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Output Loss from the Banking Crisis in Cyprus†

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Abstract

This article provides estimates of output losses of the banking crisis in Cyprus for the period 2012-2020. Unlike most studies, where the effects of banking crises are computed ex post using actual data, the crisis in Cyprus is still evolving and thus the output losses and the period over which the economy will be below its potential output are not known. The analysis is, therefore, conducted on the basis of the output gap approach, where projected replaces actual output in the comparison with potential output. Furthermore, we provide alternative output loss estimates to account for the uncertainty about the magnitude and the duration of the recession. Our results show that the crisis can be very costly in terms of lost output/income and growth.

Keywords: Banking crisis, potential output, output loss.

1. Introduction

In this article we provide estimates of output losses from the current economic crisis in Cyprus. To our knowledge, there are no studies that attempt to quantify output losses from downturns in Cyprus, as the country has never undergone an economic crisis of the current proportions.[1] Nonetheless, a recent IMF Country Report refers to an estimate of output loss in Cyprus for 2013-2016 noting that the estimate is larger than losses from other banking crises found in the literature (IMF 2013). This is alarming, given that the output losses inflicted by banking crises on the economy are found to be vast (e.g. Boyd et al. 2005; Reinhart

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[1] There are studies, however, that evaluate the economic effects of the Turkish invasion (Pashardes and Hajispyrou 2003), or estimate the output gap, i.e. the deviation of GDP from its potential trend, for the Cypriot economy (Haroutunian et al. 2003).

and Rogoff 2008, 2009; Haugh et al. 2009), and often impossible to be regained (e.g. Cerra and Saxena 2008; Oxford Economics 2012).

The analysis of systemic banking crises in developed and emerging markets by Reinhart and Rogoff (2009) is revealing of the depth and duration of the damage to the economy: (i) large and prolonged declines of asset prices (e.g. real house prices decrease by 36% over 6 years); (ii) increase in the unemployment rate by 7 percentage points lasting for about 5 years, and severe fall in output (over 9%) - although with shorter duration compared to unemployment; and (iii) enormous increase in real public debt, not necessarily because of bailout costs but from the collapse in tax revenues due to the contraction of economic activity and, in some cases, countercyclical fiscal policies.

The economic disruptions associated with banking, currency and sovereign debt crises have drawn the interest of academia and international organisations (e.g. IMF, OECD) producing a large volume of research on the measurement of output losses from such crises. As explained by Angkinand (2008) there are mainly two approaches to measuring the output losses associated with crises.

- The *dummy variable* approach, where time series data for different countries are used and output losses are computed from the coefficients of 'crisis' dummy variables obtained from a regression of output growth on these variables, while controlling for other economic variables.

- The *output gap* approach, where the output loss associated with a crisis is measured as the sum of the differences between actual and potential output over the duration of the crisis; the end of the crisis occurs when actual output returns to its potential level.

The literature suggests that the output gap approach is more appropriate for representing the output loss from crises, although it is argued to yield outcomes that can be sensitive to the estimation techniques employed (e.g. whether the output variable is defined as growth rate or level) and to how potential output is estimated.

Most studies estimating the effects of banking crises are conducted ex post using actual data before, during and after the crisis (e.g. Angkinand 2008; Haugh et al. 2009; IMF 2009).[2] In the case of Cyprus, however, the crisis is

[2] There is also a large body of literature on sovereign debt crises, which are more complicated to analyse than banking crises, as the former can be endogenous to serious economic downturns. Moreover, there is a strong connection between sovereign debt and

still on-going and the post-crisis actual output losses are not known. This renders the dummy variable method inapplicable so our analysis is conducted entirely on the basis of the output gap approach, where projected replaces actual output in the comparison with potential output. In the context of this methodology, the output losses are computed from both the level and growth rate of real GDP methods (Angkinand 2008; Bordo et al. 2001; Boyd et al. 2005; IMF 1998), described as follows.

- When the *growth rate* is used, output loss is measured by the sum of the differences between actual and potential GDP growth over the crisis period, with the end of the crisis being defined as the period when actual growth first returns to its potential trend. Potential growth trend is usually computed from the average of the growth rates of a number of years prior to the crisis. The number of years used to compute the average growth rate varies in the literature from one to ten years. Notably, too short a period could generate high potential growth as financial crises usually follow booms, while a long period may include the impact of other types of crises. Furthermore, output may often remain below its potential level, even if the growth rate recovers to its potential (pre-crisis) rate. Thus, the economy continues to incur losses as long as output is below its potential level, regardless of whether the growth rate itself fully recovers.
- In the case of the *level* of GDP, output loss is measured by the net present value of the sum of the differences of actual from potential GDP over the crisis period, using an assumed discount rate. The end of the crisis is defined as the year when actual GDP returns to its potential trend; as the latter may never happen, the end of the crisis is sometimes taken to be when the growth rate returns to its potential. The potential GDP level is computed by applying a statistical filter, such as the Hodrick-Prescott filter (Hodrick and Prescott 1997), which removes short-run fluctuations in output over the period up to the crisis. Potential GDP after the crisis is extrapolated by applying the average growth rate of the potential GDP over, for example, a three-year period prior to the crisis. Deterministic time trends to allow for changes in potential GDP over time can also be used.

As the crisis in Cyprus is underway the output losses and the period over which the economy will be below its potential output are not known. In this article the output losses are forecasted over 2013-2020, a period sufficiently long for the economy to return to its potential production capacity according to the literature (e.g. Boyd et al. 2005; Haugh et al.

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banking crises with the causality between the two being unclear (Furceri and Zdzienicka 2011).

2009). Furthermore, we compute alternative evolution paths over the period 2013-2020 for actual GDP growth, as well as for potential GDP growth and level. Thus, we provide alternative output loss estimates to account for the uncertainty about the magnitude and the duration of the recession.

Section 2 describes the methodology used in the estimation of potential output. Section 3 presents the results of the output loss estimations. Section 4 offers a discussion and some conclusions.

2. Potential output

Annual data on GDP in constant market prices (real GDP) covering the period 1980-2012 from the Statistical Service of Cyprus are used in the empirical analysis.[3] Figure 1 shows GDP in constant market prices of 2005 and real GDP growth for the period 1980-2012; the lowest growth rate in the 33-year period was recorded in 2012.

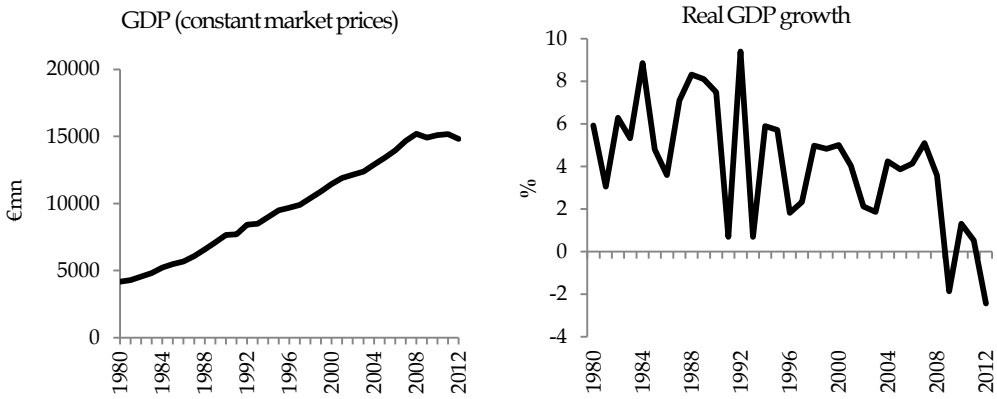
As said in the introduction, the empirical analysis in this article is conducted using the output gap approach and the results are computed in terms of both the growth rate and the level of GDP. First, we obtain estimates for the potential growth and potential trend of the output level. Then we calculate projections for GDP growth for the period 2013-2020, under alternative potential growth scenarios.[4] For comparison purposes we also use the projections of the European Commission and IMF in the Cyprus economic adjustment programme (European Commission 2013; IMF 2013).

In the context of the output gap approach the potential GDP level needs to be estimated and compared with the level of actual GDP for the calculation of the output losses attributed to the banking crisis. The same holds true when the output losses are calculated from growth rates: the potential GDP growth rate has to be estimated and set against the actual one. In this section we describe how the estimations of the potential GDP growth rate and level are conducted.

[3] In the case of banking crises the literature (e.g. Angkinand 2008) suggests, among other things, that the occurrence of large-scale government interventions in banks can signal the beginning of a crisis, thus the first year of the crisis in our case is defined as 2012.

[4] Estimation results on potential output and projections can be found in the appendices in http://www.erc.ucy.ac.cy/en/documents/Publications/DOP_7-13.pdf.

FIGURE 1
GDP in constant market prices of 2005 and real GDP growth



2.1 Potential GDP growth rate

Instead of computing the potential GDP growth rate as a simple mean of the actual growth rate over an arbitrary period, we use a method which is more appropriate in the sense that it allows the potential GDP growth rate to be decided by, rather than imposed on, the data. In the context of this method there can be various ways to compute the potential GDP growth rate, one of which is taking the simple mean over some period. More precisely, we model the actual growth rate as a function of the previous year's growth and dummy variables that capture the effects of outliers on the mean. The resulting potential growth rate, therefore, has the advantage over the simple mean calculation that, if shown to be statistically significant, the time dependency of the GDP growth rate and the excess impact of certain years on this rate can be taken into account in the calculation of mean.

The model can be written as

$$y_t = a_0 + a_1 y_{t-1} + \sum_{k=1}^{K} \delta_k \, d_{kt} + e_{t,} \qquad 1, \dots, T \tag{1}$$

where: y_t is real GDP growth at time t; d_{kt} is a dummy variable that takes the value 1 in a year of unusually high/low growth; and e_t is a random error.[5] The long-run or potential growth rate is computed by solving the estimated equation for y^P after setting $y^P = y_{t-1} = y_t$ and $d_{kt} = \overline{d_k}$, where $\overline{d_k}$ is the average value of the dummy variable k over the sample period.

[5] Years of unusually high/low growth are shown as outliers in the graph of GDP growth (Figure 1). The statistical significance of the dummy variables in the models is tested.

Equation (1) is estimated for three alternative time periods: 1980-2012, 1995-2012 and 2000-2012. This is done in order to investigate the sensitivity of the value of the potential growth rate to the time period used in estimation. The results point to a decreasing potential growth rate in Cyprus in recent years. Thinking that the period over which the potential growth rate has to be estimated is likely to be turbulent, we have chosen to perform the calculations of the output losses caused by the banking crisis using two estimates of the potential growth rate, 2.44% and 1.84%. These are the lowest rates obtained from the estimation periods 1995-2012 and 2000-2012, respectively.

The potential GDP growth rates estimated as described above are below the growth rates computed as simple averages over the corresponding time periods because the data suggest that the growth rate of the Cyprus GDP has been declining over time. However, it is worth noting that the upper bound of output losses obtained from the parameter estimates of (1) coincide with those calculated using the mean of the actual GDP growth rate over six years before the onset of banking crisis, (i.e. the period 2005-2011), which according to the literature is a plausible estimate of the potential GDP growth rate.

2.2 Potential GDP level

Following standard statistical practice we estimate the potential level of GDP using the Hodrick-Prescott filter (Hodrick and Prescott 1997) to decompose the GDP series into a trend and a cyclical component. The trend component from this decomposition, which is free of short-term fluctuations and represents only the long-term movements in output, is then taken to be the potential level of GDP.

Unlike similar studies reported in the literature, where data before, during and in some cases after the banking crisis are used, in the context of our analysis the trend component of GDP level can only be estimated for the period before the banking crisis. Here we perform this estimation using two alternative periods: 1995-2012 and 2000-2012.[6] For the years after 2012 the trend component of GDP is based on projections estimated as follows.

We first estimate two alternative models:

$$\ln Y_t^P = b_0 + b_1 t + u_t, \quad t = 1, \dots T \tag{2}$$

[6] As found in the case of potential GDP growth rate, the period 1980-2012 leads to much higher potential growth, thus we focus only on the recent periods that are more likely to be representative of future potential output levels.

$$\ln Y_t^P = c_0 + c_1 t + c_2 t^2 + w_{t,} \quad t = 1, \dots T \tag{3}$$

where: Y_t^P is the potential level of GDP at time t, obtained via the application of the Hodrick-Prescott filter; t and t^2 represent a linear and a quadratic trend, respectively; and u_t and w_t are the random errors in the two models.[7] The parameter estimates obtained from (2) and (3) for the sample periods 1995-2012 and 2000-2012 are then used to estimate the potential level of GDP over the expected banking crisis period 2013-2020.[8]

Estimation results show that the coefficient of the quadratic trend is statistically significant and has a negative sign indicating that the level of potential output increases over time, but with a small declining rate. This is consistent with the decreasing potential growth rate of the Cyprus GDP estimated in the previous subsection; it can be interpreted as evidence that after 1995 Cyprus has been acquiring features of a developed (as opposed to developing) economy that tend to slow down the growth rate of its economy.

The results from the two time periods are very similar and we have chosen to focus on those from the most recent period 2000-2012. The implied potential growth rates corresponding to this period - on average between 1.8% (quadratic model) and 2.5% (linear model) - are close to those obtained using the potential GDP growth rate method described in the previous subsection.

As in the case of the future GDP growth rates, the future values of the potential GDP level are typically calculated in the literature by extrapolation using the average growth rate of the potential GDP in the period prior to the crisis. The simple averages of the growth rate of the filtered GDP over the period 2005-2011 and 2009-2011 obtained from our data are 2.30% and 1.80%, respectively. These growth rates yield potential GDP values below those obtained from the linear model (2) and above those obtained from the quadratic model (3). This suggests that the output losses obtained from extrapolating the average growth rate of the potential GDP in the period prior to the crisis would lie within the range of those obtained from the more informed approach based on estimation of the parameters of equations (2) and (3).

[7] For estimation purposes the potential level of GDP, Y_t^P, is expressed in logarithms.

[8] Note that the prediction based on (2) and (3) cannot be contaminated by non-deterministic regressors because the values of t and t^2 for $T > 2012$ are known.

3. Output loss

In order to evaluate the output loss from the on-going crisis we need to assume a path for the evolution of the actual growth rate in Cyprus for the period 2013-2020. The recent developments in the banking sector make the task of computing projections for actual GDP growth for this period very difficult, as historical relationships between macroeconomic variables and data offer little information about future changes in output. There is, also, a high degree of uncertainty about the direct effects of the banking sector downsizing and of capital controls on the real economy; and the indirect effects from falling business and consumer confidence.

In view of this uncertainty we employ two alternative scenarios about the development of GDP growth over the period 2013-2020:

A. GDP contraction over the period 2013-2015 amounting to about 17%; subsequently output expands at a rather slow rate and reaches the lower bound of potential GDP growth (about 1.8%) by the end of the period;

B. GDP contraction over the period 2013-2015 amounting to about 21%; afterwards output expands somewhat faster than in scenario A and reaches the upper bound of potential growth (about 2.5%) by 2020.

Under scenario A the depth of the slump is less severe followed by a slow/moderate recovery; in scenario B recession is assumed to be deeper, followed by a rather stronger recovery pattern than in scenario A.[9]

In this section we present the results for output loss due to the crisis for the period 2012-2020. Output losses are computed using both GDP growth rates and GDP levels. The projections for the period 2013-2020 are calculated as described above. For comparison purposes we also employ the projections prepared by the European Commission and IMF (EC/IMF) in relation to the economic adjustment programme of Cyprus. The latter projections are more optimistic than those obtained under our scenarios.[10]

[9] The GDP projections here were made prior to the release of GDP data for the second quarter of 2013. The recent data point to a milder recession in 2013 than those assumed in the scenarios. Nevertheless, the risks to the outlook in the next few years are numerous and the losses computed (especially those for 2012-2020) could serve as lower bounds.

[10] European Commission (2013) provides projections for GDP growth for the period 2013-2016 which are the same as those given in IMF (2013). Furthermore, IMF (2013) presents projections for 2017-2020.

3.1 Level

Figure 2 depicts the level of real GDP up to 2012 and the projected level for the period 2013-2020; it also shows the potential GDP trend derived by fitting a linear and a quadratic model after having removed all short-term fluctuations. The potential GDP trend obtained from the linear model is steeper than that generated by the quadratic model; therefore, the two trends can be viewed as representations of an upper and a lower bound for the evolution of output in the absence of the banking crisis.

Output loss is computed as the deviation of actual from potential GDP trend level for each year. Subsequently the difference is expressed in present value terms with 2011 being the start year (period 0); 2011 is assumed to be the year prior to the crisis period. The sum of the discounted deviations over a particular period gives the cumulative output loss (in 2005 prices) for that period.

FIGURE 2
Actual and projected real GDP (level) and estimated potential GDP level

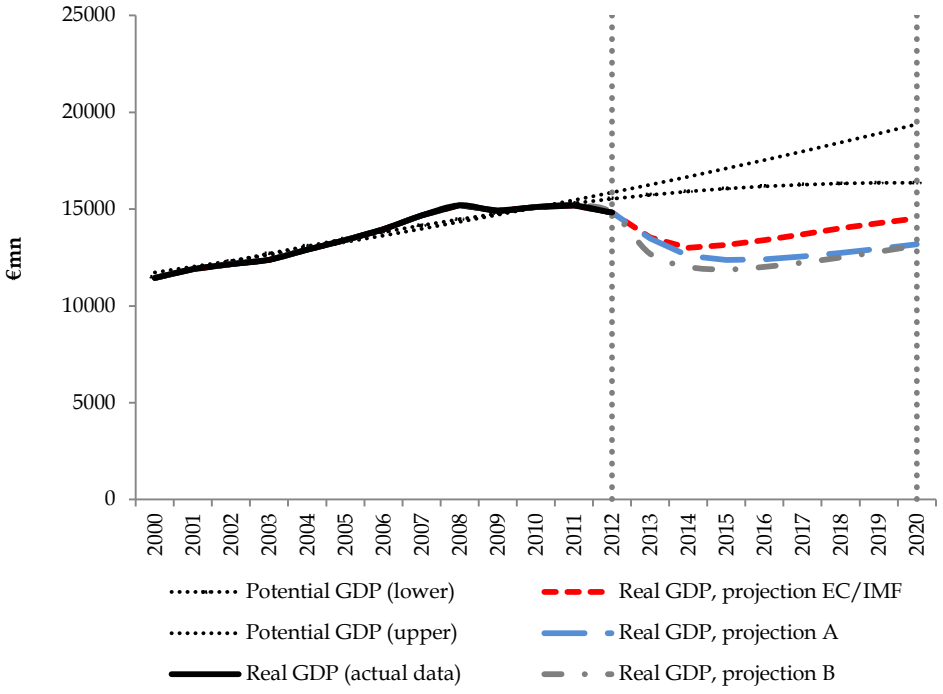


Table 1 presents the output loss for 2012-2020 under the alternative scenarios about the projected GDP level and for the upper and lower bound of potential trend explained above. Output losses are apparently

larger when the steeper linear trend is used. Over 2012-2014, output loss ranges from about -7.0 €bn (scenario B) to -5.3 €bn (EC/IMF projections) when the flatter (quadratic) trend is used; whereas losses vary from -8.4 €bn (scenario B) to -6.8 €bn (EC/IMF projections) in the case of the steeper (linear) trend.[11] Losses expressed as percentages of 2011 GDP are estimated between -56% to -35% for the period 2012-2014. Using the lower bound of the potential level, losses are limited to -46% (scenario B) to -35% (EC/IMF); while employing the upper bound for the potential level, they increase to -56% (scenario B) to -45% (EC/IMF).

TABLE 1
Output losses, level[*]

	Potential: lower (quadratic trend)			Potential: higher (linear trend)		
Scenario	A	B	EC/IMF	A	B	EC/IMF
	€mn (2005 prices)			€mn (2005 prices)		
2012	-685	-685	-685	-996	-996	-996
2013	-2086	-2813	-2038	-2571	-3298	-2523
2014	-2948	-3459	-2585	-3626	-4138	-3263
2015	-3151	-3569	-2489	-4040	-4459	-3378
2016	-3099	-3419	-2286	-4214	-4535	-3401
2017	-2936	-3183	-2025	-4292	-4539	-3380
2018	-2722	-2905	-1762	-4329	-4511	-3369
2019	-2481	-2596	-1521	-4348	-4464	-3388
2020	-2223	-2272	-1280	-4359	-4407	-3416
2012-2014	-5719	-6958	-5308	-7193	-8432	-6782
As % of 2011 GDP	-38%	-46%	-35%	-47%	-56%	-45%
As % of 2011 potential GDP	-37%	-46%	-35%	-47%	-55%	-44%
2012-2020	-22331	-24902	-16670	-32775	-35346	-27115
As % of 2011 GDP	-147%	-164%	-110%	-216%	-233%	-179%
As % of 2011 potential GDP	-146%	-163%	-109%	-212%	-229%	-175%

Note: [*] Losses are expressed in present values of 2011 (i.e. the year before the beginning of the crisis period) by assuming a discount rate of 4%.

[11] The analysis is conducted using GDP in constant 2005 prices, and therefore losses are different when they are expressed in current prices due to inflation effects.

Over the period 2012-2020 losses lie between -24.9 €bn (scenario B) to -16.7 €bn (EC/IMF) when the more conservative estimates for the evolution of potential trend are applied. For the same period the estimated output losses range between -35.3 €bn (scenario B) to -27.1 €bn (EC/IMF) in the case of the steeper potential trend. During the same period losses as percentages of 2011 GDP increase by three to four times, with the estimates ranging from -233% to -110%. Lower potential output level results in smaller losses (-147% to -110%); whereas higher potential GDP generates larger losses (-233% to -179%).

Furthermore, the output losses in Table 1 are also reported as a percentage of potential GDP, as this method of presenting losses is often encountered in the literature. It should be noted here that, since the potential level of GDP is slightly higher than the actual for 2011, losses computed as a percentage of potential output are somewhat lower than those expressed as a percentage of actual 2011 GDP

Table 2 shows the output loss in each year expressed as a percentage of the actual (projected) GDP in that year. When the computations are carried out using the steeper potential trend level output losses peak in 2020, ranging between -47.8% (scenario B) to -33.5% (EC/IMF). The picture is somewhat different when the potential trend used in the computations is flatter: output loss as a percentage of each year's GDP peaks between 2014 (EC/IMF) and 2016 (scenario A) and declines afterwards. During the period 2012-2014 the loss as a percentage of GDP is found to vary on average from -24.6% (scenario B) to -14.5% (EC/IMF) per year. Over the period 2012-2020 annual output loss as a percentage of GDP is, on average, estimated between -39.3% (scenario B) and –16.5% (EC/IMF).

Table 3 reports the output losses expressed as a percentage of potential GDP in each year resulting in the same pattern as in Table 2. As the potential GDP level is higher than that of actual one, output losses in this case are lower, from -18.8% to -12.3% and from -27.5% to -14% for the periods 2012-2014 and 2012-2020, respectively. The persistence of large negative percentages up until 2020 in both Table 2 and 3 shows that the level of GDP is not expected to recover to its potential, i.e. the level that could have been achieved if the banking crisis had not occurred. The finding that output does not rebound to its pre-crisis level is common in the analysis of banking crises (e.g. IMF 2009).

TABLE 2
Output losses as a percentage of GDP (level)

	Potential: lower (quadratic trend)			Potential: higher (linear trend)		
Scenario	A	B	EC/IMF	A	B	EC/IMF
2012	-4.8	-4.8	-4.8	-7.0	-7.0	-7.0
2013	-16.7	-24.0	-16.3	-20.6	-28.1	-20.2
2014	-26.3	-32.4	-22.4	-32.4	-38.7	-28.2
2015	-29.8	-35.1	-22.2	-38.2	-43.9	-30.1
2016	-30.4	-34.6	-20.8	-41.3	-45.9	-30.9
2017	-29.6	-32.9	-18.7	-43.3	-46.9	-31.2
2018	-28.1	-30.6	-16.6	-44.7	-47.5	-31.7
2019	-26.2	-27.8	-14.6	-45.9	-47.7	-32.5
2020	-24.0	-24.7	-12.5	-47.1	-47.8	-33.5
Average 2012-2014	-16.0	-20.4	-14.5	-20.0	-24.6	-18.5
Average 2012-2020	-24.0	-27.4	-16.5	-35.6	-39.3	-27.2

TABLE 3
Output losses as a percentage of potential GDP (level)

	Potential: lower (quadratic trend)			Potential: higher (linear trend)		
Scenario	A	B	EC/IMF	A	B	EC/IMF
2012	-4.6	-4.6	-4.6	-6.5	-6.5	-6.5
2013	-14.3	-19.3	-14.0	-17.1	-21.9	-16.8
2014	-20.8	-24.5	-18.3	-24.5	-27.9	-22.0
2015	-23.0	-26.0	-18.1	-27.6	-30.5	-23.1
2016	-23.3	-25.7	-17.2	-29.2	-31.5	-23.6
2017	-22.8	-24.8	-15.8	-30.2	-31.9	-23.8
2018	-21.9	-23.4	-14.2	-30.9	-32.2	-24.0
2019	-20.8	-21.7	-12.7	-31.5	-32.3	-24.5
2020	-19.4	-19.8	-11.1	-32.0	-32.4	-25.1
Average 2012-2014	-13.3	-16.1	-12.3	-16.0	-18.8	-15.1
Average 2012-2020	-19.0	-21.1	-14.0	-25.5	-27.5	-21.1

Finally, for comparison with results obtained elsewhere in the literature, we should add that when the potential GDP level in 2013-2020 is extrapolated by applying the average growth rate of the real GDP over the period 2005-2011 and 2009-2011, we obtain results that fall within the ranges reported above.[12]

3.2 Growth rate

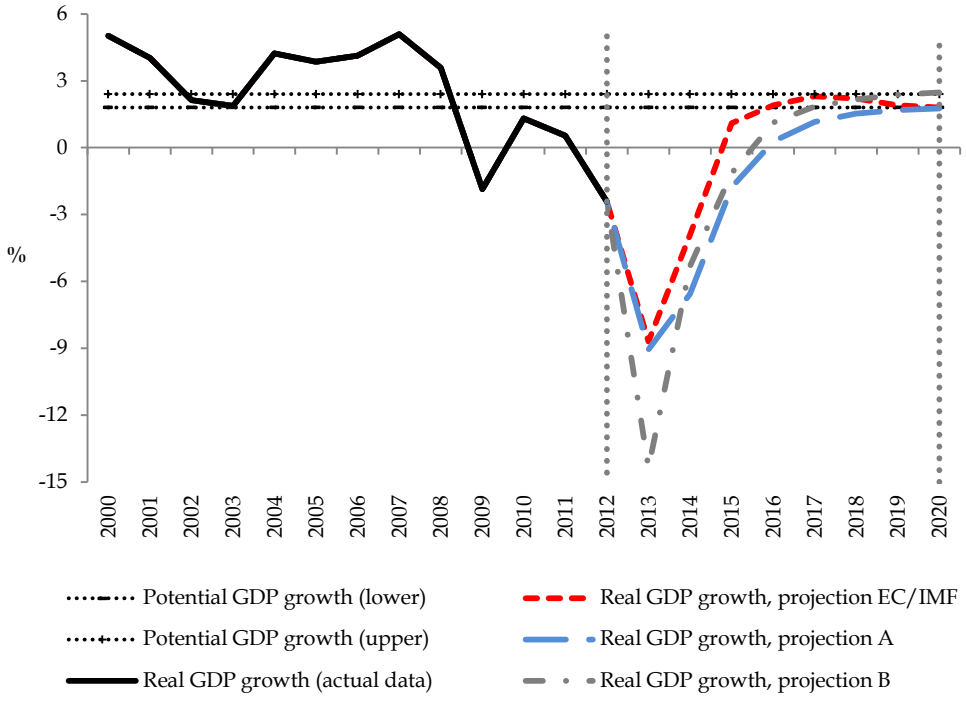
Here we discuss the output loss results in terms of growth rates to be able to compare our estimates of the output losses of the banking crisis in Cyprus with those obtained in other studies, as the growth rates method of computing output losses from crises is the most commonly used in the literature. Based on this method the output loss each year is computed as the deviation of the actual from the potential GDP growth rate for that year (projections for 2013-2020). As discussed in section 2, we use two estimates for potential GDP growth rate which act as bounds: 1.8% and 2.4%. Figure 3 plots actual GDP growth rates for 2000-2012, and the projections for the period 2013-2020 under scenarios A, B and those by EC/IMF, as well as the two alternative estimates for the potential growth rate.

Table A1 (Appendix) presents the output losses in terms of percentage points (ppts) of growth for the period 2012-2020, under the different scenarios regarding the evolution of GDP growth over 2013-2020 and for the two alternative potential growth rates we use in calculations.[13] Output loss in Table A1 is decomposed into: (i) the loss due to downturn given by the cumulative contraction that occurs over a given period, and (ii) the loss due to the failure of the economy to expand at its potential rate, which is given by the cumulative potential growth rates over the period, with a negative sign. In the short run (2012-2014) output losses due to the recession are larger than losses due to foregone potential growth. In the long run the opposite occurs, as recovery is forecasted after 2015 under scenario A and B, and after 2014 in the case of EC/IMF projections.

[12] As mentioned in section 2, according to the literature the potential GDP can be also extrapolated by using its average growth rate over a period prior to the crisis. Detailed results can be found in http://www.erc.ucy.ac.cy/en/documents/Publications/DOP_7-13.pdf.

[13] The numbers in Table A1 can be interpreted as the ppts of foregone growth because the banking crisis prevents the economy from expanding at its potential rate. Output loss increases with the potential growth rate assumed. Output loss ranges from -29.3 to -20.4 ppts over 2012-2014 and -35.0 to -20.0 ppts for the longer time period 2012-2020.

FIGURE 3
Actual and projected real GDP growth and estimated potential GDP growth rates



For comparison of the losses obtained here (through the growth rate) with those obtained using the level of GDP (Table 1), the results reported for each year in Table A1 are summed recursively to get the cumulative output losses as percentage of the GDP in 2011. Cumulative losses in ppts relative to 2011 are also expressed as present values (€mn) for each year using a discount factor of 4% and the results are shown in Table 4.

- When the slower potential growth rate is assumed, losses vary from -7.2 €bn (scenario B) to -5.4 (EC/IMF) for the period 2012-2014; and from -28.8 €bn (scenario B) to -20.0 €bn (EC/IMF) for the period 2012-2020. Losses expressed as a percentage of 2011 GDP are estimated to range from -47% to -36% and from -189% to -131% during 2012-2014 and 2012-2020, respectively.

TABLE 4
Cumulative growth rate loss compared to 2011 (percentage points) and loss in €mn (2005 prices)[1, 2]

	Potential growth rate: 1.8%						Potential growth rate: 2.4%					
Scenario	A		B		EC/IMF		A		B		EC/IMF	
	ppts	€mn	ppts	€mn	ppts	€mn	ppts	€mn	ppts	€mn	ppts	€mn
2012	-4.2	-617	-4.2	-617	-4.2	-617	-4.8	-704	-4.8	-704	-4.8	-704
2013	-15.1	-2117	-20.4	-2862	-14.7	-2067	-16.3	-2285	-21.6	-3031	-15.9	-2236
2014	-23.4	-3164	-27.5	-3710	-20.4	-2757	-25.2	-3407	-29.3	-3953	-22.2	-3000
2015	-27.0	-3505	-30.4	-3949	-21.1	-2742	-29.4	-3817	-32.8	-4261	-23.5	-3054
2016	-28.5	-3560	-31.1	-3881	-21.0	-2624	-31.5	-3935	-34.1	-4256	-24.0	-2999
2017	-29.2	-3500	-31.1	-3727	-20.5	-2463	-32.8	-3932	-34.7	-4159	-24.1	-2895
2018	-29.4	-3397	-30.7	-3542	-20.1	-2322	-33.6	-3881	-34.9	-4027	-24.3	-2807
2019	-29.5	-3278	-30.1	-3342	-20.0	-2222	-34.3	-3811	-34.9	-3874	-24.8	-2755
2020	-29.6	-3157	-29.4	-3141	-20.0	-2137	-35.0	-3733	-34.8	-3717	-25.4	-2713
	%	€mn	%	€mn	%	€mn	%	€mn	%	€mn	%	€mn
2012-2014	-39	-5897	-47	-7189	-36	-5442	-42	-6396	-51	-7688	-39	-5941
2012-2020	-173	-26295	-189	-28771	-131	-19952	-194	-29505	-211	-31982	-153	-23163

Notes: [1] Losses are expressed in present values of 2011 (i.e. the year before the beginning of the crisis period) by assuming a discount rate of 4%.
[2] For the period 2012-2014 and 2012-2020 the present value of losses is expressed as a percentage of GDP in 2011 i.e. the year before the crisis.

- The assumption about higher potential growth rate results in greater losses; the estimates range from -7.7 €bn (scenario B) to -5.9 €bn (EC/IMF) and from -32.0 €bn (scenario B) to –23.2 €bn (EC/IMF) for the period 2012-2014 and 2012-2020 respectively. These losses as percentages of 2011 vary from -51% to -39% and from -211% to -153% for the short and the long period respectively.

In the case of lower potential growth rate (Table 4) the resulting losses are more negative than those estimated using the lower potential level (Table 1). When the higher potential growth rate is used (Table 4) the estimates of output losses are less negative than those obtained using the higher potential level (Table 1). Thus, the method that uses the level of GDP presented in subsection 3.1 gives a wider interval for output losses that contains the range estimated by the growth rate method presented in this section. Table 5 summarises the ranges estimated for output losses from the two approaches.

TABLE 5
Summary of output losses by estimation approach

	Approach	
	Level of GDP	Cumulative growth rate of GDP
	2012-2014	2012-2014
€bn	-8.4 to -5.3	-7.7 to -5.4
% of 2011 GDP	-56% to -35%	-51% to -36%
	2012-2020	2012-2020
€bn	-35.3 to -16.7	-32.0 to -20.0
% of 2011 GDP	-233% to -110%	-211% to -131%

4. Discussion and conclusions

This study provides estimates of output losses for the period 2012-2020 associated with the economic crisis in Cyprus. The losses can largely be attributed to the banking crisis, though one has to bear in mind that the accumulated excessive public deficits aggravated the problem, insofar as they undermined the role of government as guarantor of the banking system. Furthermore, the long-standing structural weaknesses of the Cyprus economy have also contributed to the problem through limiting the capacity of the economy to react swiftly so as to dampen the negative impact of the crisis.

The failure of the economy to produce its potential level of GDP or to expand at its potential growth rate during the banking crisis occurs for a number of reasons, including:

- the tightening of credit conditions (limited supply of credit and stricter lending standards) due to the crisis impacting negatively on investment and, consequently, on wages and employment;
- the loss of deposits due to banking sector downsizing triggering loss of wealth for business and households with adverse consequences on consumption, investment and employment;
- the enforcement of restrictive measures on transactions and the freeze on uninsured deposits limiting liquidity in the market and depriving businesses of working capital with adverse effects on firms' viability and, therefore, on economic activity and employment;
- the absence of substantial new inflows in Cyprus effected through international business activities that are supported by the banking

industry and have positive spillovers to domestic business activity (legal, audit, etc.);
- the fiscal consolidation leading to lower disposable income, as the government cuts expenditure (salaries, pensions, benefits) and increases taxes, public sector fees and employee/pensioner contributions; and
- increased uncertainty due to the loss of confidence in the banking sector.

As stressed in the literature it is difficult to disentangle output losses due to a banking crisis (and in general financial, currency or twin crises) from those resulting from recession, as banking crises often break out during recessions (e.g. Angkinand 2008). In their assessment of the depth of recessions with and without a banking crisis, Bordo et al. (2001) find that cumulative output losses are significantly larger when a recession is accompanied by a banking crisis; interestingly they also find that losses are larger for developed rather than for emerging economies.

To estimate output losses from the crisis we employ an output gap method which is widely used in the literature (Angkinand 2008; Bordo et al. 2001; Boyd et al. 2005; Haugh et al. 2009; IMF 1998). With this method the loss each year is computed as the deviation of actual output from its potential trend. There are two variants of the output gap method: one that uses output growth rates and another applied to the level of output. As shown in the literature (e.g. Angkinand 2008; Boyd et al. 2005) the two variants of the output gap method can lead to widely different output cost estimates. This is expected, as the two methods do not measure the same outcome of the crisis: the growth rates method gives the percentage points of lost output (GDP) growth over the period under investigation; while the output level method yields the present value of the deviation of actual from potential GDP level (i.e. foregone output) as a percentage of GDP in the last year before the onset of the crisis (in our case 2011). As shown in this article, the results of the two approaches are similar when the cumulative losses from the growth rate approach are expressed in present values.

The use of GDP growth rates to estimate the output losses from banking crises is more frequently encountered in the literature than the use of the level of GDP (e.g. Angkinand 2008; Bordo et al. 2001; Haugh et al. 2009; IMF 1998). However, studies that base their estimations on the impact of banking crisis on the level of output argue that while the growth rate can eventually return to its potential rate, the same is not also true for the level of output (e.g. Boyd et al. 2005). This argument is supported by our empirical findings: as shown in Tables 2 and 3 the losses obtained from the output level method remain negative until the end of the period under

examination[14]. Boyd et al. (2005) indicate that an explanation for the greater output losses obtained from the use of output levels method is the fact that this method, unlike the growth rates one, allows the effects of the banking crisis to compound over time.

The output losses attributed to the banking crisis in Cyprus which are estimated in this article can be briefly summarised and compared with findings about banking crisis reported elsewhere in the literature as follows.

- Computing output gap using the *level of real GDP* we find that the cumulative loss of output as a percentage of GDP in 2011 (i.e. the last year before the crisis) ranges from -35% to -56% for 2012-2014; and from -110% to -233% for the period 2012-2020.[15] Boyd et al. (2005) investigate the consequences of banking crises in countries with developed financial markets using the level of GDP (per capita). For 18 countries that experienced output losses during their crises they find that, on average, the economic cost was -76% to -369% of GDP in the year before the onset of crisis.[16] Notably, the range of losses given in Boyd et al. (2005) is rather large, as they are obtained using two alternative periods. The smaller losses are calculated from the onset of the crises until the last year in which actual data were available; this computation of losses establishes "an absolute lower bound"; whereas the larger losses, which can be viewed as upper bounds, are computed after the estimation of a break point (at 17 years), when the actual growth rate returns to its potential trend rate.[17] In relation to the recent financial crisis (2007-2009), Laeven and Valencia (2010) estimate median output losses over 22 countries and a four-year period of

[14] This can also be seen by comparing the results reported in Figure 2 (level) and Figure 3 (growth).

[15] Thus based on the wider interval, output losses are estimated between -8.4 €bn to -5.3 €bn for the period 2012-2014 and from -35.3 €bn to -16.7 €bn for the period 2012-2020. These losses as a percentage of 2011 GDP vary from -56% to -35% and -233% to-110% for the period 2012-2014 and 2012-2020 respectively.

[16] Boyd et al. (2005) also estimate output losses for individual countries. For example, defining as "non-systemic" banking crises in Denmark (1987-1992), Greece (1991-1995) and Italy (1990-1995) they find their output losses ranging from -45% to -74%, from -43% to -245% and from -45% to -322%, respectively; while the crises in Finland (1991-1994), Sweden (1991) and Norway (1987-1993), which are considered as "systemic", caused losses from -97% to -474%, from -86% to -314% and from -59% to -257% respectively. A crisis is classified as "systemic" when most or all of the capital of the banking system is exhausted (see e.g. Boyd et al. 2005 and the references therein).

[17] If output level reverts to its potential trend by this break point, no further losses are incurred; if it does not, it is assumed that output expands at the potential growth rate after the break point and an infinite sequence of output losses is estimated. As both historical and future output losses are computed, predictions of future actual output and potential growth rate are estimated.

about -25% of potential GDP; they find output losses of -110% and -116% for Ireland and Latvia respectively, whose banking crises were systemic.

- Using the *growth rate of real GDP* in the computations of output gap, we estimate the cumulative GDP growth loss of Cyprus over the period 2012-2014 to be between -20.4 and -29.3 percentage points (ppts). Losses during the period 2012-2020 range from -20.0 to -35.0 ppts. Studies in the literature that use similar methodology usually pool together a large number of countries and provide the average output loss due to banking crises. For example Bordo et al. (2001) use 56 counties over the period 1973-1997 and find average losses of -6.2 ppts, while IMF (1998) employs 22 industrial and 31 developing countries for the period 1975-1997 and concludes that the cumulative loss of output growth per banking crisis is -15.2 ppts and -14.0 ppts for industrial and emerging markets, respectively. Haugh et al. (2009) provide separate output loss estimates for the banking crises that occurred in Spain (1977-1985), Finland, Norway, Sweden (all in the 1990s), Japan (late 1990s) and in the United States (late 1980s). They find output losses as high as -40.6 ppts and -34.8 ppts for Finland and Norway respectively, -16.7 ppts for Sweden and slightly above -10 ppts for the remaining countries. Thus, our estimates are close to those for the Nordic countries, where the duration of the downturn due to the crisis was estimated around 7 to 8 years (Haugh et al. 2009).

The country report on Cyprus by IMF (2013) briefly mentions cumulative output losses relative to the trend for the period 2013-2016 of about 50% of potential output. For the same period, and using EC/IMF projections and our assumptions we find losses of over 60% of potential GDP.[18]

Comparing our findings with those in the literature, it could be inferred that the economic costs of the current crisis in Cyprus are similar in magnitude to those incurred by Finland, Norway and Sweden during their crises in the 1990s. The financial liberalisation in these countries led to a credit expansion accompanied by rather expansionary fiscal and monetary policies; as a response to the boom tighter monetary policy in Finland and Sweden, and a decline in oil revenues in Norway, which led to currency devaluation and high interest rates, resulted in a sharp drop in asset prices; and, subsequently, in bank losses from bad loans (see Haugh et al. 2009). Similarly in Cyprus the credit boom (due to the inflow of foreign deposits

[18] IMF (2013) does not provide details about the methodology underlying the output loss estimate given, thus our findings might not be directly comparable. The estimate for 2013-2016 of over 60% of potential GDP can be found by adding the percentages in Table 3 (column EC/IMF) for the period 2013-2016.

and lower lending interest rates) led to hiking property prices in the period prior to 2009. The transient government revenues from property taxes were used to finance an expansionary fiscal policy. The growth rates however, registered during the period 2004-2008 were not sustainable, as they were not fully reflecting improvements in the productive capacity of the Cypriot economy, but rather generated by excessive borrowing by the private and public sector, creating unsustainable current account and government deficits. The international financial crisis and afterwards the Greek sovereign debt crisis revealed the vulnerability of the Cypriot economy to these shocks and the pressing need for correcting the generated imbalances.

Our results show that the crisis can be very costly in terms of lost output/income and growth. Costs of analogous magnitude were experienced by other countries due to similar banking crises. As the crisis in Cyprus is still underway, it should be stressed that the results computed here are conditional on assumptions about the evolution of actual and potential GDP, hence: (a) better (worse) actual GDP outcomes would lead to lower (higher) losses for a given potential growth rate or level; and (b) higher (lower) assumed potential GDP growth or level, would result in higher (lower) output losses for a given evolution path of actual GDP. In fact the recent GDP data published after the completion of this article point to a milder recession in 2013 than that assumed in each of the scenarios employed here. Nevertheless, the risks to the outlook in the next few years are numerous; especially as part of the adjustment cost could be shifted to 2014 or even to 2015. Therefore the losses computed over the period 2012-2020 could serve as lower bounds.

The large economic costs associated with crises cannot be fully explained by exogenous real or financial shocks, but are also found to be connected with banking sector characteristics and crisis management policies. Research shows that the magnitude of output losses is positively and significantly related to banking sector size, bailout and recapitalisation costs incurred by the government; and to large amounts of liquidity infused in the banking system by the central bank (Boyd et al. 2005). Crises are very difficult to predict, but given the economic burden that they inflict on countries for a number of years, indicators that are found to signal that the economy could be approaching a crisis should be closely monitored by policymakers. Such vulnerability indicators include widening current account deficits, rapid growth in domestic credit, inflated asset prices (property or equity) and non-performing loans.

Appendix

TABLE A1
Output losses, growth rate (percentage points - ppts)

	Potential: 1.8%			Potential: 2.4%		
Scenario	A	B	EC/IMF	A	B	EC/IMF
2012	-4.2	-4.2	-4.2	-4.8	-4.8	-4.8
2013	-10.9	-16.2	-10.5	-11.5	-16.8	-11.1
2014	-8.4	-7.1	-5.7	-9.0	-7.7	-6.3
2015	-3.6	-2.9	-0.7	-4.2	-3.5	-1.3
2016	-1.5	-0.7	0.1	-2.1	-1.3	-0.5
2017	-0.6	0.0	0.5	-1.2	-0.6	-0.1
2018	-0.3	0.4	0.4	-0.9	-0.2	-0.2
2019	-0.1	0.6	0.1	-0.7	0.0	-0.5
2020	0.0	0.7	0.0	-0.6	0.1	-0.6
2012-2014	-23.4	-27.5	-20.4	-25.2	-29.3	-22.2
Breakdown of loss						
Downturn	-18.0	-22.1	-15.0	-18.0	-22.1	-15.0
Underperformance against potential	-5.4	-5.4	-5.4	-7.2	-7.2	-7.2
2012-2020	-29.6	-29.4	-20.0	-35.0	-34.8	-25.4
Breakdown of loss						
Downturn	-13.4	-13.2	-3.8	-13.4	-13.2	-3.8
Underperformance against potential	-16.2	-16.2	-16.2	-21.6	-21.6	-21.6

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