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ABSTRACT

The Overhang Hangover*

We revisit the debt overhang question. We first use non-parametric techniques to isolate a panel of countries on the downward sloping section of a debt Laffer curve. In particular, overhang countries are ones where a threshold level of debt is reached in sample, beyond which (initial) debt ends up lowering (subsequent) growth. On average, significantly negative coefficients appear when debt face value reaches 60% of GDP or 200% of exports, and when its present value reaches 40% of GDP or 140% of exports. Second, we depart from reduced form growth regressions and perform direct tests of the theory on the thus selected sample of overhang countries. In the spirit of event studies, we ask whether, as the overhang level of debt is reached: (i) investment falls precipitously as it should when it becomes optimal to default; (ii) economic policy deteriorates observably, as it should when debt contracts become unable to elicit effort on the part of the debtor; and (iii) the terms of borrowing worsen noticeably, as they should when it becomes optimal for creditors to pre-empt default and exact punitive interest rates. We find a systematic response of investment, particularly when property rights are weakly enforced, some worsening of the policy environment, and a fall in interest rates. This easing of borrowing conditions happens because lending by the private sector virtually disappears in overhang situations, and multilateral agencies step in with concessional rates. Thus, while debt relief is likely to improve economic policy (and especially investment) in overhang countries, it is doubtful that it would ease their terms of borrowing, or the burden of debt.

JEL Classification: E62, F34, F43 and H63
Keywords: debt contracts, debt overhang, debt relief, investment and kernel estimation

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1 Introduction

Most developing economies can not grow without borrowing to finance the technology gains and capital deepening that come with economic progress. On the other hand, high levels of debt are (again) increasingly accused of deleterious effects on economic development, in what appears to be a revival of a 20-year-old debate on the virtues of debt relief. The notion of debt overhang is coming back to the forefront, and with it a renewed interest in empirical work identifying what countries have reached the downward segment of a debt Laffer curve, and why. This paper is part of that effort.

Theoretical arguments supporting the existence of a debt Laffer curve fall into two broadly defined categories. First are theories based on multiple equilibria, where investment endogenously collapses beyond a certain level of indebtedness, in preparation for default and in order to minimize penalty payments, exogenously assumed to equal a fixed proportion of output. Second are theories where the nature and terms of the optimal debt contract are affected by the level of existing indebtedness. As debt levels rise, it becomes increasingly difficult, and eventually impossible, for a creditor with imperfect monitoring technology to elicit effort on the part of the debtor. The borrowing economy then loses all incentives to implement policies that are painful in the short-run but beneficial in the long-run.

In this paper, we evaluate the plausibility of these (relatively) old theories in (relatively) recent data, using modern empirical techniques. We do this in two steps. First, we implement standard reduced form growth regressions, with a view to selecting a panel of countries that have effectively gone through a debt overhang episode in a sample of 87 developing economies. Our selection device is simple. We use a variety of kernel estimators to characterize the relation between debt and growth at different levels of indebtedness. This verifies whether economic growth depends non-monotonically on debt levels without imposing any restriction on the shape of the non-linearity, quadratic or otherwise. In other words, we investigate the existence and shape of a hypothetical debt Laffer curve in the developing world. This also identifies precisely the level of debt at which the sign reversal occurs, i.e. the maximum point on the Laffer curve, again without any parametric restrictions. Overhang countries are defined as those going through this reversal in sample.[1]

We pay special attention to the possibility that high indebtedness and low growth arise simultaneously from omitted variables. This is illustrated in the substantial differences that exist between the debt Laffer curve implied by growth regressions with or without country-specific intercepts. The estimated number of countries on the downward segment of the debt Laffer curve is much larger without any fixed effects, which suggests that in many a case, low growth and high debt occur for time-invariant, country specific reasons. This is conceptually very different from debt overhang, which rests fundamentally on a dynamic argument, i.e. on the within-country variation in the panel.[2] We use our kernel approach to identify the variables that affect both indebtedness and growth. In particular, we isolate

[1] Timing issues are treated with care. We estimate the (conditional) effect of *initial* debt on *subsequent* economic growth, and illustrate the importance of simultaneity bias in the context of these growth regressions.

[2] Even in the case of an economy particularly prone to overhang problems for institutional reasons (for instance one where creditors can only monitor loans imperfectly), the variation of interest remains over time and within-country. There, debt overhang can be particularly severe once the threshold level of indebtedness is reached, but it will be absent at lower levels, in the same exact way it would be in a country with good creditors' rights.

the sample of overhang countries as implied by (kernel) growth regressions *without* country fixed effects, and investigate which controls affect the significance of the effect of debt in a sample where it is initially significantly negative. We focus in particular on institutional characteristics of the economy.

The paper's second step involves departing from reduced form growth regressions, and performing direct tests of the mechanisms that underpin the debt Laffer curve. Overhang countries are regrouped in a balanced panel which we subject to an event study, where the onset of debt overhang is the shock whose chronology we seek to characterize. We use our non-parametric estimates to date the threshold level of indebtedness, and ask three questions of the event study. First, is investment falling precipitously about the overhang date? Theories of optimal default suggest investment should respond at or after the overhang date, but not before. A collapse in investment prior to the overhang date would be suggestive that an explosion of the debt to GDP ratio is a symptom, rather than the cause of an investment slump. Second, is economic policy observably deteriorating at or after the overhang date? Theories of optimal debt contracts suggest incentives alter as a result of reaching a threshold level of indebtedness; again, the reverse timing is suggestive of reverse causality. Third, do the terms under which borrowing is contracted worsen noticeably at the threshold debt level? There, debt overhang occurs because creditors become unable to write incentive compatible contracts with highly indebted debtors, and choose instead to exact punitive premia. This effect should be tempered somewhat in environments where creditors are protected, or have access to monitoring technologies that limit debtors' moral hazard, as for instance in economies with developed financial markets.

Our results are as follows. Most of our estimates are supportive of a debt Laffer curve - or at least a negatively sloped relation between debt and growth at high levels of indebtedness. On average, debt overhang occurs when the face value of debt reaches 55 to 60 percent of GDP or 200 percent of exports, or when the present value of debt reaches 35 to 40 percent of GDP or 140 percent of exports. Then, initial debt tends to be associated with subsequently low growth. These thresholds apply within-countries, accounting for country-specific institutional arrangements. They are valid for the average developing economy in our sample. Still, institutions do matter for debt and growth. In particular, we find that government effectiveness, the rule of law and bureaucratic quality all correlate positively with economic growth, and tend to limit debt build-up. Debt overhang may still happen in economies endowed with good institutions, but for higher values of debt.[3]

The event study provides clear support for a fall in investment after the onset of overhang. We uncover some evidence that economic policy -in particular price stability- deteriorates. Indices capturing the overall quality of economic policy markedly worsen once the overhang threshold is reached. Interest rates on new borrowing, on the other hand, tend to fall. This runs contrary to the theory, but can actually stem from extensive rationing. Indeed, we find that at the overhang date, *quantities* lent by the private sector collapse precipitously, and the bulk of lending originates then from multilateral official agencies, at concessional rates.

We ascertain our results indeed arise because of overhang mechanisms, and rule out the following two prominent alternatives. First, we consider the possibility that world interest

[3] Our event study ignores this heterogeneity, in that it uses the average estimated overhang threshold for all countries.

rates soared during our sample, with the resulting crowding out of investment particularly prevalent amongst highly indebted economies. Actually, debt service tends to fall over the event chronology - a result that is consistent with falling interest rates, but not with crowding out effects on investment. In addition, we find only muted decreases in investment during overhang episodes in countries where property rights are strongly enforced. This is consistent with the notion that creditors are best able to monitor debtors when the required institutions are present, and thus continue to be able to sign optimal debt contracts even at high levels of indebtedness. But again, this is inconsistent with global interest rate shocks affecting investment indiscriminately amongst highly indebted economies. By the same token, we find important differences in the sample formed by low income overhang countries, relative to the rest of our events. Low income economies seem to suffer the brunt of the overhang effects we identify. Since both sub-samples have by definition similar indebtedness levels, this suggests once more ours is not a story of high world interest rates hampering investment in high-debt countries.

Second, we ensure our results are not driven by the debt crisis of the 1980's and the ensuing wave of debt rescheduling agreements. In theory, rescheduling may alleviate overhang issues, in that it could bring the debtor back in the region where incentive-compatible contracts are possible, and investing in the future optimal. In practice however, measures of external debt do respond to restructuring episodes. In other words, we may exclude some countries from our sample of overhang events simply because, in sample, debt ratios fall back below our estimated thresholds once rescheduling occurs. This tends to exclude cases when incentives might actually have altered as theory predicts, and thus acts against us finding any evidence of overhang mechanisms. If anything, excluding rescheduling episodes should reinforce our results. We investigate this in two ways. First, we simply eliminate all years between 1979 and 1984 from our sample, and continue finding the same dynamics. Second, we eliminate from our sample all substantial rescheduling episodes.[4] The same conclusions obtain: debt relief may improve investment and economic policy, but is unlikely to ease borrowing conditions, as the private sector comes back to take over from concessional loans.

The rest of the paper is structured as follows. We set the stage in section 2 with a helicopter tour of the theoretical mechanisms whereby unsustainable debt hampers economic growth. We also review some of the recent (and less recent) empirical evidence. We next present, in section 3, our measurement strategy and detail our considerable dataset. Section 4 contains the body of our results, separated into parametric and non-parametric estimates of a debt Laffer curve. We also discuss the role of country fixed effects in affecting economic growth and debt accumulation simultaneously. Section 5 then describes the event of interest - the onset of debt overhang - and tracks its impact on investment, policy choices and the terms of borrowing. Section 6 reviews some robustness tests, and Section 7 concludes.

2 Overhang Overview

We review the literature on debt sustainability and the theoretical mechanisms whereby (high level) debt can have deleterious effects on economic growth. We stress in particular

[4] We choose to eliminate all episodes that reschedule more than 5 percent of the face value of debt.

three mechanisms, based on the increasing difficulty in writing incentive-compatible debt contracts as the level of debt rises, and in particular the possibility that default become optimal at high debt levels. We also review the relevant empirical work.

Krugman (1988) defines debt overhang as a situation where "the expected present value of future country transfers is less than the current face value of its debt". In an overhang situation it may still be profitable for debt lenders to roll over the debt in order to recoup part of their claims and extract some future country resources. However, if these in turn depend on the debtor's effort, creditors will have to take into account the incentives effects of demanding further payments. If all future debtor's resources are to be used to repay its creditors, there will be little incentive to follow policies that may be painful in the short run but growth-enhancing in the long-run. An optimal debt contract strikes a balance between two constraints: on the one hand the necessity to set repayments high enough so that lucky outcomes will effectively generate transfers back to creditors, but exorbitant demands would compromise any willingness on the debtor's part to increase or even maintain its ability to repay.[5] The higher the level of debt, the harder it becomes to preserve incentives When the optimal incentive-compatible contract implements a positive level of effort, a suboptimal contract - like the one that forces maximum repayment - will reduce effort, expected growth and therefore the present value of repayments as well. This is the basis for a debt Laffer curve: the present value of debt repayments first increases in debt's face value, up to a point beyond which the correlation becomes negative. Then, a higher face value of debt is associated with lower effort, and lower present value of repayments. As long as the ability to repay depends on growth performance, the negative portion of the debt Laffer curve also correspond to a negative correlation between debt and growth, where increasing debt tends to be associated with worsening policy choices.

An important question is why some countries lay on the right side of the debt Laffer curve, even though debt forgiveness would be Pareto-improving. A classical explanation builds on a free rider problem: while all lenders collectively would be better-off financing a portion of the debt and forgiving the rest, each lender taken individually would prefer to opt out of the roll-over and demand full repayment.

Piketty (1997) shows there might be situations where even a debt contract that elicits high effort on the borrower's part can itself be suboptimal. In highly indebted economies, or ones with poor institutions, signing debt contracts that preserve the borrower's incentives to repay becomes increasingly difficult. Creditors prefer to give up incentives altogether, expect high repayments only if a lucky state of nature realizes, and thus exact prohibitive conditions from the borrower. The level of debt where creditors eschew incentive-compatible contracts is the maximum in a debt Laffer curve, as beyond this level borrowers do not try anymore to maintain or improve their ability to pay. We should observe a deterioration in the terms of borrowing along with a lower mean growth.

Obstfeld and Rogoff (1996) show that Krugman (1988) debt overhang problem can be reformulated as the outcome of a simple two-period consumption-investment decision. Suppose that a debtor country has to make a risky investment decision while an inherited stock of debt is due to mature the following period. For a given investment, a higher debt level increases the number of states of nature where default occurs. Assuming that the

[5] Aghion and Bolton (1997) and Piketty (1997) provide a general characterization of this problem and its dynamic implications

default penalty is proportional to output, the inherited debt plays the role of an effective tax on investment: as default becomes more likely or optimal, the borrower's purpose becomes to minimize penalty payment, that is minimize future output, for instance reducing investment. Inherited liabilities have a debt overhang effect on investment. Once again, debt forgiveness will increase investment as well as the present value of debt repayments.

Krugman (1988) suggests that a way to escape the trade-off between debt forgiveness (to preserve incentives) and debt financing (to obtain maximum repayment in good states of the world) is to convert debt into state-contingent claims. Cohen and Sachs (1986) and Cohen (1995) develop this view in an infinite horizon model of debt and growth with a risk of debt repudiation. At first, high growth is financed with increasing debt to GDP ratios until an endogenous debt ceiling is reached. When the credit constraint binds, growth performance depends on the repayment strategy followed by creditors, and its implication on debtors incentives. The optimal repayment strategy is to let the performing debt assets grow with the expected growth of the economy. If this is implemented, growth is faster than under autarky and a crowding in effect ensues, with debt service negatively correlated with the borrower's investment decisions. But such a "smooth payments" policy requires that the creditor be able to monitor the borrower's investment strategy. If the nature of institutions or contractual arrangements are such that monitoring cannot be ensured, the creditors optimal strategy is to claim a *constant* share of output. This amounts to a distortionary debt tax on output, leads to inefficiently depressed levels of investment and low growth. The terms of borrowing for highly indebted economies should once again worsen observably once the overhang zone is reached, and the severity of this response should depend on the creditors ability to monitor borrowers' investment policy.

Finally, the political economy can shed some light on the reasons why countries end up highly indebted, but this literature does not address directly the mechanisms that link debt and growth. For instance Velasco (1997) shows that fragmentation in fiscal authorities can create a tragedy of commons, which results in overspending and excessive debt accumulation.[6] Alesina and Tabellini (1989), in turn, explain why successions of government with different distributional goals creates fiscal uncertainty that generates capital flight, low investment and over-accumulation of external debt. There, high debt and low growth prevail simultaneously because of institutions that are prone to over-borrowing, and that tend to divert investment from efficient uses, rather than as cause and consequence. High levels of debt do not inherently alter borrower's behavior or incentives, and most importantly, debt relief would not prevent renewed debt accumulation, low investment and low growth. Distinguishing between these two possibilities is obviously of paramount importance, if only for policy reasons.

The empirical literature on debt and growth has followed two strands. A first set of papers have attempted to test directly the potential crowding-out effect of debt on investment. The second approach fits in the empirical growth literature, and investigates the reduced form (conditional) effects of debt on growth in cross-country regressions, with particular focus on the presence of non-linear relations. Cohen (1993) finds that the level of debt had no significant impact on investment during the debt crisis of the early eighties. Over the same period however, the surprise increase in debt *payments* correlated negatively with

[6] The benchmark model in this literature is Barro's (1979) model of optimal level of public debt where debt is used to smooth the effect of distortionary taxation.

investment, thus suggesting a crowding out effect. In contrast, Warner (1992) shows that some significant determinants of investment which are unrelated to debt can explain well the decline observed in highly indebted countries in the eighties. In particular, the combination of an increase in world interest rates and a fall in commodity prices can account for most of the observed decline in investment.[7]

Patillo, Poirson and Ricci (2002) [henceforth PPR] follow the alternative route. They estimate the conditional correlation between debt and growth in the context of standard panel growth regressions, and investigate whether the sign reverts at high enough debt levels. They find clear evidence that debt becomes detrimental for growth in highly indebted economies, and quantify the threshold levels in the thus confirmed debt Laffer curve using a variety of debt measures.

As will become clear, parts of this paper are largely inspired by PPR. One key difference however pertains to the actual estimates of debt levels beyond which the marginal effects of debt become negative. PPR's results suggest the marginal effects of debt are negative for face values larger than 30 to 115 percent of exports, or 5 to 90 percent of GDP, and for present values larger than 30 to 295 percent of exports, or 5 to 50 percent of GDP. The imprecision in their results may be due to their using quadratic functional forms, or spline estimators that select the threshold level on the basis of goodness of fit criteria (R-squared).[8] In contrast, the kernel approach we adopt enables more precision, in that it identifies the very first sample where debt correlates negatively with growth, when countries and years are ranking by increasing level of indebtedness. The median debt in that sample indicates the threshold of interest, which does not depend on the arbitrary choice of a functional form.

Finally, Clements, Bhattacharya and Nguyen (2003) estimate a quadratic relation between debt and growth, in a sample of low income countries. Their estimates point to an important role for public investment, which they argue high levels of debt tend to crowd out.

3 Data

Of crucial importance for our purposes is the strategy we adopt to capture a country's level of indebtedness. We focus on measures of gross external debt, for a sample of developing economies that includes low and middle income according to the World Bank classification. Financial flows are largely unilateral over our sample for a vast majority of developing economies, which justifies our focus on gross measures.[9] As is well known, a large proportion of debt in developing economies is also external. At the very least, this is the component of debt that relief programs propose to target, and thus presumably the most relevant from the standpoint of discussing debt overhang. We use two measures: Total Outstanding External

[7] More precisely, estimating the determinants of investment to GDP ratios (debt excluded) before the debt crisis performs well out-of-sample during the high debt period.

[8] In Patillo, Poirson and Ricci (2003), the same authors use growth accounting techniques to identify the sources of the growth effects of debt. They conclude that debt deteriorates growth via lower capital accumulation and a fall in Total Factor Productivity.

[9] Information on net debt is also substantially harder to come by for the type of coverage we endeavor.

Debt (TOD), taken from the Global Development Finance dataset, which tracks the face value of the stock of external debt, and a Present Value measure (PV), computed as the discounted sum of future external debt payments. The former is standard in the empirical literature on debt, whereas the latter is more recent and relies on specific assumptions regarding the discount rates and amortization profiles. PPR use both and so do we. We do however use two PV measures, one constructed by Easterly (2001) (PVE) and the second by Dikhanov (2004), PVY.

The two measures differ in three ways. PVE builds from aggregate country-level data on the terms of borrowing, whereas PVY is based on loan-by-loan data that are aggregated up to the country level. In addition, PVY allows for currency-specific and time-varying discount rates. Unlike PVE, it is however restricted to public and publicly guaranteed debt. While this is a narrower measure than PVE, it will also provide some robustness checks on the importance of debt ownership. Both measures assume a linear amortization schedule.

We follow PPR and construct two ratios for each debt measure, expressed relative to GDP or to exports. The ratio of debt to exports captures the external resources effectively available to cover external debt liabilities, and is often used by practitioners, but it is also more sensitive to term of trade shocks, and thus more volatile, than ratios to GDP

The rest of our data are standard, but offer relatively broad coverage. We construct a panel of observations for 87 developing economies over the period 1969-2002, which we use in two empirical exercises. First in standard growth regressions, based on three- or five-year averages; second in an event study where we use all the available time variation. Our control variables in the growth analysis are classic and inspired from the robust sets proposed in Levine and Renelt (1992).[10] They include initial income, openness to trade, population growth, secondary schooling and the growth rate of the terms of trade. We also experimented with the fiscal balance, with no changes in conclusions. Construction of these variables is standard; the sources used are the World Development Indicators, the World Economic Outlook and the International Financial Statistics.

In the event study, we track the response over time of investment, macroeconomic policy, and the terms of borrowing. Of these, only investment is readily available and its measure relatively uncontroversial. We choose to investigate the dynamic response of two policy related variables: inflation and government expenditures. If the conduct of economic policy does indeed deteriorate at high levels of debt, we conjecture that at least one of these measures will show a systematic response. We also include an index computed by the World Bank, the Country Performance International Assessment, or CPIA, meant to summarize in one number an assessment of the overall quality of policy stance.[11] Because we are interested in the terms under which debt is contracted, we finally bring in additional information from Global Development Finance publications, with a view to isolating changes in the rate of interest for different countries and debt levels. In particular, we collect the value of new

[10] Doppelhofer, Miller and Sala-i-Martin (2004) recently used Bayesian techniques to isolate an alternative, updated set of control variables. The approach is however purely cross-sectional, and its results cannot be used in the present context where within-country growth determinants are of the essence. For instance, the most robust correlates of economic growth include the extents of confucianistic or protestant religions, or geographic binary variables, none of which lend themselves to a panel estimation.

[11] These data are confidential.

loan agreements contracted by either private or official creditors, as well as the average rate at which they are contracted.[12]

Finally, several institutional factors can affect the relationship between external debt and growth, as well as the onset of an overhang episode. We seek to characterize the institutional arrangements likely to result in both high indebtedness and low growth. We investigate the role of government efficiency, as institutions prone to tolerate the official squandering of resources are likely to hamper growth while they also facilitate debt build-up. We use the measure of bureaucratic quality constructed in the International Country Risk Guide (ICRG), as well as government effectiveness, one of the Kaufmann, Kraay and Mastruzzi (2004) (KK) indicators.

4 A Debt Laffer Curve

We first revisit the role of debt as implied by standard growth regressions, paying particular attention to timing issues. We then introduce our kernel estimator to characterize a debt Laffer curve with as little parametric assumptions as possible. Finally, we discuss the discrepancies that arise when comparing between- and within-countries estimates. We relate these differences to the role of institutions, and investigate which tend to result simultaneously in high debt and low growth

4.1 Debt and Growth Regressions

Debt overhang should prevail only for high enough levels of indebtedness. Below that, the relation between debt and growth is theoretically ambiguous. For instance Barro and Sala-i-Martin (1995) show, in an augmented Solow growth model, that access to foreign borrowing leads to a faster rate of convergence. In that context however the role of external debt should be entirely reflected in the rate of investment and should not have an independent effect of growth. Debt finances investment, and thus fosters growth, but no direct effect is discernible. For this reason, we omit investment from the set of control variables in what follows. We want to allow for a possible channel that works via investment, since this is one of the prominent theoretical possibilities.[13]

For purposes of comparison with the existing empirical literature, we first briefly reassess the link between debt and growth in the context of a linear panel approach using non-overlapping windows of three- and five-year.[14] We consider the general growth specification

$$y_{it+1} - y_{it} = \gamma D_{it} + X_{it}\beta' + \eta_i + \zeta_t + \varepsilon_{it} \tag{1}$$

where y_{it} is the log of per capita GDP, D_{it} a debt ratio, X_{it} a vector of control variables and η_i and ζ_t are country and time fixed effects, respectively. There are six measures of

[12] These data include new money lent as part of restructuring deals, and thus does not strictly focus on the terms of purely new contracted debt.

[13] In fact, including investment yields overall similar results, with perhaps slightly higher estimated overhang thresholds. This indicates that investment is a relevant channel for overhang effects, but not the only one, which is confirmed later in the paper.

[14] With three-year windows, the dataset includes up to eleven time units from 1969-1972 to 1999-2002. With five-year windows, the dataset includes up to seven times unit from 1971-1975 to 1976-2000.

D_{it}: we normalize each of our debt measure, total outstanding debt and the two alternative present value measures (PVE or PVY) with either the value of exports or nominal GDP. The set of control variables, in turn, includes: population growth, secondary schooling, investment to GDP and the growth rate in terms of trade. We estimate equation (1) using three techniques: i) Ordinary Least Squares, ii) Fixed Effects, and iii) a GMM system estimator. The GMM estimator controls for the bias resulting from the correlation between the lagged dependent variable and the fixed effect. The GMM system estimator corrects for the imprecision of the difference estimator by jointly estimating equation (1) in difference and in level. The set of instruments used with GMM are lagged levels for the difference equations and lagged differences for the level equation.

A similar approached was followed by PPR. An important difference concerns the treatment of the potential endogeneity in the debt and growth relation. Specifically, it is crucial to separate the period used to measure GDP growth from that used to measure indebtedness as a ratio of this very same GDP. A period of high growth will mechanically reduce the debt to GDP ratio and induce a negative relation that bears no relation to overhang mechanisms.[15] In what follows we compare the relation between *average* GDP growth and debt ratios, where they are both computed over the same period, to that between *initial* debt and subsequent growth. We show using average values tend to generate a negative bias in the estimation of the debt effect. Using initial debt ratio is also more consistent with the theoretical prediction that relates high debt levels to lower subsequent growth performance. Further, we present results based on a panel constructed using five-year averages, in order to filter out the effect business cycles fluctuations. Tables 1, 2 and 3 summarize our findings.

Table 1 presents the results of the estimation using Present Value of Debt (PVY) and three-year windows. Two features emerge. First, a negative and significant link between debt and growth appears only in OLS estimations; second the point estimate on debt is reduced when initial rather than average debt ratios are used. This will be a regularity across all debt measures.

Regarding the control variables, we find that the convergence terms is negative and significant in all regressions. The coefficient for the other variables tend to exhibit the expected sign but are not always significant.[16] From the Sargan test and second-order Serial Correlation test, we conclude that overall validity of the instruments used in GMM estimation cannot be rejected.

Table 2 summarizes the effect of debt on growth when the regressions reported in Table 1 are performed with various measures of debt ratios. The reduction of the debt coefficient when we use initial rather than average ratio is a common pattern across all regressions. Table 3 presents regressions results obtained with five-year non-overlapping windows and using initial debt ratios. Only one estimation out of eighteen exhibits a negative and significant effect of the initial debt ratio on growth. Overall, we can conclude that there

[15] This problem is not solved when internal instruments are used in the GMM estimation. The validity of the GMM identification relies on the assumption of weak exogeneity of the explanatory variables, which is not fulfilled under the scenario we discuss here.

[16] The relatively low t-statistics in the two steps GMM system estimation can be largerly attributed to the use of the Windmeijer (2005) small sample correction.

is no robust linear evidence of a negative relationship between debt and growth in the full sample. Of course, this may well reflect the prevalence of non-linearities.

4.2 Two Kernel Estimators

In this section, we propose a non-parametric empirical strategy meant to assess the existence of a debt Laffer curve, while imposing as little structure on functional forms as possible. In addition, we seek to identify a sub-sample of country-years in which overhang mechanisms may be operating.

We use two kernel estimators. The first one derives from sequential estimations of equation (1) on rolling sub-samples of observations, ranked by their initial level of indebtedness. N country-years observations are ranked by increasing values of (initial) debt ratios. Let j denote the rank of each country-year observation according to this ordering. The kernel bandwidth, denoted by l, is chosen arbitrarily, but robustness along this margin is ensured.[17] We then estimate equation (1) on the first l observations, roll the sub-sample over by one unit and perform a new estimation on the thus modified sample. We stop when we reach the sub-sample of l observations with highest indebtedness. Each sub-sample is characterized by its mid-point debt level $\widetilde{D_j}$, the median (initial) debt ratio computed for each window. Formally, for each $j \in (1, N-l+1)$, we estimate

$$y_{it+1} - y_{it} = \gamma_j D_{it} + Z_{it}\beta_j' + \varepsilon_{it},\ (i,t) \subset \Omega_j^l \tag{2}$$

where $Z_{it} = [X_{it}, \eta_i, \zeta_t]$ and Ω_j^l denotes the sub-sample j of l country-years observations.

Each individual coefficient is derived from a parametric linear estimation, but we do not impose any functional forms on the relationship between growth and debt, nor on that between growth and the other control variables. Crucially, estimates of γ_j at high levels of debt do not depend on observations at low debt levels. This is consistent with theory, where the onset of an overhang episode corresponds to dramatic changes in incentives once, and only once, the debt threshold is reached. This independence feature will be absent from any parametric estimation of non-linearities performed over the full sample.

While this approach has the simplicity afforded by a "rolling window" interpretation, it does not go without problems. First and foremost, it allows for all co-variates to depend non-parametrically on debt levels. This complicates interpretation, as estimates of the impact of debt on growth taken from successive samples are not directly comparable. A difference could arise because other co-variates also change in significance or in importance. Second, even if the linear coefficients were stable across samples, the presence of a non-linearity creates a bias, which in turn can affect all estimates. We address these concerns using the partial-linear kernel estimator introduced in Robinson (1988). The approach involves a sequence of parametric and non-parametric regressions, with straightforward intuition. The non-linearity is first eliminated from both dependent and independent variables, through bi-variate kernel estimations. Ordinary least-squares using the two resulting residuals provides unbiased estimates of the linear coefficients. With these in hands, the dependent variable is

[17] We experimented with bandwidths going from 150 to 300 observations. Unsurprisingly, the shape of the Laffer curve smoothens as l increases, but our main result of a a significantly negative effect of debt on growth at high debt levels always prevails.

purged of its linear determinants, and the residual used to estimate the non-linear relation of interest.

More formally, we first use simple kernel techniques to estimate $E\{(y_{it+1} - y_{it}) \ / \ D_{it}\}$ and $E\{Z_{it} \ / \ D_{it}\}$ for all $(i,t) \subset \Omega_j^l$, . We then construct the corresponding residuals $(y_{it+1} - y_{it}) - E\{(y_{it+1} - y_{it}) \ / \ D_{it}\}$ and $Z_{it} - E\{Z_{it} \ / \ D_{it}\}$, and use least squares to obtain unbiased estimates of β_j. Finally, we implement a kernel estimator of $(y_{it+1} - y_{it}) - Z_{it}\beta_j'$ on debt. The approach addresses the issues created by the hybrid nature of the relation we seek to identify, but at some efficiency costs. To ascertain significance, we present bootstrapped standard errors.[18]

Using GMM estimators in either kernel estimation is in practice unwieldy. Indeed, the ordering of our observations by country-year does not guarantee the presence of the relevant lags necessary to build up the internal instrument matrix.[19] We are therefore restricted to kernel estimations based on OLS and Fixed Effects. When using the latter, each individual coefficient estimate is based on a within-country estimation, but as the sample of country-years changes across windows, variation in estimates also reflects between-countries differences.[20]

In contrast, PPR look for non-linearities imposing one of two functional forms. First they investigate the significance of a linear-quadratic component, and second they impose a piecewise affine function or linear spline. But the linear-quadratic specification can be misleading in that it can confuse monotonic concavity with non-monotonicity. Furthermore, linear quadratic functional forms tend to deliver estimation results that can depend heavily on extrema.[21] The piecewise linear estimation solves some of these issues, but it can deliver vastly different results depending on the number of assumed discontinuity points. In general, a drawback of non-linear parametric specifications is they often lead to conclusions based on out-of sample thresholds. This is especially problematic when the aim is to select sub-samples of observations with certain properties, as is the case for the purposes of our event study.

Our kernel estimates are derived from a panel of five-year averages, using the initial values of total outstanding debt or the updated measure of debt present value constructed by Dikhanov (2004), PVY. Figures 1 and 2 present the kernel estimations for ratios of debt to GDP and to exports, respectively. The bandwidth is set to $l = 200$. On each scatterplot, mid-point level of debt ratios $(\widetilde{D_j})_{j\in(1,N-l+1)}$ are on the horizontal axis and estimates of the partial effect of debt on growth $(\gamma_j)_{\in(1,N-l+1)}$ on the vertical axis. For each figure, the left and right panels report estimates as implied by OLS and panel Fixed Effects, respectively.

[18] We follow Yatchew (2003) , and bootstrap the residuals corresponding to the last kernel in the procedure. We simulate 10,000 repetitions, with replacement, for each step of the kernel.

[19] In addition, the poor small sample properties of GMM make it undesirable to run this estimator on truncated slices of our initial panel, with each much fewer observations.

[20] The Monte Carlo simulations in Hauk and Wacziarg (2004) suggest that our inability to use a GMM estimator may not be problematic after all. Their results suggest the archetypical growth regression is actually best estimated by Ordinary Least Squares, even in the presence of country-specific intercepts and a lagged dependent variable. GMM estimations suffer from small sample biases, whereas the within-group estimator exacerbates measurement error. In our case, the additional covariate, debt, demands that we investigate the importance of country fixed effects, in order to isolate the dynamic impact of increasing debt on growth.

[21] Especially when applied on logarithms.

Points in bold correspond to estimates of γ_j significantly different from zero, at the 10 percent confidence level.

OLS-based kernel estimates suggest debt starts having significant deleterious effects on growth when it reaches just above half of GDP. With fixed effects on Figure 1, the non-linearity exhibits a similar pattern but the threshold level now increases to around 60 percent of GDP. In this region the point estimate for γ_j is around -1.7. This implies an increase in the debt to GDP ratio by a factor of 1.5 translates into an annual GDP growth rate lower by 0.7 percent.[22] Interestingly, the link between debt and growth becomes insignificant at high debt levels when country fixed effects are included: it is largely because of time invariant controls that high debt tends to be associated to in low growth. The Figure's lower panel presents the kernel estimation results for the ratio of debt face value to exports. As in Figure 1, controlling for fixed effects tends to substantially increase the range over which a negative and significant relationship between debt and growth exists, from 150 to 200 percent of exports. A noticeable difference is that coefficients γ_j do not exhibit a similar downward pattern in OLS based kernel estimations. This might by explained by cross-country differences in export levels, which are captured imperfectly by the control variables and, in particular, by trade openness. In fact, when fixed effects are controlled for, the kernel estimation of debt to exports coefficients do exhibit a downward pattern again.

The results for the ratios involving the present value of debt are reported on Figure 2. The same phenomena are apparent: the estimated overhang range shifts to the right when country specific intercepts are allowed for. OLS suggests a maximum in the debt Laffer curve occurs when the present value of debt reaches around 30 percent of GDP, but it is closer to 40 percent with country specific fixed effects. OLS estimates for the ratio to exports are once again not downward sloping, but this is corrected when the kernel implements a within-group estimator. Interestingly, both present value measures also point to a positive and significant effect of debt on growth at low debt levels, i.e. below 20 of GDP and 50 percent of exports.[23]

The debt relief initiative has been targeting especially low income economies, where overhang issues are argued to be most prevalent. It is therefore of particular interest to reproduce our analysis inside and outside of the sample formed by the 45 countries categorized as low income by the World Bank. Figures 3 and 4 report the corresponding estimates. Even though the conclusions are somewhat weakened in reduced samples, the distinction according to income levels is clearly relevant.[24] While significantly negative coefficients continue to prevail in the sample of low income countries, they are completely absent from the complementary set of countries. This suggests the view that low income countries are disproportionately affected by debt overhang problems is justified, at least on grounds of growth effects. It remains to be seen whether the mechanisms at play are indeed consistent with theory: comparing Figures 3 and 4 suggests the main reason why low income countries may experience overhang is simply because they are more indebted on average.

[22] I.e. ln(1.5)*1.7

[23] The actual number of significant coefficients represented on the Figures cannot straighforwardly be interpreted as reflecting the number of actual observations driving the evidence on debt overhang. Rather, each significantly negative point in the kernel reflects a sample where overhang prevails, whose size equals the bandwidth used in the estimator.

[24] Our initial sample splits roughly half way between the two income categories.

Figure 5 presents the debt Laffer curves as implied by the "double residuals" kernel estimator. All estimations allow for country effects. Several results are worth pointing out. First, estimates are rather imprecise. This is inherent to the estimator, and possibly worsened by relatively small bandwidths.[25] Imprecision is the reason why we privilege the results implied by the "rolling window" lowess kernel. We adopt a prudent approach in this paper and would rather investigate whether a negative coefficient in a growth regression does indeed reflect overhang mechanisms, than perhaps mistakenly dismiss an insignificant coefficient. That said however, the "double residuals" estimates are strikingly close to our first set of results. In two cases, the coefficient estimates become significantly negative at virtually identical levels of indebtedness: 60 percent of GDP for debt face value, and 35 percent for debt present value. Given the inefficiency of the estimator, it is remarkable that such similar conclusions obtain. Abstracting from significance issues, minimum point estimates for measures based on exports are actually reached for levels of indebtedness not dissimilar to what is implied by the lowess estimator, i.e. when debt face value reaches between 170 and 200 percent of exports, and its present value reaches 150 to 170 percent of exports. In this last case, the estimator's low efficiency makes it impossible to ascertain whether the threshold is a local extremum.

The kernel approach has three merits. First, it provides some support for a non-linear relation between debt and growth, or at least for deleterious effects of debt at high levels. The evidence is general and not built on specific parametric assumptions. Second, in this specific case, the approach illustrates the importance of time-invariant country characteristics in jointly affecting economic growth and indebtedness: a Laffer curve prevails for a much smaller set of countries, and for much higher debt levels, once country specific features are accounted for. In other words, the negative relation is partly driven by omitted time invariant (institutional?) variables which drive debt up but growth down. With fixed effects, the relation between debt and growth becomes more elusive, perhaps partly because of the available menu of estimators. This supports a dynamic, within-country view of debt overhang, whereby debt build-up opens the door to pathological overhang episodes irrespective of the quality of the institutional environment. This of course does not mean institutional quality does not affect the severity of an overhang episode. The next Section asks which institutional variables appear to belong in that list. Third, the kernel approach provides an objective criterion to isolate a sample of countries where debt overhang is estimated to occur *in sample*. This is crucial for the event study we describe in Section 5.

4.3 The Role of Institutions

In this Section, we seek to identify which institutions tend to jointly explain high debt and low growth. We focus on a sub-sample of observations where OLS estimates predict a significantly negative relation between debt and growth, and augment the specification with institutional controls. Relevant institutional arrangements are those which affect the significance of the debt-growth estimates.[26]

[25] The results reported correspond to a bandwidth of 200 observations. We experimented with up to 300 observations, without noticeable change in the bootstrapped standard errors. Similarly, increasing the number of repetitions beyond 10,000 has little effect on the bands.

[26] We also experimented with augmenting our kernel with relevant institutional controls. Predictably, the resulting relation resembled a mid-point between the OLS and the Fixed-Effects curves.

Without fixed effects, the kernel estimates point to a significantly negative coefficient when debt face value ranges between 30 and 250 percent of GDP.[27] We focus on the subsample formed by this range of indebtedness, and ask what institutional controls best mimic the inclusion of fixed effects in Figure 2, i.e. act to weaken the estimated coefficient on debt. We consider the benchmark OLS regression and augment it with a single institutional variable at a time. As most of the institutional variables are not available for the early part of the sample, we take a timeless perspective and use country means for all the institutional indicators. This approach, consistent with the objective of uncovering specific fixed effects, is valid under the assumption of a high degree of persistence in institutional variables. Formally, we estimate

$$y_{it+1} - y_{it} = \gamma D_{it} + X_{it}\beta' + I_i + \zeta_t + \varepsilon_{it}$$

where I_i is a time-invariant institutional variable.

Results are reported on Table 4 for the Kaufmann, Kraay and Mastruzzi (2004) synthetic institutional indexes, which include voice and accountability, political rights, corruption, government effectiveness and rule of law. A striking result appears. Government effectiveness and rule of law knock all significance out of the coefficient on debt. The same is however not true of any time invariant control, as introducing the other three KK institutional variables leaves the link between debt and growth virtually unchanged. These findings are consistent with theory. Debt overhang is less likely to occur with more effective governments and within a better legal and contractual environment. It might still happen, but will do so at higher levels of indebtedness.

Table 5 reports similar results with ICRG average indexes. An index of bureaucratic quality is the only variable that affects significantly the debt and growth relationship. Neither the level of democratic rights, nor the occurrence of conflicts or ethnic tensions alter the negative link between debt and growth.

5 Debt Overhang: An Event Study

We use the non-parametric results to identify country-years where an overhang episode is estimated to have happened in sample. In other words, we isolate a panel of country-years where we know the link between debt and growth to be negative. If the mechanisms underpinning debt overhang are to be observed anywhere in available data, it is bound to be in this sample where we know debt has *within-country* deleterious effects on growth. In choosing these samples, we opt for prudence. We investigate the possibility of overhang as soon as one of our estimator points to a negative and significant debt-growth relation, rather than dismissing the argument if and when the estimates are not unanimous. In fact, since the “double residuals” estimator tends to lack efficiency, we focus on the thresholds implied by the simple rolling window, lest we mistakenly reject overhang phenomena. (Fixed effects) kernel estimation results imply the following threshold levels for our various measures of indebtedness:

[27] This excludes the nine country-observations year with highest debt to GDP ratio in our sample. Inclusion of these extreme values results in insignificant coefficient estimates in Figure 1. Chances are these are outliers, with ratios of debt in excess of 500 percent of GDP, or even sometimes 1,000 as Nicaragua in the late 90s.

Ratio	Threshold
Total Debt to GDP	60%
Total Debt to Exports	200%
Present Value of Debt to GDP (PVY)	40%
Present Value of Debt to Exports (PVY)	140%

We seek to characterize the dynamic response of investment, policy and the terms of borrowing before, during and after the onset of an overhang episode. Thus, a definition for an overhang episode is called for, that distinguishes situations where debt is continuously high except for one or two exceptionally high growth years for instance, or where debt is on the whole low, but passes above the threshold for a few years in a row. We arbitrarily label an overhang episode a sequence of at least eight consecutive years above the threshold, following five consecutive years below.[28] Imposing at least eight years above the threshold rules out configurations where a high debt to GDP ratio only reflects a decline in real GDP during a business cycle recession. Requiring five years below screens out countries permanently located in a high debt trap.[29] The notion of an "overhang episode" should be understood in a hypothetical way, as the objective of this Section is precisely to assess whether these episodes exhibit a pattern consistent with overhang theories.

We follow a standard procedure.[30] First we identify country-years constituting overhang episodes. Second, we demean all the variables of interest, controlling for both time and country averages.[31] Third, we average the resulting series across all overhang episodes. The average path of each variables and the standard error band is displayed on a sixteen-year window going from $t = -5$ to $+8$, where $t = 1$ corresponds to the onset of the overhang episode. We track the responses of investment, macroeconomic policy and the terms of borrowing. The results of the study are presented in Figures 6 to 12, and are discussed over the next few sections. Each Figure reports the responses of a variable of interest under the four alternative definitions of an overhang episode, according to either TOD to GDP, TOD to exports, PVY to GDP or PVY to exports ratios.

5.1 Overhang Countries

We list all overhang countries, as well as the onset date in Appendix A. Using the ratio of PVY to GDP, we identify 37 episodes of debt overhang in our sample of 87 low and middle income countries. Of these, 23 are in Africa, 12 in Latin America and only 2 in Asia.[32] The mean real per capita GDP at the inception of each debt overhang episode is $877, the poorest being Ethiopia ($111) and the richest Venezuela ($3500). The historical concentration of episodes over-represents the eighties (24 episodes). This selection partly derives from our definition of overhang episodes.

[28] We experimented with imposing five or ten years after the threshold, without substantial changes in the conclusions.

[29] We also permit one year spent above or below the threshold during the event years. Thus, four out of five years spent below the threshold, or seven out of eight years above the threshold is still considered a relevant event.

[30] See for instance Henry and Arslanalp (forthcoming).

[31] For interest rates, we actually demean the spread with US ten-year Treasury Bills.

[32] The Asian cases are the Philippines (1985) and Syria (1986).

Using total debt to GDP, we find an almost identical number of episodes (36), which also reflects the predominance of African Countries (24). The average per capita income in this sample is slightly lower ($800). There are 25 countries that exhibit overhang episodes according to either debt measure.[33] The lists are overall similar when considering definitions based on the ratio of PVY (TOD) to exports, with 38 and 39 countries, respectively. These include large countries such as Argentina, Brazil or India that do not experience overhang episodes according to debt to GDP ratios. In addition, geographic and time coverage tend to be more balanced according to these criteria.

5.2 The Response of Investment

The common hypothesis derived from overhang theories is that countries experience a reduction in investment once they reach a high enough debt level, either directly through an anticipation of the costs associated with a potential default or as a response to a deterioration of policies as debtor countries lose incentives to follow sound macro policies. Figure 6 provides some support for this hypothesis.

For all measures of indebtedness, investment follows a clear and significant downward trend over the fourteen years considered around the event. Investment is (significantly) above or around its mean in the pre-overhang period, but significantly below afterwards. In addition, in three out of four cases, investment actually builds up prior to the overhang date, which argues against the possibility that an investment slump actually predates the overhang and explains the debt build-up. Investment does not fall in earnest until the overhang date, or a couple of years thereafter. For instance, when indebtedness is measured by the face value of debt as a proportion of GDP, investment does fall precipitously at $t = 0$, as predicted by theory. For alternative measures based on debt face value to exports or debt present value to GDP, investment actually increases slightly at the overhang date, before collapsing to its lowest level one or two years later.[34]

5.3 The Response of Policy

Figures 7 and 8 plot the typical response in government expenditures and inflation before and during an overhang episode. Here the evidence is more mixed. Government expenditures show no systematic pattern, while we do observe a clear and significant increase in inflation during the overhang period in three out of four cases. The response of inflation is in all cases occurring at positive values of t: entering the overhang zone tends to be associated with increasing inflation, as it would if price stability became less of a policy priority. The absence of any response in government expenditures might actually reflect a policy deterioration, as a sound macroeconomic response to debt build-up might be to attempt and reduce the level of public expenditures.[35]

[33] For these countries, the timing of episodes may change slightly accross the two debt measures but usually by no more than two years

[34] The number of observations used to compute Figure 6 can be different from the total number of events, as investment data are not available everywhere debt or growth data are. This is true throughout the event study.

[35] In fact, one of our criterion suggests such a contraction in spending in the overhang years.

Figure 9 plots the response of the CPIA index which reflects a (subjective) World Bank ranking of the overall quality of economic policy. The response in CPIA is close to mirroring inflation, possibly because it figures prominently in the list of ingredients World Bank economists use to provide an assessment of the quality of overall policy. In three out of four cases, policy deteriorates after the overhang. While these results are less unanimous than those quantifying an investment effect, and also more difficult to interpret, they do provide some support to the hypothesis that overhang episodes coincide with a noticeable deterioration in macroeconomic policies.

5.4 The Response of the Terms of Borrowing: Interest Rates and Commitments

Figures 10 plots the dynamic response in the interest rate spread, measured by the (demeaned) difference between local rates as implied by Global Development Finance sources, and the yield on a ten-year Treasury Bill. Interestingly, the onset of debt overhang appears to be characterized by a *fall* in spreads. What is more, in all cases this easing of borrowing conditions tends to follow a tightening, with interest rates actually increasing prior to the event threshold. This runs exactly contrary to the theoretical prediction that an overhang problem appears because of prohibitive borrowing terms. Here, debt seems to become more concessional as the overhang zone is reached.

A natural explanation for this rests in possible changes in the composition of debt, as if private investors exit the market, and are replaced by an increasing share of multi-lateral agencies lending at concessional rates. But this would suggest debt relief would have hardly any easing impact on the conditions at which highly-indebted countries can borrow, and indeed would if anything worsen the terms of borrowing. Figures 11 and 12 plot the average dynamic path of (the value of) new commitments arising from the private and the official sectors, respectively. Private commitments fall precipitously in all cases for non-negative values of t; what is more, the overhang is preceded by a build-up of private lending, so that our event study is not merely capturing a trend "rush for the exit" amongst private investors. In stark contrast, official commitments increase in value after the threshold. In fact, changes in private lending are actually close to one order of magnitude larger than official ones. Figure 13 illustrates this discrepancy, and plots the ratio of official to total commitments. In all cases, we osberve a large and significant increase in the importance of official -presumably concessional- lending with the onset of an overhang. Remarkably, this always tends to happen for positive values of t.

The change in the composition of debt with the onset of overhang is actually not phrased out in any theory that we are aware of, but it is presumably what exonerates highly-indebted countries from having to face exorbitant borrowing conditions. We later present evidence that the servicing of debt actually falls at positive values of t as well, which is also consistent with the terms of borrowing becoming increasingly concessional in the overhang zone. Importantly, this also means that debt relief could actually *increase* debt service and have the type of crowding out effects on investment that are customarily ascribed to a high debt burden.

6 Robustness

We check robustness along two important dimensions. First, we verify whether the dynamics we identify are not caused by global shocks, for instance to interest rates, that would act to lower investment, particularly in highly indebted economies forced to dedicate a large share of their resources to servicing debt. Second, we exclude from our sample all the countries that experienced sizeable rescheduling in our sample.

6.1 Interest Rate Shocks

If $t = 1$ tends to correspond on average with a period of increasing interest rates worldwide, it is possible that the fall in investment that we capture should be a mere manifestation that increasing debt service makes it particularly hard for highly-indebted economies to invest. In addition, rising interest rates could also account for falling output (and perhaps exports), and so explain a sudden jump in debt ratios. And since we use interest rate spreads, we do not capture a world increase in rates. Here we offer two rebuffals to this alternative scenario. First, we provide evidence that debt service actually does not rise during our average event (which is consistent with falling interest rates). Second, we provide sample splits showing that for similar levels of indebtedness, different countries display different investment responses .Heterogeneous responses -for a given debt level- rule out the possibility that our evidence stems from indiscriminate crowding out of investment, mechanically caused by high debt service.

Figure 14 plots the time path of debt service. There is no evidence that the debt burden increases for positive values of t. In two cases, debt service increases in the first years of the event, but if anything it turns downward in the overhang zone, undoubtedly thanks to the concessional borrowing conditions we document in the previous section. This is inconsistent with the view that would ascribe the observed fall in investment to mechanical crowding out effects.

On Figure 15, we plot the response of investment for two sub-samples of events, according to the enforcement of property rights as measured by Acemoglu, Johnson and Robinson (2001).[36] Arguably, property rights are relevant theoretically, since they may capture the ability creditors have to monitor and sanction debtors' behavior, and thus they may reflect the gravity of an overhang problem. And indeed, the fall in investment is clearly subdued in countries with good enforcement, between two and three times smaller than in the rest of the overhang sample. While investment tends to fall as well even with good property rights, the relevance of the actual overhang date is much less clear. The response of investment is much more severe with poor property rights, which is consistent with theory, and rules out the possibility that our event study merely captures the chronology of a world recession.

Finally, Figure 16 reports the time path of investment in two samples, characterized by the World Bank classification of low income countries.[37] Consistent with the non-parametric results, debt overhang appears to set mostly in low income countries, where investment falls

[36] Low enforcement countries are ones with grades of 1 or 2, whereas high ones take values 3, 4 or 5.

[37] We have between 21 and 23 low income countries in our sample of events, depending on the criterion used to identify the event.

by the largest proportion in most cases.[38] An explanation of our results based on a global recession would have difficulties accounting for these differential responses.

6.2 Rescheduling and Default Episodes

While the bias this would create is ambiguous, it is possible that some of our results are influenced by the debt crisis of the 1980's, and the associated wave of debt rescheduling programs. Our data reflect restructuring programs, and debt ratios may be falling from high levels because of rescheduling agreements, rather than because countries grow themselves outside of a debt spiral. If anything, this would bias our results against finding evidence for debt overhang, since we would mistakenly exclude from our sample a country with a debt history that does not fit our criterion because it goes through rescheduling episodes.

In Figure 17, we omit the period from 1979 to 1984 from our sample, and therefore characterize our chronology on the basis of overhang episodes outside the range customarily associated with the debt crisis. The response of investment is virtually unchanged.[39] Finally, in Figure 18, we omit from our study all rescheduling episodes targeting more than 5 percent of debt face value. This is meant to ensure the debt ratios in the sample we end up focusing on are not perturbed by punctual restructuring agreements. As expected, investment continues to fall markedly at the overhang date.[40] These results suggest that the presence of rescheduling episodes in our benchmark data tends if anything to obscure the main results of the paper.[41],[42]

7 Conclusion

We provide non-parametric evidence supporting a debt Laffer curve among 87 developing economies. Overhang sets in when the face value of debt reaches 60 percent of GDP or 200 percent of exports, or when the present value of debt reaches 40 percent of GDP or 140 percent of exports. Then, initial debt tends to be associated with subsequently low growth. These thresholds apply within countries, that is accounting for country-specific institutional arrangements. This does not mean institutions do not matter for debt and growth. In

[38] In results available upon request, we also investigate the response of interest rates in both samples. The split continues to be relevant, with most fall in interest rates occurring in the low income countries.

[39] As are the responses of economic policy, interest rates and commitments, which are available upon request for the sake of brevity.

[40] As indeed do rates and private commitments. Official commitments and inflation, in turn, increase markedly. These results are available upon request.

[41] In results available upon request, we plot the time paths of GDP growth and the terms of trade, as they could both affect the dynamics of the debt ratios we examine. There is some evidence that the terms of trade worsen and growth decelerates somewhat prior to the event date. But both tend to recover quickly and rise throughout the actual overhang dates. This is consistent with the notion that negative terms of trade shocks or a recession may actually trigger debt overhang. More importantly it suggests the fall in investment and economic policy deteriorating tend to happen in a relatively mild macroeconomic environment.

[42] We also restricted our analysis to the 90s only. We relaxed our selection criterion, and singled out episodes characterized by at least four years above the debt threshold, followed by at least four years below. This multiplied the number of overhang episodes we identified, and for eight of them the threshold was crossed in the 90s. The same results prevailed in this reduced sample: investment fell precipitously, policy worsened somewhat and interest rates *fell*.

particular, we find that government effectiveness, the rule of law and bureaucratic quality all act to limit debt build-up while encouraging economic growth. We provide direct tests of the theoretical conjecture that high debt worsens incentives. We find that investment collapses in the overhang zone, and the conduct of economic policy deteriorates observably. However, spreads fall. This is due to official lenders taking over from private creditors, and extending loans at concessional rates. Borrowing conditions do not become exorbitant with debt overhang because the high interest rates private creditors would impose on overhung creditors do not happen in equilibrium. Our results suggest that debt relief might have a stimulating effect on investment, and possibly on economic policy, but would if anything result in worse borrowing conditions, and thus possibly in a rising debt burden.

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Table 1 : Present Value of Debt to GDP and Growth: three-year average panel

	1	2	3	4	5	6
	[OLS]	[OLS]	[FE]	[FE]	[GMM system]	[GMM system]
Net Present Value of Debt [PVY]/GDP (avg)	-0.606		-0.19		-0.397	
	[2.66]***		[0.63]		[0.47]	
Net Present Value of Debt [PVY]/GDP (initial)		-0.484		0.217		-0.496
		[2.42]**		[0.88]		[0.65]
Initial GDP per Capita	-0.674	-0.598	-6.981	-6.691	-1.933	-1.913
	[3.01]***	[2.68]***	[8.46]***	[8.22]***	[2.04]**	[2.11]**
Population Growth	-21.165	-21.329	1.449	0.965	20.304	25.419
	[1.33]	[1.31]	[0.08]	[0.05]	[0.58]	[0.63]
Secondary Schooling	1.312	1.277	0.021	-0.115	4.93	4.996
	[4.94]***	[4.79]***	[0.03]	[0.16]	[3.07]***	[3.21]***
Terms of Trade Growth	0.017	0.016	0.011	0.01	0.038	0.058
	[1.28]	[1.23]	[0.99]	[0.84]	[1.07]	[1.21]
Trade Openness	1.013	0.935	3.643	3.47	1.21	0.987
	[2.24]**	[2.07]**	[4.43]***	[4.23]***	[1.14]	[1.11]
Observations	604	604	604	604	604	604
Sargan P-value					0.62	0.41
Serial Correlation (second order) P-value					0.97	0.82

* significant at 10%; ** significant at 5% ***significant at 1%

Absolute value of t statistics in brackets

Note: [GMM System]: Two System Estimator with Small Sample Windmejer (2005) Robust Correction

[PVE]= PV data from B.Easterly; [PVY]: PV data from Yuri Dikhanov

All regressions include time effects

Table 2 : External Debt and Growth: three-year average panel

	1	2	3
	[OLS]	[FE]	[GMM system]
Present Value of Debt [PVY]/Exports (avg)	-0.591	-0.93	-0.397
	[2.46]*	[2.96]**	[0.46]
Present Value of Debt [PVY]/Exports (initial)	-0.445	-0.325	-0.735
	[1.96]*	[1.12]	[0.89]
Present Value of Debt [PVE]/Exports (avg)	-0.454	-1.468	-1.21
	[1.55]	[3.78]***	[1.33]
Present Value of Debt [PVE]/Exports (initial)	-0.175	-0.691	-0.873
	[0.62]	[1.99]**	[0.89]
Total Outstanding Debt/Exports (avg)	-0.562	-1.207	-0.178
	[1.88]*	[3.44]***	[0.17]
Total Outstanding Debt/Exports (initial)	-0.408	-0.593	-0.206
	[1.45]	[1.92]*	[0.17]
Present Value of Debt[PVE]/GDP (avg)	-0.559	-0.4	-1.292
	[1.95]*	[1.08]	[1.26]
Present Value of Debt [PVE]/GDP (initial)	-0.388	0.01	-0.606
	[1.48]	[0.03]	[0.54]
Total Outstanding Debt/GDP (avg)	-0.607	-0.378	-0.364
	[2.05]*	[1.11]	[0.30]
Total Outstanding Debt/GDP (initial)	-0.541	-0.024	-0.296
	[2.04]**	[0.08]	[0.31]

* significant at 10%; ** significant at 5%; *** significant at 1%

Absolute value of z statistics in brackets

Note: [GMM System]: Two System Estimator with Small Sample Windmejer (2005) Robust Correction

[PVE]= PV data from B.Easterly; [PVY]: PV data from Yuri Dikhanov

Set of Control Variable identical to Table 1

All regressions include time effects

Table 3 : External Debt and Growth: 5-year average panel

	1 [OLS]	2 [FE]	3 [GMM system]
Present Value of Debt [PVY]/GDP (initial)	-0.208	0.561	-0.323
	[0.99]	[2.26]*	[0.54]
Present Value of Debt [PVE]/GDP (initial)	-0.118	0.28	0.215
	[0.47]	[0.89]	[0.39]
Total Outstanding Debt/GDP (initial)	-0.269	0.053	-0.236
	[1.19]	[0.18]	[0.41]
Present Value of Debt [PVY]/Exports (initial)	-0.011	0.267	0.051
	[0.05]	[1.02]	[0.08]
Present Value of Debt [PVE]/Exports (initial)	0.298	0.067	0.147
	[1.12]	[0.20]	[0.25]
Total Outstanding Debt/Exports (initial)	0.007	-0.437	0.168
	[0.03]	[1.42]	[0.26]

* significant at 10%; ** significant at 5%; *** significant at 1%
Absolute value of z statistics in brackets
Note: [GMM System]: Two System Estimator with Small Sample Windmejer (2005) Robust Correction
[PVE]= PV data from B.Easterly; [PVY]: PV data from Yuri Dikhanov
Set of Control Variable identical to Table 1
All regressions include time effects

Table 4: Kaufman and Kray Controls

	1	2	3	4	5	6
	[OLS]	[OLS]	[OLS]	[OLS]	[OLS]	[OLS]
Total Outstanding Debt/GDP (initial)	-0.771	-0.771	-0.839	-0.59	-0.581	-0.792
	[1.82]*	[1.82]*	[2.02]*	[1.55]	[1.43]	[2.02]*
Initial GDP per Capita	-0.407	-0.526	-0.648	-0.967	-0.911	-0.923
	[1.63]	[1.93]*	[2.53]*	[3.96]**	[3.65]**	[3.69]**
Population Growth	-62.015	-53.03	-48.783	-24.355	-32.314	-39.386
	[2.19]*	[1.78]*	[1.73]*	[0.95]	[1.14]	[1.55]
Secondary Schooling	1.027	1.095	1.224	1.034	1.064	1.059
	[3.01]**	[3.14]**	[3.49]**	[3.17]**	[3.15]**	[3.28]**
Trade Openness	0.925	0.929	0.422	0.487	0.261	0.429
	[1.51]	[1.51]	[0.65]	[0.85]	[0.44]	[0.74]
Voice and accountability		0.3				
		[0.94]				
Political Statbility			0.724			
			[2.92]**			
Government Effectiveness				2.383		
				[6.55]**		
Rule of Law					1.896	
					[4.85]**	
Corruption						2.111
						[4.88]**
Observations	250	250	250	250	250	250

Robust t statistics in brackets

* significant at 10%; * significant at 5%; ** significant at 1%

Table 5: International Country Risk Guide Controls

	1	2	3	4	5	6
	[OLS]	[OLS]	[OLS]	[OLS]	[OLS]	[OLS]
Total Outstanding Debt/GDP (initial)	-0.912	-0.763	-0.912	-0.887	-0.908	-0.991
	[1.80]*	[1.52]	[1.79]*	[1.76]*	[1.80]*	[1.92]*
Initial GDP per Capita	-0.109	-0.283				
	[0.40]	[1.07]				
Population Growth	-62.641	-63.279	-62.649	-60.607	-66.274	-64.203
	[2.12]*	[2.18]*	[2.12]*	[1.99]*	[2.16]*	[2.21]*
Secondary Schooling	0.477	0.495	0.476	0.432	0.38	0.572
	[1.35]	[1.38]	[1.36]	[1.13]	[1.08]	[1.56]
Trade Openness	1.162	0.936	1.165	1.234	1.369	1.214
	[1.48]	[1.17]	[1.47]	[1.50]	[1.74]*	[1.52]
bureaucratic quality		0.569				
		[1.76]*				
democratic accountability			-0.007			
			[0.03]			
internal conflict				-0.052		
				[0.34]		
external conflicts					-0.295	
					[1.73]*	
ethnic tensions						0.202
						[1.12]
Observations	211	211	211	211	211	211

Robust t statistics in brackets

* significant at 10%; * significant at 5%; ** significant at 1%

Figure 1: Kernel Estimates - Debt Face Value

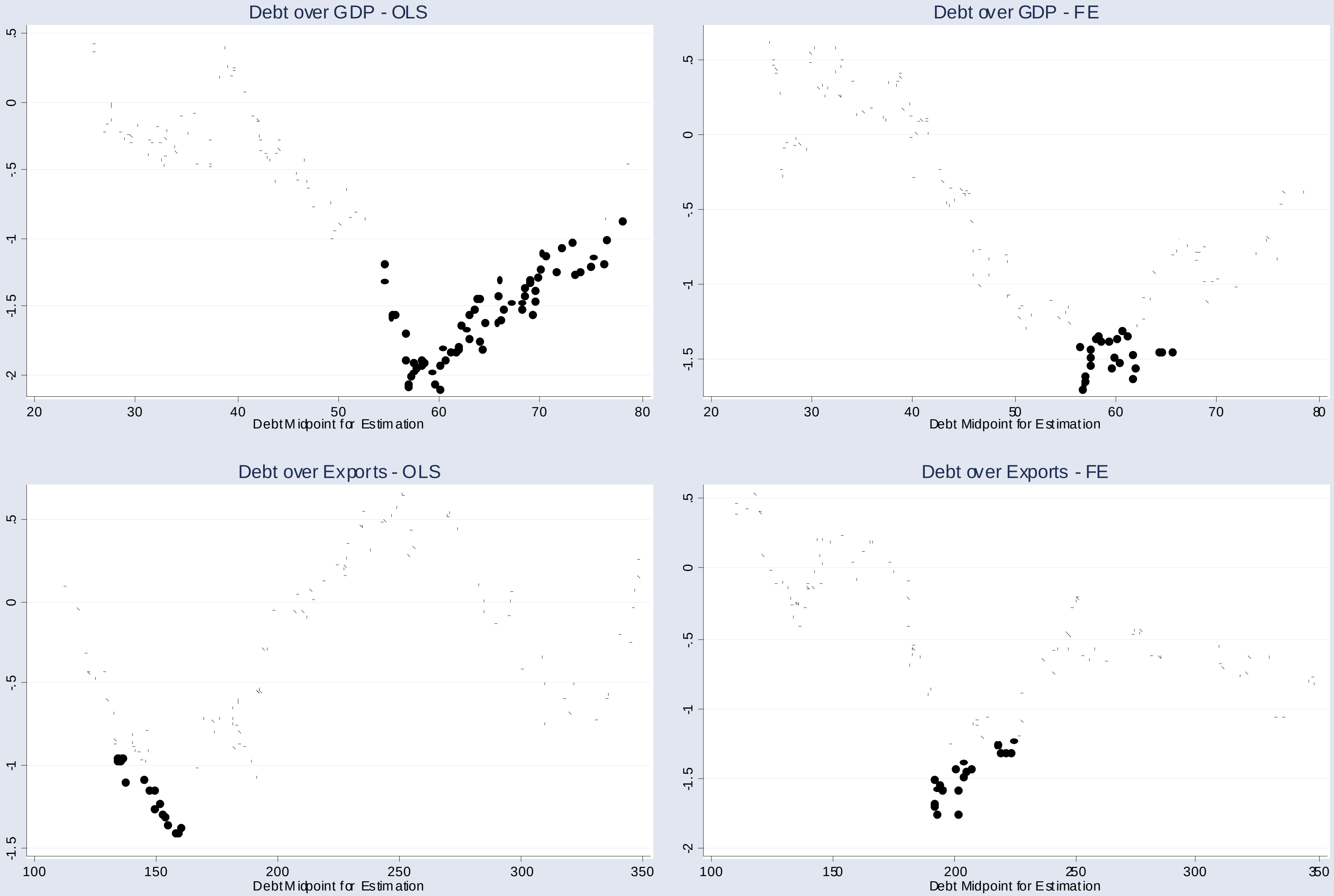


Figure 2: Kernel Estimates - Debt Present Value

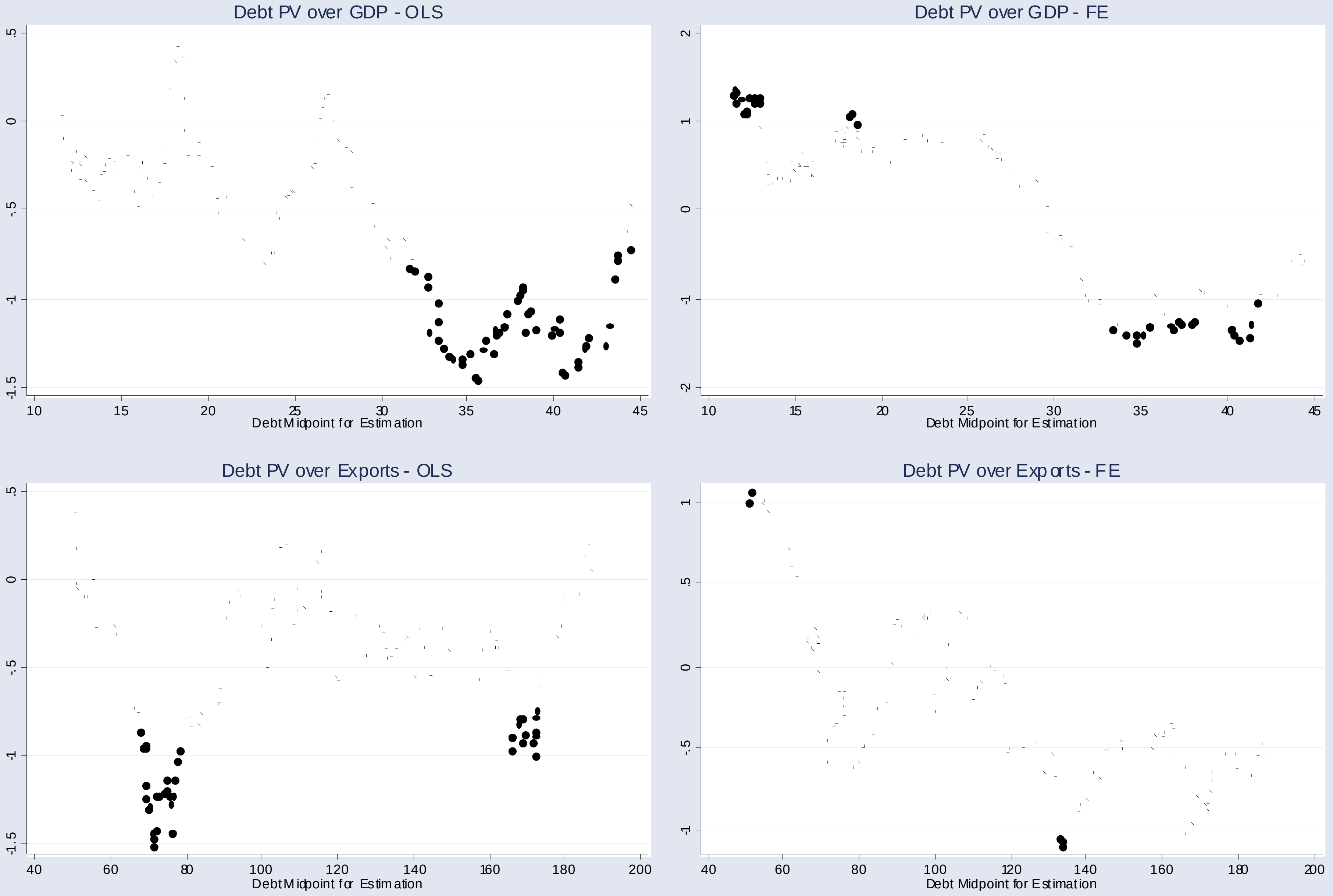


Figure 3: Kernel Estimates - Low Income Countries

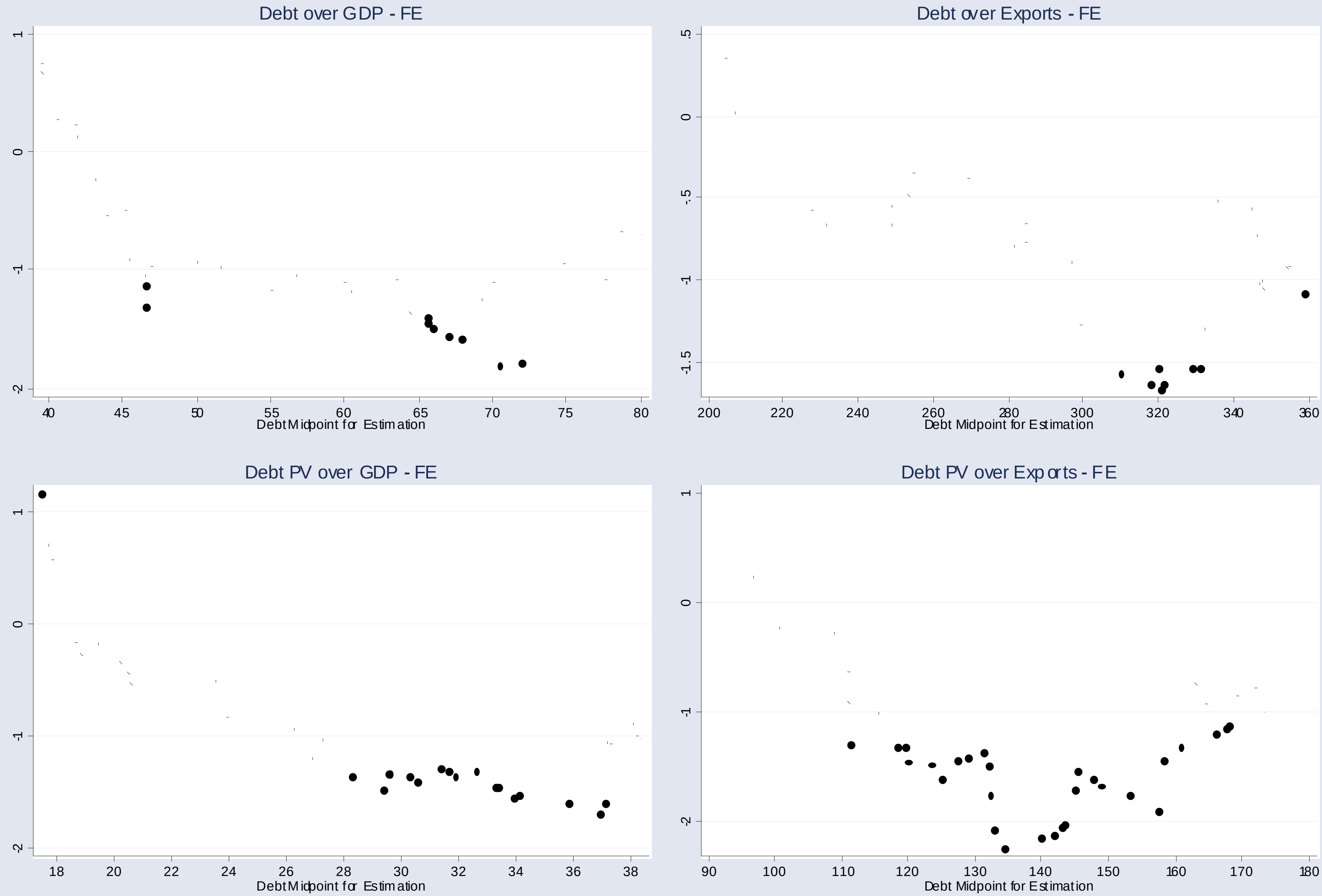
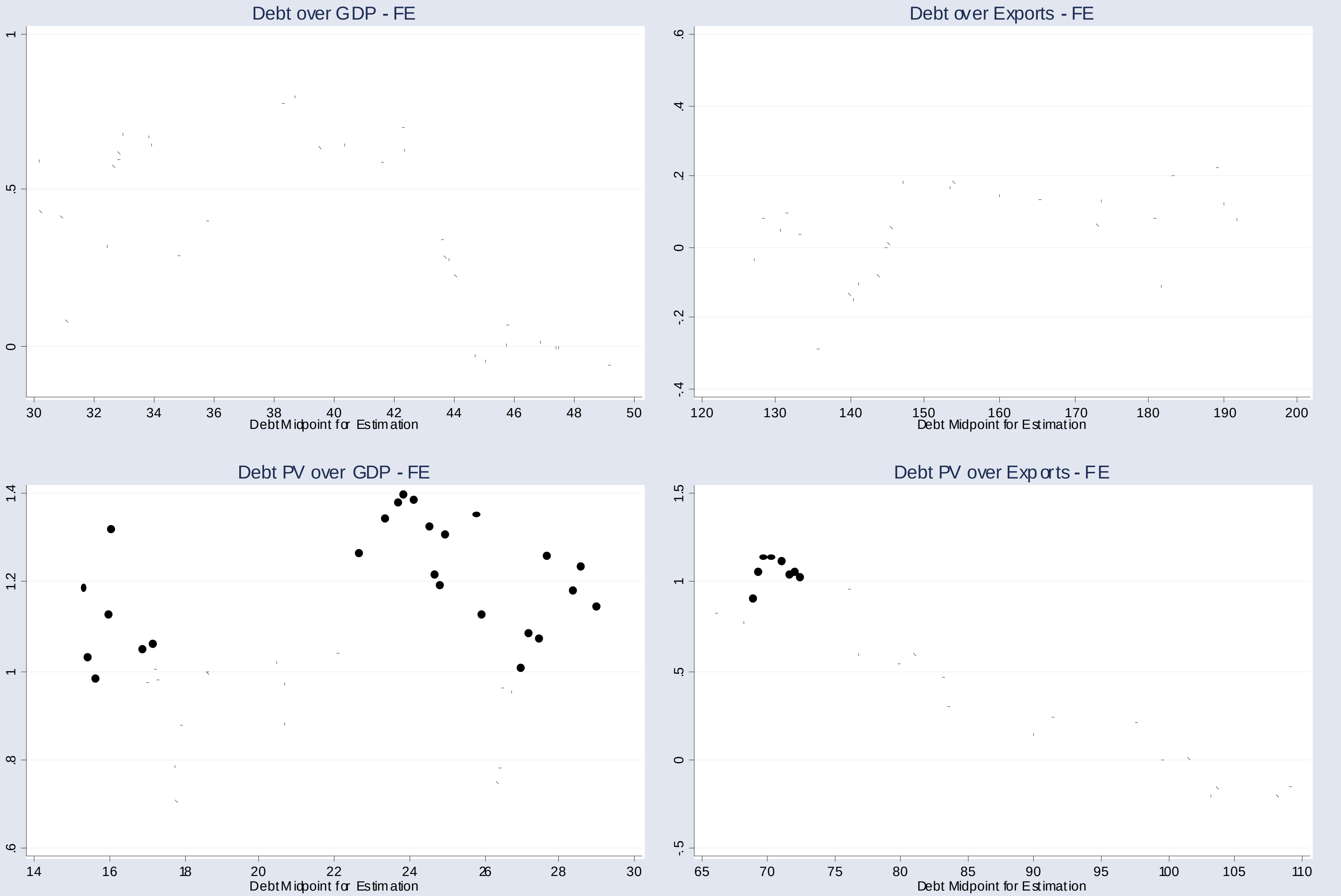


Figure 4: Kernel Estimates - Non Low Income Countries



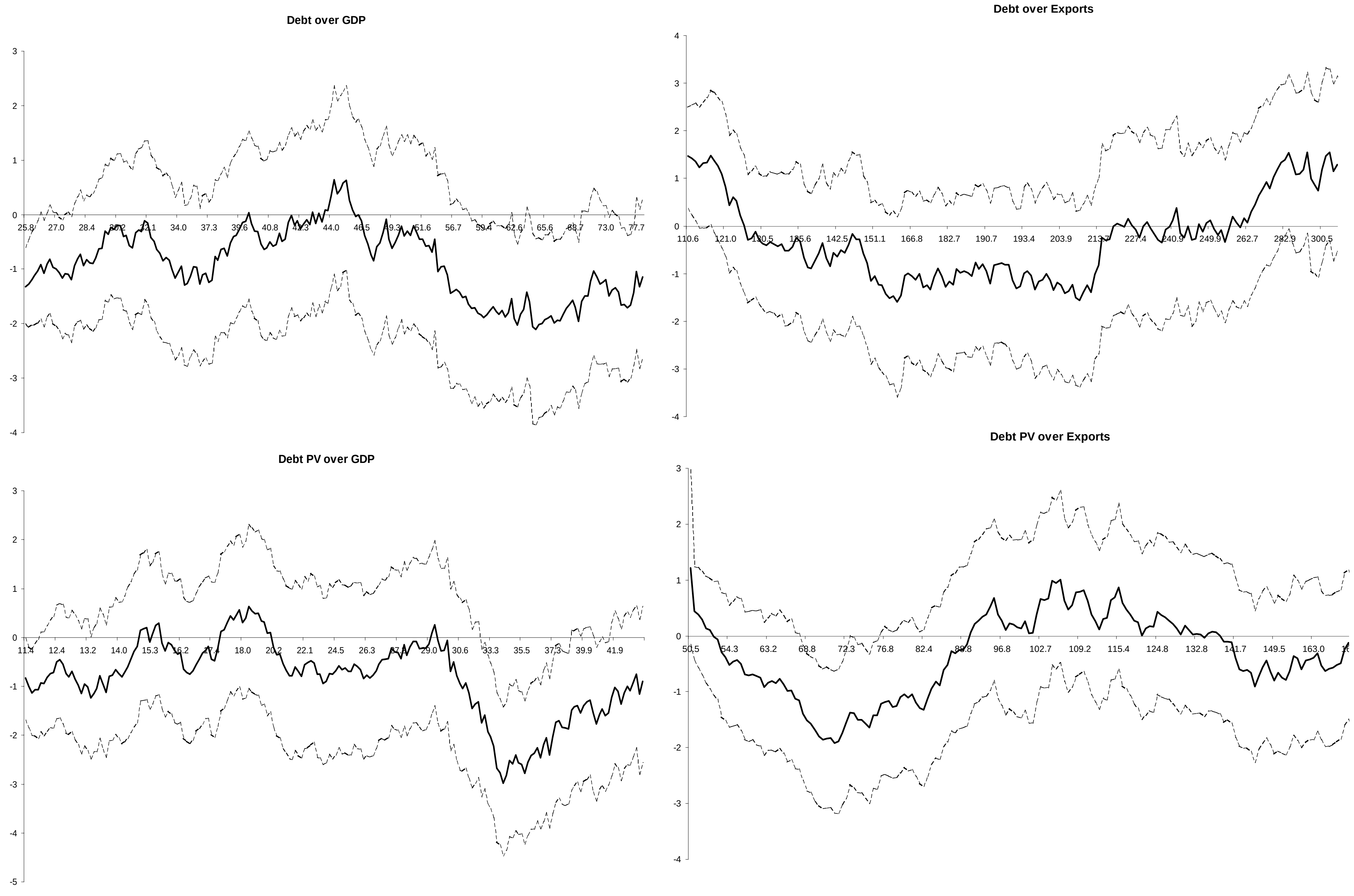


Figure 5: “Double Residuals” Kernel Estimates

Figure 6: The Response of Investment

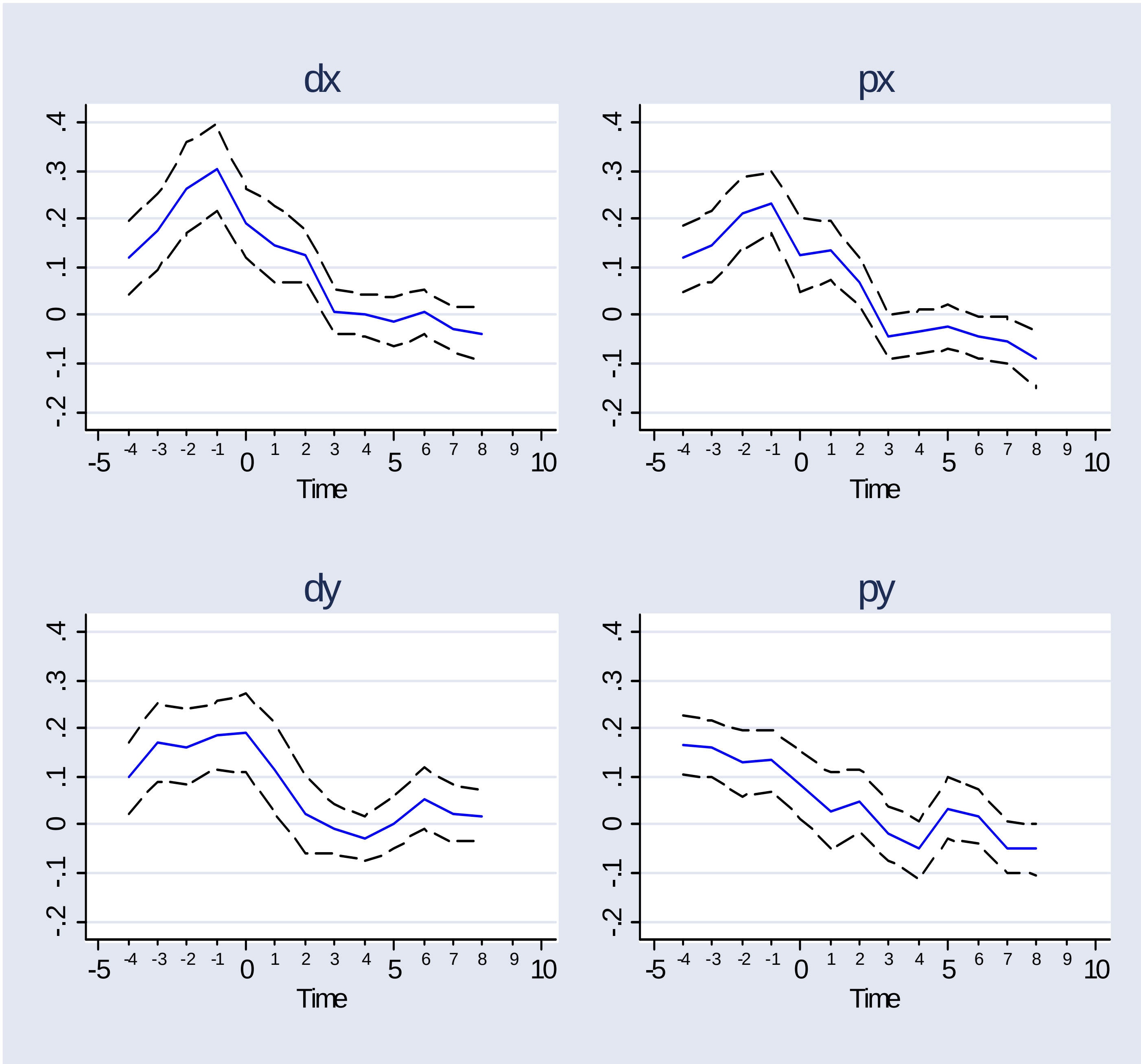


Figure 7: The Response of Policy (I): Government Expenditures

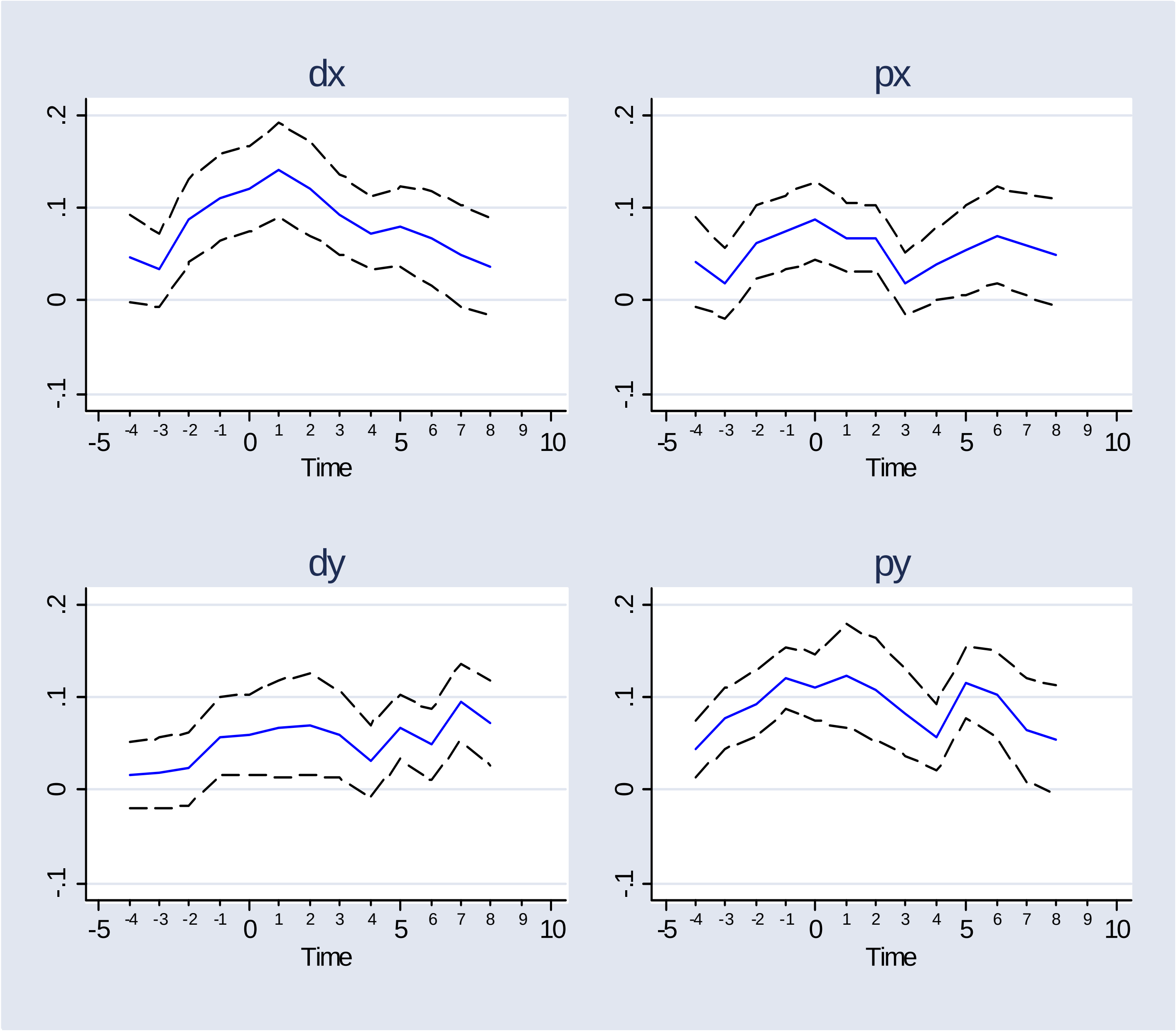


Figure 8: The Response of Policy (II): Inflation

Figure 9: The Response of Policy (III): CPIA

Figure 10: The Response of Borrowing Conditions: Interest Rate

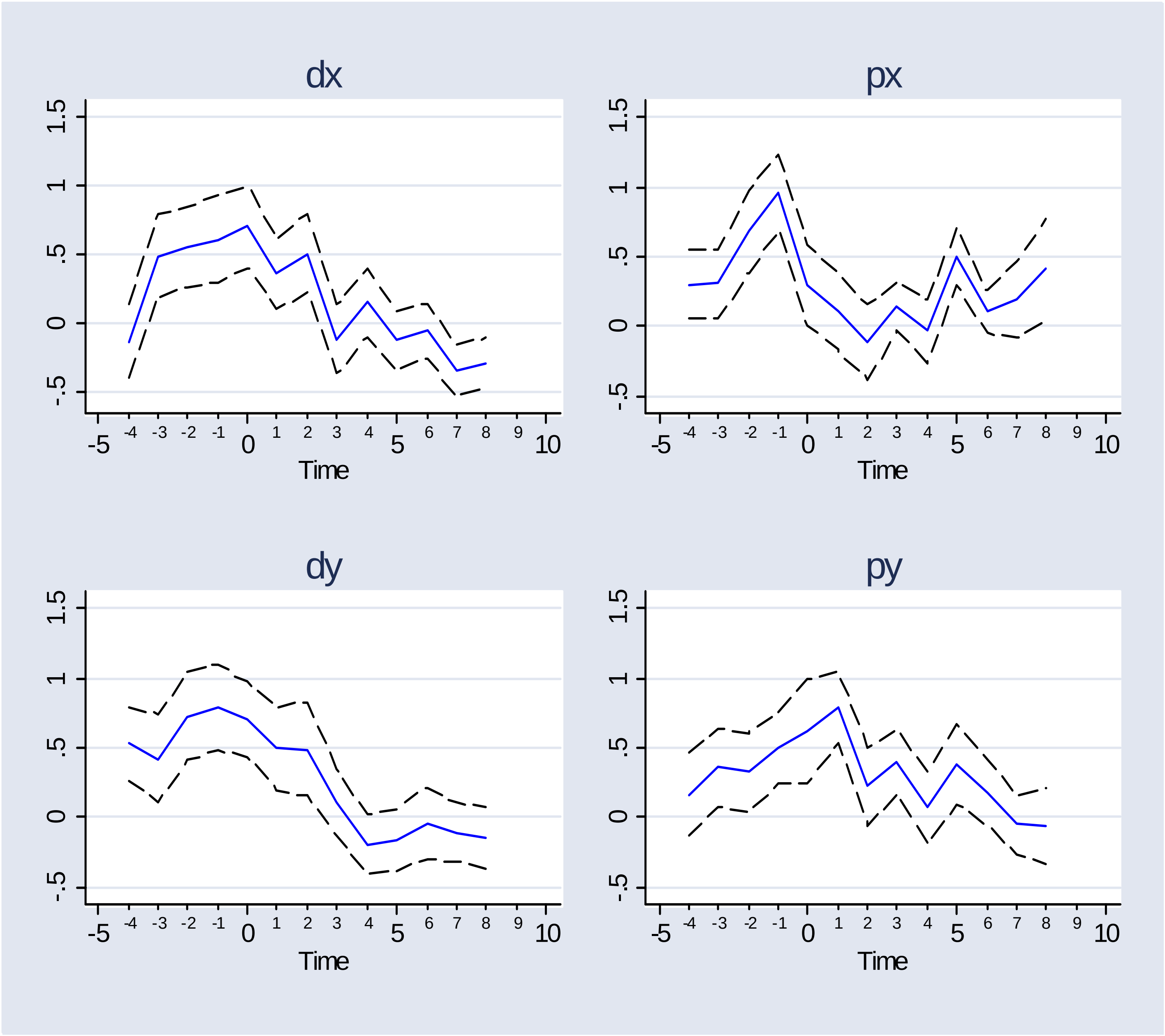


Figure 11: The Response of New Commitments: Private Creditors

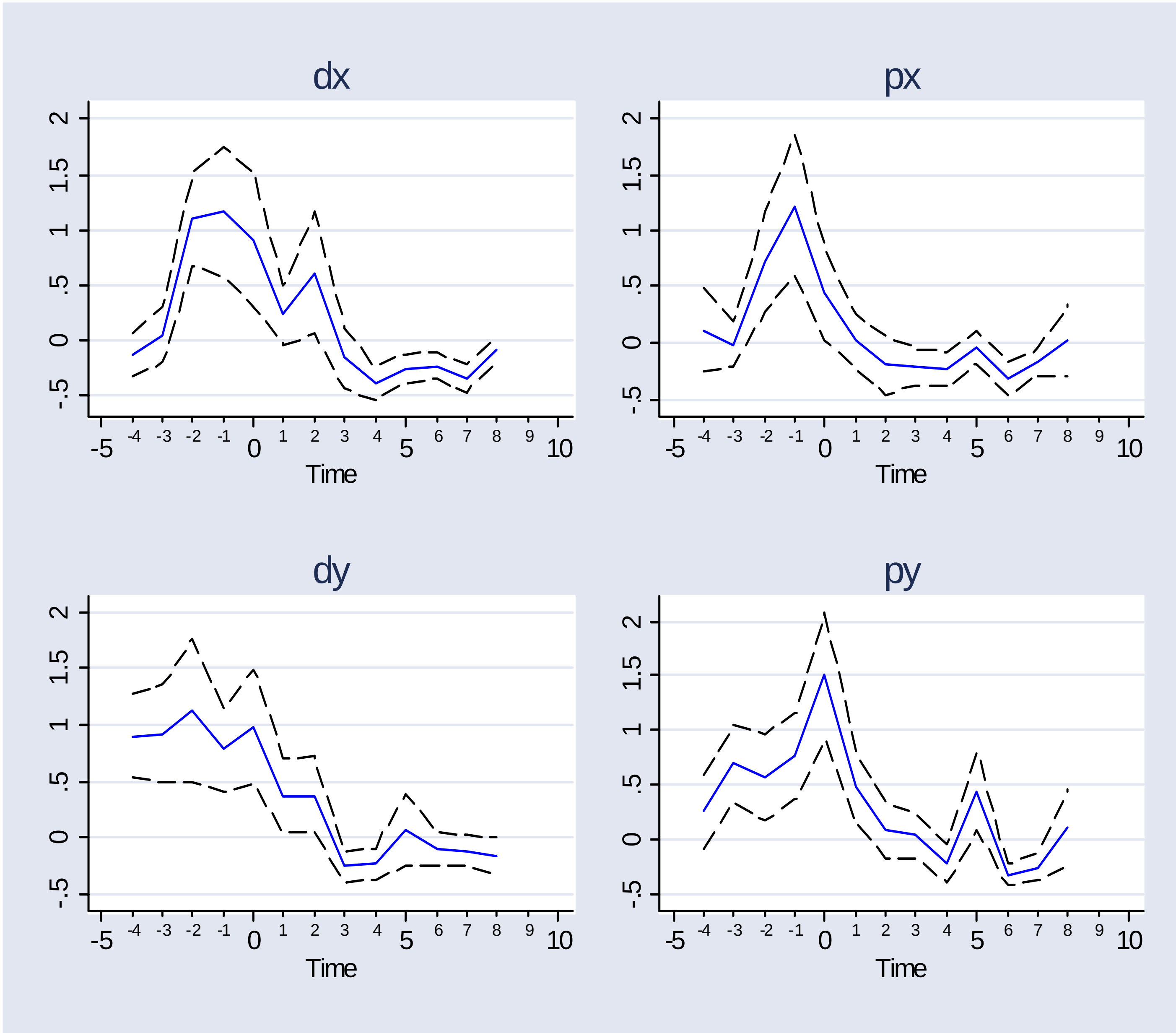


Figure 12: The Response of New Commitments: Official Creditors

Figure 13: The Ratio of Official to Total Commitments

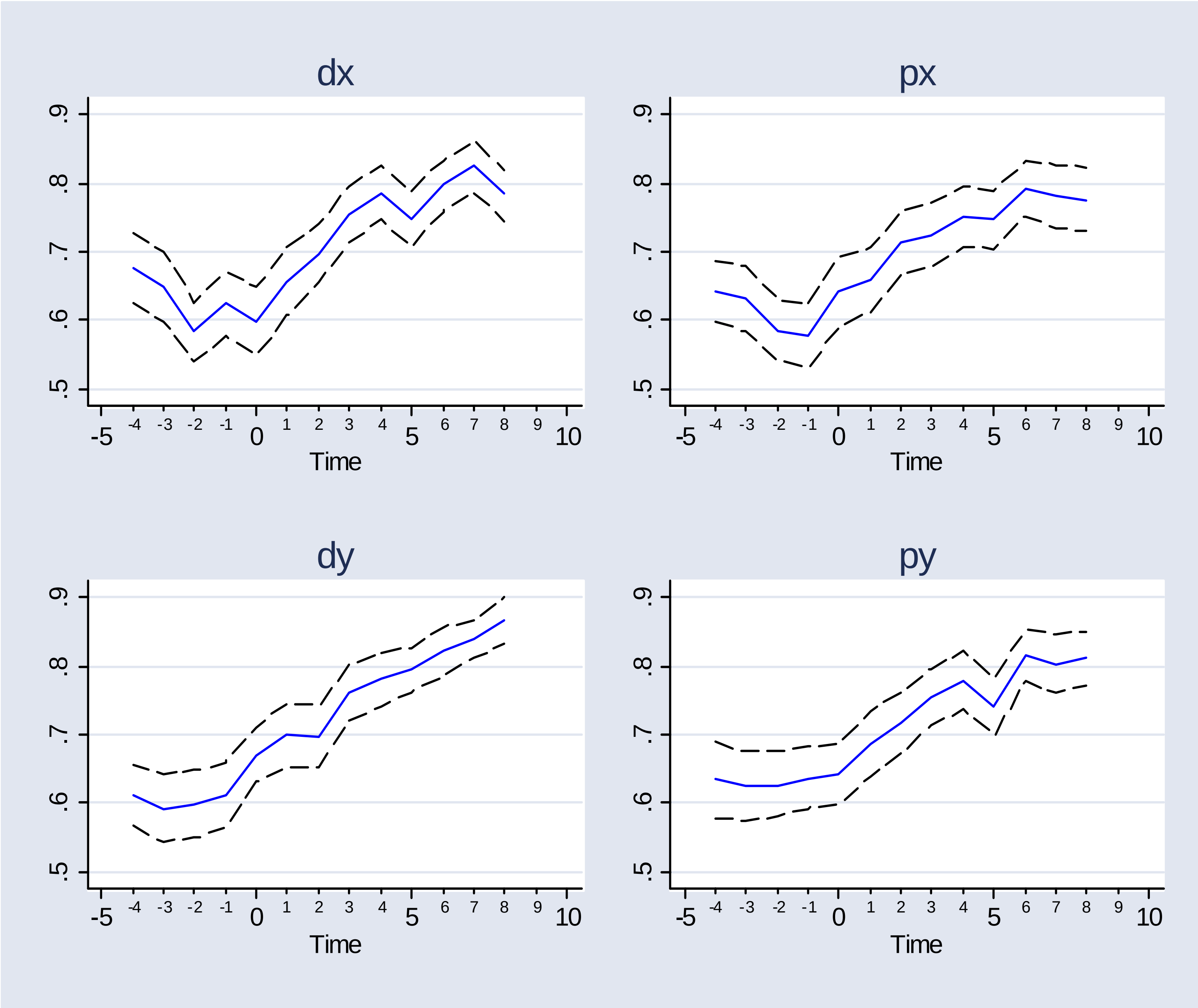


Figure 14: Robustness (I) Total Debt Service

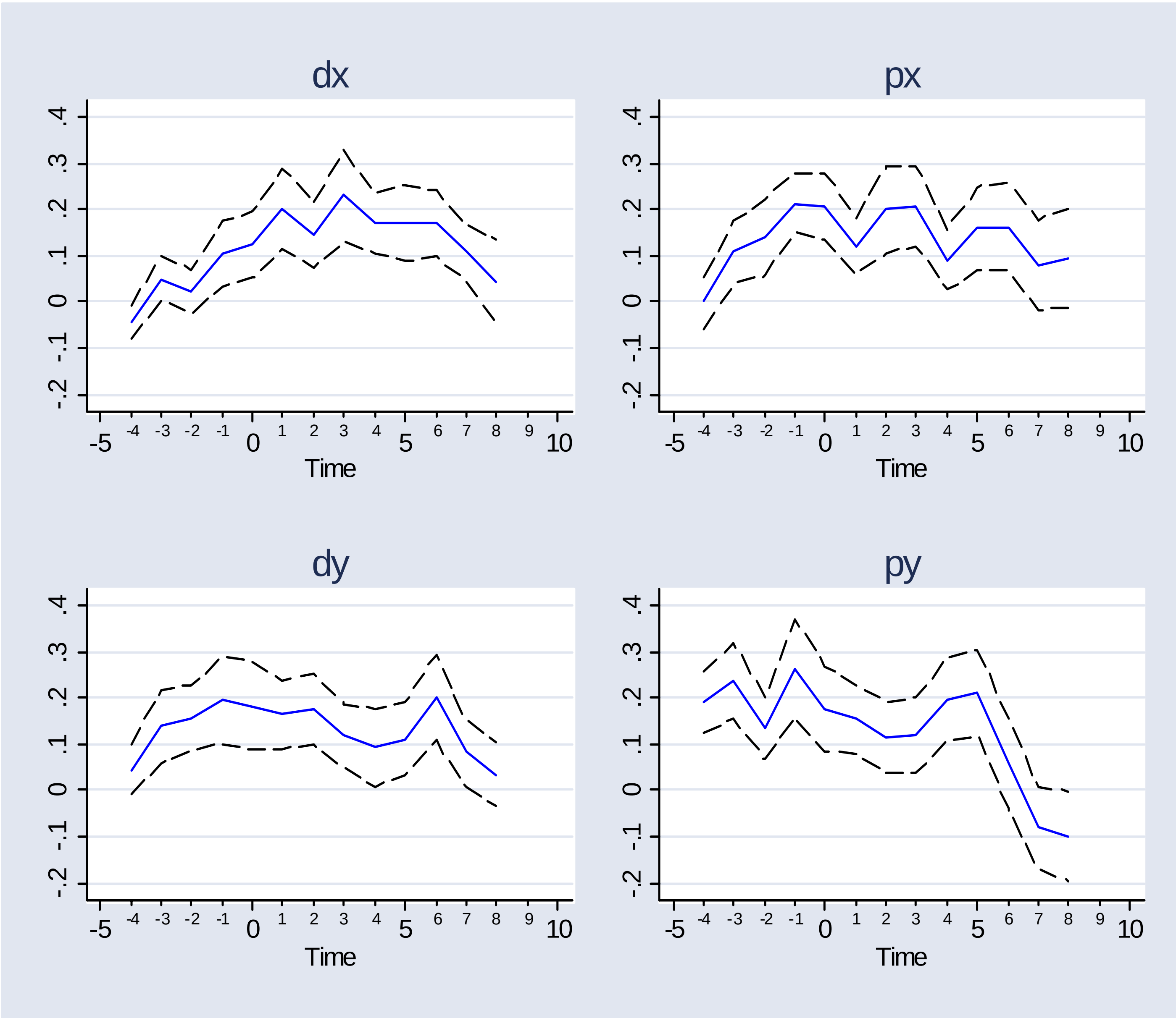


Figure 15: Robustness (II) : Property Rights and The Response of Investment

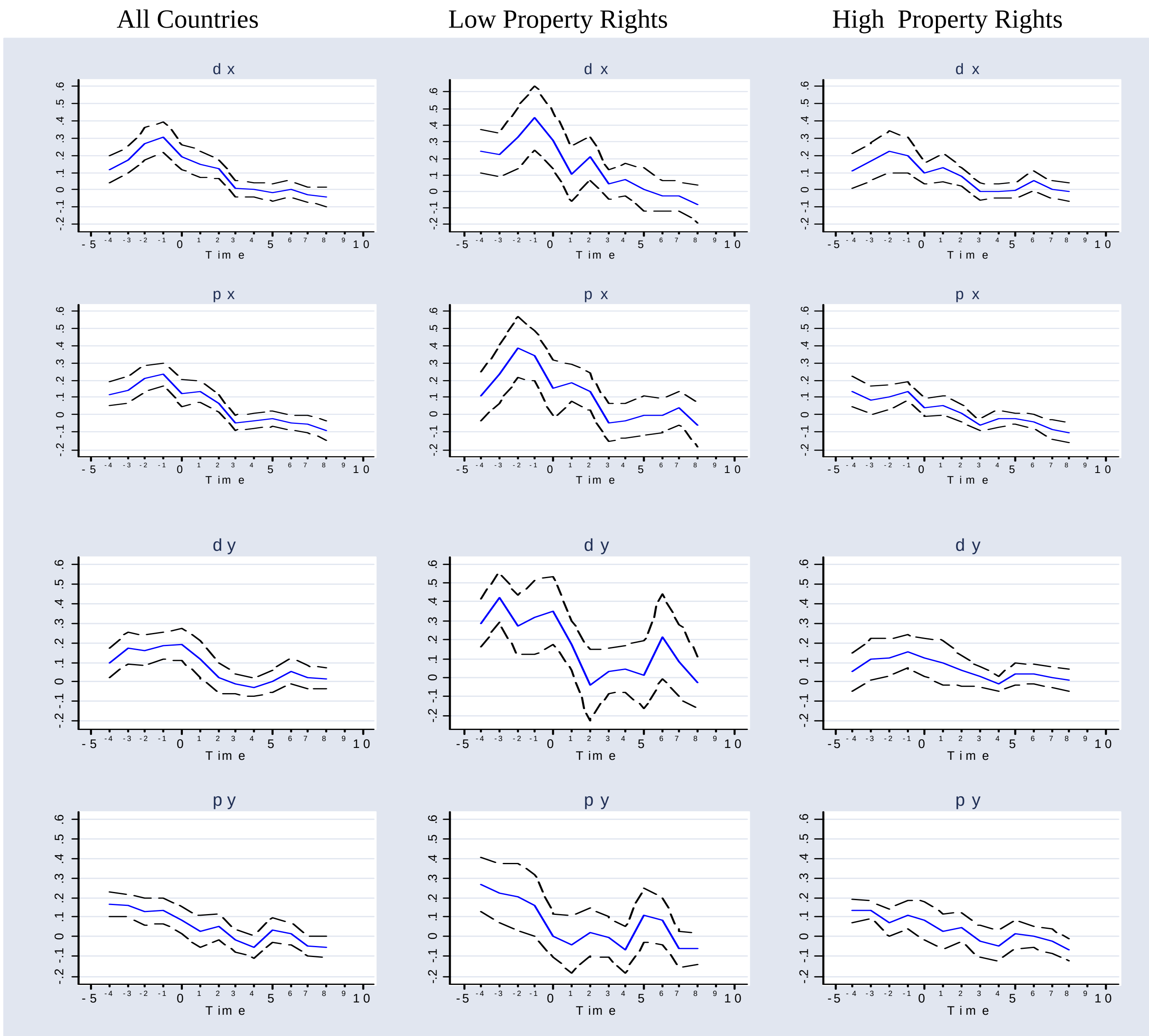


Figure 16: Robustness (III) : Low-Income Countries and The Response of Investment

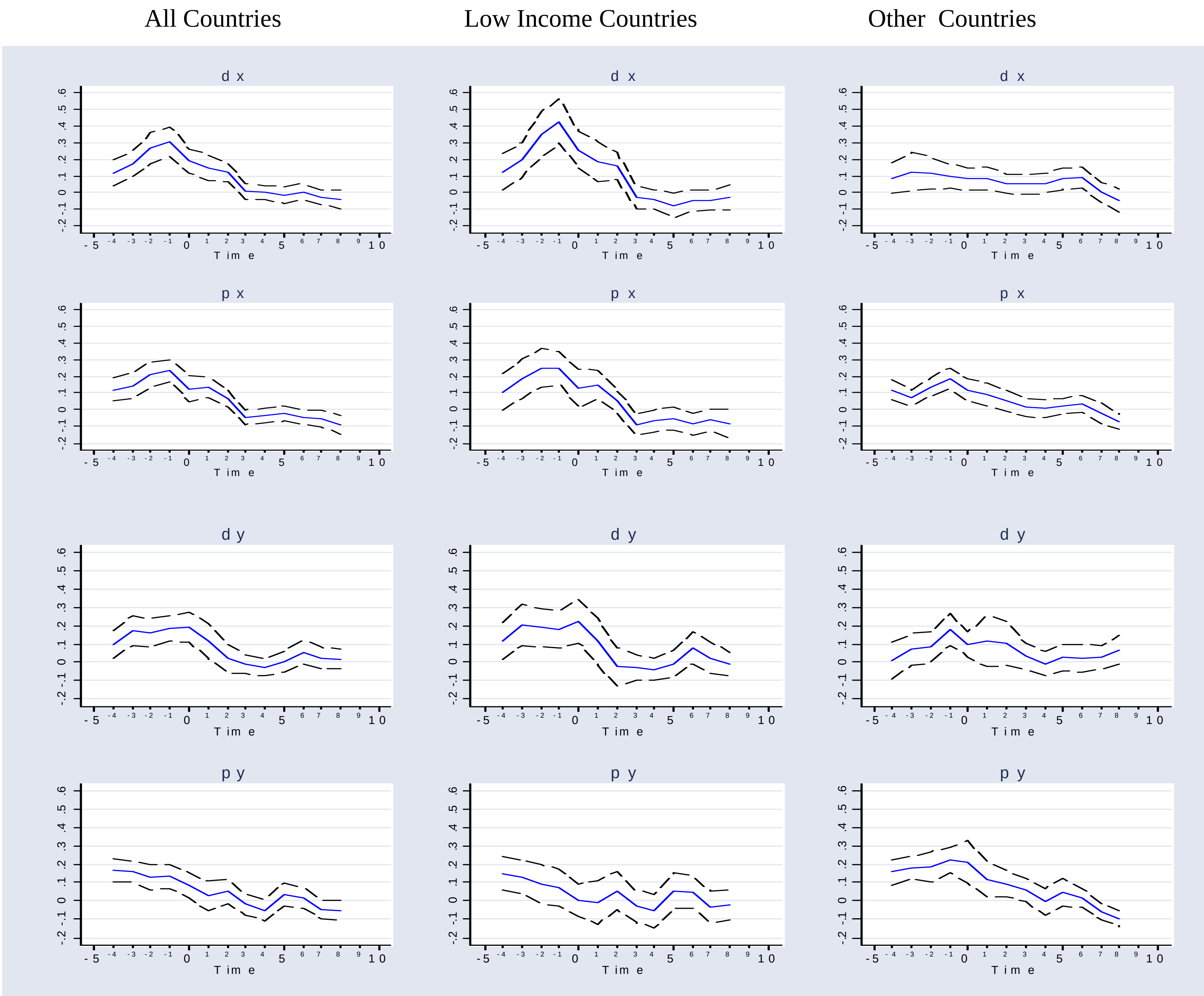


Figure 17: Robustness (IV) : Excluding Events between 1979 and 1984 - The Response of Investment

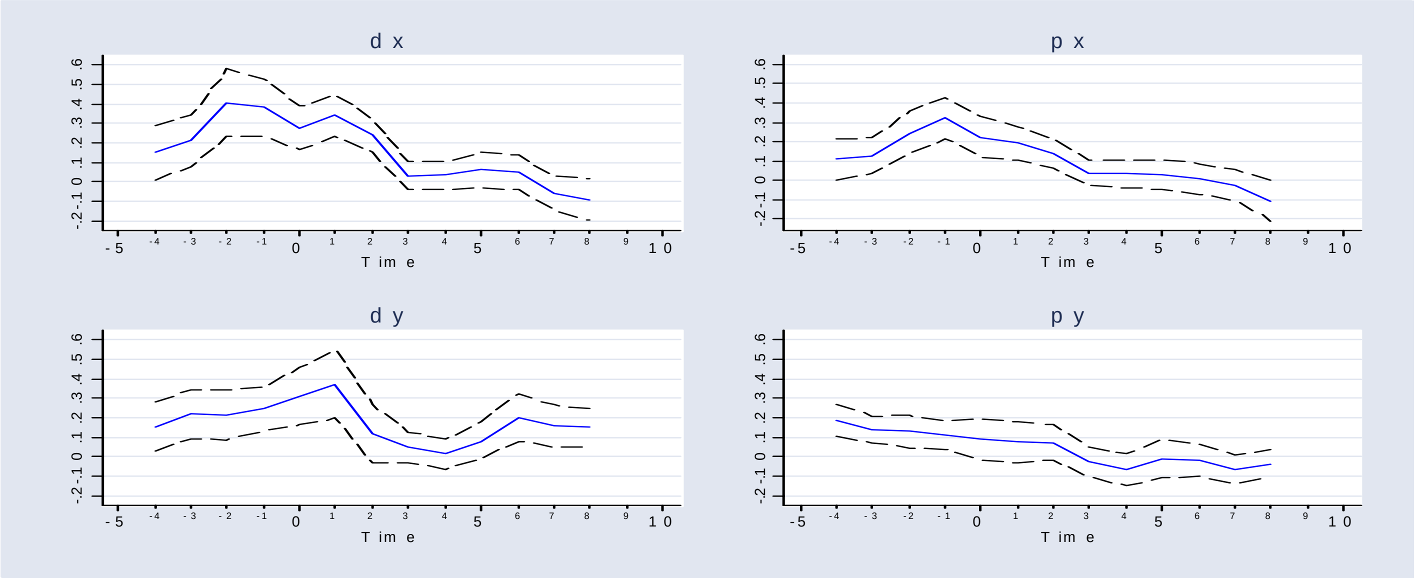
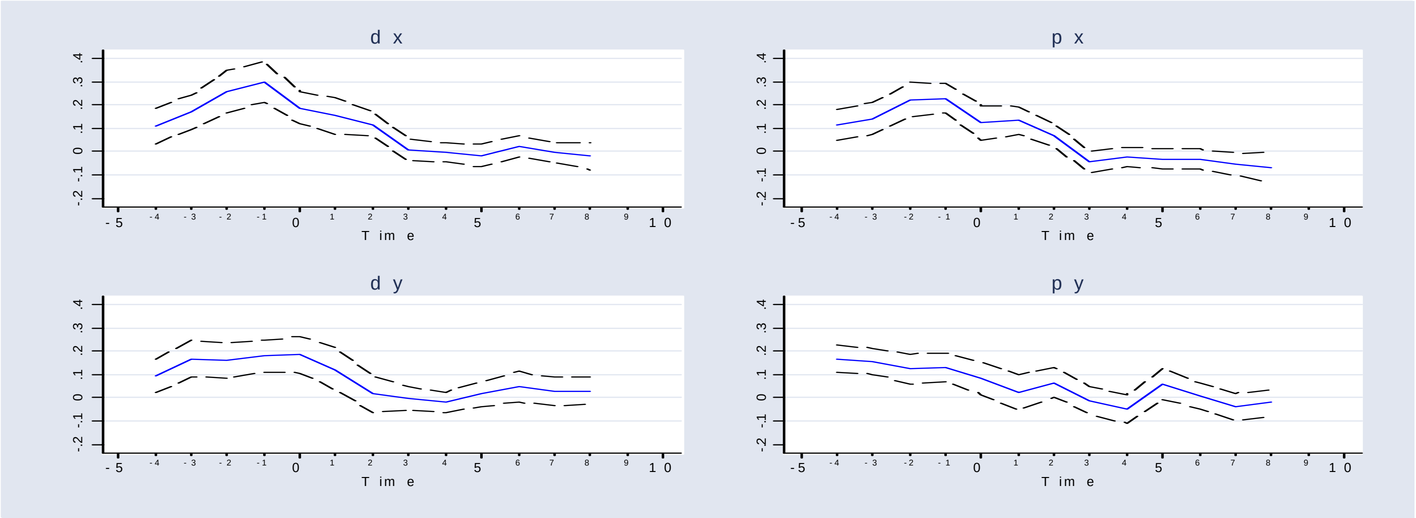


Figure 18: Robustness (V) : Excluding Rescheduling Episodes - The Response of Investment



*country-year with rescheduling of at least 5% of total external debt