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Credit and Business Cycles in Greece: Is there any relationship?

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ABSTRACT

This paper examines the relationship between real credit and future movements in real output at business-cycle frequencies in Greece. Importantly, the evidence suggests that real credit is found to significantly affect real output, given the trade deficit ratio. This finding implies that the U-turn of the Greek economy requires a positive credit shock which will stimulate aggregate demand and real output.

JEL classification: E32; E51; E52; E58

Keywords: Real output, business cycles, real credit, trade deficit ratio

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1. Introduction

The recent global financial crisis has questioned the usefulness of economic models to predict and explain the real world. The dominant paradigm of economic modeling, the so-called dynamic stochastic general equilibrium (DSGE) model, has come under severe criticism for its restrictive assumptions of efficient financial markets, rationality and optimizing agents. In this narrow setting, global financial shocks of the type recently observed cannot be accommodated. Thus, this framework is subject to what Caballero (2010) has termed Hayek's pretence-of-knowledge syndrome, since it confuses the precision it theoretically defines with the precision of the real world. A notable feature of the DSGE model is that business cycles occur because the economy is driven by nominal and real shocks and there are rigidities which prevent the agents to adjust instantaneously to them. In other words, in this framework, which does not account for credit markets and financial imperfections, credit shocks do not play any role in explaining aggregate fluctuations. Given the restrictions surrounding this type of model, there are other theoretical attempts which draw attention to financial markets for macroeconomic performance. The early literature has recognized the important role played by credit markets in shaping real outcomes. The Austrian view of business cycles with its roots in the work of Hayek (1929) emphasizes the role of credit creation in affecting business cycles. A credit expansion by reducing interest rates would increase investment relative to savings. The rising consumer prices as a result of increased consumption, indicates that consumer goods are more profitable than producer goods, thus forcing producers to reassess investment plans. That situation would eventually cause recession. An alternative theory which stresses the importance of financial institutions in understanding business cycles was proposed by Minsky (1982). Financial innovations and periods of economic tranquility will encourage greater risk taking. This will result in

excessive leverage and a lower quality of investment during the rising cycle. The overheating economy will bring about a tightening in monetary policy which will eventually cause recession. Brunner and Meltzer (1990), extending the ISLM model to incorporate the credit market, show that credit and asset price shocks are relevant sources of business cycle fluctuations. Some other studies have addressed the relationship between financial markets and the real economy, when financial imperfections are present. Kiyotaki (1998) shows how the credit system becomes a propagation mechanism of business cycles, when the economy is subjected to a temporary productivity shock. Kocherlakota (2000) uses a small open economy version of a neoclassical growth model to show how credit constraints can transform small asymmetric shocks into large movements in real output. Werner (2011) reformulates the quantity equation by substituting credit for money and differentiating the use of credit for real and asset transactions. He argues that bank credit creation will boost nominal income growth, if used in real transactions, or boost asset prices, if used in asset transactions.

In empirical literature, interactions between credit markets and the real economy have been investigated using different methods. Lown and Morgan (2004) examine the role of bank lending standards in explaining business cycles in the United States. They demonstrate that shocks to credit standards explain variations in banking lending and real output. Helbling, et. al. (2010) investigate the role of credit shocks in explaining global business cycles. They show that credit market shocks are as important as productivity shocks in explaining movements in real output in the G-7 countries. Zhu (2011) examines the credit-output link using time and frequency-domain methods. He demonstrates that the cyclical relationship between the two variables is weak in the United States, relatively weak in Japan, and strong in the euro area.

This paper adds to the existing empirical literature by examining the credit-output link in Greece during the last decade which is characterized by two events. First, it is the period during which Greece has joined the euro area. Second, it covers the latest global financial crisis and the eruption of the Greek debt crisis. If credit cycles are driving business cycles, then the severe credit constraint which the Greek economy has experienced during the implementation of the austerity programs is responsible for the collapse of the real economy. We investigate the credit-output relationship at business-cycles frequencies with three empirical methods, including cross correlation, regression and simulation analysis.

2. The stylized facts

In Figure 1, we plot the levels of real output and real credit during the period 2000:Q1 to 2011:Q1. The real output is measured by the real GDP and the real credit is measured by the aggregate claims on the private sector, households and firms, by domestic financial institutions discounted by the consumer price level.² On inspection, we observe that both variables have steadily increased up to the fourth quarter of 2008, and then, as a result of the global financial crisis and the subsequent eruption of the Greek debt crisis, they have gradually declined. In Figure 2, we plot the cyclical components of real output and real credit which are derived after applying the Hodrick-Prescott filter with a smoothing parameter of 1600 to the logarithms of real GDP and real credit. The plot shows that Greece has experienced two mild recessions, one prolonged boom and the current collapse. In particular, the first recession lasted from the second quarter of 2001 to the fourth quarter of 2002, with the real output dropping cumulatively by 6,33%, and the second recession lasted

² The real GDP and the consumer price index are obtained from OECD Main Economic Indicators, and the aggregate claims on private sector are obtained from the Bank of Greece.

from the third quarter of 2004, after the termination of the Olympic games, to the first quarter of 2006, with the real output dropping cumulatively by 6,18%. From the third quarter of 2006 to the end of 2009, the Greek economy has experienced a real output boom, accompanied by a real credit boom. The real output has cumulatively increased by about 26% and the real credit has cumulatively increased by 112%. Since then, the eruption of Greek debt crisis and the subsequent implementation of austerity measures have brought about a substantial decline in real output and real credit of about 15% and 35% respectively. In Figure 3, we plot the demeaned growth rates of real output and real credit. The two variables have moved close together during the last decade.

[Figures 1 -2-3]

3. Empirical analysis

To get a clearer view of the role of credit in propagating the business cycle fluctuations in Greece, we will examine the credit-output relationship at business-cycle frequencies using cross correlation, regression and simulation analysis. We have computed the cyclical components of the two variables, using the Hodrick-Prescott filter and the first difference filter.³ The Hodrick-Prescott filter despite its desirable properties (removes unit root trend components, it has no phase shift and, for an appropriate choice of its smoothing parameter, closely approximate the optimal filter that isolates only components having business cycle frequencies) it does not avoid distortions that are caused by rapidly changing weights at the

³ A flexible trend for cyclical components of real output and real credit, such as a quadratic trend, has been also used. The results have remained the same as those obtained with the Hodrick-Prescott filter and they are available upon request. The band-filter proposed by Baxter and King would constitute a better choice, but its application, for an appropriate choice of its parameters, will reduce significantly the present sample size to about 20 observations.

ends of the sample. Thus, as a robustness test to the choice of the business cycle filter, we will present additional evidence with the first difference filter.

Firstly, we test for the presence of unit roots with the efficient ADF-GLS test developed by Eliot, Rothenberg and Stock (1996) that has a maximum power against very persistent alternatives. For the cyclical component of real output ($\tilde{y}$) including six lags, the asymptotic p -value is equal to 0,02, and for the cyclical component of real credit ($\tilde{c}$) including eight lags, the asymptotic p -value is equal to 0,005. These results indicate that both series can be characterized as stationary processes.

Then, we examine the co-movements between real credit and real output, using cross correlation analysis. We say that the real credit cycle is leading by j quarters, is synchronous, or is lagging by j quarters the real output cycle, if the correlation coefficients $corr(y_t, c_{t-j})$, $corr(y_t, c_t)$, $corr(y_t, c_{t+j})$, respectively, take on the largest value (in absolute terms) at that quarter. In addition, a positive and significant value indicates that the real credit cycle is procyclical with the real output cycle, a negative and significant value indicates that the real credit cycle is countercyclical with the real output cycle, and a number close to zero indicates that the two cycles are uncorrelated. The results reported in Table 1 indicate that the cyclical component of real credit is leading the cyclical component of real output by one quarter and the relationship between the two cycles is strongly procyclical. In addition, the growth rate of real credit is leading the growth rate of real output by three quarters and the relationship between the two variables is also strongly procyclical.

Having established that real credit leads real output, we proceed further to examine the credit-output relationship in the context of a regression model which also incorporates the trade deficit ratio. The forecasting model we consider has the form,⁴

$$\tilde{y}_t = a + \tilde{\theta}_{t-1} + \gamma \tilde{c}_{t-1} + \delta x_{t-1} + v_t \quad (1)$$

where $\tilde{y}_t$, $\tilde{c}_t$ are the cyclical components of real output and real credit, x_t is the trade deficit as a percentage of real output (d_t/y_t) and v_t is the error term.⁵ Our primary focus is on real credit as the predictor variable in (1), which is examined by applying an in-sample Granger causality F -test for testing the null hypothesis: $\gamma=0$, using HAC standard errors. In the context of a backward-looking model, the Lucas Critique may apply with particular force, so it is important to gauge the historical importance of the IS curve with stability tests. The temporal stability of (1) is tested by means of the sup-Wald statistic, which has good power against other forms of parameter instability (Stock and Watson, 1998).⁶ Having established (1), we have also conducted an out-of-sample Granger causality test, proposed by McCracken (2007), comparing the predictive ability of (1) with the predictive ability of its benchmark version which excludes real credit. If the mean square prediction error (MSPE) is used as a measure of prediction performance, then, if the MSPE of model (1) is smaller than the MSPE of the benchmark version it will imply that real credit Granger causes real output.

We have also estimated a variant of (1) which relates the growth rate of real output, $\hat{y}_t$, with the growth rate of real credit, $\hat{c}_t$, given the change in the trade deficit as a percentage of

⁴ A similar equation was used by Eichengreen and Mitchener (2003) to study the relationship between changes in real output and credit boom during the Great Depression.

⁵ The trade balance in constant prices has been constructed after subtracting from real GDP in constant prices the sum of the three components of domestic absorption in constant prices, that is, private consumption, investment and government consumption. The data for these variables are obtained from OECD Main Economic Indicators.

⁶ For a comparison of the power and size properties of various structural stability tests, see El-Shagi and Giesen (2011).

the lagged real output ($\Delta d_t / y_{t-1}$). Since the cross correlation analysis has indicated that real credit leads real output with three quarters, we have followed Rudebusch and Svensson (1999) and constructed the growth rate of real credit as lagged moving average. Thus, the growth rate of real credit is defined as the difference between the four-quarter moving average of quarterly growth rates of aggregate claims and the four-quarter moving average of quarterly growth rates of inflation, $\bar{c}_t = 1/4 \left(\sum_{j=0}^3 (c_{t-j} - \pi_{t-j}) \right)$, where c_t is the logarithm of aggregate claims on private sector and π_t is the quarterly inflation in the consumer price index, that is $\pi_t = 100(p_t - p_{t-1})$, with p the logarithm of the price level.

In Table 2, we report the results from the estimated equations. The cyclical component of real credit has a statistically significant impact on output gap, with a positive sign revealing that a credit boom, that is an increase in real credit above trend, is associate with a real output boom. The F -test for in-sample Granger causality indicates that (1) is fully supported by the data. In addition, the trade deficit ratio affects the real output with a negative sign, implying that a deterioration in trade balance will reduce aggregate demand and real output. The Quandt likelihood ratio (QLR) statistic, computed over all possible break dates in the central 70 percent of the sample, reveals that the regression coefficients are stable over the sample. In addition, the reset test and the Jarque-Bera test do not reject linearity and normality, respectively. Given that specification (1) is temporally stable, we proceed then to investigate further the credit-output link by the out-of-sample Granger causality test. The sample period is split at the fourth quarter of 2008 and a one-step-ahead pseudo out-of-sample forecast is conducted for both (1) and its benchmark version which excludes real credit. Next, the two specifications are estimated using data up to first quarter of 2009 and a one-step-ahead pseudo out-of-sample forecast is again conducted. The forecasting exercise is

conducted up to the end of the sample and the averages for the out-of-sample MSPEs are calculated. The average MSPEs for (1) and its benchmark version are, respectively, equal to 0,000828 and 0,00123. The null hypothesis is that the two MSPEs are the same and the alternative hypothesis is that the MSPE of (1) is smaller than the MSPE of the benchmark specification. The calculated value of McCracken F statistic is equal to 4,38, which is statistically significant at 1% significant level, indicating that the information contained in real credit significantly improves upon the benchmark forecast for real output. This finding is consistent with the results obtained from the in-sample Granger causality test.

The estimation results of the relationship between the growth rates of real credit and real output, reported in the Panel B of Table 2, are qualitative similar to those obtained before and show that the credit-output link is robust to the choice of the business cycle filter. In particular, the growth rate of real credit, calculated as lagged moving average, has a statistically significant positive impact on the growth rate of real output. This finding suggests that real credit is important to understanding future movements in real output, given the trade deficit ratio, and thus the aggregate claims on the private sector represent an effective mechanism of monetary policy in Greece. The QLR statistic reveals that the regression coefficients are stable over the sample, while the reset test and the Jarque-Bera test do not reject linearity and normality, respectively.

Having established a systematic credit-output relationship, we examine then the effects of a real credit shock on output gap in a VAR of the form,

$$z_t = A + B(L)z_{t-1} + \Gamma x_{t-1} + w_t \quad (2)$$

where $z_t' = (\tilde{z}_t, \tilde{y}_t)$, A is a 2x1 vector of constant terms, $B(L) = B + B' L^{-1}$, where B and B' are 2x2 coefficient matrices of lagged endogenous variables, Γ is a 2x1 vector of

coefficients of the trade deficit ratio which is the exogenous variable and w is a 2x1 vector of white noise error terms with covariance matrix Σ_w . The null hypothesis of no Granger causality from real credit cycles to real output cycles is presented by the restriction, $\beta_{21} = \beta'_{21} = 0$. The results are reported in Table 3. The maximum lag order is set at two by reference to Akaike information and Schwarz Bayesian criteria. The chosen lag length does not exhibit serial correlation and heteroscedasticity. The p -value of the F -statistic for the restriction that the coefficients of the lagged values of real credit in real output equation is jointly zero is less than 1%. Thus, the Granger causality test indicates that the cyclical component of real credit is important for understanding future changes in the cyclical component of real output, which is consistent with the evidence derived from the univariate model (1). The joint restriction that the history of business cycles does not Granger cause the cycles of real credit is not rejected at a 5% significance level, showing that the credit developments have not been directly influenced by developments in the real economy, but rather reflected the liquidity positions of domestic financial institutions. In addition, the trade deficit ratio negatively impacts aggregate fluctuations. Figure 4 shows the response of output gap to a shock in the cyclical component of real credit. As we observe, real output significantly increases above trend for a period of 10 quarters and then it smoothly dies out. This finding suggests that the negative credit shocks which the Greek economy has experienced during the years of the implementation of the austerity programs have been driving the real economy into an economic slump. Figure 5 shows the response of real credit to a shock in the cyclical component of real output. Together, this evidence and that obtained from the Granger causality analysis indicate that the behaviour of real credit is independent from aggregate fluctuations at business-cycle frequencies. Figure 6 presents the forecast variance decomposition for the output gap. The cyclical component of real credit

after one year explains the bulk of the variance decomposition of the cyclical component of real output.

An economic interpretation of the results indicates the following. 1) The measure of aggregate claims on the private sector is a useful indicator for understanding future changes in business fluctuations in Greece. 2) Since credit is driving business cycles, the credit collapse during the years of the implementation of the austerity measures is responsible for the collapse of the real economy. An economic recovery requires a credit expansion which will support aggregate demand and the real economy. 3) The backward-looking model is a good representation of the aggregate demand in Greece, and thus an analysis of aggregate fluctuations based on models that ignore credit as a monetary measure will produce inadequate results.

4. Concluding remarks

In this paper, we present empirical evidence about the relationship between credit and future movements in real output at business-cycle frequencies in Greece. Overall, the analysis indicates that the credit-output link is significant and robust, implying that the measure of aggregate claims on the private sector is a useful indicator which provides information about future movements in real output, given the trade deficit ratio. Failure to acknowledge this empirical fact could give rise to undesirable economic consequences. In other words, the credit collapse during the eruption of the Greek debt crisis is responsible for the collapse of the real economy. An economic recovery requires a positive credit shock which will support aggregate demand and real output.

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Table 1. Cross correlation of real output with real credit

$V/bles$	$\tilde{y}(t-3)$	$\tilde{y}(t-2)$	$\tilde{y}(t-1)$	$\tilde{y}(t)$	$\tilde{y}(t-1)$	$\tilde{y}(t-2)$	$\tilde{y}(t-3)$
$(\tilde{y}, \tilde{c})$	0,7373	0,8063	0,8178	0,8069	0,7529	0,6136	0,4497
$p-values$	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
$V/bles$	$\hat{y}(t-3)$	$\hat{y}(t-2)$	$\hat{y}(t-1)$	$\hat{y}(t)$	$\hat{y}(t-1)$	$\hat{y}(t-2)$	$\hat{y}(t-3)$
$(\hat{y}, \hat{c})$	0,7056	0,6430	0,5554	-0,2581	0,6189	0,5621	0,5857
$p-values$	[0,000]	[0,000]	[0,000]	[0,009]	[0,000]	[0,000]	[0,000]

Notes: The entries are the correlation coefficients between real output (y) and real credit (c). The notation $\tilde{y}, \tilde{c}$ refers to the cyclical components of real output and real credit, obtained after using the Hodrick-Prescott filter to the levels of the two variables, while the notation $\hat{y}, \hat{c}$ refers to the growth rates of real output and real credit.

Table 2. Estimated output equations

A. Dependent variable: Output cycle: $\tilde{y}$

<i>Regressors</i>	<i>Coefficients</i>	<i>St. Errors</i>	<i>T-ratio [p-value]</i>	<i>Granger causality test</i>
$\tilde{y}_{t-1}$	0,59	0,10	5,79[0,00]***	
$\tilde{c}_{t-1}$	0,18	0,05	3,48[0,00]***	$F(1,40)=270,38[0,00]***$
d_{t-1} / y_{t-1}	-0,23	0,10	-2,21[0,02]**	$F(1,40)=142,23[0,00]***$

Diagnostics

<i>Adjusted R²</i>	0,81
<i>SEE</i>	0,008
<i>Quandt LR test</i>	$F(4,36)=2,47[10\% \text{ value}=3,59]$
<i>Reset test</i>	$F(2,38)=0,14[0,87]$
<i>Jarque-Bera test</i>	$\chi^2(2)=1,82[0,40]$

McCracken Test of Forecast Accuracy, 2009Q1 to 2011Q1

$F_{1,0,2} = 4,38 > 2,129$ (critical value at 1%)

B. Dependent variable: Output growth rate: $\hat{y}$

<i>Regressors</i>	<i>Coefficients</i>	<i>St. Errors</i>	<i>T-ratio [p-value]</i>	<i>Granger causality test</i>
$\tilde{c}_{t-1}$	0,28	0,04	7,00[0,00]***	$F(1,37)=41,30[0,00]***$
$\Delta d_t / y_{t-1}$	-0,18	0,09	-2,00[0,05]**	$F(1,37)=4,15[0,04]**$

Diagnostics

<i>Adjusted R²</i>	0,52
<i>SEE</i>	0,008
<i>Quandt LR test</i>	$F(4,33)=1,41[10\% \text{ value}=3,59]$
<i>Reset test</i>	$F(2,35)=0,94[0,40]$
<i>Jarque-Bera test</i>	$\chi^2(2)=5,20[0,07]$

Notes: The first equation includes a constant term which is significant. The second equation uses the demeaned real output and includes a time trend which is significant. HAC standard errors are used. ***, **, * indicate significance at 1%, 5%, 10% significance level, respectively. $F_{1,0,2}$ is the F -statistic, where 1 denotes the excess parameter, appearing in (1) and 0,2 is the value of parameter π (see Table 4 in McCracken (2007)).

Table 3. Granger causality tests of the VAR model

Tested Hypotheses	F-tests	p-values
Credit does not cause output	$F(2,37)=8,3174$	0,00***
Output does not cause credit	$F(2,37)=2,4596$	0,10*
Credit does not cause credit	$F(2,37)=90,902$	0,00***
Output does not cause output	$F(2,37)=12,219$	0,00***
Exogenous Regressor: d_{t-1} / y_{t-1}		
Credit equation:	T-ratio=0,35[0,73]	
Output equation:	T-ratio=-1,80[0,08]*	
<hr/>		
System selection	Null hypothesis=VAR(1) Alternative hypothesis=VAR(2)	
LR test:	$\chi^2(4)=16,42[0.00]$ ***	
AIC and BIC select a VAR(2)		
DIAGNOSTICS		
Portmanteau test	$\chi^2(10)=29,32[0.60]$	
Doornik-Hansen test	$\chi^2(4)=3,91[0.42]$	

Notes: HAC standard errors are used.

Figure 1. Real Output and Real Credit (in logs)

Figure 2. The cycles in real output and real credit

Figure 3. The growth rates of real output and real credit (first differences in logs)

Figure 4. Response of output gap to a shock in real credit, with bootstrap confidence interval

Figure 5. Response of real credit to a shock in real output, with bootstrap confidence interval

Figure 6. Forecast variance decomposition for output gap