Agricultural Productivity and Growth in Turkey

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Abstract

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 the 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 the agricultural output indicates that policies that have different effects across sectors and across time may be important in explaining the growth experience of countries.

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Key Words: Sectoral productivity differences; International comparisons; Turkey; Agriculture; Two-sector model

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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 for this experience.

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. Acemoglu, Johnson, and Robinson (2001) estimated large effects of institutions on income per capita. Glaeser, La Porta, Lopez-de-Silanes, Schleifer (2004) and Barro (1999), among others, have focused on the role of human capital.

Recently, models of sectoral transformation have been emphasized in providing an alternative insight into these differences. For example, Gollin, Parente, and Rogerson (2002) and Restuccia, Yang, and Zhu (2008) discuss the importance of the agricultural sector in accounting for the differences in income per capita while 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 peers took place in a period where 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, neither one 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 compared to its peers.

These observations steered us towards examining the growth experience of Turkey through the lens of a multi-sectoral model. Our results indicate that the main reason behind Turkey’s relative stagnation was its low agricultural productivity growth. While this result may not be surprising given the large differences in agricultural productivity levels across these countries, it transforms the focus of the investigation, for Turkey, into 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 U.S. between 1950 and 2008. Comparing the growth experience of these countries relative to the U.S. highlights the difference between countries who caught up with the U.S. versus countries who did not. We divide the European countries into two sub groups: “Europe 1” (Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, and the United Kingdom) and “Europe 2” (Greece, Portugal, and Spain).

![Figure 1: GDP per Capita Relative to the U.S.](image)

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. Since per capita GDP relative to the U.S. 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 U.S. by the mid-1970s while Turkey had

\(^1\)Data are from the Conference Board, Total Economy Database. 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.
remained relatively stagnant. Consequently, the divergence in the 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 its peers in 1960 to 50% in 1977 and stayed around 47% in the 1980s and 1990s.

Before 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 attributed the “high” growth rates in this period to be a consequence of the state-led import-substitution strategy. Our analysis, however, identifies 1960 to 1976 as the period where Turkey fell behind its peers.

Examining the sectoral data reveals that while GDP per capita in Turkey was similar to 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 de-agriculturalization was also very different between these countries. While 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.

In this paper we use a two-sector model to examine the reasons behind the slow de-agriculturalization, and increased divergence of income per capita in Turkey relative to its peers. In our model, labor allocation between sectors is driven by the differences in sectoral productivity growth rates as well as the income effect of non-homothetic 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 if it is low productivity in agriculture or industry (or both) that is responsible for the slow de-agriculturalization and the low overall productivity in Turkey. We conduct a counterfactual experiment in which

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2See, for example, Çeçen, Doğruel, and Doğruel (1994), and Güncavdı, Bleaney, and McKay (1999).
3The data are from the OECD Employment and Labor Market Statistics.
4Our framework is similar to 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, Parente, and Rogerson (2002, 2004, 2007); Restuccia, Yang, and Zhu (2008); and Lagakos and Waugh (2011).
5Gollin (2009) provides a detailed survey of theories related to the role of agriculture in economic growth. He summarizes some of the debate 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
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, de-agriculturalization would have been much faster and the growth rate of aggregate GDP per capita would have been much higher. Inheriting Spanish industrial productivities, 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 while Turkish productivity growth was lagging behind its peers in both sectors, it was particularly worse in agriculture. Our results provide support for the general finding in this literature where 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 of the recent attention has been on the role of institutions, low human capital, and flawed macroeconomic policies in hampering growth.

Our results may help refocus the attention to 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, like those discussed in Krueger (1974), Olgun (1991) or Olgun and Kasnakoğlu (1989), 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, Lagakos and Waugh (2012). The literature has come up with two basic explanations for this puzzle: lower human capital levels and/or hours in non-agriculture; and serious mis-measurement issues in value added in agriculture. However, none of these explanations has proven entirely satisfactory. Gollin, Lagakos and Waugh (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 mis-measurement issues in agriculture are very important. However, Gollin, Lagakos and Waugh (2012) argue that even after taking all these measurement issues into account, 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).

See, for example, Altuğ, Filiztekin, and Pamuk (2008).
consideration, a large agricultural productivity gap remains. We leave more comprehensive work in 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 a recent growing interest in multi-sector 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 non-agriculture) 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 Baumol (1967) and Ngai and Pissarides (2007) view the structural transformation as a supply-side phenomenon based on the sectoral differences in productivity growth. The second type of models views the structural transformation as a demand-side phenomenon based on the sectoral differences in income elasticities of demand (see, for example, Kongsamut, Rebolo, and Xie (2001)). There are also some models, known as hybrid models, that combine two types of channels (see, for example, Duarte and Restuccia (2010) and Rogerson (2008)).

Our model is based on a hybrid model of structural change, in which the re-allocation of economic activity between agriculture and nonagriculture is driven by non-homothetic 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 on the structural transformation of Turkey combined with the Engel’s law of demand.


8Closed economy abstraction is quite reasonable especially until the 1980s where 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.

9Strictly speaking, Engel’s law refers to low income elasticity of demand for agricultural good. Historically, increasing per-capita incomes were not only associated 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 İscan (2010)).
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 non-agricultural sector. It incorporates both services and manufacturing. The production function for sector $j=A,I$ is given by:

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

(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:

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

(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., $p_{I,t}/p_{A,t} = \theta_{A,t}/\theta_{I,t}$. Since we abstract from capital and fixed factors in production, differences in labor productivity implicitly incorporate differences due to capital as well as due 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:

$$U(C_t) = \log(C_t).$$

(3)

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

$$C_t = \frac{\gamma_{A}^{1/\eta} (A_t - \bar{A})^{(\eta-1)/\eta} + \gamma_{I}^{1/\eta} I_t^{(\eta-1)/\eta}}{(\gamma_{A}^{1/\eta} + \gamma_{I}^{1/\eta})^{1/(\eta-1)}}.$$

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

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

(4)

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).
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 non-homothetic 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 that 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:

$$p_{A,t}A_t + p_{I,t}I_t = 1,$$  \hspace{1cm} (5)

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

$$N_{A,t} + N_{I,t} = 1.$$ \hspace{1cm} (6)

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

$$A_t = Y_{A,t}, \quad I_t = Y_{I,t}.$$ \hspace{1cm} (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 that explicitly char-
acterizes the equilibrium employment share in agriculture:

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

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 to determine relative productivity differences between two countries.

In order 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. Since \( \eta \) determines the amount of substitution among different goods, it dictates the amount of labor that will be reallocated to the non-agricultural 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 \( \theta_{I,1968} \)) such that using \( \gamma_A \), \( \eta \) and \( \bar{A} \) the 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\(^{12}\).

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\(^{11}\)Therefore matching the share of employment in non-agriculture as well.

\(^{12}\)We use the Conference Board, Total Economy Database to get the aggregate labor productivity relative
This method results in productivity levels in agriculture and non-agriculture in Turkey to be 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.

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 non-agricultural 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 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 non-agriculture in impacting the speed of de-agriculturalization 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 inherited Spanish productivity growth rates starting in 1968. More importantly, we are interested in finding out if inheriting sectoral productivity growth rates in both sectors or in one of them in particular would have put the Turkish economy in a significantly different growth path. In the following counterfactual experiment, we allow Turkey to inherit productivity growth rates of Spain starting in 1968 in each sector one at a time.

13Sectoral 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 and the OECD Employment and Labor Market Statistics. All time series are de-trended 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)).
Figure 2: Benchmark

Figure 3: Role of Agriculture
Figure 3 shows the share of employment in agriculture and the GDP per worker that is obtained under the first counterfactual experiment where we only use the agricultural productivity growth from Spain and keep the non-agricultural productivity growth as it is in the benchmark. Compared to the benchmark results, this counterfactual experiment generates a much faster de-agriculturalization 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 both sectors from Spain. Comparing the series labeled “Counterfactual A only” to 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 share in agriculture implied by both counterfactual experiments coincide. This is due to the fact that, first, differences in growth rates in the industrial sector between Turkey and Spain 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 is 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 counterfactual experiment where Spanish productivity growth in both sectors are inherited 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 agricul-
tural 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 non-agricultural sector (the “pull” channel) were the main driver of structural change before 1960 for a large set of countries. 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 de-agriculturalization, while the “push” channel dominates the later periods. These results are in line with 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 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, Chapter 9).

Krueger, Schiff, and Valdes (1988) use a measure called the relative rate of assistance (RRA) to quantify the impact of sector-specific and economy wide policies on agricultural incentives. Anderson and Valenzuela (2008) provide data on estimates of (RRA) for 75 countries from 1955 to 2008. These estimates attempt to capture the entire array of governmental policies that affect agricultural incomes relative to what they would be in

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14 Alvarez-Cuadrado and Poschke (2011) study the de-agriculturalization 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 

\[
\frac{1 + NR_{ag}}{1 + NR_{non-ag}} - 1
\]

where \(NR_{ag}\) is the nominal rate of assistance to agriculture and \(NR_{non-ag}\) is the nominal rate of assistance to non-agriculture. There is no data for Greece.
the presence of a free market system. Policies considered include direct interventions to agricultural prices (price setting by the government, subsidies to inputs, policies affecting the costs of transportation and marketing). Indirect interventions are the ones that affect the prices of agricultural tradables relative to non-tradables 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.

Figure 6: Relative Distortion

Krueger, Schiff, and Valdes (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 eighteen 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 while direct policies were subsidizing agriculture at a rate of 5.3% between 1961 and 1983.\footnote{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.}
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 while the rest of the countries exhibit varying degrees of protection to agriculture.

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, Yang, and Zhu (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:

$$Y_{A,t} = X_t^\alpha (\theta_{A,t}N_{A,t})^{1-\alpha},$$  \hspace{1cm} (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, Yang, and Zhu (2008) introduce a distortion that requires one unit of non-agricultural output to produce $1/\pi_t$ units of $X_t$. Therefore, a low value of $\pi_t$ implies 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 non-agricultural goods.

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

$$\max \quad p_{A,t}X_t^\alpha (\theta_{A,t}N_{A,t})^{1-\alpha} - \pi_tX_t - \omega_tN_{A,t},$$  \hspace{1cm} (12)

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

$$\frac{X_t}{Y_{A,t}} = \frac{\alpha p_{A,t}}{\pi_t}. \hspace{1cm} (13)$$
and
\[ p_{A,t}(1-\alpha) \frac{Y_{A,t}}{N_{A,t}} = \omega_t = \theta_{I,t}. \]  

(14)

The intensity of using 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 non-agricultural 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 non-agricultural 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:

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

(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:

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

(16)

and

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

(17)

The consumption allocation equations of the representative household imply:

\[ A_t = \bar{A} + \gamma A p_{A,t}^{-\eta} I_t. \]  

(18)

Substituting the market-clearing conditions for \( A_t \) and \( I_t \) into the above equation, we obtain:

\[ Y_{A,t} = \bar{A} + \gamma A p_{A,t}^{-\eta} (Y_{I,t} - \pi_t X_t). \]  

(19)

\(^{17}\)Restuccia, Yang, and Zhu (2008) also consider labor market distortions that increase the cost of reallocating labor from agriculture to non-agriculture.
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:

\[
N_{A,t} = \bar{A} + \frac{\gamma_A}{\gamma_I} \left( \frac{Y_{A,t}}{N_{A,t}} \right)^\eta \left( \frac{1-\alpha}{\theta_{I,t}} \right)^\eta \theta_{I,t} \left( \frac{\alpha}{\pi_t(1-\alpha)} \right)^{\alpha} \left( \theta_{A,t} \right)^{1-\alpha} + \frac{\gamma_A}{\gamma_I} \left( \frac{Y_{A,t}}{N_{A,t}} \right)^\eta \left( \frac{1-\alpha}{\theta_{I,t}} \right)^{\eta-\frac{1}{\eta}}.
\] (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 exogenously taken \( \pi_t \). We solve equation (17) for \( \theta_{A,t} \) that, 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.

### 3.2.1 Results

In this section, we assume that Spain has no distortions in the use of intermediate inputs (\( \pi_t = 1 \)), while \( \pi_t \) in Turkey is set to 1.36 between 1968 and 1980, 1.25 until 1990, and 1.0 afterwards. 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. While 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 on the economy that mainly affects the use of intermediate inputs. We interpret the size of RRA to reflect 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 since 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 on the use of intermediate inputs results in a 16% higher share of employment and 14% lower productivity in agriculture.

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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.
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 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 multi-sectoral model. We compare the Turkish experience with 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 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, Portugal a military coup in 1974 and its first free elections in 1975, while Spain ended the Franco regime in 1975. Neither one of the countries were yet a member of the European Union. Greece joined the European Union in 1981, while Spain and Portugal in 1986. Growth rate 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.

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 for understanding the lack of convergence in the Turkish economy. Our results may help refocus the attention to policies that have different effects across sectors and across time.

References


