SEYCHELLES

SELECTED ISSUES

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SEYCHELLES

SELECTED ISSUES

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CONTENTS

ESTIMATING A FINANCIAL CONDITIONS INDEX FOR SEYCHELLES[1]

Financial Conditions Indices (FCIs) have become a widely-used instrument to gauge the operational state of the financial sector and to act as a reliable predictor for real economy activity. The estimated FCI for Seychelles—which reflects both external and domestic financial conditions—constructed in this paper tracks the country's economic activity and is a leading indicator of real GDP and credit growth. This highlights the usefulness of an FCI as a potential forecasting tool for Seychelles' economy and as a potential instrument for macroprudential policy.

A. Introduction

1.   This paper develops a Financial Conditions Index (FCI) for Seychelles. The FCI is an instrument to gauge the operational state of the financial sector and predict real economy activity. Seychelles is a financially-integrated economy, with the financial sector playing an important role in generating economic activity and employment

2.   The FCI is a logical extension of the monetary conditions index (MCI) that became popular in the 1990s. Subsequently, researchers increasingly included financial market variables such as asset prices and long-term interest rates as well as liquidity indicators, particularly following the Global Financial Crisis (GFC), giving rise to the construction of explicit financial condition indices. FCIs can be a better indicator of financial conditions than traditional MCIs, for example, in times of financial stress (such as after the GFC), when despite monetary loosening, overall financial conditions remained tight as lending rates did not decrease much reflecting banks' unwillingness to lend due to balance sheet constraints (Manning and Shamloo, 2015). The purpose of an FCI can be to assess whether financial conditions are lax or tight, or it can be used as a forecasting instrument summarizing the impact of financial factors on economic activity (Hatzius et al., 2010). While individual financial variables may also be good predictors, the pooling of financial information has been shown to improve predictive power (Hatzius et al., 2010).

3.   In general, tests of the FCIs corroborate the hypothesis that financial conditions matter for future economic growth. In- and out-of-sample tests generally show good predictive power of FCIs, and they are increasingly being used as a tool for in-house forecasting by policymaking institutions. The IMF, e.g., has been using FCIs among other inputs to project the "growth-at-risk"—both at the global level (IMF, 2017; IMF, 2018a), and for individual countries (e.g. IMF, 2018b).

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[1] Prepared by Salifou Issoufou, based on the Mauritius 2019 Article IV Consultation Selected Issues Paper titled "Developing A Financial Conditions Index for Mauritius" prepared by Salifou Issoufou and Torsten Wezel.

4.   Two approaches stand out in constructing FCIs. First, the weighted-sum approach, based on vector autoregressive (VAR) models, obtains the weights of the individual financial variables in the FCI from the cumulative impulse-response functions. Second, the common factor approach, typically estimated through Principal Components Analysis (PCA), models the variance structure of the financial variables using optimal linear combinations of them. Occasionally, other methods such as common factor analysis using a Kalman filter (Gumata et al., 2012) or semi-structural models (Krznar and Matheson, 2017) are employed. The VAR approach has the advantage of linking financial conditions and GDP as the variable of ultimate interest in a system of equations but may present econometric challenges (most notably issues related to degrees of freedom), while the PCA allows for inclusion of ample financial variables, but is, by construction, agnostic about the relationship to output (Ho and Lu, 2013)[2] despite having been found to predict future growth well and occasionally outperforming leading indicators (Gumata et al., 2012).

5.   Financial variables to be included fall into several categories reflecting prices, quantities and risk factors (e.g. Kongsamut et al., 2017). Variables that are almost always incorporated in FCIs include a market interest rate such as for private sector loans, the nominal or real effective exchange rate, asset prices having wealth effects such as stock prices and their volatility as well as house prices, and risk factors such as credit or bonds spreads, both within the economy and to the exterior. More rarely, monetary variables like money aggregates or bank reserves are accounted for. Where available, the information content of loan officer surveys of credit standards has been exploited as well (Swiston, 2008, Hatzius et al., 2010, Angelopoulou et al., 2013, Ho and Lu, 2013).

6.   Typically, the FCI is purged from the effects of real sector developments. To measure the pure impact of financial variables on economic activity and exclude feedback from past economic events on the former, almost all studies purge the FCI by regressing either the individual (raw) variables on GDP growth and inflation or the readily-constructed FCI on these variables and utilizing the residuals for the purged FCI. Some studies (e.g. Hatzius et al., 2010) purge even from monetary conditions by including the policy rate among the regressors. The financial variables are typically demeaned and occasionally also divided by their standard deviation to remove the influence of the unit of measurement (as in Khundrakpam et al., 2017). Sometimes a moving average of the indicator is used to reduce excessive short-term volatility and focus on more persistent deviations (Gómez et al., 2011; Manning and Shamloo, 2015).

7.   This study computes VAR- and PCA-based FCIs in their purged and unpurged variants and uses them for growth prediction and macroprudential policy purposes. Upon obtaining the different FCIs, the study then runs in-sample and "pseudo out-of-sample" forecasts to test the predictive quality of the FCIs for future economic activity. Introducing a new aspect in the literature, the study uses the computed FCIs for macroprudential policy purposes, notably as an alternative to the prevailing credit-to-GDP gap in the setting of the countercyclical capital

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[2] However, it may be sensible to exclude candidate variables that have a low predictive power of GDP growth in a VAR (Gómez et al., 2011).

buffer (CCB) for banks which Seychelles plans to introduce as part of its adoption of the Basel III reform package.

8.   The study is organized as follows. Section two presents methodological aspects surrounding the construction of the FCI, the data space and variable selection. Section three presents estimation results, notably the evolution of the various indices since the mid-2000s in relation to GDP growth. Section four tests whether the new FCI is a good predictor of short-run economic activity using in- and out-of-sample forecasts and assesses the usefulness of the FCIs for detecting boom-bust episodes in Seychelles and for informing macroprudential policy by assessing whether an FCI can predict credit booms and busts. Section five concludes and provides some policy recommendations.

B. Methodology

9.   The variables used in this paper to construct the FCIs consist of global and domestic factors. Global variables represent external financial conditions that would likely affect the Seychellois economy through the exposure of its international financial center to Europe. Domestic variables capture the various channels through which financial conditions affect the real economy. The global factors are the Europe (EUR) Morgan Stanley Capital International index (MSCI EUR) and Europe's stock market volatility index (VSTOXX). The domestic factors are nominal effective exchange rate (NEER), the average lending rate, the Treasury Bill rate (T-bill rate), the growth rates of credit to the private sector, and currency in circulation. We initially considered more global and domestic factors but decided to settle on those factors with the highest, and significant, correlation coefficient with Seychelles' real GDP growth. Also, many of the excluded global (domestic) factors are highly correlated with the selected global (domestic) factors. The sample spans 2003Q2–2018Q3.

10.   To construct the FCI for Seychelles, we use the following methodologies: Weighted-sum approach using Vector Auto-Regression (VAR) and factor analysis approach using Principal Component Analysis (PCA).

Vector Auto-Regression (VAR)

11.   VAR modelling allows obtaining the weights of the individual financial variables in the FCI. The weights are obtained from the cumulative impulse-response functions of GDP growth to a one standard deviation shock to each of the variables. The VAR approach has the advantage of relating financial conditions directly with GDP developments. However, the list of covariates may empirically be restricted by the degrees of freedom, whereby having too many variables or rather short-time series runs the risk of overfitting. As a result, only a few financial variables are typically included.

12.   To construct the weighted-sum FCI, a recursive VAR model consisting of the seven variables plus the annualized quarterly real GDP and the consumer price index (CPI) is estimated. The inclusion of GDP and CPI considers the impact of current and past economic

activity on financial conditions. The derived FCI is therefore stripped of the feedback from current and past economic activity. The identification of structural shocks is achieved through a Cholesky decomposition, which assumes that domestic financial conditions do not have contemporaneous effects on growth and inflation, and that domestic developments (real and financial) do not contemporaneously affect external variables. Specifically, we employ the following Cholesky ordering: MSCI EUR, VSTOXX, GDP growth, consumer price index, NEER, lending rate, Treasury Bill rate, credit to the private sector and currency in circulation.[3]

13.   Augmented Dickey-Fueler tests confirm that all variables in level except the lending rate and VSTOXX are non-stationary. The Treasury Bill rate is first-difference stationary. The rest of non-stationary variables (MSCI EUR, NEER, currency in circulation, credit to the private sector, GDP and CPI) enter the VAR as year-on-year percentage change while the lending rate and VSTOXX enter in levels, and the treasury bill rate enters in first difference.

14.   The weighted-sum FCI is then calculated as follows:

$$FCI_t = \sum_{j=1}^{k} w_j(x_{jt} - u_j) \quad (1)$$

The FCI in each period *t* is a weighted average of the *k* different financial variables (in this case *k*=7) denoted x_{jt}, where w_j is the weight and u_j is the mean of the financial variable over the sample period. The weight w_j is the cumulative two-quarter impulse response of real GDP growth to a one-unit shock to f_{jt}.

Principle Component Analysis (PCA)

15.   Principal Components Analysis models the variance structure of the financial variables. This is achieved by using optimal linear combinations of the observed financial variables, i.e. the principal component accounts for a maximum amount of the variables' total variance.[4] As mentioned, the PCA typically allows for inclusion of more financial variables compared to the VAR approach. However, constructing FCIs using PCA is done without explicit regard for the impact on economic activity—it may be that a variable has a large factor loading implying that the variable explains most of the common factor's variance but irrespective of whether the variable matters for growth in a given case. Also, including too many similar indicators runs the risk of giving too much weight to a certain set of drivers, which, in addition, may be less relevant for future economy activity. To mitigate this problem and thus safeguard a

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[3] Note that the ordering would change based on the software used to estimate the VAR as some software use a lower triangular matrix while others use upper triangular matrix when implementing the Cholesky ordering. This ensures that the response of the variable to a shock would be zero contemporaneously if the response variable is ordered in such a way that it is not affected by the shock variable on impact.

[4] Put differently, a principal component is a weighted average of the variables where the weights ("loadings") are derived so that the index explains the maximum amount of variation of all included financial variables (Krznar and Matheson, 2017). In practice, only the first few principal components are considered for the FCI, assuming they capture a large share of the variation cumulatively (e.g. a minimum of 70 percent, as suggested by Gómez et al., 2011, and Khundrakpam et al., 2017).

parsimonious specification, only one variable depicting developments in a given area (e.g. stock market developments, bond spreads) is chosen.

16.   The principal component methodology is used to extract common factors (F_t) that represent the greatest common variation in a group of k financial variables (X_t). The model can be presented as follows:

$$X_t - \mu = \beta F_t + U_t \quad (2)$$

Where X_t is a $k \times 1$ vector of variables' means, μ is the mean of the observables over the sample period, β is a $k \times m$ matrix of coefficients, and F_t is a vector of $m \times 1$ unobserved common factors, U_t is a $k \times 1$ vector of errors. The model assumes that the errors are orthogonal to the common factors, which in turn are assumed to have mean zero.

17.   The factor-based FCI includes both domestic and global financial variables, as in the VAR framework (except GDP and inflation). It is derived from PCA-based common factors calculated for the period of 2003Q2–2018Q3 using the seven global and domestic financial variables. Two sets of common factors are calculated. One using the static approach and the second using the dynamic approach. To introduce dynamics into the common factors, we add lags of each financial variable in the matrix X_t of observables.[5]

18.   Given that the number of common factors derived from the PCA is a multiple of variables used (including lags), we chose the optimal number of common factors based on the Bai and Ng (2002) selection criteria. The three Bai and Ng criteria suggest 7 common factors, which in this case account for 100 percent of variation in the data. For that reason, we combined the 7 common factors into single common factors using weighted averaging with weights equal to the factors' respective coefficients of variation.

The combined common factors are then each stripped of feedback from past economic activity to construct the two purged PCA-based FCIs using the following equation:

$$F_t = A(L)y_t + A(L)\pi_t + \varepsilon_t \quad (3)$$

where A(L) is the lag operator reflecting current and lagged GDP and inflation. y_t denotes y-o-y GDP growth rate and π_t denotes y-o-y inflation rate. The respective error terms ε_t are the PCA-based FCIs capturing only exogenous developments in financial conditions that would predict future economic activity.

C.   Financial Conditions Index for Seychelles

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[5] Essentially, X_t is replaced by $Z_t = [X_t - X_{t-p}]$ in equation (2), where p in the number of lags. We include 1 lag based on results from performing the Akaike Information Criterion (AIC) lag selection test.

Overview of the Constructed FCIs

19.   Financial conditions in Seychelles are strongly correlated with both domestic and external factors. Figure 1 presents the correlation coefficients (or factor loadings) between the two factor-based FCIs (unpurged) and the financial variables.[6] These factor loadings represent the relative importance of each financial variable in the factor based FCIs. Positive factor loadings imply that a higher value of the financial variable is associated with better financial conditions in Seychelles. Negative factor loadings on the other hand imply that lower values of the financial variables are associated with better financial conditions. The loadings suggest that financial conditions in Seychelles are positively affected by: the MSCI EUR, NEER, and growth in credit and currency in circulation. Financial conditions in Seychelles are negatively affected by a higher volatility in Europe's stock market index, and higher domestic lending and T-bill rates.

20.   Figures 2 depicts the FCIs constructed using VAR and PCA methods. An increasing FCI implies looser financial conditions while a decreasing index indicates tighter financial conditions. The constructed FCIs are highly correlated with each other. Both the static and dynamic FCIs are constructed using static and dynamic PCA, respectively. Seychelles seems to have experienced about four financial cycles during 2003Q2-2018Q3, as indicated by the dynamics of the constructed FCIs. Of the four financial cycles, two appear to have clear peaks and throughs: The first and second cycles. The first cycle started before Seychelles' 2009 financial crisis and ended with the trough of the 2009 recession, in the second quarter of 2009. The subsequent cycle ended around the second quarter of 2012 and appears to have reached the highest peak of loose financial conditions in Seychelles around the end of 2010, which coincides with a recovery of private sector credit amid the large banking sector excess liquidity that emerged from the quick reduction of domestic public debt.[7] Based on PCA FCIs, the third cycle spanned 2012Q2-2015Q2 while the subsequent fourth and last cycle appears to be nearing its end, perhaps reflecting the impact of recent monetary policy tightening.

21.   The constructed FCIs appear to track GDP growth well (Figure 2, panel 2). This is a testament to their potential forecasting power and the importance of the financial sector in Seychelles' economy. For example, financial conditions began tightening in early 2007, about three quarters before Seychellois GDP began its largest contraction in the post-2000 period. Overall, the constructed FCI appears to lead GDP growth accelerations as well as decelerations.

Forecast Evaluation

22.   The forecasting power of most of the constructed FCIs is confirmed by their correlation with real GDP (Table 1). The VAR-based FCI correlates the most with one- to four-quarter ahead growth rates, suggesting potential predicting power for near-term growth. Unsurprisingly, the unpurged dynamic PCA-based FCI has the highest contemporaneous

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[6] All the factor loadings are statistically significant except for the average lending rate.
[7] See IMF Country Report No. 11/5.

correlation with GDP growth, while the purged dynamic PCA-based FCI is uncorrelated with future growth. This reflects the fact that the purged PCA-based FCI is stripped of feedback from current and previous quarters' real economic activity.

Table 1. Seychelles: Correlations Between FCIs and Real Activity, 2003Q2-2018Q3 1/					
	Real GDP (annualized year-on-year percent change)				
Varible	**t**	**t+1**	**t+2**	**t+3**	**t+4**
Static FCI	0.52*	0.68*	0.72*	0.68*	0.6*
Static FCI (purged)	0	-0.03	-0.13	-0.24	-0.28*
Dynamic FCI	0.63*	0.73*	0.73*	0.67*	0.56*
Dynamic FCI (purged)	0	-0.05	-0.17	-0.22	-0.2
VAR FCI	0.66	0.76*	0.71*	0.58*	0.42*

1/ GDP growth and purged FCIs span 2007Q4-2018Q3
* = statistically significant at the 10 percent level
Source: IMF Staff estimates

23. **To evaluate the strength of the constructed FCIs in forecasting GDP, we use the following diffusion index model:**

$$y_t = \alpha(L)y_{t-1} + \theta(L)F_t + \xi_t \quad (4)$$

where y is real GDP growth and F is the FCI of interest. The optimal number of lags for each estimation is chosen based on the Bayesian Information Criterion (BIC).[8] The model in equation (4) is estimated with and without the FCI, and the relevant root mean squared errors (RMSEs) are compared.

24. **As can be seen in Table 2 below, root mean squared errors are better (smaller) when FCIs are included in the estimation.** For this exercise, we focus on the FCIs that are stripped of feedback from current and past economic activity, namely purged PCA-based FCIs and VAR FCI. The highest improvement in RMSE occurs when the VAR-based FCI is included in the regression, suggesting that the VAR-based FCI has a marginally better forecasting power than the PCA-based FCIs. For this reason, the VAR-based FCI is used for the rest of the analysis.

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[8] Optimal lags based on AIC are higher, and more unstable, than those based on BIC.

Table 2. Seychelles: Root Mean Squared Errors

	RMSEs		Optimal Lags	
Diffusion Index Equation	RMSE - BIC	RMSE - AIC	BIC	AIC
Purged Static Common Factor FCI	0.75	0.75	2	2
Purged Dynamic Common Factor FCI	0.74	0.98	2	4
VAR FCI	0.43	0.43	2	2
Simple AR process	0.79	0.79	2	2
Source: IMF Staff estimates				

D. Using the FCI for Macroprudential Policy Purposes

25.   The new FCI could also be used for macroprudential policy, specifically for setting the Basel III Countercyclical Capital Buffer (CCB). Seychelles is in the process of implementing the adoption of Basel II. The full transition to Basel II and adoption of the Basel III capital definition is expected to be completed by the end of 2019 as it is one of reform targets under Seychelles' authorities program supported by the Fund's Policy Coordination Instrument (PCI). The CCB is an additional capital buffer that should be built when credit to the private sector grows disproportionately. This cushion may then serve to absorb mounting losses in an ensuing downturn. The Basel Committee on Banking Supervision (BCBS, 2010) recommends using a specification of the credit-to-GDP gap for activation of the CCB.[9] Several country authorities deviate from the pure BCBS buffer guide and consider other indicators for setting the CCB such as asset prices or financial sector conditions more broadly. As Seychelles adopts Basel III capital definition, the FCI could serve as one of the other indicators for setting CCB.

26.   Given its GDP forecasting qualities, we assess whether the FCI performs well as predictor for credit boom-bust episodes. Specifically, we check whether the FCI can help predict more accurately unsustainable credit boom conditions that are followed by downturns than the credit-to-GDP gap. Such downturn episodes are manifested in rising NPLs and falling bank profits.

27.   Estimation results show that the FCI is a leading indicator for credit accelerations. As can be seen from Figure 3 and, based on the dynamics of year on year growth in nominal private sector credit, Seychelles experienced four credit cycles over 2007Q1–2018Q3. These include 2007Q1–2009Q4, 2009Q4–2013Q2, 2013Q2–2017Q1 and 2017Q1–2018Q3 (Figure 3). These four credit growth cycles roughly coincide with the four credit to GDP gap cycles whereas the financial cycles as identified through the dynamics of the FCI begin and end about two to

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[9] According to the BCBS (2010), banks should start building the CCB when the credit-to-GDP gap surpasses 2 percentage points, up to a maximum of 10 percentage points, at which point the maximum size of the CCB of 2.5 percent of risk-weighted assets is normally reached. Banks can reduce the buffer when allowed so by the regulator. This is normally the case when the credit boom episode is over or when bank losses rise in a downturn.

three quarters before the credit boom-bust cycles (Figure 3). This indicates that in the case of Seychelles, FCI is a better predictor of credit booms and bust than the credit-to-GDP gap.

28.   In the case of Seychelles, the FCI also appears to be a better predictor for deteriorating loan quality and loss of profitability than the credit gap (Figure 4). The rise to the peak of the FCI started in early 2009, just a few quarters before the NPL ratio[10] was beginning to rise. The FCI then kept rising for about two years, a few quarters ahead of the continued deterioration of the loan portfolio. The credit gap on the other hand either turned positive contemporaneously with rising NPLs or turned negative as the loan portfolio deterioration intensified. A similar pattern can be observed through the dynamics of the FCI, the credit gap and the return on equity (ROE) ratio. Thus, in addition to being a better predictor of credit booms and busts, the FCI appears to also be a better predictor of run-ups in NPLs and deterioating profitability. As the credit gap did not predict the past credit boom/bust episodes in time, it may be better to rely mainly on the FCI. It is however challenging to give concrete guidance on setting the CCB based on only one recent episode of mild banking distress.

E.   Conclusions

29.   This paper develops a financial condition index for Seychelles using different approaches. Two sets of FCIs derived from the standard VAR and PCA approaches reassuringly display a high correlation and thus strongly agree in their trajectories. This includes only slight differences between the constructed FCI and the one purged from the influence of real variables as well as between the static and the dynamic FCI that also incorporates variable lags.

30.   Domestic financial conditions dominate domestic conditions in the FCIs. The NEER has the highest factor loading and thus contribute the most to the FCIs, followed by currency in circulation and private sector credit. Lending and Treasury bill rates feature least prominently. Among the external variables, the Morgan Stanley Capital International index for Europe (MSCI EUR) has the highest importance, followed by Europe's stock market volatility index (VSTOXX).

31.   We show that financial conditions matter for Seychelles' economy and that the predictive power of FCIs is high. The FCI predicts changes in economic activity well. This was particularly true for the 2008-09 and the 2011-13 economic downturns that were signaled by a marked decline in the FCIs one year before as well as the subsequent recovery when the FCI turned around ahead of the real economic activity.

32.   The FCI can also help inform macroprudential policy decisions. Once Seychelles completes the transition to Basel II and the adoption of Basel III capital definition, decisions on setting the countercyclical capital buffer of Basel III that may be introduced could be informed by scrutinizing FCI developments. Historically Seychelles has experienced one financial crisis since the early 2000s, and the constructed FCIs predicts well the boom-bust episodes. Hence, the FCI

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[10] Consistent information on NPLs is available only from 2008.

and perhaps other relevant information could be used for macroprudential policy purposes (such as activating the countercyclical capital buffer).

33.   In sum, the economic forecasting framework for Seychelles could be usefully augmented with the FCI. While there may exist other variables that can be thought of as leading indicators of economic activity in Seychelles, the FCI conveniently aggregates key external and domestic variables that are shown to influence future domestic real and financial activity.
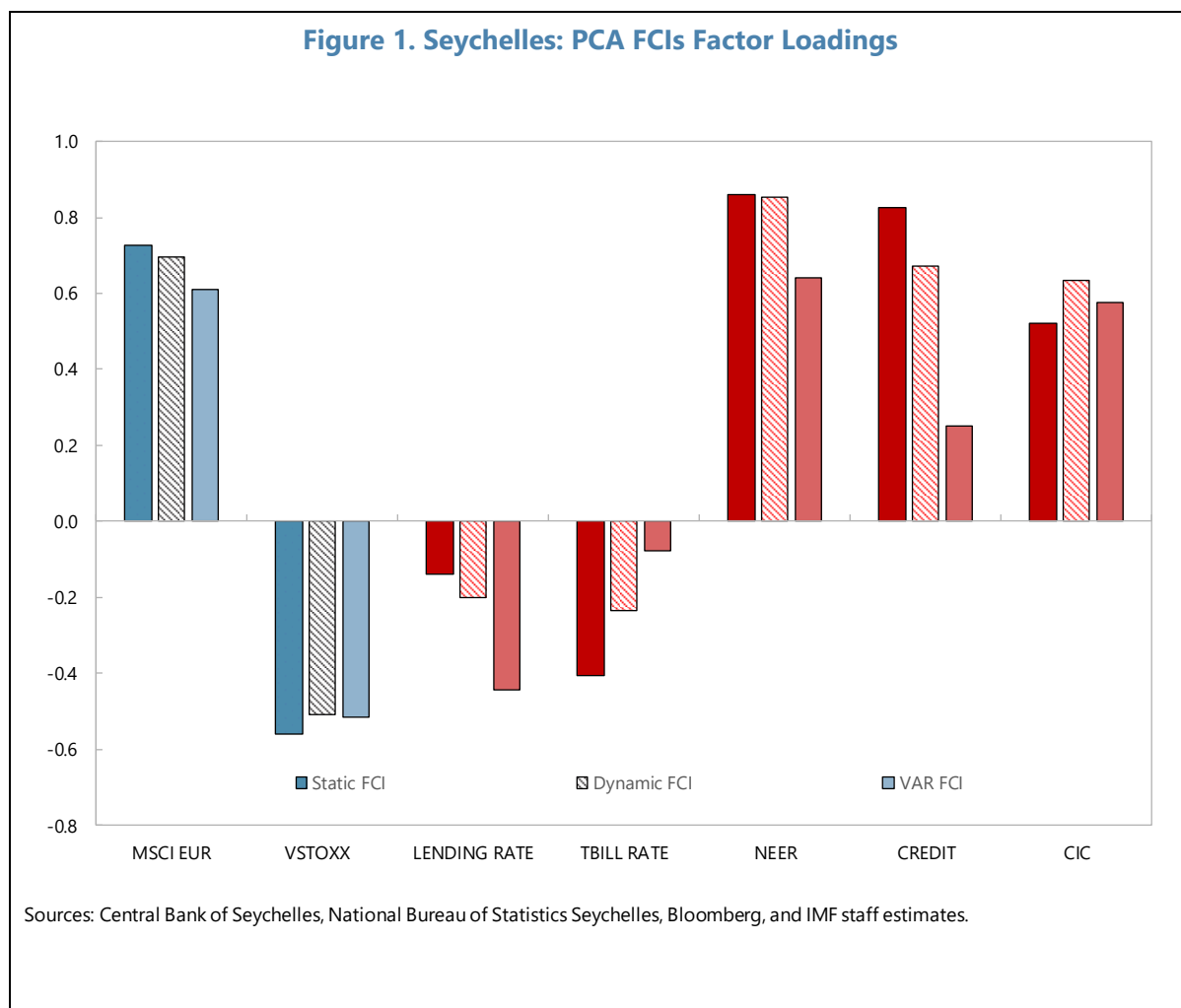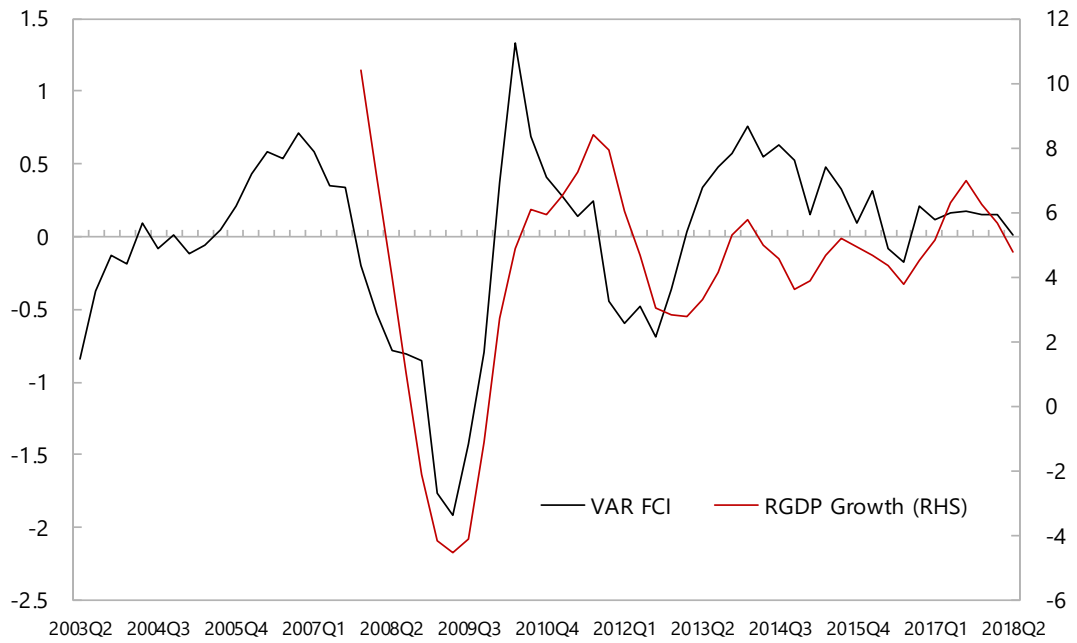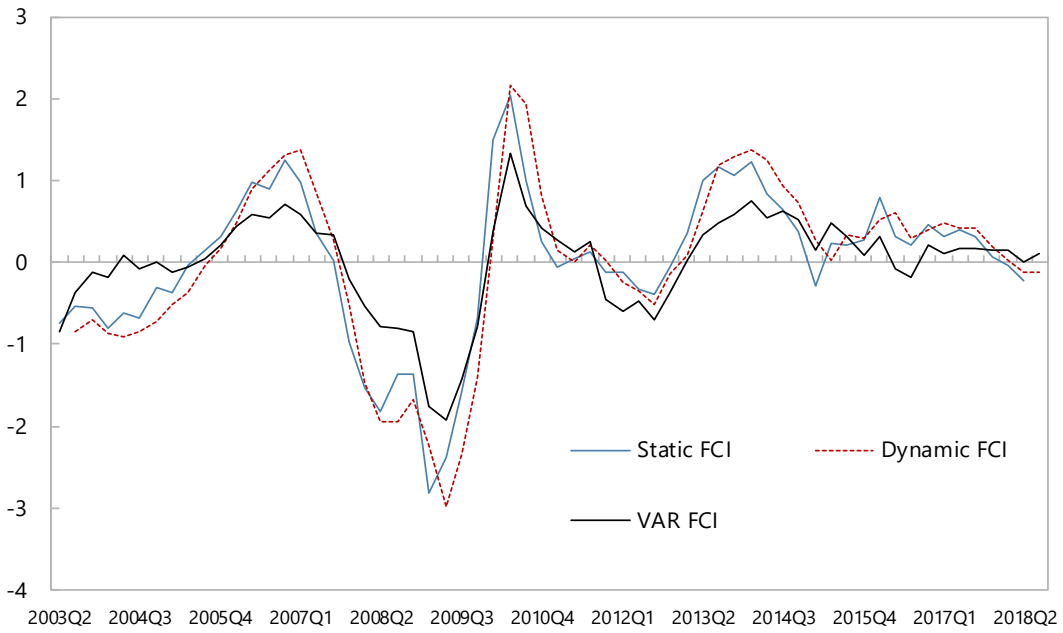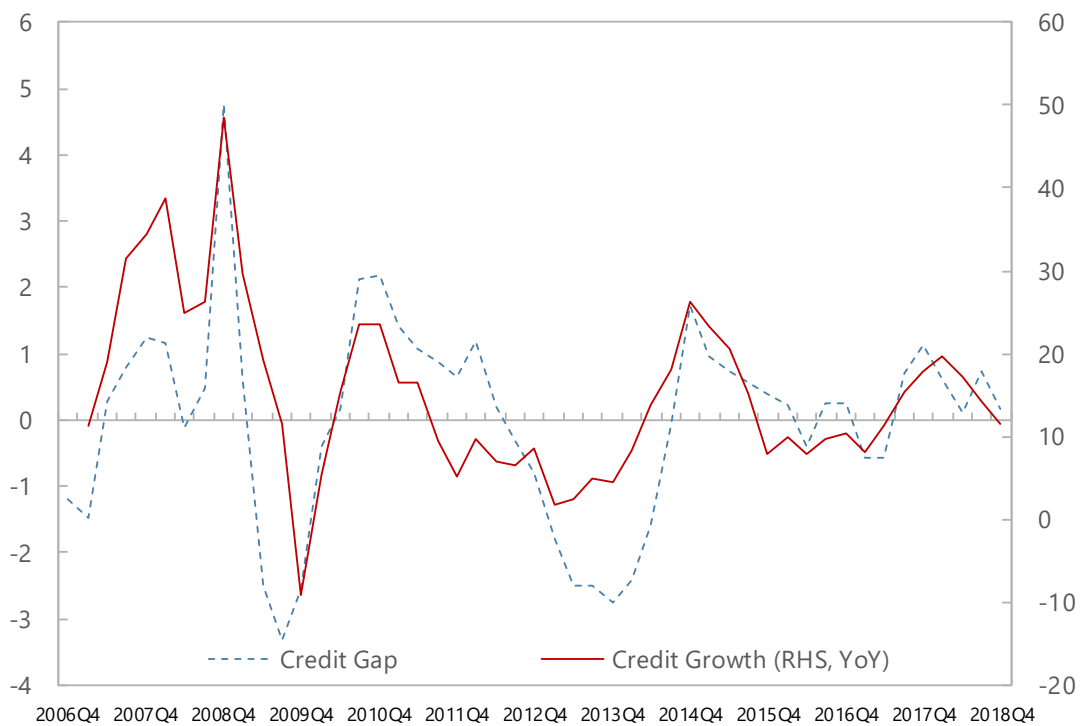
Figure 1. Seychelles: PCA FCIs Factor Loadings

Sources: Central Bank of Seychelles, National Bureau of Statistics Seychelles, Bloomberg, and IMF staff estimates.
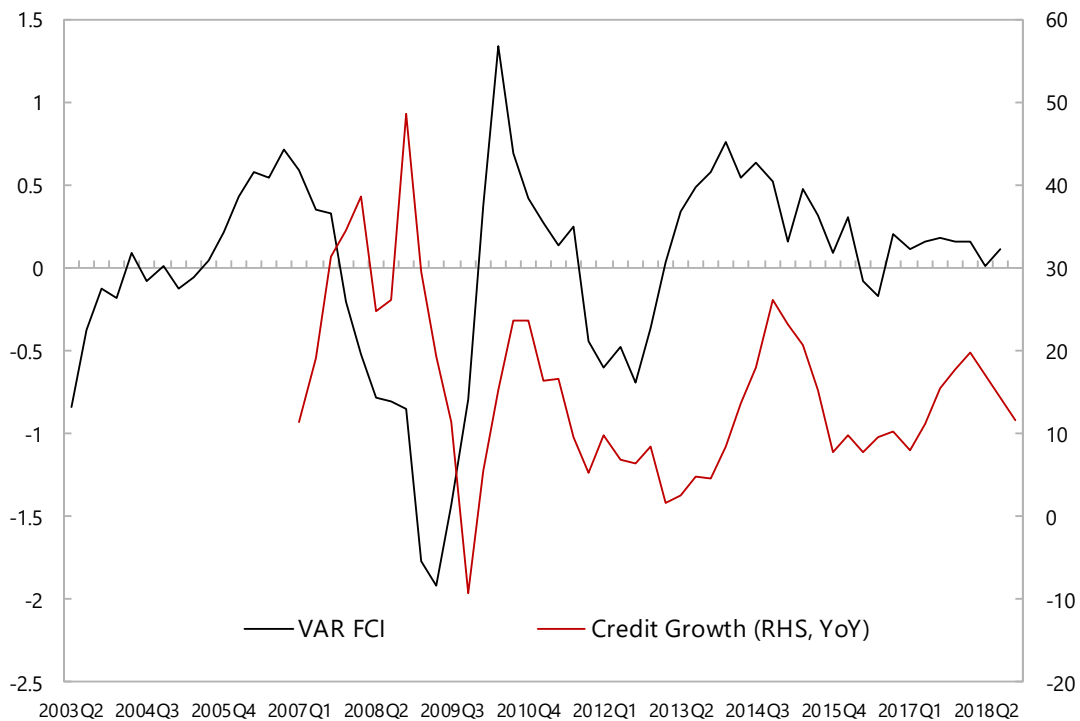
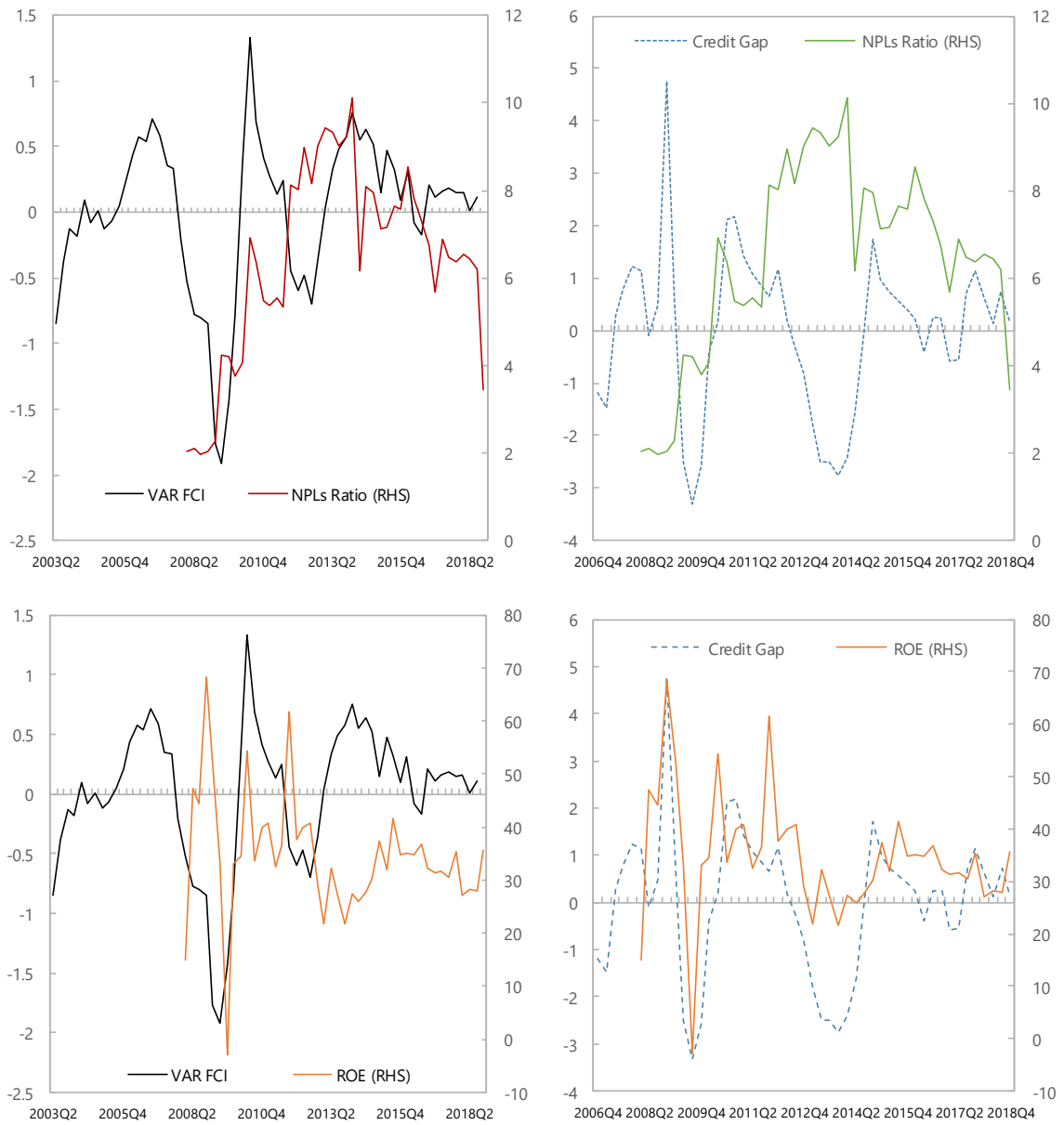**Figure 2. Seychelles: Constructed FCIs and GDP Growth, 2003Q2-2018Q3**

Sources: Central Bank of Seychelles, National Bureau of Statistics Seychelles, Bloomberg, and IMF staff estimates.

Figure 3. Seychelles: FCI, Credit Gap and Credit Booms and Busts, 2003Q2-2018Q4

Sources: Central Bank of Seychelles, National Bureau of Statistics, Bloomberg, and IMF staff estimates.

Figure 4. Seychelles: FCI, Credit Gap, Loan Quality and Banks' Profitability, 2003Q2-2018Q4

Sources: Central Bank of Seychelles, National Bureau of Statistics Seychelles, Bloomberg, and IMF staff estimates.

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