Exchange Rate Regimes and Sudden Stops

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Abstract

The recent global financial crisis has re-emphasized the need for better understanding the relation between exchange rate regimes (ERRs) and Sudden Stops' severity. Global credit supply shocks produce a suitable quasi-natural experiment for studying this relation. Toward this end, I use popular ERR measures for a panel of 29 emerging market economies (EMEs) to establish that output responds significantly more adversely to contractionary global credit supply shocks in the fixed ERR than in the non-fixed ERR; net capital outflows are much more severe in the fixed ERR; and the drop in exports (currency) is higher (lower) in the fixed ERR.

JEL classification: F38,F41,F44

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1 Introduction

Sudden Stops in emerging market economies (EMEs) - defined as abrupt loss of foreign investors' willingness to invest in domestic assets - are associated with acute downturns in economic activity (e.g., Mendoza (2010)). The empirical question this paper tries to address is the following: Are the contractionary effects of Sudden Stops more adverse in EMEs that have fixed exchange rate regimes (ERRs)? Milton Friedman, more than 60 years ago, was the first to put forward the notion that flexible exchange rates can serve as shock absorbers (Friedman (1953)). Traditional models such as the open economy Mundell-Fleming framework as well its micro-founded, dynamic successor, the New Keynesian (NK) Open Economy model, formally encapsulate this notion by assigning an important shock-absorbing role to flexible exchange rates owing to the favorable expenditure-switching effect of a Sudden Stop induced currency depreciation.

More sophisticated recently developed models focus on the shock-amplifying nature of fixed ERRs in the presence of downward nominal wage rigidly, where the lack of currency depreciation in a Sudden Stop enhances the increase in unemployment (Schmitt-Grohé and Uribe (2013, 2014, 2016)). In models containing financial frictions, the shock-amplifying nature of fixed ERRs becomes less conclusive in theory due to the adverse balance sheet effect of currency depreciations in the presence of foreign currency denominated debt;[1] however, models that allow the favorable and adverse effects of fixed ERRs on Sudden Stops' severity to compete broadly find that the latter prevail, both under financial frictions based on the costly state verification framework (e.g., Cspedes et al. (2004) and Gertler et al. (2007)) as well as those based on occasionally binding credit constraints (e.g., Ottonello (2015), Fornaro (2015), and Devereux and Yu (2017)).

Notwithstanding the rather vast theoretical work cited above, there has been quite limited empirical work on the relation between ERRs and Sudden Stops' effects. To the best of my knowledge, there has been no empirical work that has provided direct empirical evidence on this topic. The few papers that have looked at the general shock-amplifying nature of fixed ERRs relative to

[1] Focusing mainly on this channel by precluding nominal rigidities and the benefits from currency depreciation in terms of the classical expenditure-switching effect, Benigno et al. (2016) establish that fixed ERRs can greatly moderate the adverse effects of Sudden Stops.

non-fixed ERRs can be divided into two strands: *i*) one which has studied the shock-amplifying nature of fixed ERRs indirectly, i.e., not by conditioning on a particular identified shock, and *ii*) one that has done so directly but by focusing on aspects of the regime's shock-amplifying nature that are not explicitly related to Sudden Stops.

The first strand of the literature has been initiated by Edwards (2004), who shows that more fixed ERRs generate more adverse effects of current account reversals on output growth. While there is a positive relation between current account reversals and Sudden Stops, this relation is quite imperfect; as reported by Edwards (2004), more than 50% of the Sudden Stops in his sample are not related to current account reversals. Moreover, his analysis is mostly static, focusing on the effect of current account reversals on impact while ignoring the potentially interesting dynamics of this effect. Hence, the results of Edwards (2004) have limited informativeness for the relation between ERRs and Sudden Stops' effects.

Subsequent works belonging to this strand of literature focused on the current account as their main outcome variable. Chinn and Wei (2013) show that EMEs that move from a fixed regime to a less fixed regime do not necessarily benefit from a more rapid adjustment of the current account; rather than measuring the type of ERR with de facto regime measures, Ghosh et al. (2013) use a trade-weighted bilateral exchange rate volatility measure to characterize the level of exchange rate flexibility and find that flexible exchange rates imply less persistent current account dynamics. While these two papers have not explicitly controlled for the occurrences of Sudden Stops, Eguren-Martin (2016) compares the speed of current account adjustment across ERRs while explicitly accounting for the occurrence of sudden stops, finding that flexible exchange rates deliver a faster current account adjustment among EMEs. Although useful for our understanding of the mean-reverting behavior of the current account and thus its ability to adjust in response to its reduced form innovations, these papers (much like the paper of Edwards (2004)) do not directly shed light on the role of fixed ERRs in amplifying Sudden Stops' adverse effects because the latter innovations are essentially combinations of various structural shocks, some of which are likely

non-Sudden-Stop type shocks.[2]

The second strand includes Broda (2004) and Edwards and Levy-Yeyati (2005), who examine the effects of terms of trade shocks as a function of the ERR, and di Giovanni and Shambaugh (2008), who study the effects of foreign interest rate shocks as a function of the ERR. All papers find that a fixed exchange rate regime amplifies the effects of the respective shocks they consider. However, these two shocks are not natural candidates for exogenous forces of the type that produce Sudden Stops and their associated highly severe recessions. E.g., as shown by Schmitt-Grohé and Uribe (2017), terms of trade shocks move output and the trade balance in the same direction, which contrasts with stylized facts about Sudden Stops; and Uribe and Yue (2006) show that foreign interest rate shocks, while producing point estimate responses of output and trade balance of the opposite sign, have statistically insignificant effects on both variables.

Taken together, the limited direct empirical evidence advanced by these two strands of literatures on the capacity of fixed ERRs to enhance Sudden Stops' adverse effects emphasizes the empirical gap that needs filling in order to be able to answer the question posed in this paper. The objective of this paper is to bridge this empirical gap. Toward this end, I employ three popular, widely used *de-facto* ERR classification measures to divide the observations in my sample into fixed and non-fixed ERRs: the Shambaugh (2004) ERR measure (available through 2014), Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure (available through 2013), and Reinhart and Rogoff (2004) ERR measure (available through 2010). (See Section 2.1 and Appendix A for details on these measures.) Producing similar results across these state-of-the-art ERR measures will go a long way toward establishing a robust set of empirical results that can be arguably interpreted as stylized facts.[3]

[2]Also susceptible to this limitation are the works by Ghosh et al. (2015) and Magud and Vesperoni (2015). Ghosh et al. (2015) study the link between different ERRs and financial variables, crisis propensities, and real variables for an annual 1980-2011 panel of 50 EMEs by regressing the latter on the IMF de facto ERR measures; Magud and Vesperoni (2015) use a similar methodology but focus on the effect of ERRs on credit behavior during capital outflow crises preceded by capital inflow surges. This methodological approach, while suitable for studying the general relation between macroeconomic performance and ERRs, is unsuitable for uncovering the nexus between ERRS and Sudden Stops' effects given that it does not condition on a Sudden Stop shock but rather captures the unconditional effect of ERRs on macroeconomic performance, which can be thought of as the average effect of various economic shocks in a particular ERR.

[3]These ERR measures have generally been found to entail inconsistent implications for GDP growth and

To measure Sudden Stop shocks, I make use of the Gilchrist and Zakrajek (2012) credit supply shock series.[4] Their shock series serves as an exogenous and common global credit supply shock to EMEs which constitutes a natural proxy for Sudden Stop shocks, as been made evident from the recent global financial crisis; as such, the Gilchrist and Zakrajek (2012) series can be employed to study whether fixed ERRs amplify Sudden Stops' adverse effects. I then integrate the ERR and credit supply shock data with quarterly frequency macroeconomic data of 29 EMEs and estimate nonlinear dynamic fixed-effect panel regressions to study whether the effect of global credit supply shocks differs across peggers and non-peggers.[5] Furthermore, I employ the Jorda (2005) local projections approach in the panel regression specification so as to be able to directly estimate the nonlinear, state-dependent impulse responses to global credit supply shocks.

My empirical findings can be summarized as follows. Across all ERR measures, there is a statistically significant negative difference between the response of output in the fixed ERR state and the non-fixed one. This difference is also economically significant. Specifically, for the Shambaugh (2004) ERR measure, the peak output decline in the fixed ERR state takes place after one year reaching -4.3%, compared to -2.8% in the non-fixed ERR state, reflecting a t-statistic of -7.4 associated with the response difference across the two states; 3.5% (also after one year) compared to 2.5%, with a t-statistic of -4.6 for the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) measure; and -3.5% (after 5 quarters) compared to -2.7%, with a t-statistic of -3.9 for the Reinhart and Rogoff (2004) measure. Both investment and consumption also decline significantly more in the fixed ERR state for all ERR measures. And there is a generally significantly positive difference between the responses of the trade balance across the two ERR states, with both exports and imports declining

inflation (see, e.g., Rose (2011). Notably, however, as discussed above, the shock-amplifying nature of fixed ERRs has not been directly studied using any of these ERR measures, let alone all three of them.

[4] Gilchrist and Zakrajek (2012) use micro-level data to construct a credit spread index which they decomposed into a component that captures firm-specific information on expected defaults and a residual component that they termed as the excess bond premium.Gilchrist and Zakrajek (2012) show that their spread measure has better predicative power for macroeconomic variables than more standard credit spread measures such as the Baa-Aaa Moody's bond spread.

[5] Throughout my empirical analysis, I control for the level of capital controls and economic development in the regressions so as to ensure that my results are not driven by EMEs' capital control policies and level of economic development. This will be elaborated upon in Section 2.

significantly more in the fixed ERR state.

To shed light on the mechanism behind these results, I turn my analysis to capital flows, exchange rate, leverage, and country credit spreads data. Using data from the Balance of Payments (BOP), I first show that in both states there is an outflow of capital from EMEs in response to credit supply shocks, in accordance with the interpretation of global credit supply shocks as Sudden Stop shocks. Notably, however, the capital outflow in the fixed ERR state is much more acute than in the complementary, non-fixed ERR state. I also study the response of capital outflows to being in the two ERR states, conditional on no shock taking place, to learn whether fixed ERR EMEs are more prone to larger net capital inflows which in turn increase their vulnerability to Sudden Stop shocks (see, e.g., Edwards (2007) and Agosin and Huaita (2012)). The results from this exercise reveal that this conjecture is at odds with the data: Not only do net capital outflows from fixed ERR EMEs resulting from credit supply shocks far exceed those in the non-fixed state, but also merely being in the fixed ERR state (with no shocks taking place) produces much more capital outflows.

The extent to which the central bank responds to the shock is different across the two states, but mainly for the Shambaugh (2004) and Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measures: While foreign exchange intervention for these two measures (via selling of foreign exchange currency) by the central bank takes place in both states, the intervention is more significant in the fixed ERR state. Utilizing both nominal and real exchange rate data, I demonstrate that the exchange rate falls significantly more (both in nominal and real terms) in the non-fixed ERR state relative to the fixed ERR state, in accordance with the stronger exports decline in the latter state.

Consistent with the stronger net capital outflow observed in the fixed ERR state, I also find a more acute fall in this state of a measure of leverage that is based on the GDP share of total claims of foreign banks on the EMEs in my sample. This result stresses that a stronger deleveraging process takes place in the fixed ERR state following credit supply shocks. Lastly, using the Emerging Markets Bond Index (EMBI) Global computed by JP Morgan as a measure of country credit spread, I show that country risk-premiums rise significantly more in the fixed ERR state.

How should these results be interpreted from a structural standpoint? The results of this paper are broadly in line with financial frictions based models which integrate exchange rate policy into a small open economy model with financial frictions and show that Sudden Stops have more severe effects under fixed ERRs due to the lack of exchange rate depreciation in these regimes (e.g., Cspedes et al. (2004), Gertler et al. (2007), Ottonello (2015), Fornaro (2015), and Devereux and Yu (2017)). While the specific mechanisms emphasized in these models are not the same, they all seem to deliver the basic implication that fixed ERRs ultimately lead to greater deleveraging and net capital outflows in the presence of Sudden Stops.

The remainder of the paper is organized as follows. In the next section, I begin with a description of the data, after which the methodology and main empirical evidence are presented. Section 3 examines the response of capital flows to being in the two states (conditional on no credit supply shocks taking place). The final section concludes.

2 Empirical Analysis

2.1 Data

Data are quarterly, cover 29 EMEs with samples that span 1994-2014. Strictly speaking, the panel is an unbalanced panel but the samples are mostly balanced aside from some discrepancies. The chosen countries were those belonging to the universe of EMEs for which quarterly data with reasonable length was available for both real macroeconomic aggregates as well as international capital flows. Appendix A contains a detailed description of the data and its sources. The main outcome variable I consider is output, defined as local currency current GDP divided by the GDP deflator. I seasonally adjusted the output variable using ARIMA X12 and enter it in the regression in logs.

The variable I use to measure credit supply shocks is the excess bond premium (EBP) from Gilchrist and Zakrajek (2012), who use micro-level data to construct a credit spread index which they decomposed into a component that captures firm-specific information on expected defaults

and a residual component that they termed as the excess bond premium.

To measure the ERR in each EME, I utilize updated versions of three popular *de-facto* ERR classification measures: the Shambaugh (2004) (JS) measure (available through 2014),[6]; the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) (LYS) measure, as updated by Levy-Yeyati and Sturzenegger (2016) through 2013 and taken From Eduardo Levy-Yeyati's website; the Reinhart and Rogoff (2004) (RR) measure, as updated by Ilzetzki et al. (2010) through 2010 and taken from Carmen Reinhart's website.

The JS measure focuses exclusively on the volatility of the exchange rate and divides countries into pegs and non-pegs, where the former are classified as such if their official exchange rate remains within a 2% band with respect to its base country. In addition, to prevent breaks in the peg status due to one-time realignments, Shambaugh (2004) classify as fixed any exchange rate that had a zero percentage change in eleven out of twelve months in a given year. The LYS measure is based on cluster analysis to group countries according to the relative volatility of exchange rates and reserves; I identify fixed ERR observations in line with the grouping of Levy-Yeyati and Sturzenegger (2001, 2003, 2005), who divide the observations into fixed, intermediate, and flexible regimes.

Both of these ERR measures are annual and highly auto-correlated, as clearly manifested by a one lagged auto-correlation coefficient of 0.94 for the JS series and 0.89 for the LYS measure; I have therefore made the arguably innocuous assumption that regime changes do not occur within the year, thus transforming annual values to quarterly ones for these two measures by assuming within-year identical quarterly observations.

Lastly, the RR measure uses monthly data on market-determined parallel exchange rates to construct a fine classification of ERRs comprising of 15 categories. These categories appear in Table 1, where larger category integers represent more flexible ERRs. I convert monthly values to quarterly ones by averaging over the respective values in each quarter and define the fixed ERR state as a dummy that obtains 1 if the RR measure obtains an integer that is not greater than 4. In

[6]This updated dataset is available from the NBER data sources catalogue website, whose link is http://www.nber.org/data/international-finance/#err.

sum, this measure as the other two measures enter the regressions as dummy variables that obtain 1 if the corresponding observation belongs to a fixed ERR state and 0 otherwise.

Throughout my empirical analysis I control for the level of financial openness of each EME. Toward this end, I use the *de jure* annual measures of capital controls from Fernández et al. (2015), which provide a quantitative measure of the existence of capital controls in both inflows and outflows separately, across 10 asset categories, for 100 economies between 1995 and 2013.[7] The index is defined between zero (absence of controls in all asset categories) and one (controls in all categories). My focus in this paper, as explained in the next section, is on controlling for the capital inflow control index.[8] Furthermore, I control for economic development by including in my analysis 1995 PPP-adjusted per capita GDP for the EMEs in my sample taken from the World Bank database.

To establish the Sudden Stop nature of global credit supply shocks, I employ the following data on international capital flows: net outflows related to foreign direct investment, portfolio investment, and other investment; and capital flows related to the monetary authority's foreign exchange reserves. All of these items are in raw dollar values and are thus converted to local currency using the respective dollar exchange rates and then divided by local currency current GDP. I seasonally adjusted the raw variables using ARIMA X12.

Other outcome variables I consider to learn more about the mechanism behind the results are investment, consumption, trade balance, exchange rates, leverage, country credit spreads, and central bank policy rates. The first two are defined as gross fixed capital formation and private consumption expenditure (both in local currency) divided by the GDP deflator; the trade balance

[7]Even though the capital controls data start in 1995 and run through 2013 only, I am still able to let the outcome and EBP data series start in 1994 and run through 2014 owing to the fact the capital controls measures enter my regressions with 4 lags and the outcome variables and EBP enter them with 9 lags (see discussion on why these numbers of lags are warranted in Section 2.2). A similar reasoning applies to the case of the LYS ERR measure, which also runs only through 2013. For the RR measure, I am limited to allowing the outcome and EBP variables to run through 2011.

[8]Given the robust finding by Fernández et al. (2015) that capital controls are strongly acyclical and have a very small standard deviation at annual frequencies, I make the thus innocuous assumption that capital controls do not exhibit variation within the year; accordingly, and similar to the transformation made to the ERR measure, I transform the capital control annual measures into quarterly ones by assuming identical quarterly values equal to the corresponding annual values.

is export minus imports (both in local currency) divided by local currency current GDP. I use effective nominal and real exchange rate data, where the latter are CPI-based.

Leverage is the ratio of total claims of Bank for International Settlements (BIS) reporting banks' claims on each EME to its GDP, where the former is taken from the consolidated banking statistics database of the BIS and is converted to local currency by multiplying the dollar value of claims by the corresponding dollar exchange rate. The country credit spread is the stripped Emerging Markets Bond Index (EMBI) Global computed by JP Morgan, which is a composite of different U.S. dollar-denominated bonds. The Stripped Spread is computed as an arithmetic, market-capitalization-weighted average of bond spreads over U.S. Treasury bonds of comparable duration. The central bank policy rate represents the interest rate used by a central bank to implement its monetary policy stance; the underlying financial instrument of the policy rate varies across the EMEs in my sample, being the discount rate for some while in others it is a repurchase agreement rate.

Except for exchange rates, central bank policy rate, and EMBI, all variables were seasonally adjusted using ARIMA X12. Apart from the trade balance, capital flows, EMBI, and central bank policy rates, I take logs of all of the variables. Data on all variables are covered by 29 countries (that correspond to the output sample) except for EMBI and central bank policy rate for which only 20 and 27 countries' data are available, respectively.

2.2 Methodology

I follow the econometric framework employed in Auerbach and Gorodnichenko (2012), Owyang et al. (2013), Ramey and Zubairy (2017), and Tenreyro and Thwaites (2016), who use the local projection method developed in Jorda (2005) to estimate impulse responses. This method allows for state-dependent effects in a straightforward manner while involving estimation by simple regression techniques. Moreover, it is more robust to misspecification than a non-linear VAR. As in Auerbach and Gorodnichenko (2012), I make use of the Jorda (2005) local projections method within a fixed effects panel model, where inference is based on Driscoll and Kraay (1998) standard

errors that allow arbitrary correlations of the error term across countries and time.

In particular, I estimate the impulse responses to the credit supply shock by projecting a variable of interest on its own lags and current and lagged values and lags Gilchrist and Zakrajek (2012)'s EBP variable, while allowing the estimates to vary according to the level of ERR fixity in place in a particular country and time. Throughout my empirical analysis, I control for the level of EMEs' economic development and financial openness so as to ensure that the results are not driven by characteristics related to the level of development (e.g., quality of institutions) and the presence or absence of capital inflow controls.[9]

Econometric Specification. For example, when I use the log of output (y_t) as the dependent variable, which is the main variable of interest in this paper, the response of output at horizon h is estimated from the following non-linear panel fixed effects regression:

$$\begin{aligned} y_{i,t+h} - y_{i,t-1} = I_{i,t-4}[\alpha_{A,i,h} + \Xi_{A,h}EBP_t + \Omega_{A,h}(L)EBP_{t-1} + \Gamma_{A,h}(L)\Delta y_{i,t-1}] + \\ +(1 - I_{i,t-4})[\alpha_{B,i,h} + \Xi_{B,h}EBP_t + \Omega_{B,h}(L)EBP_{t-1} + \Gamma_{B,h}(L)\Delta y_{i,t-1}] + \\ +I^S_{i,t-4}[\alpha_{S,i,h} + \Upsilon_{S,h} + \Xi_{S,h}EBP_t + \Omega_{S,h}(L)EBP_{t-1} + \Gamma_{S,h}(L)\Delta y_{i,t-1}] + \\ +(1 - I^S_{i,t-4})[\alpha_{M,i,h} + \Xi_{M,h}EBP_t + \Omega_{M,h}(L)EBP_{t-1} + \Gamma_{M,h}(L)\Delta y_{i,t-1}] + \\ +I^R_{i,t-4}[\alpha_{R,i,h} + \Xi_{R,h}EBP_t + \Omega_{R,h}(L)EBP_{t-1} + \Gamma_{R,h}(L)\Delta y_{i,t-1}] + \\ +(1 - I^R_{i,t-4})[\alpha_{P,i,h} + \Xi_{P,h}EBP_t + \Omega_{P,h}(L)EBP_{t-1} + \Gamma_{P,h}(L)\Delta y_{i,t-1}] + u_{i,t+h}, \end{aligned} \tag{1}$$

where i and t index countries and time; α_i is the country fixed effect; $\Omega(L)$ and $\Gamma(L)$ are lag polynomials; Ξ_h gives the response of the outcome variable at horizon h to a credit supply shock at time t; $u_{i,t+h}$ is the residual; and, importantly, coefficients vary according to whether we are in state "A", i.e., fixed ERRs are in place, state "B", i.e., a state of non-fixed ERRs, state "S", i.e.,

[9] My focus on capital inflow controls, rather than outflow controls, follows that of the theoretical strand of the literature on capital controls (see, e.g., Bianchi (2011), Farhi and Werning (2012, 2014), Bianchi and Mendoza (2013), Brunnermeier and Sannikov (2015), Ottonello (2015), Schmitt-Grohé and Uribe (2016), Benigno et al. (2016), Korinek and Sandri (2016), and Davis and Presno (2016)), as well as the more policy-oriented strand (see, e.g., Ostry et al. (2010) and Ostry et al. (2011)) and the empirical strand (see, e.g., Gupta et al. (2007), Edwards and Rigobon (2009), and Ben Zeev (2017)).

a state of strict capital inflow controls, state "M", i.e., a state of lighter capital inflow controls, state "R", i.e., a state of high economic development, or state "P", i.e., a state of lower economic development.[10]

I is a dummy variable that takes the value of one when the ERR is fixed. After accounting for the loss of observations resulting from the number of lags included in the regressions well as from unavailability of data for some countries in some of the periods, a total of 332 observations, or 17% of all available observations, are consistent with being in a state of fixed ERR for the JS ERR measure; 584 observations, or 30%, for the LYS measure; and 256 observations, or 16%, for the RR measure.

I^S is a dummy variable that represent a state of strict inflow controls. Specifically, I^S takes the value of one when the Fernández et al. (2015) capital inflow controls level is at or above the upper quartile level of controls across all observations while the light controls state is defined as the complementary state of the strict state. This percentile threshold implies a cutoff value of 0.7 for the inflow controls index, which can be interpreted as being consistent with having restrictions on 70% of all asset categories underlying the index. (This cutoff value for capital controls, which was also used in Ben Zeev (2017), is arguably sufficiently large for successfully identifying differential levels on controls' intensity.) I^R obtains 1 if an observation corresponds to an EME that belongs to the upper quartile of the distribution of 1995 PPP-adjusted per capita GDP (initial value of economic development).[11,12]

[10]Note that all dummy variables' are included in the regressions with four lags, rather than one lag. The reason for this is that all measures on which these dummy variables are based were converted from annual to quarterly frequency by assuming identical values within the year, thus making it necessary to include them in the regression with four lags so as to avoid correlation of the error term with it.

[11]Since including two pairs of perfectly complementary state dummies renders perfect colinearity, I define the complementary states of $I^S_{i,t-4}$ and $I^R_{i,t-4}$ only approximately as $1 - I^S_{i,t-4}$ and $1 - I^R_{i,t-4}$ by letting them obtain 1 if the corresponding inflow controls index and economic development values are at or below the threshold that is closest to the 0.75 percentile whilst still making the system estimable. Effectively, the complementary state dummies takes on 1 if the corresponding controls and economic development values are below the 0.70 percentile threshold, implying that 5% of the observations are in neither state and are thus unaccounted for in the regression.

[12]1995 is the effective year at which the first observation of the regressions' ERR and capital controls states takes place due to the 9 lag specification for output and EBP and the 4 lag specification for these states (see below for more details on these lag specifications). Hence, the level of economic development in 1995 can be considered as the initial level of development for my sample.

Controlling for Capital Controls. The purpose of controlling for the non-linear effects arising from being in the two capital inflow control states is to ensure that the estimated differences between being in a fixed and non-fixed ERR state are not contaminated by being in a state of strict controls or light controls. This is particularly important given that there is a significant correlation of 0.09 and 0.13 between I and I^S for the JS and RR ERR measure, respectively, and a significant correlation of 0.12 between I and $1 - I^S$ for the LYS measure. I.e., being in a fixed ERR state is positively associated with being in a strict controls state for the former two measures, while it is associated with being in a light controls state for the LYS measure. Note that, since Ben Zeev (2017) found that strict capital controls significantly moderate the effects of credit supply shocks on EMEs, not controlling for them would produce an upward bias in the output response difference across the two ERR states for the JS and RR ERR measure; and a similar reasoning indicates that a downward bias would follow if light capital controls were not controlled for. Ideally, I would obtain precise identification if I were comparing the effects of credit supply shocks across EMEs that differ only along the ERR dimension; ensuring that the capital controls dimension is controlled for, as done, e.g., in Magud et al. (2014), goes a long toward nearing this ideal experiment.

Controlling for Economic Development. There is simple unconditional evidence pointing to a significantly positive relation between being in a fixed ERR and being less economically developed, as manifested by a significantly positive correlation (0.17, 0.15, and 0.08 for the JS, LYS, and RR ERR measures, respectively) between I and $1 - I^R$. Given these significant correlations, it seems important to control for the level of economic development in the regressions because of at least two potential channels by which economic development can alter an economy's sensitivity to credit supply shocks: First, more developed EMEs may have better monetary and fiscal policies, and more generally better institutions, which in turn can act as potentially important shock absorbers; and, second, although less developed EMEs have less sound institutions which limits their shock-absorbing capacity, they are likely to have less financial depth which is likely to moderate the effects of Sudden Stop shocks. While these two channels counteract one another, it is unclear which should dominate. Either way, it is imperative to control for these effects so as to

ensure that the identification strategy only picks up ERR driven effects.

Identification. Lags of output and EBP are included in the regression to remove any predictable movements in EBP; this facilitates the identification of the unanticipated shock to EBP, which is what is sought after. I assign the value of the order of lag polynomials $\Omega(L)$ and $\Gamma(L)$ to 8, i.e., I allow for 8 lags of output growth and EBP in the regression. I assume a relatively large number of lags because of the construction of the JS and LYS ERR series and capital controls variables. Since the latter were converted from annual to quarterly frequency by assuming identical values within the year, it is necessary to include them in the regression with four lags so as to avoid correlation of the error term with it; this in turn requires that more than 4 lags of output and EBP be included in the regression so as to purge $I_{i,t-4}$, $I^S_{i,t-4}$, and $I^R_{i,t-4}$ of any potentially endogenous sources. Note that when estimating the RR-based specification, the associated ERR dummy enters the regression only with one lag.

The impulse responses to the credit supply shock for the two states at horizon h are simply $\Xi_{A,h}$ and $\Xi_{B,h}$, respectively. The EBP credit supply shock is normalized so that it has a zero mean and unit variance. I base inference on Driscoll and Kraay (1998) standard errors that account for the serial and spatial correlation of $u_{i,t+h}$. Note that a separate regression is estimated for each horizon and for each ERR measure. I will estimate a total of 16 regressions for each ERR measure and collect the impulse responses from each estimated regression, allowing for an examination of the state-dependent effects of credit supply shocks for the 4 years following the shock.

For comparison purposes, I will also estimate a linear analogue of Specification (1):

$$y_{i,t+h} - y_{i,t-1} = \alpha_{i,h} + \Xi_h EBP_t + \Omega_h(L) EBP_{t-1} + \Gamma_{A,h}(L)\Delta y_{i,t-1} + u_{i,t+h}. \tag{2}$$

The coefficient of interest from this linear regression is Ξ_h, which gives the linear impulse response to the credit supply shock at horizon h. The linear specification effectively assumes equality of the model's coefficients across the two states.

2.3 Results

This section presents the main results of the paper. It is first established that being in a fixed ERR state increases the adverse output effects of global credit supply shocks. In what follows after that, I turn to inspecting the behavior of other macroeconomic variables as a function of the ERR state in order to uncover the underlying mechanisms that drive the output-based results.

Output. The first set of results, shown in Figures 1-2b, depicts the output response to credit supply shocks in the non-linear model for the JS, LYS, and RR ERR measures. For comparison purposes, the results from the linear model are also shown in these figures, as well as in all of the remaining figures. Specifically, in each Figure the first sub-figure jointly shows the point estimates of the linear model (solid lines), fixed ERR state (dotted lines), and the non-fixed ERR state (dashed lines); the next three sub-figures depict the impulse responses along with Driscoll and Kraay (1998) 90% confidence bands for the linear model, the fixed ERR state, and the non-fixed ERR state; and the last sub-figure shows the t-statistics of the difference between impulse responses in the fixed ERR state and the non-fixed ERR state.

The results from Figures 1-2b clearly indicate that being in a fixed EER state significantly amplifies the effects of credit supply shocks on output. The amplification is both economically and statistically significant. The peak output response in the fixed ERR state takes place after one year reaching -4.4%, compared to -2.9% in the non-fixed ERR state for the JS ERR measure; 3.6% (also after one year) compared to 2.6% for the LYS ERR measure; and 3.5% (after 5 quarters) compared to 2.7% for the RR measure. The difference between the responses in the two states for all ERR measures is statistically significant at a considerable share of the horizons with t-statistics of this difference generally far exceeding conventional rejection levels, troughing at -7.4 after one year for the JS measure; -3.6 after one year for the LYS measure; and -6.7 after 9 quarters for the RR measure).

These results clearly show that the data support the notion that a fixed ERR is a stability-reducing policy tool in the presence of Sudden Stop shocks. I now turn to inspecting the behavior

of other macroeconomic variables so as to help in uncovering the mechanism behind the output-based results.

Investment, Consumption, and the Trade Balance. Figures 3a-7b depict the responses of investment, consumption, and the GDP share of the trade balance for the three ERR measures. The results from Figures 3a, 4a, and 5a, which depict the investment responses, indicate that investment responds much more adversely in the fixed ERR state, with a trough t-statistic for the response difference of -4.1 taking place after one year for the JS ERR measure; -3.8 (also after one year) for the LYS ERR measure; and -4.7 after 4 years. As in the case of output, the main takeaway from Figures 3a-5a is that a fixed ERR state appears to significantly enhance the adverse response of investment to credit supply shocks.

Figures 3b, 4b, and 5b present the responses of consumption for the three ERR measures. Consumption responds significantly more strongly in the fixed ERR state than in the strict controls state. Except for the RR ERR measure, for which consumption responses are largely insignificant across the two ERR states, the consumption response for the JS and LYS ERR measures is significantly negative in both ERR states. Overall, similar to investment, the differential behavior of consumption seems to contribute to the more adverse response of output in the fixed ERR state.

Figures 6-7b present the responses of the GDP share of the trade balance for the three ERR measures. The trade balance mostly significantly rises in the first year across both states and three ERR measures, after which it begins to decline (albeit insignificantly so except for the JS measure). Importantly, for most considered horizons, the trade balance is significantly higher in the fixed ERR state than in the non-fixed state following a credit supply shock. This result is broadly consistent with an interpretation that is based on the Sudden Stops literature where a contractionary global shock induces a sharper fall in capital inflows in the fixed ERR state and consequently a more acute economic downturn. (This interpretation will be further explored and formalized in the next sections that deal with responses of international capital flows, country credit spreads, and leverage.)

Figures 8a-10b depict the responses of exports and imports shares of GDP for the three ERR

measures. The behavior of exports is broadly in line with the predictions of basic theory, declining significantly more in the fixed ERR state. However, there is a stronger imports decline in the fixed ERR state that more than fully offsets the stronger exports decline, leading to the relatively more favorable trade balance response in the fixed ERR state.

Note that, for the JS ERR measure, the export response becomes significantly positive in the fixed ERR state after about two years compared to an insignificant response of exports in the non-fixed ERR state; this in turn produces significantly positive response differences for exports across the two states for a few periods from the two-year mark onwards. But since this reversal takes place at a relatively late horizon and rather long after the output response differences from Figure 1 become significant, it does not seem to play a role in driving the main result of this paper concerning the significantly stronger (and rapid) output response in the fixed ERR state. (This reasoning also largely applies to the RR ERR measure, although the aforementioned export response difference reversal is much more short-lived and less significant.)

By contrast, the significantly stronger rapid decline in exports observed for the JS ERR measure, as well as more generally for all ERR measures, is consistent with the notion that economic activity is depressed further and quite rapidly in the fixed ERR state due to the stronger fall in foreign demand and its implications for the severity of financial frictions. The latter relation to financial frictions is established below in the investigation of the state-dependent responses of capital flows, leverage, and country credit spreads. (I now turn to capital flows; leverage and credit spreads are the two last variables looked at in this section.)

Capital Flows. I now turn my attention to studying the behavior of international capital flows, which should help in establishing the Sudden Stop nature encapsulated in global credit supply shocks as well as in ascertaining its relative significance across the two states. Figures 11a-12b depict the responses of total net capital outflows and their components: net outflows of foreign direct investment, portfolio investment, and other investment, respectively, for the JS measure; Figures 13a-14b correspond to the LYS measure; and Figures 15a-16b depict results for the RR ERR measure. All variables are in terms of shares of GDP.

Taken together, the results stress that the Sudden Stop element encapsulated in global credit supply shocks is significantly stronger in the fixed ERR state than in the non-fixed ERR state, as capital flows out of the average EME in a more significant and persistent manner in the former state.[13] The difference between the net capital outflows' response across the fixed the and non-fixed ERR states is significantly positive for the majority of the horizons, far exceeding conventional rejection levels. These results establish the Sudden Stop interpretation of global credit supply shocks as they emphasize that these shocks erode international investors' confidence in domestic assets. Importantly, a valuable takeaway from these results is that this erosion of confidence is much stronger in the fixed ERR state.

In terms of the sub-components of the net capital outflows variable, the subsequent figures seem to indicate that largely all components experience a stronger net capital outflow in the fixed ERR state, although some heterogeneity across the different ERR measures is apparent. For the JS ERR measure, the differential response of total net outflows seem to be mainly driven by that of 'other investment', which mainly consists of debt related flows,[14] and foreign direct investment. The latter component seems to be more dominant for the LYS and RR ERR measures, although in terms of the impact response for the LYS measure it is clear that other investment outflows play the biggest role. Lastly, net portfolio outflows seem to be the least important factor behind the differential movement in total flows.

Foreign Exchange Reserves. How does the central bank respond, it terms of foreign exchange market intervention, to the above-mentioned capital outflows? Conventional wisdom and the mere essence of the definition of a fixed ERR imply that such intervention will be much stronger in the fixed ERR state. And this is precisely what the data deliver, at least for the JS and LYS ERR measure. As will be seen below, for the RR measure results are different, potentially reflecting the fact that this measure is based on parallel market exchange rates rather than official ones, as I elaborate upon below.

[13] A positive response of this variable implies that capital flows out of the economy.

[14] 'Other investment' includes loans as well as other forms of cross-border finance such as trade credit, bank deposits, and cash.

Figures 17-18b present the response of foreign exchange reserves' inflows as a share of GDP for the three ERR measures. (A positive response of this measure implies a drawing down of reserves.) It is apparent that in the fixed ERR state the monetary authority has a much stronger tendency to intervene in the foreign exchange market for the JS (Figure 17) and LYS (Figure 18a) ERR measures. I.e., for these ERR measures, in response to the capital outflow that takes place in both states, the monetary authority in the fixed ERR state sells foreign currency to defend the exchange rate (here this selling is represented by a negative response) to a significantly greater extent than its counterpart in the less fixed ERR state.[15] Accordingly, the t-statistics of the differences between the responses in the two states exceed conventional rejection levels.

However, for the RR measure (Figure 18b), intervention is not significantly more aggressive in the fixed ERR state and is also weaker in absolute terms in both states. One potential reason for this result is that the RR measure is based on parallel market exchange rates rather than official ones, which may mean that it's a more of a proxy for the credibility of the regime than the JS and LYS measures. In other words, since for the RR measure the fixed ERR state is associated with stability in effective market exchange rates, this measure proxies for credibility and, as such, it implies that the central bank need not intervene as much in times of a Sudden Stop. This interpretation is also consistent with the results on capital flows, which imply that the response differences in net capital outflows for the RR measure are less strong than those for the JS and LYS measures.

Nominal and Real Exchange Rate. Figures 19a-21b present the responses of the effective nominal and real exchange rate for the three ERR measures. The exchange rate, both in nominal and real terms, falls significantly more in the non-fixed ERR state (a negative response corresponds to a weakening, or depreciation, of the exchange rate), for all ERR measures. The significantly stronger depreciation of the exchange rate in the non-fixed ERR state can be explained by the

[15] Note that we should expect that non-peggers' central banks also intervene in foreign exchange markets, at least to some extent, given that the non-fixed ERR state corresponds to intermediate ERRs and floaters, both of which may also have a tendency to intervene in foreign exchange markets. The latter group in theory should not intervene but may very well be susceptible to the 'fear of floating' phenomena originally documented by Calvo and Reinhart (2002), where EMEs claiming to be floater are de facto reluctant to let their exchange rates float freely.

fact that the net capital outflow in this state is much stronger, thus putting more downward pressure of the exchange rate. And ,at least for the JS and LYS ERR measure, this relatively stronger downward pressure is further enhanced by the fact that the central bank intervenes in the foreign exchange market much less in the non-fixed ERR state, thus absorbing much less the capital outflow and associated increased demand for foreign currency.

In absolute terms, the nominal exchange rate significantly depreciates in the non-fixed ERR state throughout roughly the first year following the shock, while only significantly depreciating in real terms for a few horizons after one year for the RR ERR measure.[16] By contrast, the response of both the nominal and real exchange rates is mostly insignificant in the fixed ERR state. (The only exception is the LYS ERR measure, for which the exchange rate exhibits a marginally significant fall in the first two quarters after the shock.)

Leverage. Given the important theoretical role of leverage in models of EMEs based on credit constraints (e.g., Durdu et al. (2009), Mendoza (2010), Edwards (2007), and Agosin and Huaita (2012)) as well as those based on the Bernanke et al. (1999) financial accelerator framework (e.g., Fernández and Gulan (2015)), it is important to uncover the behavior of leverage across the two states to better understand the mechanism underlying the results shown so far. Studying the behavior of leverage can be seen as complementary to the previous analysis of capital flows as it facilitates a finer investigation into the dynamics of debt flows across the two states.

Toward this end, I measure leverage using BIS-reporting banks' claims on an EME divided by its GDP. This debt-to-GDP measure embodies debt of all economic agents in the economy to internationally active foreign banks that report to the BIS (currently consisting of banking groups from 31 countries).[17] The results for leverage appear in Figures 22-23b.

[16] This can be explained by the significant deflation that takes place in both states and which moderates the real depreciation. The inflation based results are available upon request from the author.

[17] This measure of debt is termed as '*international claims*' in the BIS dataset and excludes local currency claims of parent banks' subsidiaries in EMEs on domestic borrowers. There is also a breakdown of this measure into claims on the private non-financial sector, financial sector, and public sector. In results that are available upon request from the authro, I have found that the results for the aggregate leverage measure are driven mainly by private non-financial and financial sector leverages' behavior.

These results stress that leverage falls much more in the fixed ERR state for all considered ERR measures. This significantly stronger deleveraging process experienced in the fixed ERR state is consistent with the recent models developed in Edwards (2007), and Agosin and Huaita (2012), which combine exchange rate policies and occasionally binding credit constraints within a small open economy framework. These models emphasize that a fixed ERR exacerbates financial frictions due to a lack of exchange rate adjustment, which in turn produces a more acute delveraging process.

Country Credit Spreads. The previous results on capital flows and leverage indicate that financial frictions may have role in driving the differential output response across the two ERR states. To further study this financial frictions based channel, I end this section with a focus on the role of EMEs' perceived riskiness in driving this paper's results.

Perhaps the most natural empirical proxy for the level of riskiness of EMEs as perceived by international credit market participants is the Emerging Markets Bond Index (EMBI) Global variable, which is computed by JP Morgan and proxies for country credit spreads.[18] I utilize the Stripped Spread version of the index, which is computed as an arithmetic, market-capitalization-weighted average of bond spreads over U.S. Treasury bonds of comparable duration. Understanding the behavior of this variable across the states in response to global credit supply shocks can shed important light on whether financial frictions may play a role in driving this paper's results.[19]

The results for EMBI appear in Figures 24-25b, showing that EMBI rises significantly more in the fixed ERR state. The significantly stronger increase in perceived riskiness is consistent with the stronger net capital outflow and deleveraging process already established above. And it is a

[18] Data on EMBI is available for 20 countries, where the longest range of the unbalanced panel is 1994:Q1-2014:Q4. More details are provided in Appendix A. I have confirmed that the bseline output-based results are robust to using the smaller EMBI-based sample. These results are available upon request from the author.

[19] As emphasized in Elekda and Tchakarov (2007) and Fernández and Gulan (2015), EMBI constitutes a suitable proxy for the external finance premium in EMEs. As such, it encapsulates valuable information about the magnitude of financial frictions and their potential dependence on the state of ERR.

clear indication that an important interplay between the type of ERR and financial frictions takes place following a credit supply shocks, in line with the theoretical implications of Edwards (2007), and Agosin and Huaita (2012).

3 Additional Potential Mechanisms

The results presented in the previous section suggest that financial frictions play a role in driving the different output responses across the two ERR states. E.g., interpreted through the lens of models with occasionally binding credit constraints, this paper's results imply that Sudden Stop shocks make credit constraints tighter in the fixed ERR than in the non-fixed ERR owing to the favorable implications of the currency depreciation for economic activity in the latter state; this, in turn, produces a much more acute deleveraging process in the fixed ERR that exacerbates the fall in economic activity in this state.

Notwithstanding the aforementioned, potentially important role of financial frictions, it is also important to look at other potential, theoretically sound mechanisms which may also play a role in driving this paper's results. Toward this end, I study in this section the potential role of two such additional mechanisms: *i*) monetary policy response to the Sudden Stop and *ii*) preceding capital inflow levels.

Monetary Policy. The way by which monetary policy responds to Sudden Stop shocks can affect their level of severity. E.g., one may argue that Sudden Stops have more adverse effects on EMEs with fixed ERRs in part because they are forced to keep rates relatively higher in order to defend the peg (e.g., Lahiri and Vgh (2007)). To examine this reasoning, I estimate Specification 1 when using the central bank policy rate as the outcome variable. These results are shown in Figures 26-27b.

By and large, there are no significant differences in the way monetary policy responds to credit supply shocks across the two ERRs, with rates generally tending to go down at business cycle frequencies in both states and go up in the 4th year. The only measure for which there is some

significance in the response difference is the JS measure (Figure 26), for which interest rates are significantly higher in the fixed ERR state on the impact period and in the 11th horizon. But this significance is limited only to these two horizons and is absent in entirety from the other two figures. Overall, it does not seem that monetary policy plays an important role in driving the results of this paper.

Are Preceding Capital Inflow Surges Driving the Results? To preclude an additional potentially viable channel that can account for my baseline empirical results, I now turn my attention to the response of capital flows to being in the two ERR states, conditional on no shocks taking place. This is an important exercise as the preceding level of net capital inflows may be a decisive factor in the transmission of Sudden Stop shocks (more discussion on this appears below).

The general specification that I estimate to identify the effects of the ERR states on capital flows is given by

$$\begin{aligned} cf_{i,t+h} - cf_{i,t-1} = I_{i,t-4}[\Upsilon_{A,h} + \Xi_{A,h}EBP_t + \Omega_{A,h}(L)EBP_{t-1} + \Gamma_{A,h}(L)\Delta cf_{i,t-1}] + \\ +(1 - I_{i,t-4})[\Upsilon_{B,h} + \Xi_{B,h}EBP_t + \Omega_{B,h}(L)EBP_{t-1} + \Gamma_{B,h}(L)\Delta cf_{i,t-1}] + \\ +I^S_{i,t-4}[\alpha_{S,i,h} + \Xi_{S,h}EBP_t + \Omega_{S,h}(L)EBP_{t-1} + \Gamma_{S,h}(L)\Delta cf_{i,t-1}] + \\ +(1 - I^S_{i,t-4})[\alpha_{M,i,h} + \Xi_{M,h}EBP_t + \Omega_{M,h}(L)EBP_{t-1} + \Gamma_{M,h}(L)\Delta cf_{i,t-1}] + \\ +I^R_{i,t-4}[\alpha_{R,i,h} + \Xi_{R,h}EBP_t + \Omega_{R,h}(L)EBP_{t-1} + \Gamma_{R,h}(L)\Delta cf_{i,t-1}] + \\ +(1 - I^R_{i,t-4})[\alpha_{P,i,h} + \Xi_{P,h}EBP_t + \Omega_{P,h}(L)EBP_{t-1} + \Gamma_{P,h}(L)\Delta cf_{i,t-1}] + u_{i,t+h}, \end{aligned} \tag{3}$$

where cf is the GDP share of capital flows and the only difference relative to the baseline specification is that $\Upsilon_{A,h}$ and $\Upsilon_{B,h}$ replace $\alpha_{A,i,h}$ and $\Upsilon_{B,i,h}$, respectively;[20] $\Upsilon_{A,h}$ and $\Upsilon_{B,h}$ represent the average effects of being in a state of fixed ERR and non-fixed ERR, respectively. My interest lies in estimating these coefficients and ascertain whether they are significantly different from one another.

[20]Note that, since perfect collinearity results from putting together state-specific fixed effects ($\alpha_{A,i,h}$ and $\alpha_{B,i,h}$) and state-specific dummies ($\Upsilon_{A,h}$ and $\Upsilon_{B,h}$), I omit the former from the regression.

My main variable of interest in this section is total net capital outflows because a reasonable explanation for the increased severity of Sudden Stops in the fixed ERR state may lie in decreased net capital outflows in this state, i.e., that a capital inflow boom (or 'Bonanza') in the fixed ERR state increases the economy's vulnerability to credit supply shocks. This hypothesis has received some empirical support from the literature (see, e.g., Edwards (2007) and Agosin and Huaita (2012)). From a theoretical standpoint, the link between capital inflow booms and busts can be structurally explained through the lens of the models advanced in the Sudden Stops literature, where a higher initial level of leverage moderates the effects of contractionary shocks relative to a state of lower initial leverage as in the former case the likelihood of a binding credit constraint is higher (see, e.g., Durdu et al. (2009)).

Figures 28-29b depict the responses of total net capital outflows for the three ERR measures. All variables are in terms of shares of GDP. The results stress that the boom-bust based explanation is strongly rejected by the data: being in the fixed ERR state steers away foreign investment in a significant manner, both in absolute terms as well as relative terms. Net capital outflows increase significantly for most horizons from being in the fixed ERR state, while mostly deceasing significantly in the non-fixed ERR state. The t-statistics of the response difference are highly significant, clearly indicating that being in a fixed ERR state is associated with much more net capital outflows.

These results indicate that the output-based results are unlikely to stem from preceding capital inflow booms that lead to increased leverage and financial vulnerabilities at the time of the Sudden Stop shock's realization.[21] This in turn implies that the main underlying cause of the output-based results is likely to be related to the specific nature of the ERR in place in terms of its implications for exchange rate- and export-adjustment and this adjustment's connection to the level of financial frictions. And this cause ought to lie at the heart of the observation that net capital outflows are much more significant in the fixed ERR state both in response to credit supply shocks as well as conditional on no such shocks taking place, in accordance with theoretical results from Fornaro

[21] I also confirm this assertion using data on EMEs' debt to BIS-reporting international banks. These results are available upon request from the author.

(2015) and Devereux and Yu (2017) which show that net capital inflows actually tend to be lower on average in fixed ERRs due to the greater consequences of a crisis under a peg while tending to be much higher in this state in the presence of Sudden Stops.

4 Conclusion

The question of whether the type of ERR in place constitutes a relevant policy tool for affecting Sudden Stops' adverse effects is an important question from both a policy standpoint as well as an intellectual curiosity standpoint. Since ERR flexibility facilitates exchange rate depreciation in response to capital outflows, conventional economic intuition an well as formal theory seem to suggest that EMEs with fixed ERRs should be more sensitive to credit supply shocks relative to those with less fixed ERRs.

This paper empirically formalizes this intuitive notion, but stresses that there is an important interaction between the fixity of the ERR and the level of financial frictions, whereby the former seems to amplify the severity of the latter. This is an important result as it goes beyond the classical expenditure switching-exchange rate channel emphasized in more traditional models by providing evidence that financial frictions are an important element that facilitates the shock-amplifying nature of fixed ERRs. And this empirical result is consistent with recent theoretical models that study the role of exchange rate policies in Sudden Stops (e.g., Cspedes et al. (2004), Gertler et al. (2007), Ottonello (2015), Fornaro (2015), and Devereux and Yu (2017)).

The empirical evidence put forward in this paper, which shows that fixed ERRs enhance the effects of global credit supply shocks, lends credence to the view that ERR fixity is unwarranted on the grounds of its negative effect on macroeconomic stability. Therefore, the policy implications of this paper are that policymakers should seriously consider abandoning fixed ERRs as an effective tool for increasing macroeconomic stability.

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Appendix A Data

A.1 Output, Investment, Consumption, and the Trade Balance.

Variables Definitions. Output is defined as local currency nominal GDP divided by the GDP deflator; investment is local currency gross private capital formation divided by the GDP deflator; consumption is defined as local currency nominal household consumption divided by the GDP deflator; and the trade balance is the difference between local currency exports and imports divided by local currency nominal GDP. All series were seasonally adjusted using ARIMA X12 and downloaded from the International Financial Statistics (IFS) database, which is published by the International Monetary Fund, except for China for which data from Chang et al. (2015) was collected from the Atlanta Fed website.

Sample. My panel for these variables consists of a total of 2245 observations. I use quarterly data for the following countries (29 in total) and periods: Argentina 1995:Q1-2014:Q4; Bolivia 1995:Q1-2014:Q4; Brazil 1995:Q1-2014:Q4; Bulgaria 1995:Q4-2014:Q4; Chile 1996:Q1-2014:Q4; China 1995:Q1-2014:Q4; Colombia 1995:Q1-2014:Q4; Costa Rica 2000:Q1-2014:Q4; Czech Republic 1995:Q1-2014:Q4; Georgia 1996:Q1-2014:Q4; Guatemala 2001:Q1-2014:Q4; Hungary 1994:Q1-2014:Q4; India 2004:Q1-2014:Q4; Indonesia 1997:Q1-2014:Q4; Korea 1994:Q1-2014:Q4; Kyrgyz 1999:Q1-2014:Q4; Latvia 1994:Q1-2014:Q4; Malaysia 1994:Q1-2014:Q4; Mauritius 2000:Q1-2014:Q4; Mexico 1994:Q1-2014:Q4; Paraguay 1994:Q1-2014:Q4; Peru 1994:Q1-2014:Q4; Philippines 1994:Q1-2014:Q4; Poland 1994:Q1-2014:Q4; Romania 1998:Q1-2014:Q4; Russia 1994:Q1-2014:Q4; South Africa 1994:Q1-2014:Q4; Thailand 1994:Q1-2014:Q4; Turkey 1994:Q1-2014:Q4; Ukraine 2001:Q1-2014:Q4.

A.2 Exchange Rate Regime.

Variables Definitions. I use three popular ERR measures in this paper:

Shambaugh (2004) ERR Measure. This annual measure focuses exclusively on the volatility of the exchange rate and divides countries into pegs and non-pegs, where the former are classified as such if their official exchange rate remains within a 2% band with respect to its base country. In addition, to prevent breaks in the peg status due to one-time realignments, Shambaugh (2004) classify as fixed any exchange rate that had a zero percentage change in eleven out of twelve months in a given year. I directly employ the raw Shambaugh (2004) peg dummy variable (which obtains 1 if an observation corresponds to a peg) in my analysis, which is available through 2014 and downloaded from the NBER data sources catalogue website (http://www.nber.org/data/international-finance/#err). I convert annual values into quarterly ones by assuming within-year constancy of observations.

Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR Measure. This annual measure is based on cluster analysis to group countries according to the relative volatility of exchange rates and reserves; I identify fixed ERR observations in line with the grouping of Levy-Yeyati and Sturzenegger (2001, 2003, 2005), who divide the observations into fixed, intermediate, and flexible regimes. They define fixed ERRs as those corresponding to low volatility of exchange rates and high volatility of foreign exchange reserves. My fixed ERR dummy is defined such that it obtains 1 if it corresponds to the fixed grouping of Levy-Yeyati and Sturzenegger (2001, 2003, 2005). I make use in my analysis of the updated series from Levy-Yeyati and Sturzenegger (2016), which runs through 2013 and is available from Eduardo Levy-Yeyati's website (http://eduardolevyyeyati.com.ar/publicaciones/).

Reinhart and Rogoff (2004) ERR Measure. This monthly measure is based on the classification codes from Reinhart and Rogoff (2004). The series I use are taken from Carmen Reinhart's website (http://http://www.carmenreinhart.com/data/browse-by-topic/topics/11/), as updated by Ilzetzki et al. (2010) through 2010. Its construction makes use of monthly data on market-determined parallel exchange rates to generate a fine classification of ERRs comprising of 15 categories. These categories appear in Table 1, where larger category integers represent more

flexible ERRs. I convert monthly values to quarterly ones by averaging over the respective values in each quarter and define the fixed ERR state as a dummy that obtains 1 if the RR measure obtains an integer that is not greater than 4.

A.3 Capital Controls.

Variable Definition. The capital controls data is taken from Fernández et al. (2015), who revise, extend, and widen the dataset originally developed by Schindler (2009) and later expanded by Klein (2012) and Fernández et al. (2015). This dataset reports the presence or absence of capital controls, on an annual basis, for 100 countries over the period 1995 to 2013 and provides information on restrictions on capital inflows and outflows separately while distinguishing between six categories of assets and the residency of the transacting agent.

Given the robust finding by Fernández et al. (2015) that capital controls are strongly acyclical and have a very small standard deviation at annual frequencies, I make the thus innocuous assumption that capital controls do not exhibit variation within the year; accordingly, I transform the capital control annual measures into quarterly ones by assuming identical quarterly values equal to the corresponding annual values.

Below is the specific definition of the capital inflow control measure I use in the paper:

Total Capital Inflow Controls Index. This index is an average of the following 10 inflow restrictions binary sub-indices: Equity inflow restrictions; Bond inflow restrictions; Money Market inflow restriction; Collective Investments inflow restrictions; Derivatives inflow restrictions; Commercial Credits inflow restrictions; Financial Credits inflow restrictions; Guarantees, sureties and financial backup facilities inflow restrictions; Direct Investment inflow restrictions; and Real Estate inflow restrictions.

A.4 Economic Development.

Variable Definition. To control for the level of economic development in my analysis, I use 1995 PPP-adjusted per capita GDP for the EMEs in my sample taken from the World Bank Database. I construct a dummy variable for economic development that obtains 1 if an observation exceeds or is equal to the upper quartile of the 1995 PPP-adjusted per capita GDP distribution.

A.5 Global Credit Supply Shock.

Variable Definition. To measure global credit supply shocks, I make use of the Gilchrist and Zakrajek (2012) credit supply shock series. Gilchrist and Zakrajek (2012) use micro-level data to construct a credit spread index which they decomposed into a component that captures firm-specific information on expected defaults and a residual component that they termed as the excess bond premium. The most updated series of the excess bond premium variable, available from Favara et al. (2016),[22] is my measure of credit supply shocks in this paper. It is in quarterly frequency and covers the sample period 1994:Q1 to 2014:Q4. Quarterly values are averages of corresponding raw monthly values.

A.6 Balance of Payments.

Variables Definitions. The balance of payments data consists of the sum of GDP shares of local currency net capital outflows of foreign direct investment, portfolio investment, and other investment;[23] and changes of the monetary authority's local currency foreign exchange reserves as a share of GDP. All variables were available in dollar values in raw form and were thus converted to local currency values by using the dollar exchange rate. All raw series were seasonally adjusted using ARIMA X12 and downloaded from the IFS.

[22] The permanent link for this updated excess bond premium series is https://www.federalreserve.gov/econresdata/notes/feds-notes/2016/files/ebp_csv.csv.

[23] 'Other investment' includes loans as well as other forms of cross-border finance such as trade credit, bank deposits, and cash.

Sample. My panel for these variables corresponds to the countries and periods covered by the output, investment, consumption, and trade balance variables. The only exception is a sub-component of capital flows, portfolio investment, for which data from Paraguay are unavailable. Hence, for this two countries I measure net capital flows as the sum of only foreign direct investment and other investment.

A.7 Exchange Rates.

Variables Definitions. The exchange rate data consist of the nominal effective exchange rate and real effective exchange rate (CPI based). These series were downloaded from the IFS database. Since the latter source missed data for several countries, I complemented it with the Bank for International Settlements (BIS) exchange rate dataset.

Sample. My panel for the nominal and real exchange rate variables corresponds to the countries and periods covered by the output, investment, consumption, and trade balance variables.

A.8 Leverage.

Variable Definition. The leverage data is defined as the ratio of total BIS-reporting banks' international claims on each country to its GDP. The claims series are taken from the BIS consolidated banking statistics database. Raw claims are in dollar terms and are therefore converted to local currency terms using the average quarter dollar exchange rate from each country taken from the IFS database. The BIS claims data exclude intragroup positions and are currently reported to the BIS by banking groups from 31 countries.

Sample. The panel for leverage consists of a total of 1716 observations. The data is quarterly and covers the 30 countries that correspond to the output-based sample of countries for the sample period 2000:Q1-2014:Q4.

A.9 EMBI Spread.

Variable Definition. I use the Emerging Markets Bond Index (EMBI) Global computed by JP Morgan as a measure of country spread. This index is a composite of different U.S. dollar-denominated bonds. The Stripped Spread is computed as an arithmetic, market-capitalization-weighted average of bond spreads over U.S. Treasury bonds of comparable duration and downloaded from Datastream. Quarterly values are average of corresponding raw spread daily values.

Sample. My panel for EMBI consists of a total of 1449 observations. I use quarterly data for the following countries (20 in total) and periods: Argentina 1994:Q1-2014:Q4; Brazil 1994:Q1-2014:Q4; Bulgaria 1995:Q4-2014:Q4; Chile 1999:Q2-2014:Q4; China 1994:Q1-2014:Q4; Colombia 1997:Q1-2014:Q4; Ecuador 1994:Q1-2014:Q4; Hungary 1999:Q1-2014:Q4; Indonesia 2004:Q2-2014:Q4; Korea 1994:Q1-2004:Q2; Kyrgyz 1999:Q1-2014:Q4; Malaysia 1996:Q4-2014:Q4; Mexico 1994:Q1-2014:Q4; Peru 1997:Q1-2014:Q4; Philippines 1994:Q1-2014:Q4; Poland 1994:Q1-2014:Q4; Russia 1997:Q4-2014:Q4; South Africa 1994:Q1-2014:Q4; Thailand 1997:Q2-2006:Q1; Turkey 1996:Q3-2014:Q4.

A.10 Central Bank Policy Rate.

Variable Definition. The central bank policy rate represents the interest rate used by a central bank to implement its monetary policy stance; the underlying financial instrument of the policy rate varies across the EMEs in my sample, being the discount rate for some while in others it is a repurchase agreement rate. Data for this variable was downloaded from the IFS database.

Sample. My panel for policy rates consists of a total of 1729 observations. Data for this variable is covered by 27 countries (Argentina and Ukraine are excluded) and in terms of the time dimension, there are the following differences with respect to the output-based sample: Brazil 1999:Q2-2014:Q4; Costa Rica 2006:Q1-2014:Q4; Georgia 2008:Q1-2014:Q4; Guatemala 2005:Q1-2014:Q4; Korea 1999:Q2-2014:Q4; Kyrgyz 2000:Q1-2014:Q4; Malaysia 2004:Q2-2014:Q4; Mauritius 2006:Q4-2014:Q4; Mexico 2008:Q1-2014:Q4; Paraguay 2011:Q1-2014:Q4; Philippines 2001:Q4-

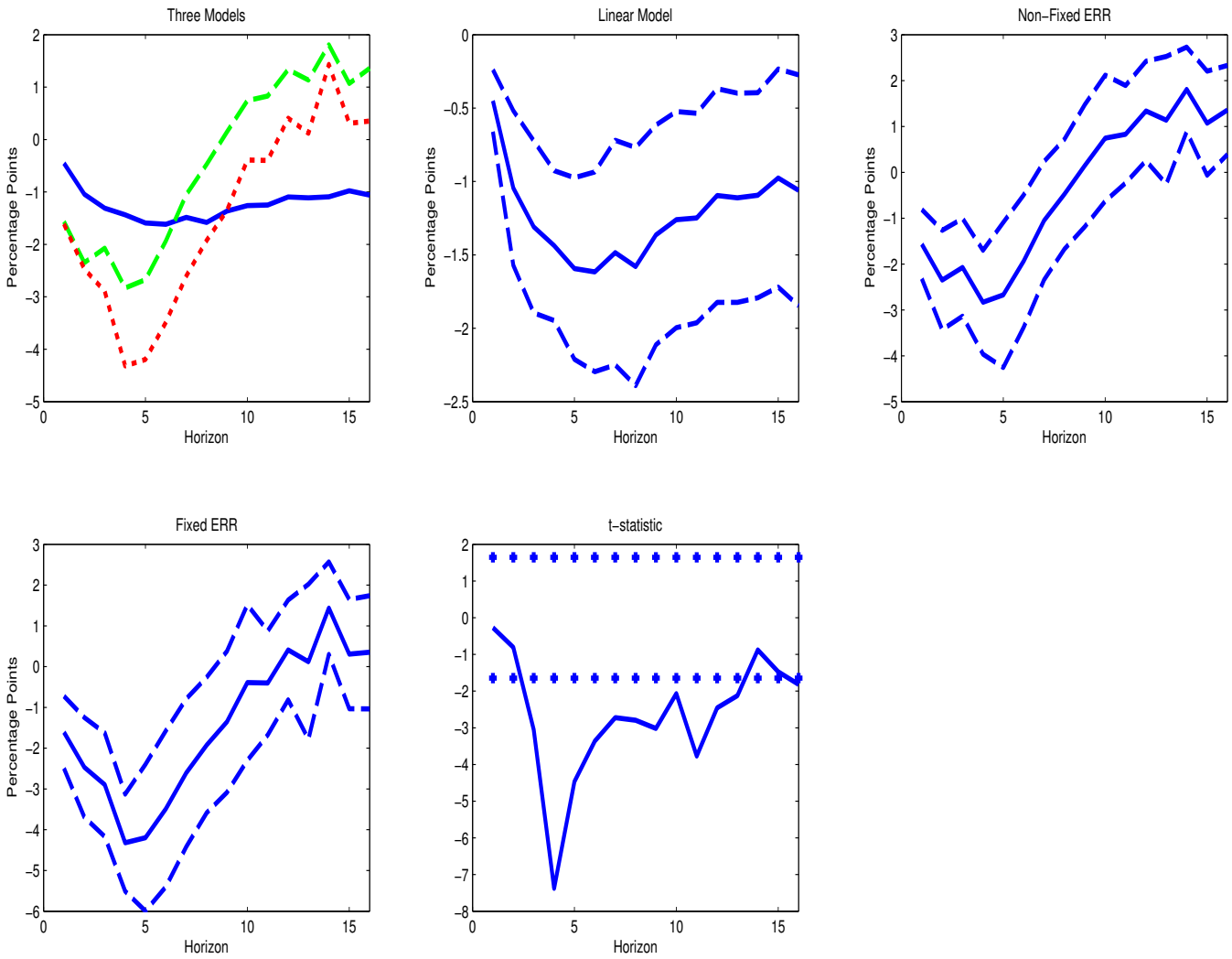
2014:Q4; Poland 1998:Q1-2014:Q4; Russia 2011:Q1-2014:Q4; Turkey 1999:Q4-2014:Q4.

Table 1: **Reinhart and Rogoff (2004) Exchange Rate Regime Classification**.

Category	Description
1	No Separate Legal Tender
2	Pre-Announced Peg or Currency Board Arrangement
3	Pre-Announced Horizontal Band that is Narrower than or Equal to $+/-2\%$
4	De Dacto Peg
5	Pre-Announced Crawling Peg
6	Pre-Announced Crawling Band that is Narrower than or Equal to $+/-2\%$
7	De Facto Crawling Peg
8	De Facto Crawling Band that is Narrower than or Equal to $+/-2\%$
9	Pre-Announced Crawling Band that is Wider than or Equal to $+/-2\%$
10	De Facto Crawling Band that is Narrower than or Equal to $+/-5\%$
11	Moving Band that is Narrower than or Equal to $+/-2\%$
12	Managed Floating
13	Freely Floating
14	Freely falling
15	Dual Market in which Parallel Market Data is Missing

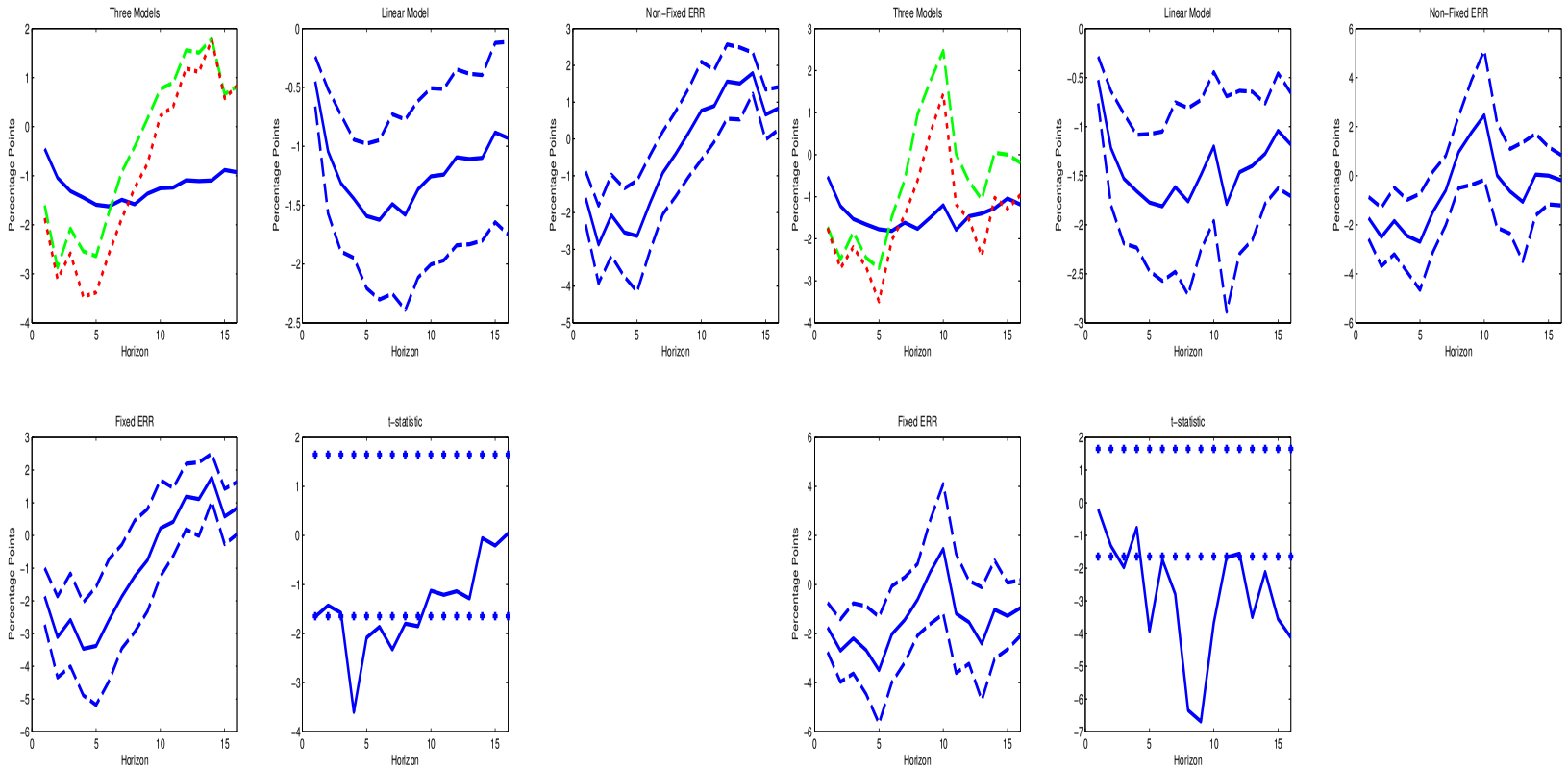
Notes: The table consists of the ERR classification codes from Reinhart and Rogoff (2004), which is the basis for one of the three ERR measures used in this paper.

Figure 1: **ERR's Effect on Output's Sensitivity to Credit Supply Shocks: JS ERR Measure**.



Notes: This figure presents the impulse responses of output to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. In the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 2: **ERR's Effect on Output's Sensitivity to Credit Supply Shocks: (a) LYS ERR Measure; (b) RR ERR Measure**.

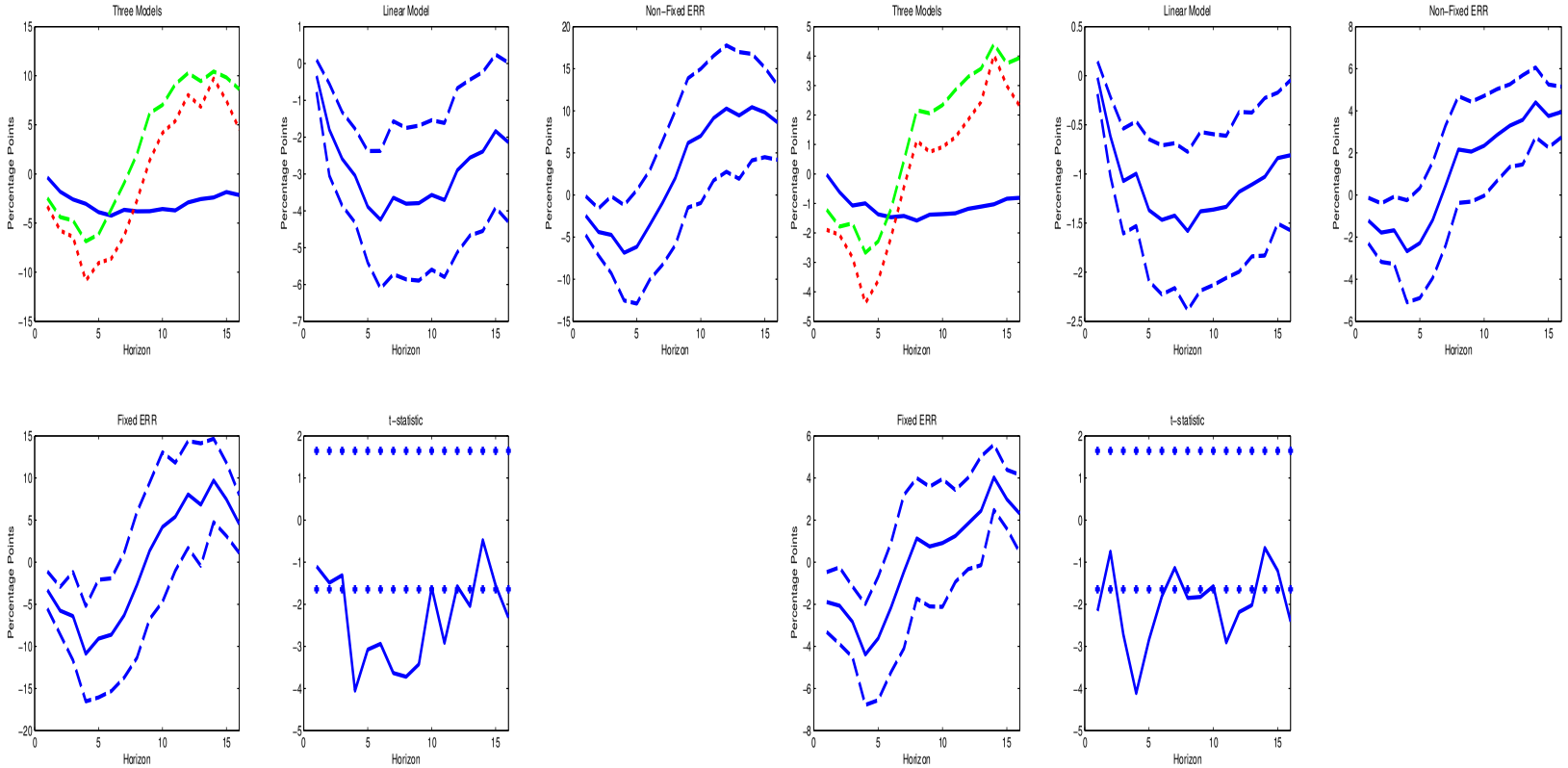


(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (LYS).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (RR).

Notes: Panel (a): This figure presents the impulse responses of output to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. Panel (b): This figure presents the impulse responses of output to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure.
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 3: **ERR's Effect on Investment's and Consumption's Sensitivity to Credit Supply Shocks for the JS ERR measure: (a) Investment; (b) Consumption**.

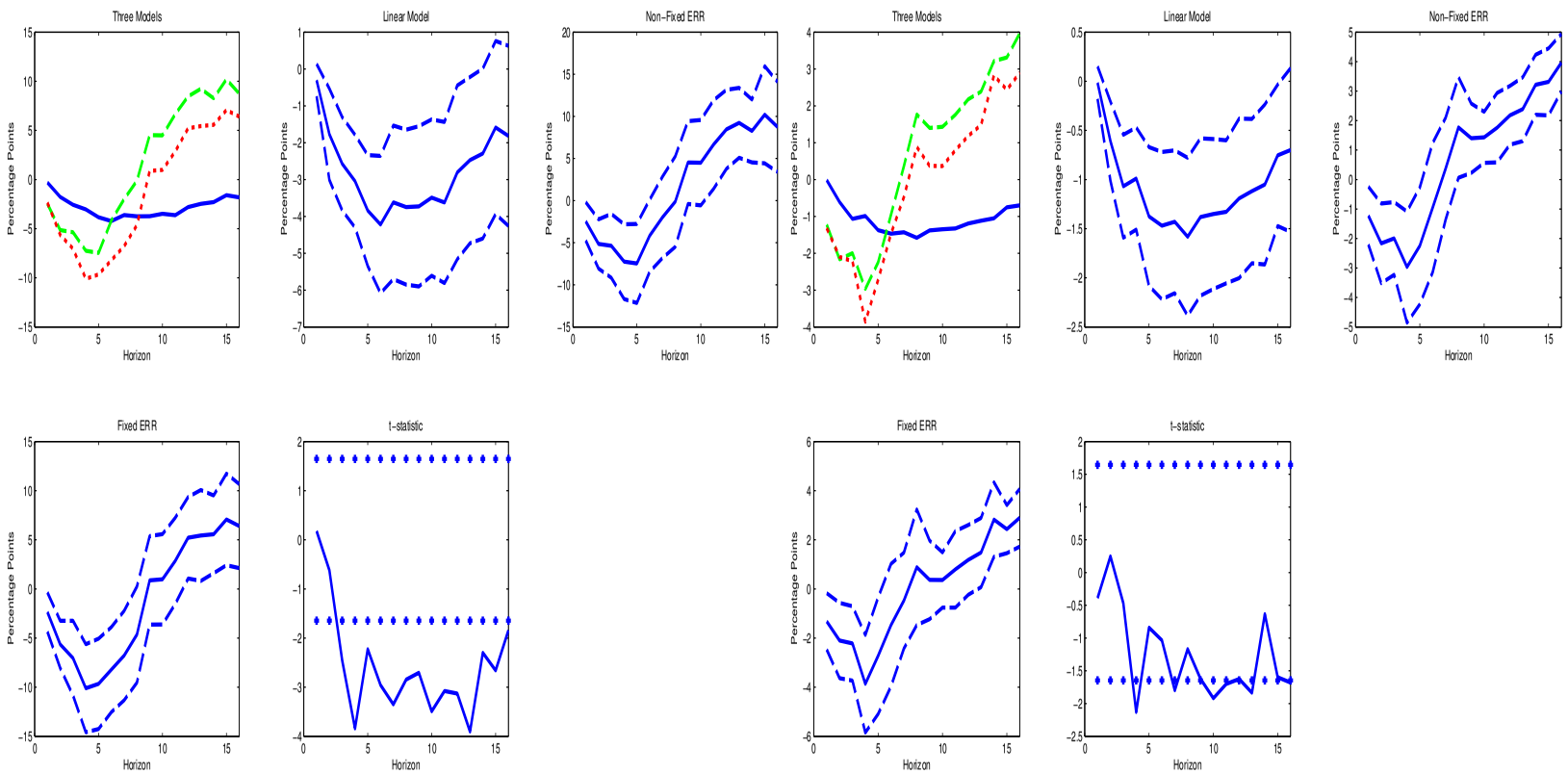


(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (Investment).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (Consumption).

Notes: Panel (a): This figure presents the impulse responses of investment to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. Panel (b): This figure presents the impulse responses of consumption to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure.
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 4: **ERR's Effect on Investment's and Consumption's Sensitivity to Credit Supply Shocks for the LYS ERR measure: (a) Investment; (b) Consumption.**



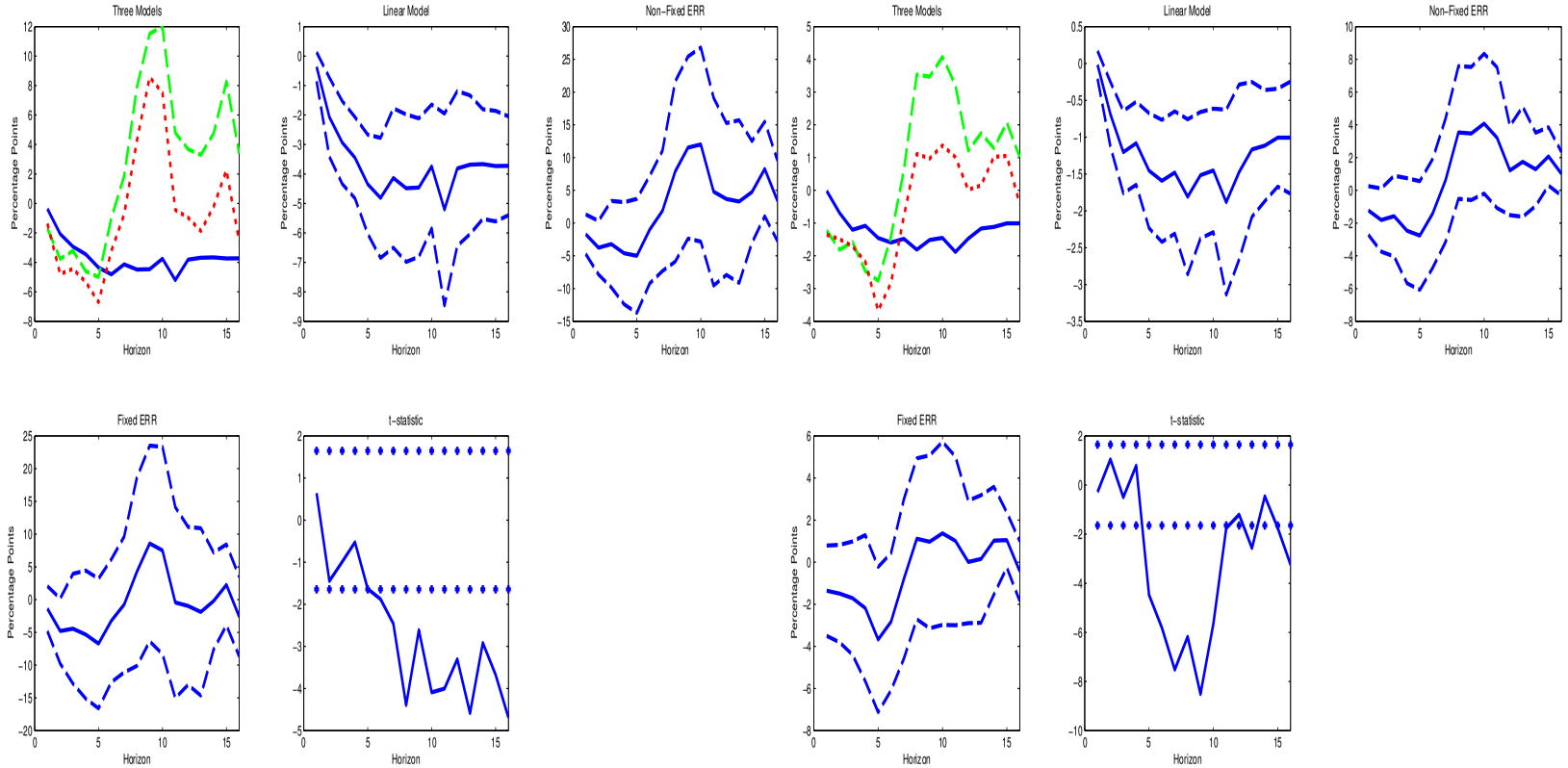
(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (Investment).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (Consumption).

Notes: Panel (a): This figure presents the impulse responses of investment to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. Panel (b): This figure presents the impulse responses of consumption to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure.

For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 5: **ERR's Effect on Investment's and Consumption's Sensitivity to Credit Supply Shocks for the RR ERR measure: (a) Investment; (b) Consumption**.

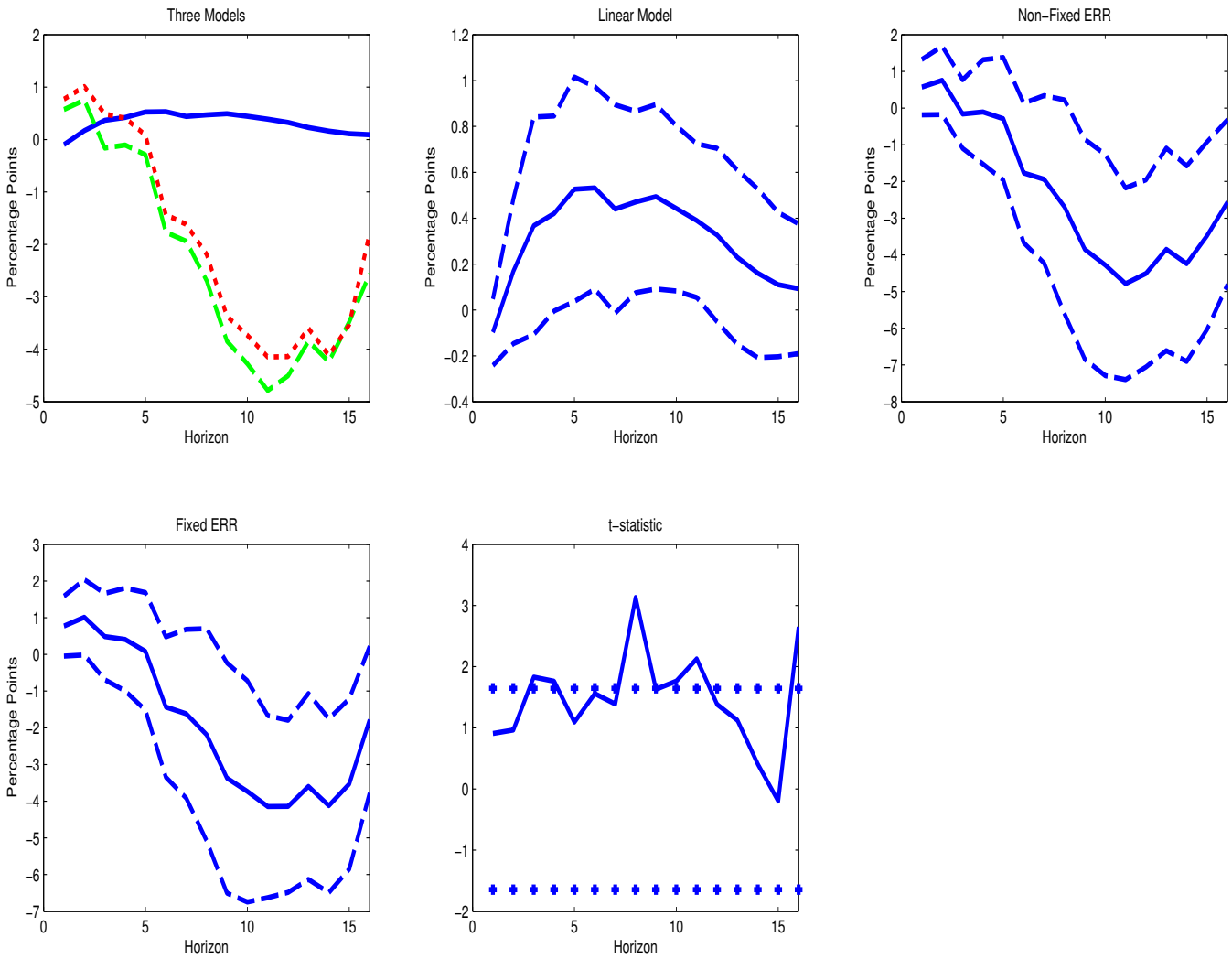


(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (Investment).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (Consumption).

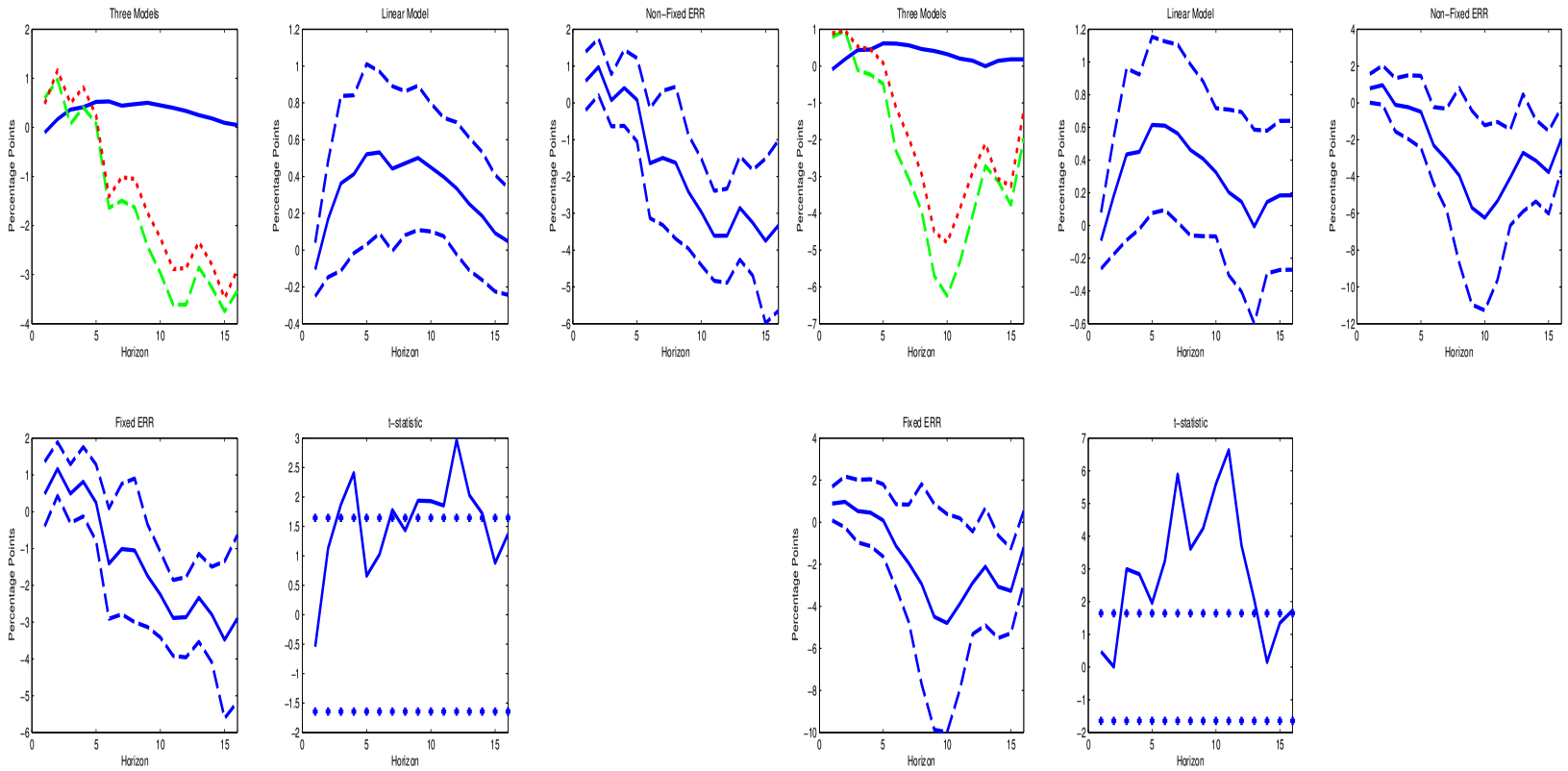
Notes: Panel (a): This figure presents the impulse responses of investment to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure. Panel (b): This figure presents the impulse responses of consumption to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure.
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 6: **ERR's Effect on the Trade Balance's Sensitivity to Credit Supply Shocks: JS ERR Measure**.



Notes: This figure presents the impulse responses of the GDP share of the trade balance to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. In the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 7: **ERR's Effect on Trade Balance's Sensitivity to Credit Supply Shocks: (a) LYS ERR Measure; (b) RR ERR Measure**.

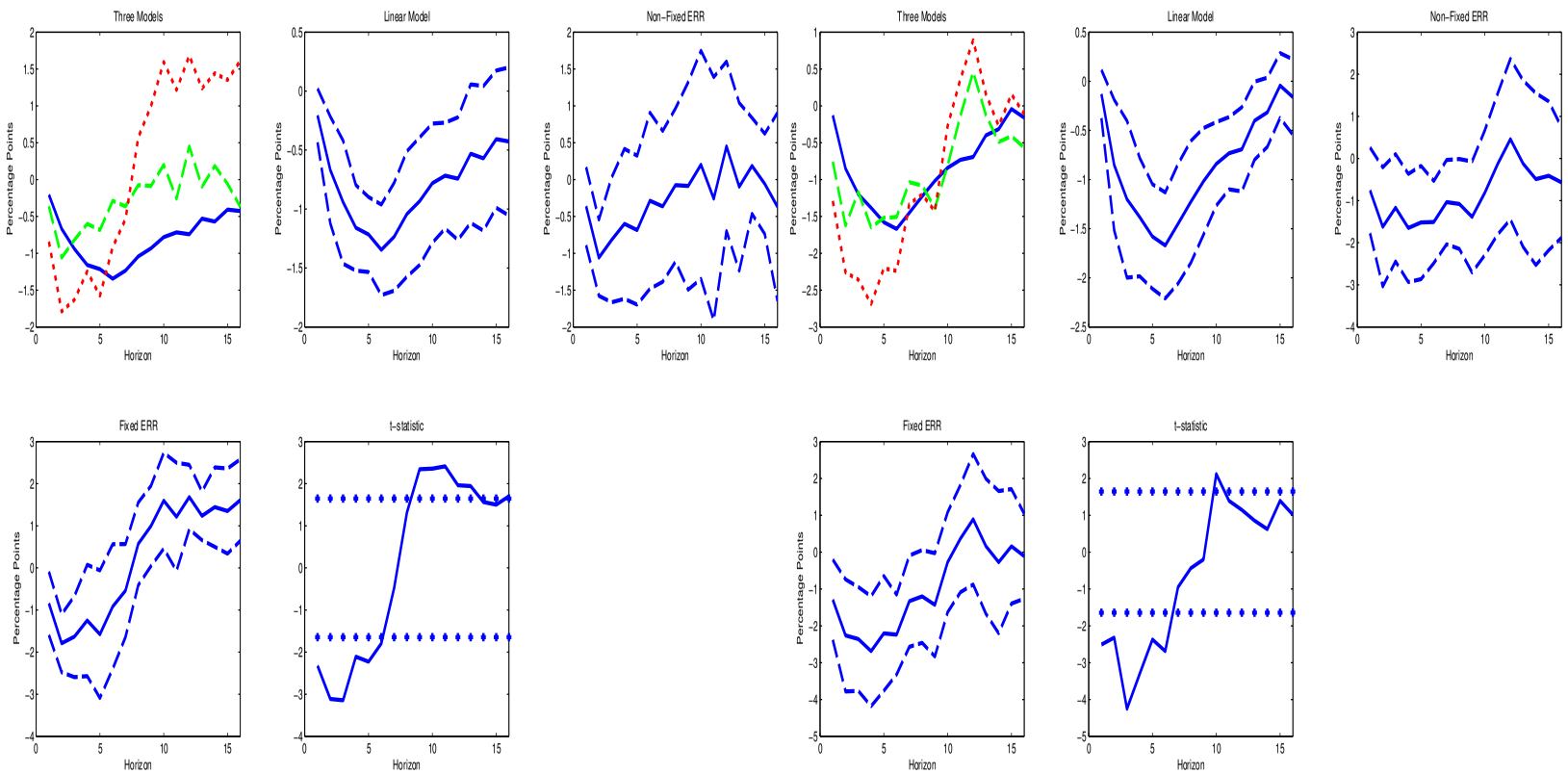


(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (LYS).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (RR).

Notes: Panel (a): This figure presents the impulse responses of the GDP share of the trade Balance to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. Panel (b): This figure presents the impulse responses of of the GDP share of the trade Balance to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure.
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 8: **ERR's Effect on Exports' and Imports' Sensitivity to Credit Supply Shocks for the JS ERR Measure: (a) Exports; (b) Imports.**

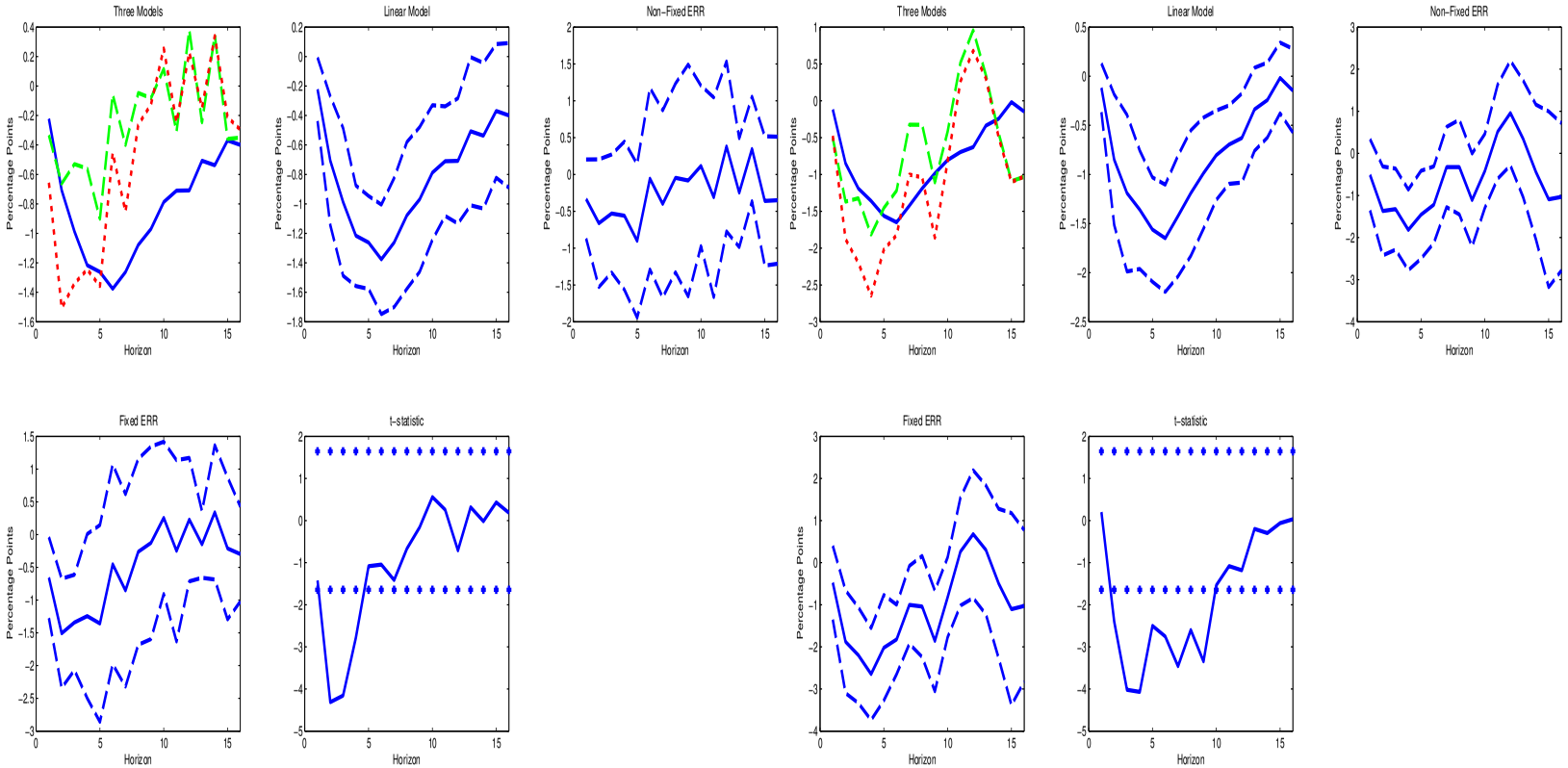


(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (Exports).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (Imports).

Notes: Panel (a): This figure presents the impulse responses of exports' GDP share to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. Panel (b): This figure presents the impulse responses of imports' GDP share to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure.
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage points deviations from steady state values. Horizon is in quarters.

Figure 9: **ERR's Effect on Exports' and Imports' Sensitivity to Credit Supply Shocks for the LYS ERR Measure: (a) Exports; (b) Imports.**



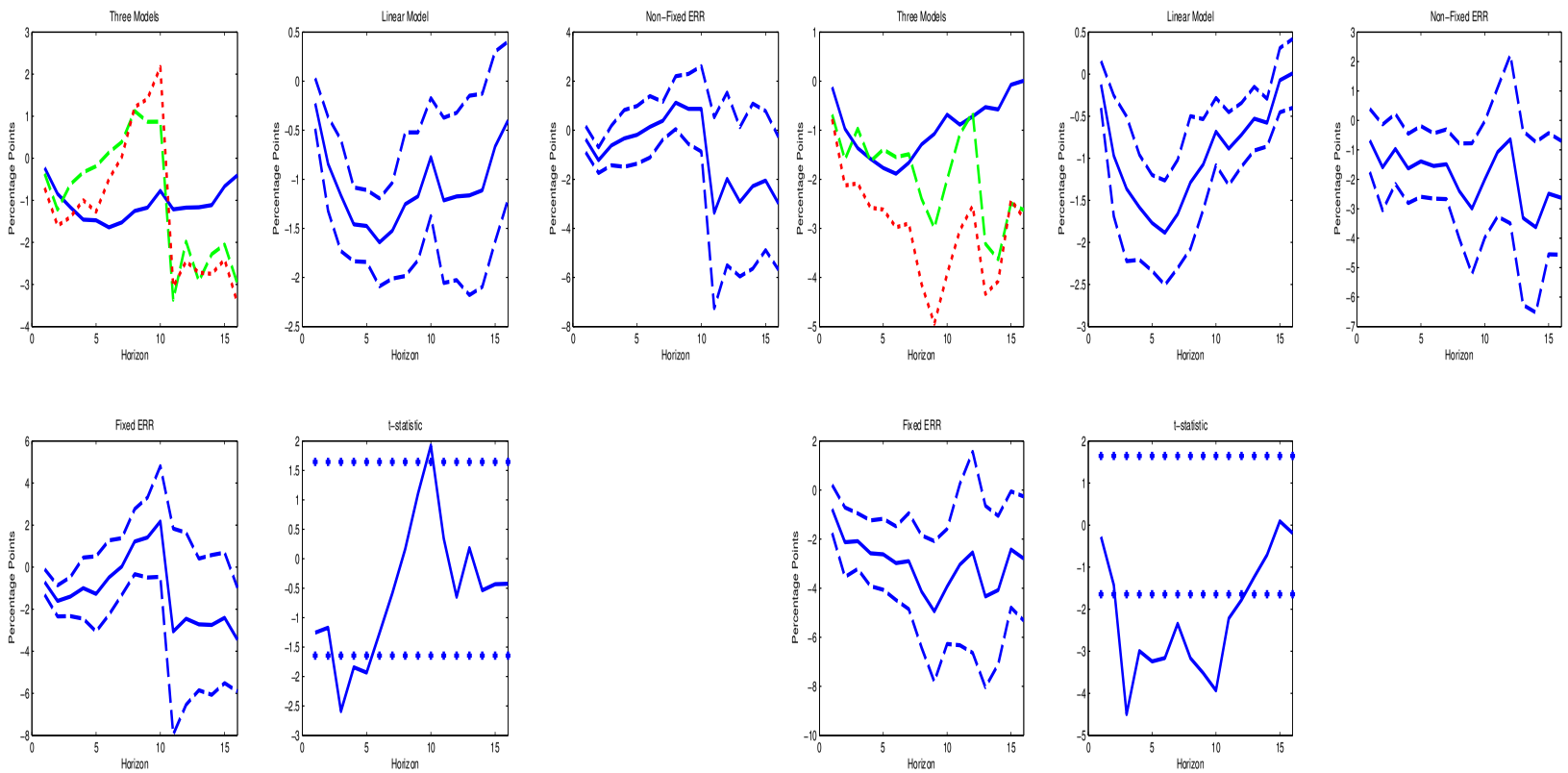
(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (Exports).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (Imports).

Notes: Panel (a): This figure presents the impulse responses of exports' GDP share to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. Panel (b): This figure presents the impulse responses of imports' GDP share to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure.

For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage points deviations from steady state values. Horizon is in quarters.

Figure 10: **ERR's Effect on Exports' and Imports' Sensitivity to Credit Supply Shocks for the RR ERR Measure: (a) Exports; (b) Imports**.

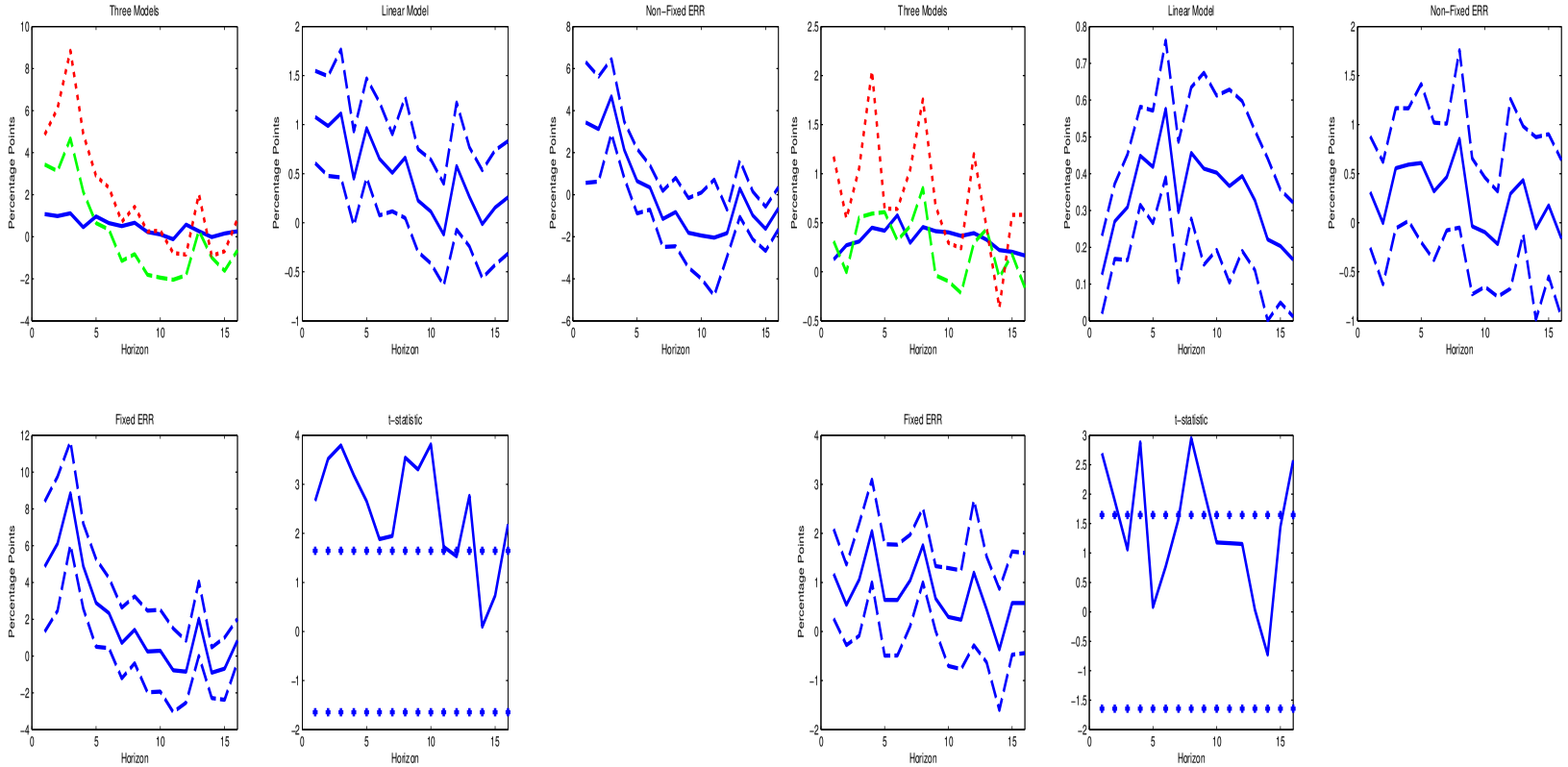


(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (Exports).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (Imports).

Notes: Panel (a): This figure presents the impulse responses of exports' GDP share to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure. Panel (b): This figure presents the impulse responses of imports' GDP share to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure.
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage points deviations from steady state values. Horizon is in quarters.

Figure 11: **ERR's Effect on Total Capital Flows' and Foreign Direct Investment Flows' Sensitivity to Credit Supply Shocks for the JS ERR Measure: (a) Total Capital Flows; (b) Foreign Direct Investment**.

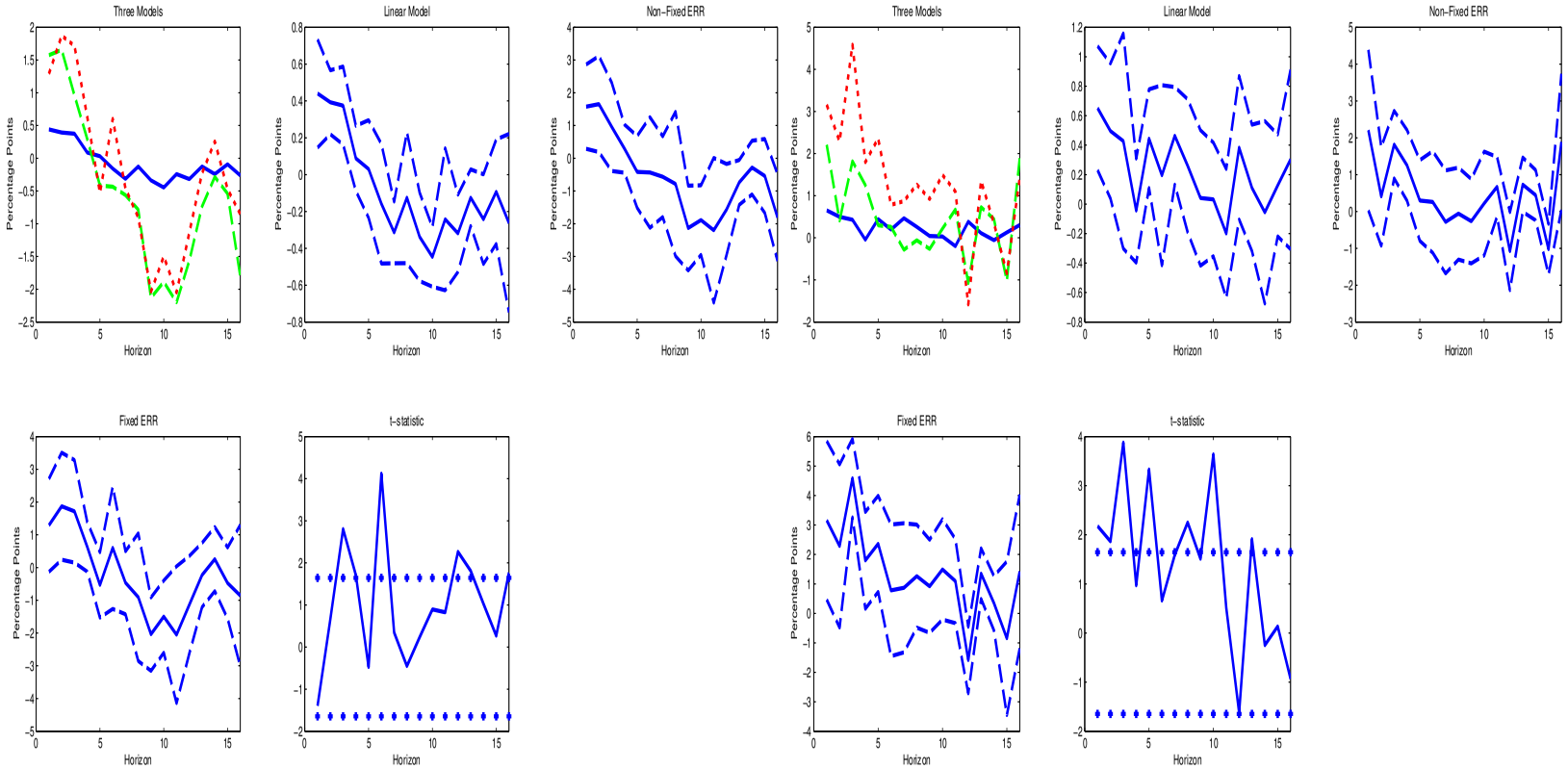


(a) Impulse Responses of Total Capital Flows to a One Standard Deviation Credit Supply Shock.

(b) Impulse Responses of Foreign Direct Investment Flows to a One Standard Deviation Credit Supply Shock.

Notes: Panel (a): This figure presents the impulse responses of total net capital outflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. See notes from Figure 1 for details on this figure's components. Panel (b): This figure presents the impulse responses of net foreign direct investment outflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. See notes from Figure 1 for details on this figure's components.

Figure 12: **ERR's Effect on Portfolio Flows' and Other Investment Flows' Sensitivity to Credit Supply Shocks for the JS ERR Measure: (a) Portfolio Flows; (b) Other Investment Flows**.

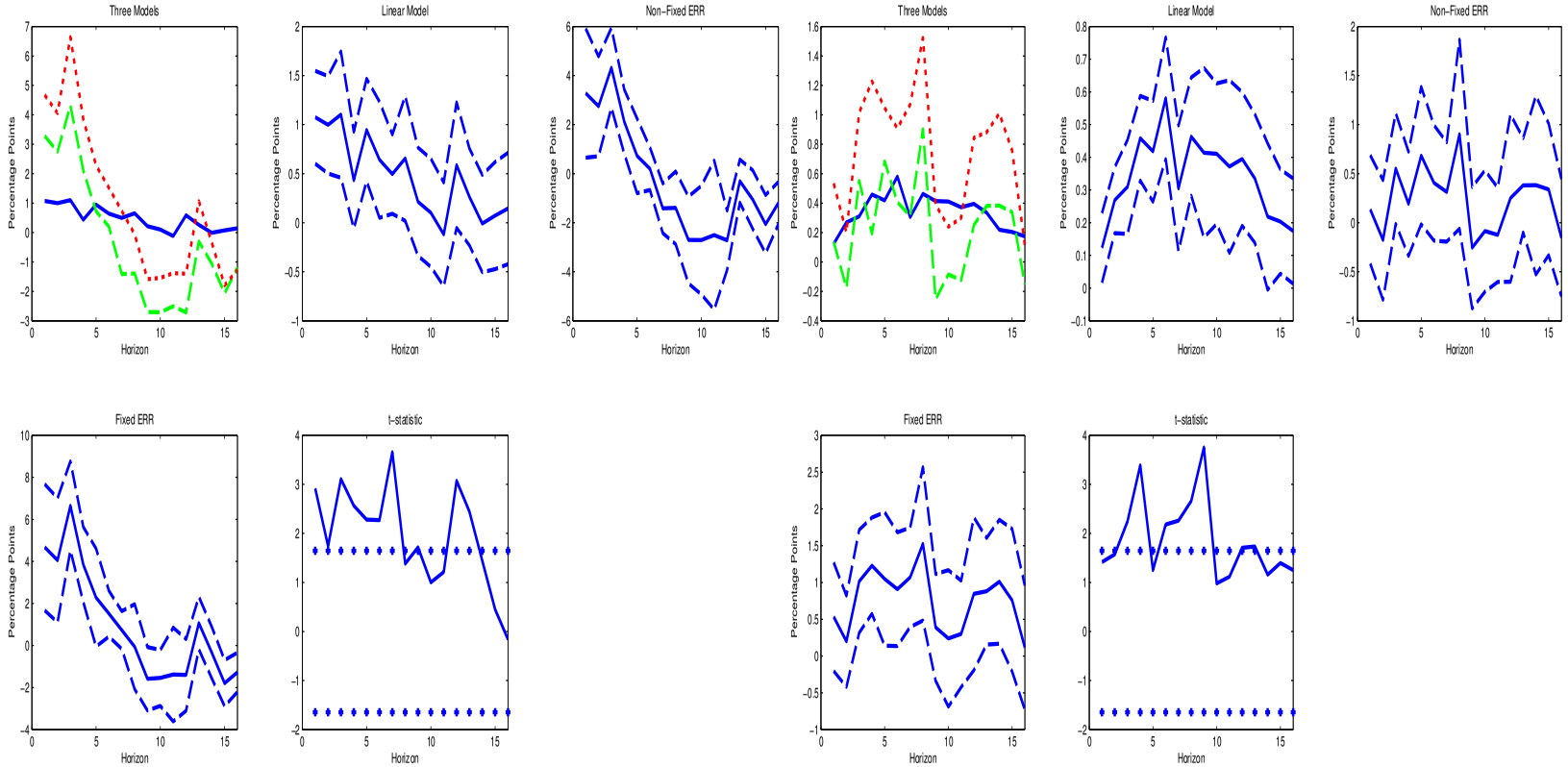


(a) Impulse Responses of Portfolio Flows to a One Standard Deviation Credit Supply Shock.

(b) Impulse Responses of Other Investment Flows to a One Standard Deviation Credit Supply Shock.

Notes: Panel (a): This figure presents the impulse responses of net portfolio outflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. See notes from Figure 1 for details on this figure's components. Panel (b): This figure presents the impulse responses of net other investment outflows (these include loans as well as other forms of cross-border finance such as trade credit, bank deposits, and cash) to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. See notes from Figure 1 for details on this figure's components.

Figure 13: **ERR's Effect on Total Capital Flows' and Foreign Direct Investment Flows' Sensitivity to Credit Supply Shocks for the LYS ERR Measure: (a) Total Capital Flows; (b) Foreign Direct Investment**.

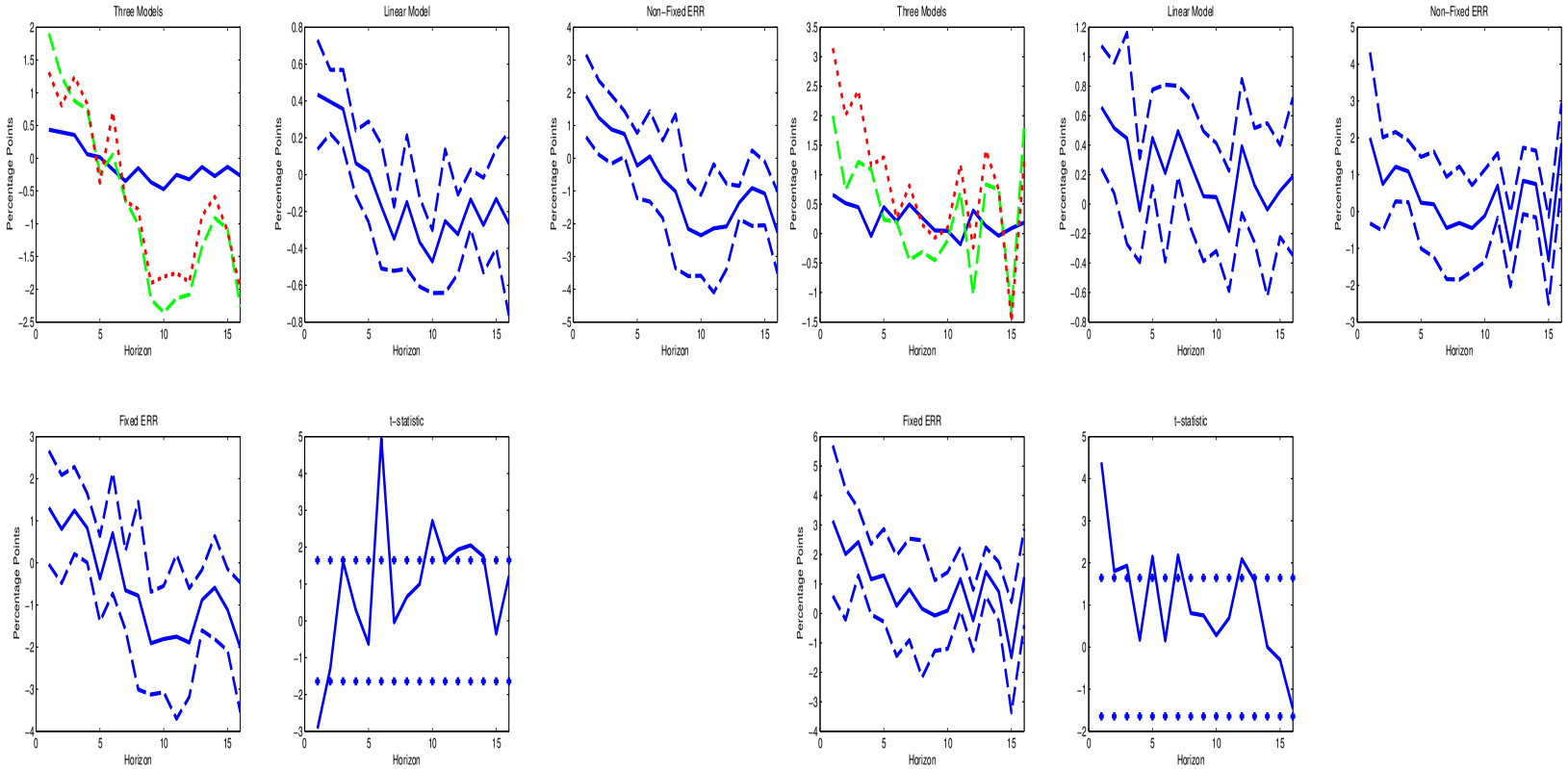


(a) Impulse Responses of Total Capital Flows to a One Standard Deviation Credit Supply Shock.

(b) Impulse Responses of Foreign Direct Investment Flows to a One Standard Deviation Credit Supply Shock.

Notes: Panel (a): This figure presents the impulse responses of total net capital outflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. See notes from Figure 1 for details on this figure's components. Panel (b): This figure presents the impulse responses of total foreign direct investment outflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. See notes from Figure 1 for details on this figure's components.

Figure 14: **ERR's Effect on Portfolio Flows' and Other Investment Flows' Sensitivity to Credit Supply Shocks for the LYS ERR Measure: (a) Portfolio Flows; (b) Other Investment Flows**.

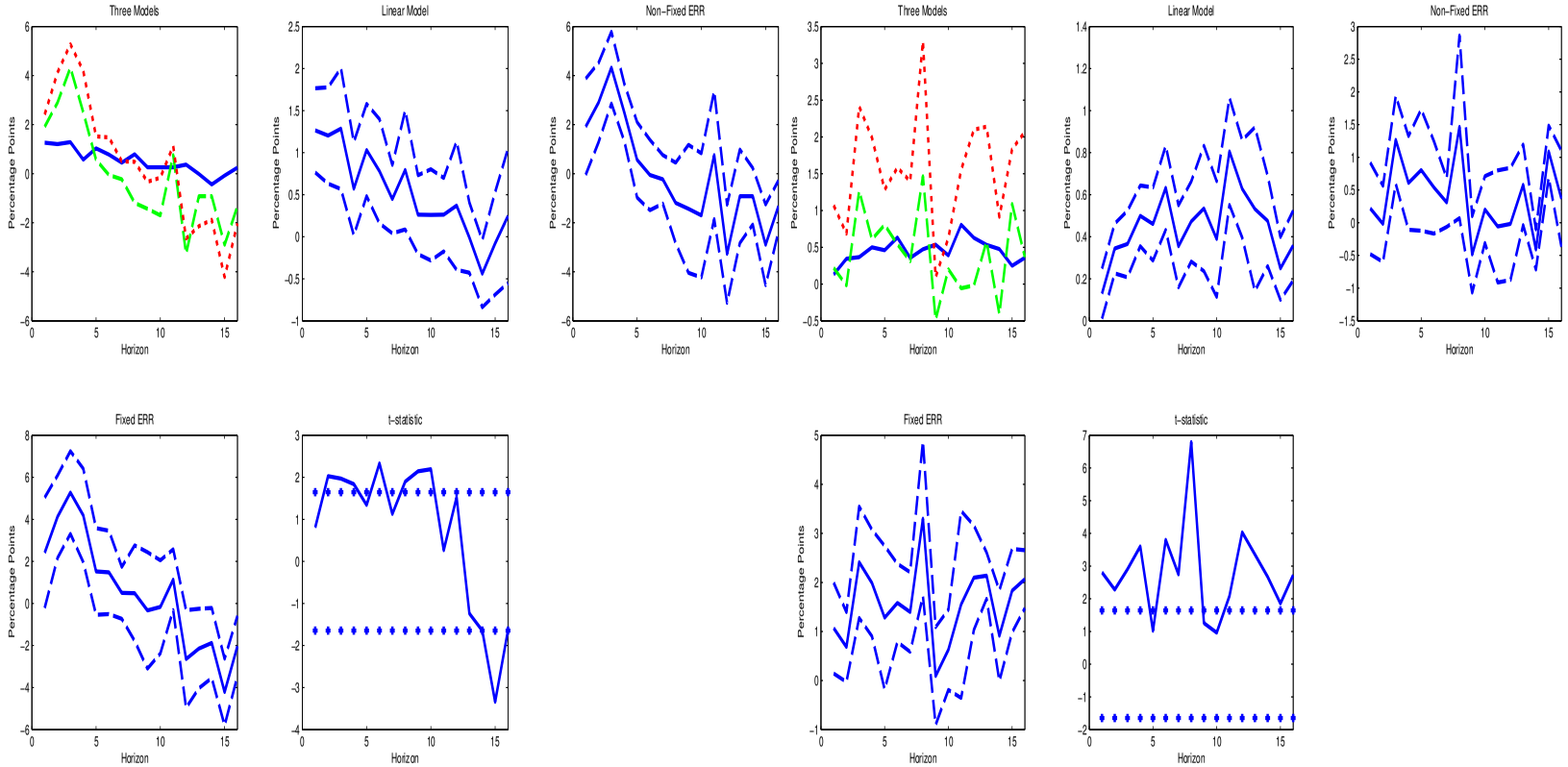


(a) Impulse Responses of Portfolio Flows to a One Standard Deviation Credit Supply Shock.

(b) Impulse Responses of Other Investment Flows to a One Standard Deviation Credit Supply Shock.

Notes: Panel (a): This figure presents the impulse responses of net portfolio outflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. See notes from Figure 1 for details on this figure's components. Panel (b): This figure presents the impulse responses of net other investment outflows (these include loans as well as other forms of cross-border finance such as trade credit, bank deposits, and cash) to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. See notes from Figure 1 for details on this figure's components.

Figure 15: **ERR's Effect on Total Capital Flows' and Foreign Direct Investment Flows' Sensitivity to Credit Supply Shocks for the RR ERR Measure: (a) Total Capital Flows; (b) Foreign Direct Investment**.

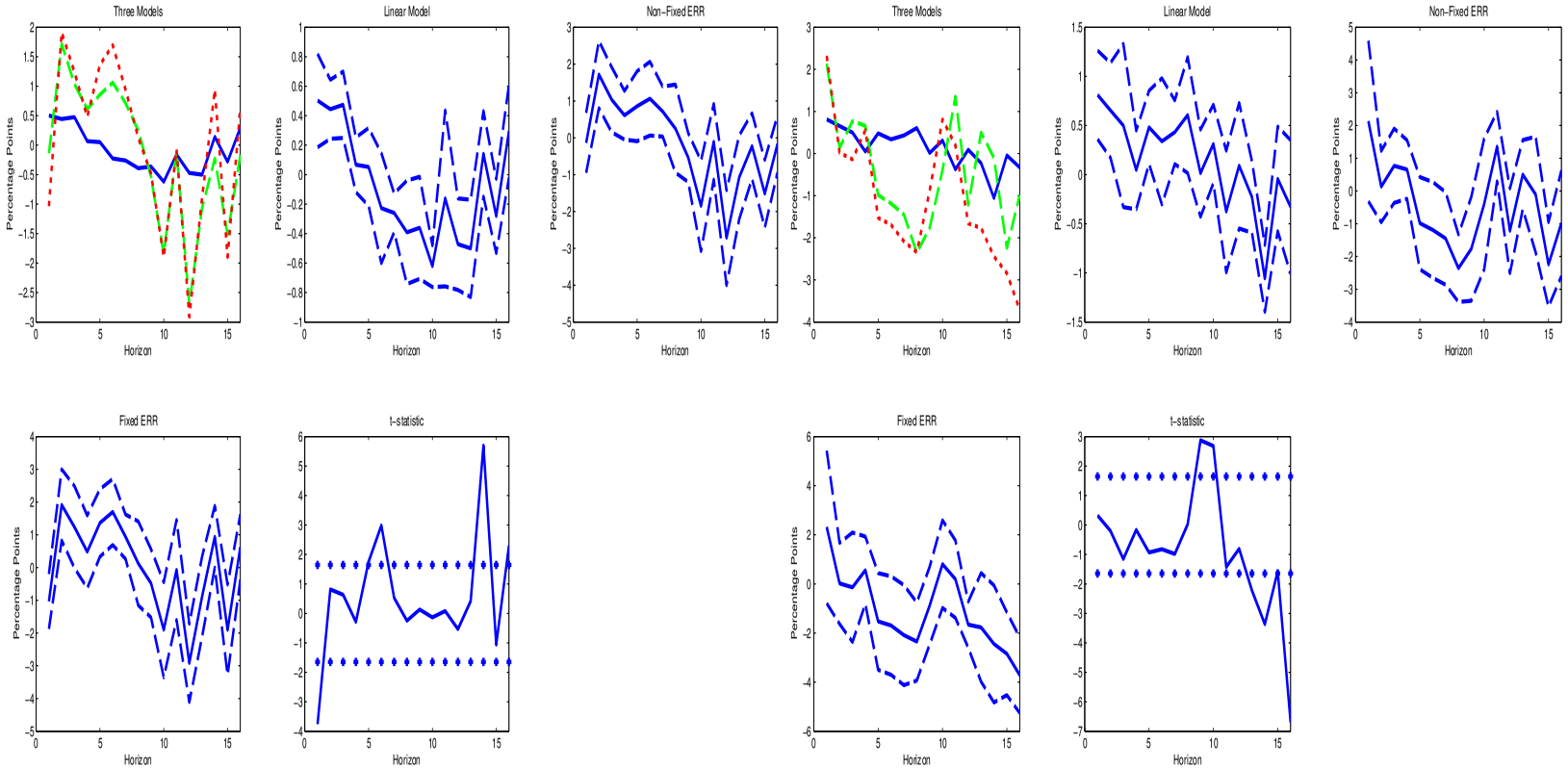


(a) Impulse Responses of Total Capital Flows to a One Standard Deviation Credit Supply Shock.

(b) Impulse Responses of Foreign Direct Investment Flows to a One Standard Deviation Credit Supply Shock.

Notes: Panel (a): This figure presents the impulse responses of total net capital outflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure. See notes from Figure 1 for details on this figure's components. Panel (b): This figure presents the impulse responses of net foreign direct investment outflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure. See notes from Figure 1 for details on this figure's components.

Figure 16: **ERR's Effect on Portfolio Flows' and Other Investment Flows' Sensitivity to Credit Supply Shocks for the RR ERR Measure: (a) Portfolio Flows; (b) Other Investment Flows**.

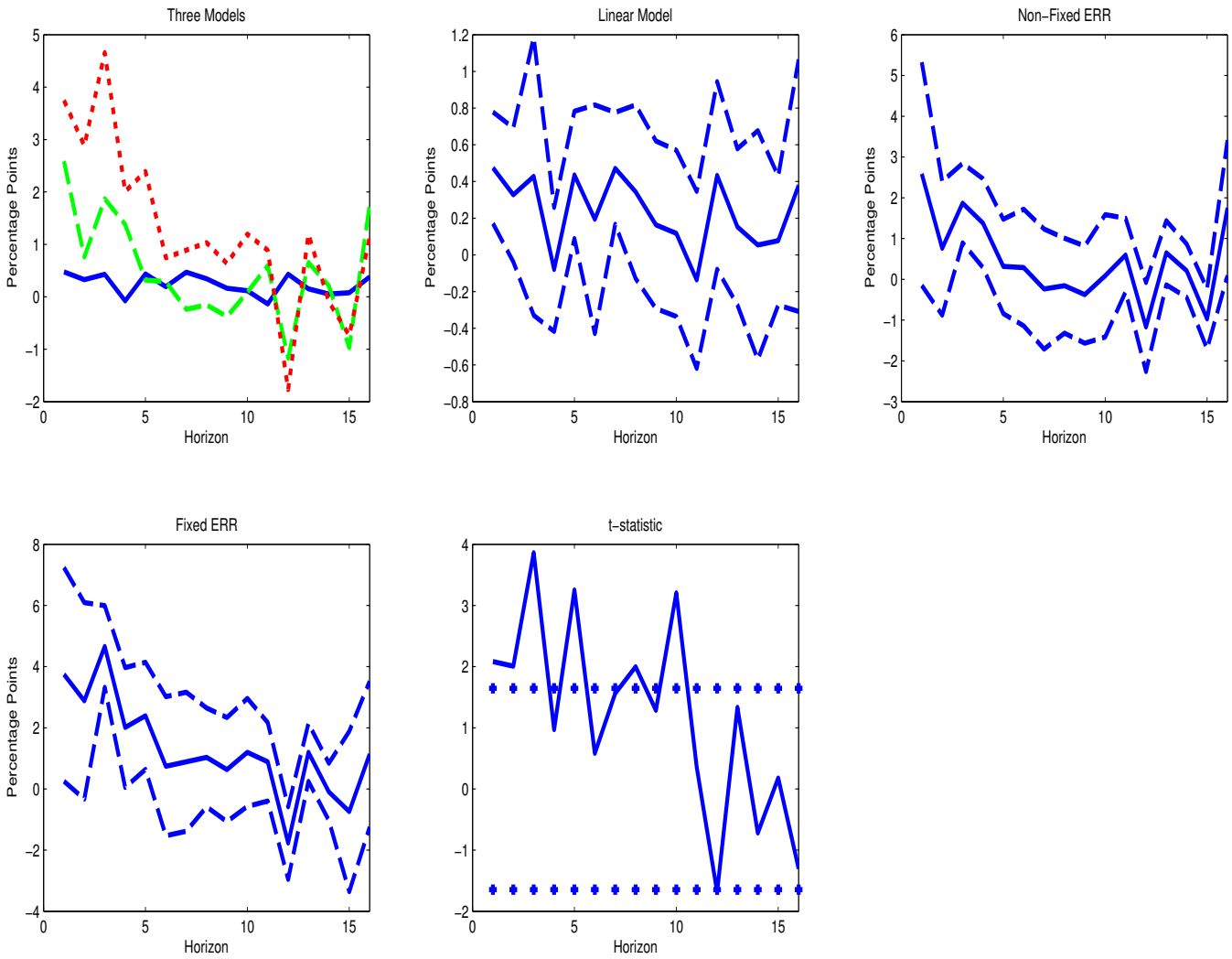


(a) Impulse Responses of Portfolio Flows to a One Standard Deviation Credit Supply Shock.

(b) Impulse Responses of Other Investment Flows to a One Standard Deviation Credit Supply Shock.

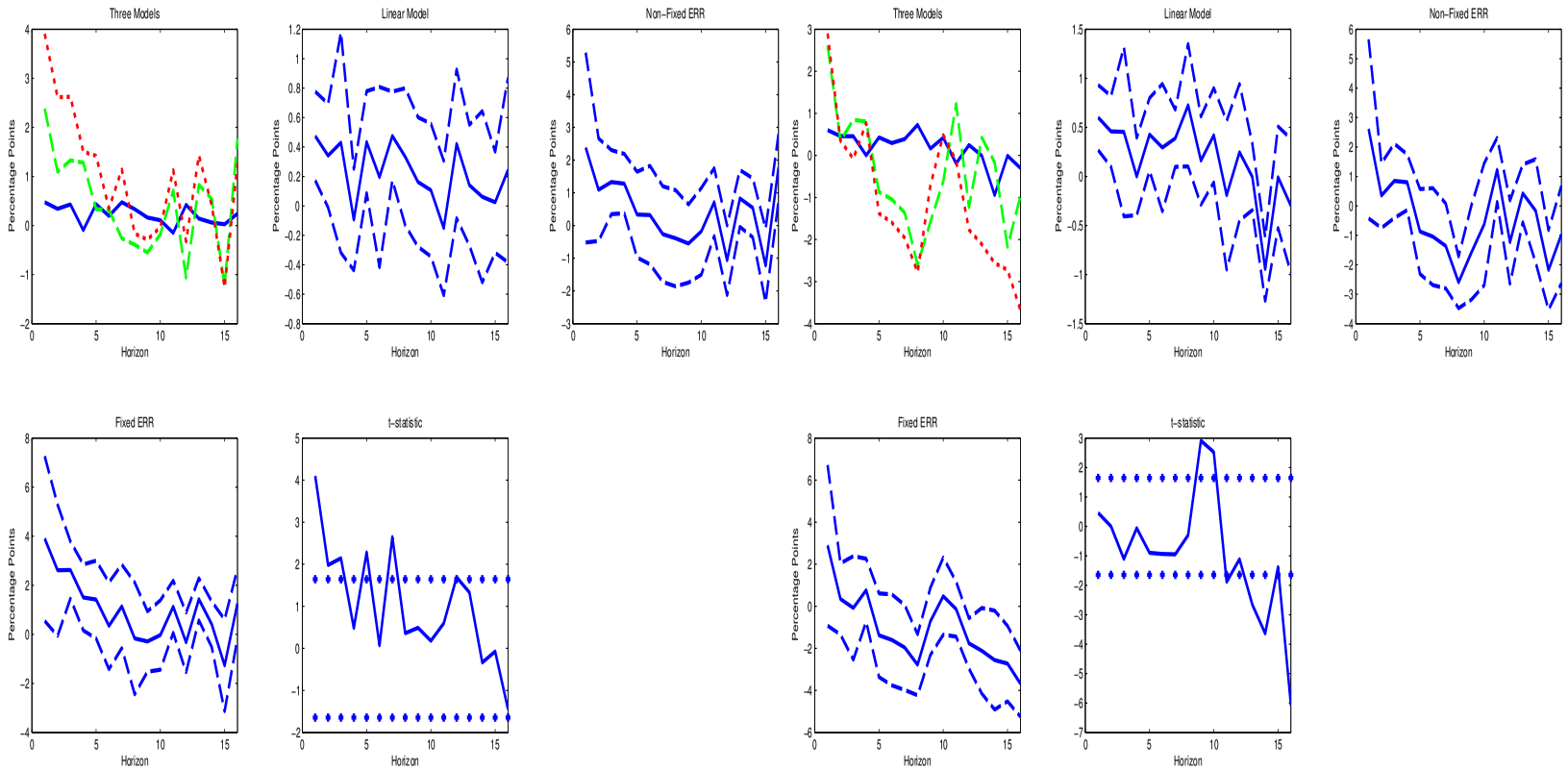
Notes: Panel (a): This figure presents the impulse responses of net portfolio outflows debt to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure. See notes from Figure 1 for details on this figure's components. Panel (b): This figure presents the impulse responses of net other investment outflows (these include loans as well as other forms of cross-border finance such as trade credit, bank deposits, and cash) to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure. See notes from Figure 1 for details on this figure's components.

Figure 17: **ERR's Effect on Foreign Exchange Reserves' Sensitivity to Credit Supply Shocks: JS ERR Measure**.



Notes: This figure presents the impulse responses of the GDP share of foreign exchange reserves' inflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. In the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 18: **ERR's Effect on Foreign Exchange Reserves' Sensitivity to Credit Supply Shocks: (a) LYS ERR Measure; (b) RR ERR Measure**.

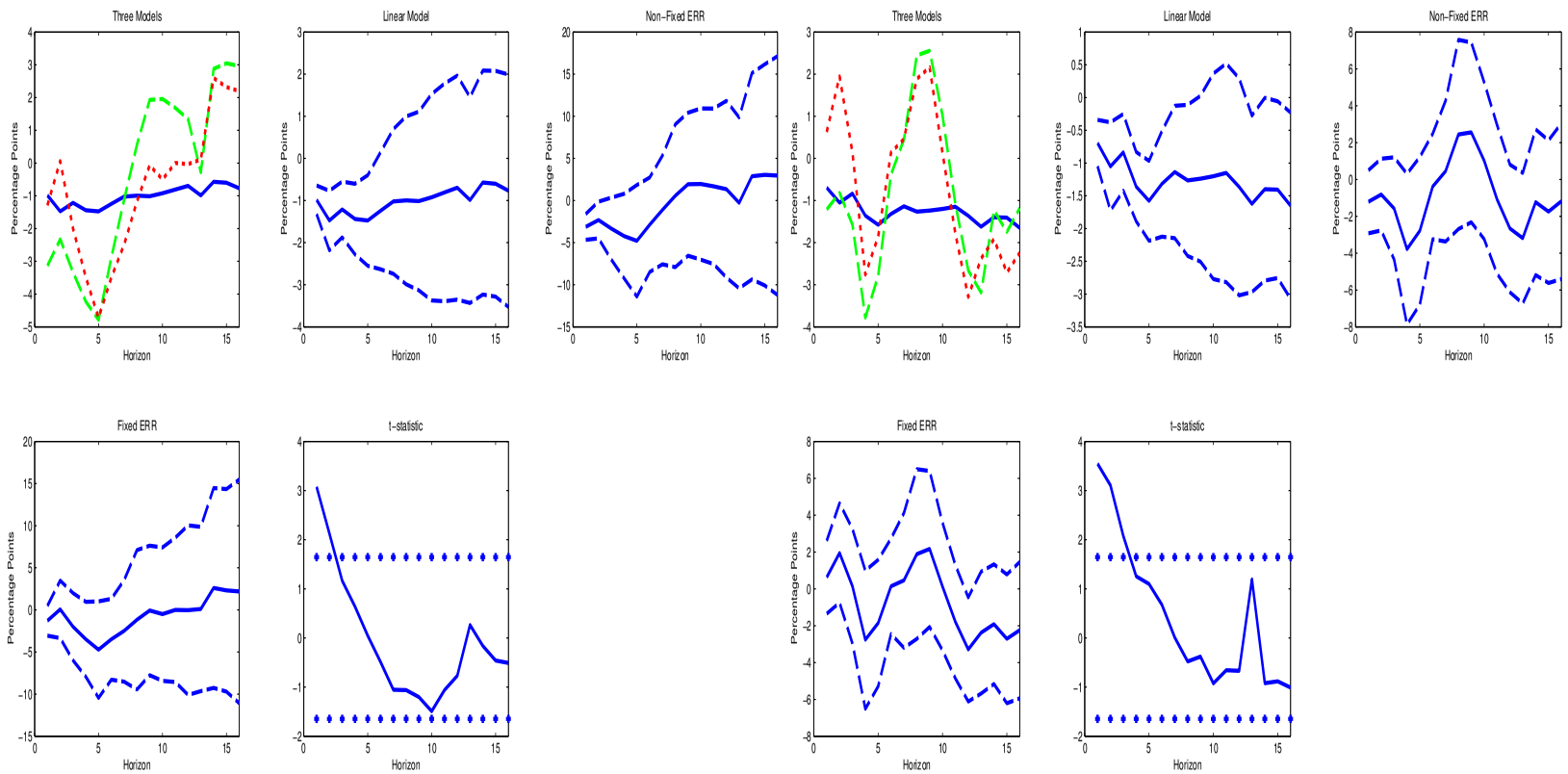


(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (LYS).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (RR).

Notes: Panel (a): This figure presents the impulse responses of the GDP share of foreign exchange reserves' inflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. Panel (b): This figure presents the impulse responses of the GDP share of foreign exchange reserves' inflows to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure.
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 19: **ERR's Effect on Nominal and Real Exchange Rate's Sensitivity to Credit Supply Shocks for the JS ERR Measure: (a) Nominal Exchange Rate; (b) Real Exchange Rate**.



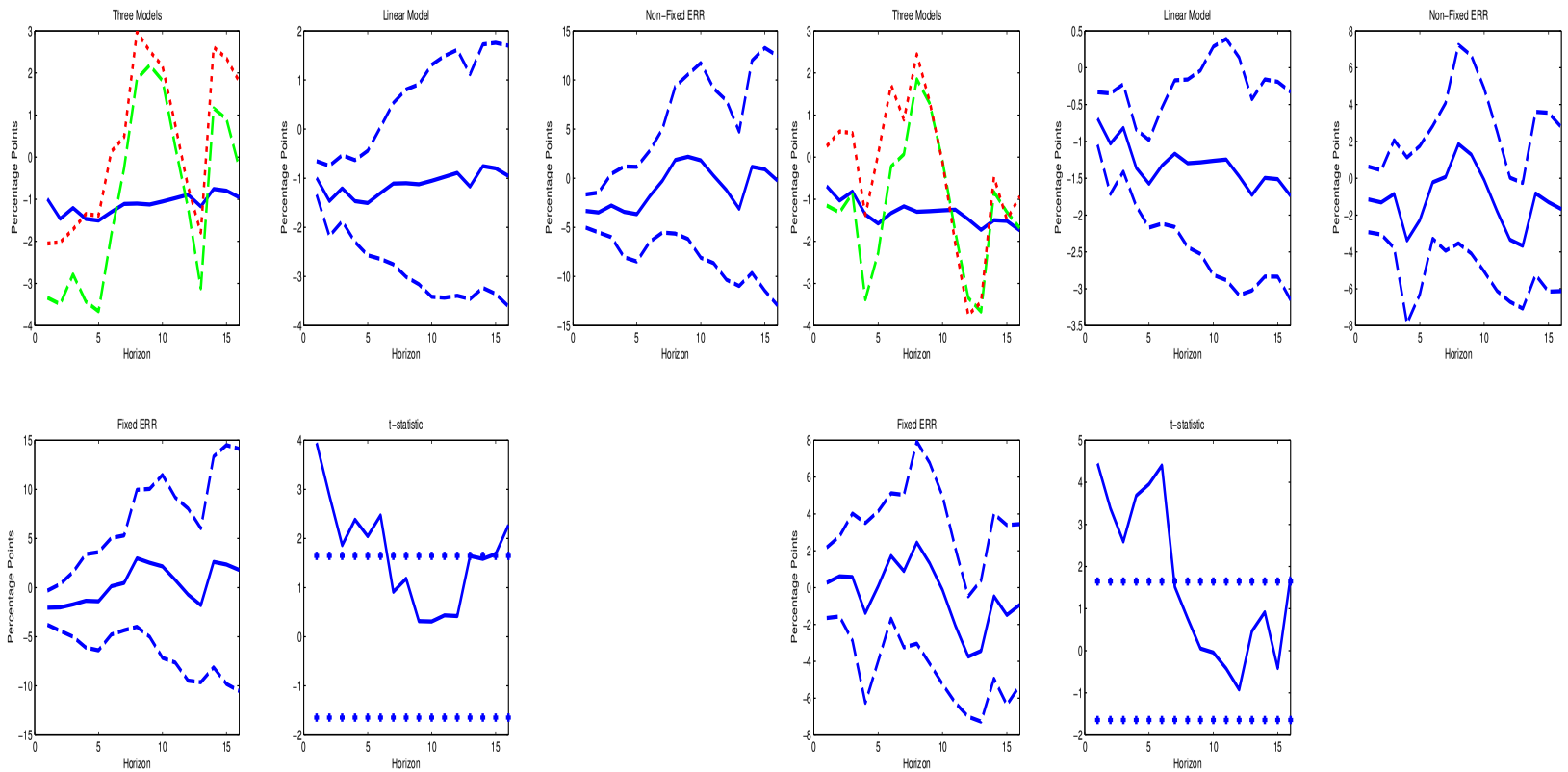
(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (Nominal Exchange Rate).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (Real Exchange Rate).

Notes: Panel (a): This figure presents the impulse responses of the nominal effective exchange rate to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. Panel (b): This figure presents the impulse responses of the real effective exchange rate to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure.

For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the strict capital controls state and the light controls state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 20: **ERR's Effect on Nominal and Real Exchange Rate's Sensitivity to Credit Supply Shocks for the LYS ERR Measure: (a) Nominal Exchange Rate; (b) Real Exchange Rate.**

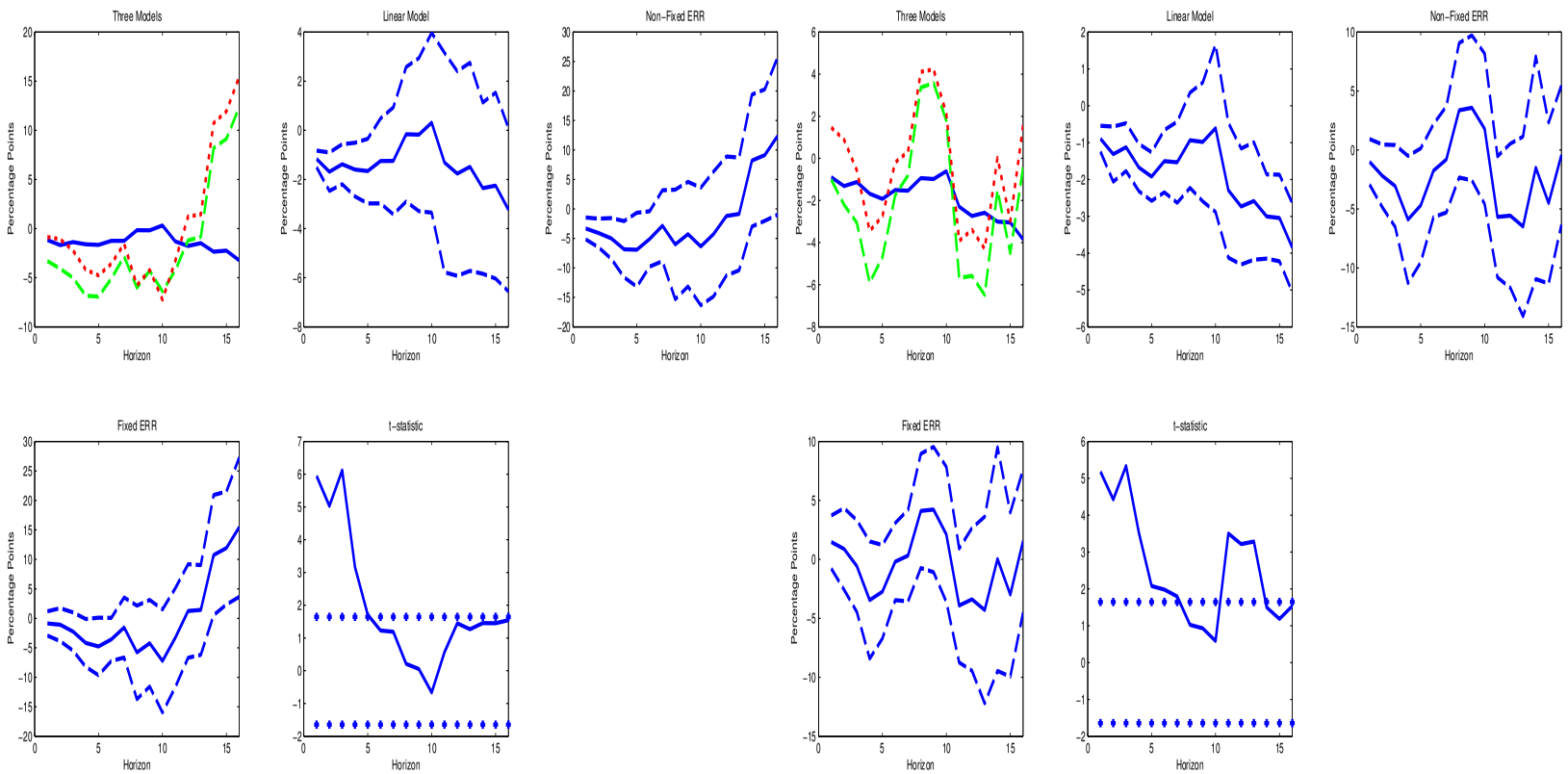


(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (Nominal Exchange Rate).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (Real Exchange Rate).

Notes: Panel (a): This figure presents the impulse responses of the nominal effective exchange rate to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. Panel (b): This figure presents the impulse responses of the real effective exchange rate to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure.
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the strict capital controls state and the light controls state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 21: **ERR's Effect on Nominal and Real Exchange Rate's Sensitivity to Credit Supply Shocks for the RR ERR Measure: (a) Nominal Exchange Rate; (b) Real Exchange Rate**.



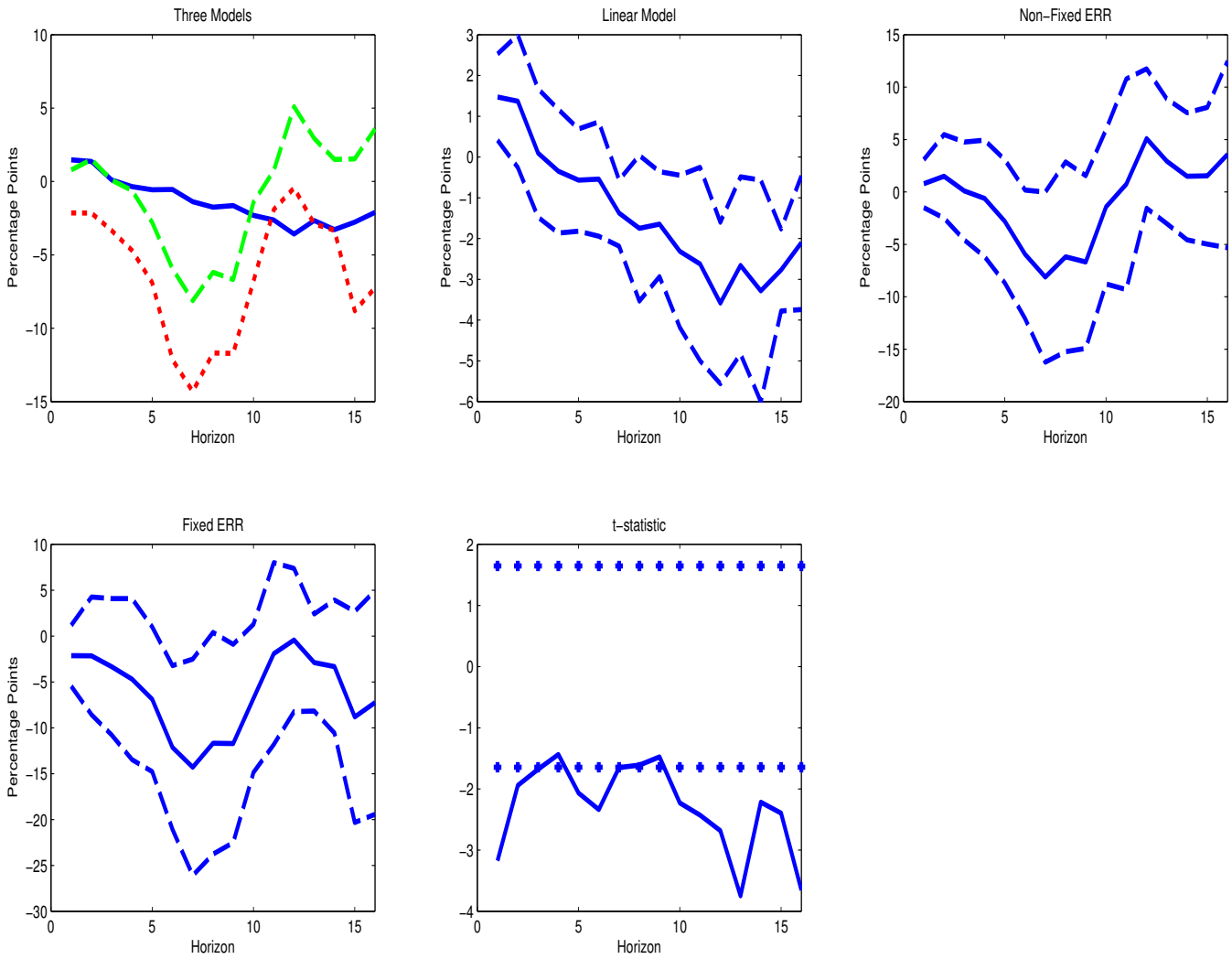
(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (Nominal Exchange Rate).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (Real Exchange Rate).

Notes: Panel (a): This figure presents the impulse responses of the nominal effective exchange rate to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure. Panel (b): This figure presents the impulse responses of the real effective exchange rate to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure.

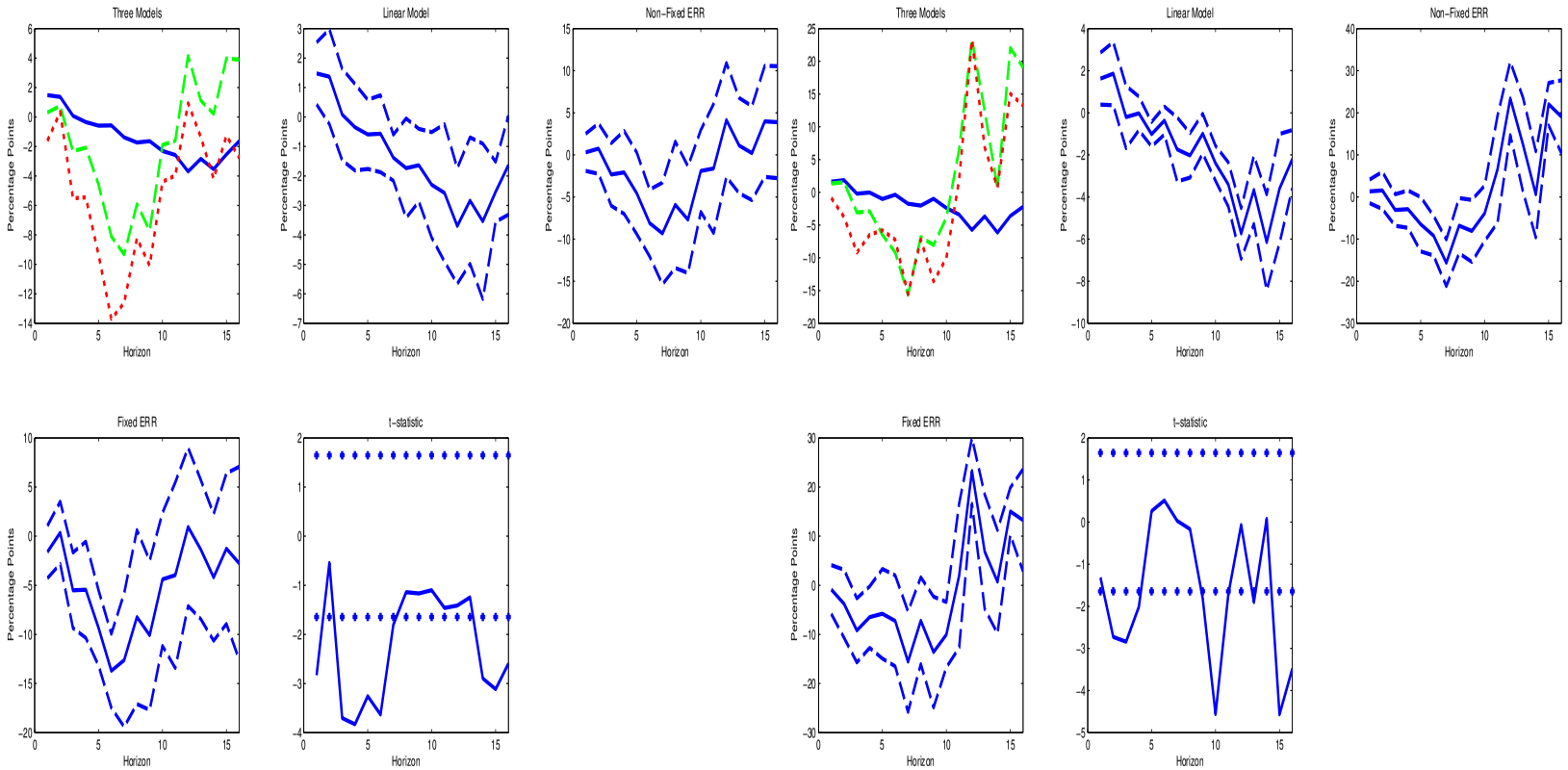
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the strict capital controls state and the light controls state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 22: **ERR's Effect on Leverage's Sensitivity to Credit Supply Shocks: JS ERR Measure**.



Notes: This figure presents the impulse responses of leverage to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. In the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 23: **ERR's Effect on Leverage's Sensitivity to Credit Supply Shocks: (a) LYS ERR Measure; (b) RR ERR Measure**.

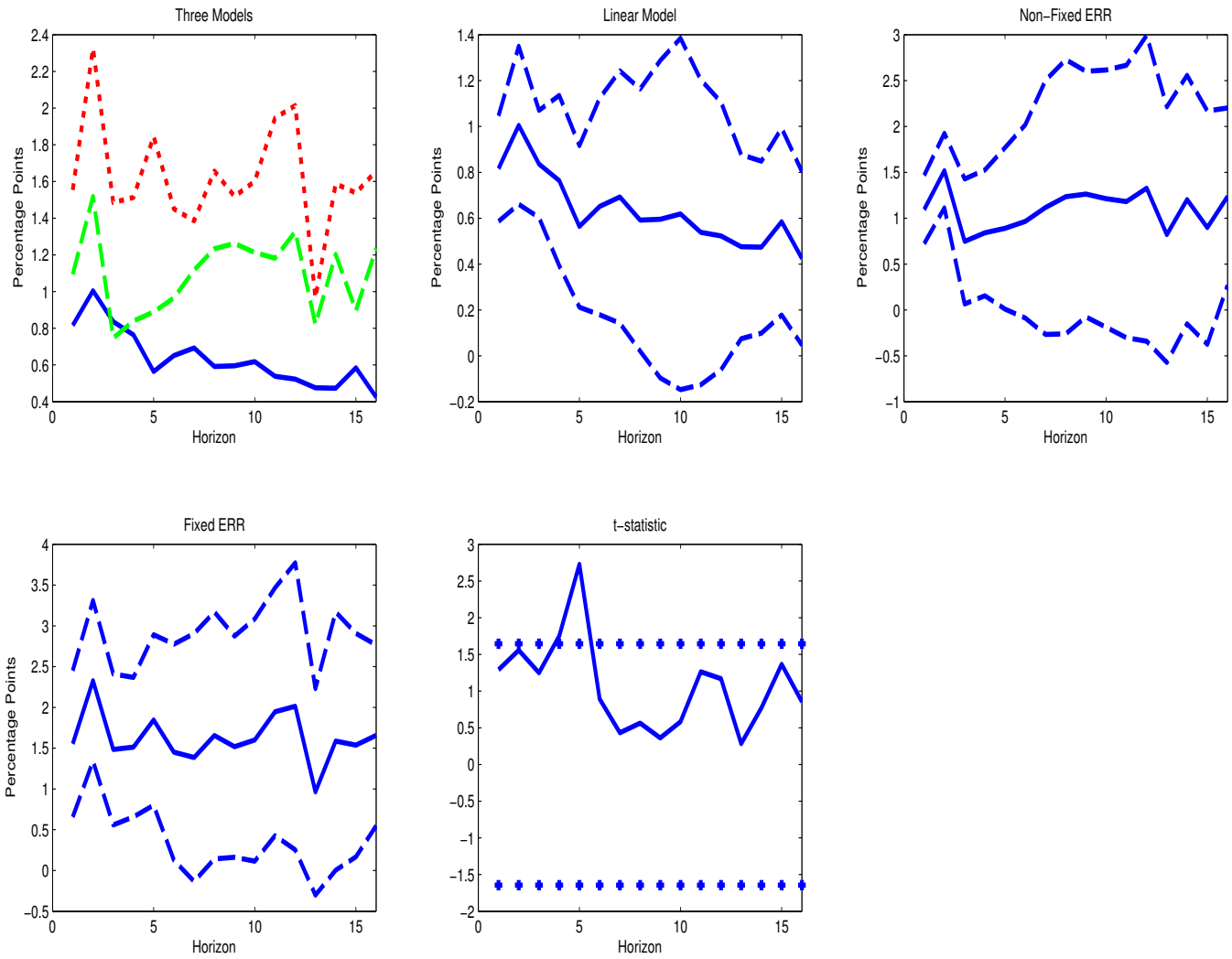


(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (LYS).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (RR).

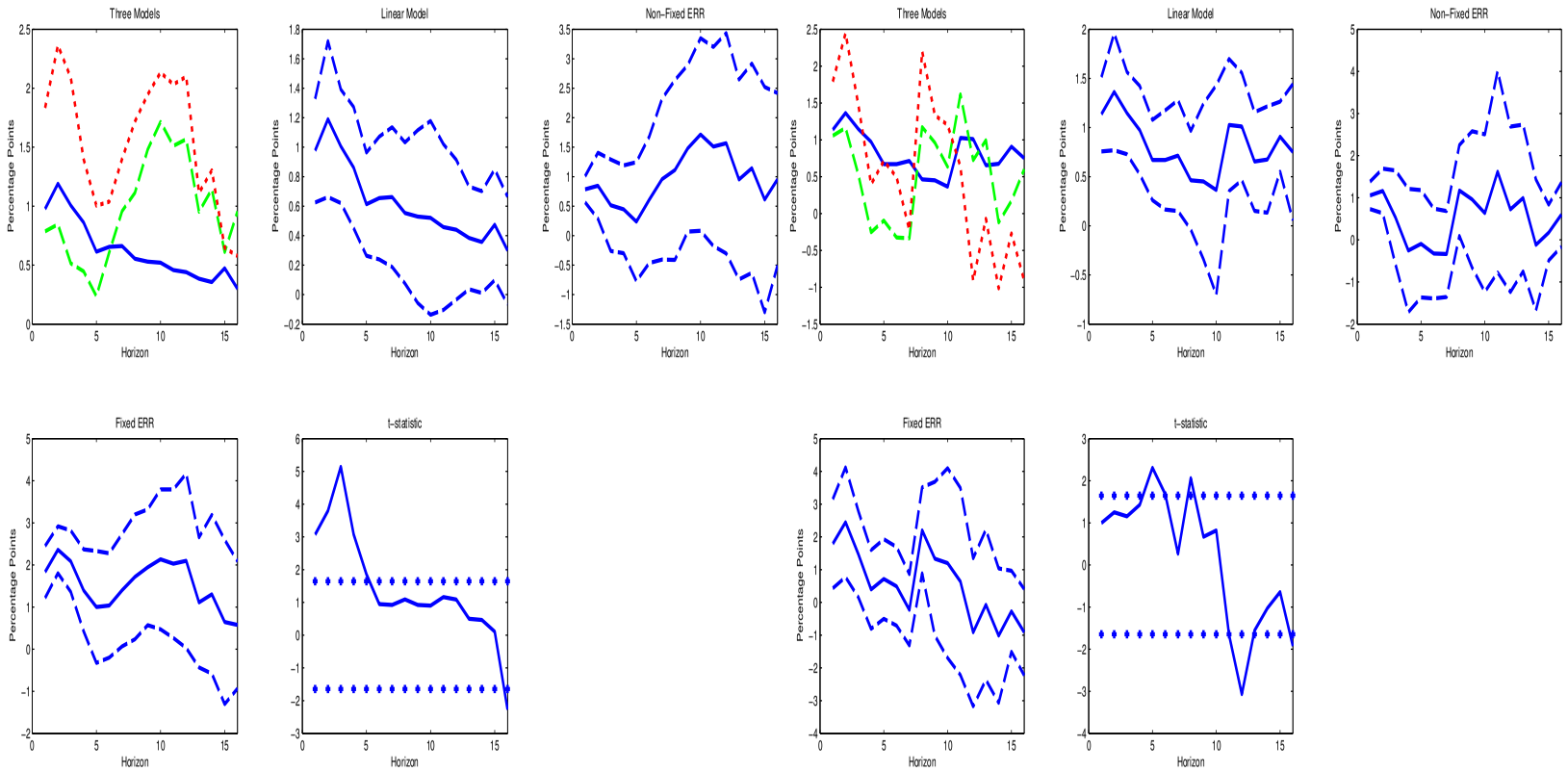
Notes: Panel (a): This figure presents the impulse responses of leverage to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. Panel (b): This figure presents the impulse responses of leverage to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure. For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 24: **ERR's Effect on EMBI's Sensitivity to Credit Supply Shocks: JS ERR Measure.**



Notes: This figure presents the impulse responses of EMBI (country credit spreads) to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. In the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 25: **ERR's Effect on EMBI's Sensitivity to Credit Supply Shocks: (a) LYS ERR Measure; (b) RR ERR Measure.**



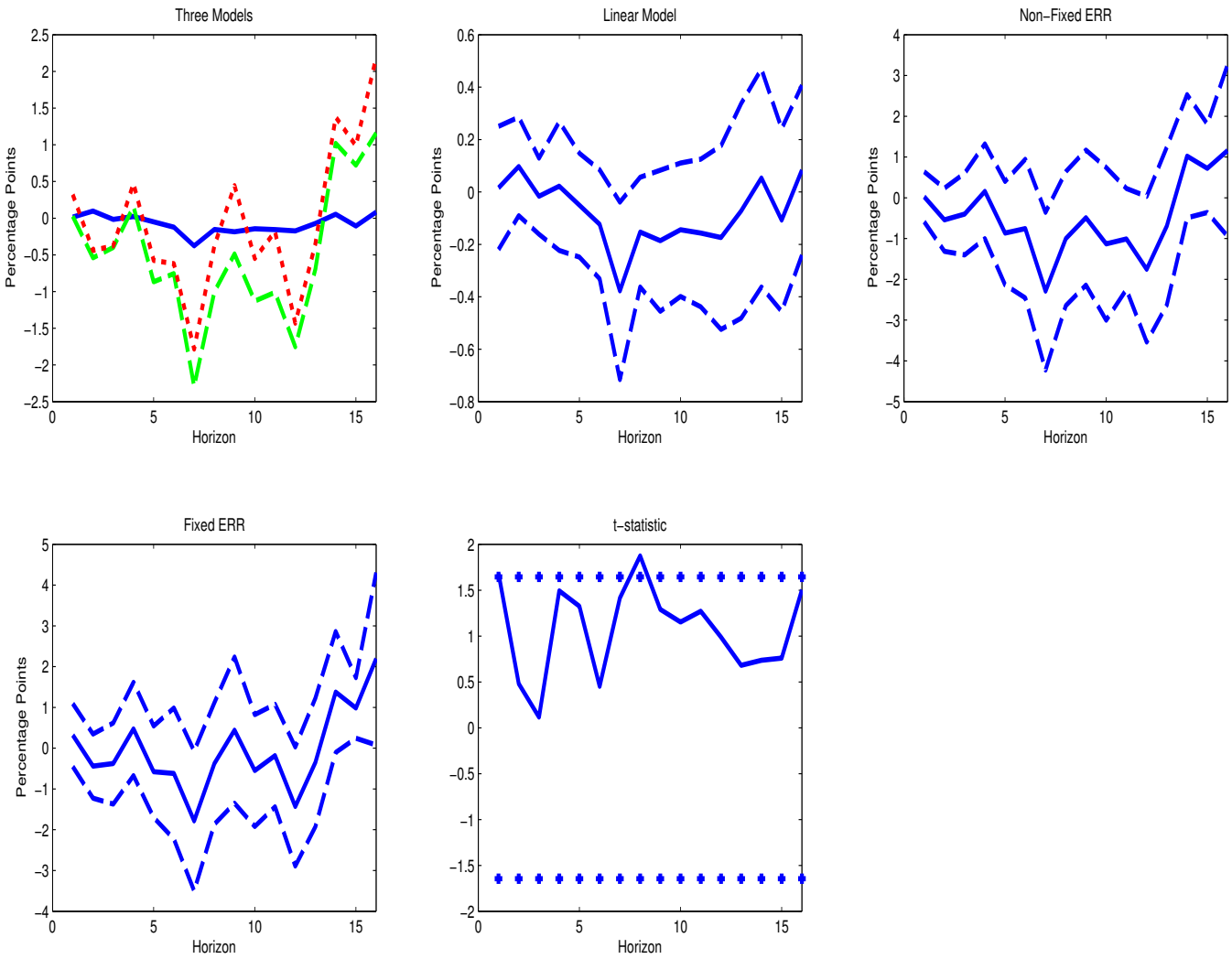
(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (LYS).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (RR).

Notes: Panel (a): This figure presents the impulse responses of EMBI (country credit spreads) to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. Panel (b): This figure presents the impulse responses of EMBI (country credit spreads) to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure.

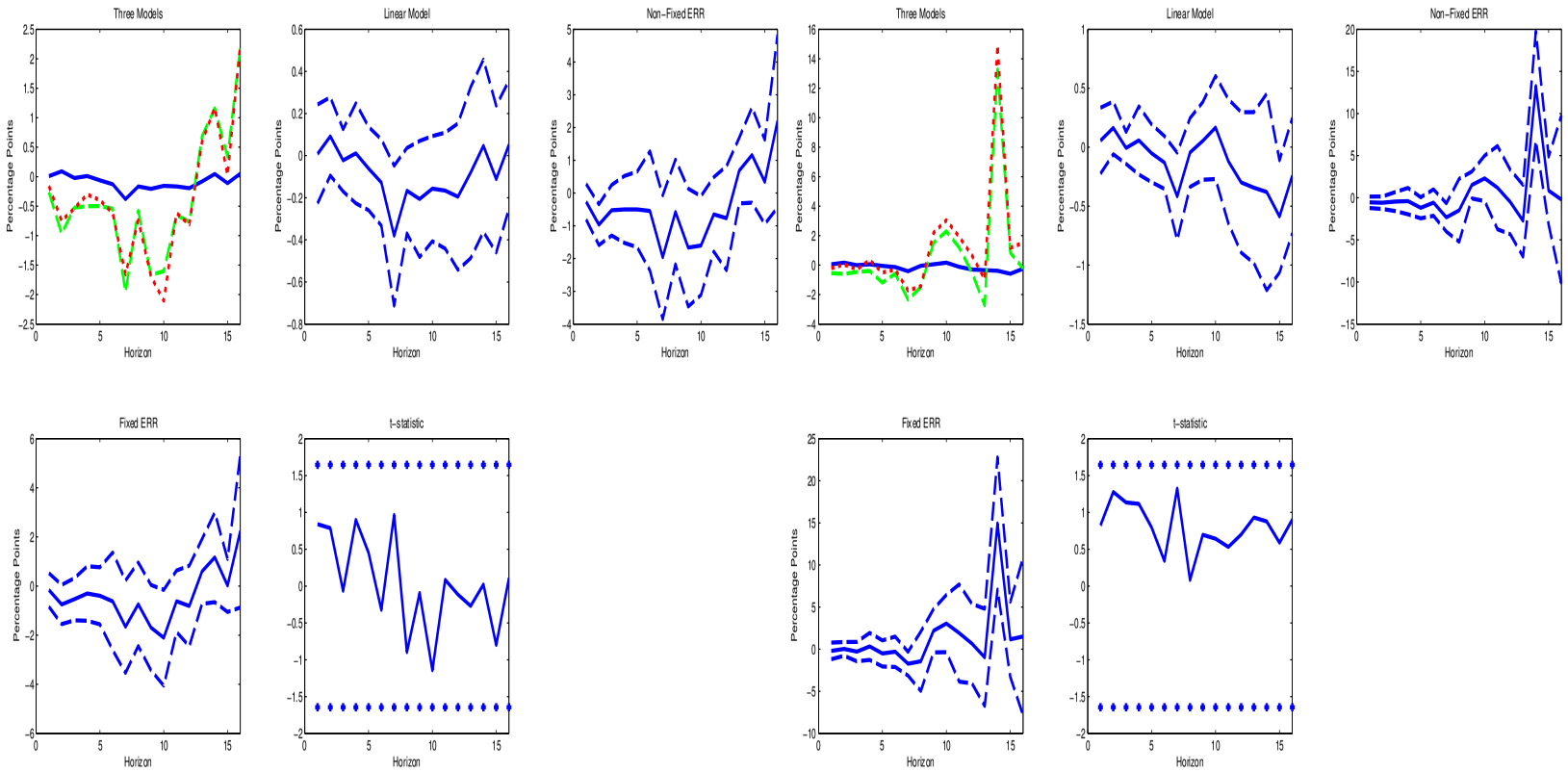
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 26: **ERR's Effect on Central Bank Rate's Sensitivity to Credit Supply Shocks: JS ERR Measure**.



Notes: This figure presents the impulse responses of the central bank rate (country credit spreads) to a one standard deviation credit supply shock from the linear model and non-linear model when using the Shambaugh (2004) ERR measure. In the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 27: **ERR's Effect on Central Bank Rate's Sensitivity to Credit Supply Shocks: (a) LYS ERR Measure; (b) RR ERR Measure**.



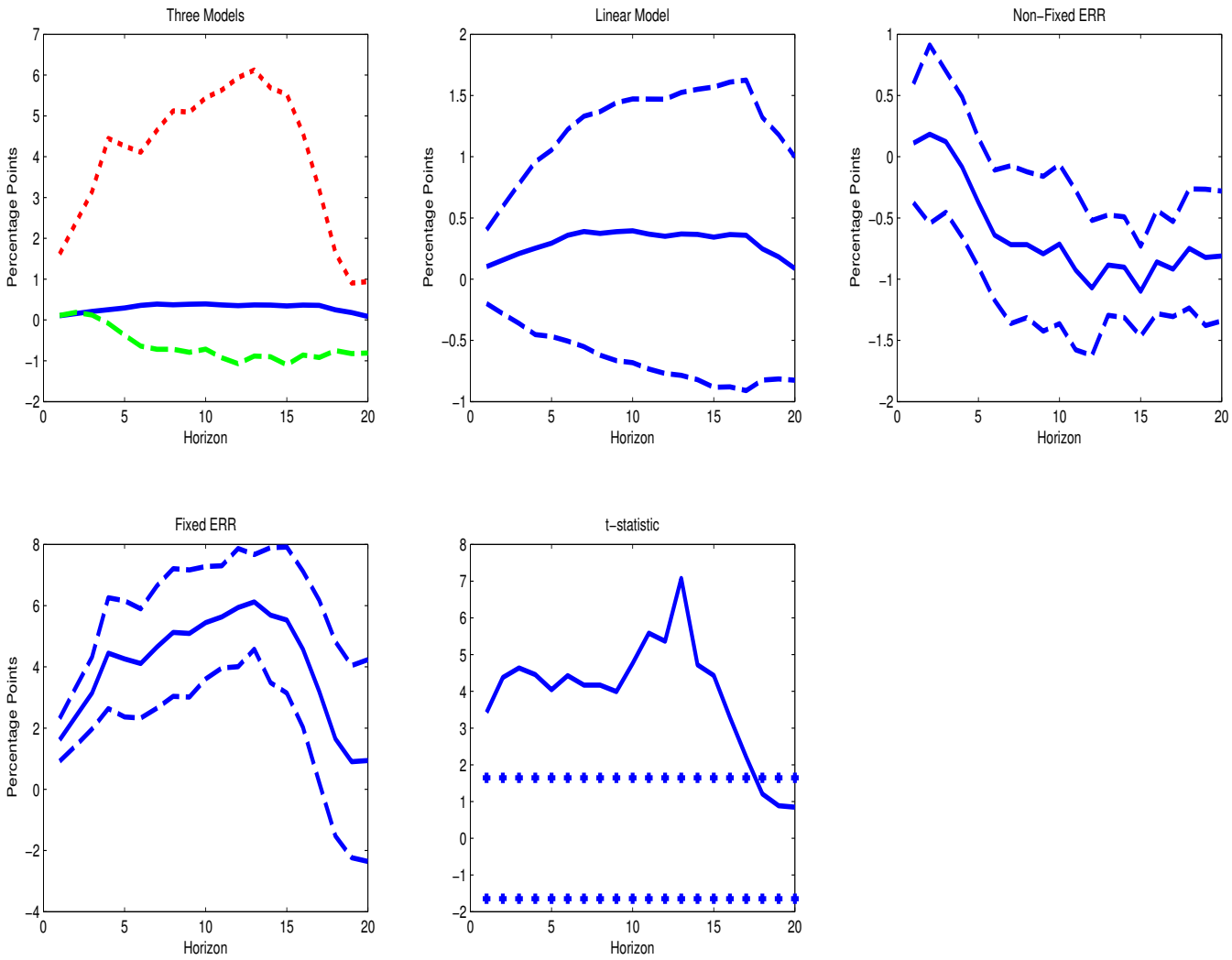
(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (LYS).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (RR).

Notes: Panel (a): This figure presents the impulse responses of the central bank policy rate to a one standard deviation credit supply shock from the linear model and non-linear model when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. Panel (b): This figure presents the impulse responses of the central bank policy rate to a one standard deviation credit supply shock from the linear model and non-linear model when using the Reinhart and Rogoff (2004) ERR measure.

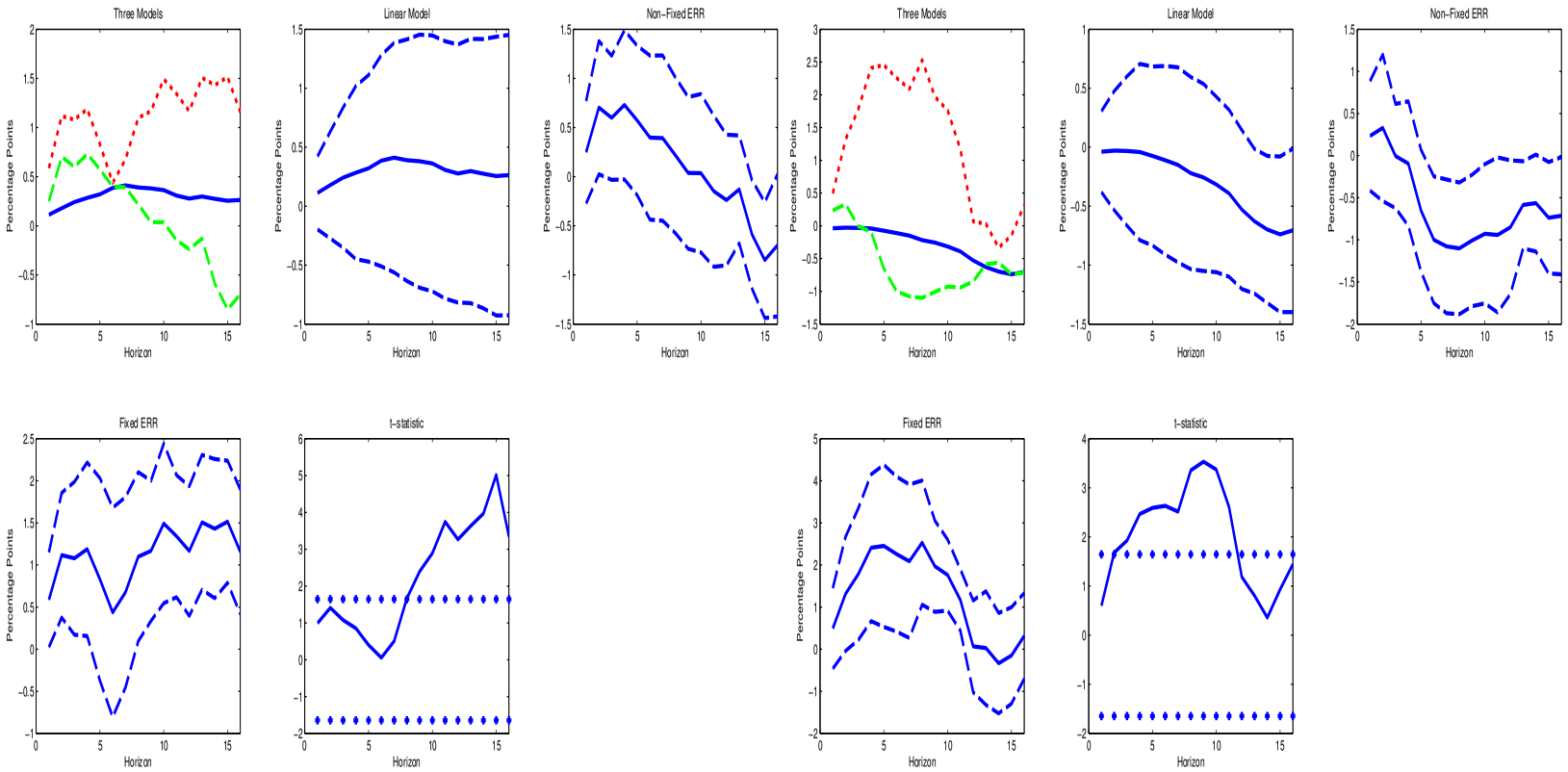
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 28: **ERR's Effect on Capital Flows: JS ERR Measure**.



Notes: This figure presents the impulse responses of capital flows to the two ERR state dummies from the non-linear model described in Specification (3) when using the Shambaugh (2004) ERR measure. In the first sub-figure the solid lines show the responses to the non state and the dashed lines are the responses to the strict capital controls state. The next two sub-figures present the impulse responses to the two state dummies along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 29: **ERR's Effect on Capital Flows: (a) LYS ERR Measure; (b) RR ERR Measure**.



(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (LYS).

(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (RR).

Notes: Panel (a): This figure presents the impulse responses of capital flows to the two ERR state dummies from the non-linear model described in Specification (3) when using the Levy-Yeyati and Sturzenegger (2001, 2003, 2005) ERR measure. Panel (b): This figure presents the impulse responses of capital flows to the two ERR state dummies from the non-linear model described in Specification (3) when using the Reinhart and Rogoff (2004) ERR measure.
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the non-fixed ERR state, and the dotted lines are the responses in the fixed ERR state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 90% confidence bands. The last sub-figure shows the t-statistic of the difference between the responses in the fixed ERR state and the non-fixed ERR state, where for convenience the 5% significance levels (± 1.645) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.