Credit and business cycles in Greece: Is there any relationship?☆

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This paper examines the relationship between real output and real credit at business-cycle frequencies in Greece. The Granger causality tests indicate that real credit is important to understanding future movements in real output, given the trade deficit ratio. The impulse response analysis implies that the recovery of the Greek economy requires a positive credit shock which will stimulate real output.

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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 pretense-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

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nominal income growth, if used in real transactions, or boost asset prices, if used in asset transactions.

On the empirical side, there are a few recent papers which have studied the relationship between credit and real economy. 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 shocks in explaining global business cycles. They demonstrate that the cyclical relationship between the two variables is weak in the United States, relatively weak in Japan, and strong in the euro area.

Given that no work has been done in analyzing the credit–output link in Greece, this paper aims to fill in the gap and examines the role of credit in explaining business cycles in Greece during the last decade. In this period, the country has joined the euro area with the risk premium of the Greek economy, as reflected in the spread between Greek and German long-term interest rates, initially disappearing and then soaring dramatically as a result of the eruption of Greek debt crisis at the end of 2009. We investigate the credit–output relationship at business-cycle frequencies with three empirical methods, including cross correlation, regression and simulation analysis. If credit cycles are driving business cycles, then the severe credit constraint which the Greek economy has experienced during the implementation of the adjustment programs may be one of the forces which are responsible for the collapse of the real economy.

2. The stylized facts

In Fig. 1, we plot the levels of real output and real credit from 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. 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 Fig. 2, we plot the cyclical components of real output and real credit, which are derived after applying the Hodrick–Prescott (HP) 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 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 the adjustment programs have brought about a substantial decline in real output and real credit of about 15% and 35% respectively. In Fig. 3, we plot the demeaned growth rates of real output and real credit. The two variables have moved close together during the last decade.

3. Empirical analysis

To get a clearer view of the role of real 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 HP filter and the first-difference (FD) filter. The HP 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 approximates the optimal filter that isolates only components having business cycle frequencies) does not avoid distortions that are caused by rapidly changing weights at the ends of the sample. Thus, as a robustness test to the choice of the business cycle filter, we will present additional evidence with the FD filter. Before analyzing the credit–output link, we test whether the variables used in the analysis are

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1 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.
stationary processes in order to avoid the spurious regression problem. For the cyclical component of real output, the asymptotic p-value of the t-ratio of the ADF-GLS test (Elliot et al., 1996), including six lags, is equal to 0.02, while for the cyclical component of real credit, the corresponding value of the ADF-GLS test, including eight lags, is equal to 0.005. These results indicate that both series can be characterized as stationary processes. On the other hand, the growth rates of real output and real credit have achieved stationarity, after allowing for a structural break point, using the method proposed by Zivot and Andrews (1992). For the growth rate of real output, the ADF test, including one lag, attains the value $-8.27$, after allowing for a break at the fourth quarter of 2007, while for the growth rate of real credit, the ADF test attains the value of $-10.82$, after allowing for a break at the third quarter of 2007.

Initially, we examine the credit–output link by looking at the co-movements of the two variables, 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 $\text{corr}(y_t, x_{t-j})$, $\text{corr}(y_t, y_{t-j})$, respectively, take on the largest value (in absolute terms) at that quarter, where $y_t$ is the real output cycle and $x_t$ is the real credit cycle. 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. On the other hand, 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 then to analyze the credit–output relationship in the context of a

![Fig. 2. The cycles in real output and real credit.](image1)

![Fig. 3. The growth rates of real output and real credit (first differences in logs).](image2)

<table>
<thead>
<tr>
<th>$x_{t-3}$</th>
<th>$x_{t-2}$</th>
<th>$x_{t-1}$</th>
<th>$x_t$</th>
<th>$x_{t+1}$</th>
<th>$x_{t+2}$</th>
<th>$x_{t+3}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP filter</td>
<td>0.7373</td>
<td>0.8063</td>
<td><strong>0.8178</strong></td>
<td>0.8069</td>
<td>0.7529</td>
<td>0.6136</td>
</tr>
<tr>
<td>MSL</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
</tr>
<tr>
<td>FD filter</td>
<td><strong>0.7056</strong></td>
<td>0.6430</td>
<td>0.5554</td>
<td>-0.2581</td>
<td>0.6189</td>
<td>0.5621</td>
</tr>
<tr>
<td>MSL</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.005]</td>
<td>[0.000]</td>
<td>[0.000]</td>
</tr>
</tbody>
</table>

Notes: The entries are the values of the correlation coefficients. The highest values are boldly marked. The null hypothesis is that the correlation coefficient is zero. Marginal significance levels (MSL) refer to a two-tailed t-test.
regression model, which also incorporates the trade deficit ratio. The forecasting model we consider has the form,

\[ y_t = \alpha + \beta y_{t-1} + \gamma y_{t-1} + \delta z_{t-1} + v_t \]  

(1)

This equation is a backward-looking aggregate demand specification, according to which the real output cycle is determined by its own lagged value, the lagged value of the real credit cycle, and the lagged value of the ratio of trade deficit to GDP. \( z_t \) and \( v_t \) is the error term.\(^3\) Given that Greece is a small open economy, we have incorporated the trade deficit ratio in order to capture the external effects on aggregate demand. Our primary focus is on real credit as the predictor variable in Eq.(1), which is examined by applying an in-sample Granger causality F-test for testing the null hypothesis that \( \gamma = 0 \), 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 aggregate demand equation with stability tests. The temporal stability of Eq.(1) is tested by means of the sup-Wald statistic, which has good power against other forms of parameter instability (Stock and Watson, 1998).\(^4\)

Table 2, the in-sample test of Granger causality reveals that the regression coefficients are stable over the sample, and the Jarque–Bera test do not reject linearity and normality, respectively.

In panel B, we present the results from the FD filter. Since the correlation analysis has indicated that the growth rate of real credit is leading the growth rate of real output by three quarters, we have estimated model (1) with real credit containing one and three lags. The empirical results 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 lagged values of the growth rates of real credit have 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. Thus, the aggregate claims on the private sector represent an effective mechanism of monetary policy in Greece. The diagnostic tests reveal that the regression coefficients are stable over the sample, and linearity and normality are not rejected by the data.

An alternative way of testing \( \gamma = 0 \) in Eq. (1) is to conduct an out-of-sample Granger causality test, proposed by McCracken (2007), comparing the predictive ability of Eq. (1) with the predictive ability of its restricted version, which excludes real credit. If the mean squared prediction error (MSPE) is used as a measure of prediction performance, then, if the MSPE of model (1) is smaller than the MSPE of its restricted version it will imply that real credit Granger causes real output. We have split the sample at the fourth quarter of 2008 and evaluated the forecasting accuracy of the models over the period of the debt crisis. We have not applied a recursive regression approach to forecasting because the real output model does not exhibit parameter instability. The results are reported in Panel C of Table 2. The out-of-sample Granger causality test indicates that the MSPE of Eq. (1) is significantly lower than the MSPE of its restricted version, implying that the information contained in real credit significantly improves the forecast of real output. This finding is consistent with the results obtained from the in-sample Granger causality test.

The analysis so far has revealed a systematic credit–output relationship, which is temporally stable. We proceed further to analyze

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3 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.

4 For a comparison of the power and size properties of various structural stability tests, see El-Shagi and Giesen (2011).
the effects of a real credit shock on real output in the context of a VAR model of the form,

\[ Y_t = \alpha + \beta(L)Y_t + \gamma Z_{t-1} + \epsilon_t \]  

where \( Y_t = (y_t, x_t) \) is a 2 \times 1 vector of endogenous variables, A is a 2 \times 1 vector of constant terms, \( B(L) \) is a 2 \times 2 matrix polynomial in the lag operator \( L \), \( \Gamma \) is a 2 \times 1 vector of parameters, \( z_t \) is the exogenous variable, and \( \epsilon_t \) is a 2 \times 1 vector of white noise error terms with covariance matrix \( \Sigma_\epsilon \). The maximum lag order is set at four and the optimal length is selected by reference to Akaike information criterion and Schwarz Bayesian criterion. For the VAR model with the HP filter, the optimal lag length is equal to two quarters, which is longer than the one lag used in Eq. (1). Since the real credit equation in the VAR system suffers from serial correlation when one lag is used, the selection of the two lags alleviates this problem. A robust F-test for the hypothesis that the regression parameters of \( y_{t-2} \) and \( x_{t-2} \) in the real output equation are jointly zero is equal to F(2, 37) = 0.44, with a marginal significance level (MSL) of 0.64, indicating that the dynamics of Eq. (1) is adequately specified. For the VAR model with the first-difference filter, the optimal lag is set at one. In Table 3, we present the estimated equations from the two VAR models. The in-sample Granger causality test indicates that the lagged value of real credit has information content that helps predict movements in real output in both models, independently of the trade deficit ratio. This finding is consistent with the evidence derived from the analysis of Eq. (1). On the other hand, the history of business cycles does not Granger cause the cycles of real credit 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.

### Table 3

Estimated equations of the VAR model.

<table>
<thead>
<tr>
<th>Dep. v/ble:</th>
<th>Output Coefficients</th>
<th>MSL</th>
<th>Credit Coefficients</th>
<th>MSL</th>
<th>Null</th>
<th>F-test</th>
<th>MSL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. HP filter</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( y_{t-1} )</td>
<td>0.62</td>
<td>0.00***</td>
<td>0.43</td>
<td>0.03**</td>
<td>( x \neq &gt; y )</td>
<td>8.32</td>
<td>0.00***</td>
</tr>
<tr>
<td>( y_{t-2} )</td>
<td>-0.11</td>
<td>0.46</td>
<td>-0.28</td>
<td>0.23</td>
<td>( y \neq &gt; x )</td>
<td>2.46</td>
<td>0.10**</td>
</tr>
<tr>
<td>( x_{t-1} )</td>
<td>0.15</td>
<td>0.11</td>
<td>1.40</td>
<td>0.00***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( x_{t-2} )</td>
<td>0.06</td>
<td>0.55</td>
<td>-0.50</td>
<td>0.00***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( z_{t-1} )</td>
<td>-0.23</td>
<td>0.08**</td>
<td>0.04</td>
<td>0.73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B. FD filter</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( y_{t-1} )</td>
<td>0.07</td>
<td>0.66</td>
<td>0.33</td>
<td>0.17</td>
<td>( x \neq &gt; y )</td>
<td>7.38</td>
<td>0.00***</td>
</tr>
<tr>
<td>( x_{t-1} )</td>
<td>0.25</td>
<td>0.00***</td>
<td>0.79</td>
<td>0.00***</td>
<td>( y \neq &gt; x )</td>
<td>2.00</td>
<td>0.17</td>
</tr>
<tr>
<td>( z_{t-1} )</td>
<td>-0.17</td>
<td>0.08*</td>
<td>0.18</td>
<td>0.34</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See notes to Table 2.

Fig. 4. Response of output to a shock in credit, with bootstrap confidence interval (HP filter).
alternative filters. As we observe, real output significantly increases above trend for a period of about 10 quarters and then it smoothly dies out. This finding suggests that the negative credit shocks which the Greek economy has experienced during the implementation of the adjustment programs have been driving the real economy into an economic slump. Figs. 6 and 7 present the response of real credit to a shock in the real output. As we observe, real credit does not significantly respond to a shock in real activity, indicating that the behavior of real credit is independent from aggregate fluctuations at business-cycle frequencies.

The results we have obtained imply the following: 1) The measure of the aggregate claims on the private sector is a useful indicator for understanding future changes in business fluctuations in Greece. Thus, an analysis of aggregate fluctuations based on models that ignore credit as a monetary measure will produce inadequate results. 2) The credit collapse during the implementation of the adjustment programs seems to be one of the forces which are responsible for the collapse of the real economy. Therefore, the recovery of the Greek economy, apart from structural changes, which will strengthen its competitiveness, also requires a credit expansion, which will support aggregate demand. The required credit can be facilitated by the bailout tranches, the Guarantee Fund for Greek enterprises, and the Greek banks' access to European Central Bank's financing.\(^5\)

\(^5\) The bailout tranches, totaling EUR 43.7 billion for 2012, will cover budgetary financing, amounting EUR 10.6 billion, and bank recapitalization, amounting EUR 23.8 billion (European Commission, 2012). The Guarantee Fund, established in March 2012 as a joint initiative between the Hellenic Republic, the European Commission and the European Investment Bank (EIB), using EUR 500 million from unabsorbed Structural Funds for Greece, will be guaranteeing EIB loans to small and medium-sized enterprises (SMEs) via partner banks in Greece totaling up to EUR 1 billion. The SMEs’ financing is the key in relaunching growth, securing and creating jobs. Moreover, it will provide support to the banking sector in order to reduce the cost of financing for SMEs (European Investment Bank, 2012). The European Central Bank’s decision to ease Greek banks’ access to funding by accepting the country’s bonds in exchange for cash will reduce the cost of financing, since the Greek banks had been reliant on more expensive emergency liquidity assistance from the Bank of Greece (European Central Bank, 2012).
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, robust and temporally stable, implying that the measure of aggregate claims on the private sector is a useful indicator which provides information about future movements in real output, independently of 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 seems to be one of the forces which are 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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