Capital Controls as Shock Absorbers*

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Abstract

The recent global financial crisis has resuscitated the debate on the relevance of capital controls as effective policy instruments. This paper contributes to this debate by studying the shock-absorbing capacity of capital controls. Using a recently developed capital control dataset for a panel of 30 emerging market economies, I show that output in economies with stricter capital *inflows* controls responds significantly less to global credit supply shocks, whereas capital *outflow* controls have no shock-absorbing capacity. Leverage is significantly lower in economies enacting stricter inflow controls, suggesting that financial frictions play a role in driving the shock-absorbing capacity of inflow controls.

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1 Introduction

The Great Recession has revived the debate on the merit of international capital mobility restrictions. In the early 1990s, as large amounts of capital flowed into emerging market economies (EMEs), capital inflow controls were largely viewed as an anachronism that leads to distortions that slow economic growth; in accordance with this view, policymakers did not consider them as appropriate policy tools for macroeconomic stabilization. However, the subsequent economic crises in Southeast Asia and Russia in the late 1990s and South America in the early 2000s, and especially the recent financial crisis that produced abrupt and large capital outflows from peripheral Europe and many emerging economies, have altered the view on capital inflow controls into a more favorable one that supports their inclusion as a viable macroprudential policy tool. The recent shift of opinion on the efficacy of capital inflow controls on the part of researchers is apparent both on the theoretical side (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), and Korinek and Sandri (2016))[1] as well as on the policy side (see, e.g., Ostry et al. (2010) and Ostry et al. (2011)).

The objective of this paper is to conduct an empirical examination of the hypothesis that capital inflow controls constitute absorbers of global shocks. While this hypothesis has received strong support from the above cited theoretical work, empirical work on this topic has been quite limited; to the best of my knowledge, there has been no empirical work that provided direct empirical evidence on this hypothesis. The few papers that have looked at the shock-absorbing capacity of capital controls have either done so indirectly, i.e., not by conditioning on a particular identified shock but rather by regressing output on capital flows alone or its interaction with capital controls during episodes of economic crises, or have done so directly but by only focusing on limited aspects of the controls' shock-absorbing capacity. In particular, Gupta et al. (2007) shows that EMEs that had in place capital inflow controls prior to currency crises recovered from them much faster;

[1] Jeanne and Korinek (2010) develop a closed economy model in which taxes on borrowing are welfare increasing and thus, notwithstanding the absence of an exchange rate and international trade from their model, can also be viewed as work that lends support to using capital controls as a stabilizing policy tool.

and Ostry et al. (2010) and Ostry et al. (2011) provide evidence that in the recent financial crisis EMEs that had capital inflow controls prior to the crisis suffered less from it. Lastly, Edwards and Rigobon (2009) did directly examine the shock-absorbing capability of capital inflow controls, but did so only in the context of the sensitivity of the exchange rate to external shocks and only in the context of Chile; the evidence in Edwards and Rigobon (2009) is also favorable in the sense that it indicates that capital inflow controls moderated the sensitivity of the Chilean exchange rate to external shocks.

This paper conducts a thorough empirical investigation of the effects of capital inflow controls on the sensitivity of output to global credit supply shocks. To properly fill in the empirical gap in the literature, I improve upon the previous empirical work along two important dimensions. First, I make use of the Gilchrist and Zakrajek (2012) credit supply shock series to measure global credit supply shocks. Gilchrist and Zakrajek (2012) use micro-level data to construct a credit spread index which they decompose into a component that captures firm-specific information on expected defaults and a residual component that they term as the excess bond premium.[2] Their shock series serves as an exogenous and common shock to EMEs; as such, it can be employed to study whether capital inflow controls constitute shock absorbers in EMEs.

Second, I utilize a newly developed capital control dataset from Fernández et al. (2015b) that revises, extends, and widens 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. The aggregate capital control index is an average of the various sub-indices. Details of the aggregation procedure are given in Appendix A. I integrate this capital control data with quarterly frequency output data of 30 EMEs and run nonlinear, state-dependent dynamic fixed-effect panel regressions to study whether the ef-

[2] 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.

fect of global credit supply shocks differs across states of strict and light capital controls.[3] I employ the Jorda (2005) local projections approach in the panel regression specification so as to be able to directly estimate the state-dependent impulse responses to the shocks to EBP.

My empirical findings can be summarized as follows. There is a statistically significant difference between the response of output in the strict controls state, defined as being equal or greater to the 75th percentile of the capital inflow control index, relative to the light controls state (i.e., being in the lower three quartiles). This difference is also economically significant, peaking at about 1.5 percentage points after 1.5 years; in relative terms, this difference implies that the response of output in the strict capital controls state is 2.5 times higher than that in the light capital controls state. The behavior of both real consumption and investment, which depict significant differences in their response declining more in strict capital controls economies, is consistent with that of output; the trade balance declines in the strict controls state and rises in the light controls state, broadly consistent with the much stronger output decline in the latter state.

To shed light on the mechanism behind these results, I turn my analysis to financial variables. 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 respond much more aggressively in the light capital controls state. Then, using a measure of leverage that is based on the ratio of total claims of foreign banks on the corresponding EME to its GDP, I show that leverage does not fall in the strict controls state in response to a global credit supply shock, while significantly falling in the light controls state. This deleveraging process experienced in the light controls state, which is avoided by being in the strict controls state, is consistent with the significant rise (fall) in the trade balance in the light (strict) controls state. Finally, and importantly, I demonstrate that this measure of leverage is significantly lower in the strict capital controls state relative to the light controls state.

How should these results be interpreted from a structural standpoint? Since capital controls on

[3] I transform the capital control annual measures into quarterly ones by assuming identical quarterly values equal to the corresponding annual values. This is an innocuous assumption given the strongly acyclical nature of these controls and their very small standard deviation at annual frequencies, as documented in Fernández et al. (2015b).

capital inflows effectively act as a credit-limiting tool, and since global credit supply shock produce much stronger economic downturns accompanied by acute deleveraging in the light controls state, a suitable framework that can be used to interpret this paper's findings is the one put forward by the Sudden Stop literature. Specifically, as emphasized in Durdu et al. (2009), the effects of macroeconomic shocks are significantly amplified for reasonably higher initial levels of debt-to-GDP ratios. The reason for this amplification is that there is a credit constraint that limits the EME's ability borrow from abroad and its presence causes nonlinear effects of shocks that lead the economy sufficiently close to making this constraint bind. Hence, interpreted through the lens of the Sudden Stops framework, this paper's results seem to suggest that EMEs with strict control in place are able to better absorb shocks owing to having lower debt-to-GDP ratios which make it less likely to make credit constraints bind in the presence of contractionary global shocks.

The remainder of the paper is organized as follows. Section 2 begins with a brief description of the data, after which it presents the methodology and main empirical evidence. Section 2 examines the robustness of the baseline results. Section 5 examines the role of individual inflow controls categories. The final section concludes.

2 Empirical Analysis

2.1 Data

Data are quarterly and cover 30 EMEs with samples that span 1995-2013. Strictly speaking, the panel is an unbalanced panel but the samples are mostly balanced aside from some discrepancies. In line with the theoretical literature in capital controls which has focused on models of small open economies, the chosen countries were those belonging to the universe of small EMEs for which quarterly data with reasonable length was available. 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 X13 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.

The capital control measures I employ are based on the *de jure* measures of capital controls from Fernández et al. (2015), which provides 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. The index is defined between zero (absence of controls in all asset categories) and one (controls in all categories). The total index is an average of the inflows and outflows control indices, which are in turn averages of their respective 10 asset category indices. My focus in this paper is on the capital *inflow* control index.

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.

Other outcome variables I consider to learn more about the mechanism behind the results are investment, consumption, trade balance, country credit spreads, and leverage. 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 is export minus imports (both in local currency) divided by local currency current GDP.

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. 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 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. All five variables were seasonally adjusted using ARIMA X13. Apart from the trade balance and EMBI, I take logs of all of all of the variables. Data on investment, trade balance, and leverage span the 30 countries covered by the output variable; EMBI and consumption are covered by only 15 countries (see Appendix A for sample details).

2.2 Methodology

I follow the econometric framework employed in Auerbach and Gorodnichenko (2012), Owyang et al. (2013), Ramey and Zubairy (2014), and Tenyero 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 capital controls in place in a particular country and time. 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:

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

where i and t index countries and time; α_i is the country fixed effect; Υ is the average effect of being in a certain state; $\Omega(L)$ 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, all the coefficients vary according to whether we are in state "A", i.e., strict capital controls are in place, or state "B", i.e., there are light capital controls. I is a dummy variable that takes the value of one when the capital controls level is above a threshold. Since I am looking for a threshold that divides capital controls into strict versus light levels of controls, I define $I_{i,t-4} = 1$ when the level of controls is at or above the upper quartile level of controls across all observations. This threshold dictates that a total of 508 observations are consistent with being in a state of strict capital controls.

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 controls variable. Since the latter was converted from annual to quarterly frequency by assuming identical values within the year, it is necessary to include it 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 $I_{i,t-4}$ of any potentially endogenous sources.

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 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. I will estimate a total of 16 regressions 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):

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

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 capital *inflow* controls, rather than *outflow* controls, are relevant for reducing the output effects of credit supply shocks. In what follows after that, I turn to inspecting the behavior of other macroeconomic variables as a function of the capital inflows controls state in order to uncover the underlying mechanisms that drive the output-based results.

Capital Inflow Controls Versus Capital Outflow Controls. The first set of results, shown in Figures 1a and 1b, depicts the output response to credit supply shocks in the non-linear model considering two measures of capital controls: the capital inflow controls index (Figure 1a) and the capital outflows controls index (Figure 1b). Notwithstanding the theory-driven focus of the literature on capital inflow controls, it is still useful for comparison purposes to examine the empirical role of both control types and to substantiate the centrality of inflow controls.

For comparison purposes, the results from the linear model are also shown in all of the figures. Specifically, in each Figure the first sub-figure jointly shows the point estimates of the linear model (solid lines), strict capital controls state (dotted lines), and the light capital controls state (dashed lines); the next three sub-figures depict the impulse responses along with Driscoll and Kraay (1998) 95% confidence bands for the linear model, the strict capital controls state, and the light capital controls state; and the last sub-figure shows the t-statistics from the hypothesis that the impulse responses in the strict capital controls state are larger than in the light capital controls state.

The results from Figure 1a clearly indicate that controls on total capital inflows reduce the effects of credit supply shocks on output. The reduction is both economically and statistically significant. The peak output response in the light capital controls state takes place after 1.5 years reaching -2.5%, compared to only -1% in the strict capital controls state. Beginning with two quarters following the shock, the difference between the responses in the two states becomes very statistically significant with t-statistics of this difference far exceeding 2 peaking at 4 after 1.5 years.

In contrast, the results from Figure 1b demonstrate that outflow controls are unable to moderate the sensitivity of output to credit supply shocks; the difference between the responses in the strict and light capital outflow states is statistically insignificant for the bulk of the horizons, and is actually even significantly negative in the first two periods. Overall, for nearly 70% of the horizons the difference is negative.

Taken together, the results of the two figures clearly show that the theory-driven emphasis on inflow controls as policy tools for increasing macroeconomic stability is very much warranted for. Having established the shock-absorbing capacity of capital *inflow* controls, I now turn to inspecting the mechanism behind this result by studying the response of various other macroeconomic variables.

Investment, Consumption, and the Trade Balance. Figures 2, 3a, and 3b depict the responses of investment, consumption, and the GDP share of the trade balance from the model with the capital inflows control index. For investment and the trade balance, data availability is the same as for output; for consumption, however, data is only available for 15 countries (see Appendix A for details).

The results from Figure 2 indicate that investment responds much more strongly in the light capital controls state, with a peak decline of 6.4% after 6 quarters compared to only 1% at this time in the strict capital controls state. The t-statistics for the difference between the responses in the two states start exceeding conventional rejection levels after one year. As in the case of output, the main takeaway from 2 is that imposing controls on capital inflows appears to significantly reduce the sensitivity of investment to credit supply shocks.

Figures 3a and 3b present the responses of consumption and the trade balance share of GDP, respectively. Consumption responds significantly more strongly in the strict capital controls state than in the light controls state. The difference is statistically significant at conventional rejection levels for 5 quarters following the shock. Notably, the response of consumption in the strict capital controls state is insignificant for most horizons, this in contrast to the significant negative response observed for most horizons in the light capital controls state.

The trade balance response is positive in the light capital controls state and negative in the light controls state; the former is statistically significant from the fifth period through the three year mark while the latter is significant at the impact period and from the ninth period onwards. Accordingly, the difference between the responses is significant for the majority of the horizons. This is broadly consistent with an interpretation that is based on the Sudden Stops literature where a negative global shock induces a sharper fall in capital inflows in the light controls 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 country credit spreads and leverage.

Country Credit Spreads. 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 computed by JP Morgan which proxies for country credit spreads.[4] 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.[5]

Figure 4 presents the response of EMBI to a credit supply shock. The results can be summarized as follows. First, the response in the linear model and in the light controls state is significantly positive for two years; in contrast, the response in the strict controls stat is only significant for the first year and much lower than in the light controls state (e.g., its response in the second period is 1.3 percentage points compared to 2.1 percentage points in the light controls state). Second, the difference between the responses is very significant throughout the two year period following the

[4] Data on EMBI is available for 15 countries, where the longest range of the unbalanced panel is 1995:Q1-2013:Q4. More details are provided in Appendix A.

[5] 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 capital inflow controls.

shock. In sum, the results from Figure 4 stress that credit supply shocks' effects are transmitted through the increase of riskiness in the economy as measured by EMBI.

Leverage. Given the important theoretical role of leverage in models of EMEs based on credit constraints (e.g., Durdu et al. (2009) and Mendoza (2010)) 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. Towards 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).

Figure 5 presents the response of leverage to a credit supply shock. The results indicate that leverage significantly drops in the light controls state, stressing that a sharp process of deleveraging takes place following the credit supply shock in this state. Note that, since output also drops in this state, we can deduce that capital inflows also decline in absolute terms in the light controls state. In contrast, in the strict controls state, leverage does not change significantly for nearly all horizons, stressing that the acute decline in capital inflows that is apparent in the light controls state is avoided by being in the strict controls state. The difference between the responses, though positive at all horizons, starts being significant from the two-year mark; this timing which roughly coincides with the time at which the leverage response in the light controls state becomes significantly negative.

2.4 Do Capital Inflow Controls Reduce Leverage?

Interpreted through the lens of the models advanced in the Sudden Stops literature, the empirical results presented so far imply that steady state leverage should be lower in economies which have strict capital inflow controls in place. This lower steady state leverage, in turn, should moderate the effects of contractionary shocks relative to a state of higher initial leverage as in the former case the likelihood of a binding credit constraint is lower (see, e.g., Durdu et al. (2009)).

To formally test this notion, I estimate Specification (1) using leverage as the outcome variable, but rather than focusing on the coefficients $\Xi_{A,h}$ and $\Xi_{B,h}$ I center my attention on $\Upsilon_{A,h}$ and $\Upsilon_{b,h}$; these two coefficient represent the average effect of being in a state of strict controls and light controls, respectively. My interest lies in estimating these coefficients and ascertain whether they are statically different from one another.

Figure 6 shows the impulse responses of leverage to being in the two states. The results clearly demonstrate that the strict controls state moves the economy into a new steady state with lower leverage. Already after two periods and onwards, leverage becomes significantly lower in the strict controls state relative to the light controls state, in which the leverage response is insignificant. This result can be viewed as supporting evidence for the notion that strict inflow controls shift an economy into a steady state characterized by lower leverage. And, in line with economic theory, this result can help explain why real activity is more sensitive to credit supply shocks in the light controls state.

3 Robustness Checks

This section examines the robustness of the baseline results along three dimensions: the number of lags specified in the regressions; adjusting the sample in accordance with the samples covered by the EMBI and leverage variables; and excluding the financial crisis period from the analysis. In all checks I consider output as the outcome variable and employ the capital inflow controls index to distinguish between strict and light control states.

3.1 Number of Lags

As explained in Section 2.2, the state dummy variable appears in its fourth lag in the regression due to the fact that it is converted from annual to quarterly frequency by assuming identical values within the year. It is therefore important to include a relatively large number of lags in my estimations so as to purge the state dummy variable of any potentially endogenous sources. I now confirm that specifying a smaller number of lags, while still ensuring that some amount of the potentially endogenous variation in the state dummy is removed by past output growth realizations, has no significant bearing on the baseline results.

Figures 7a-7c present the response of output to a credit supply shock for a 7 lag specification, 6 lag specification, and 5 lag specification. It is apparent the main results of the paper are unaffected by assuming a smaller number of lags. In all three specifications the output response continues to be significantly stronger in the light controls state than in the strict controls state.

3.2 EMBI and Consumption Samples

The EMBI country credit spread variable and consumption have a much narrower cross-sectional coverage relative to output. It is therefore important to confirm that the baseline results with respect to output are insensitive to using the same cross-sectional coverage that is available for the EMBI and leverage variables.

Figure 8 presents the responses of output for the EMBI- and consumption-based 15 country sample. It is evident the baseline results are unaffected by the matching of the sample of countries to that covered by the EMBI and consumption. For this sample also output responds much more strongly in the light controls state with the t-statistics of the difference in responses between the two states far exceeding conventional rejection levels.

3.3 Excluding the Financial Crisis Period

The 2008-2009 global financial crisis generated large adverse global credit supply shocks that provide a suitable natural experiment for addressing the research question of this paper. It is interesting, however, to examine whether the the qualitative nature of the results still holds when the financial crisis period is excluded from the analysis. This type of exclusion will be informative as to whether the main results of the paper are also relevant in more normal time when credit supply shocks are smaller.

Towards this end, I estimate the baseline model for the sample 1995-2007. Figure 9 presents the response of output to a credit supply shock from this estimation. While results are expectedly quantitatively weaker than in the baseline case, the qualitative nature of the results largely holds. Specifically, the difference between the responses across the two states is generally significant at conventional rejection levels, with the response in the light controls state being significantly negative whereas that in the strict controls state being insignificant. These results seem to suggest that, even during normal times in which credit supply shocks are largely small, the response of output is significantly stronger in the light controls state.

4 Individual Inflow Controls Categories

As documented in Fernández et al. (2015), policymakers tend to place inflow controls on the various inflow categories quite in tandem, in accordance with the strong correlation between the various restrictions sub-indices that comprise the capital inflow controls index. It is therefore sensible, from an empirical standpoint, to follow the strategy pursued in this paper and consider the average inflow controls index in my analysis rather than looking at its individual sub-indices. Nevertheless, despite the fact that policymakers have rarely opted for imposing restrictions on a specific type of asset category independently of other categories, it still seems potentially appealing to study which components of the inflow controls index are responsible for driving the baseline results.

Figure 10 presents the t-statistics for the hypothesis that the difference between the output responses across the two states are zero, where the states are defined on the basis of the 10 sub-indices comprising the aggregate inflow controls index.[6] The findings from Figure 10 suggest that 5 category restrictions act as shock absorbers: Equity inflow restrictions; Commercial Credits inflow restrictions; Financial Credits inflow restrictions; Guarantees, sureties and financial backup facilities inflow restrictions; and Direct Investment inflow restrictions. While it is beyond the scope of this

[6] To save on space, I only present here the t-statistics. The full set of results that includes the impulse responses in both states are available upon request form the author. Importantly, the response for all categories and both states are generally significantly negative; hence, a significantly positive t-statistic should be interpreted as implying that the strict controls state produces a significantly less negative output response.

paper to provide an explanation for the results on each individual asset category restrictions, the finding that restrictions on commercial credit succeed in moderating the response of output is worth highlighting. In particular, one potential reason for this result may lie in the fact that the most obvious way to overcome capital controls, frequently cited by the literature albeit not quantified, is for firms to register short-term credit as commercial credit (see, e.g., Neely (1999), Cowan and Gregorio (2007), and Forbes (2007)). Hence, commercial credit controls may be important for enforcing controls and reducing their evasion, thus increasing in turn the overall effectiveness of capital inflows controls for increasing macroeconomic stability.

This line of reasoning applied to the case of commercial credit restrictions implies that their contribution to macroeconomic stability should be enhanced once they are combined with other asset category controls. It is possible that this reasoning also applies to other asset category restrictions. But this is a conjecture that may or may not be borne out by the data and it is therefore important to test its validity. To be more precise, the specific question arising from the findings of Figure 10 that I view as worth addressing is whether conditioning on the effects of the individual asset category restrictions eliminates the shock-absorbing capacity of the total inflow controls index. In other words, is there significant added value from the joint interaction of the various asset category restrictions?

To answer this question, I estimate the following extended nonlinear model:

$$\begin{aligned} y_{i,t+h} - y_{i,t-1} = I_{i,t-4}[\alpha_{A,i,h} + \Upsilon_{A,h} + \Xi_{A,h} EBP_t + \Omega_{A,h}(L) EBP_{t-1} + \Gamma_{A,h}(L)\Delta y_{i,t-1}] + \\ +(1 - I_{i,t-4})[\alpha_{B,i,h} + \Upsilon_{B,h} + \Xi_{B,h} EBP_t + \Omega_{B,h}(L) EBP_{t-1} + \Gamma_{B,h}(L)\Delta y_{i,t-1}] + \\ +I^{Ind}_{i,t-4}[\alpha_{Ind,i,h} + \Upsilon_{Ind,h} + \Xi_{Ind,h} EBP_t + \Omega_{Ind,h}(L) EBP_{t-1} + \Gamma_{Ind,h}(L)\Delta y_{i,t-1}] + u_{i,t+h}, \end{aligned} \tag{3}$$

where the only extension relative to Specification 1 is the addition of the state $I^{Ind}_{i,t-4}$ and its associated coefficients; this state take on the value of one if the considered individual asset category restriction sub-index takes on the value of one. I estimate Specification (3) for all ten asset category restriction sub-indices that comprise the total inflow controls index and focus, as usual, on coefficients $\Xi_{A,h}$ and $\Xi_{B,h}$ which now measure the output response in the strict and light inflow controls state conditioned on the considered individual asset restrictions state.

Figure 11 presents the results from this exercise. It is apparent that none of the individual asset category restrictions eliminate, or even reduce to any noticeable extent, the shock-absorbing capacity of the average inflow controls index. For all individual categories, the t-statistics far exceed conventional rejection levels. This indicates that the interaction between the different asset category restrictions is important in that it seems to significantly contribute to the shock-absorbing capacity of the total inflows controls index.

5 Conclusion

The question of whether capital inflow controls constitute a viable policy tool used for bolstering macroeconomic stability has become increasingly important in the last few years following the global financial crisis. Since capital controls on inflows effectively act as a credit-limiting tool, conventional economic intuition seems to suggest that economies with light controls should be more sensitive to credit supply shocks relative to those with strict controls. This paper empirically formalizes this intuitive notion.

The empirical evidence put forward in this paper, which shows that strict capital inflow controls moderate the effects of global credit supply shocks, lends credence to the potential viability of inflow controls as a stabilizing policy tool. Therefore, the policy implications of this paper are that policymakers should seriously consider inflow controls as an effective tool for increasing macroeconomic stability.

The finding that leverage in the stricter capital inflow controls state is significantly lower than that in the light controls state advances a structural interpretation of this paper's results in the spirit of the Sudden Stops literature. This is also an intuitive explanation of the driving mechanism behind this paper's results: EMEs that are hit by contractionary global shocks and have higher leverage to begin with are more likely to face binding credit constraints, thus resulting in an amplified output response.

I leave for future research the interesting task of better understanding the specific role of each asset category restrictions in producing the shock-absorbing capacity of capital inflow controls. This paper has demonstrated that there is added value in terms of achieving macroeconomic stability from allowing the different asset category restrictions to take place in tandem. And, indeed, policymakers have often opted for placing capital restrictions in an across-the-board manner, rather than focusing on specific categories in isolation.

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Appendix A Data

A.1 Output, Investment, 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; 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 X13 and downloaded from the International Financial Statistics (IFS) database, which is published by International Monetary Fund.

Sample. My panel for these variables consists of a total of 2107 observations. I use quarterly data for the following countries (30 in total) and periods: Argentina 1995:Q1-2013-Q4; Bolivia 1995:Q1-2013:Q4; Brazil 1995:Q1-2013:Q4; Bulgaria 1995:Q4-2013:Q4; Chile 1996:Q1-2013:Q4; Colombia 1995:Q1-2013:Q4; Costa Rica 2000:Q1-2013:Q4; Czech Republic 1995:Q1-2013:Q4; Ecuador 1995:Q1-2013:Q4; Egypt 2002:Q1-2013:Q4; Georgia 1996:Q1-2013:Q4; Guatemala 2001:Q1-2013:Q4; Hungary 1995:Q1-2013:Q4; Indonesia 1997:Q1-2013:Q4; Iran 1997:Q1-2007:Q4; Korea 1995:Q1-2013:Q4; Kyrgyz 1999:Q1-2013:Q4; Latvia 1995:Q1-2013:Q4; Malaysia 1995:Q1-2013:Q4; Mauritius 2000:Q1-2013:Q4; Mexico 1995:Q1-2013:Q4; Paraguay 1995:Q1-2013:Q4; Peru 1995:Q1-2013:Q4; Philippines 1995:Q1-2013:Q4; Romania 1998:Q1-2013:Q4; Russia 1995:Q1-2013:Q4; South Africa 1995:Q1-2013:Q4; Thailand 1995:Q1-2013:Q4; Turkey 1995:Q1-2013:Q4; Ukraine 2001:Q1-2013:Q4.

A.2 Capital Controls.

Variables Definitions. 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 are the specific definitions of the capital control measures 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.

Total Capital Outflow Controls Index. This index is an average of the same asset restrictions categories that underlie the total inflow index, only that the restrictions for the outflow index pertain to outflows of these assets.

A.3 Global Credit Supply Shock.

Variables 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 updated series of the excess bond premium variable, available on Simon Gilchrist's webpage, is my measure of credit supply shocks in this paper; it is in quarterly frequency and covers the sample period 1995:Q1 to 2013:Q4.

A.4 Consumption.

Variable Definition. Consumption is defined as local currency nominal household consumption divided by the GDP deflator, where both series were seasonally adjusted using ARIMA X13 and downloaded from the International Financial Statistics (IFS) database.

Sample. My panel for consumption consists of a total of 1142 observations. I use quarterly data for the following countries (15 in total) and periods: Argentina 1995:Q1-2013-Q4; Brazil 1995:Q1-2013:Q4; Bulgaria 1995:Q4-2013:Q4; Chile 1996:Q1-2013:Q4; Colombia 1995:Q1-2013:Q4; Ecuador 1995:Q1-2013:Q4; Hungary 1995:Q1-2013:Q4; Korea 1995:Q1-2013:Q4; Kyrgyz 1999:Q1-2013:Q4; Malaysia 1995:Q1-2013:Q4; Mexico 1995:Q1-2013:Q4; Peru 1995:Q1-2013:Q4; Philippines 1995:Q1-2013:Q4; South Africa 1995:Q1-2013:Q4; Thailand 1995:Q1-2013:Q4; Turkey 1995:Q1-2013:Q4.

A.5 EMBI Spread.

Variable Definition. My panel for the EMBI spread consists of a total of 994 observations. 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. The EMBI series was also seasonally adjusted using ARIMA X13.

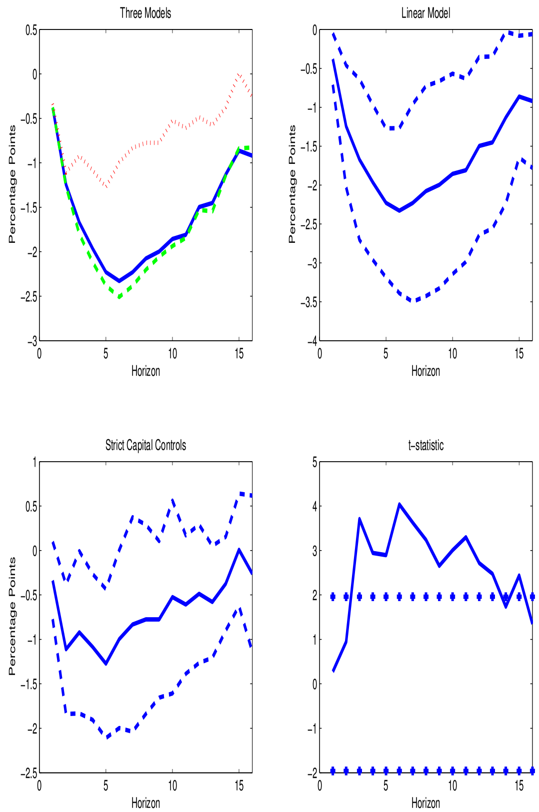
Sample. My panel for EMBI consists of a total of 1142 observation. I use quarterly data for the following countries (15 in total) and periods: Argentina 1995:Q1-2013-Q4; Brazil 1995:Q1-2013:Q4; Bulgaria 1995:Q4-2013:Q4; Chile 1999:Q2-2013:Q4; Colombia 1997:Q1-2013:Q4; Ecuador 1995:Q1-2013:Q4; Hungary 1999:Q1-2013:Q4; Korea 1995:Q1-2013:Q4; Kyrgyz 1999:Q1-2013:Q4; Malaysia 1996:Q4-2013:Q4; Mexico 1995:Q1-2013:Q4; Peru 1997:Q1-2013:Q4; Philippines 1995:Q1-2013:Q4; South Africa 1995:Q1-2013:Q4; Thailand 1997:Q2-2013:Q4; Turkey 1996:Q3-2013:Q4.

A.6 Leverage.

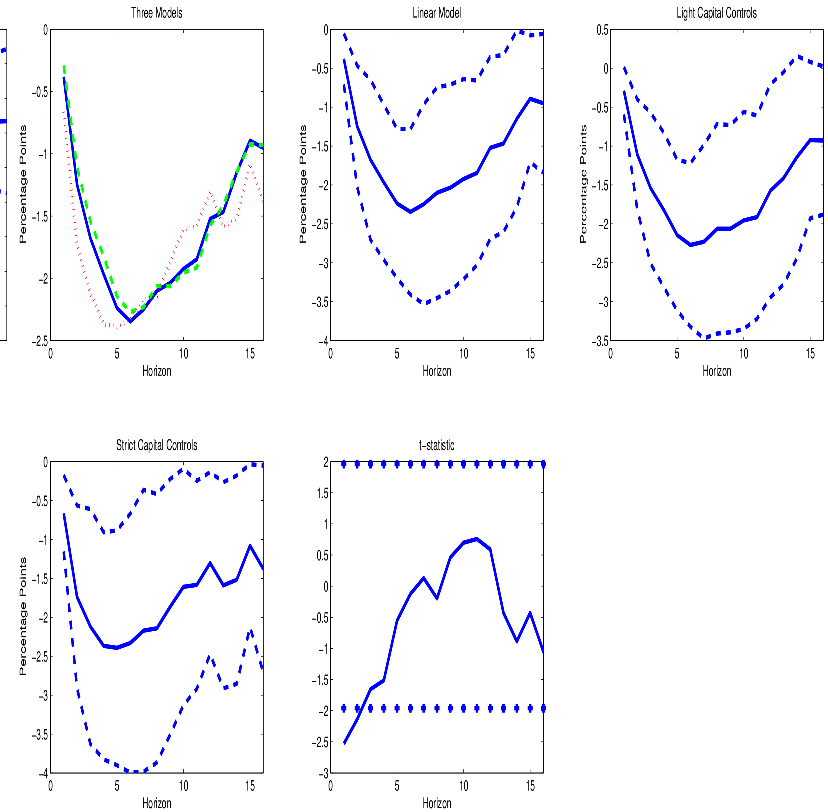
Variable Definition. The leverage data is defined as the ratio of total BIS-reporting banks' claims on each country to its GDP. The former series are taken from the BIS consolidated banking statistics database and the latter is taken from the IFS database. Raw total claims are in dollar terms and are therefore converted to local currency terms using the end of quarter dollar exchange rate from each country taken from the IFS database. The BIS claims data include the claims of reporting banks' foreign affiliates but exclude intragroup positions, similarly to the consolidation approach followed by banking supervisors. Currently, banking groups from 31 countries report their claims to the BIS.

Sample. The panel for leverage consists of a total of 1644 observations. The data is quarterly and pertains to the 30 countries that correspond to the output-based sample of countries (30 countries in total) for the sample period 2000:Q1-2013:Q4.

Figure 1: **Capital Controls' Effect on Output's Sensitivity to Credit Supply Shocks: (a) Inflow Controls Index; (b) Outflow Controls Index**.



(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (Inflow Controls Index).

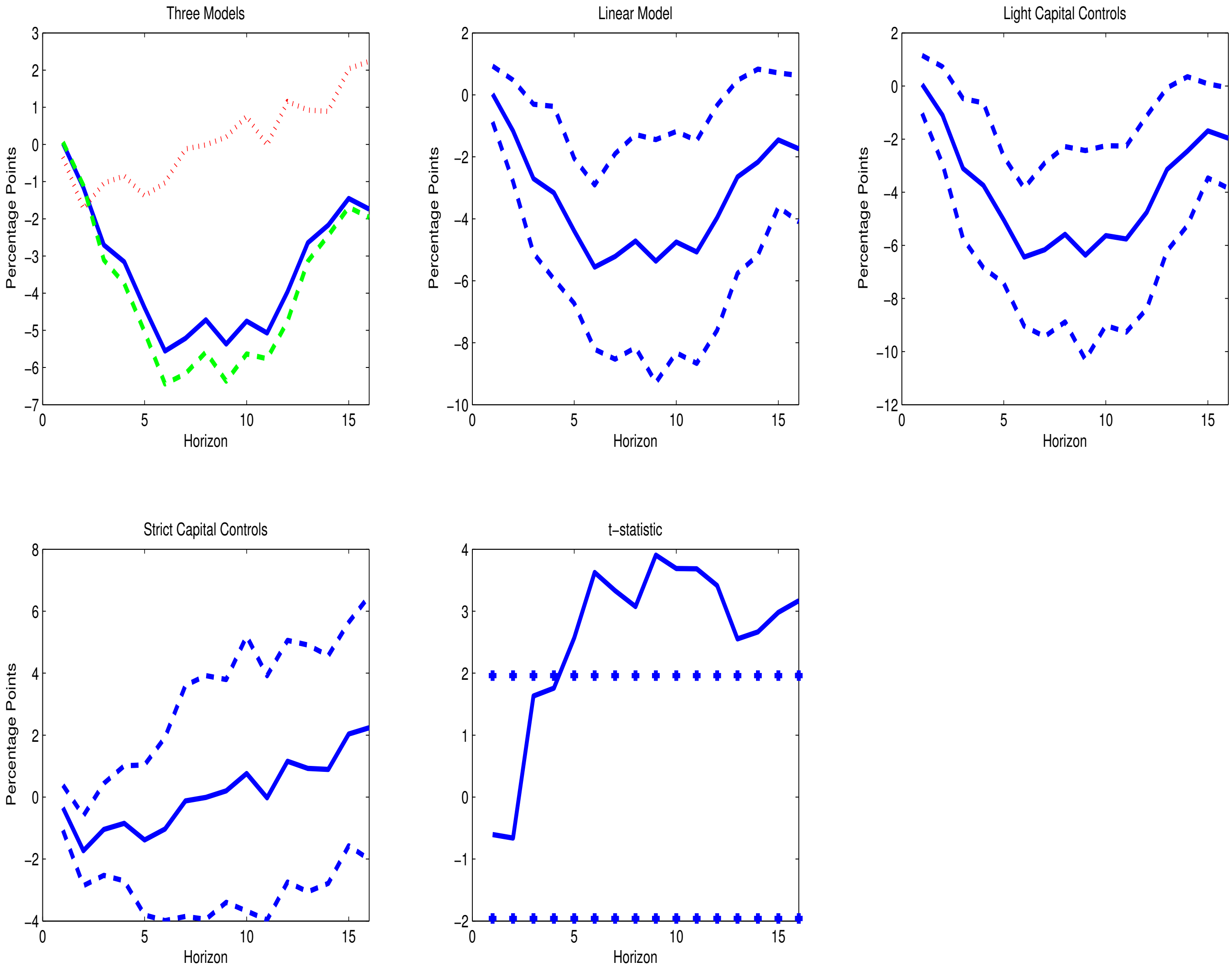


(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (Outflow Controls Index).

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, where in the latter the capital inflow controls index is used. 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, where in the latter the capital outflow controls index is used.

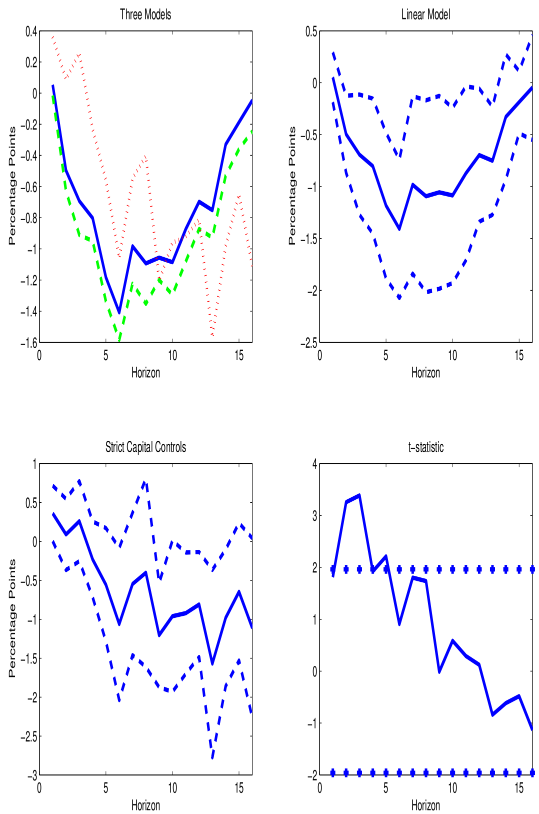
For both panels, in the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the light capital controls state, and the dotted lines are the responses in the strict capital controls state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 95% 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 2.5% significance levels (± 1.96) are added. The responses are shown in terms of percentage deviations from pre-shock values. Horizon is in quarters.

Figure 2: **Capital Inflow Controls' Effect on Investment's Sensitivity to Credit Supply Shocks**.

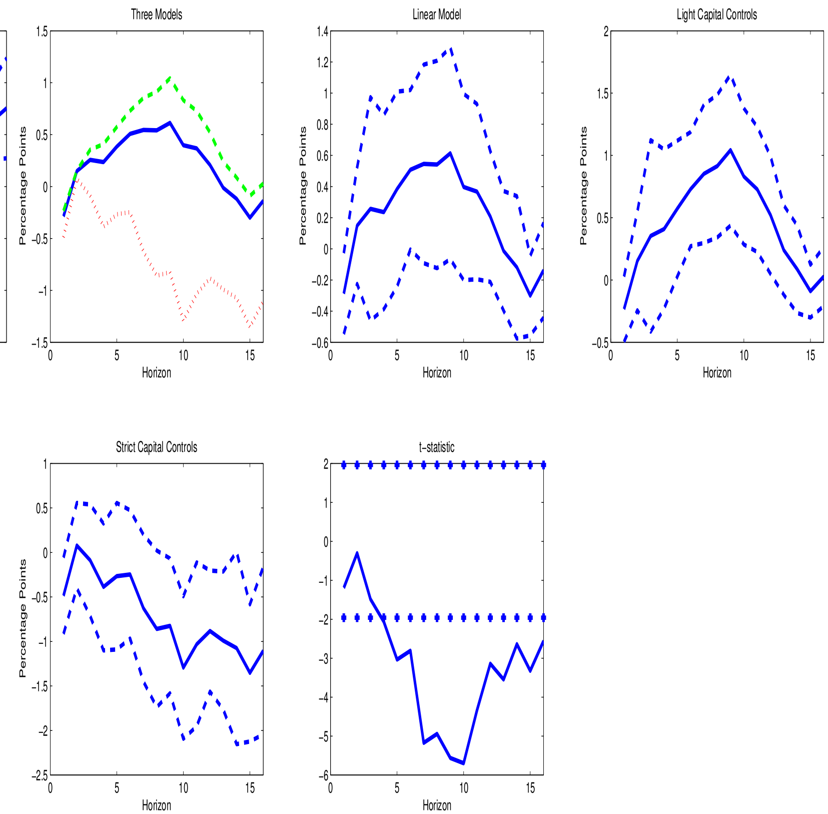


Notes: This figure presents the impulse responses of investment to a one standard deviation credit supply shock from the linear model and non-linear model. In the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the light capital controls state, and the dotted lines are the responses in the strict capital controls state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 95% 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 2.5% significance levels (± 1.96) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 3: **Capital Inflow Controls' Effect on Consumption's and Trade Balance's Sensitivity to Credit Supply Shocks: (a) Consumption; (b) Trade Balance**.



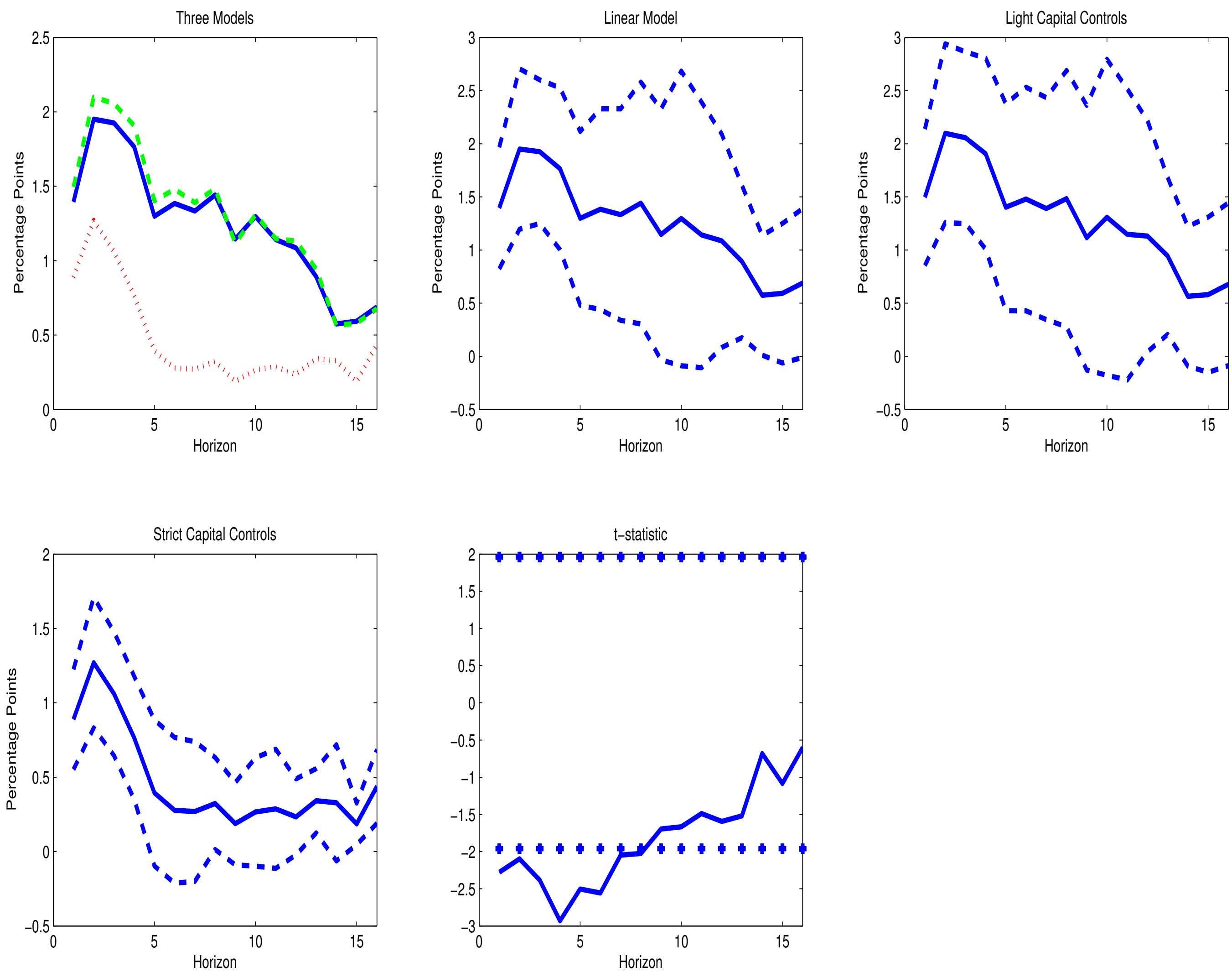
(a) Impulse Responses of Consumption to a One Standard Deviation Credit Supply Shock.



(b) Impulse Responses of the Trade Balance to a One Standard Deviation Credit Supply Shock.

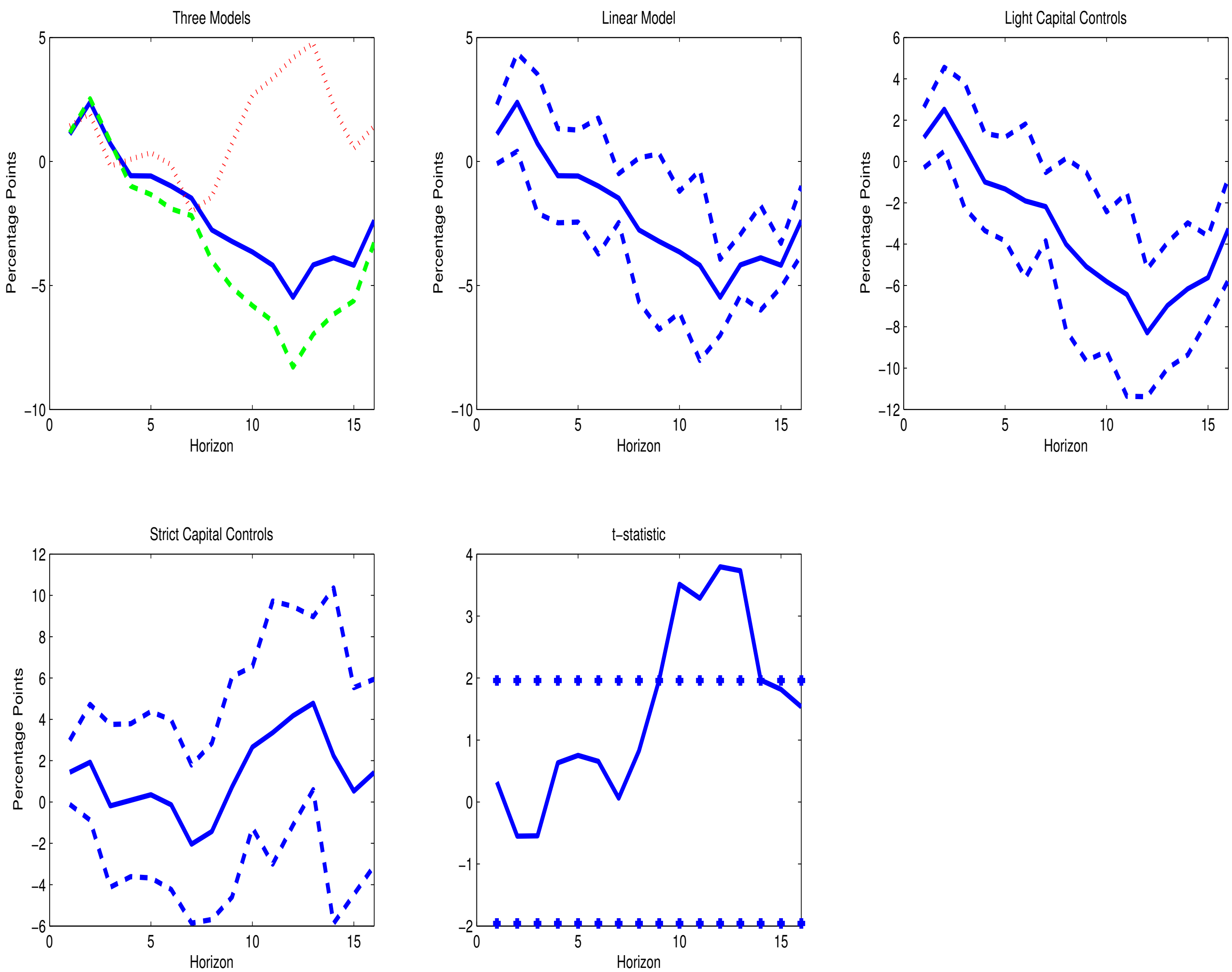
Notes: Panel (a): This figure presents the impulse responses of consumption to a one standard deviation credit supply shock from the linear model and non-linear model. See Section 2.3 for details on its components. Panel (b): This figure presents the impulse responses of the trade balance to a one standard deviation credit supply shock from the linear model and non-linear model. See Section 2.3 for details on its components.

Figure 4: **Capital Inflow Controls' Effect on EMBI's Sensitivity to Credit Supply Shocks**.



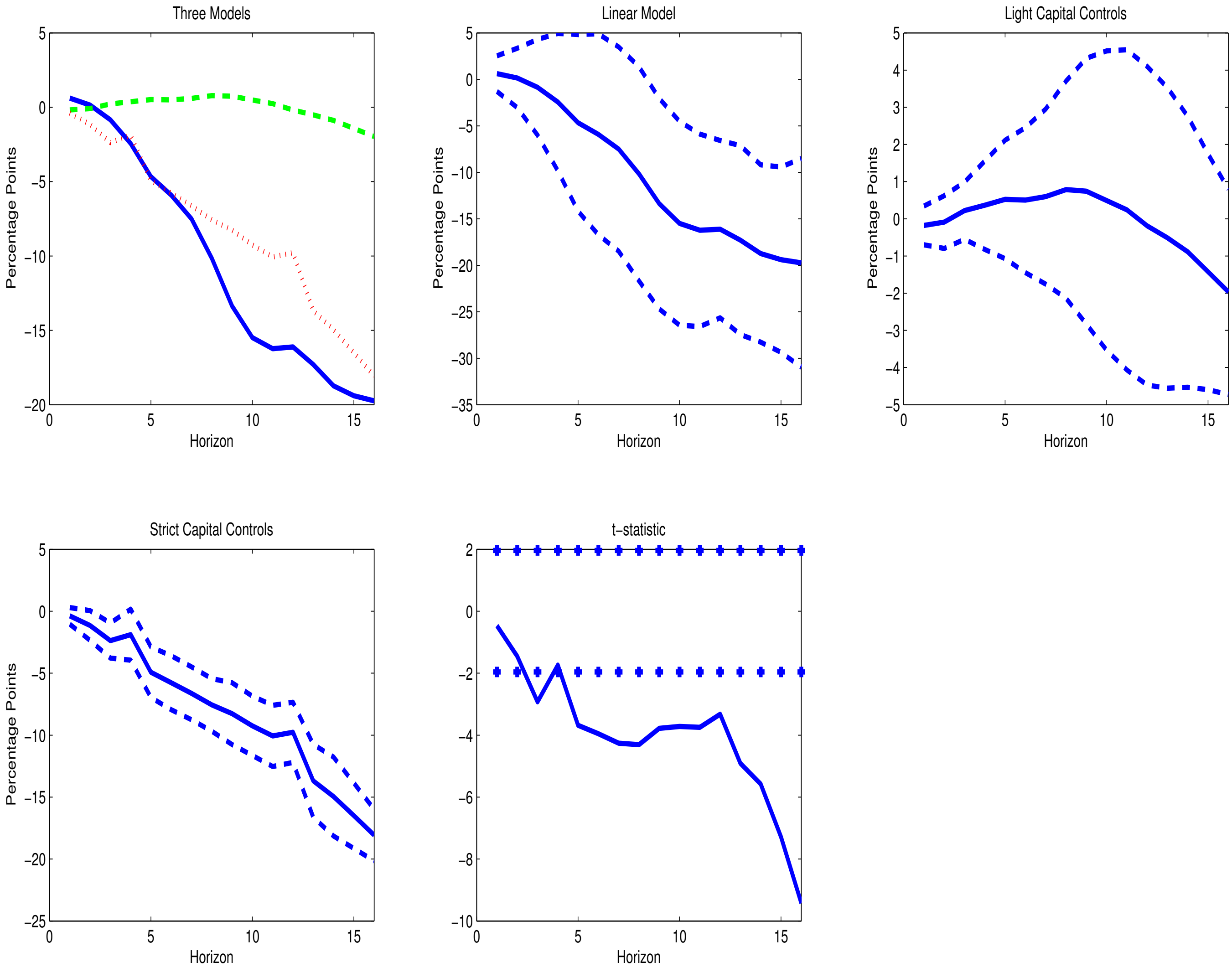
Notes: This figure presents the impulse responses of EMBI (country credit spread) to a one standard deviation credit supply shock from the linear model and non-linear model. In the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the light capital controls state, and the dotted lines are the responses in the strict capital controls state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 95% 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 2.5% significance levels (±1.96) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 5: **Capital Inflow Controls' Effect on Leverage's Sensitivity to Credit Supply Shocks**.



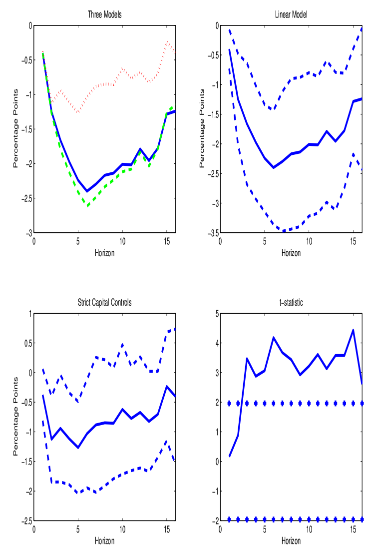
Notes: This figure presents the impulse responses of leverage to a one standard deviation credit supply shock from the linear model and non-linear model. In the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the light capital controls state, and the dotted lines are the responses in the strict capital controls state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 95% 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 2.5% significance levels (±1.96) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 6: **Capital Inflow Controls' Effect on Leverage**.

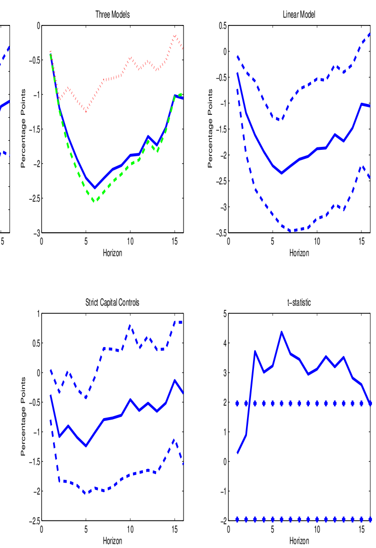


Notes: This figure presents the impulse responses of leverage to the two inflow state dummies from the non-linear model described in the baseline specification (Equation 1). In the first sub-figure the solid lines show the responses in the light capital controls state and the dashed lines are the responses in 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) 95% 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 2.5% significance levels (±1.96) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

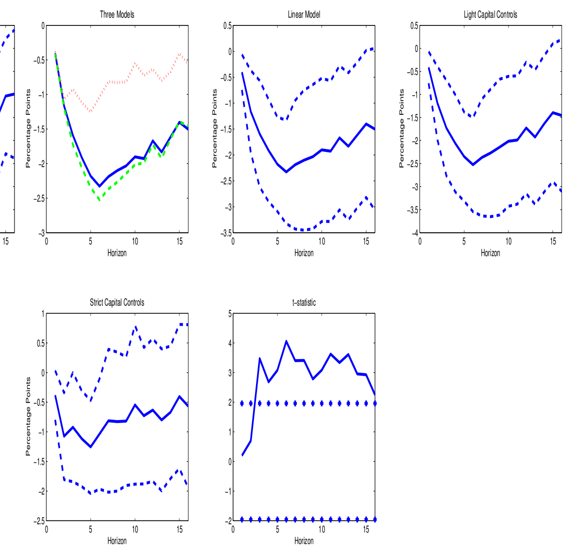
Figure 7: **Capital Inflow Controls' Effect on Output's Sensitivity to Credit Supply Shocks: (a) 7 Lags; (b) 6 Lags; (c) 5 Lags** .



(a) Impulse Responses to a One Standard Deviation Credit Supply Shock (7 Lags).



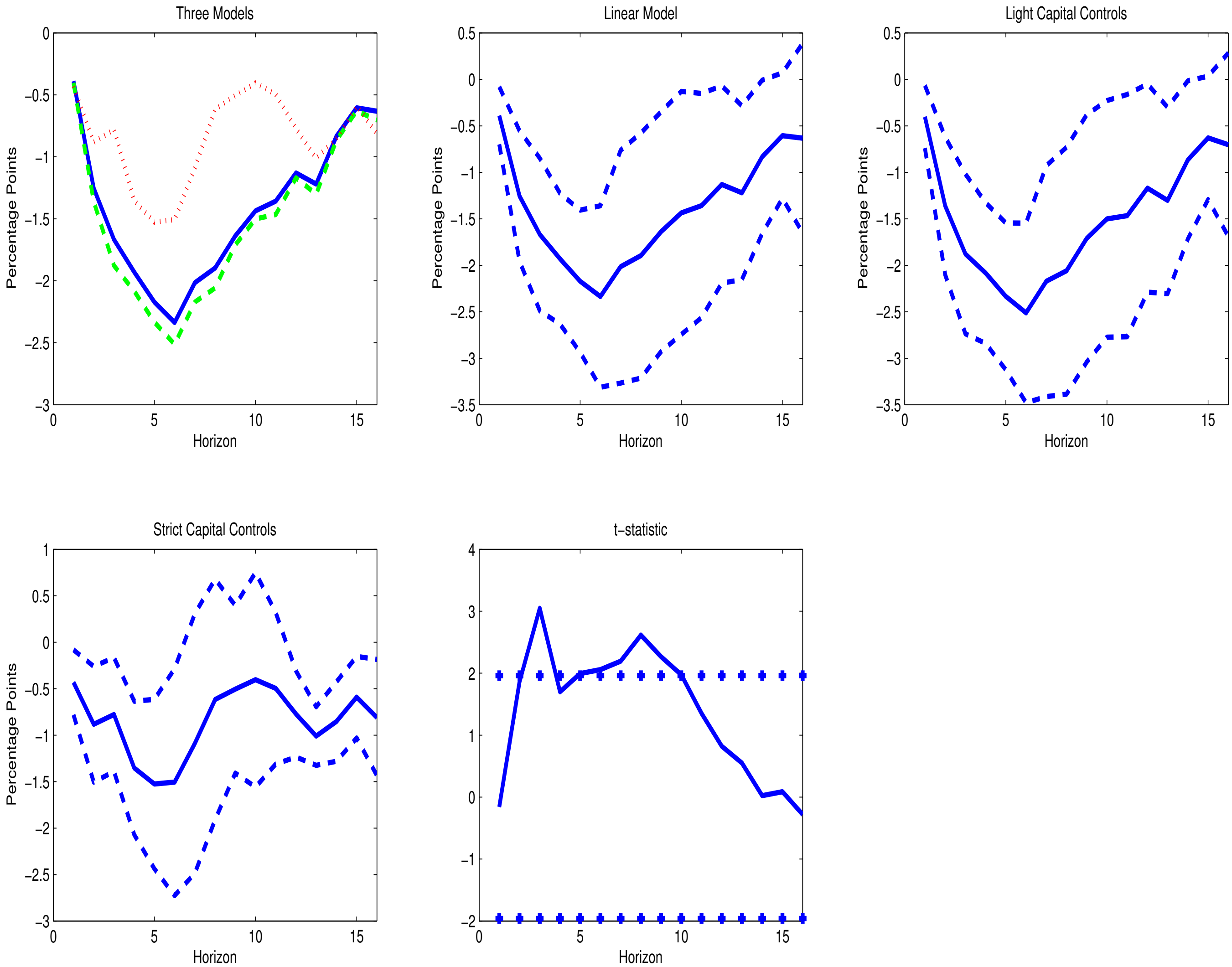
(b) Impulse Responses to a One Standard Deviation Credit Supply Shock (6 Lags).



(c) Impulse Responses to a One Standard Deviation Credit Supply Shock (5 Lags).

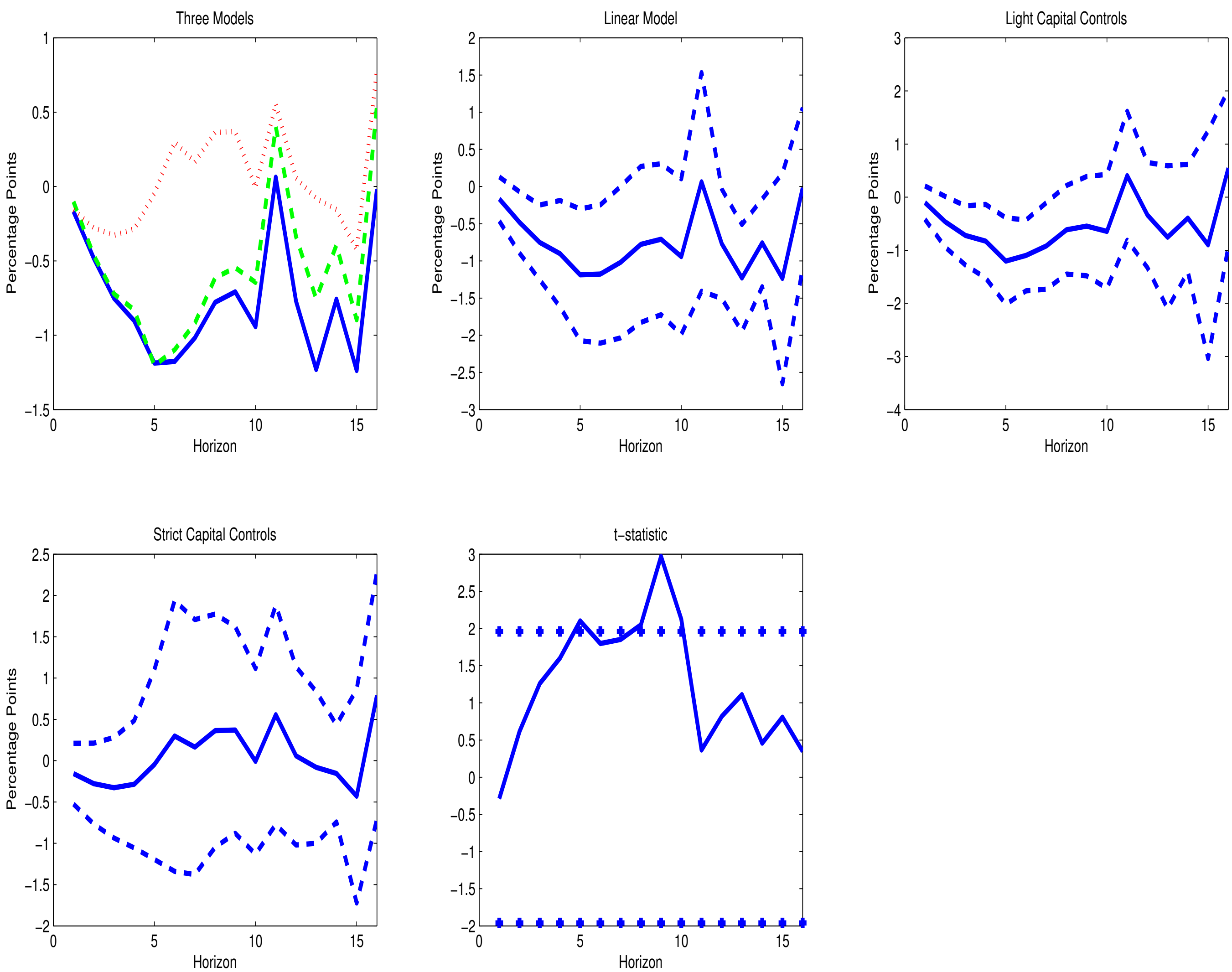
Notes: Panel (a): This figure presents the impulse responses of output to a one standard deviation credit supply shock from the linear model and non-linear model, where the number of specified lags in the model is 7. Panel (b): This figure presents the impulse responses of output to a one standard deviation credit supply shock from the linear model and non-linear model, where the number of specified lags in the model is 6. Panel (c): This figure presents the impulse responses of output to a one standard deviation credit supply shock from the linear model and non-linear model, where the number of specified lags in the model is 5.

Figure 8: **Capital Inflow Controls' Effect on Output's Sensitivity to Credit Supply Shocks: EMBI- and Consumption-Based 15 Country Sample**.



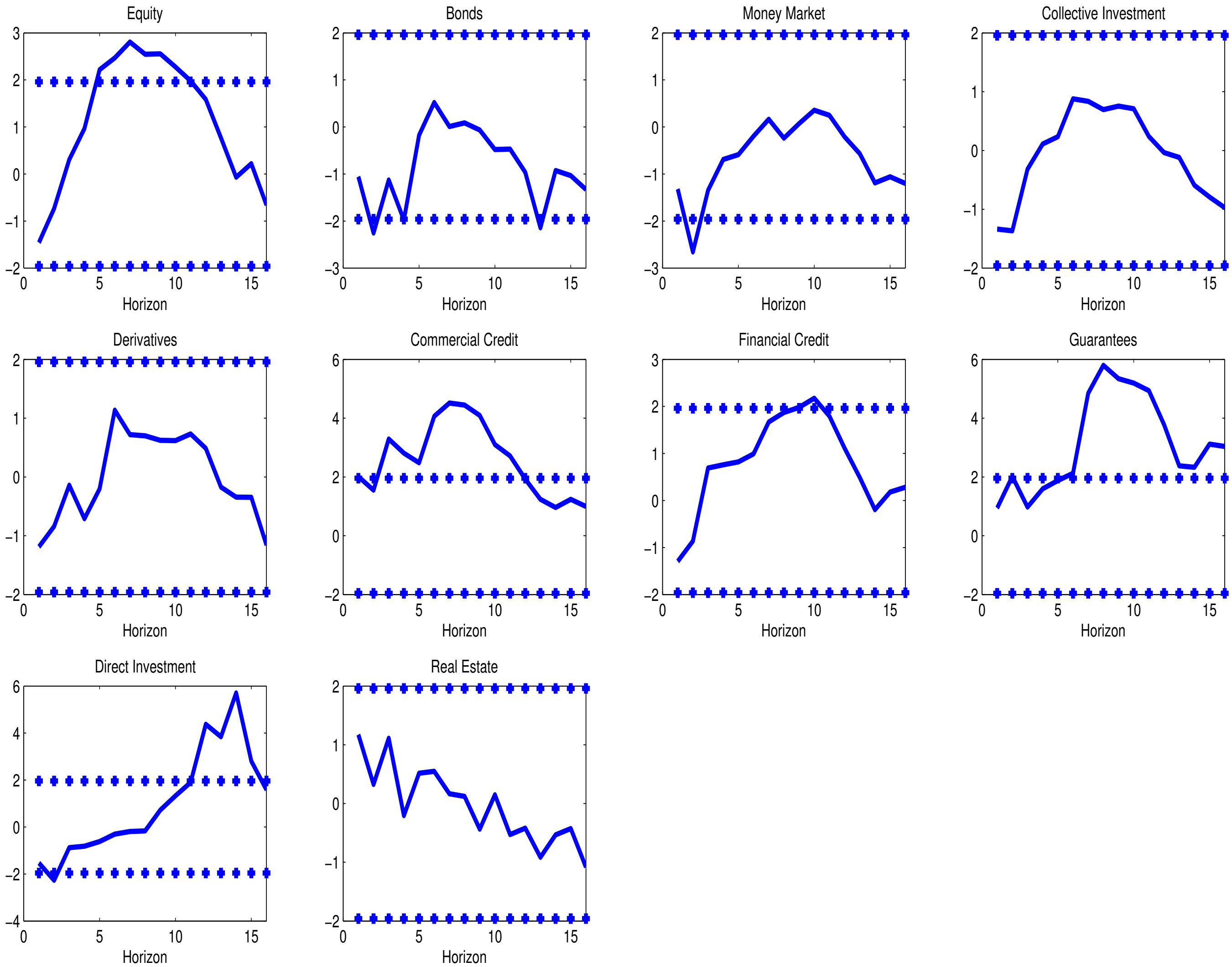
Notes: This figure presents the impulse responses of output to a one standard deviation credit supply shock from the linear model and non-linear model, where the sample of countries corresponds to that covered by EMBI and consumption. In the first sub-figure the solid lines show the responses in the light capital controls state and the dashed lines are the responses in 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) 95% 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 2.5% significance levels (± 1.96) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 9: **Capital Inflow Controls' Effect on Leverage's Sensitivity to Credit Supply Shocks: 1995-2007 Sample Period**.



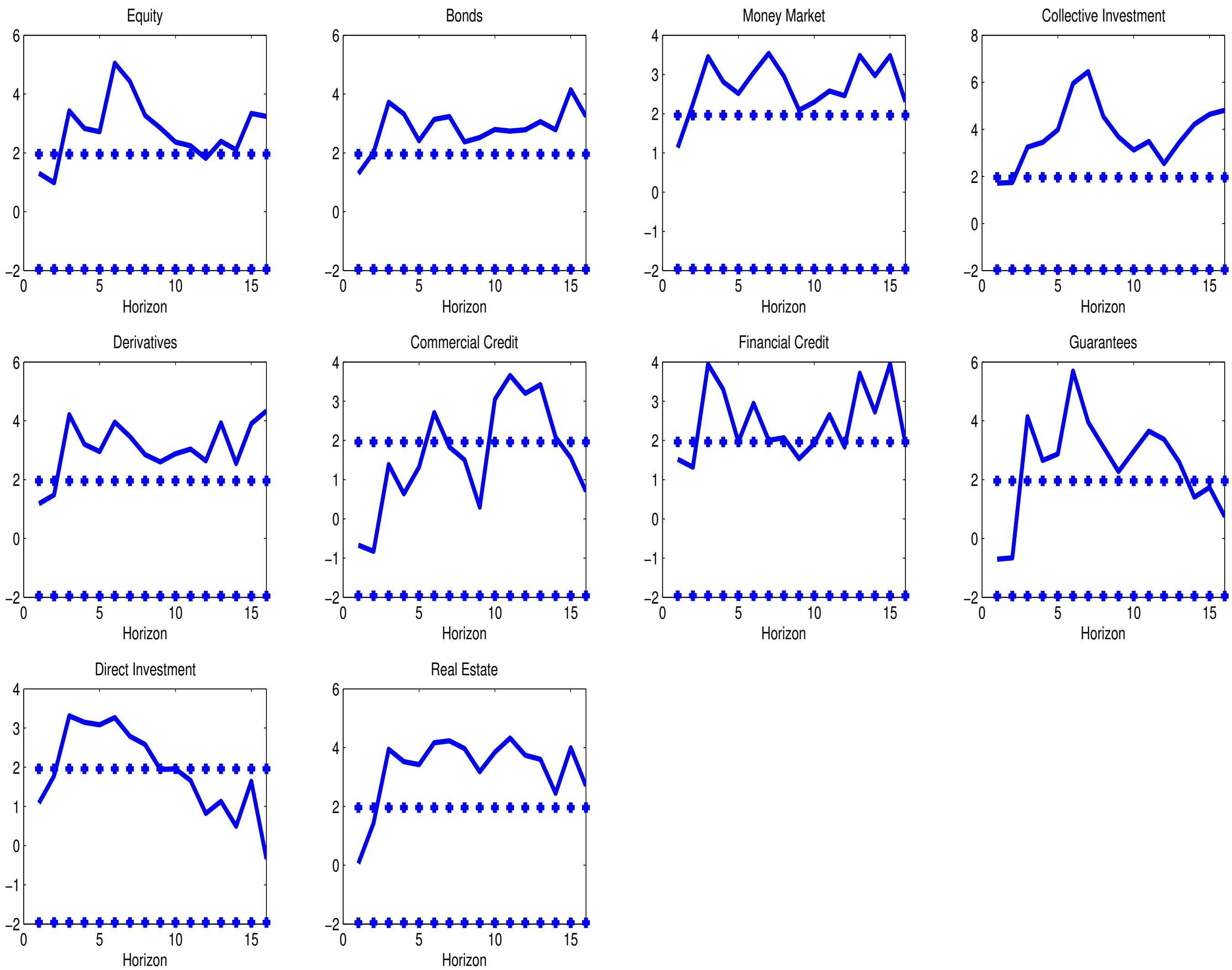
Notes: This figure presents the impulse responses of leverage to a one standard deviation credit supply shock from the linear model and non-linear model, where the sample period is truncated at the end of 2007 so as to exclude the global financial crisis period. In the first sub-figure the solid lines show the responses from the linear model, the dashed lines depict the responses in the light capital controls state, and the dotted lines are the responses in the strict capital controls state. The next three sub-figures present the impulse responses from the linear model and the two states along with Driscoll and Kraay (1998) 95% 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 2.5% significance levels (± 1.96) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 10: **Individual Asset Controls' Effect on Output's Sensitivity to Credit Supply Shocks**.



Notes: This figure presents the impulse responses of output to a one standard deviation credit supply shock for the 10 different sub-components of the total inflow controls index: 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. For brevity, the figure only shows the t-statistic of the difference between the responses in the strict capital controls state and the light controls state for all inflow controls indices, where for convenience the 2.5% significance levels (± 1.96) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.

Figure 11: **Capital Inflow Controls' Effect on Leverage's Sensitivity to Credit Supply Shocks: Conditioning on the Effects of Individual Asset Controls**.



Notes: This figure presents the impulse responses of output to a one standard deviation credit supply shock while conditioning on the 10 different sub-components of the total inflow controls index. Each sub-figure corresponds to a model (Specification (3)) in which conditioning on the category corresponding to the sub-figure title was made. For brevity, the figure only 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 2.5% significance levels (± 1.96) are added. The responses are shown in terms of percentage deviations from steady state values. Horizon is in quarters.