Finance-driven business cycles in emerging markets? An empirical assessment of Minskyan endogenous cycle approaches

Karsten Kohler*

Abstract
Post-Keynesian and structuralist approaches argue that business cycles in emerging market economies (EMEs) are generated by endogenous cycle mechanisms rather than exogenous shocks. The paper considers three distinct financial variables that may interact with output in a cyclical manner: interest rates, external debt, and the nominal exchange rate. We estimate country-wise VARs to test these three cycle mechanisms using data for 13 emerging market economies over the period 1960-2017. We find evidence for a cyclical interaction mechanism between output and the exchange rate in Chile the Philippines, and South Africa, consistent with business cycle models that highlight the role of balance sheet effects. There is some evidence for a cycle mechanism in Israel, in line with models in which currency depreciations are expansionary. With respect to external debt, we find some evidence for a Minskyan interaction mechanism with contractionary effects of external debt in Mexico and South Africa. Lastly, there is some but weaker evidence for an interaction mechanism with the real interest rate in Argentina, Mexico and South Africa. Overall, the results indicate that different variables are likely to be relevant for business cycles in different countries but that multiple cycle mechanisms can coexist and produce different business cycle frequencies.

JEL codes: E12, E32, F31, C32

Key words: Minsky, structuralism, emerging market economies, business cycle, financial-real cycles, vector-autoregression.

* Kingston University London, Department of Economics, Penrhyn Road, Kingston upon Thames, Surrey, KT1 2EE, UK. E-Mail: k_koehler@ymail.com
1 Introduction

Business cycles in emerging market economies (EMEs) are considerably more volatile compared to industrial economies and are often referred to as boom-bust cycles. Recessions are typically deeper and costlier compared to rich economies, and tend to be more severe when they coincide with banking and currency crises (Calderón and Fuentes, 2014). As a result, boom-bust cycles have received much attention from both the policy-making and academic world. Economic theory faces the challenge to develop business cycle models that adequately account for structural features of EMEs, especially their dependence on external and financial factors.

Mainstream economist have modified standard real business cycle (RBC) models to explain some of the specificities of EM business cycles (Neumeyer and Perri, 2005; Aguiar and Gopinath, 2007; Chang and Fernández, 2013). RBC models study different propagation mechanisms that can account for excess volatility in EME cycles, but the ultimate source of fluctuations are exogenous shocks. By contrast, Post-Keynesians and structuralists (PK-S) highlight the endogenous nature of (EME) cycles (Palma, 1998; Harvey, 2010). PK-S approaches offer various endogenous interaction mechanisms between certain macroeconomic variables that generate aggregate fluctuations. The Minskyan branch of the PK-S approach argues that business cycles are finance-driven (for a survey see Nikolaidi and Stockhammer, 2017). Variables that have been considered key for finance-driven business cycles in EMEs are interest rates (Foley, 2003; Frenkel, 2008; Frenkel and Rapetti, 2009), external debt (Palma, 1998; Taylor, 1998; Taylor, 2004, chap. 10; Botta, 2017), and exchange rates (Stiglitz et al., 2006, chap. 6; Ocampo, 2016; Kohler, 2019). However, there are only a few fully specified business cycles models that consider how these variables interact with output, as many approaches remain partial (e.g. Taylor, 2004, chap. 10; Botta, 2017) or descriptive (e.g. Palma, 1998; Taylor, 1998; Frenkel and Rapetti, 2009; Harvey, 2010).

The empirical literature on business cycles in EMEs broadly falls into three categories. First, there is a large number of event studies that either identifies factors that make the occurrence of crisis episodes more likely or that examines the behaviour of key macroeconomic indicators around those events (Kaminsky and Reinhart, 1999; Reinhart and Reinhart, 2009; Reinhart and Rogoff, 2011; Gourinchas and Obstfeld, 2012; Catão and Milesi-Ferretti, 2014; Calderón and Fuentes, 2014; Ghosh et al., 2016). Crisis episodes in this literature are discrete events such as currency, financial or external debt crises, and the predominant econometric methods relies on models with limited dependent variable models (e.g. logit or probit) or descriptive statistics. Second, there is a growing literature on the effects of global financial shocks on domestic variables in EMEs (Adler and Tovar, 2013; Carrière-Swallow and Céspedes, 2013; Cesa-Bianchi et al., 2015; Choi, 2018). These
studies typically rely on impulse response functions from vector-autoregressions (VARs), which track the dynamic behaviour of a set of endogenous variables in response to external shocks. Lastly, the heterodox empirical literature offers rich descriptive accounts that try to capture the complex mechanisms behind cycles and often pay close attention to the institutional and historical context of specific episodes (Palma, 1998; Taylor, 1998; Frenkel, 2008; Frenkel and Rapetti, 2009; Harvey, 2010; Herr, 2013; Ocampo, 2016).

Overall, the existing empirical literature has not aimed at identifying interaction mechanisms that may endogenously generate boom-bust cycles. Event studies, by construction, treat EME crises as discrete events without investigating macroeconomic mechanisms that would bring about those events with a certain periodicity. Similarly, the research on external shocks does not offer an explanation for the occurrence and frequency of shocks. While it discusses domestic amplification mechanisms of global financial shocks, these mechanisms by themselves do not (necessarily) generate periodic cycles, they merely make the response to shocks more volatile. These two strands of the empirical literature are thus close in spirit to the RBC approach, where business cycles are ultimately driven by exogenous shocks. The heterodox literature, in contrast, highlights the endogenous generation of cycles, as well as their periodicity. However, it has hitherto mostly remained at a descriptive level and has not attempted to test the key cycle mechanisms proposed in theoretical models econometrically.

The contribution of the present paper is to test a set of endogenous business cycle mechanisms discussed in the Minskyan open economy literature empirically. We consider three distinct variables that may interact with output in a cyclical manner: the interest rate, external debt, and the exchange rate. The paper employs the econometric approach developed in (Stockhammer et al., 2019) and estimate a set of bivariate VARs that allows for an assessment whether the key interaction mechanism postulated in those models is satisfied.

The dataset covers 13 EMEs (Argentina, Brazil, Chile, Colombia, India, Indonesia, Israel, Korea, Mexico, Philippines, South Africa, Thailand, and Turkey) and the maximum sample size ranges from 1960 to 2017. As the key variable to capture the business cycle, we use real gross domestic product (GDP). We consider three different variables that may interact with GDP in a cyclical manner: short-term real interest rates, external debt, and the nominal exchange rate with respect to the US dollar.

1 Palma (1998, p. 790, emphasis in original) claims that “‘over-lending' and 'over-borrowing' are essentially endogenous market failures: under-regulated and over-liquid financial markets setting in motion Kindleberger’s cycles of 'mania, panic and crash’”. Frenkel and Rapetti (2009) suggesting that “the nature of these cycles is fairly general” (ibid., p. 690).
We find strong evidence for Chile and South Africa, and some evidence for the Philippines for an interaction mechanism between output and the exchange rate, where exchange rate depreciations drag down output dynamics due to balance sheet effects, whereas economic expansions reduce the value of the currency. There is some evidence for an exchange rate mechanism with opposite signs in Israel, in line with models in which currency depreciations are expansionary. With respect to external debt, we find some evidence for an interaction mechanism between output and external debt in Mexico and South Africa, consistent with the hypothesis of rising indebtedness during economic booms, which then feed negatively into output. Lastly, there is weak evidence for an interaction mechanism between the short-term interest rate and output, where rising interest rates depress output, whereas economic expansions lead to an increase in interest rates in Argentina, Mexico, and South Africa.

The remainder of the paper is structured as follows. The second section provides a brief overview of PK-S theories of business cycles in EMEs. Section 3 develops a simple formal framework for endogenous interaction mechanisms and summarises the relevant interaction mechanisms that will be tested empirically. The fourth section introduces the data set and estimation framework. Section 5 presents the estimation results. Finally, section 6 concludes.

2 Post-Keynesian and structuralist theories of business cycles in emerging market economies

While PK-S have traditionally placed a somewhat stronger focus on the determinants of long-run growth, they have also made major contributions to a better understanding of short- to medium-run macroeconomic fluctuations in EMEs. Business cycles in PK-S theories are conceived of as an endogenous outcome of specific macroeconomic interaction mechanisms rather than the result of stochastic shocks. Such cycle-generating mechanisms typically consist of the dynamic interaction of two or more state variables whereby one variable pushes up the other, which in turn drags down the first variable (see for instance Taylor, 2004, chap. 9). While traditional heterodox business cycle models in the spirit of Kalecki, Kaldor, Goodwin, and Minsky are predominantly closed economy models,\(^2\) there is a handful of open economy business cycle models that are applicable to EMEs.

Differences between PK-S approaches to cycles in EMEs arise with respect to the assumed exchange rate regime – largely for historical reasons. Narrative accounts that were written

---

\(^2\) For a survey of vintage Kaleckian, Kaldorian, and Goodwinian cycle models see Semmler (1986). For a recent survey of Minskyan approaches see Nikolaidi and Stockhammer (2017). Notably, none of the reviewed business cycles models therein is an open economy model.
under the impression of the Latin American crises in the 1990s and early 2000s, as well as the East Asian crisis in 1997-98, highlight the role of a fixed exchange rate regime, reflecting the dominant exchange rate policy at the time (e.g. Taylor 1998, Frenkel and Rapetti 2009). This is embodied in the assumption of a fixed nominal exchange rate in several formal models (Sethi 1992, Foley 2003, Taylor 2004, chap. 10). More recent approaches highlight the role of exchange rate volatility (Herr 2013, Kaltenbrunner and Painceira 2015, Ocampo 2016), which came with the adoption of (semi-)flexible exchange rate regimes in the last two decades. The switch to flexible or at least semi-flexible exchange rates has been captured in more recent cycle models (Lima and Porcile 2013, Sasaki et al. 2013, Botta 2017, Kohler 2019).

A second dimension along which PK-S approaches to EM cycles differ concerns the role of (external) financial factors. Heterodox open economy business cycle models in the Kaldorian, Goodwinian, and Kaleckian traditions are more tilted to the real side and typically focus on multiplier-accelerator effects, distributional conflict, and the real exchange rate (Sethi, 1992; Asada, 1995; La Marca, 2010; Lima and Porcile, 2013; Sasaki et al., 2013). By contrast, approaches in the Minskyan tradition of finance-driven business cycles assign a key role to finance; in particular to the role of interest rates, external debt, and nominal exchange rates (Foley, 2003; Taylor, 2004, chap. 10; Botta, 2017; Kohler, 2019). The focus of this paper is on Minskyan theories of finance-driven business cycles. This approach has consistently accounted for the implications of financial openness for macroeconomic dynamics, which is widely considered to be the defining feature of emerging market economies.

Foley (2003) and Taylor (2004, chap. 10) develop models in which interest rate dynamics are at the centre. In Foley (2003), boom-bust cycles are generated by the interplay of a confidence factor that drives up investment expenditures when interest rates fall and a central bank that raises the interest rate whenever the growth rate of the economy is above its target level. In Taylor (2004), interest rate dynamics are governed by risk premia which are decreasing in the stock of foreign reserves - a mechanism that is also highlighted in Frenkel (2008) and Frenkel and Rapetti (2009). Capital inflow shocks increase the stock of reserves and diminish risk premia, but the resulting boom leads to a build-up of a current account deficits. As a result, foreign reserves begin to shrink, the risk premium increases, and the boom comes to an end.

There is also a rich, but largely informal literature, that introduces open economy aspects into the Minskyan framework and highlights them importance of external debt in EME business cycles (Palma, 1998; Taylor, 1998; Kregel, 1998; Arestis and Glickman, 2002; Cruz et al., 2006; Frenkel and Rapetti, 2009; Harvey, 2010; Kaltenbrunner and Painceira,
External debt is considered a key source of financial instability in EMEs, which often borrow from abroad given high domestic funding cost and weak financial institutions. While capital inflows may finance real investment expenditures, rising external debt burdens are associated with increasing interest payments and decreasing net worth of economic units, which often involve higher risk premia, credit rationing or sudden capital outflows when foreign investors become nervous. External debt thereby becomes a key variable for business cycle dynamics.

Lastly, recent approaches have addressed the role of flexible exchange rates for Minskyan business cycle dynamics in open economies (Botta, 2017; Kohler, 2019). In the nominal exchange rate interacts with external debt in a cyclical manner. Capital inflows lead to nominal exchange rate appreciation; however, as the stock of external debt successively increases during the boom, foreign investors get anxious and curb the supply of foreign finance. At the same time, the resulting real appreciation worsens the current account position, which puts further downward pressure on the nominal exchange rate. This mechanism leads to external deleveraging. Kohler (2019) presents a model in which procyclical exchange rates and currency mismatches drive EM business cycles. Exchange rate appreciation improves the balance sheets of firms with foreign-currency debt. The resulting boom drives up the current account deficit, which puts pressure in exchange rates. The currency depreciation induces contractionary balance sheet effects then turn the boom into a bust.

Overall, the PK-S literature identifies several interaction mechanisms that may generate business cycles endogenously. The more recent Minskyan literature highlights the role of financial factors. Key variables that feature prominently in finance-driven business cycle mechanisms are interest rates, external debt, and the exchange rate.

3 A basic formal framework for endogenous cycle mechanisms

The endogenous cycle-generating mechanism postulated by PK-S theories of business cycles can be formalised as follows. Consider a bivariate first-order system of differential equations in which two variables \((y, z)\) interact dynamically:

\[
\begin{bmatrix}
\dot{y} \\
\dot{z}
\end{bmatrix} = \begin{bmatrix}
\alpha_0 \\
\beta_0
\end{bmatrix} + \begin{bmatrix}
\alpha_1 & \alpha_2 \\
\beta_1 & \beta_2
\end{bmatrix} \begin{bmatrix}
y \\
z
\end{bmatrix},
\]

(1)

---

3 To facilitate comparison with the PK-S literature where models are predominantly written in continuous time, the framework presented in this section is in continuous rather than discrete time. However, the key condition for a cycle mechanism derived in continuous time equally holds in the discrete time framework employed in the econometric analysis of this paper.
The system in (1) can be regarded as a generic linearized reduced-form representation of the basic structure of many of the PK-S models discussed in the previous section.

The Jacobian matrix $J$ of (1) is given by,

$$J = \begin{bmatrix} J_{11} & J_{12} \\ J_{21} & J_{22} \end{bmatrix} = \begin{bmatrix} \alpha_1 & \alpha_2 \\ \beta_1 & \beta_2 \end{bmatrix}. \quad (2)$$

The system in (1) will produce oscillations when the eigenvalues of the Jacobian in (2) are complex conjugates. As shown in Stockhammer et al. (2019), complex conjugates can only emerge if $J_{21}J_{12} < 0$, or $\alpha_2\beta_1 < 0$ in (1) and (2). The economic intuition behind this condition is that cycles can only arise if there is an interaction mechanism by which an increase in one variable pushes up the dynamics of the second variable, which in turn drags down the first.

While a two-dimensional (2D) model is somewhat restrictive given that real world time series are likely to be determined by higher-dimensional processes, the two dimensional framework has the advantage that a tractable condition with a clear economic interpretation for the presence of cycles can be derived. Moreover, many theoretical benchmark models in the PK-S tradition are 2D (see e.g. Taylor 2004, chap. 9; Asada 2001; Foley 2003). We therefore consider the 2D framework as the most appropriate to identify relevant cycle-generating mechanisms. A practical implication of this approach is that in principle the same variable may interact with multiple variables in a cyclical manner. Therefore, the reduced-form in (1) should not be regarded as unique, as there are possibly several of such interaction mechanisms which are not mutually exclusive.

Applying this simple formal framework to the issue of finance-driven business cycles, one can interpret $y$ as a measure for real activity, e.g. output. The variable $z$ then represent a financial variable that interacts with output in a cyclical manner. Based on our discussion of the PK-S literature in section 2, we will consider three different variables: the interest rate, the external debt ratio, or the exchange rate. The literature suggests a negative effect of the interest rate and external debt on output ($\alpha_2 < 0$), while output in turn is expected to push up the interest rate and external debt ($\beta_1 > 0$). The exchange rate cycle mechanism allows for two regimes: in the case where the Marshall-Lerner condition holds, exchange rate depreciations boost output dynamics, which in turn lead to currency appreciation ($\alpha_2 > 0, \beta_1 < 0$). We will call this the Marshall-Lerner regime. If, on the other hand, depreciations are contractionary because of foreign currency-denominated debt on private balance sheets and if economic booms reduce the value of the currency, the
economy is in a *balance sheet effect regime* \((\alpha_2 < 0, \beta_1 > 0)\). The three different cases and its main properties are summarised in Table 1:
Table 1: Summary of cyclical interaction mechanisms

<table>
<thead>
<tr>
<th>Interaction mechanism</th>
<th>Motivated by</th>
<th>Interest rate</th>
<th>Exchange rate</th>
<th>Output</th>
<th>Predicted signs in (1)</th>
</tr>
</thead>
</table>
| Output - interest rate| Foley (2003)                                    | Determined by central bank | Fixed           | Sensitive to interest rate | $\alpha_2 < 0$  
$\beta_1 > 0$ |
| Output - external debt| Minskyan open economy literature (e.g. Arestis and Glickman, 2002; Cruz et al., 2006; Frenkel and Rapetti, 2009) | Exogenous     | Fixed           | Sensitive to external debt | $\alpha_2 < 0$  
$\beta_1 > 0$ |
| Output - exchange rate| Kohler (2019); Stiglitz et al. (2006); Harvey (2010); Ocampo (2016) | Exogenous     | Flexible       | Sensitive to exchange rate | Marshall-Lerner regime:  
Marshall-Lerner regime:  
Balance sheet effect regime: | $\alpha_2 < 0$  
$\beta_1 > 0$.  
Balance sheet effect regime: | $\alpha_2 > 0$  
$\beta_1 < 0$. |

4 Econometric approach

4.1 Estimation framework

The estimation strategy employed in this paper follows Stockhammer et al. (2019). As argued therein, the basic reduced-form interaction cycle model given by equation (1) can be written as a system of difference equations to which the condition for a cycle mechanism identified in section 3 applies in the same way. In principle a discretised version of the system in (1) could be estimated as VAR(1). However, the system in (1) is likely to be mis-specified as the data generating process may be a higher-dimensional, higher-order dynamic system. If these higher-order lags are omitted from the estimated model, they will render the error terms serially correlated. A more realistic representation of the data-generating process is thus given by

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \alpha_0 \\ \beta_0 \end{bmatrix} + \begin{bmatrix} \alpha_1 & \alpha_2 \\ \beta_1 & \beta_2 \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix},$$  (3)

$$\begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix} = \sum_{i=1}^{p} A_i \begin{bmatrix} y_{t-i} \\ z_{t-i} \end{bmatrix} + \begin{bmatrix} \epsilon_{yt} \\ \epsilon_{zt} \end{bmatrix},$$  (4)

where $\epsilon_{yt}$ and $\epsilon_{zt}$ are white noise error terms, and $A_i$ are diagonal parameter matrices. Substituting (3) into (4) and re-arranging, one can rewrite this as a VAR($p$) with $p$ lags in which $\alpha_2$ and $\beta_1$ are the only parameters which are uniquely identified:
\[
\begin{bmatrix}
y_t \\
z_t
\end{bmatrix} = \begin{bmatrix}
\alpha_0 \\
\alpha_1 \\
\alpha_2
\end{bmatrix} + \begin{bmatrix}
\beta_0 \\
\beta_1 \\
\beta_2
\end{bmatrix} \begin{bmatrix}
y_{t-1} \\
z_{t-1}
\end{bmatrix} + \sum_{i=1}^{p} A_t \left( \begin{bmatrix}
y_t \\
z_t
\end{bmatrix} - \begin{bmatrix}
\alpha_0 \\
\alpha_1 \\
\alpha_2
\end{bmatrix} \begin{bmatrix}
y_{t-i} \\
z_{t-i}
\end{bmatrix} \right) + \begin{bmatrix}
\epsilon_y \\
\epsilon_z
\end{bmatrix}.
\]

(5)

By estimating the higher-order \text{VAR}(p) in (5), the necessary condition for the existence of a cycle mechanism in (1), i.e. \( \alpha_2 \beta_1 < 0 \) can be evaluated. We can further assess whether the predicted signs summarised in Table 1 are empirically valid. To determine the appropriate lag length \( p \) in practice, we start with a minimum lag length of 2. We then check for serial correlation in the residuals and successively increase the number of lags up to 6 until all serial correlation is removed. If this approach fails to remove serial correlation, we disregard the respective country from the results as irreducible serial correlation might point to model mis-specification.

Lastly, the \text{VAR} approach can also be used to obtain the eigenvalues of the Jacobian matrix. From the complex conjugate eigenvalues, the implied cycle length can be calculated (see Shibayama, 2008; Stockhammer et al., 2019). Each pair of complex eigenvalues of the estimated system in (5) corresponds to a distinct cycle frequency in the endogenous variables of the system. We will assess the implied cycle frequencies to examine whether different financial variables may be associated with different cycle frequencies in real activity.

4.2 Dataset

The dataset consists of 13 medium- to large EMEs: Argentina, Brazil, Chile, Colombia, India, Indonesia, Israel, Korea, Mexico, Philippines, South Africa, Thailand, and Turkey. The data is at annual frequency and, depending on the country and variables for which the \text{VAR} is estimated, the sample size ranges from 1960 to 2017. In the estimations, we impose a minimum of 30 degrees of freedom and exclude those countries whose number of observations do not permit to meet this requirement. As the standard measure of the business cycle is gross domestic product (GDP), we use the natural logarithm of real GDP (GDP) in each of the bivariate \text{VAR}s. To test for an output-interest rate interaction mechanism, we use the short-term real interest rate (INTR). For the cycle mechanism with external debt, we construct a proxy for private external debt by deducting long-term public external debt from total external debt and divide by gross domestic product (EXDEBT).\(^5\)

Unfortunately, data availability does not permit to subtract short-term public debt. It should thus be borne in mind that \text{EXDEBT} is only a proxy for private external debt. Moreover, note that we use debt to income ratios rather than the level of debt because the

\(^4\) Details on data sources and construction can be found in the Appendix.

\(^5\) For Chile, Israel and Korea long-term public external debt series are not available. Hence, \text{EXDEBT} for these countries is total external debt.
negative effects of rising debt assumed in the theoretical literature typically hinge on deteriorating financial robustness, which can be proxied by debt to income ratios. Lastly, to test theories where exchange rates are at the heart of the interaction mechanism, we use the natural logarithm of the bilateral nominal exchange rate with the US dollar (\( XRATE \)). Compared to effective exchange rate series, the exchange rate with the US dollar has considerably more observations and is thus preferred.\(^6\)

The VAR is estimated in (log-) levels, which is common in the VAR literature when it is unclear whether the relevant variables contain a unit root and/or are cointegrated. As Kilian and Lütkepohl (2017, chap. 3) point out, there is an asymmetry between incorrectly imposing a unit root (and then over differencing the data) and failing to impose a unit root when there is one. While the former renders the VAR estimator inconsistent under standard assumptions, the latter approach preserves consistency and may only come with a loss in efficiency (i.e. a reduction in the precision of the estimator). The VAR can be consistently estimated in levels with asymptotically normal standard errors even if some variables are I(1) because the presence of lags would allow the I(1) variables to be re-written as coefficients on differenced and thus I(0) variables (Sims et al., 1990). If the I(1) variables drift, this will be captured by the intercept term of the VAR model. This approach may require a lag augmentation of the VAR (which We practically achieve by adding lags to the model until all serial correlation in the errors is removed), hence the loss in efficiency. However, compared with the potential inconsistency of a VAR in differences, the VAR in levels clearly is the preferable alternative. Furthermore, no further insights for our purposes would be gained from imposing a specific cointegration structure and estimating a vector error correction model (VECM). In sum, the VAR model in (log) levels is the most appropriate specification for the purposes of this paper.

The coefficients of the matrix \((1)\) will be functions of structural parameters of the economy, e.g. the import propensity and the sensitivity of investment with respect to output, which are likely to differ across countries. Point estimates are thus expected to be heterogeneous across countries, which would render a dynamic panel estimator inconsistent (Pesaran and Smith, 1995). We consider econometric remedies to this heterogeneity-problem such as mean group estimators which aggregate point estimates after estimation not useful for our purposes, as the aggregation procedure would potentially even out different country-specific regimes. We therefore opt to estimate country-wise VARs rather than pooling all series in a panel.

\(^6\) Moreover, external liabilities are predominantly denominated in US-dollars. Bilateral US dollar exchange rates are therefore more suitable to capture balance sheet effects than trade-weighted effective exchange rates.
EMEs are well known for undergoing turbulent episodes in their monetary history, for instance due to speculative attacks on the exchange rate, hyperinflation, or large-scale debt default. Oftentimes, these episodes are not systematically related to the business cycle and stem from extraneous international events or unique policy interventions. These episodes can manifest themselves in time series mainly in two forms, either as outliers or as mean shifts. Insofar as they remain unexplained by the interaction mechanism captured by the VAR model, they can bias the estimated coefficients due to model mis-specification. In order to detect possible outliers or mean shifts we plot the time series of the financial variables in Figure 1:
Figure 1: Scatterplots of financial variables

INTR

EXDEBT
Notes: ARG: Argentina; BRA: Brazil; CHL: Chile; COL: Colombia; IND: India; IDN: Indonesia; ISR: Israel; KOR: South Korea; MEX: Mexico; PHL: Philippines; SAF: South Africa; THA: Thailand; TUR: Turkey. Data definitions in the Appendix.
Visual inspection of the series leads to the following observations:

- In the \textit{INTR} series, the observations for Argentina (1989), Brazil (1898-1990) and the Philippines (1984) are potential outlier candidates, as they appear to be relatively isolated hikes. In contrast, there do not appear to be mean shifts. Upon closer inspection, the value for Argentina in 1989 is identified as a clear outlier, which constitutes a one-off interruption (probably due to hyperinflation in that year) of an otherwise fairly regular cycle in \textit{INTR}. For the outlier candidates in Brazil and the Philippines, the situation is less clear-cut as the spikes could also be regarded as the (especially strong) peak (trough) of a cycle.

- In \textit{EXDEBT} no outliers are immediate. Mean shifts do not appear to be an issue either.

- Lastly, the \textit{XRATE} series appears to undergo multiple mean shifts in several countries. This is not surprising, as EMEs have often experienced currency crises after which the exchange rate stabilised at a higher (i.e. more depreciated) level. An example that is clearly visible in the sample is the attack on the Thai baht in 1997, which triggered the Asian financial crisis and hit other regional countries’ currencies too, such as Indonesia. Another cause for mean shifts are currency reforms which are often enacted in order to end periods of hyperinflation, for instance in Brazil in the early 1990s.

In order to deal with potential outliers in the \textit{INTR} series, we include dummy variables that assume the value 1 in the respective year and zero otherwise. Accounting for the mean shifts in \textit{XRATE} is more difficult, as visible inspection alone often does not allow for a clear-cut identification of the exact dates where mean shifts occur. For that reason, we resort to the step indicator saturation (SIS) approach developed in Castle et al. (2015). The simplest version of SIS is based on the split half approach: create step indicators (i.e. dummy variables that are equal to 1 from a specific break year onwards and zero before) for the entire sample period and split them in half. Then estimate the model on the full sample, first with only the first half of step indicators, and then with the second half. Retain those step indicators from both estimations whose p-value is equal or below \(1/T\) and re-estimate the model with only those step indicators. Lastly, further exclude step indicators whose p-value exceeds \(1/T\). As we are mainly interested in controlling for mean shifts in the \textit{XRATE} series, we only select those step indicators that are statistically significant in the \textit{XRATE}-equation. We then use those step indicators in both equations in order to maintain the symmetry of the VAR and to ensure that the slope coefficients on \textit{XRATE} in the \textit{GDP} equation capture only those effects that stem from the regular business cycle mechanism rather than exogenous shocks to the exchange rate regime.
5 Estimation results

5.1 Output-interest rate interaction

The estimation results with \textit{INTR} for the eight countries with at least 30 degrees of freedom are displayed in Table 2. For Argentina and Brazil, two separate models were estimated one without outlier dummies and one including impulse dummy (ID) variables to control for potential outliers visible in Figure 1. As these are statistically significant, we regard specifications (ID) for Argentina and Brazil preferable. For the Philippines, a model with an outlier dummy for 1984 was discarded as this introduced serial correlation, which also did not vanish after the inclusion of up to six lags.
Table 2: Estimation result for the VAR(q) with GDP and INTR

<table>
<thead>
<tr>
<th></th>
<th>ARG</th>
<th>ARG (ID)</th>
<th>BRA</th>
<th>BRA (ID)</th>
<th>IND</th>
<th>KOR</th>
<th>MEX</th>
<th>PHL</th>
<th>SAF</th>
<th>TUR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GDP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.GDP</td>
<td>1.172***</td>
<td>1.128***</td>
<td>1.277***</td>
<td>1.323***</td>
<td>0.914***</td>
<td>0.967***</td>
<td>1.166***</td>
<td>1.522***</td>
<td>1.282***</td>
<td>1.034***</td>
</tr>
<tr>
<td></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>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>L.INTR</td>
<td>-0.010</td>
<td>-0.012</td>
<td>-0.007</td>
<td>0.007</td>
<td>-0.226**</td>
<td>0.017</td>
<td>-0.073</td>
<td>0.127</td>
<td>-0.262***</td>
<td>0.163***</td>
</tr>
<tr>
<td></td>
<td>(0.457)</td>
<td>(0.342)</td>
<td>(0.291)</td>
<td>(0.467)</td>
<td>(0.031)</td>
<td>(0.944)</td>
<td>(0.400)</td>
<td>(0.187)</td>
<td>(0.000)</td>
<td>(0.006)</td>
</tr>
<tr>
<td><strong>INTR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.GDP</td>
<td>-1.701</td>
<td>0.180</td>
<td>-0.715</td>
<td>-0.600</td>
<td>0.113</td>
<td>0.100</td>
<td>0.299</td>
<td>-0.233</td>
<td>0.346</td>
<td>-0.059</td>
</tr>
<tr>
<td></td>
<td>(0.395)</td>
<td>(0.600)</td>
<td>(0.794)</td>
<td>(0.506)</td>
<td>(0.590)</td>
<td>(0.270)</td>
<td>(0.257)</td>
<td>(0.377)</td>
<td>(0.211)</td>
<td>(0.864)</td>
</tr>
<tr>
<td>L. INTR</td>
<td>-0.136</td>
<td>-0.041</td>
<td>0.747***</td>
<td>0.125*</td>
<td>0.345**</td>
<td>0.828***</td>
<td>-0.005</td>
<td>0.171</td>
<td>0.589***</td>
<td>0.244*</td>
</tr>
<tr>
<td></td>
<td>(0.414)</td>
<td>(0.150)</td>
<td>(0.000)</td>
<td>(0.053)</td>
<td>(0.023)</td>
<td>(0.000)</td>
<td>(0.972)</td>
<td>(0.309)</td>
<td>(0.000)</td>
<td>(0.072)</td>
</tr>
<tr>
<td>Obs</td>
<td>39</td>
<td>39</td>
<td>52</td>
<td>52</td>
<td>53</td>
<td>39</td>
<td>40</td>
<td>40</td>
<td>54</td>
<td>37</td>
</tr>
<tr>
<td>Lags (q)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Df</td>
<td>34</td>
<td>33</td>
<td>47</td>
<td>45</td>
<td>44</td>
<td>32</td>
<td>35</td>
<td>35</td>
<td>47</td>
<td>30</td>
</tr>
<tr>
<td>Necessary condition satisfied</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Expected signs</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Impulse dummy (ID)</td>
<td>no</td>
<td>1989</td>
<td>no</td>
<td>1989, 1990</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

Notes: ARG: Argentina; BRA: Brazil; IND: India; KOR: South Korea; MEX: Mexico; PHL: Philippines; SAF: South Africa; TUR: Turkey; p-values in parentheses; * p<0.10, ** p<0.05, *** p<0.01; Obs: number of observations; Df: degrees of freedom in each equation. Each equation was estimated with an intercept, which is not reported. Only the coefficients on the first lags are reported.
Overall, we note that the necessary condition for a cycle mechanism is satisfied in seven out of eight countries (for Argentina and Brazil, this is only the case in the models with outlier dummies). Out of these seven countries, four countries (Argentina, India, Mexico, South Africa) exhibit the expected signs discussed in section 3 of this paper ($\alpha_2 < 0$, $\beta_1 > 0$). Brazil, the Philippines, and Turkey, in contrast, display theoretically unexpected signs. Note that p-values are mostly below conventional levels of statistical significance with the exception of India and South Africa, where interest rates exert a statistically significant negative effect on GDP (at the 5% and 1% level, respectively). This is not untypical for VAR models with several lags where multicollinearity is often strong due to autocorrelated regressors. This means that the results have to be taken with some caution.

In order to gain further insights into the robustness of those estimates where the necessary condition for a cycle mechanism is satisfied, we conduct forward recursive estimations in which the parameters of the VAR are estimated for a restricted sample from the sample start to 1990, and then successively extend the sample by one period each. This exercise allows to assess whether the estimated coefficients are structurally stable over time: if the point estimates retain their sign over time, the parameter can be regarded as structurally stable. In contrast, if it passes through zero, the coefficients suffer from structural instability.
Figure 2: Forward recursive parameter estimation, VAR with GDP and INTR

Argentina (ID)

Brazil (ID)

India

Mexico

- Graphs showing parameter estimates over time for different countries with GDP and INTR.
Overall, parameters tend to be stable in the VARs for Argentina, Brazil, Mexico, South Africa, and Turkey. India and the Philippines, in contrast, exhibit parameter instability with the coefficient $\beta_1$ changing signs throughout the sample period. We therefore regard the estimates for these two countries as not robust.

Lastly, we use the estimated eigenvalue from the VARs to calculate the implied cycle frequency. The results are summarised in Table 3. Notably, we do not find complex eigenvalues for the VARs with Brazil and Turkey, where the coefficients exhibit unexpected signs. This suggests that although the necessary condition for a cycle mechanism is met, there is no cycle mechanism between interest rates and output. For Argentina, Mexico, South Africa, we do find complex eigenvalues with relatively short cycle lengths of around 3 $\frac{1}{2}$ to 4 $\frac{1}{2}$ years for those. This corresponds to the findings in Stockhammer et al. (2019) for advanced economies.

<table>
<thead>
<tr>
<th></th>
<th>Real part ($h$)</th>
<th>Modulus ($R$)</th>
<th>Cycle length ($L$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>-0.040</td>
<td>0.270</td>
<td>3.65</td>
</tr>
<tr>
<td>Brazil</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mexico</td>
<td>-0.008</td>
<td>0.614</td>
<td>3.97</td>
</tr>
<tr>
<td>South Africa</td>
<td>0.045</td>
<td>0.494</td>
<td>4.25</td>
</tr>
<tr>
<td>Turkey</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: The cycle length is calculated as $L = 2\pi / \arccos \left( \frac{h}{R} \right)$. For Argentina, specification with ID from Table 2 was used.

In sum, there is some support for a stable interaction mechanism between interest rates and output in Argentina, Mexico, and South Africa as hypothesized in some PK-S business cycle models (e.g. Foley 2003). The estimations suggest a cycle length between 3 $\frac{1}{2}$ to 4 $\frac{1}{2}$ years in those countries. Most coefficients lack statistical significance (except for the effect of interest rates on GDP for South Africa), so that the evidence is overall only weak.

5.2 Output-external debt interaction

Table 4 reports estimation results for the VAR with GDP and EXDEBT. Overall, the necessary condition for a cycle mechanism is satisfied in 7 of the 12 countries: Colombia, India, Indonesia, Korea, Mexico, the Philippines and South Africa. While the estimated coefficients for India exhibit unexpected signs, the coefficients for the remaining 6 countries display expected signs, where increases in external debt drag down output dynamics.

---

7 The VAR for Chile exhibited serial correlation in the residuals, which did not vanish after the inclusion of up to 6 lags and was therefore excluded.
whereas increases in output accelerate debt dynamics. Most coefficients are not statistically significant at conventional levels with the notable exception of the positive effect of $GDP$ on $EXDEBT$ in Indonesia and Mexico, and the negative effect of $EXDEBT$ on $GDP$ in South Africa, which are statistically significant at the 5% and 1% level.
Table 4: Estimation result for the VAR(q) with GDP and EXDEBT

<table>
<thead>
<tr>
<th></th>
<th>ARG</th>
<th>BRA</th>
<th>COL</th>
<th>IND</th>
<th>IDN</th>
<th>ISR</th>
<th>KOR</th>
<th>MEX</th>
<th>PHL</th>
<th>SAF</th>
<th>THA</th>
<th>TUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.GDP</td>
<td>1.066***</td>
<td>1.269***</td>
<td>1.274***</td>
<td>0.856***</td>
<td>1.186***</td>
<td>1.136***</td>
<td>0.881***</td>
<td>1.107***</td>
<td>1.404***</td>
<td>1.154***</td>
<td>1.380***</td>
<td>1.013***</td>
</tr>
<tr>
<td></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>
<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>L. EXDEBT</td>
<td>-0.003</td>
<td>-0.045</td>
<td>-0.039</td>
<td>0.148</td>
<td>-0.011</td>
<td>-0.023</td>
<td>-0.104</td>
<td>-0.032</td>
<td>-0.157</td>
<td>-0.246***</td>
<td>0.044</td>
<td>0.190</td>
</tr>
<tr>
<td></td>
<td>(0.982)</td>
<td>(0.801)</td>
<td>(0.845)</td>
<td>(0.694)</td>
<td>(0.915)</td>
<td>(0.697)</td>
<td>(0.399)</td>
<td>(0.874)</td>
<td>(0.116)</td>
<td>(0.004)</td>
<td>(0.702)</td>
<td>(0.463)</td>
</tr>
<tr>
<td>EXDEBT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.GDP</td>
<td>-0.291</td>
<td>-0.091</td>
<td>0.015</td>
<td>-0.038</td>
<td>1.224*</td>
<td>-0.932**</td>
<td>0.434</td>
<td>0.327***</td>
<td>0.255</td>
<td>0.345</td>
<td>0.135</td>
<td>0.127</td>
</tr>
<tr>
<td></td>
<td>(0.151)</td>
<td>(0.470)</td>
<td>(0.910)</td>
<td>(0.526)</td>
<td>(0.095)</td>
<td>(0.018)</td>
<td>(0.194)</td>
<td>(0.006)</td>
<td>(0.139)</td>
<td>(0.170)</td>
<td>(0.473)</td>
<td>(0.118)</td>
</tr>
<tr>
<td>L. EXDEBT</td>
<td>0.796***</td>
<td>1.081***</td>
<td>0.887***</td>
<td>0.857***</td>
<td>0.862***</td>
<td>0.934***</td>
<td>1.231***</td>
<td>1.025***</td>
<td>1.397***</td>
<td>1.207***</td>
<td>1.098***</td>
<td>1.012***</td>
</tr>
<tr>
<td></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>
<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>Obs</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>44</td>
<td>43</td>
<td>44</td>
<td>43</td>
<td>45</td>
<td>44</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Lags (q)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Df</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>34</td>
<td>39</td>
<td>38</td>
<td>40</td>
<td>40</td>
<td>39</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>Necessary condition satisfied</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Expected signs</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

ARG: Argentina; BRA: Brazil; COL: Colombia; IND: India; IDN: Indonesia; ISR: Israel; KOR: South Korea; MEX: Mexico; PHL: Philippines; SAF: South Africa; THA: Thailand; TUR: Turkey. p-values in parentheses; * p<0.10, ** p<0.05, *** p<0.01; Obs: number of observations; Df: degrees of freedom in each equation. Each equation was estimated with an intercept, which is not reported. Only the coefficients on the first lags are reported.
Again, we investigate parameter stability by forward recursive estimation for those countries where the necessary condition for a cycle mechanism is satisfied, starting from a restricted sample (sample start to 1985) and then successively adding one more observation. The results are displayed in Figure 3:
Figure 3: Forward recursive parameter estimation, VAR with GDP and EXDEBT

Colombia

India

Indonesia

Korea
Recursive parameter estimation for Colombia, India, Indonesia and Korea reveals parameter instability as either or both coefficients pass through zero at relatively late stages of the sample period (i.e. past 1990), often multiple times. In contrast, Mexico, the Philippines and South Africa display structural stability over time. The implied cycle length for those countries meeting the condition for a cycle mechanism and exhibiting stable parameters is calculated in Table 5. Mexico exhibits a complex eigenvalue implying a cycle length of around 18½ years. Similarly, the complex eigenvalue from the VAR for Philippines implies a cycle length of 19 years. For South Africa, we find a comparatively shorter cycle length of 11 years. Overall, this suggests that external debt cycles are of a medium-run to long-run frequency, and thereby longer than cycles with interest rates.

Table 5: Estimated cycle length based on eigenvalues, VAR with GDP and EXDEBT

<table>
<thead>
<tr>
<th>Country</th>
<th>Real part (h)</th>
<th>Modulus (R)</th>
<th>Cycle length (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>0.547</td>
<td>0.580</td>
<td>18.48</td>
</tr>
<tr>
<td>The Phillipines</td>
<td>0.684</td>
<td>0.723</td>
<td>19.00</td>
</tr>
<tr>
<td>South Africa</td>
<td>0.419</td>
<td>0.502</td>
<td>10.84</td>
</tr>
</tbody>
</table>

Note: The cycle length is calculated as $L = 2\pi / \arccos \left( \frac{h}{R} \right)$.

In sum, three countries exhibit stable coefficients that are consistent with an endogenous cycle mechanism between output and external debt: Mexico, the Philippines, and South Africa.

5.3 Output-exchange rate interaction
The estimation results for the VARs with GDP and XRATE are presented in Table 6. We restrict the sample start to 1970 as exchange rates were mostly fixed under the Bretton-Woods Regime, which prevailed during the 1960s. For each country, the VAR is estimated once without step indicators and once with step indicators (SI), which were selected following the procedure discussed in section 4.1. Again, we exclude estimation results that suffered from serial correlation that did not vanish after the inclusion of up to six lags.

---

8 Korea is an interesting case. A sign-switch of the two coefficients occurs at around 1998, i.e. after the East Asian crises. It is surprising that the conditions for a Minskyan cycle mechanism with external debt are only satisfied when adding the sample period after Asian crisis for Korea.

9 The VARs for the Philippines without step indicators and for Indonesia with step indicators were dropped due to serial correlation. The models with step indicators for Brazil and Turkey were dropped because of a lack of degrees of freedom.
Table 6: Estimation result for the VAR(q) with GDP and XRATE

<table>
<thead>
<tr>
<th></th>
<th>ARG (SI)</th>
<th>ARG (SI)</th>
<th>BRA (SI)</th>
<th>CHL (SI)</th>
<th>CHL (SI)</th>
<th>COL (SI)</th>
<th>COL (SI)</th>
<th>IND (SI)</th>
<th>IND (SI)</th>
<th>IDN (SI)</th>
<th>ISR (SI)</th>
<th>ISR (SI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GDP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. GDP</td>
<td>1.014***</td>
<td>1.112***</td>
<td>1.158***</td>
<td>1.011***</td>
<td>0.491***</td>
<td>1.195***</td>
<td>0.981***</td>
<td>0.891***</td>
<td>0.769***</td>
<td>1.307***</td>
<td>1.113***</td>
<td>0.897***</td>
</tr>
<tr>
<td></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>
<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>L. XRATE</td>
<td>-0.006</td>
<td>0.030*</td>
<td>-0.004</td>
<td>-0.077**</td>
<td>-0.175***</td>
<td>-0.049*</td>
<td>0.009</td>
<td>0.058</td>
<td>0.077</td>
<td>0.009</td>
<td>-0.010</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>(0.615)</td>
<td>(0.086)</td>
<td>(0.421)</td>
<td>(0.013)</td>
<td>(0.000)</td>
<td>(0.083)</td>
<td>(0.770)</td>
<td>(0.295)</td>
<td>(0.270)</td>
<td>(0.844)</td>
<td>(0.326)</td>
<td>(0.698)</td>
</tr>
<tr>
<td><strong>XRATE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. GDP</td>
<td>-0.036</td>
<td>-0.966</td>
<td>-1.057</td>
<td>1.046</td>
<td>0.653***</td>
<td>-0.385</td>
<td>0.102</td>
<td>0.387</td>
<td>-0.014</td>
<td>-0.399</td>
<td>-1.336</td>
<td>-0.952***</td>
</tr>
<tr>
<td></td>
<td>(0.986)</td>
<td>(0.266)</td>
<td>(0.629)</td>
<td>(0.132)</td>
<td>(0.006)</td>
<td>(0.954)</td>
<td>(0.797)</td>
<td>(0.273)</td>
<td>(0.955)</td>
<td>(0.811)</td>
<td>(0.324)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>L. XRATE</td>
<td>1.581***</td>
<td>0.600***</td>
<td>1.789***</td>
<td>2.246***</td>
<td>1.625***</td>
<td>1.584***</td>
<td>1.590***</td>
<td>1.404***</td>
<td>0.809***</td>
<td>0.691**</td>
<td>1.692***</td>
<td>0.857***</td>
</tr>
<tr>
<td></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>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.012)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Obs</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>47</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>Lags (q)</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Df</td>
<td>43</td>
<td>30</td>
<td>43</td>
<td>35</td>
<td>43</td>
<td>35</td>
<td>43</td>
<td>37</td>
<td>38</td>
<td>43</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Necessary condition satisfied</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>
Table 6 (continued): Estimation result for the VAR(q) with GDP and XRATE

<table>
<thead>
<tr>
<th>KOR (SI)</th>
<th>KOR (SI)</th>
<th>MEX (SI)</th>
<th>MEX (SI)</th>
<th>PHL (SI)</th>
<th>SAF (SI)</th>
<th>SAF (SI)</th>
<th>THA (SI)</th>
<th>THA (SI)</th>
<th>TUR (SI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP L.GDP</td>
<td>0.936***</td>
<td>0.737***</td>
<td>0.953***</td>
<td>0.943***</td>
<td>1.189***</td>
<td>1.223***</td>
<td>1.176***</td>
<td>1.306***</td>
<td>1.106***</td>
</tr>
<tr>
<td>(0.000)</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>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>GDP L. XRATE</td>
<td>0.033</td>
<td>0.100**</td>
<td>-0.031</td>
<td>0.029</td>
<td>-0.046</td>
<td>-0.077***</td>
<td>-0.068***</td>
<td>-0.045</td>
<td>-0.038</td>
</tr>
<tr>
<td>(0.599)</td>
<td>(0.019)</td>
<td>(0.217)</td>
<td>(0.210)</td>
<td>(0.267)</td>
<td>(0.000)</td>
<td>(0.003)</td>
<td>(0.681)</td>
<td>(0.673)</td>
<td>(0.436)</td>
</tr>
<tr>
<td>EXDEBT L.GDP</td>
<td>0.999*</td>
<td>1.123***</td>
<td>1.849*</td>
<td>0.986**</td>
<td>0.540</td>
<td>1.142</td>
<td>2.723***</td>
<td>-0.432</td>
<td>-0.215</td>
</tr>
<tr>
<td>(0.091)</td>
<td>(0.005)</td>
<td>(0.094)</td>
<td>(0.027)</td>
<td>(0.244)</td>
<td>(0.148)</td>
<td>(0.000)</td>
<td>(0.213)</td>
<td>(0.299)</td>
<td>(0.046)</td>
</tr>
<tr>
<td>EXDEBT L. XRATE</td>
<td>1.209***</td>
<td>1.066***</td>
<td>1.690***</td>
<td>0.988***</td>
<td>1.095***</td>
<td>1.244***</td>
<td>0.920***</td>
<td>0.917***</td>
<td>0.940***</td>
</tr>
<tr>
<td>(0.000)</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>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Obs</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>Lags (q)</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Df</td>
<td>43</td>
<td>34</td>
<td>43</td>
<td>37</td>
<td>41</td>
<td>43</td>
<td>41</td>
<td>37</td>
<td>34</td>
</tr>
<tr>
<td>Necessary condition satisfied</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Expected signs satisfied</td>
<td>no</td>
<td>no</td>
<td>Balance sheet effect regime</td>
<td>no</td>
<td>Balance sheet effect regime</td>
<td>Balance sheet effect regime</td>
<td>Balance sheet effect regime</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARG: Argentina; BRA: Brazil; CHL: Chile; COL: Colombia; IND: India; IDN: Indonesia; ISR: Israel; KOR: South Korea; MEX: Mexico; PHL: Philippines; SAF: South Africa; THA: Thailand; TUR: Turkey. p-values in parentheses; * p&lt;0.10, ** p&lt;0.05, *** p&lt;0.01; Obs: number of observations; Df: degrees of freedom in each equation. Each equation was estimated with an intercept, which is not reported. Only the coefficients on the first lags are reported.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the estimation without step indicators, 5 out of 12 countries meet the necessary condition for a cycle mechanism: Chile, Indonesia, Mexico, South Africa, and Turkey. The coefficients for Indonesia correspond to the Marshall-Lerner regime, discussed in section 3, where a depreciation of the currency pushes up output, which in turn leads to an appreciation of the currency. Chile, Mexico, South Africa, and Turkey, in contrast, display coefficients in line with the balance sheet effect regime in which balance sheet effects lead to contractionary depreciations while increases in output put pressure on the currency due to a worsening current account.

When step indicators are added to account for mean shifts in the exchange rate, the qualitative results change for a few countries, suggesting that some of the estimates are sensitive to mean shifts. Argentina, India, and Israel now meet the necessary condition for a cycle mechanism with coefficients corresponding to the Marshall-Lerner regime. Mexico ceases to meet the necessary condition for a cycle mechanism. The Philippines (whose VAR without step indicators suffered from serial correlation) now fall into the category of a balance sheet effect regime. The coefficients for Chile and South Africa still correspond to the balance sheet effect regime and now become statistically significant.

Figure 4 displays the results of forward recursive estimation of the VARs for those countries where the condition for a cycle mechanism is satisfied. Structurally stable parameters are found in the models with step indicators for Chile, Israel, the Philippines, and South Africa. The VARs for Argentina, India, and Turkey suffer from structural instability with coefficients switching signs at a relatively late point of the sample period. The VAR for Indonesia is an interesting borderline case with mostly stable coefficients that, however, are subject to a large negative shock in 1997-98, which is no doubt due to the East Asian crisis. Surprisingly, when estimating the model with step indicators, which were highly significant for those two years, the model suffers from serial correlation. Overall, we thus regard the results for Indonesia unreliable.
Figure 4: Forward recursive estimation, VARs with GDP and XRATE

Argentina (SI)

Chile (SI)

India (SI)

Indonesia
Notes: ARG: Argentina; CHL: Chile; IND: India; IDN: Indonesia; ISR: Israel; MEX: Mexico; PHL: Philippines; SAF: South Africa; TUR: Turkey. Two-scaled axes were used where this improved visibility.
Table 7 presents estimated cycle length for the countries with stable parameters. For Chile, we find a short cycle length of around 3 years and a medium length of around 8 years. Israel exhibits a high cycle frequency of around 3 ½ years. The Philippines have a medium frequency of around 8 ½ years. Lastly, South Africa also exhibits a medium frequency of about 5 years. Overall, exchange rate cycles seem to be in the short-to-medium range of cycle lengths.

Table 7: Estimated cycle length based on eigenvalues, VAR with GDP and XRATE

<table>
<thead>
<tr>
<th>Country</th>
<th>Real part (h)</th>
<th>Modulus (R)</th>
<th>Cycle length (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chile</td>
<td>0.539</td>
<td>0.783</td>
<td>7.75</td>
</tr>
<tr>
<td></td>
<td>-0.238</td>
<td>0.423</td>
<td>2.90</td>
</tr>
<tr>
<td>Israel</td>
<td>-0.019</td>
<td>0.099</td>
<td>3.57</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.267</td>
<td>0.364</td>
<td>8.43</td>
</tr>
<tr>
<td>South Africa</td>
<td>0.184</td>
<td>0.5110</td>
<td>5.23</td>
</tr>
</tbody>
</table>

Note: The cycle length is calculated as \( L = \frac{2\pi}{\arccos \left( \frac{h}{R} \right)} \).

In sum, there is evidence for a stable interaction mechanism in line with the balance sheet effect regime in three countries (Chile, the Philippines, and South Africa), with statistically significant coefficients in Chile and South Africa. Stable parameters for the Marshall-Lerner regime could only be found for Israel, and this evidence is weaker as the relevant coefficients lack statistical significance at conventional levels.

5.4 Summary and discussion of estimation results

Overall, the results provide evidence for the existence of stable Minskyan financial-real interaction mechanisms in 6 countries. Specifically, there is evidence for interaction mechanisms between output and

- the real interest rate in Argentina, Mexico, and South Africa at high frequencies (3-4 years).
- the private external debt ratio in Mexico, the Philippines, and South Africa at medium to low frequencies (11 - 19 years).
- the exchange rate in Chile, the Philippines and South Africa (corresponding to the balance sheet effect regime), as well as Israel (corresponding to the Marshall Lerner regime). The estimated cycles are at short-to-medium lengths (3 – 8 years).

Out of these results, the evidence for an interaction mechanism between output and exchange rates for Chile and South Africa is the strongest, with both relevant coefficients statistically significant at conventional levels. The evidence for interaction mechanisms in
external debt is weaker with only one of the two relevant coefficients statistically significant for Mexico, the Philippines, and South Africa. The evidence for an interest rate mechanism is weak only, as the estimated coefficients mostly lack statistical significance.

The fact that the estimation results for Mexico, the Philippines, and South Africa are consistent with several of the interaction mechanisms discussed in the literature indicates that these are not mutually exclusive – a possibility that we stressed from the outset. Indeed, our examination of implied cycle frequencies suggests that different business cycle frequencies in output may stem from different interaction mechanisms with different variables. Interest rates seem to play a role for high frequency business cycles in Mexico and South Africa, whereas external debt appears to interact with output at low frequencies. For South Africa, there is furthermore a medium frequency in the interaction between output and exchange rates.

Lastly, the fact that we find evidence for cyclical interaction mechanisms in only 6 of the 13 countries in the sample raises the question why there is no such evidence for the remaining 7 countries. There are at least two possible explanations:

(i) Limited data availability and structural change (e.g. due to political and institutional instability), as evident in the recursive parameter estimations, overall render it difficult to obtain robust estimates from macro-econometric models for EMEs. Consequently, it is not entirely surprising that for many countries no clear-cut results emerge.

(ii) It is possible that there are no Minskyan financial-real interaction mechanisms in place in these 7 countries. Their business cycles may thus be driven by other endogenous mechanisms, such as Kaldorian goods market instability (Sethi, 1992), Goodwinian distributive cycles (La Marca, 2010), or distributional conflict around the real exchange rate (Sasaki et al., 2013; Lima and Porcile, 2013).

Both explanations cannot be ruled out and should be considered in future research. The possibility that business cycles are generated by other interaction mechanisms, such as output and the money supply (Sethi, 1992), output and the wage share (La Marca, 2010), or the nominal exchange rate and the price mark-up (Lima and Porcile, 2013) could be investigated by means of the estimation strategy employed in this paper. Limited data availability and structural change cannot be addressed as easily. This points to the limitations of macroeconometric analyses and suggest that case studies that focus on specific episodes using a variety of data (qualitative and quantitative) remain an important component of research on boom-bust cycles in EMEs (Palma, 1998; Taylor, 1998; Kregel,
6 Conclusion
The aim of this paper was to test set of finance-driven business cycle mechanisms for emerging market economies mechanisms empirically. We took a post-Keynesian/structuralist theoretical approach that highlights the role of endogenous interaction mechanisms in the generation of business cycle dynamics. For emerging market economies, we have identified the interest rate, external debt, and the exchange rate to be theoretically relevant interacting variables for finance-driven business cycles. We provided evidence for the existence of such interaction mechanisms from bivariate VAR-models.

We find strong evidence for Chile and South Africa and some evidence for the Philippines for the existence of an interaction mechanism between exchange rate and output. This is consistent with business cycle theories that highlight the role of contractionary balance sheet effects due to foreign currency debt (Kohler, 2019; Stiglitz et al., 2006, chap. 6; Harvey, 2010; Ocampo, 2016). There is some evidence for a cycle mechanism in Israel that works in the opposite direction with depreciations being expansionary and economic booms leading to currency appreciation. We further find some evidence indicating the existence of a cycle mechanism with external debt in Mexico, the Philippines, and South Africa providing support for business cycle theories for open economies that emphasise cyclical dynamics of external overlending and overborrowing (Palma 1998; Taylor, 1998; Kregel, 1998; Arestis and Glickman, 2002; Cruz et al., 2006; Frenkel and Rapetti, 2009; Harvey, 2010; Agosin and Huaita, 2011; Kaltenbrunner and Painceira, 2015). Lastly, for Argentina, Mexico, and South Africa, there is weak evidence for an interaction mechanism between output and the interest rate along the lines of Foley (2003) and other authors that have highlighted the role of interest rates (Taylor 2004, chap. 10; Frenkel 2008).

Overall, the results provide support to the Minskyan branch of post-Keynesian and structuralist theories of endogenous business cycles that place financial and external variables at the centre of aggregate fluctuations in EMEs. In contrast to real business cycle theory where fluctuations are driven by unexplained shocks, post-Keynesian and structuralist theories identify specific economic mechanisms that may drive output volatility. The empirical analysis contributes to this research programme by suggesting, first, that different variables are likely to be relevant across countries (e.g., exchange rates seem to be relevant for the business cycle mechanism in Chile, but less important for Argentina). Second, we show that the same country can exhibit several business cycle mechanisms, which potentially drive different cycle frequencies in output (e.g., interest
rates are involved in high frequency cycles of around 4 years in Mexico, whereas external debt cycles display lower frequencies of around 18 years).

This approach helps identify areas for policy intervention. For example, in Chile where exchange rates appear to be an important driver of business cycles, countercyclical exchange rate policies such as managed floating may help curb the cycle. For Argentina there is instead (weak) evidence for a mechanism with interest rates in which raising interest rates during economic booms can generate cyclical dynamics (Foley, 2003), suggesting alternative monetary policy rules. For Mexico, the Philippines and South Africa, both external debt and exchange rates seem to be relevant, so that a policy mix of disincentivising procyclical capital flows through capital controls combined with exchange rate management may be attractive.

In providing a first attempt at testing endogenous cycle mechanism for emerging markets, this paper has focused Minskyan financial-real interaction mechanisms. It turned out that for a subset of countries no robust evidence for any of the cycle mechanisms could be found (Brazil, Colombia, India, Indonesia, Korea, Thailand, Turkey). Indeed, other interaction mechanisms may be relevant for these countries. Future research could test for other mechanisms involving wage shares, price mark-ups or the money supply. Second, our approach highlights endogenous mechanisms that can operate autonomously at the country-level. However, emerging markets are often hit simultaneously by exogenous global shocks, such as uncertainty shocks (Carrière-Swallow and Céspedes, 2013), waves in capital flows (Rey, 2015) or commodity price cycles (Erten and Ocampo, 2013). It would be interesting to investigate to what extent domestic fluctuations are driven by autonomous endogenous cycle mechanisms as opposed to joint external shocks.
References


Appendix

Data description

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Data source(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXDEBT</td>
<td>External debt to GDP</td>
<td>External Wealth of Nations dataset (updated and extended version of dataset constructed by Lane and Milesi-Ferretti, 2007); WDI (World Bank)</td>
<td>The ratio was constructed manually by transforming external debt stock measured in US dollars into domestic currency and dividing by nominal GDP.</td>
</tr>
<tr>
<td>GDP</td>
<td>Natural log of real gross domestic product</td>
<td>OECD; WDI (World Bank)</td>
<td></td>
</tr>
<tr>
<td>INTR</td>
<td>Short-term real interest rate</td>
<td>IFS (IMF); OECD</td>
<td>Real interest rate was calculated as $r = (i - \pi)/(1 + \pi)$, where $i$ is the nominal interest rate and $\pi$ is the growth rate of the GDP deflator. Depending on data availability, either the deposit, lending rate, or money market rate from IFS was used for $i$. For India, the money market rate was extrapolated forward with the growth rate of the lending rate.</td>
</tr>
</tbody>
</table>
For Thailand, a gap in the deposit rate series in 2002-2003 was closed through linear interpolation.

| $X RATE$ | Natural log of nominal exchange rate with respect to US dollar | IFS (IMF) | The average of period series was used. |