In this study, we explore the potential effect of the informal economy on economic growth in the Turkish economy for the time interval between 1950-2013. Specifically, by defining total GDP as the aggregation of the formal and informal GDP, we perform growth accounting exercises on the formal GDP per capita and total GDP per capita under two frameworks. In our benchmark framework, we implicitly assume that the formal and informal sectors are isolated from each other and utilize potentially different technologies, while under our second model we unite the two sectors and assume that the total economy is governed by a single production function. Results of the two methodologies imply that the potential interactions between the two sectors may have played a role in determining the growth performance of the total GDP in the Turkish economy. Moreover, our results indicate that the major contributor to growth in both formal and total GDP is total factor productivity, which is followed by human capital per capita. Informal sector seems to have negatively contributed to the growth in total GDP since the size of the informal sector has declined dramatically over time in Turkey.

**Introduction**

One of the most popular research topics in macroeconomics is the identification of the main determinants of long-run economic growth. Although our understanding of the topic has significantly improved over time, various questions on the determinants and effects of economic growth still remain under-investigated. One such issue is the impact of the extent of informality on economic growth.

To address this gap in the literature, in this paper we bring two strands of the literature together within the scope of the Turkish economy. That is using annual data from Turkey, we extend a standard growth accounting exercise to incorporate the role of the informal sector. To do this we basically study the factors that contribute to the growth of formal GDP as well as of the sum of the formal and informal GDP in Turkey and quantitatively examine the effect of the informal sector on the growth rates of these variables as well their growth accounts. We also compare the results coming from the informality-augmented growth accounting framework with the standard growth accounting methodology focusing only on the growth of formal sector.
Our results indicate that while the formal GDP per capita in Turkey has grown by 2.75% on average between 1950-2013, the total GDP per capita (defined as formal plus informal GDP per capita) has grown around 2.53% each year in this time interval - and on average the ratio of informal to formal GDP has been around 36%. Furthermore, the growth of total GDP per capita has been more volatile compared to that of formal GDP – the standard deviation of the growth rate of total GDP is 5.12 while for formal GDP this value is only 3.91. Therefore, from these numbers only we can conclude that the unobserved informal economy has constituted a substantial part of the Turkish economy and exhibited a strikingly different growth path compared to the formal GDP. Our analysis also enables us to decompose the determinants of the growth in formal GDP and total GDP separately. The results of this procedure indicate that the most important component of growth in formal or total GDP per capita in the Turkish economy has been the growth in total factor productivity (TFP). Aside from TFP, the growth in human capital per capita is the other major determinant of formal and total GDP per capita. The contraction of the informal economy over time seems to negatively contribute to the growth performance of the total economy in general. In addition to this, the results from the informality-augmented growth accounting framework suggest that a growth accounting exercise that only focuses on formal GDP, and neglects the informal economy, exacerbates the adverse effect of the fall in per capita labor supply on economic growth in Turkish economy – especially for the period between 1977-1983.

A general empirical result arising from the empirical growth economics literature is that the total factor productivity is the main source of economic growth for a large set of countries and a significant time horizon. (See Prescott (1998) or Senhadji (2000) among many others in the literature). Independent of the production function or the dataset Turkey is also not an exception with respect to the growth accounting. Even though in some sub-episodes of the Turkish economy, inputs other than the TFP might play some significant roles, TFP is also the main general source of growth in Turkish economy over the past 60 years. (See Ismihan and Metin-Ozcan (2006), Imrohoroglu and Ungor (2009), Cicek and Elgin (2011) and more recently Ungor (2013)) Therefore, it is very important for economists as well as policymakers in Turkey to understand the evolution of the TFP and its effect on economic growth. On the theoretical side, De Soto (1989), Raj and Natarajan (2007), Benjamin and Mbaye (2012) show that the fear of detection by authorities forces informal firms to operate on a small scale that is far from efficient scale of production, thereby reducing productivity.

Therefore, taking informality into consideration may change the share of the growth of production factors as well as total factor productivity in the growth of total output.

Furthermore, for yet another growth account, the growth in the capital intensity, the informal sector might also play a crucial role. The prevalence of informality is potentially negatively related to productivity and accumulation - or utilization - of capital. Caro, Galindo and Melendez (2012), Dabla-Norris and Koeda (2008) and Moron, Salgado and Seminario (2012) argue that informal economy lacks of access to credit markets.

Turkey with an informal sector size at about 25-30 % of official GDP has the largest informal sector size (relative to GDP) among OECD members along with Mexico. Even though the informal sector size has declined significantly after 1980.s, it still constitutes a large fraction within the economy and acts as a barrier for growth, technological advancement and efficiency of the public finance. Even though, the analysis we present here only applies to the Turkish economy (See Elgin and Birinci, 2016 for a cross-sectional panel data analysis), it can also be generalized to include any other economy with a significant informal sector size.

The rest of the paper is organized as follows: In Section 2, we provide a brief summary of the main time-series data used in our analysis. In Section 3, we introduce the benchmark growth accounting methodology as well as alternative approaches used for sensitivity analysis. In Section 4, we discuss the calibration of the setups. In Section 5, we summarize the quantitative results from the growth accounting exercises considered in Section 3. Finally, in Section 6, we conclude.

Data

The formal sector macro data that used in our analysis is from Penn World Tables and cover the years between 1950 and 2013. The data on informal sector is from Elgin and Oztunalı (2012). Below, we provide a short summary of the key data series used in our analysis.

Figure 1 plots (i) the ratio of informal output to total output, and (ii) the ratio of informal output as a share of formal output. The figure shows that while the informal output to total output ratio was around 35% in the early 1950s, it rapidly decreased to approximately 30% in the late 1950s and has been stable at round this level since then. When we focus on the informal output to formal output ratio, we see a similar trend with different levels; while the ratio was around 55% in the early 1950s, it fell approximately to a level of 43% in the late 1950s and has been stable at around
this level since then. The main message of this figure is that the informal sector constitutes an important part of the Turkish economy.

In a similar fashion, Figure 2 plots (i) the ratio of informal labor to total labor, and (ii) the ratio of informal labor as a share of formal output. The figure shows that while the informal labor to total labor ratio was around 30% in the early 1950s, it has steadily decreased over the post-war period and reached approximately to a level of 20% in the 2012. When we look at the ratio of informal labor to formal labor, while the ratio was around 45% in the early 1950s, it has steadily decreased since then to reach approximately to a level of 24% in 2012. In contrast to output series, we observe a steady decrease in informal labor in Turkey over the post-war period.

Figure 3 plots TFP series for Turkey over the post-war period. While we observe a steady increase in TFP from 1950s to late 1980s, we observe that the 1990s seems to be a lost decade in terms of TFP growth. On the other hand, while early 2000s seems to be a boom period for TFP growth, once more the late 2000s seems to be a sub-period with TFP stagnation.
Figure 4 plots the human capital stock in Turkey over the post-war period. We observe that the stock of human capital continuously increased in this period. On the other hand, we also observe that the rate of increase accelerated after the 1980s, which seems to be consistent with the increased educational spending patterns in Turkey over the same period.
Model

First, we will describe the benchmark methodology that we adopt during the growth accounting procedure of the total GDP per capita (i.e. formal + informal GDP per capita), in which formal and informal sectors are treated as separate sectors with potentially different production technologies, and compare this methodology with the one used for the growth accounting of formal GDP per capita. Secondly, we will repeat this procedure via incorporating human capital into our model. Finally, we will describe the second methodology in which we unite the formal and informal sectors and assume that the total economy is characterized by a single production technology.

Benchm

ark Growth Accounting Models for Total GDP and Formal GDP

Our benchmark growth accounting methodology is based on the two sector variant of the one sector model use by Mankiw et al. (1992). Specifically, we assume that the total economy consists of a formal sector and an informal sector which potentially exhibit distinct production technologies:

\[ Y_t = Y_{ft} + Y_{it} \quad (1) \]

where total output \( Y_t \) is defined as the sum of formal output \( Y_{ft} \) and informal output \( Y_{it} \). The formal sector production technology is assumed to utilize capital \( K_{ft} \) and formal labor \( L_{ft} \). In this exercise, we do not impose a functional form on the informal sector as we directly borrow the estimated values of \( Y_{it} / Y_{ft} \) ratio for the Turkish economy from Elgin and Oztunali (2012). Therefore, the total output can be written in terms of production factors and \( Y_{it} / Y_{ft} \) in the following way:

\[ Y_t = Y_{ft} + Y_{it} = \left[ 1 + \left( \frac{Y_{it}}{Y_{ft}} \right) \right] Y_{ft} = \left[ 1 + \left( \frac{Y_{it}}{Y_{ft}} \right) \right] A_t K_{ft}^{\alpha} L_{ft}^{1-\alpha} \quad (2) \]

where \( A_t \) corresponds to the formal sector total factor productivity. Dividing with population \( N_t \), taking the natural logarithm and then first-differencing both sides of (2) allows us to decompose the growth of total per capita output (}
\[ \Delta Y / N \] in terms of the growth in informal to formal output ratio \( (\Delta IS) \), growth in formal TFP \( (\Delta A) \), growth in capital to total output ratio \( (\Delta K / Y) \) and growth in formal labor supply per capita \( (\Delta L_F / N) \) in the following way:

\[
\begin{align*}
\ln \left( \frac{Y_t}{N} \right) - \ln \left( \frac{Y_{t-1}}{N} \right) &= \frac{1}{1-\alpha} \left[ \ln \left( 1 + \frac{Y_t}{Y} \right) - \ln \left( 1 + \frac{Y_{t-1}}{Y} \right) \right] \\
&+ \frac{1}{1-\alpha} \left[ \ln \left( \frac{A_t}{Y} \right) - \ln \left( \frac{A_{t-1}}{Y} \right) \right] \\
&+ \left[ \ln \left( \frac{K_t}{Y} \right) - \ln \left( \frac{K_{t-1}}{Y} \right) \right] \\
&+ \left[ \ln \left( \frac{L_{Ft}}{Y} \right) - \ln \left( \frac{L_{Ft-1}}{Y} \right) \right] \\
&+ \left[ \ln \left( \frac{\ell_{t}}{N} \right) - \ln \left( \frac{\ell_{t-1}}{N} \right) \right] \\
\end{align*}
\]

After decomposing the growth of total GDP into its main elements, we compare our results with those coming from the standard methodology of the growth accounting literature - decomposition of the growth in formal GDP per capita under a single sector setting a la Mankiw et al. (1992). However, since this practice omits the informal sector the potential effect of the informal sector's relative size to the formal sector on the growth performance is neglected. (4) displays how the standard methodology decomposes the growth of formal GDP per capita \( (\Delta Y_F / N) \) into the growth in formal TFP \( (\Delta A) \), the growth in capital to formal output ratio \( (\Delta K / Y_F) \) and the growth in formal labor supply per capita \( (\Delta L_F / N) \):

\[
\begin{align*}
\ln \left( \frac{Y_{Ft}}{N} \right) - \ln \left( \frac{Y_{Ft-1}}{N} \right) &= \frac{1}{1-\alpha} \left[ \ln \left( \frac{A_t}{Y_F} \right) - \ln \left( \frac{A_{t-1}}{Y_F} \right) \right] \\
&+ \frac{1}{1-\alpha} \left[ \ln \left( \frac{K_t}{Y_F} \right) - \ln \left( \frac{K_{t-1}}{Y_F} \right) \right] \\
&+ \left[ \ln \left( \frac{L_{Ft}}{Y_F} \right) - \ln \left( \frac{L_{Ft-1}}{Y_F} \right) \right] \\
\end{align*}
\]

As (4) shows, the standard growth accounting equation differs from our practice due to the definition of output \( Y = Y_F + Y_I \) vs. \( Y_F \), definition of capital to output ratio \( K_Y \) vs. \( K / Y_F \) and the existence of the informal sector \( (Y_I / Y_F) \).

**Benchmark Growth Accounting Models with Human Capital for Total GDP and Formal GDP**

In order to account for the potential effect of the growth of human capital on economic growth, we incorporate human capital in the formal production function. In this case, total output takes the following functional form:

\[
Y = 1 + \left( \frac{Y_I}{Y_F} \right) Y_F = 1 + \left( \frac{Y_I}{Y_F} \right) A K^{\eta} H^{(\eta-\beta)} L^{(1-\eta-\beta)}
\]

where \( H_I \) corresponds to total human capital. Similar to the previous exercise, we can now decompose the growth rate of total output per capita \( (\Delta Y / N) \) in terms of the growth in informal to formal output ratio \( (\Delta IS) \), growth in formal TFP \( (\Delta A) \), growth in capital to total output ratio \( (\Delta K / Y) \), growth in human capital per capita \( (\Delta H / N) \) and growth in formal labor supply per capita \( (\Delta L_F / N) \) by dividing with population \( N \), taking the natural logarithm and then first-differencing both sides of (5):
\[
\frac{\ln \left( \frac{Y_i}{N} \right) - \ln \left( \frac{Y_{i+1}}{N} \right)}{\Delta Y/N} = \frac{1}{1 - \eta} \left[ \frac{1}{1 - \eta} \ln \left( \frac{K}{Y} \right) - \ln \left( \frac{K_{i+1}}{Y} \right) \right] + \frac{1}{1 - \eta} \left[ \frac{1}{1 - \eta} \ln \left( \frac{H}{N} \right) - \ln \left( \frac{H_{i+1}}{N} \right) \right] \\
+ \frac{\eta}{1 - \eta} \left[ \frac{1}{1 - \eta} \ln \left( \frac{K}{Y} \right) - \ln \left( \frac{K_{i+1}}{Y} \right) \right] \\
+ \frac{1 - \eta - \beta}{1 - \eta} \left[ \frac{1}{1 - \eta} \ln \left( \frac{L_0}{N} \right) - \ln \left( \frac{L_{0,i+1}}{N} \right) \right]
\]

(6)

Similar to the previous section, we will compare our results with those from a standard growth accounting practice with a single formal sector model a la Mankiw et al. (1992). Again across exercise that also take into account the effect of human capital on economic growth, the two models will potentially yield different results as our output and capital to output definitions are different than the standard growth accounting literature due to the existence of informal sector. (7) describes the standard growth accounting model with human capital:

\[
\frac{\ln \left( \frac{Y_i}{N} \right) - \ln \left( \frac{Y_{i+1}}{N} \right)}{\Delta Y/N} = \frac{1}{1 - \eta} \left[ \frac{1}{1 - \eta} \ln \left( \frac{K}{Y} \right) - \ln \left( \frac{K_{i+1}}{Y} \right) \right] \\
+ \frac{1 - \eta - \beta}{1 - \eta} \left[ \frac{1}{1 - \eta} \ln \left( \frac{L_0}{N} \right) - \ln \left( \frac{L_{0,i+1}}{N} \right) \right]
\]

(7)

Second Growth Accounting Model for Total GDP

In addition to accounting for the effect of the informal sector on growth performance in an indirect manner via \( Y_f / Y_F \) term, we follow a second approach in which we unite the formal and informal sectors. In doing so, we first estimate the informal labor supply by assuming a functional form for informal production. This practice enables us to obtain the total labor supply (which corresponds to formal plus informal labor supplies). Then, we assume that the total output is produced a single overall production function which utilizes capital (for which we generate a new series as we implicitly assume that informal sector also has access to capital in this methodology) and the newly estimated total labor supply. We repeat the same exercise by incorporating the human capital into the overall production function as well.

We first estimate the informal labor supply (\( L_{\gamma} \)) by assuming that the following function characterizes the informal production technology:

\[ Y_{\gamma} = \theta_{\gamma} L_{\gamma} \]  

(8)

After estimating informal labor supply, we assume that the total output is produced with the following production technology:

\[ Y_{F} = Y_{F1} + Y_{\gamma} = B_T K_{\gamma}^{a} L_{\gamma}^{1-\alpha} = B_T K_{\gamma}^{a} (L_{F1} + L_{\gamma})^{1-\alpha} \]  

(9)

where \( L_{\gamma} \) is the total labor supply, \( B_T \) is the total factor productivity and \( K_{\gamma} / \) is the informality-augmented capital. We create this new capital variable as (9) implicitly assumes that all productive activities utilize capital. Therefore, we estimate a new capital series during this exercise and call it as the informality-augmented capital. After this step, we normalize both sides of (9) with population, take natural logarithms and first-difference both sides in order to decompose the growth in total output per capita (\( \Delta Y / N \)) into growth in total factor productivity (\( \Delta B \)), growth in informality-augmented capital to total output ratio (\( K / Y \)) and growth in total labor supply per capita (\( \Delta L / N \)):
Finally, we modify the overall production function by incorporating human capital in order to account for the effect of human capital in our second methodology. In this case, the total output is produced with the following technology:

\[ Y_t = B_t K_t^\alpha H_t^\beta L_t^{1-\alpha-\beta} \]  

(11)

where \( H_t \) again corresponds to human capital. Using this production technology, one can decompose the growth rate of total output into the growth in total factor productivity (\( \Delta B \)), growth in informality-augmented capital to total output ratio (\( K_t / Y_t \)), growth in human capital per capita (\( \Delta H_t / N_t \)) and growth in total labor supply per capita (\( \Delta L_t / N_t \)) in the following way:

\[
\ln \left( \frac{Y_{t+1}}{Y_t} \right) - \ln \left( \frac{Y_{t+1}}{Y_t} \right) = \frac{1}{1-n} \left[ \ln(B_{t+1}) - \ln(B_{t-1}) \right] + \frac{\eta}{1-n} \left[ \ln \left( \frac{K_t}{Y_t} \right) - \ln \left( \frac{K_{t-1}}{Y_{t-1}} \right) \right] \\
+ \frac{\beta}{1-n} \left[ \ln \left( \frac{H_t}{N_t} \right) - \ln \left( \frac{H_{t-1}}{N_{t-1}} \right) \right] + \frac{1-\eta-\beta}{1-n} \left[ \ln \left( \frac{L_t}{N_t} \right) - \ln \left( \frac{L_{t-1}}{N_{t-1}} \right) \right] 
\]  

(12)

Calibration

Recall that, the time interval of our study spans the period between 1950-2013. Formal output \( Y_{F_t} \), population \( N_t \), human capital \( H_t \) and formal labor supply \( L_{F_t} \) are from Penn World Tables. We borrow the data for the ratio of informal output to formal output \( Y_{I_t} / Y_{F_t} \) of the Turkish economy from Elgin (2012). We generate the formal sector capital \( K_{F_t} \) and informality-augmented capital \( K_{I_t} \) series using the perpetual inventory method\(^2\). Following Mankiw et al. (1992) we assume that \( \alpha = 0.36, \eta = 0.14, \beta = 0.49 \) and \( \delta = 0.047 \).

During the estimation of the informal labor supply by using (8) we adhere to the following strategy: According to an OECD report (Charmes, 2009) the ratio of \( L_{I_t} / L_{F_t} = 0.3 \) in year 2008. Using this observation together with the 2008 values of \( Y_{F_t}, Y_{I_t} \) and \( L_{F_t} \), for which we have data, and assuming that \( \gamma = 0.65 \) following Ihrig and Moe (2004) we calculate informal sector TFP \( \theta_t \) for year 2008. Then, by assuming that the growth rate of \( \theta_t \) is equal to the average of the growth rate of formal capital and formal TFP we estimate informal labor supply for the remaining years in or dataset.

---

\(^2\) The initial capital to formal output ratio is calculated with \( K_{1990} / Y_{F,1990} = g_F / (i + \delta) \) where \( i \) and \( g_F \) correspond to the average share of investment in formal GDP and growth rate of formal output in 1950-2013. \( i \) and \( g_F \) are obtained from Penn World Tables.

\(^3\) The initial informality-augmented capital to total output ratio is calculated with \( K_{I,1990} / Y_{1990} = g / (i + \delta) \) where \( i \) and \( g \) correspond to the average share of investment in formal GDP (we assume that share of investment in total GDP and formal GDP are equal) and growth rate of total output in 1950-2013.
Quantitative Analysis

We will first compare the results from the growth accounting exercises with formal GDP and total GDP under the benchmark model. Here, we will also compare the effect of introducing human capital across the growth accounting exercises under the two settings. Then, we will describe the results from the second methodology and compare our findings with the benchmark model.

Benchmark Model - Total vs. Formal GDP

Table 1 displays the decomposition of the growth rate of total output into its components according to (3). The first striking observation is the fact that the highest weight in this decomposition is always formal sector TFP. On average the magnitude of $|\Delta A| = 3.98$ and always larger than other components of formal per capita GDP growth. Per capita formal labor supply turns out to be the second component with highest magnitude - $|\Delta L_f / N| = 1.24$ for the interval between 1950-2013. However, the sign of this component is negative as per capita formal labor supply exhibits a declining trend over time in Turkey. At the other end of the spectrum, capital to total output ratio $\Delta K / Y$ is the component with the smallest magnitude ($|\Delta K / Y| = 0.13$ for 1950-2013) as capital to output ratio exhibits a relatively more stagnant trend over time compared to the other variables listed here. The relative size of the informal sector compared to the formal sector is the third component with highest magnitude ($|\Delta IS| = 0.345$ for 1950-2013). The growth of the relative size of the informal sector seems to contribute negatively to the growth of total output per capita. This is an expected result, as the relative size of the informal sector has sharply declined especially between 1950-1977 (from %53 to %20) according to the estimates of Elgin and Oztunali (2012). Only in 1977-1983 the growth rate of the informal sector seems to have positively contributed to the growth of total output per capita as the relative size of the informal sector grew by %12 on average in this interval - which is not surprising due to the political and economic turmoil experienced during these years.

Table 2 shows the growth accounting results for formal GDP in Turkey between 1950-2013. Compared to Table 1, the contributions of total factor productivity and formal per capita labor supply seem to be identical. This is not a coincidence, but instead a natural result of our methodology. Specifically, we construct total output as $Y_t = [1 + (Y_f / Y_{ft})] Y_{ft}$ where $Y_f / Y_{ft}$ can be treated as an exogenously given number. Therefore, both sides of (3) actually correspond to the multiplication of the formal output with this constant number. Hence, the contributions of formal TFP and per capita formal labor supply turn out to be identical in Table 1 and Table 2.

Table 1: Benchmark Model – Total GDP per capita

<table>
<thead>
<tr>
<th>Period</th>
<th>$\Delta Y / N$</th>
<th>$\Delta IS$</th>
<th>$\Delta A$</th>
<th>$\Delta K / Y$</th>
<th>$\Delta L_f / N$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-2013</td>
<td>2.53</td>
<td>-0.34</td>
<td>3.98</td>
<td>0.13</td>
<td>-1.24</td>
</tr>
<tr>
<td>1950-1960</td>
<td>2.65</td>
<td>-0.95</td>
<td>8.44</td>
<td>-0.47</td>
<td>-4.38</td>
</tr>
<tr>
<td>1961-1976</td>
<td>3.11</td>
<td>-1.10</td>
<td>4.78</td>
<td>0.99</td>
<td>-1.56</td>
</tr>
<tr>
<td>1977-1983</td>
<td>1.23</td>
<td>1.43</td>
<td>-0.05</td>
<td>1.27</td>
<td>-1.42</td>
</tr>
<tr>
<td>1984-1990</td>
<td>3.37</td>
<td>-0.18</td>
<td>5.09</td>
<td>-0.70</td>
<td>-0.84</td>
</tr>
<tr>
<td>1991-2001</td>
<td>1.10</td>
<td>-0.07</td>
<td>1.05</td>
<td>0.13</td>
<td>-0.02</td>
</tr>
<tr>
<td>2002-2013</td>
<td>3.23</td>
<td>-0.23</td>
<td>3.60</td>
<td>-0.68</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Table 2: Benchmark Model – Formal GDP per capita

<table>
<thead>
<tr>
<th>Period</th>
<th>$\Delta Y_f / N$</th>
<th>$\Delta A$</th>
<th>$\Delta K / Y_f$</th>
<th>$\Delta L_f / N$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-2013</td>
<td>2.75</td>
<td>3.98</td>
<td>0.01</td>
<td>-1.24</td>
</tr>
<tr>
<td>1950-1960</td>
<td>3.26</td>
<td>8.44</td>
<td>-0.81</td>
<td>-4.38</td>
</tr>
<tr>
<td>1961-1976</td>
<td>3.81</td>
<td>4.78</td>
<td>0.59</td>
<td>-1.56</td>
</tr>
<tr>
<td>1977-1983</td>
<td>0.31</td>
<td>-0.05</td>
<td>1.79</td>
<td>-1.42</td>
</tr>
<tr>
<td>1984-1990</td>
<td>3.49</td>
<td>5.09</td>
<td>-0.76</td>
<td>-0.84</td>
</tr>
<tr>
<td>1991-2001</td>
<td>1.14</td>
<td>1.05</td>
<td>0.11</td>
<td>-0.02</td>
</tr>
<tr>
<td>2002-2013</td>
<td>3.37</td>
<td>3.60</td>
<td>-0.76</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Table 3 displays the results of the growth accounting exercise for total output with human capital. Similar to what we observe in Table 1, formal TFP $\Delta A$ is the major component of total GDP per capita while the capital to total output
ratio \( \Delta K / Y \) is the component with smallest effect. The most striking observation here is the contribution of human capital per capita: the magnitude of the growth of per capita human capital seems to be higher remaining components (except for formal TFP). This is also expected as per capita human capital seems to have grown continuously between 1950-2013 according to our data from Penn World Tables. Finally, the growth of the relative size of the informal sector seems to have negatively contributed to the growth in total GDP per capita as we also have observed in Table 1. However, the magnitude of informal sector's contribution is now smaller.

<table>
<thead>
<tr>
<th>Period</th>
<th>( \Delta Y / N )</th>
<th>( \Delta IS )</th>
<th>( \Delta A )</th>
<th>( \Delta K / Y )</th>
<th>( \Delta H / N )</th>
<th>( \Delta L_f / N )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-2013</td>
<td>2.53</td>
<td>-0.26</td>
<td>2.64</td>
<td>0.04</td>
<td>0.64</td>
<td>-0.53</td>
</tr>
<tr>
<td>1950-1960</td>
<td>2.65</td>
<td>-0.70</td>
<td>4.87</td>
<td>-0.14</td>
<td>0.50</td>
<td>-1.88</td>
</tr>
<tr>
<td>1961-1976</td>
<td>3.11</td>
<td>-0.82</td>
<td>3.70</td>
<td>0.29</td>
<td>0.61</td>
<td>-0.67</td>
</tr>
<tr>
<td>1977-1983</td>
<td>1.23</td>
<td>1.07</td>
<td>-0.77</td>
<td>0.37</td>
<td>1.17</td>
<td>-0.61</td>
</tr>
<tr>
<td>1984-1990</td>
<td>3.37</td>
<td>-0.13</td>
<td>3.38</td>
<td>-0.20</td>
<td>0.69</td>
<td>-0.36</td>
</tr>
<tr>
<td>1991-2001</td>
<td>1.10</td>
<td>-0.05</td>
<td>0.52</td>
<td>0.04</td>
<td>0.59</td>
<td>-0.01</td>
</tr>
<tr>
<td>2002-2013</td>
<td>3.23</td>
<td>-0.17</td>
<td>2.86</td>
<td>-0.20</td>
<td>0.50</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Table 4 indicates that, aside from the effect of capital to formal output ratio, the contributions of other components are identical across the growth accounting exercise with total GDP and the exercise with formal GDP. Again, this is due to our methodology: both sides of (6) actually correspond to the multiplication of the formal output with this constant number. Hence, the contributions of formal TFP, per capita human capital and per capita formal labor supply turn out to be identical in Table 3 and Table 4.

### Table 4: Benchmark Model with Human Capital – Formal GDP per capita

<table>
<thead>
<tr>
<th>Period</th>
<th>( \Delta Y_f / N )</th>
<th>( \Delta A )</th>
<th>( \Delta K / Y_f )</th>
<th>( \Delta H / N )</th>
<th>( \Delta L_f / N )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-2013</td>
<td>2.75</td>
<td>2.64</td>
<td>0.00</td>
<td>0.64</td>
<td>-0.53</td>
</tr>
<tr>
<td>1950-1960</td>
<td>3.26</td>
<td>4.87</td>
<td>-0.24</td>
<td>0.50</td>
<td>-1.88</td>
</tr>
<tr>
<td>1961-1976</td>
<td>3.81</td>
<td>3.70</td>
<td>0.17</td>
<td>0.61</td>
<td>-0.67</td>
</tr>
<tr>
<td>1977-1983</td>
<td>0.31</td>
<td>-0.77</td>
<td>0.52</td>
<td>1.17</td>
<td>-0.61</td>
</tr>
<tr>
<td>1984-1990</td>
<td>3.49</td>
<td>3.38</td>
<td>-0.22</td>
<td>0.69</td>
<td>-0.36</td>
</tr>
<tr>
<td>1991-2001</td>
<td>1.14</td>
<td>0.52</td>
<td>0.03</td>
<td>0.59</td>
<td>-0.01</td>
</tr>
<tr>
<td>2002-2013</td>
<td>3.37</td>
<td>2.86</td>
<td>-0.22</td>
<td>0.50</td>
<td>0.23</td>
</tr>
</tbody>
</table>

**Benchmark Model vs. Second Model**

In this section we compare the results of the second model with the benchmark model. Table 5 provides the results from the growth accounting exercise with the second model. Since our benchmark model with total GDP involves a higher number of components compared to the second model, we will compare the second model's results with those obtained from the benchmark model with formal GDP. When we compare Table 2 and Table 5, we observe that while the contribution of labor supply to growth is always negative, this effect is somewhat exacerbated in the case of formal GDP. Specifically, between 1977-1983 benchmark model results indicate that the fall in formal labor supply lowered growth by %1.42 while according to the second model the negative effect of the labor supply channel was %0.48. This can occur if the decline in the informal labor supply was much lower in that period - which is not unexpected given the political and economic conditions of 1977-1983 period during which the growth rate of total GDP per capita nearly dipped. Therefore, a growth accounting exercise that neglects the existence of the informal sector cannot capture this effect and may overemphasize the role of declining per capita labor supply in cases where informal labor supply increases or exhibits a relatively stable trend.

Aside from the contribution of the labor supply to economic growth, the contribution of TFP is another dimension along which the benchmark model and the second model differ from each other. The comparison of results from Table 2 and Table 5 indicate that, while the major determinant of economic growth is TFP across the two models, these results also indicate that the contribution of TFP to economic growth in second model is smaller (on average 3.86% for 1950-2013) compared to the benchmark model (3.98% for 1950-2013). One can observe that this result is even more pronounced when human capital is incorporated into the analysis: the contribution of TFP in the second model is now 2.46 on average between 1950-2013 (Table 6), whereas it is 2.64 in the benchmark model (Table 3). Therefore, the second methodology – which unites the formal and informal sectors under a single production function that utilizes informality-
augmented capital and total labor supply (formal plus informal hours of work) – suggests that the contribution of TFP to economic growth is smaller than what the benchmark methodology predicts.

Table 5: Second Model

<table>
<thead>
<tr>
<th>Period</th>
<th>ΔY/N</th>
<th>ΔB</th>
<th>ΔK/Y</th>
<th>ΔL/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-2013</td>
<td>2.53</td>
<td>3.86</td>
<td>0.01</td>
<td>-1.34</td>
</tr>
<tr>
<td>1950-1960</td>
<td>2.65</td>
<td>7.64</td>
<td>-0.63</td>
<td>-4.37</td>
</tr>
<tr>
<td>1961-1976</td>
<td>3.11</td>
<td>4.75</td>
<td>0.73</td>
<td>-2.36</td>
</tr>
<tr>
<td>1977-1983</td>
<td>1.23</td>
<td>0.69</td>
<td>1.02</td>
<td>-0.48</td>
</tr>
<tr>
<td>1984-1990</td>
<td>3.37</td>
<td>4.74</td>
<td>-0.71</td>
<td>-0.65</td>
</tr>
<tr>
<td>1991-2001</td>
<td>1.10</td>
<td>1.07</td>
<td>0.17</td>
<td>-0.14</td>
</tr>
<tr>
<td>2002-2013</td>
<td>3.23</td>
<td>3.42</td>
<td>-0.73</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Table 6 displays the results of the second model in the existence of human capital. The introduction of human capital reduces the magnitudes of other components substantially. Compared to Table 4, we again observe that the benchmark methodology with formal output exacerbates the role of the fall in labor supply in 1977-1983 (-0.61) compared to the second model (-0.21).

Table 6: Second Model with Human Capital

<table>
<thead>
<tr>
<th>Period</th>
<th>ΔY/N</th>
<th>ΔB</th>
<th>ΔK/Y</th>
<th>ΔH/N</th>
<th>ΔL/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-2013</td>
<td>2.53</td>
<td>2.46</td>
<td>0.00</td>
<td>0.64</td>
<td>-0.58</td>
</tr>
<tr>
<td>1950-1960</td>
<td>2.65</td>
<td>4.21</td>
<td>-0.18</td>
<td>0.50</td>
<td>-1.88</td>
</tr>
<tr>
<td>1961-1976</td>
<td>3.11</td>
<td>3.31</td>
<td>0.21</td>
<td>0.61</td>
<td>-1.02</td>
</tr>
<tr>
<td>1977-1983</td>
<td>1.23</td>
<td>-0.03</td>
<td>0.29</td>
<td>1.17</td>
<td>-0.21</td>
</tr>
<tr>
<td>1984-1990</td>
<td>3.37</td>
<td>3.17</td>
<td>-0.21</td>
<td>0.69</td>
<td>-0.28</td>
</tr>
<tr>
<td>1991-2001</td>
<td>1.10</td>
<td>0.52</td>
<td>0.05</td>
<td>0.59</td>
<td>-0.06</td>
</tr>
<tr>
<td>2002-2013</td>
<td>3.23</td>
<td>2.71</td>
<td>-0.21</td>
<td>0.50</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Conclusion

In this study, to account for the effect of the informal economy on the growth performance of the Turkish economy, we performed various growth accounting exercises under different frameworks on both formal GDP per capita and total GDP per capita (which we have defined as the sum of formal and informal GDP per capita). Our main motivation for these growth accounting exercises relied on some key observations regarding the informal and total GDP: (i) the informal sector has constituted a major part of the Turkish economy, (ii) the informal sector’s size relative to the observed formal sector declined over time, (ii) the growth rate of the total GDP per capita has been lower than the growth rate of the formal GDP per capita on average, while the growth rate of the total GDP exhibited a relatively higher variance on average.

We adopted two methodologies during our analysis. First, in our benchmark model we implicitly assumed that the dynamics of the formal and informal sector did not affect each other and then performed growth accounting exercises on the formal GDP per capita and total GDP per capita separately. In our alternative second model, we instead united the two sectors under a single production function and performed growth accounting exercises on the total GDP per capita. The differences between the results from the growth accounting of the formal GDP under the benchmark framework and the growth accounting of total GDP under the second model indicate that the interplay between the two sectors over time may have played an important role in the growth performance of the Turkish economy.

Our results indicate that TFP has been the major driving force behind the growth of both the formal GDP per capita and total GDP per capita in the Turkish economy. The accumulation of human capital has been another major component of both the formal and total GDP per capita. The relative size of the informal economy fell from around 49% in 1950 to nearly 30% in 2013, and because of that reason the informal economy has inversely contributed to the growth of total GDP per capita.

References


This article is a chapter in a book (*Unregistered Employment*). If you want to access full version of the book please click: [http://library.ecoei.org/book/unregistered-employment/](http://library.ecoei.org/book/unregistered-employment/)