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THE EFFECTS OF THE INVESTMENT DECLINE ON POTENTIAL GDP IN TURKEY'S 2001 AND 2009 CRISES

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ABSTRACT Investment tends to fall dramatically in economic crises, which slows down the growth of the capital stock and thereby potential GDP. This note estimates the extent of such slowdown in the Turkish crises of 2001 and 2009. Capital growth fell significantly in both crises below its 1987-2011 average, but the fall in the 2001 crisis was deeper and much more persistent. The accumulated loss of capital arising from those two episodes of below-average growth is about 11% and 4% (of the trend level), respectively, in the 2001 and 2009 crises. The corresponding potential GDP losses are respectively about 6% and 2% of GDP. The loss in 2009, in addition to being smaller, was recovered much faster than in 2001. In the 4th year after the onset of the crisis, the 2009 crisis loss was recovered by about two-thirds, while the recovery of the 2001 crisis loss had barely begun in the 4th year. The limited nature of the loss in potential GDP in the 2009 crisis played a crucial role in ensuring that the ensuing rapid post-crisis recovery did not cause "overheating".
JEL E22
Keywords Turkish Economy, Capital Stock in Turkey, Turkish Capital Services Index, 2001 Crisis, 2009 Crisis

ÖZ Ekonomik krizlerde yatırımlar şiddetli azalma eğilimi göstermekte, bunun sonucunda sermaye stoğunun ve dolayısıyla üretim kapasitesinin büyüme hızı yavaşlamaktadır. Bu not söz konusu yavaşlamayı 2001 ve 2009 krizleri için incelemektedir. Örneklem döneminde ortalama yıllık %5,1 olan sermaye büyüme hızı her iki krizde belirgin şekilde bu seviyenin altına düşmüş, ancak 2001 krizindeki düşüş daha belirgin olmuştur. Bu ortalama altı büyümelerden kaynaklanan birikimli sermaye kaybı 2001 krizinde eğilim seviyesinin %11'i civarında iken 2009 krizinde %4'ü civarındadır. Bu kayıpların neden olduğu potansiyel GSYH kaybı ise 2001 krizinde GSYH'nin %6'sı, 2009 krizinde %2'si civarında olmuştur. Anılan kayıpların kriz sonrası telafileri de 2009 krizi için daha olumlu gelişmiştir. 2001 krizindeki kayıp krizin dördüncü yılında daha yeni telafi edilmeye başlanmışken, 2009 krizindeki kayıp dördüncü yılda üçte iki civarında telafi edilmiş durumdadır. Sonuç olarak, potansiyel GSYH'ye yatırım azalmasından gelen olumsuz etki 2001 krizinde önemli iken, bu etki 2009 krizinde sınırlı kalmış, bu durum 2009 krizi sonrasındaki hızlı toparlanma döneminde "aşırı ısınma" olmamasında önemli rol oynamıştır.
TÜRKİYE'NİN 2001 VE 2009 KRİZLERİNDEKİ YATIRIM DÜŞÜŞÜNÜN POTANSİYEL GSYH'YE ETKİSİ
JEL E22
Anahtar Kelimeler Türkiye Ekonomisi, Türkiye'de Sermaye Stoğu, Sermaye Hizmetleri Endeksi, 2001 Krizi, 2009 Krizi

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1. Introduction

Some recent studies reach the conclusion that severe crises have adverse persistent effects on potential output.[1] Those effects are not particularly important during the crises, when GDP is generally agreed to be below its potential and the aim of macroeconomic policy is to raise it closer to that potential. But they can become important during the recovery periods that follow the crises, as those losses in potential GDP may prevent the economy from reverting to their pre-crisis trends. Those effects on potential GDP are particularly important from the central banks' point of view, because the loss in the production potential of the economy might imply that the limits of that production potential would be reached sooner in the recovery period, and hence result in inflationary pressures. In the specific case of the Turkish economy after the 2009 crisis, the widening current account gap and the high GDP growth figures during the rapid recovery brought up discussions of whether the Turkish economy was experiencing "overheating". Those discussions make it important to understand and assess the negative effects of the 2009 crisis on potential GDP.

The slowdown of the growth of capital is one of many possible reasons why potential GDP growth might fall in a crisis, but it is a leading adverse effect of crises on potential GDP.[2] In economic crises, the existing facilities remain idle in line with the fall in demand, and credit becomes scarce. Consequently, both the incentive and the ability to continue ongoing investments and start new capital projects are reduced for many businesses. This, in turn, adversely affects the economy's future production capacity.

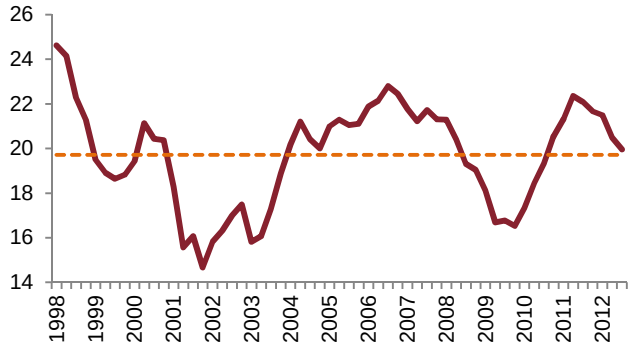
Figure 1 shows the decline in investment during Turkey's 2001 and 2009 crises. While investment fell significantly in both crises, the fall in the 2001 crisis was deeper and more persistent. A direct result of this is that, as Figure 2 shows, the damage to capital accumulation was relatively limited in the 2009 crisis compared to the 2001 crisis, and the recovery of the 2009 loss

[1] Examples of estimates for the size of those adverse effects can be found in Furceri and Mourougane (2009) and Cerra and Saxena (2008). Examples of discussions regarding the mechanisms by which those adverse effects are generated can be found in Blanchard (2009), CBO (2010), Weidner and Williams (2009), Jaillet (2011), and Basu and Fernald (2009).

[2] "Recessions typically have little effect on potential output beyond the direct effect of lower investment on capital accumulation, and that effect tends to diminish in the long run when investment recovers to normal levels." CBO (2010, p.38). See Footnote 1 for citations containing discussions of other possible channels. In addition to the effect on the capital stock, the global crisis may have had adverse effects on potential GDP through damages to the financial system and/or some specific sectors (such as construction) in some countries (such as the United States). However, in the Turkish experience of the 2009 crisis, such sectoral experiences are not viewed to be prominent, and the Turkish financial system came out of the crisis unscathed.

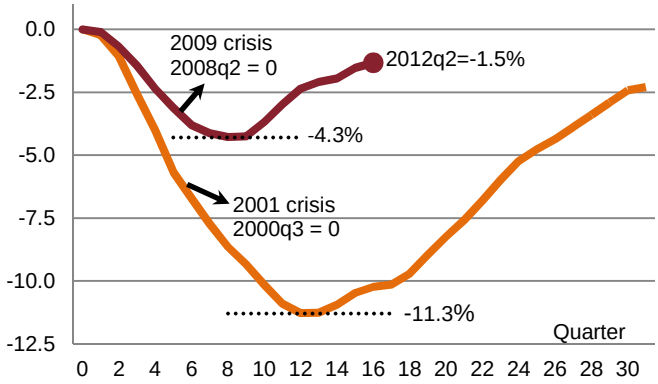
was faster.[3] How we go from Figure 1 to Figure 2 is explained below. More specifically, after some definitional clarifications in Section 2, and after discussing the measure of capital used in the analysis in Section 3, Section 4 explains how Figure 2 is obtained. The implications of those capital losses for potential GDP and for the question of overheating are discussed respectively in Sections 5 and 6. Sections 7 and 8 contain sensitivity analysis and Section 9 concludes.

Figure 1. Investment (Percent of GDP, seasonally adjusted)



Source: Turkstat, CBRT.

Figure 2. The Impact of Investment Slowdown on Capital in the 2001 and 2009 Crises*



* These two series show the percentage amounts by which the capital input fell below its growth trend because of the 2001 and 2009 crises. The horizontal axis shows the number quarters since the beginning of the crisis.

[3] The periods in which capital growth was below its average trend were 2000q4-2003q3 in the 2001 crisis and 2008q3-2010q2 in the 2009 crisis. Accordingly, the beginning quarter is taken to be 2000q4 for the 2001 crisis and 2008q3 for the 2009 crisis.

2. Definitions and Some Clarifications

The stock of land is left out of the analysis because its quantity is not sensitive to the business cycle. Thus, throughout this paper "capital" means the reproducible fixed capital stock, which consists of the stock of machinery and equipment and the stock of structures (i.e., residences, offices, factories, dams, roads and so on).

"Potential GDP" refers to the highest level of GDP attainable with the economy's resources (physical capital, labor force, technological knowledge, etc.) without causing an increase in inflation. This definition takes inflation as the main criterion for potential GDP, and indicates the level of GDP that a central bank would prefer not to exceed. In contrast, an alternative interpretation might maintain the viewpoint that potential GDP should reflect possible changes in the economic environment that reduces the attainable level of GDP at the time of the crisis (and also possibly later), regardless of whether those changes result in reduced capacity usage or not. However, that alternative would not be a functional definition from the viewpoint of inflationary pressures.

Related to potential GDP is the concept of "overheating", which refers to a situation in which GDP significantly exceeds potential GDP and causes a buildup of inflationary pressures. This clarification is important because in some recent discussions on the Turkish economy the term "overheating" has been used to define the Turkish economic situation for reasons such as the large current account deficit, rapid growth of GDP, or rapid growth of outstanding credits. An example of such arguments can be found in IMF's most recent Article IV report on Turkey (IMF 2012). A box in that report argues at length that there is overheating in Turkey on several grounds including those three above. While those observations (current account deficit, rapid growth etc.) could be symptoms of overheating, they do not determine that there is overheating by themselves. As for rapid growth, when it takes place at a time of excess unused capacity in the economy (such as when the cyclical bottom is reached at the end of a recession), it reflects a healthy situation (the reduction of a negative output gap) and not overheating. In fact, a recovery from a recession ordinarily involves above-trend growth, and it would be unusual to assume such growth reflects overheating. Similarly, a current account deficit can arise for reasons other than overheating. One such possible reason is that strong capital inflows could move the exchange rate away from its level that equilibrates the external deficit. Another possible reason specific to the recent Turkish situation is the drag on Turkish exports from the lackluster global recovery in Europe, which is Turkey's main trade partner. Finally, in an emerging market economy where the size of financial markets relative to GDP is small, financial deepening would normally be a part of structural maturation,

and the rapid credit growth associated with it does not necessarily involve overheating. The signs of overheating should be searched for in measures of activity (e.g., GDP growth), because rapid credit growth might only be showing the growth of financial intermediation. All those cases exhibit the supposed signs of overheating without actually suffering from that problem.

3. The Measure of Capital Used in the Analysis

This study uses the capital input series calculated by Demiroğlu (2012). The data for that series are provided as a Data Appendix at the end of this paper. The Demiroğlu (2012) series is a capital services index that summarizes the productive capacity of the capital stock composed of different types of capital (such as equipment and structures). The growth of that index is calculated by a weighted average of the percentage growth rates of different types of capital, where the weight of each type is proportional to the contribution of that type of capital to GDP.[4]

It is worthwhile to emphasize the importance of using such an index for the capital input, given that some previous growth accounting studies on the Turkish economy fail to take sufficient account of the differences in the nature of different types of capital. In order to be able to assess the GDP contribution of different types of capital, such an index (or an approach that is equivalent to calculating such an index) must be used.[5]

4. The Drag on Capital Accumulation from the 2001 and 2009 Crises

Figure 3 shows the growth of the capital input series. Both the 2001 and 2009 crises (as well as the recessions before those) are periods when the growth rate of capital fell below its %5.1 average. To emphasize that observation, Figure 4 shows the amounts by which the growth rate of capital was below or above its average. In Figure 4, the two shaded areas show the capital losses in the 2001 and 2009 crises (relative to the average growth trend of capital). Those losses are 11.3% and 4.3%, respectively, for the 2001 and 2009 crises.

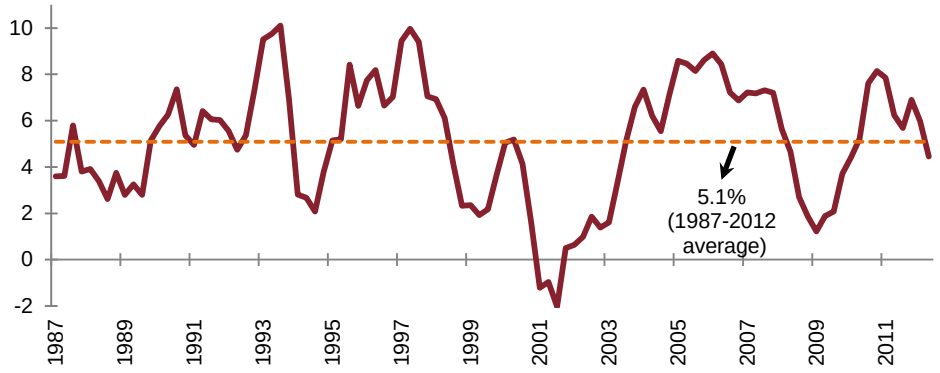
The two series shown earlier in Figure 2 are the time paths of the accumulated versions of the two shaded areas in Figure 4; those two series show the losses starting with zero in the quarter that precedes the crisis, becoming increasingly more negative in the early quarters, then gradually recovering as investment recovers after the crisis. For example, the series for the 2001 crisis in Figure 2 tells us that the loss in capital due to the

[4] See Demiroğlu (2012) for more detail and the rationale.

[5] Demiroğlu (2012) provides a compact review (in Turkish) of the topic of capital services. The use of such an index is the commonly accepted method (see, for example, OECD 2009). Note that some careful growth accounting studies do not use the term "capital services" but nevertheless employ an equivalent calculation; see, for example, Hsieh (2002, Section II).

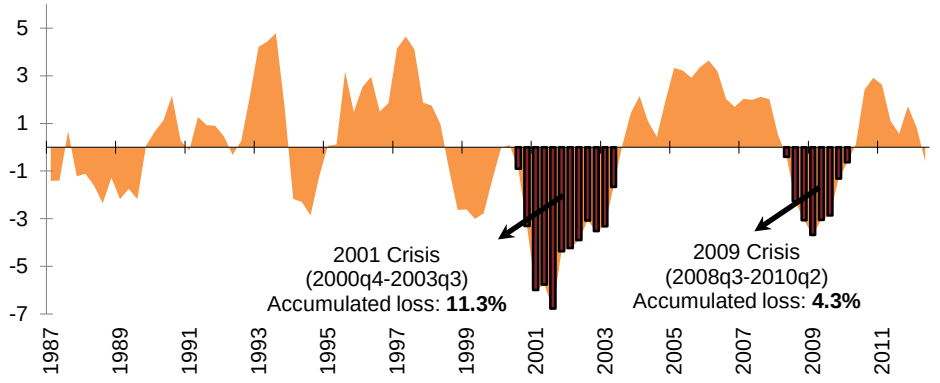
investment decline reached its peak at -11.3% three years (in the twelfth quarter) after the start of the crisis. After that quarter, investment was strong enough that the growth of capital was above its average, and the earlier losses were gradually made up for. The amount of losses that were recovered later reached about 80% just before the next crisis, but that was about 8 years (in the 31st quarter) after the onset of the 2001 crisis. As for the 2009 crisis, the losses reached their peak two years after the start of the crisis (in the 8th quarter) to -4.3%, and after that a rapid recovery began whereby the losses were recovered to an important extent (by two-thirds) by the 16th quarter of the crisis, receding back to -1.5%.

Figure 3. The Growth Rate of the Capital Input (Seasonally adjusted, annualized percentage growth)



Source: Demiroğlu (2012).

Figure 4. The Deviation of Capital Input Growth from Its Mean (Seasonally adjusted, annualized percentage growth)



Note: The plotted series is demeaned annualized growth rate of the capital input.
Source: Demiroğlu (2012).

5. The Effect on Potential GDP

This section explores how much loss in potential GDP would be caused by the capital losses estimated above. The answer is found by multiplying those capital losses (which, again, were found to be 11.3% and 4.3%, respectively, for the 2001 and 2009 crises) by the elasticity of potential GDP with respect to capital. It is well known in growth accounting that the elasticity in question is determined by the share of capital in overall income, which tends to be around 1/3 in developed countries but tends to be higher in emerging and developing markets. The capital share for Turkey is not known precisely but the estimates are centered around 0.5 (see, for example, İsmihan and Metin-Özcan (2006) and Tiryaki (2010)). That would mean that every 1% increase in capital services increases potential GDP by 0.5%. Therefore, the estimated peak potential GDP loss for the 2001 and 2009 crises, respectively, are 5.6% and 2.1%.

In some other studies (for example, Saygılı and Cihan, 2008), capital share is estimated somewhat above 0.5. The capital share needed for our analysis, however, is the share of capital *excluding land*. The capital share is calculated for many countries as one minus the income share of labor. However, in Turkey, the household survey does not include answers to enable a fully satisfactory determination of labor income. Nevertheless, an important portion of labor income is known through the wages and salaries of officially employed. A higher figure for the capital share, when combined with those available wage data and a reasonable assumption for the income share of land, leaves too small a value for the share of the unrecorded labor income to be credible. Conversely, the value of 0.5 might be too high for the income share of capital excluding land. If so, using 0.5 would result in an overstated estimate of the potential GDP loss. The sensitivity of estimates to the capital income share is examined in detail in Section 7.

6. The Issue of "Overheating"

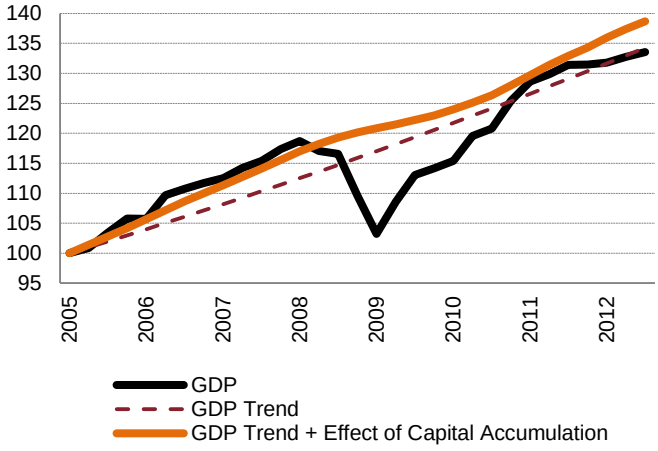
The question of whether the potential GDP loss in the 2009 crisis calculated above was large enough to cause overheating in the recovery period can be examined with the help of Figure 5. This figure compares GDP, the GDP trend, and the GDP trend adjusted for the effect of capital accumulation. The figure starts from 2005q1, which is a quarter for which the output gap is estimated to be relatively close to zero.[6] Consequently, the series are equalized in 2005q1 to 100. The dotted straight line in Figure 5 shows the average GDP growth trend.[7] This average GDP trend line reflects

[6] For example, see Öğünç and Sarıkaya (2011, the graphic on page 23), or Üngör (2012, Figure 2c).

[7] The linear growth trend shown in Figure 5 increases at 4.0% per annum, the average growth rate of GDP in the 1987-2011 period. The current trends for GDP and capital growth might differ from the sample averages, a possibility discussed at length in Section 8.

a situation where the factors that determine the production capacity (labor, capital, technology, etc.) grow at their average rates. It is not straightforward to determine the annual growth rates of the (potential) levels of those factors other than capital. However, for capital, the calculations provided by Demiroğlu (2012) can be employed. The series shown earlier in Figure 4 (a series showing how much annual capital growth differed from its average growth trend) is multiplied by 0.5, accumulated starting from 2005q1, and added to the linear trend in Figure 5. The result is shown by the solid light-colored series in the same figure. This last series shows how much potential GDP growth has differed from its average trend line due to the fluctuations in the growth of capital. This last series would be a good measure of potential GDP if the growth of the potential labor force and TFP (total factor productivity) did not deviate much from their trends.

Figure 5. GDP Growth Trend and the Effect of Capital Accumulation (2005q1=100)



Note: The GDP trend line is based on the average GDP growth over the sample. The effect of capital is calculated by multiplying the detrended capital input series by the capital income share.
Source: Turkstat, Demiroğlu (2012), and author's calculations.

This measure of potential GDP in question (the light-colored solid line in Figure 5) grew faster than the GDP trend in the 2005-2008 period thanks to the strength of investment, but slowed down in the 2009 crisis as investment fell. It can be seen from Figure 5 that, without the rapid increase in capital in the 2005-2008 period, the rapid GDP growth in the same period would have resulted in a rapidly widening output gap in the inflationary direction. The growth of that potential GDP measure slowed down in the 2009 crisis, but that slowdown was not to an extent that made the rapid post-crisis recovery inflationary. Such an inflationary situation would arise if we saw GDP significantly exceeding the measure of potential in question, but GDP stayed

below that measure throughout. Unless there has been a significant independent fall in TFP or the labor force, this figure tells us that there has been no overheating in the sense defined in Section 2. In other words, the decrease in capital accumulation during the 2009 crisis was not to an extent that resulted in overheating in the recovery period.

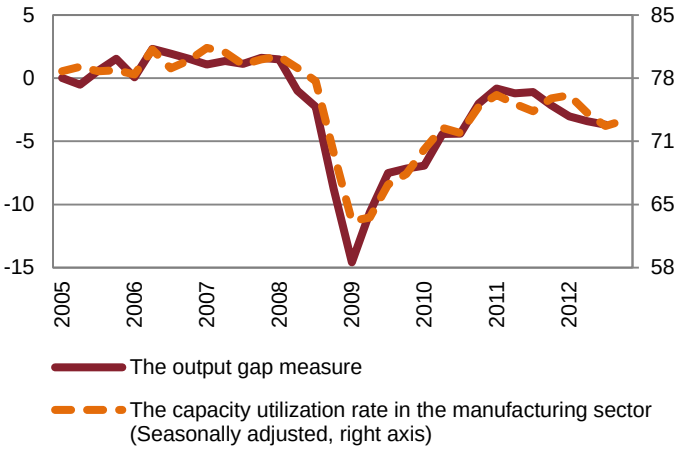
The impression obtained from Figure 5 that GDP did not exceed its potential is consistent with the picture obtained from the manufacturing capacity utilization rate (CUR). To show that consistency, the gap between GDP and the measure of potential in Figure 5 is compared to CUR in Figure 6. That gap (calculated as a percentage of GDP) is a measure of the output gap; if the deviations in the growth of the labor force and TFP from their average growth rates are negligible, and if the 2005q1 output gap is not too far from zero, then the gap series in Figure 6 would roughly be equal to the output gap. (If the output gap in 2005q1 was not zero but, say, was +2%, then by shifting the labels on the left y-axis by 2 percentage points would be sufficient and the rest of the figure would stay unchanged.) This output gap measure is obtained by data collected completely independently from the source data for the CUR survey, but nevertheless is very similar to the CUR series in Figure 6. Since CUR can be thought of an output gap measure for the manufacturing sector, Figure 6 in essence compares one output gap measure to another (albeit one measure is for the overall economy while the other is only for manufacturing). This figure shows the consistency of the output gap implied by Figure 5 with the output gap measure for manufacturing.[8] The fact that this consistency is obtained without incorporating in the latter measure fluctuations in the growth rates of either TFP or the labor force suggests that the fluctuations in those two variables may have played a limited role in the GDP movements in the 2005-2012 period covered by Figure 6.[9] In contrast, removing the effect of capital on potential significantly reduces the harmony observed in Figure 6—the emerging picture is shown as Figure 7.[10]

[8] It could be argued that the drop in capacity utilization during crises might reflect wholly or in part a drop in potential GDP, and therefore capacity utilization may not be a fully accurate measure of the output gap for this reason (in addition to other possible reasons). However, as discussed in Section 2, in this paper potential GDP is taken to mean the level of GDP that does not cause an increase in inflation. If the excess capacity that producers perceive is a key determinant of inflationary pressures, capacity utilization conceptually would fit well as a measure of the output gap, albeit not in terms of coverage, given that the Turkish capacity utilization measure is available only for manufacturing.

[9] There are three possibilities regarding this: Either the fluctuations in those two variables (TFP and labor force) did not play an important role in that period, or they had important effects but those effects largely offset each other (for example, rapid growth in labor force participation may have offset the negative impact from real TL depreciation), or both of the output gap measures in Figure 6 are flawed and their apparent consistency is a coincidence.

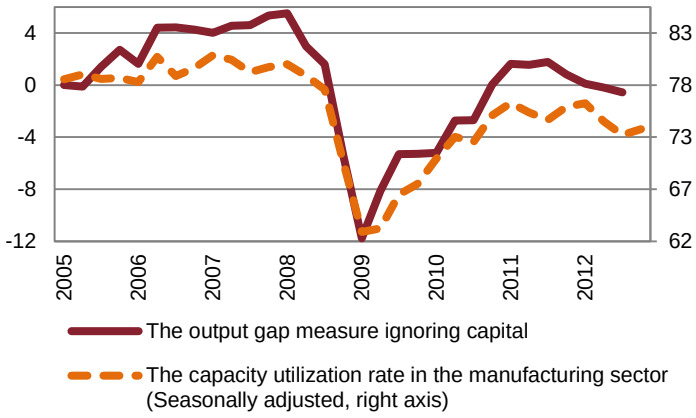
[10] To explain Figure 7, removing the effect of capital on potential GDP results in the following. (1) That eliminates the rapid increase in the measure of potential GDP in the 2005-2008 period associated with the rapid capital accumulation in those years. Consequently, the measure of potential GDP grows less rapidly,

Figure 6. The Output Gap Measure and Manufacturing Capacity Utilization Rate



Note: The output gap measure is based on the series shown in Figure 5, calculated as the gap between GDP and the GDP trend adjusted for capital accumulation. Note that this gap measure ignores possible fluctuations in the labor force and TFP growth, and assumes that the output gap in 2005q1 was zero.
Source: Turkstat, Demiroğlu (2012), and author's calculations.

Figure 7. If Capital Accumulation is Ignored, the Parallel with the Capacity Utilization Rate is Reduced



Note: See the explanation in the note for Figure 6. Differently from Figure 6, the output gap measure in this figure additionally ignores capital—it is based only on the GDP trend. This results in a less close relationship of the output gap measure to the manufacturing capacity utilization rate. See the text for more detail.
Source: Turkstat, Demiroğlu (2012), and author's calculations.

while actual GDP grew rapidly in that period. That, in turn, results in an output gap measure that rises up rapidly, reducing the harmony of the output gap measure with the capacity utilization series, as the latter exhibits a flat trend over that period. (2) The output gap measure finishes the figure at about the same rate as at the beginning of the figure, which again reduces the harmony of the series with the capacity utilization series, as the latter falls 8% over the same period.

7. Sensitivity to Assumptions

Demiroğlu (2012) finds that the capital services series has limited sensitivity to the assumptions needed in its calculation (more detail on that below), but the impact on potential GDP relies additionally on the assumption for the capital income share, to which the results *are* sensitive—the potential GDP impact estimate is calculated by multiplying the capital income share with the estimate for the capital impact; in other words, the estimate is proportional to the capital income share.

A safe range for the capital income share, which is taken to be 0.5 in the analysis, is 0.3-0.6.[11] This sensitivity range implies a range of 1.3%-2.6% for the potential GDP impact, which is a large range as a proportion of the initial point estimate of 2.1%, but all of this range still represents a limited impact that can be summarized as "around 2%," as done in the abstract. To clarify, the 1.3%-2.6% range is for the estimate of the peak loss in potential GDP, which takes place in the quarter 2010q2. That loss is recovered later on in part. It is estimated, for example, to have been recovered by about two-thirds by mid-2012. That would imply for mid-2012 a range of 0.4%-0.9% for the remaining potential GDP loss associated with the investment decline in the 2009 crisis, i.e., less than 1% of GDP.

Table 1. Sensitivity to Assumptions

Variable	Base Value of the Variable	Alternative Value of the Variable	Estimate Under the Alternative (Base value 2.1%)
Depreciation rate (structures)	2.0%	1.0%	2.0%
Depreciation rate (equipment)	16%	12%	1.8%
Real cost of borrowed funds	12%	16%	2.0%
Average real cost of funds in construction	9.5%	12%	2.0%
Real appreciation rate for residential real estate	2.0%	0.0%	2.0%

Note: This table shows the value of the peak potential GDP impact estimate for the 2009 crisis under alternative assumptions. (The final estimate also relies on the capital income share. The sensitivity to that variable is discussed in the text.)

[11] The assessment of İsmihan and Metin-Özcan (2006) is that capital income share could vary between 0.35 and 0.65. However, for the capital income share *excluding land*, which is the variable needed here, 0.65 might be too high. For example, recorded employment in 2005 was 59% of the total labor force and had an income share of 29%. The value of 0.65 for the capital income share would leave only 6% of income for land and unrecorded employment that accounts for the remaining 41% of the labor force. The range of 0.3-0.6 might be excessively large but this does not pose a problem for the sensitivity analysis here.

The potential GDP impact estimate has limited sensitivity to the other assumptions. Those other assumptions are needed to calculate the capital services index, and the sensitivity to them are already discussed in Demiroğlu (2012), but a table is provided here to give the reader an idea. Table 1 shows how the final estimate for the peak potential GDP effect for the 2009 crisis changes as the assumptions are varied. The alternative values in Table 1 represent substantially different values from the base assumptions. The final estimate changes by about 0.1 percentage point under all the alternatives considered except for the one for the depreciation rate for machinery and equipment, which changes the final estimate by 0.3 percentage points. (That variable has a somewhat higher influence because it changes both the calculated series for equipment stock and its weight substantially.) Nevertheless, despite the important changes made in the assumptions for this table, the alternative values of the final estimate do not appear to put an important question mark on the concluding assessment that the peak potential GDP loss associated with the investment decline in the 2009 crisis was "around 2%."

8. Possible Differences between the Actual Trends and the Estimates Based on Sample Averages

In this note the sample average growth rates (5.1% annual growth rate for the capital input and 4.0% for GDP) are taken as reference levels for trend growth. For example, the capital loss is calculated based on the amounts by which capital growth fell below the 5.1% average, and GDP growth of 4.0% is taken as the basis for the discussion on overheating. However, during the periods within which the 2001 and 2009 crises happened, the "normal" growth trend (or the "medium term" growth rate, i.e., the tendency for the growth rate if cyclical influences are removed) could be different from the sample averages. If those sample averages are markedly different from the true growth trends, the reported capital loss estimates might not be informative. Therefore, it is important to examine how well the sample averages might be reflecting those true trends, how much might they differ, and how important might their difference be for the results. Those questions are discussed below, with particular emphasis on the 2009 crisis given that it has greater importance for current monetary policy than the earlier crisis.

The conclusion that comes out of the discussion below is that the use of sample averages is informative and the conclusions are not materially different under plausible alternative assumptions about the growth trends. When higher growth rates are assumed for recent years, in order to reflect a common perception that growth trend might have been higher recently, similar conclusions are reached. In fact, a leading conclusion of this paper, that the potential GDP loss in the 2009 crisis from the investment decline

was sufficiently limited (so that the rapid recovery after the crisis did not result in overheating), becomes stronger under that assumption. This is simply because assuming a higher potential GDP growth trend for recent years strengthens the conclusion that the realized actual GDP growth was not inflationary. The other important conclusion in this paper, that the capital loss was limited in the 2009 crisis relative to that in 2001 also remains intact under the alternative assumptions; although the difference in capital loss between the two crises is reduced under some alternative plausible growth trend assumptions, it remains large. Moreover, the tendency of the investment deflators to rise less rapidly than the GDP deflator appears to have abated since after the 2001 crisis. If this change is taken into account, the alternative values that can be considered as the growth trend of the capital input is reduced for the 2009 crisis but raised for the 2001 crisis.[12] Since the capital losses are measured by the amounts by which actual capital input growth fell below those growth trends, taking this consideration into account would raise the capital loss estimate for the 2009 crisis and lower it for the 2001 crisis, which would make the relevant conclusion (that the capital loss in 2009 was relatively limited compared to the loss in the 2001 crisis) only stronger.

8.1. Alternative Scenarios for the Growth Trends

The average GDP growth rate in the sample period is 4.0%, which is taken as the GDP trend growth rate for both crises. That is the same value as the one assumed in IMF's most recent Article IV report for the current "medium-term potential" growth rate for Turkish GDP. However, arguably a widely shared impression is that the trend growth rate of potential GDP might have been higher over the past 10 years. For example, the above-mentioned Article IV analysis reports the estimate of Turkish authorities to be 4.5%. In addition, the labor force participation of women appears to be on an upward track, which may continue to contribute to potential GDP growth in the years ahead. In light of those considerations, the analysis considers two higher values for GDP trend growth as an alternative to the 4.0% assumed in the analysis: 4.5% and 5.0%.

As for the growth trend of capital, no direct estimates are available, but that trend is expected to be related to GDP trend and the difference between

[12] An example is the rapid fall in the relative prices of computers and other information technology products at the time of the 2001 crisis. Such a decrease in relative prices means that a given increase in nominal investment expenditure (for example, an increase proportional to nominal GDP) would correspond to a greater increase in real investment spending. Therefore, during times of a rapidly falling relative investment deflator (relative to the GDP deflator), real investment and real GDP can be expected to have a greater difference between their growth rates. The observation that the differential between the inflation rates of the GDP deflator and the investment deflator tended to narrow from 2001 to 2009 implies that real investment growth trend should be expected to have been higher in the 2001 crisis period relative to the 2009 period (*ceteris paribus*).

the trends in deflators for investment and GDP. Capital goods prices tend to increase less rapidly than the GDP deflator. Consequently, growth trend of the real capital stock is expected to be greater than that of GDP slightly (by the amount of their inflation differential) in order to keep the ratios of the nominal quantities balanced. The 1.1 percentage point difference between the 4.0% and 5.1% trend growth rates in the sample period indeed accords well with the 1.3 percentage point difference between the deflators of GDP and investment in the sample period.[13] When investment deflators fall, the same nominal investment spending results in a faster real spending increase (in the long term as well as the short term).

While the high frequency changes in the deflators make it difficult to discern their growth trends, the smoothed versions of deflators using simple moving averages make the trends more visible. The relative price declines in machinery and equipment (relative to the GDP deflator) appear to continue in recent years, but the relative price declines in the construction deflator lost their pace and might have even started a slightly rising trend, a finding consistent with the rise in commodity prices in the mid-2000s. Consequently, the tendency of the overall investment deflator to fall relative to the GDP deflator is not as strong in the past 10 years as in the overall sample period. In fact, the inflation differential was below its 1.1 percentage point average recently; it was 0.8 percentage points in the 2006-2011 period. As alternatives to the 1.1 percentage point inflation differential in the baseline, the analysis below considers the values of 0.8 (recent years' average) and 1.3 (the average in the whole sample).

The sum of the GDP trend discussed two paragraphs ago and the inflation differential in the preceding paragraph is taken as the growth trend for capital, as that would be the value that yields a balanced growth path for nominal quantities. Those alternatives provide 3x3=9 different scenarios (one of which is the baseline scenario) for the GDP trend and the capital trend, and their results are shown in Table 2. More specifically, Table 2.A. shows how the estimate for the peak potential GDP loss change under those scenarios, and Table 2.B. shows the closest point the economy gets to an inflationary situation (measured by the highest value of the output gap in the post-2009 crisis period, usually realized in 2011q1).

Table 2 establishes that the conclusions of the paper are not altered in those scenarios. To give more detail, the main results in the paper are that (1) the loss in capital in the 2009 crisis was limited relative to the loss in the 2001 crisis, and that (2) the 2009 crisis loss was not to an extent that would have led to overheating in the recovery period. Each of those can be inspected more closely as follows:

[13] That value of 1.3 is calculated from the trends in those deflators between 1987 and 2012.

Table 2. The Effect of Alternative Assumptions of Growth Trend on the Estimates

Table 2.A. The Estimate of the Peak Potential GDP Impact, % of potential GDP (Base scenario: -2.1%)

		Growth Trend Differential between Capital and GDP		
		0.8	1.1	1.3
GDP Trend (Annual growth rate)	4.0	-1.9	**-2.1**	-2.3
	4.5	-2.4	-2.6	-2.8
	5.0	-2.9	-3.1	-3.3

Table 2.B. The Maximum Value for the Estimated Output Gap in the post-2009 Crisis Period, % of potential GDP (Base scenario: -1.0%)[a]

		Growth Trend Differential between Capital and GDP		
		0.8	1.1	1.3
GDP Trend (Annual growth rate)	4.0	-1.8	**-1.0**	-0.5
	4.5	-3.2	-2.5	-2.0
	5.0	-4.7	-4.0	-3.5

Note: The numbers in bold in the table are the base scenario, corresponding to the cases when average sample growth rates are taken as the trend.
[a] The output gap estimate relies on the series shown in Figure 5, and does not incorporate changes in the growth rates of the labor force and TFP. The highest value for the output gap is often realized in 2010q2.
Source: Demiroğlu (2012), and the calculations explained in the text.

(1) As shown in Table 2.A., under the alternative assumptions the potential GDP loss due to investment slowdown varies between 1.9% and 3.3% (baseline estimate is 2.1%). Again, this is the peak loss in potential GDP—some of those losses are recovered in the recovery period. That 1.9%-3.3% range is roughly consistent with the language used in the abstract that it is "about 2%." The range is admittedly a bit higher than what that language suggests at the upper end, but it is still substantially below the 6% estimate for the 2001 crisis. The comparison with the 2001 crisis stands.

(2) In Figure 5, the closest GDP comes toward the potential GDP measure (or the most by which GDP exceeds that measure), can be used as a measure of the most inflationary point the economy reaches in the post-2009 crisis period (which is often in 2011q1). In Figure 5, that value is -1.0% (meaning that the output gap is reduced to -1.0% but widened again after that quarter). As Table 2.B shows, under the alternative scenarios, that value changes between -0.5% and -4.7%. In other words, GDP stays under the measure of potential GDP in all those scenarios. Note that "overheating" (in the sense of Section 2) requires a significant rise of GDP over its potential, which is displayed in none of the cases in the table. Moreover, the amount by which GDP stays below potential is larger than in the base scenario in all but one of the cases in Table 2.B.[14] Therefore, the conclusion that the loss in capital accumulation did not result in overheating in the post-2009 crisis

[14] It tends to be larger because, although the capital losses are higher in those alternatives, GDP growth trend is also higher. The higher GDP growth trend means that the dashed line in Figure 5 rises more rapidly, and so does the potential GDP measure by an equal amount. In contrast, higher capital losses do not alter the dashed line but make the potential GDP measure rise less rapidly, albeit by a fraction (equalling the capital income share) of the increase from the higher GDP trend.

period is not only intact but generally much stronger in those alternative scenarios.

In conclusion, the alternative scenarios above do not alter the main conclusions reached in this paper: the capital loss in the 2009 crisis was limited relative to the loss in the 2001 crisis, and it was not to an extent that would have caused an inflationary situation in the recovery period.

The 2001 Crisis:

It could be argued that the GDP growth trend was lower around the time in which the 2001 crisis took place. But that conjecture is not straightforward. In the part of the sample that was up to the 2001 crisis (i.e., in the 1987-2000 period), average GDP growth rate was 3.8% per annum. In the period from the beginning year 1987 to 1998, which was a year that was cyclically more compatible with 1987 than 2000 was (in terms of, for example, capacity utilization rate), the average growth rate was 4.2%, slightly above the sample average of 4.0%. Both values (4.2% and 3.8%) are fairly close to 4.0%. Thus, taking 4.0% also as the GDP trend for the period surrounding the 2001 crisis does not appear to be misleading.

As mentioned before, the inflation differential between investment and GDP should be viewed as being related to the growth trend of capital. When the inflation differential is large, that would tend to make the growth of capital faster. As argued above, the differential was likely greater at the time of the 2001 crisis than in the 2009 crisis. In the former period, the rapid fall in the prices of computers and other IT equipment, combined with the continued downward trend in commodity prices, made the relative investment deflator fall more rapidly than in the latter period. Consequently, inflation differential between GDP and investment deflators must have made a greater contribution to real investment growth trend in the 2001 period relative to the sample average. Taking the sample average as representative also for the 2001 crisis likely results in a (limited) understatement of the loss in capital in the estimate for the 2001 crisis. No adjustment is made for this in the paper but if one were made, it would have resulted in a greater capital loss estimate for the 2001 crisis, enforcing the conclusion that the loss in 2001 was greater than in the 2009 crisis.

8.2. Cyclical Situation

In addition to growth trends, it could be argued that the cyclical situation must also be taken account. For example, in Figure 3, the growth of capital tended to be around 7% both before and after the 2009 crisis. That might give the impression that the 2009 crisis gave a temporary break to a variable that was trending at 7%. That impression would then give grounds to wonder if the proper measure of capital loss for the 2009 crisis might have

been the amounts by which capital growth falls below 7% rather than 5%. However, 7% would be overly high as a trend growth rate—it needs to be considered as a value that can be possible only for limited periods of time, such as that after the 2001 crisis when a large amount of lost investment gave room for high levels of capital growth in the ensuing years. The level of the output gap immediately before the 2009 crisis, according to the "real time" estimates at the time, was close to zero, and is somewhat positive according to more recent estimates (see, for example, Öğünç ve Sarıkaya, 2011). In other words, any remaining output gap was largely closed before the 2009 crisis. Therefore, 7% would be too high a capital growth rate to continue even if the 2009 crisis did not take place. In fact, as the output gap that emerged with the 2009 crisis narrowed after the crisis, growth slowed down, and capital growth rate not only fell below 7% but even below 5%.

Thus, some other values different from the trend growth rates could be more appropriate in some situations due to cyclical considerations. However, that does not appear to be the case for the 2009 crisis.

The analysis for the 2001 crisis is less straightforward. If the exchange rate peg did not fall apart and the 2001 crisis did not happen, the high rates needed to maintain the peg could have kept the growth rate low (below the prevailing medium-term potential growth rate). However, the 1990s were plagued with the crises and saw low rates of growth. The untapped growth potential associated with that lackluster decade might have made higher growth rates possible around the year 2001 (but probably with different policies). An analyst with a prior view one way or the other might want to take a different alternative value as the reference level for capital and GDP growth in the 2001 crisis. But the existence of arguments in both directions makes it difficult to pick a value. The path that is taken in this paper is to make the calculations relative to the sample average and report the results as such.

For comparison, the OECD study that estimates the impact of crises on potential GDP (Furceri and Mourougane, 2009) compares the potential GDP growth trends before and after each crisis. In other words, that study takes the pre-crisis trend as the reference value and looks at how much the post-crisis trend differs from it, paying no attention to the cyclical situation. Given that cyclical situation is not given a weight in the analysis here, this paper and the OECD study are similar in that aspect of the analysis.

9. Conclusion

The loss in capital accumulation due to the investment decline in the 2009 crisis was limited, not only relative to the loss in the 2001 crisis but also in absolute terms. The associated potential GDP loss reached its highest point

of about 2% in 2010q2, and was recovered rapidly in the two years that followed thanks to the strong post-crisis recovery in investment (and especially in machinery and equipment investment). The loss was recovered by about two-thirds by mid-2012, and the remaining potential GDP loss was less than 1% of GDP by that time.

In contrast, the 2001 crisis illustrates that the loss in potential GDP associated with an investment slowdown can be substantial. That loss was about one year's worth of Turkey's potential GDP growth, and its recovery came late and slowly—the recovery of that lost ground gained traction only in the fifth year of the crisis (Figure 2).

One might question the usefulness of looking at the potential GDP effect only of capital, given that TFP and labor force might also be influenced by the crises. An answer is that the investment slowdown is estimated by some to be the main source of potential GDP loss during downturns (see Footnote 2). The large size of the loss due to the investment decline in the 2001 crisis appears to confirm that point of view. That loss was greater than the total potential GDP loss estimated by Furceri and Mourougane (2009) for an average severe crisis—an estimate that includes the effects on potential GDP from all possible sources, not just the slowdown in capital accumulation. The average of the losses (due to capital slowdown) estimated in this paper for the 2001 and 2009 crises roughly equal the Furceri and Mourougane estimate of the average loss (due to all possible mechanisms including capital slowdown) in severe crises.

To wrap up, the loss in potential GDP in crises due to investment slowdown can be large and persistent, as illustrated by the 2001 crisis, but that loss was limited in the case of the 2009 crisis, and its recovery was relatively rapid, thanks to the strong recovery in investment. The interest rate reductions of the Central Bank of Turkey in the 2009 crisis, which totaled more than 1000 basis points, likely made a substantial contribution to that recovery. The limited nature of the potential GDP loss in the 2009 crisis and the rapid recovery of that loss played an important role in ensuring that the rapid recovery in GDP in the post-2009 crisis period did not raise the utilization of the economy-wide production capacity to an inflationary level.

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Appendix: Data

The Capital Services Index Used in the Analysis (Revision including 2013q1)

1987Q1	77915095	2000Q2	156963445
1987Q2	78605287	2000Q3	159045329
1987Q3	79322167	2000Q4	161168979
1987Q4	80822143	2001Q1	161094229
1988Q1	81186220	2001Q2	160750074
1988Q2	81968655	2001Q3	160432690
1988Q3	82673583	2001Q4	160083904
1988Q4	83590562	2002Q1	159602533
1989Q1	83956591	2002Q2	160014407
1989Q2	84540345	2002Q3	160464116
1989Q3	85243269	2002Q4	161654498
1989Q4	86220611	2003Q1	161547215
1990Q1	86887168	2003Q2	162367669
1990Q2	88118170	2003Q3	163746290
1990Q3	89497135	2003Q4	166251881
1990Q4	91508039	2004Q1	168260905
1991Q1	92259162	2004Q2	171475457
1991Q2	93387658	2004Q3	174104725
1991Q3	94886318	2004Q4	176906198
1991Q4	96719336	2005Q1	179291581
1992Q1	97663260	2005Q2	183257885
1992Q2	99011974	2005Q3	187036120
1992Q3	100204815	2005Q4	191190152
1992Q4	101961611	2006Q1	194453555
1993Q1	103272043	2006Q2	198907474
1993Q2	105672279	2006Q3	202980096
1993Q3	108204559	2006Q4	207030401
1993Q4	111315776	2007Q1	209737851
1994Q1	112623765	2007Q2	213700004
1994Q2	113443690	2007Q3	217418516
1994Q3	114245430	2007Q4	221801852
1994Q4	115310919	2008Q1	224911451
1995Q1	115806129	2008Q2	228300704
1995Q2	117322951	2008Q3	230873651
1995Q3	118883487	2008Q4	232954384
1995Q4	121796280	2009Q1	233255287
1996Q1	123141968	2009Q2	234255869
1996Q2	125535739	2009Q3	235285849
1996Q3	128108299	2009Q4	237051873
1996Q4	130684293	2010Q1	238447876
1997Q1	132246671	2010Q2	241342232
1997Q2	135361921	2010Q3	244334848
1997Q3	138708751	2010Q4	249446466
1997Q4	142373372	2011Q1	253582588
1998Q1	144094074	2011Q2	258748824
1998Q2	146640733	2011Q3	262566787
1998Q3	148928103	2011Q4	266836632
1998Q4	150958290	2012Q1	270487269
1999Q1	151088159	2012Q2	274787241
1999Q2	152095469	2012Q3	277643482
1999Q3	152915756	2012Q4	280938850
1999Q4	154242905	2013Q1	283976528
2000Q1	154906790		

Note: For details of the calculation of the series above, see Section 3 and Demiroğlu (2012). The growth rate of this index roughly equals an average of the growth rates of the stock of structures and the stock of machinery and equipment. The level of this index is pinned down by setting it equal to the sum of the stocks of structures and machinery and equipment in 2007 (an arbitrary choice).