the GDP per capita in Turkey and in a set of European countries, relative to the GDP per capita in the United States between 1950 and 2008. Comparing the growth experience of these countries relative to the United States highlights the difference between countries who caught up with the United States versus countries who did not. We divide the European countries into two subgroups: "Europe 1" (Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, and the United Kingdom) and "Europe 2" (Greece, Portugal, and Spain).

Relative income in Europe 1 started at 45% of the U.S. level in 1950, reached 66% in 1982, and then fluctuated around 60% after that. Relative income in Europe 2 was 22% of the U.S. level in 1950 and ended up at 54% in 2008. Turkish GDP per capita started at 17% of the U.S. level in 1950 and ended up at only 28% in 2008. Because per capita GDP relative to the United States in the second set of European countries was similar to that in Turkey in the 1950s, we define them as a relevant peer group for Turkey.[1] This set of European countries had caught up significantly with the United States by the mid-1970s, whereas Turkey had remained relatively stagnant. Consequently, the divergence in Turkish GDP per capita relative to its peers took place mainly before the mid-1970s. In particular, Turkish GDP per capita declined from 73% of that for its peers in 1960 to 50% in 1977 and stayed around 47% in the 1980s and 1990s.

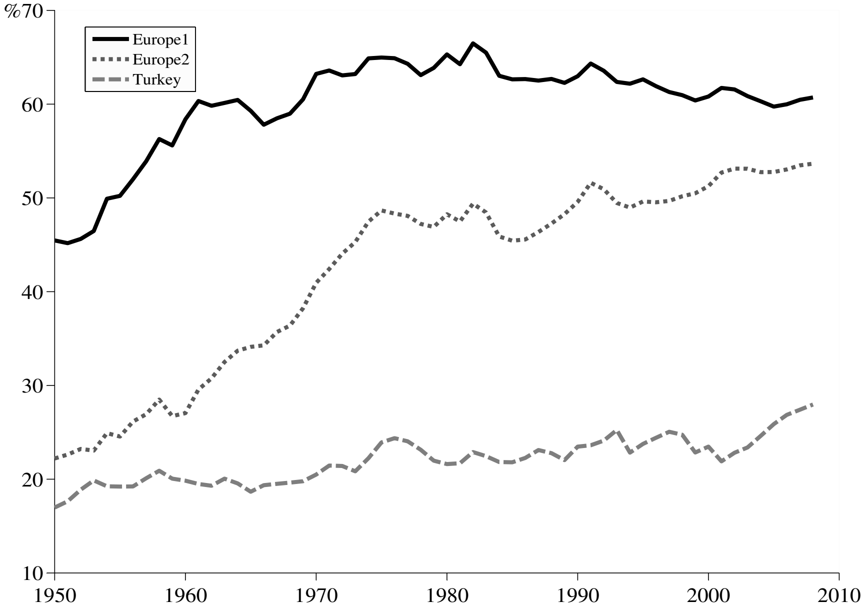


**FIGURE 1.** GDP per capita relative to the United States.

Before the mid-1970s, Turkey had enjoyed high growth rates relative to its own historical averages. For example, between 1960 and 1977, the growth rate of per capita GDP was 3.8% compared to 1.6% between 1977 and 2001. Examining the Turkish data in isolation led many observers to identify the period before the mid-1970s as a successful growth episode. In fact, some analysts had even explained the "high" growth rates in this period as a consequence of the state-led import-substitution strategy.[2] Our analysis, however, identifies 1960 to 1976 as the period in which Turkey fell behind its peers.

Examining the sectoral data reveals that although GDP per capita in Turkey was similar to that for its peers in 1960, there were significant differences in the sectoral allocation of labor between them. In 1960, the share of employment in agriculture was 76% in Turkey, 57% in Greece, 44% in Portugal, and 42% in Spain. The rate of deagriculturalization was also very different between these countries. Although all countries experienced a decline in the share of agriculture over time it was much slower in Turkey compared to its peers. By 2008, the share of employment in agriculture had fallen to 24% in Turkey, 11% in Greece, 12% in Portugal, and 4% in Spain.[3]

In this paper we use a two-sector model to examine the reasons behind the slow deagriculturalization and increased divergence of income per capita in Turkey relative to its peers.[4] In our model, labor allocation between sectors is driven by the differences in sectoral productivity growth rates as well as the income effect of nonhomothetic preferences. We calibrate the preference parameters of the model to Spain, the peer country with the fastest growth, between 1968 and 2005. We use this framework to examine the role of sectoral productivity growth rates in generating differences in sectoral allocations over time between these two countries. We investigate whether it is low productivity in agriculture or industry (or both) that is responsible for the slow deagriculturalization and the low overall productivity in Turkey.[5] We conduct a counterfactual experiment in which we equip Turkey with either the agricultural or the industrial productivity growth from Spain starting in 1968. Our results indicate that if Turkey had inherited Spanish agricultural productivity growth from 1968 to 2005, deagriculturalization would have been much faster and the growth rate of aggregate GDP per capita would have been much higher. Inheriting Spanish industrial productivity, on the other hand, would not have contributed to the growth experience. Our findings reveal that Turkey would not have fallen behind its peers had it inherited the Spanish productivity growth in agriculture during the 1960s and 1970s. Similar results are obtained where sectoral productivity data from several other European countries are used in the counterfactual experiment.

This result is due to the fact that although Turkish productivity growth was lagging behind its peers in both sectors, it was particularly poor in agriculture. Our results provide support for the general finding in this literature that agricultural productivity growth plays a key role in the lack of catch-up in relative incomes across countries. For the case of Turkey, however, most recent attention has been on the role of institutions, low human capital, and flawed macroeconomic policies in hampering growth.[6]

Our results may help refocus attention on policies that have different effects across sectors and across time. We show some preliminary evidence that indirect policies such as import substitution and overvalued exchange rates that discriminated against agriculture in Turkey may have hampered the efficient use of intermediate inputs, resulting in lower agricultural productivity. A more systematic study of how agricultural policies, such as those discussed in Krueger (1974), Olgun and Kasnakoğlu (1989), or Olgun (1991), among others, affect economic growth is left for future research.

Like many models in this literature, our model assumes that average wages per worker are equated across sectors. This is not the case in many developing countries, as pointed out by Gollin et al. (2012). The literature has come up with two basic explanations for this puzzle: lower human capital levels and/or hours in nonagriculture, and serious mismeasurement issues in value added in agriculture. However, none of these explanations has proven entirely satisfactory. Gollin et al. (2012) show that, quantitatively, the human capital channel provides at best a partial explanation of the gaps in developing countries. Herrendorf and Schoellman (2011) come to a similar conclusion about the role of human capital using data for the United States and report that mismeasurement issues in agriculture are very important. However, Gollin et al. (2012) argue that even after all these measurement issues are taken into consideration, a large agricultural productivity gap remains. We leave more comprehensive work examining why incomes are not equated across sectors in Turkey for future research.

The rest of the paper is organized as follows. Section 2 introduces the two-sector model and Section 3 provides the results. Section 4 concludes.

## 2. A TWO-SECTOR MODEL

There has been recent growing interest in using multisector general equilibrium models to understand the sources of the structural transformation of production and to quantify the impact of the shift in resources across the sectors on aggregate growth and productivity. These studies utilize two (agriculture and nonagriculture) or three (agriculture, industry, and services) sector models and rely on two types of forces to generate the structural transformation observed in the data. The first type of models, such as those of Baumol (1967) and Ngai and Pissarides (2007), view the structural transformation as a supply-side phenomenon based on sectoral differences in productivity growth. The second type of models view the structural transformation as a demand-side phenomenon based on sectoral differences in income elasticities of demand [see, for example, Kongsamut et al. (2001)]. There are also some models, known as hybrid models, that combine two types of channels [see, for example, Rogerson (2008) and Duarte and Restuccia (2010)].[7]

Our model is based on a hybrid model of structural change, in which the reallocation of economic activity between agriculture and nonagriculture is driven by nonhomothetic preferences and differences in sectoral productivity growth rates. Specifically, we study a two-sector closed economy model to understand the role of sectoral productivity changes in the structural transformation of Turkey combined with Engel's law of demand.[8,9]

### 2.1. Technology

At each date $t$, there are two sectors, agriculture ($A$) and industry ($I$). The industrial sector, in this section, is more properly thought of as the nonagricultural sector. It incorporates both services and manufacturing.[10] The production function for sector $j = A, I$ is given by

$$Y_{j,t} = \theta_{j,t} N_{j,t}, \tag{1}$$

where $Y_{j,t}$ is the output of sector $j$, $N_{j,t}$ is labor allocated to production, and $\theta_{j,t}$ is sector $j$'s labor productivity at date $t$. We assume that labor is fully mobile across sectors and the wage rate in the economy is given by

$$\omega_t = \theta_{j,t} p_{j,t}, \tag{2}$$

where $p_{j,t}$ is the price of good $j$ and $\omega_t$ is the wage rate in the economy at date $t$. Given the absence of any distortions, relative prices reflect relative productivities in this economy; i.e., $p_{I,t}/p_{A,t} = \theta_{A,t}/\theta_{I,t}$. Because we abstract from capital and fixed factors in production, differences in labor productivity implicitly incorporate differences due to capital as well as to technology adoption, regulation, etc. across sectors.

## 2.2. Household's Problem

The economy is populated by an infinitely lived representative household. Population is constant and normalized to one. Preferences are described by a period utility function given by

$$U(C_t) = \log(C_t). \tag{3}$$

$C_t$ is a composite consumption good derived from the agricultural, $A_t$, and nonagricultural consumption, $I_t$, via a CES aggregator:

$$C_t = \left[\gamma_A^{1/\eta}(A_t - \bar{A})^{(\eta-1)/\eta} + \gamma_I^{1/\eta} I_t^{(\eta-1)/\eta}\right]^{\eta/(\eta-1)}.$$

The parameter $\bar{A}$ represents the subsistence level of agricultural good consumption and satisfies, at each date $t$,

$$\theta_{A,t} > \bar{A} > 0. \tag{4}$$

The first inequality states that the economy's agricultural sector is productive enough to provide the subsistence level of food to all households [see Matsuyama (1992)]. The second inequality implies that preferences are nonhomothetic and the income elasticity of demand for the agricultural good is less than unity. It is also assumed that the representative household has enough income to purchase more than $\bar{A}$ units of agricultural good. The weight $\gamma_j$ influences how consumption expenditure is allocated between the two sectors, with $\gamma_A, \gamma_I > 0$, and $\gamma_A + \gamma_I = 1$.

The parameter $\eta > 0$ is the (constant) elasticity of substitution between agricultural and industrial goods, and it underlies the magnitudes of price responses to quantity adjustments. A lower substitution elasticity implies that sharper price changes are needed to accommodate a given change in quantities consumed. If $\eta$ approaches 1, preferences over the two goods approach a Cobb–Douglas, so that the substitution effect vanishes regardless of the magnitude of the differences between sectoral productivities.

We assume that the household is endowed with one unit of productive time in each period, which it supplies inelastically to the market. At each date, the household chooses consumption of each good to maximize its lifetime utility subject to the budget constraint

$$p_{A,t}A_t + p_{I,t}I_t = 1, \tag{5}$$

taking prices as given. The demand for labor must equal the exogenous labor supply at every date:

$$N_{A,t} + N_{I,t} = 1. \tag{6}$$

Because there is no international trade or capital accumulation, the following conditions hold at each date, implying that the market must clear for each good

https://doi.org/10.1017/S1365100512000727 Published online by Cambridge University Press

produced:

$$A_t = Y_{A,t}, \quad I_t = Y_{I,t}. \tag{7}$$

## 2.3. Equilibrium

A competitive equilibrium consists of consumption decisions $\{A_t, I_t\}$ of the households, factor allocations $\{N_{A,t}, N_{I,t}\}$, sectoral output decisions $\{Y_{A,t}, Y_{I,t}\}$ of the firm, and prices $\{p_{A,t}, p_{I,t}\}$ such that given prices, the firm's allocations solve its profit maximization problem, the household's allocations solve the household's utility maximization problem, and all product and factor markets clear.

One can combine the first-order conditions for the household maximization problem with the market-clearing conditions to obtain the following equation, which explicitly characterizes the equilibrium employment share in agriculture:

$$N_{A,t} = \left(\frac{\gamma_A \theta_{A,t}^{\eta-1}}{\gamma_A \theta_{A,t}^{\eta-1} + \gamma_I \theta_{I,t}^{\eta-1}}\right) + \left(\frac{\gamma_I \theta_{I,t}^{\eta-1}}{\gamma_A \theta_{A,t}^{\eta-1} + \gamma_I \theta_{I,t}^{\eta-1}}\right) \frac{\bar{A}}{\theta_{A,t}}. \tag{8}$$

The equilibrium employment share in the industrial sector is given by

$$N_{I,t} = 1 - N_{A,t}. \tag{9}$$

## 2.4. Calibration

Our main calibration target is to match the sectoral employment shares in Turkey in 1968. Once we have those shares, we equip the model with the sectoral productivity levels for each year in Turkey, using Turkish productivity data, until 2005.

Our counterfactual experiments involve comparing sectoral productivity growth rates between Turkey and Spain. As argued in Duarte and Restuccia (2010), the lack of PPP-adjusted sectoral output data across countries necessitates a method for determining relative productivity differences between two countries.

To focus on the role of productivity differences in explaining sectoral transformation, we assume that preference parameters are invariant across countries. Therefore, we set $\gamma_A$ and $\eta$ to match the secular decline in agriculture in Spain between 1968 and 2005. We experiment with different $\gamma_A$ and $\eta$ values: $\gamma_A = 0.04$ and $\eta = 0.5$, so that the goods are complements, and $\gamma_A = 0.01$ and $\eta = 1.5$, so that the goods are substitutes. Because $\eta$ determines the amount of substitution among different goods, it dictates the amount of labor that will be reallocated to the nonagricultural sector in response to uneven changes in productivity growth.

We normalize the level of productivity in each sector to one for 1968 in Spain and set $\bar{A}$ to match the share of employment in agriculture in Spain in 1968 based on

$$\bar{A} = (N_{A,1968} - \gamma_A)/(1 - \gamma_A). \tag{10}$$

We follow Duarte and Restuccia (2010) and set the level of productivity in Turkey in 1968 for both sectors ($\theta_{A,1968}$ and $\theta_{I,1968}$) so that using $\gamma_A$, $\eta$, and $\bar{A}$ the

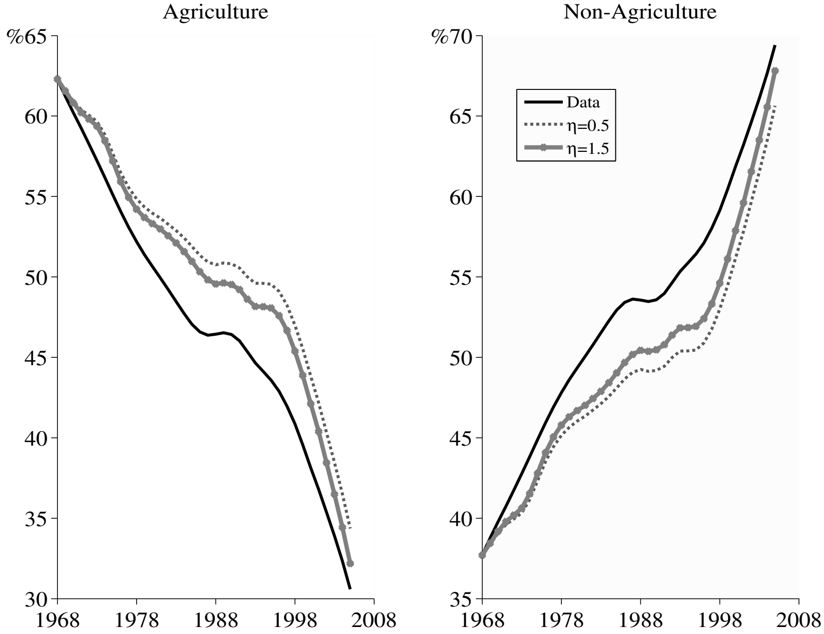


**FIGURE 2.** Benchmarks.

model economy matches the following two targets: (1) the share of employment in agriculture in Turkey in 1968[11] and (2) aggregate labor productivity level in Turkey relative to that of Spain in 1968.[12]

This method results in productivity levels in agriculture and nonagriculture in Turkey around 45% and 65%, respectively, of Spanish productivity levels in 1968. Once we have the initial productivity levels for each country, we use data on sectoral labor productivity growth rates, given in local currencies, to obtain the time paths of sectoral productivities for the sample period for both countries.[13]

## 3. RESULTS

We start this section by discussing our key findings. Next, we examine the properties of our model economy in more detail and conduct several sensitivity analyses.

### 3.1. Key Findings

In Figure 2, we display the agricultural and nonagricultural employment shares that are generated by the model economy against their data counterparts in Turkey. Two observations stand out. First, the model captures the secular decline in the share of employment in agriculture reasonably well. Second, $\eta$ plays a quantitatively insignificant role on the share of employment in each sector. The results with $\eta = 0.5$ and $\eta = 1.5$ are very similar. This finding indicates that labor allocation

https://doi.org/10.1017/S1365100512000727 Published online by Cambridge University Press

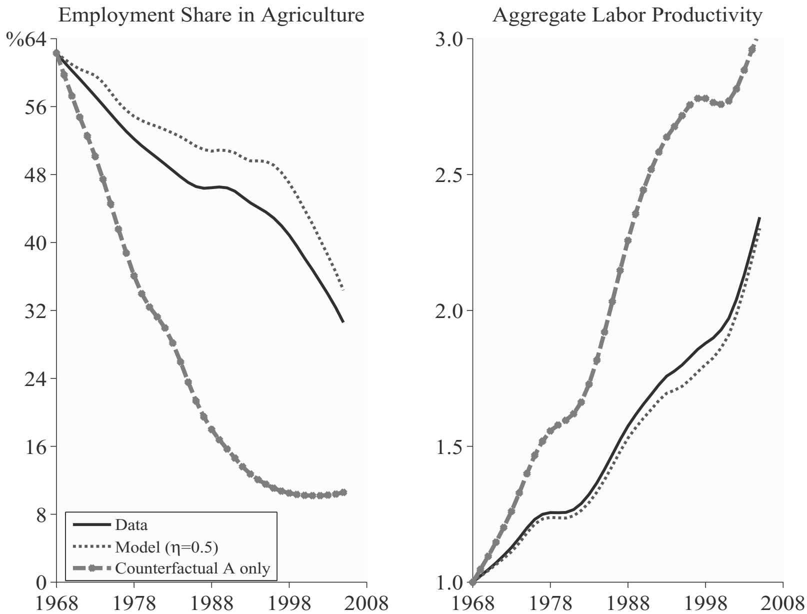


**FIGURE 3.** Role of agriculture.

is mainly determined by increases in productivity in the agricultural sector during this time period in Turkey.

We use this framework to investigate the role of productivity growth in agriculture versus nonagriculture in impacting the speed of deagriculturalization in Turkey. We ask what would have happened to the share of employment in the two sectors and the overall GDP per worker if Turkey had shared Spanish productivity growth rates starting in 1968. More importantly, we are interested in finding out if sharing sectoral productivity growth rates in both sectors or in one of them in particular would have put the Turkish economy on a significantly different growth path. In the following counterfactual experiment, we allow Turkey to share productivity growth rates of Spain starting in 1968 in each sector, one at a time.

Figure 3 shows the share of employment in agriculture and the GDP per worker that are obtained in the first counterfactual experiment, where we use only the agricultural productivity growth from Spain and keep the nonagricultural productivity growth as it is in the benchmark. Compared to the benchmark results, this counterfactual experiment generates a much faster deagriculturalization and a higher growth in overall productivity. By 2005, the share of employment in agriculture falls to around 10% and aggregate labor productivity is about three times its 1968 level.

A more interesting point emerges, however, when we compare the results from this counterfactual experiment with those from using sectoral productivities for

https://doi.org/10.1017/S1365100512000727 Published online by Cambridge University Press

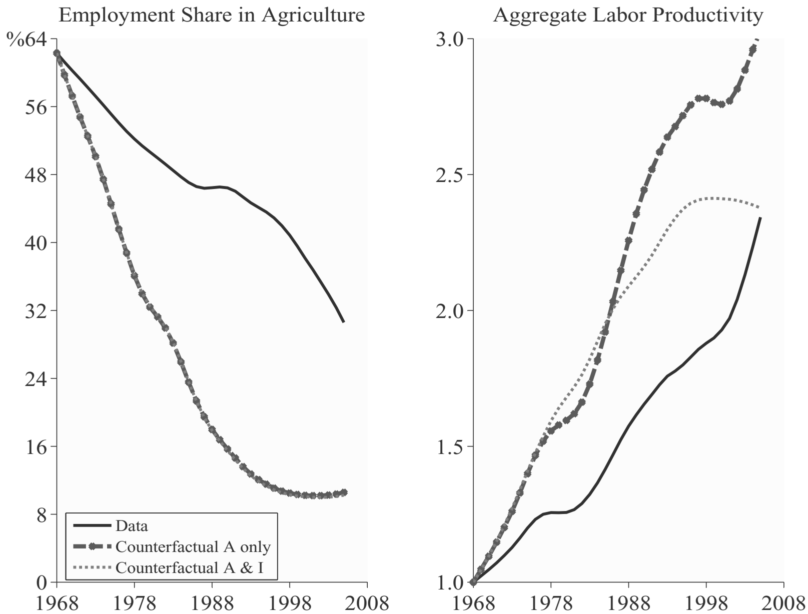


**FIGURE 4.** Role of agriculture versus nonagriculture.

both sectors from Spain. Comparing the series labeled "Counterfactual A only" with the series "Counterfactual A&I," where both productivities are taken from the Spanish data in Figure 4, reveals the importance of the agricultural sector in driving the results. In particular, the fast decline in the share of employment in agriculture and the high growth in aggregate labor productivity are accomplished by feeding in the agricultural productivities alone.

In the first panel of Figure 4, the employment shares in agriculture implied by both counterfactual experiments coincide. This is because, first, differences between Turkey and Spain in growth rates in the industrial sector are not very large, and second, their impact in equation (8) is small. The period from 1968 to the late 1970s, when Turkey was falling behind its peers, displays significantly higher growth in labor productivity that comes entirely from productivity growth in the agricultural sector. These results are nearly identical for the $\eta = 1.5$ case.

Figure 5 shows the data as well as the model simulations for GDP per worker in Turkey relative to GDP per worker in Spain between 1968 and 2005. The series labeled "Data" shows the relative stagnation of Turkey as its per-worker GDP declines from 53% of Spanish levels in 1968 to 46% in 1984. Our benchmark simulations capture this relative stagnation fairly well. Results for the counterfactual experiment when Turkey inherits Spanish agricultural growth are depicted in the series labeled "Counterfactual A only." According to this experiment, relative GDP per worker in Turkey would have increased steadily from 53% of Spanish levels in 1968 to 61% by 1984. We also report results of the

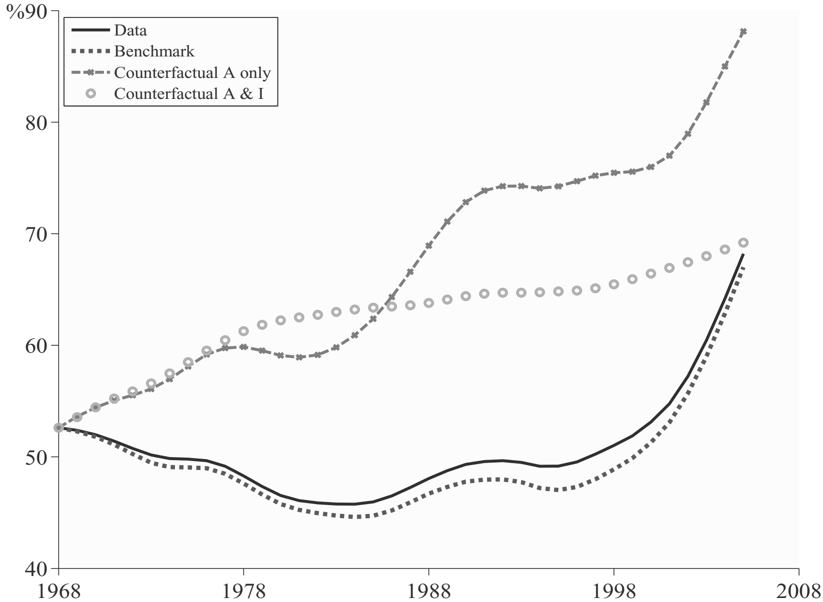


**FIGURE 5.** Convergence.

counterfactual experiment where Spanish productivity growth in both sectors is shared by the Turkish economy. Comparison of the two counterfactual experiments reveals that the role of productivity growth in industry would have been minimal in the earlier period and detrimental in the later period. These results confirm our earlier conclusion that lack of growth in agricultural productivity was the main culprit for the relative stagnation of Turkey.

Our results suggest that labor allocation to agriculture is mainly driven by agricultural productivity or the "push" channel. These findings are consistent with the recent literature. For example, Alvarez-Cuadrado and Poschke (2011) state that productivity improvements in the nonagricultural sector (the "pull" channel) were the main driver of structural change before 1960 for a large set of countries.[14] After that, the evidence indicates productivity changes in agriculture as the driver of this change. In other words, their results suggest that the pull channel dominates the earlier stages of deagriculturalization, whereas the push channel dominates the later periods. These results are in line with our findings for Turkey between 1968 and 2005.

## 3.2. An Extension

In this extension, we investigate one channel through which productivity in general and agricultural productivity in particular might have been adversely affected in

https://doi.org/10.1017/S1365100512000727 Published online by Cambridge University Press

Turkey. Between 1960 and 1980, import substitution was the official development strategy in Turkey. Under this regime, most agricultural products could only be imported by state economic enterprises. Moreover, only these enterprises could import agricultural inputs such as fertilizer and pesticides, often at an overvalued exchange rate. Krueger (1974) studies the growth effects of this regime in Turkey in the 1960s. Focusing on the income gap between Turkey and its European neighbors, Krueger (1974) conducts several counterfactual experiments to investigate the growth rate that could have been achieved under alternative policies instead of the quantitative restriction and the import-substitution regime that was present in Turkey. Krueger's econometric analysis suggests that "alternative strategies could have resulted in significant increases in the rate of growth of manufacturing output and value-added at both Turkish and international prices, reduced import requirements for both new investment and for intermediate goods, a reduced incremental capital–output ratio, and greatly increased employment opportunities for the same level of investment" (Krueger 1974, Ch. 9).

Krueger et al. (1988) use a measure called the relative rate of assistance (RRA) to quantify the impact of sector-specific and economywide policies on agricultural incentives. Anderson and Valenzuela (2008) provide data on estimates of RRA for 75 countries from 1955 to 2008.[15] These estimates attempt to capture the entire array of governmental policies that affect agricultural incomes relative to what they would be in the presence of a free market system. Policies considered include both direct interventions to agricultural prices (price setting by the government, subsidies to inputs, policies affecting the costs of transportation and marketing) and indirect interventions. Indirect interventions are the ones that affect the prices of agricultural tradables relative to nontradables through their impact on the real exchange rate or to other tradables as a result of industrial protection or import substitution policies. These policies affect production incentives by making agriculture more or less attractive than other sectors of the economy. Using this data set, Dennis and İşcan (2011) find that the rates of both structural change and productivity growth in agriculture have been very slow in countries that discriminated against their agricultural sector.

Krueger et al. (1988) show that government policies regarding agriculture have adversely affected agricultural incentives in developing countries where the bulk of the discrimination was due to indirect price interventions. Among the 18 developing countries examined, indirect taxation and tax due to industrial protection were highest in Turkey. The average reduction in farm prices relative to nonfarm prices because of the indirect interventions was 37% in Turkey, whereas direct policies were subsidizing agriculture at a rate of 5.3% between 1961 and 1983.[16]

Figure 6 provides data on the relative rate of assistance to agriculture for Spain, Portugal, and Turkey obtained from Anderson and Valenzuela (2008). Turkey exhibits high but declining levels of discrimination against agriculture until the 1990s, whereas the rest of the countries exhibit varying degrees of protection of agriculture.

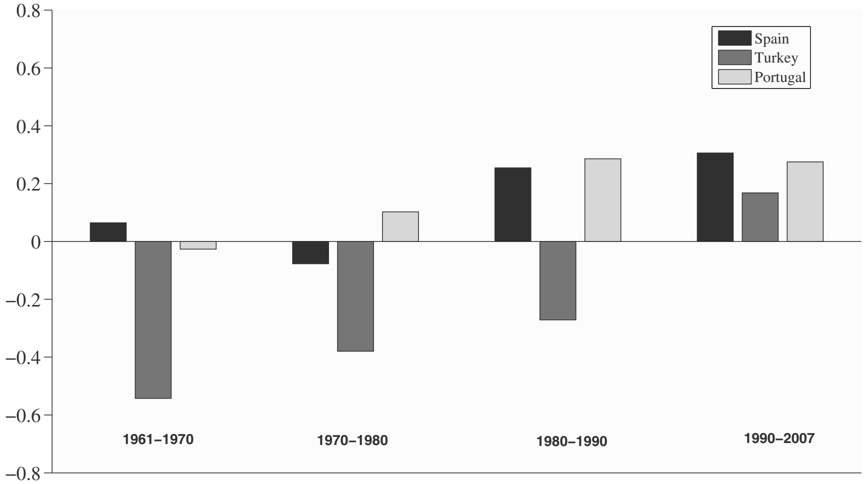


**FIGURE 6.** Relative distortion.

One way to incorporate the measure of RRA into the two-sector model of the previous section is to assume that low output prices discourage the application of intermediate inputs that are needed for the production of the agricultural good. This is a simplification of the impact of RRA, where inefficiencies created by subsidizing one good versus the other are much more complicated. Nevertheless, we proceed with this interpretation to see the potential quantitative impact of this measure on agricultural productivity in Turkey. We use a version of the model in Restuccia et al. (2008) that incorporates the impact of distortions to intermediate goods on agricultural productivity.

In particular, we make one change in the previous model and assume a different production function in the agricultural sector given by

$$Y_{A,t} = X_t^{\alpha}(\theta_{A,t}N_{A,t})^{1-\alpha}, \tag{11}$$

where $X_t$ is the intermediate input used in the production of the agricultural good $Y_{A,t}$ and $\alpha$ is the intermediate-input elasticity of output in agriculture. This intermediate input may consist of chemical fertilizers, pesticides, hybrid seeds, fuel, energy, and other purchased factors. Restuccia et al. (2008) introduce a distortion that requires one unit of nonagricultural output to produce $1/\pi_t$ units of $X_t$. Therefore, a low value of $\pi_t$ implies a high efficiency of producing the input. With this formulation in competitive factor and output markets, $\pi_t$ is the price of intermediate inputs relative to nonagricultural goods.

In this setup, the representative farmer maximizes profits by choosing labor inputs and the use of the intermediate input,

$$\max\left[p_{A,t}X_t^{\alpha}(\theta_{A,t}N_{A,t})^{1-\alpha} - \pi_t X_t - \omega_t N_{A,t}\right], \tag{12}$$

https://doi.org/10.1017/S1365100512000727 Published online by Cambridge University Press

where $p_{A,t}$ is the price of agricultural goods relative to nonagricultural goods; thus, the price of nonagricultural goods is treated as the numeraire. The solution to this problem yields the following first-order conditions:

$$\frac{X_t}{Y_{A,t}} = \frac{\alpha p_{A,t}}{\pi_t} \tag{13}$$

and

$$p_{A,t}(1-\alpha)\frac{Y_{A,t}}{N_{A,t}} = \omega_t = \theta_{I,t}. \tag{14}$$

The intensity of use of intermediate inputs is determined by the elasticity of output to intermediate inputs, $\alpha$, and by the price of the agricultural good relative to the cost of intermediate inputs. We only consider direct barriers in the market for intermediate inputs $X_t$ that increase $\pi_t$, the resource cost of converting nonagricultural output into $X_t$. A high value of $\pi_t$ represents a high level of direct barriers confronting farmers in using the technical input.[17] The production function in the nonagricultural sector and the utility function are the same as in the previous section.

To examine changes in productivity over time in Turkey, we focus on four key variables of the competitive equilibrium: the intermediate input ratio $X_t/Y_{A,t}$, the share of employment in agriculture $N_{A,t}$, labor productivity in agriculture $Y_{A,t}/N_{A,t}$, and aggregate labor productivity $Y_t$. The agricultural production function yields the following decomposition of agricultural final output per worker:

$$\frac{Y_{A,t}}{N_{A,t}} = \theta_{A,t}\left(\frac{X_t}{Y_{A,t}}\right)^{\alpha/(1-\alpha)}. \tag{15}$$

Labor productivity in agriculture depends positively on the intensity of technical input use $X_t/Y_{A,t}$. We can get the following expressions after performing simple algebraic manipulations:

$$\frac{X_t}{Y_{A,t}} = \left[\frac{\alpha}{\pi_t(1-\alpha)}\frac{\theta_{I,t}}{\theta_{A,t}}\right]^{1-\alpha}, \tag{16}$$

and

$$\frac{Y_{A,t}}{N_{A,t}} = \theta_{I,t}^{\alpha}\theta_{A,t}^{1-\alpha}\left[\frac{\alpha}{\pi_t(1-\alpha)}\right]^{\alpha}. \tag{17}$$

The consumption allocation equations of the representative household imply

$$A_t = \bar{A} + \frac{\gamma_A}{\gamma_I}p_{A,t}^{-\eta}I_t. \tag{18}$$

https://doi.org/10.1017/S1365100512000727 Published online by Cambridge University Press

Substituting the market-clearing conditions for $A_t$ and $I_t$ into this equation, we obtain

$$Y_{A,t} = \bar{A} + \frac{\gamma_A}{\gamma_I} p_{A,t}^{-\eta}(Y_{I,t} - \pi_t X_t). \tag{19}$$

Notice that $\pi_t X_t = [\alpha/(1-\alpha)]\theta_{I,t} N_{A,t}$. Now, substituting (14), (15), and (16) into equation (19), we can derive the following equation for the share of employment in agriculture:

$$N_{A,t} = \frac{\bar{A} + \frac{\gamma_A}{\gamma_I}\left(\frac{Y_{A,t}}{N_{A,t}}\right)^{\eta}\left(\frac{1-\alpha}{\theta_{I,t}}\right)^{\eta}\theta_{I,t}}{\left[\frac{\alpha\theta_{I,t}}{\pi_t(1-\alpha)}\right]^{\alpha}(\theta_{A,t})^{1-\alpha} + \frac{\gamma_A}{\gamma_I}\left(\frac{Y_{A,t}}{N_{A,t}}\right)^{\eta}\left(\frac{1-\alpha}{\theta_{I,t}}\right)^{\eta-1}}. \tag{20}$$

If the benchmark economy for Turkey incorporates distortions, then it must be the case that the observed labor productivity, $Y_{A,t}/N_{A,t}$, is a result of an unobserved $\theta_{A,t}$ and an exogenously taken $\pi_t$. We solve equation (17) for $\theta_{A,t}$, which, together with $\pi_t$, results in the observed $Y_{A,t}/N_{A,t}$. Other than this modification, we follow the procedure outlined in the previous calibration exercise to conduct this counterfactual experiment where $\eta = 0.5$, $\gamma_A = 0.04$, and $\alpha = 0.5$. We solve equation (20) for the employment share in agriculture.

### 3.3. Results

In this section, we assume that Spain has no distortions in the use of intermediate inputs ($\pi_t = 1$), whereas $\pi_t$ in Turkey is set to 1.36 between 1968 and 1980, 1.25 until 1990, and 1.0 afterward. These numbers reflect the period averages of relative distortions capturing the existence of significant but declining distortions on the use of intermediate inputs in the Turkish economy as shown in Figure 6. Although the RRA discussed in the previous section may not directly correspond to the $\pi_t$ used to capture the distortions, the purpose of this section is to examine the quantitative implication of a distortion of the economy that mainly affects the use of intermediate inputs. We interpret the size of RRA as reflecting the potential distortions faced in the agricultural sector.

In this experiment, we are interested in measuring the quantitative impact of the distortions in the use of intermediate inputs on the share of labor in agriculture and productivity in agriculture in Turkey. The first panel in Figure 7 presents the share of employment in agriculture with and without distortions.

The economy is calibrated to start from an employment share of 62% with the distortions, because now the benchmark economy has distortions. Setting $\pi = 1$ as a counterfactual experiment where distortions are eliminated results in a starting employment share of 54% instead. In other words, the existence of a 36% distortion in the use of intermediate inputs results in a 16% higher share of employment and 14% lower productivity in agriculture.[18]

This is a stylized experiment that does not model all the complicated features of the agricultural policies that were followed in Turkey. However, it demonstrates

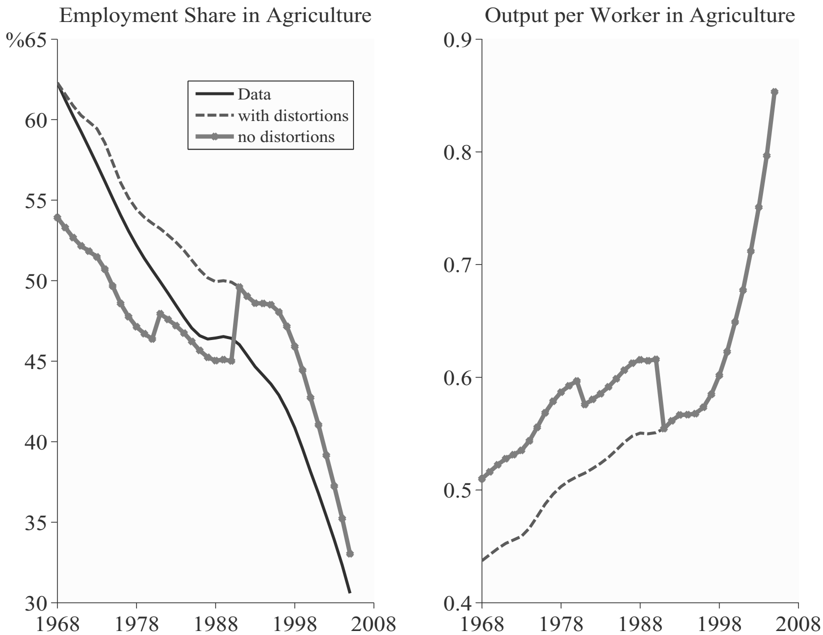


**FIGURE 7.** Role of distortions.

that policies that discriminated against agriculture indirectly can have important quantitative effects. A more detailed study of these polices is left for future research.

## 4. CONCLUSIONS

This paper examines the growth experience of Turkey through the lens of a multisectoral model. We compare the Turkish experience with that of countries that we identify as its peers: Greece, Portugal, and Spain. All of these countries had similar levels of per capita GDP in 1950. However, Turkish GDP per capita fell behind that of its peers during the 1960s and 1970s. These countries shared similar political turmoil during this period. There were at least three military coups in Turkey (1960, 1971, and 1980), Greece had a military junta between 1967 and 1974, and Portugal had a military coup in 1974 and its first free elections in 1975, whereas Spain ended the Franco regime in 1975. None of the countries were yet members of the European Union. Greece joined the European Union in 1981, Spain and Portugal in 1986. Growth rates of per capita GDP in all these countries were high relative to their historical standards during the 1960s and 1970s. However, the growth rate of the Turkish economy was about half that of its peers. Consequently, Turkey experienced a decline in living standards relative to its peers in this period.

https://doi.org/10.1017/S1365100512000727 Published online by Cambridge University Press

Using a two-sector model, we show that low agricultural productivity in Turkey accounts for the increased income gap between Turkey and its peers in the 1960s and 1970s. Our results indicate that if Turkey could have experienced the Spanish productivity growth in agriculture, the peer country with the fastest growth rate, the share of employment in agriculture would have declined much more rapidly and the overall per capita GDP would have increased more dramatically. We argue that policies that discriminated against agriculture deserve special attention in understanding the lack of convergence in the Turkish economy. Our results may help refocus attention on policies that have different effects across sectors and across time.

## *NOTES*

1. Data are from the Conference Board, Total Economy Database (2009). In addition to similar per capita GDP levels and geographical proximity, certain institutional setups such as the civil and penal codes were also comparable across these countries.
2. See, for example, Çeçen et al. (1994) and Günçavdı et al. (1999).
3. The data are from the OECD (2008).
4. Our framework is similar to that of Adamopoulos and Akyol (2009) and our results fit well with the recent literature on models of sectoral transformation that highlights the importance of agriculture, such as Gollin et al. (2002, 2004, 2007); Restuccia et al. (2008); and Lagakos and Waugh (2011).
5. Gollin (2009) provides a detailed survey of theories related to the role of agriculture in economic growth. He summarizes some of the debates in economic history, such as whether or not agricultural productivity improvements preceded the Industrial Revolution and whether government assistance should prioritize agricultural development or industrial development. There is still a debate on whether the structural transformation is achieved by increases in productivity in the industrial sector, which pulls employment out of the agricultural sector, or increases in productivity in the agricultural sector, which pushes employment out of agriculture to the industry [see Alvarez-Cuadrado and Poschke (2011) and the references therein].
6. See, for example, Altuğ et al. (2008).
7. See also Echevarria (1995, 1997), Gollin et al. (2002, 2004, 2007), Acemoğlu and Guerrieri (2008), Buera and Kaboski (2009), and Alvarez-Cuadrado and Poschke (2011), and the references therein for recent studies of structural transformation.
8. The closed economy abstraction is quite reasonable, especially until the 1980s, when Turkey followed an import substitution policy. The average ratio of imports to GNP between 1960 and 1977 is 7%. After the 1980s, there is a significant and consistent increase in the share of imports in GNP, with an average of 19.5% between 1977 and 2006.
9. Strictly speaking, Engel's law refers to low income elasticity of demand for agricultural goods. Historically, increasing per capita incomes were associated not only with a strong decline in the employment share in agriculture but also with a strongly declining budget share for food, the latter relationship being known as "Engel's law." In this paper we use it to refer to structural change driven by nonlinear income effects that influence demand for agricultural good [see, for example, Foellmi and Zweimüller (2008) and İşcan (2010)].
10. Our findings extend to a three-sector model for Turkey that separately examines agriculture, manufacturing, and services [see Duarte and Restuccia (2010) for a general equilibrium model of structural transformation with three sectors].
11. Therefore matching the share of employment in nonagriculture as well.
12. We use the Conference Board, Total Economy Database (2009), to get the aggregate labor productivity relative to Turkey and Spain in 1968. We use the series of *labor productivity per person engaged* in 1990 U.S.$ (converted at Geary Khamis PPPs). The implied aggregate productivity ratio between Turkey and Spain in 1968 was 0.5261.

https://doi.org/10.1017/S1365100512000727 Published online by Cambridge University Press

13. Sectoral value added (measured in constant prices in Euros) and employment data for Spain are obtained from the Groningen Growth and Development Centre (GGDC) 10-sector database [see Timmer and de Vries (2007)]. We use GDP by kind of economic activity in constant prices and employment by kind of economic activity to derive labor productivity series for Turkey between 1968 and 2005. Turkish data are from the Turkish Statistical Institute (2007, 2008) and the OECD (2008). All time series are detrended using the Hodrick–Prescott filter with a smoothing parameter of 6.25 for annual data before any ratios are computed [see Ravn and Uhlig (2002)].

14. Alvarez-Cuadrado and Poschke (2011) study deagriculturalization in 12 industrialized countries since the 19th century. The countries are Belgium, Canada, Finland, France, Germany, Japan, the Netherlands, South Korea, Spain, Sweden, the United Kingdom, and the United States.

15. RRA is defined as $\frac{1+\mathrm{NR}_{ag}}{1+\mathrm{NR}_{non-ag}} - 1$, where $\mathrm{NR}_{ag}$ is the nominal rate of assistance to agriculture and $\mathrm{NR}_{non-ag}$ is the nominal rate of assistance to nonagriculture. There are no data for Greece.

16. Krueger (1992) argues that in Turkey, agricultural producers associations were influential in affecting direct interventions but were virtually voiceless in affecting trade and exchange rate policies.

17. Restuccia et al. (2008) also consider labor market distortions that increase the cost of reallocating labor from agriculture to nonagriculture.

18. This framework generates the same results for the counterfactual experiment conducted earlier, where the lack of productivity in the agricultural sector is shown to be the major determinant of the divergence in income per capita between Turkey and its peers.

## *REFERENCES*

Acemoğlu, Daron and Veronica Guerrieri (2008) Capital deepening and non-balanced economic growth. *Journal of Political Economy* 116, 467–498.

Acemoğlu, Daron, Simon Johnson, and James A. Robinson (2001) The colonial origins of comparative development: An empirical investigation. *American Economic Review* 91, 1369–1401.

Adamopoulos, Tasso and Ahmet Akyol (2009) Relative underperformance *Alla Turca*. *Review of Economic Dynamics* 12, 697–717.

Altuğ, Sumru G., Alpay Filiztekin, and Şevket Pamuk (2008) Sources of long-term economic growth for Turkey, 1880–2005. *European Review of Economic History* 12, 393–430.

Alvarez-Cuadrado, Francisco and Markus Poschke (2011) Structural change out of agriculture: Labor push versus labor pull. *American Economic Journal: Macroeconomics* 3, 127–158.

Anderson, Kym and Ernesto Valenzuela (2008) Estimates of Global Distortions to Agricultural Incentives, 1955 to 2007. World Bank, Washington, DC. http://www.worldbank.org/agdistortions.

Barro, Robert J. (1999) Determinants of democracy. *Journal of Political Economy* 107, S158–S183.

Baumol, William J. (1967) Macroeconomics of unbalanced growth: The anatomy of urban crisis. *American Economic Review* 57, 415–426.

Buera, Francisco J. and Joseph P. Kaboski (2009) Can traditional theories of structural change fit the data? *Journal of the European Economic Association* 7, 469–477.

Çeçen, A. Aydın, A. Suut Doğruel, and Fatma Doğruel (1994) Economic growth and structural change in Turkey 1960–88. *International Journal of Middle East Studies* 26, 37–56.

Dennis, Benjamin N. and Talan İşcan (2011) Agricultural distortions, structural change, and economic growth: A cross-country analysis. *American Journal of Agricultural Economics* 93, 885–905.

Duarte, Margarida and Diego Restuccia (2010) The role of the structural transformation in aggregate productivity. *Quarterly Journal of Economics* 125, 129–173.

Echevarria, Cristina (1995) Agricultural development vs. industrialization: Effects of trade. *Canadian Journal of Economics* 28, 631–647.

Echevarria, Cristina (1997) Changes in sectoral composition associated with economic growth. *International Economic Review* 38, 431–452.

Foellmi, Reto and Josef Zweimüller (2008) Structural change, Engel's consumption cycles and Kaldor's facts of economic growth. *Journal of Monetary Economics* 55, 1317–1328.

Glaeser, Edward L., Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer (2004) Do institutions cause growth? *Journal of Economic Growth* 9, 271–303.

Gollin, Douglas (2009) Agricultural Productivity and Economic Growth. Mimeo, Williams College. http://sites.google.com/site/douglasgollin/doug-gollin/research.

Gollin, Douglas, David Lagakos, and Michael Waugh (2012) The Agricultural Productivity Gap in Developing Countries. Mimeo, Williams College, Arizona State University, and New York University. https://sites.google.com/site/davidlagakos/home/research.

Gollin, Douglas, Stephen L. Parente, and Richard Rogerson (2002) The role of agriculture in development. *American Economic Review Papers and Proceedings* 92, 160–164.

Gollin, Douglas, Stephen L. Parente, and Richard Rogerson (2004) Farm work, home work and international productivity differences. *Review of Economic Dynamics* 7, 827–850.

Gollin, Douglas, Stephen L. Parente, and Richard Rogerson (2007) The food problem and the evolution of international income levels. *Journal of Monetary Economics* 54, 1230–1255.

Günçavdı, Öner, Michael Bleaney, and Andrew McKay (1999) The response of private investment to structural adjustment—A case study of Turkey. *Journal of International Development* 11, 221–239.

Hall, Robert E. and Charles I. Jones (1999) Why do some countries produce so much more output per worker than others? *Quarterly Journal of Economics* 114, 83–116.

Herrendorf, Berthold and Todd Schoellman (2011) Why Is Measured Productivity So Low in Agriculture? Mimeo, Arizona State University. http://sites.google.com/site/bertholdherrendorf/Home/research-1.

İşcan, Talan B. (2010) How much can Engel's law and Baumol's disease explain the rise of service employment in the United States? *B.E. Journal of Macroeconomics* 10, Article 26.

Kongsamut, Piyabha, Sergio Rebelo, and Danyang Xie (2001) Beyond balanced growth. *Review of Economic Studies* 68, 869–882.

Krueger, Anne O. (1974) *Foreign Trade Regimes and Economic Development: Turkey.* A Special Conference Series on Foreign Trade Regimes and Economic Development. New York: National Bureau of Economic Research. http://www.nber.org/books/krue74-1.

Krueger, Anne O. (1992) *The Political Economy of Agricultural Pricing Policy. Vol. 5: A Synthesis of the Political Economy in Developing Countries.* Baltimore: Johns Hopkins University Press.

Krueger, Anne O., Maurice Schiff, and Alberto Valdés (1988) Agricultural incentives in developing countries: Measuring the effect of sectoral and economywide policies. *The World Bank Economic Review* 2, 255–271.

Lagakos, David and Michael Waugh (2011) Selection, Agriculture, and Cross-Country Productivity Differences. Mimeo, Arizona State University and New York University. https://sites.google.com/site/davidlagakos/home/research.

Matsuyama, Kiminori (1992) Agricultural productivity, comparative advantage, and economic growth. *Journal of Economic Theory* 58, 317–334.

Ngai, Rachel L., and Christopher A. Pissarides (2007) Structural change in a multisector model of growth. *American Economic Review* 97, 429–443.

Olgun, Hasan (1991) Turkey. In Anne O. Krueger, Maurice Schiff, and Alberto Valdés (eds.), *The Political Economy of Agricultural Pricing Policy. Vol. 3: Africa and the Mediterranean*, pp. 230–267. Baltimore: Johns Hopkins University Press.

Olgun, Hasan, and Haluk Kasnakoğlu (1989) *Trade, Exchange Rate, and Agricultural Pricing Policies in Turkey.* Washington, DC: World Bank, Country Economics Department, Trade Policy Division.

Organization for Economic Co-operation and Development (OECD) (2008) Employment and Labour Market Statistics Summary Tables. Paris: OECD.

Ravn, Morten O. and Harald Uhlig (2002) On adjusting the Hodrick–Prescott filter for the frequency of observations. *Review of Economics and Statistics* 84, 371–376.

Restuccia, Diego, Dennis Tao Yang, and Xiaodong Zhu (2008) Agriculture and aggregate productivity: A quantitative cross-country analysis. *Journal of Monetary Economics* 55, 234–250.

Rogerson, Richard (2008) Structural transformation and the deterioration of European labor market outcomes. *Journal of Political Economy* 116, 235–259.

The Conference Board (2009) Total Economy Database.

Timmer, Marcel P. and Gaaitzen J. de Vries (2007) A Cross-Country Database for Sectoral Employment and Productivity in Asia and Latin America, 1950–2005. Groningen, The Netherlands: Groningen Growth and Development Centre Research Memorandum GD-98, University of Groningen.

Turkish Statistical Institute (TURKSTAT) (2007) Statistical Indicators, 1923–2006. Ankara: TURKSTAT.

Turkish Statistical Institute (TURKSTAT) (2008) National Accounts. Ankara: TURKSTAT. http://www.turkstat.gov.tr/.