PERUVIAN ECONOMIC ASSOCIATION

Does uncertainty matter for the fiscal consolidation and investment nexus?

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Working Paper No. 195, July 2023

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April, 2023

Abstract

The paper searches for non-linearities in the relationship between fiscal consolidation and investment. To understand this nexus, we consider the broader state of the economy as this is represented by the degree of uncertainty. Based on a sample of 27 OECD countries over the period 1996-2019, we identify low and high uncertainty regimes within which the nature of the relationship between fiscal policy and investment differs substantially. In the low uncertainty regime, fiscal tightening has an irrelevant effect on investment; whereas, in the high uncertainty regime, this impact is negative and is three times larger than in the low uncertainty regime. Our findings maintain a robust pattern of this relationship through a series of sensitivity tests.

JEL Classification: E62, D81, C33
Keywords: Fiscal policy, real sector, threshold model, panel data.

*We are grateful to participants of the Economics Research Seminar at the University of Lincoln. We are also thankful for useful comments and suggestions to Dimitris Christopoulos, Peter McAdam, Marian Rizov, Evi Pappa and the anonymous reviewer. The usual disclaimer applies.
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1 Introduction

The early developed austerity literature (Bertola and Drazen, 1993; Alesina and Perotti, 1997; Alesina *et al.*, 2002) focuses on whether fiscal consolidation is expansionary, contractionary, or neutral regarding output. The 2008 global financial crisis reheated the debate about the effectiveness of expansionary fiscal contraction (Alesina and Ardagna, 2010) as opposed to the Keynesian wisdom that emphasizes the importance of fiscal stimulus in periods of economic downturns.[1] In assessing austerity policies, policymakers tend to focus mainly on consumption, wages, and unemployment without considering the impact on the productive capacity. On the latter impact, Alesina *et al.* (2017) and Alesina *et al.* (2019) investigate the effects of fiscal adjustment plans on various macroeconomic variables including investment, where they find negative effects on investment and the effects is higher under a tax-based rather than consumption-based or transfer-based adjustment plans. More recently, Bardaka et al. (2021) find that a higher cyclically adjusted primary balance (CAPB) decelerates total factor productivity.

In the neoclassical growth model, the capital-labor ratio is the main source of the per capita income level. Fiscal policy changes that affect the evolution of capital accumulation can cause long-term permanent shocks in social welfare and living standards.[2] Fiscal consolidation, especially in the form of spending cuts, go beyond cuts in wages of public sector employees, social transfers and reductions in infrastructure, public health and education that form the productive capacity of the economy.[3] Many advanced economies with high debt levels tried to mitigate the structural problem of low growth with solid fiscal adjustments. In circumstances of zero lower bound, fiscal consolidation is proven to be self-defeating as fiscal deficit reductions lead to lower potential output and a higher debt-to-GDP ratio (Fatás and Summers, 2018).

On the other hand, a well-established strand of literature investigates how uncertainty affects investment (see Abel, 1983, 1985, for initial contributions). Economists consider investment irreversibility (Bernanke, 1983; Pindyck, 1988; Dixit and Pindyck,

[1] Early research has shown that fiscal contraction is correlated with expansions in private consumption within one year (Giavazzi and Pagano, 1990) and output growth (Alesina and Perotti, 1997). Jordà and Taylor (2016) indicate that expansionary austerity can cause cumulative GDP losses of 3.5% during recessions, which challenges the view of expansionary austerity.

[2] Note that, a short-term effect on investment would have a permanent effect on capital accumulation, but the effect is small as any change in investment is discounted according to the capital accumulation identity (perpetual inventory method).

[3] According to Stiglitz (2016), the cost of austerity is much greater than the numbers reported in conventional metrics, because national account statistics do not account for the loss of capital and output during economic downturns. Fiscal contraction is not the only source of the OECD's low investment to GDP ratio over the last two decades (see Eggertsson *et al.*, 2021, for the role of monopoly power as another underlying factor of the sluggish investment).

1994; Abel and Eberly, 1996),[4] the degree of market power in the market (Caballero, 1991) and the share of labor (Lee and Shin, 2000) as the main factors of the relationship between uncertainty and investment. Although each of these factors might shape either a positive or a negative relationship, the consensus suggests that increased uncertainty could reduce investment, as uncertainty motivates agents to postpone decisions. Indeed, the empirical evidence tends to document that increased uncertainty lowers investment (Carruth *et al.*, 2000; Bloom, 2009; Bloom *et al.*, 2018).

The literature analyzing the impact of fiscal consolidation on macroeconomic fundamentals, including investment, downplays the role of uncertainty. Thus, the novelty and contribution of this paper is to offer a new prism on how the effect of fiscal loosening on investment varies across different uncertainty regimes. Our framework does not provide evidence *per se* for the nature of the uncertainty-investment relationship; instead, it extends the literature on the state-dependence of the fiscal policy effects on investment taking into account uncertainty regimes. Therefore, our framework allows us to understand how fiscal policy plays an active role in helping the economy to escape from the uncertainty trap. Analytically, the economy operates below potential output with little space for monetary policy intervention due to zero lower bound and the unwillingness to provide quantitative stimulus (DeLong and Summers, 2012). In this scenario, fiscal policy offers the sole stabilizing mechanism of investment sentiments.

On related literature, there are some recent studies estimating fiscal multipliers according to uncertainty regimes, with mixed results. Arčabić and Cover (2016), Berg (2019) and Gbohoui (2021) encounter those fiscal multipliers are larger; in contrast, Alloza (2018), Fritsche *et al.* (2020), and Jerow and Wolff (2022) finds a smaller multiplier when uncertainty is high. In the same vein, the literature has also explored whether the estimates of fiscal multipliers vary with the state of other variables. For instance, some studies consider the possibility that fiscal multipliers are different during recessions (see Auerbach and Gorodnichenko, 2012; Ramey and Zubairy, 2018, among others); others consider that different states of monetary policy rate could affect government spending multipliers (see Cogan *et al.*, 2010; Christiano *et al.*, 2011, among others).

On theoretical grounds, the uncertainty-investment literature implies that investment would reduce its response to fiscal stimulus because heightened uncertainty increases the real option value of postponing non-reversible investment as well as precautionary saving, which makes investment less responsive to interest rate changes (Bloom *et al.*, 2018). Thus, in periods of high uncertainty, the fiscal consolidation-investment

[4]The cost of adjusting capital downwards is usually higher than adjusting upwards. The risk-neutral investor waits for uncertainty to be resolved before making irreversible investment in the wrong projects.

nexus would be smaller. Conversely, this relationship could be stronger if fiscal consolidation improves private agents' expectations about future economic prospects and induce higher private investment. Moreover, in periods of low uncertainty, fiscal policy could weaken confidence by reinforcing investors' pessimistic expectations about near-term economic prospects (Gbohoui, 2021).

Economic theory postulates that changes in expectations and sentiments are an important driver of economic fluctuations (Beaudry and Portier, 2006); more precisely, Farmer (1998) indicates that business confidence is critical to the transmission of policy shocks. Likewise, Christiano *et al.* (2011) argue that the policy route in major economic downturns is to restore expectations and higher levels of private spending; indeed, fiscal expansion is the necessary catalyst to end the recessionary spiral, while helping consumption and investment to rebound (DeLong and Summers, 2012; Fatás and Summers, 2018). From the empirical side, Konstantinou and Tagkalakis (2011) and Gbohoui (2021) find that fiscal policy improves consumer and business confidence.

When uncertainty is low, firms do not encounter major difficulties in obtaining external financing; fiscal loosening therefore increases interest rates and crowd out private investment. In a high uncertainty regime, private markets encounter various frictions –as higher uncertainty increases asymmetric information and moral hazard (Nagar *et al.*, 2019)– that make them stringent and reluctant in supplying credit to private firms. Thus, fiscal loosening is more significant in conditions of binding credit constraints (Corsetti *et al.*, 2012), where fiscal expansion would break the chain of self-fulfilling expectations, restores economic confidence and increases private investment. In other words, in periods of heightened uncertainty, fiscal policy may act as a substitute for imperfect credit markets, which are reluctant to finance private investment projects. In addition, when nominal interest rates are close to zero, fiscal expansion rises expected inflation that decreases real interest rate, which reinforces private investment.

Methodologically, we use the newly assembled data of the World Uncertainty Index (WUI) (Ahir *et al.*, 2018) for 27 OECD countries over the period 1996 to 2019 to estimate a panel specification of investment (as percentage of GDP) on a set of covariates, including the cyclically adjusted primary balance (CAPB) as a measure of fiscal consolidation. To this end, our empirical approach is a threshold model that searches for non-linearities in the CAPB-investment nexus by separating the observations into discrete groups based on the level of uncertainty. The estimation novelty is that we split the sample endogenously into two or more regimes as dictated by the WUI data. Then, we estimate the nexus of CAPB-investment for the different uncertainty regimes within a unified framework (Hansen, 1999, 2000).

We summarize our results as follows: the average effect of CAPB on investment is negative. Nonetheless, the true nature of the CAPB-investment nexus varies when economic uncertainty is taken into account. In the low uncertainty regime, changes in the fiscal stance do not affect investment. In the high uncertainty regime, fiscal contraction is harmful as the government is expected to be more aggressive in rectifying the negative market sentiments through fiscal stimulus and not otherwise. We organize the paper as follows: section 2 discusses estimation, inference and testing issues related to the threshold model, section 3 discusses results from the linear and threshold models, section 4 shows the robustness analysis, and section 5 concludes.

2 Data and methodology

In this section, we discuss our methodology and database. We postulate that uncertainty affects the fiscal consolidation and investment nexus by separating the sample into two or more regimes. In particular, we embed an investment equation within a threshold regression model, whereby uncertainty is the threshold variable that splits the sample into separate regimes. Afterwards, we estimate the model for each regime to see if fiscal tightening maintains the same pattern. The dataset comprises yearly information for a sample of 27 OECD from 1996 to 2019. The data are mainly retrieved from the Penn World Table, World Development Indicators and Ahir *et al.* (2018).

2.1 Specification

We specify the following equation:

$$I_{it} = \mu_i + \kappa k_{it-1} + \beta x_{it} + \theta' Z_{it-1} + \epsilon_{it}, \tag{1}$$

where I_{it} is the investment (as percentage of GDP) in country i at year t; μ_i is an unobserved country-fixed effect; k_{it-1} is the capital stock to GDP ratio lagged; x_{it} is a measure of fiscal consolidation; Z_{it-1} is a set of control variables; ϵ_{it} is the error term; i indexes countries; and t indexes year. β, κ, and θ are parameters to be estimated. Note that, in empirical growth models, where the dependent variable is GDP growth, the transitory convergence variable is included as the lagged level of GDP per capita (see Barro, 1991; Loayza *et al.*, 2005). Analogously, to control for this variable, the lagged capital stock to GDP ratio k_{it-1} is included as a regressor.

In order to assess whether or not uncertainty affects the fiscal consolidation and investment relationship, equation (1) is augmented with a threshold variable resulting in the following dynamic growth model:

$$I_{it} = \mu_i + \kappa k_{it-1} + \beta_1 x_{it} 1(q_{it} \leq \gamma) + \beta_2 x_{it} 1(q_{it} > \gamma) + \theta' Z_{it-1} + \epsilon_{it}, \tag{2}$$

where q_{it} is a country's uncertainty measure; and 1(.) is an indicator variable which takes the value of 1 if uncertainty is lower (higher) than a threshold and of 0 otherwise. γ is the uncertainty threshold parameter to be estimated. In this specification, the effects of fiscal consolidation on investment depend on the uncertainty regime.

Specification (1) or (2) assumes that the fiscal consolidation variable represented by x_{it} is determined exogenously. The CAPB, by definition, stands for policy decisions that are taken under the discretion of the fiscal authorities and unaffected by the moves of the business cycles.[5] In that respect, one must expect that endogeneity bias is not a concern. There might be some endogeneity bias related to Wagner's Law –i.e. the tendency of government spending to be higher, the higher the level of GDP per capita (see Easterly and Rebelo, 1993; Hsieh and Lai, 1994; Kneller *et al.*, 1999). Since Wagner's Law associates the GDP per capita growth rate and government expenditure growth rate (not the level, as it is in our case), we are less worried about endogeneity between investment and CAPB in our estimation.

Fiscal consolidation could be endogenous to the level of economic uncertainty, as consolidation takes place during recessions or when uncertainty is high; conversely, when uncertainty is low fiscal consolidation has a lower cost and, thus, preferred by policymakers. Indeed, Bloom (2009) argue that uncertainty is a major contributor of short-term output fluctuations in the US, implying that recessions can be simply periods of high uncertainty without necessarily any negative productivity shock. In contrast, Born *et al.* (2018) found that the role of uncertainty in the US recession in 2008/09 is overstated as uncertainty is amplified by first moment macroeconomic shocks. Nevertheless, economic uncertainty may not be related to fiscal consolidation, since the cyclically-adjusted primary balance (CAPB) is calculated by removing cyclical movements.

The vector Z_{it-1} of additional controls includes lagged variables that potentially determine investment. There is extensive literature on the determinants of economic growth or its sources, such as change in capital stock (equal to new investment minus depreciation) and total factor productivity. These covariates are human capital, financial depth, public infrastructure, institutions, trade openness, price instability

[5] The cyclically-adjusted balance is computed to show the underlying fiscal position when cyclical movements are removed. In another strand of the literature on fiscal space, primary balance can be estimated by a set of some factors (see for instance Lozano-Espitia and Julio-Román, 2020).

and external factors (world GDP growth rate). To reduce potential endogeneity that commonly exists in empirical growth models between contemporary values of the control variables and the error term, we lag these controls by one year to ensure weak exogeneity.[6]

2.2 Data

Our period of study spans from 1996 to 2019 for a sample of 27 OECD countries (Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, United Kingdom and the United States). Table 1 shows the sources and the definitions of variables used for estimating (2). Data availability dictates the length of time span and the country coverage. Summary statistics of the variables used in the empirical part are provided in Table 2.

For the uncertainly variable, we use data from the World Uncertainty Index (WUI) constructed by Ahir *et al.* (2018), for 143 countries from 1996 onwards. The data is constructed using frequency counts of "uncertainty" in the quarterly Economist Intelligence Unit (EIU) country reports; these reports discuss major political and economic developments in each country, along with analysis and forecasts of political, policy, and economic conditions (Ahir *et al.*, 2018). Each country's report is written following a standardized five-step procedure.[7] To ensure cross-country comparability of the index, raw word counts are scaled over the total number of words in each report. The indices are normalized by total number of words in the EIU reports and rescaled by multiplying by 1,000 (the data corresponds from sheet "T2" in the WUI database). Note that, the data have the advantage of being comparable between countries, since they come from the same source and the same methodology.

[6] We raise here a caveat that endogeneity bias is likely to persist if current values are correlated with future errors. This calls for a more systematic treatment of endogeneity using instrumental variables, though this application is beyond the scope of this paper.

[7] (i) A field expert drafts a report of the country, (ii) a country expert at the headquarters of EIU integrates the draft with her inputs, (iii) a senior staff at the headquarters of EIU does the second round of editing with a thorough check of the draft, (iv) sub-editors do a review to ensure that the report is well-drafted, consistent, accurate including a cross-check of the facts, (v) the production stage ensures that the report is coded and styled adequately.

Table 1: Data sources and definition of variables

Variable	Definition	Source
Investment	Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories, as percentage of GDP.	World Development Indicators.
Fiscal consolidation	Cyclically adjusted primary balance as percentage of potential GDP.	OECD and IMF data.
Uncertainty	World Uncertainty Index.	Ahir *et al.* (2018).
Capital stock	Estimates based on cumulating and depreciation past investments using the perpetual inventory method, as percentage of GDP.	Penn World Table.
Human capital	Human capital index, based on years of schooling and returns to education. In logs.	Penn World Table.
Financial depth	Ratio of domestic credit claims on private sector to GDP. In logs.	World Development Indicators.
Public infrastructure	Fixed and mobile telephone lines per 100 habitants. In logs.	World Development Indicators.
Institutions	Average of four indicators: bureaucracy quality, prevalence of law and order, absence of corruption, and accountability of public officials.	International Country Risk Group (ICRG).
Trade openness	Ratio of exports plus imports to GDP. In logs.	World Development Indicators.
Price instability	Annual % change in consumer price index (CPI).	World Development Indicators.
World GDP growth	Annual % change in real world GDP per capita.	World Development Indicators.

Table 2: Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Investment (% of GDP)	648	23.5	4.1	11.9	55.0
Fiscal consolidation (%)	648	0.0	3.1	-26.1	9.7
Uncertainty (index)	648	0.7	0.5	0.0	4.7
Capital stock (% of GDP)	648	5.5	1.6	2.6	9.9
Financial depth (% of GDP)	648	101.8	44.7	0.2	221.3
Human capital (index)	648	3.3	0.3	2.1	3.9
Public infrastructure (index)	648	4.9	0.4	2.9	5.3
Institutions (index)	648	4.7	0.7	3.0	5.5
Trade openness (% of GDP)	648	82.4	39.1	18.3	239.2
Price instability (%)	648	2.2	2.3	-4.5	23.5
World GDP growth (%)	648	1.7	1.2	-2.9	3.1

2.3 Threshold regression model

We now turn to the specification of a threshold regression that identifies different regimes in the relationship between fiscal consolidation and investment. Threshold models divide individual observations into classes based on the value of an exogenous observed variable.[8] Hansen (1999) extends the use of threshold models into a balanced panel data context -mainly by introducing the use of a least-squares (LS) econometric estimator. The estimation framework proposes a within transformation of the variables involved in the estimation analysis, as in Hansen (1999).

We divide the observations into two regimes depending on whether the threshold variable q is smaller or larger than a certain value (the threshold parameter γ). The regimes are distinguished by differing regression slopes, β_1 and β_2 in (2). To identify these coefficients, the elements of q (i.e. economic uncertainty) must be time-variant. More importantly, the values of the uncertainty threshold parameter γ are estimated, so the respective uncertainty regimes are identified endogenously within the model. The error ϵ_{it} is assumed to be independent and identically distributed (iid) with mean zero and finite variance σ^2_ϵ. Implementing the threshold model involves three steps: estimation, inference and testing. We now proceed with the first step.

2.3.1 Threshold and slope estimations

Hansen (1999) proposes the least squares (LS) threshold estimator for a static panel data model. To obtain consistency of LS estimators in a static panel threshold model with fixed effects, an appropriate transformation must be made to remove the fixed effects. We proceed with this within transformation by eliminating the country-level fixed effect in equation (2) (to simplify the exposition of the method, we do not include the control variables Z_{it-1}):

$$I^+_{it} = \kappa(k_{it-1})^+ + \beta_1(x_{it}1(q_{it} \le \gamma))^+ + \beta_2(x_{it}1(q_{it} > \gamma))^+ + \epsilon^+_{it}, \tag{3}$$

where we define $I^+_{it} \equiv I_{it} - T^{-1}\sum_{t=1}^{T} I_{it}$, $k^+_{it-1} \equiv k_{it-1} - T^{-1}\sum_{t=1}^{T} k_{it-1}$, $x_{it}1(q_{it} \le \gamma))^+ \equiv x_{it}1(q_{it} \le \gamma) - T^{-1}\sum_{t=1}^{T} x_{it}1(q_{it} \le \gamma)$, $x_{it}1(q_{it} > \gamma))^+ \equiv x_{it}1(q_{it} > \gamma) - T^{-1}\sum_{t=1}^{T} x_{it}1(q_{it} > \gamma)$, and $\epsilon^+_{it} \equiv \epsilon_{it} - T^{-1}\sum_{t=1}^{T} \epsilon_{it}$; note that this latter equation is simply the original threshold panel regression model (2) after removing individual-specific means.

Next, we define the following matrices stacked over time

[8] Threshold models have been previously used in time series analysis (see Hansen, 2011, for a review).

$$X_i(\gamma) = \begin{bmatrix} (k_{i0})^+ & (x_{i1}1(q_{i1} \le \gamma))^+ & (x_{i1}1(q_{i1} > \gamma))^+ \\ (k_{i1})^+ & (x_{i2}1(q_{i2} \le \gamma))^+ & (x_{i2}1(q_{i2} > \gamma))^+ \\ \vdots & & \\ (k_{iT-1})^+ & (x_{iT}1(q_{iT} \le \gamma))^+ & (x_{iT}1(q_{iT} > \gamma))^+ \end{bmatrix};$$

$$I_i = \begin{bmatrix} I_{i1}^+ \\ I_{i2}^+ \\ \vdots \\ I_{iT}^+ \end{bmatrix}; \quad \text{and} \quad \epsilon_i^+ = \begin{bmatrix} \epsilon_{i1}^+ \\ \epsilon_{i2}^+ \\ \vdots \\ \epsilon_{iT}^+ \end{bmatrix};$$

with this notation, the algorithm for the LS estimation proceeds in the following steps. It starts by fixing γ at any value of the empirical support of the uncertainty variable (in our case the World Uncertainty Index), then the slope coefficients κ, β_1, and β_2 are obtained by:

$$\widehat{\beta}(\gamma) = \Big(\sum_{i=1}^{n} X_i(\gamma)' X_i(\gamma)\Big)^{-1} \Big(\sum_{i=1}^{n} X_i(\gamma)' I_i\Big), \tag{4}$$

where $\beta = (\kappa, \beta_1, \beta_2)'$. Accordingly, the sum of squared errors for a given threshold parameter γ is given by:

$$S(\gamma) = \sum_{i=1}^{n} \widehat{\epsilon}_i^+(\gamma) \widehat{\epsilon}_i^+(\gamma), \tag{5}$$

where $\widehat{\epsilon}_i^+(\gamma) = I_i - X_i(\gamma)\widehat{\beta}(\gamma)$.

The criterion function (5) is not smooth. Thus, the threshold parameter is estimated with the use of grids search method across the uncertainty variable space. Finally, once $\widehat{\gamma}$ is obtained, the slope coefficient estimates are subsequently obtained as $\widehat{\kappa} = \widehat{\kappa}(\widehat{\gamma})$, $\widehat{\beta}_1 = \widehat{\beta}_1(\widehat{\gamma})$ and $\widehat{\beta}_2 = \widehat{\beta}_2(\widehat{\gamma})$.

2.3.2 Asymptotic confidence intervals

When there is a threshold effect ($\beta_1 \neq \beta_2$), Hansen (2000) has shown that threshold estimate, $\widehat{\gamma}$, is consistent for γ_0 (the true value of γ) and that the asymptotic distribution is non-standard. Following Hansen (1999), we form the no rejection region for the threshold by using the likelihood ratio statistic for the test on $\widehat{\gamma}$. To test hypothesis H_0: $\gamma = \gamma_0$, the likelihood ratio test is to reject for large values of $LR(\gamma_0)$:

$$LR(\gamma) = nT \frac{S(\gamma) - S(\widehat{\gamma})}{S(\widehat{\gamma})}, \tag{6}$$

where $S(\gamma)$ converges in distribution as $n \to \infty$ to a random variable ξ with distribution function $P(\xi \leq z) = (1 - exp(-z/2))^2$.

The asymptotic distribution of the likelihood ratio statistic is non-standard yet free of nuisance parameters (Hansen, 2000). To form valid asymptotic confidence intervals, we use the asymptotic distribution ξ, which has the following inverse:

$$c(\alpha) = -2ln(1 - \sqrt{1-\alpha}), \tag{7}$$

where α is the significance level. The "no-rejection region" of confidence level $1-\alpha$ is the set of values of γ such that $LR(\gamma) \leq c(\alpha)$. The values are identified by plotting $LR(\gamma)$ against γ with the drawing of a flat line at $c(\alpha)$.

2.3.3 Test for existence of threshold effects

It is important to determine whether the threshold effect is statistically significant. The hypothesis of no threshold effects in (2) can be represented by the linear constraint H_0: $\beta_1 = \beta_2$. Under the null hypothesis, H_0, the threshold γ is not identified, so classical tests have non-standard distributions. We use bootstrapped p-values that are asymptotically valid (Hansen, 2000).

Under the null hypothesis of no threshold, the model (1) without control variables is

$$I_{it} = \mu_i + \kappa k_{it-1} + \beta_1 x_{it} + \epsilon_{it}, \tag{8}$$

after the within transformation that eliminates the country-specific effect μ_i, we get

$$I_{it}^+ = \kappa(k_{it-1})^+ + \beta_1(x_{it})^+ + \epsilon_{it}^+; \tag{9}$$

where the parameters κ and β_1 are estimated by least squares, yielding estimates $\widehat{\kappa}$, $\widehat{\beta}_1$, residuals $\widehat{\epsilon}_{it}$ and let $S_0 = \sum_{i=1}^n \widehat{\epsilon}_i^+ \widehat{\epsilon}_i^+$ be the sum of squared errors of the linear model. Thus, the likelihood ratio F test of H_0 is based on:

$$F = nT \frac{S_0 - S(\widehat{\gamma})}{S(\widehat{\gamma})}; \tag{10}$$

accordingly, the null hypothesis of linearity is rejected if the percentage of draws for which the simulated statistic exceeds the actual value is less than some critical value.

3 Estimation and inference results

3.1 Linear model results

Table 3 provides results from three linear model specifications. We start from a parsimonious specification in column (1) that includes only two regressors, fiscal consolidation and the lagged value of capital stock that capture the transitional convergence variable. Concerning the primary variable of interest, fiscal consolidation, the statistically negative coefficient indicates that the expectation channel dominates the crowding out effect, which argues that fiscal loosening discourages private investment and impacts private sector borrowing costs negatively. The magnitude of this coefficient does not vary much across different specifications, indicating that a 1% increase in fiscal consolidation leads approximately to a reduction in investment by 0.22%.[9]

The transitional convergence variable is negative as expected, due to the diminishing marginal returns to capital. Among other factors, that matter for the investment in columns (2) and (3) are financial depth and institutions. The former highlights the too much finance effect on advanced economies, where there is a threshold above which financial depth no longer has a positive effect on economic growth (Arcand *et al.*, 2015). Meanwhile, a country with strong institutions is attractive to net savers who choose to invest in domestic asset portfolios due to a stable and predictable regime. Table 3 also indicates a negative role for trade openness in investment; the reason for this is no surprise since the countries in our sample are already close to the technological frontier with limited opportunities for capital deepening through trade (Blalock and Gertler, 2004; Delgado *et al.*, 2002).[10]

Columns 2 of Table 3 also shows substitution effects between human and physical capital (although it is not robust in all specifications), indicating that skilled workers can utilize physical capital more efficiently. More generally, an increase in the abundance of human capital, ceteris paribus, reduces the total cost of this input and induces changes in the input mix of the production process (Oldekop *et al.*, 2020). Overall, the results in Table 3 without controlling for threshold effects accords well with previous findings in the literature (see Grier, 2002).

It should be noted that the empirical growth literature usually takes five- or ten-

[9]We have added time fixed effects from 1998 to 2019, as we use 1996-1997 as the base years.

[10]Given that the sample covers high-income countries, the trade content is mainly labor-intensive imports from the developing world. These are non-durable goods that contribute less to national capital accumulation. The literature finds that trade improves investment efficiency is a fact drawn from Less Developing Countries (LDCs) that tend to import relatively cheaper advanced capital goods from developed countries. In our OECD sample, this scenario is of minor relevance.

Table 3: Estimation results of the linear model (no thresholds)

Dependent variable: Investment	(1)	(2)	(3)
Fiscal consolidation	-0.257***	-0.218**	-0.219**
Cyclically adjusted primary balance (CAPB)	(0.094)	(0.088)	(0.088)
Transitional convergence	-0.136***	-0.142***	-0.141***
Lag of capital stock/GDP, in logs	(0.024)	(0.023)	(0.023)
Financial depth	-	-0.005*	-0.005*
Domestic credit to private sector/GDP, in logs		(0.003)	(0.003)
Human capital	-	-0.049**	-0.041
Index based on schooling and returns, in logs		(0.025)	(0.027)
Public infrastructure	-	-0.031	-0.034
Fixed and mobile lines per 100 people, in logs		(0.033)	(0.033)
Institutions	-	1.295**	1.295**
Average of 4 ICRG indicators		(0.502)	(0.504)
Trade openness	-	-0.023**	-0.023**
Export plus import to GDP, in logs		(0.011)	(0.011)
Price instability	-	0.100	0.101
CPI growth		(0.071)	(0.071)
World GDP growth	-	-	0.955
Real GDP per capita % change			(1.360)
Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Number of countries	27	27	27
Time period	1996-2019	1996-2019	1996-2019

Notes: Heteroskedastic standard errors in parentheses. *, ** and *** denote statistical significance at the 10, 5 and 1% level, respectively.

year averages since growth is based on the long-term relationship (this is especially important for control variables, whose robustness has been evaluated in the literature in the long-term). We do not do so here for two reasons. First, unlike the GDP growth measure, investment is measured as the gross capital formation as a percentage of GDP, where capital stock is calculated as averages to smooth out variations caused by investment expenditures (perpetual inventory method); second, taking five- or ten-year averages drastically reduces our sample size.

3.2 Threshold effects

The first step is to test for a threshold effect in the model that relates investment and fiscal consolidation using the F test of equation (10). This also involves estimating equation (2) and computing the residual sum of squares for the uncertainty threshold. We test the existence of threshold effects using a sample of 27 OECD countries over 23 years between 1996 and 2019.[11]

The test for the existence of threshold effects is shown in Table 4. The null hypothesis of no threshold effect against a single threshold can be rejected at least at the 90% significance level. The test statistics F for the single threshold are 16.848 and 14.237, with their corresponding bootstrap p-value of 0.026 and 0.067 for the model without controls and with controls, respectively. The test indicates a highly significant single threshold; thus, we conclude that there is strong evidence for threshold effects of uncertainty in the fiscal consolidation and investment relationship.

Table 4: Tests for threshold effects

	Uncertainty threshold estimate	F Test	Bootstrap p-value	Critical values
Model without controls	0.392	16.848	0.026	12.269[1/] 14.164[2/] 23.009[3/]
Model with controls	0.390	14.237	0.067	10.891[1/] 15.561[2/] 22.933[3/]

Notes: 1/, 2/ and 3/ critical values at 10, 5 and 1%, respectively. The test shows the probability value for the null hypothesis of $\widehat{\beta}_1 = \widehat{\beta}_2$. We used 300 bootstrap replications for the test.

3.3 Threshold estimate and its confidence interval

The uncertainty threshold estimate in all specifications is 0.39, which implies the high precision of the estimation procedure. This value is lower than the mean, 0.73, and higher than the 0.25 percentile; indeed, this value is placed at the 0.31 percentile, which means that 69% of observations fall in the high uncertainty regime.

The second step is to compute the confidence intervals. The estimated threshold can be obtained by plotting the likelihood ratio function $LR(\gamma)$ of the estimate (see Figure

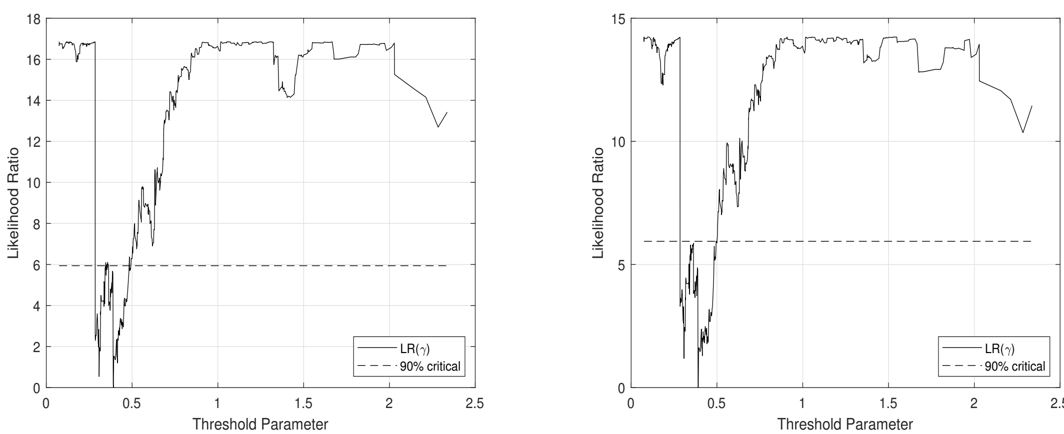
[11] These are the results when considering the model without and with control variables. The rejection of the null hypothesis also holds when considering no common factors, which corresponds to the specification in column (2) of Table 5.

1). The function is minimized at zero for the estimated threshold value, $\widehat{\gamma} = 0.39$, in both models (with and without controls). The point estimate indicates the two categories of countries and periods are those with "low uncertainty" and "high uncertainty". Moreover, the asymptotic confidence intervals for the threshold are moderately tight, indicating good precision regarding this division's nature.

The confidence interval of the threshold uncertainty estimate are the values of γ (which lives in the space of the uncertainty variable on the horizontal axis of Figure 1) for which the likelihood ratio of equation (6) is below the dotted line (the 90% confidence level) of equation (7). The estimation procedure maintains a good level of precision since the confidence interval, the set of values specified below the dotted line, is small. Note that the confidence interval is asymmetric around the uncertainty threshold estimate.

Figure 1: Confidence interval construction for threshold

(a) Model without controls (b) Model with controls



3.4 Slope estimation results

Turning to the estimates of a threshold model (all specifications in Table 5), the effect of fiscal consolidation on investment varies between the two regimes. In countries with "low uncertainty" –less than 0.39– there is no statistically significant relationship between fiscal consolidation and investment, while in "high uncertainty" periods and countries, the effect is significant negative.[12] Therefore, we conclude that two regimes are distinguished by the level of economic uncertainty within which fiscal consolidation has a different effect on investment.[13]

[12] Note, the null hypothesis of a linear model is rejected in all cases in favor of the threshold model.

[13] All regression in Table 5 use fixed effects to control for country heterogeneity. Although our sample includes only OECD countries, we still expect to have some unobserved country-specific idiosyncrasies

Table 5: Least Squares (LS) estimates of the threshold model

Dependent variable: Investment	(1)	(2)	(3)
Uncertainty threshold estimate ($\widehat{\gamma}$)	0.392	0.390	0.390
[90% Confidence Interval]	[0.285; 0.492]	[0.285; 0.501]	[0.285; 0.450]
Fiscal consolidation (Uncertainty $< \widehat{\gamma}$)	-0.131	-0.109	-0.109
Cyclically adjusted primary balance (CAPB)	(0.115)	(0.104)	(0.104)
Fiscal consolidation (Uncertainty $\geq \widehat{\gamma}$)	-0.382***	-0.331***	-0.334***
Cyclically adjusted primary balance (CAPB)	(0.064)	(0.063)	(0.063)
Transitional convergence	-0.133***	-0.137***	-0.136***
Lag of capital stock/GDP, in logs	(0.022)	(0.020)	(0.020)
Financial depth	-	-0.004	-0.004
Domestic credit to private sector/GDP, in logs		(0.003)	(0.003)
Human capital		-0.053**	-0.043
Index based on schooling and returns, in logs	-	(0.024)	(0.026)
Public infrastructure	-	-0.030	-0.034
Fixed and mobile lines per 100 people, in logs		(0.033)	(0.032)
Institutions	-	1.392***	1.393***
Average of 4 ICRG indicators		(0.482)	(0.483)
Trade openness	-	-0.020**	-0.020**
Export plus import to GDP, in logs		(0.010)	(0.010)
Price instability	-	0.092	0.094
CPI growth		(0.068)	(0.068)
World GDP growth	-	-	1.154
Real GDP per capita % change			(1.382)
Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Test for threshold effects (p-value)	0.027	0.080	0.067
Number of countries	27	27	27
Time period	1996-2019	1996-2019	1996-2019

Notes: Heteroskedastic standard errors in parentheses. *, ** and *** denote statistical significance at the 10, 5 and 1% level, respectively. The test shows the probability value for the null hypothesis of $\widehat{\beta}_1 = \widehat{\beta}_2$. We used 300 bootstrap replications for the test.

The economic magnitudes of these estimates indicate that a percentage increase in fiscal tightening, as it is expressed by CAPB (% of potential GDP), decreases investment (% of GDP) by 0.33. The latter effect becomes slightly larger when additional

that are expected to drive the relationship under investigation.

controls are not used in the model. Comparing the size of the impact of fiscal consolidation between threshold and linear estimations (Table 3), the effect in the high uncertainty regime (within the range of -0.382 and -0.331) is near 50% higher compared to the average effect found in the linear model. From a policy-making point of view, neglecting the non-linearity underestimates the negative impact of fiscal consolidation on investment. Regarding the control variables, results are identical to what is presented in Table 3.[14]

3.5 Observations of high and low uncertainty regimes

To further elaborate on the existence of uncertainty thresholds within our sample, we address the following questions: (i) what fraction of the observations belong to each uncertainty regime? (ii) which countries have the most observations in each one of the two regimes? (iii) what is the time pattern of these regimes? Table 6 provides information that sheds light on (i) and (ii). Based on the estimated uncertainty threshold, the model shows that 31% of the observations belong to the low uncertainty regime, while 69% belongs to the high uncertainty region.

Table 6: Percentage of observations in each regime by country

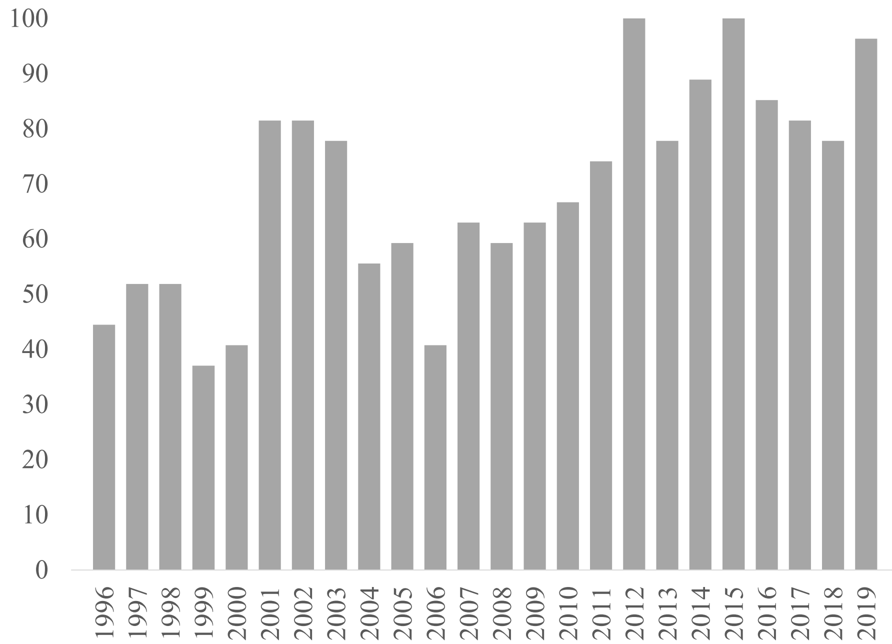
Country	Low	High	Country	Low	High
Australia	41.7	58.3	Japan	29.2	70.8
Austria	50.0	50.0	Korea	25.5	75.0
Belgium	54.2	45.8	Netherlands	41.7	58.3
Canada	25.0	75.0	New Zealand	33.3	66.7
Czech Republic	20.8	79.2	Norway	33.3	66.7
Denmark	25.0	75.0	Poland	25.0	75.0
Finland	66.7	33.3	Portugal	25.0	75.0
France	12.5	87.5	Slovenia	41.7	58.3
Germany	16.7	83.3	Spain	16.7	83.3
Greece	45.8	54.2	Sweden	20.8	79.2
Hungary	33.3	66.7	Switzerland	37.5	62.5
Ireland	50.0	50.0	United Kingdom	8.3	91.7
Israel	20.8	79.2	United States	25.0	77.0
Italy	12.5	87.5	Full sample	31.0	69.0

Among the countries with important number of their observations in the low uncertainty, regime are Austria, Belgium, Finland and Ireland, with more than 50% in this

[14]Note also that some control variables are in logarithmic terms to interpret the estimated coefficients as semi-elasticities; when estimations are made without taking logarithms, the central result of the linear and non-linear relationship between fiscal consolidation and investment holds.

regime. In contrast, France, Germany, Italy, Spain and United Kingdom have at least 80% of their observations in the high uncertainty regime. Regarding question (iii), Figure 2 shows countries' time evolution in the high uncertainty regime. Observations from this group are primarily concentrated in the period after the Great Recession of 2008, except for a short bout of high uncertainty around 2001-2003. However, the post-Great Recession period does not show a uniform pattern of increase, as years with a high percentage of countries in the high uncertainty regime are followed by years with a low share of countries in this regime.

Figure 2: Percentage of countries in the high uncertainty regime over time



4 Robustness

In this section, we examine the robustness of our main results by changing the estimation method and assessing the sensitivity of the location of the estimated uncertainty threshold across estimation methods (least squares vs. maximum likelihood estimations).

4.1 Maximum likelihood estimation

This section shows results from some additional sensitivity tests to ensure that previous results remain robust to alternative methodological approaches. The first issue addressed is whether our results are robust if we apply an estimator other than least squares. Although in equation (2), the lag of the dependent variable is not included as a regressor, the lag of the capital stock to GDP ratio may represent the dynamic feature of the model, since the investment –according to the perpetual inventory method– can be defined as $I_{it} = k_{it} - (1-d)k_{it-1}$, where d is the depreciation rate. In this context, we use the maximum likelihood (ML) estimator of a threshold model estimation following Ramírez-Rondán (2020). Our estimation framework proposes a first difference transformation of (2).

4.1.1 Threshold and slope estimations

The generic model specified in (2) may imply that a fixed effects estimator is not feasible as it introduces a correlation between the transformed regressors and the transformed error term, thus inconsistent slope parameters. To eliminate the country-specific effect, we apply the first difference transformation of model (2)[15] (Similar to LS estimation, we do not include control variables to simplify the exposition of the method). We then have:

$$\Delta I_{it} = \kappa \Delta k_{it-1} + \beta_1 \Delta x^{*}_{it}(\gamma) + \beta_2 \Delta x^{+}_{it}(\gamma) + \Delta \epsilon_{it}, \tag{11}$$

where $\Delta I_{it} \equiv I_{it} - I_{it-1}$, $\Delta k_{it-1} \equiv k_{it-1} - k_{it-2}$, $\Delta x^{*}_{it} \equiv x_{it}1(q_{it} \leq \gamma) - x_{it-1}1(q_{it-1} \leq \gamma)$, $\Delta x^{+}_{it} \equiv x_{it}1(q_{it} > \gamma) - x_{it-1}1(q_{it-1} > \gamma)$, and $\Delta \epsilon_{it} \equiv \epsilon_{it} - \epsilon_{it-1}$.

The ML estimation of the dynamic panel linear model (11) depends on the initial condition, which is key feature of the model for establishing consistent estimates (see Hsiao *et al.*, 2002). We assume that the process has started from a finite period in the past, such that the expected changes in the initial endowments are the same across all individual units. The model specification in the first period[16] $t = 1$ is then given by $\Delta I_{i1} = \delta + v_{i1}$, where δ is an auxiliary external parameter.[17] Furthermore, we assume exogeneity of x_{it}, homoscedasticity across regimes, and by construction, $E(v_{i1}|x_i) = 0$, where $x_i = (x_{i0}, x_{i1}, ..., x_{iT})'$, and $Ev^2_{i1} = \sigma^2_v$.

Let $\Delta I_i = (\Delta I_{i1}, \Delta I_{i2}, ..., \Delta I_{iT})'$ and $\Delta \epsilon_i = (v_{i1}, \Delta \epsilon_{i2}, ..., \Delta \epsilon_{iT})'$, and also define $\omega = \sigma^2_v / \sigma^2_\epsilon$. Under the assumption that ϵ_{it} is independent and normal, the joint probability

[15] This transformation also introduces a possible correlation between the lagged variable and the error term in the first differences. Nonetheless, the use of the ML estimator ensures consistent estimates.

[16] We assume that variables are available (observable) from $t = 0$.

[17] Model (11) is not well defined for $t = 0$ since Δk_{i0} are missing; that is, values for $t = -1$ are not available; for which, assumption on the initial period $t = 1$ is required to ensure consistent estimates under the ML approach.

distribution function of ΔI_i is equivalent to (in logarithm):

$$lnL(\delta, \beta, \kappa, \gamma, \sigma_\epsilon^2, \omega) = -\frac{nT}{2} ln(2\pi) - \frac{n}{2} ln|\Omega| \\ - \frac{1}{2}\sum_{i=1}^{n} \Delta\epsilon_i(\delta, \beta, \kappa, \gamma)'\Omega^{-1}\Delta\epsilon_i(\delta, \beta, \kappa, \gamma), \quad (12)$$

where the covariance matrix Ω is defined in Hsiao *et al.* (2002) as:

$$\Omega = \sigma_\epsilon^2 \begin{bmatrix} \omega & -1 & 0 & \dots & 0 \\ -1 & 2 & -1 & & \\ 0 & -1 & 2 & & \\ \vdots & & & \ddots & -1 \\ 0 & & & -1 & 2 \end{bmatrix}.$$

The algorithm for the ML estimation proceeds in the following five steps:[18] (i) form a grid on the empirical distribution of the threshold variable q_{it}, (ii) calculate $\widehat{\delta}(\gamma)$, $\widehat{\kappa}(\gamma)$, $\widehat{\beta}(\gamma)$, $\widehat{\sigma}_\epsilon^2(\gamma)$ and $\widehat{\omega}(\gamma)$ by maximizing that function (by iterative technique such as the Newton-Raphson procedure or a grid search method on ω) on the grid specified in (i); (iii) plug previous estimates in (12), which is only an expression of γ:

$$lnL(\gamma) = -\frac{nT}{2} ln(2\pi) - \frac{n}{2} ln|\widehat{\Omega}(\gamma)| - \frac{1}{2}\sum_{i=1}^{n} \Delta\widehat{\epsilon}_i(\gamma)'\widehat{\Omega}(\gamma)^{-1}\Delta\widehat{\epsilon}_i(\gamma), \quad (13)$$

as $\Delta\widehat{\epsilon}_i(\gamma) = [\Delta I_{i1} - \widehat{\delta}(\gamma), \Delta I_{i2} - \widehat{\kappa}(\gamma)\Delta k_{i1} - \widehat{\beta}_1(\gamma)\Delta x_{i2}^*(\gamma) - \widehat{\beta}_2(\gamma)\Delta x_{i2}^+(\gamma), \dots, \Delta I_{iT} - \widehat{\kappa}(\gamma)\Delta k_{iT-1} - \widehat{\beta}_1(\gamma)\Delta x_{iT}^*(\gamma) - \widehat{\beta}_2(\gamma)\Delta x_{iT}^+(\gamma)]'$. (iv) Since function (13) is not smooth in γ, we find $\widehat{\gamma}$ on the grid of the threshold variable which yields the highest value of the likelihood function; (v) we set $\widehat{\kappa} = \widehat{\kappa}(\widehat{\gamma})$, $\widehat{\beta}_1 = \widehat{\beta}_1(\widehat{\gamma})$ and $\widehat{\beta}_2 = \widehat{\beta}_2(\widehat{\gamma})$.

4.1.2 Asymptotic confidence intervals and test for threshold effects

With regards to the inference of the parameter estimates and testing for threshold effects, the steps are quite similar to the LS estimator shown before. The difference in this case is that for the formulas $LR(\gamma)$ and F, $S(\gamma) = \sum_{i=1}^{n} \Delta\widehat{\epsilon}_i(\gamma)'\widehat{\Omega}(\gamma)^{-1}\Delta\widehat{\epsilon}_i(\gamma)$ is the minimum distance estimator. To test for threshold effects, after the first difference transformation that eliminates μ_i in the linear equation (8), we get

$$\Delta I_{it} = \kappa\Delta k_{it-1} + \beta_1\Delta x_{it} + \Delta\epsilon_{it}; \quad (14)$$

[18] We refer to Ramírez-Rondán (2020) for further details on the estimation.

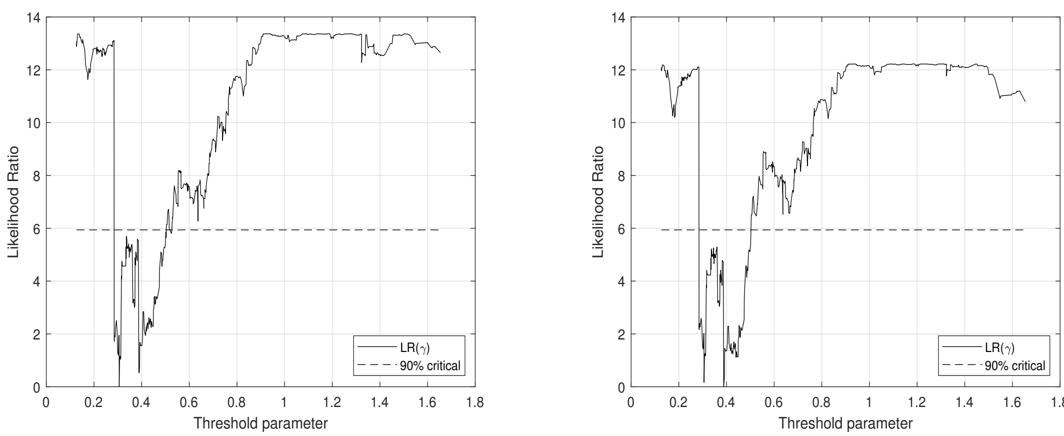
where the parameters κ, β_1 and ω are estimated by maximum likelihood, yielding estimates $\widehat{\kappa}$, $\widehat{\beta}_1$, $\widehat{\omega}$, residuals $\widehat{\epsilon}_{it}$ and let $S_0 = \sum_{i=1}^{n} \Delta\widehat{\epsilon}_i' \widehat{\Omega}^{-1} \Delta\widehat{\epsilon}_i$ be the minimum distance estimator of the linear model. The next steps are the same as in the LS approach.

4.1.3 Results from the ML estimation

Figure 3 shows the likelihood ratio for models with and without controls, likewise the LS estimator in Figure 1. The value of the uncertainty threshold parameter from ML is estimated at 0.31 and 0.39 in a model without control variables and in a model with control variables, respectively, the latter identical to the LS estimate, with a 90% confidence interval that remains broadly the same. Therefore, we can conclude that the uncertainty threshold is robust between the two estimation methods.

Figure 3: Confidence interval construction for threshold

(a) Model without controls (b) Model with controls



Turning to the ML estimates in Table 7, results are similar to the baseline findings in Table 5, nonetheless, fiscal consolidation now affects investment in both uncertainty regimes negatively in a model without controls. The economic size of this effect between regimes, though, varies substantially. Precisely, in the low uncertainty regime, the coefficient of the fiscal consolidation is not significant when controls are included, while in the high uncertainty scenario, the coefficient suggests that a percentage point increase in CAPB decreases investment by 0.34. Estimates of fiscal consolidation under low uncertainty are below the average coefficients of the linear model in Table 3, while they are more than three times smaller than those under high uncertainty.

These findings confirm the central thesis that the nexus between fiscal policy and investment is non-linear and varies with the degree of economic uncertainty in the country; furthermore, the non-linearity test tends to accept the threshold effects model.

Note that financial depth looses significance; while price stability and world GDP growth becomes significant. The robustness of these controls is usually assessed by taking 5- or 10-year averages of the variables.

Table 7: Maximum Likelihood (ML) Estimates of the threshold model

Dependent variable: Investment	(1)	(2)	(3)
Uncertainty threshold estimate ($\widehat{\gamma}$)	0.306	0.388	0.388
[90% Confidence Interval]	[0.285; 0.525]	[0.285; 0.501]	[0.285; 0.501]
Fiscal consolidation (Uncertainty $< \widehat{\gamma}$)	-0.104*	-0.104	-0.104
Cyclically adjusted primary balance (CAPB)	(0.057)	(0.072)	(0.072)
Fiscal consolidation (Uncertainty $\geq \widehat{\gamma}$)	-0.371***	-0.342***	-0.342***
Cyclically adjusted primary balance (CAPB)	(0.068)	(0.057)	(0.057)
Transitional convergence	-0.130***	-0.125***	-0.125***
Lag of capital stock/GDP, in logs	(0.021)	(0.022)	(0.022)
Financial depth	-	-0.008	-0.008
Domestic credit to private sector/GDP, in logs		(0.005)	(0.005)
Human capital		-0.043**	0.043**
Index based on schooling and returns, in logs	-	(0.020)	(0.020)
Public infrastructure	-	-0.055***	-0.055***
Fixed and mobile lines per 100 people, in logs		(0.013)	(0.013)
Institutions	-	1.500***	1.500***
Average of 4 ICRG indicators		(0.280)	(0.280)
Trade openness	-	-0.016**	-0.016**
Export plus import to GDP, in logs		(0.007)	(0.007)
Price instability	-	0.087**	0.087**
CPI growth		(0.036)	(0.036)
World GDP growth	-	-	0.316***
Real GDP per capita % change			(0.083)
Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Test for threshold effects (p-value)	0.067	0.097	0.097
Number of countries	27	27	27
Time period	1996-2019	1996-2019	1996-2019

Notes: Heteroskedastic standard errors in parentheses. *, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively. The test shows the probability value for the null hypothesis of $\widehat{\beta}_1 = \widehat{\beta}_2$. We used 300 bootstrap replications for the test.

4.2 Estimated threshold location: testing for outliers

This subsection tests the sensitivity of the estimated uncertainty threshold to outliers. To this end, we re-estimate the uncertainty threshold considering a "leave-one country out", "leave-two countries out", and "leave-three countries out" sub-samples. We then analyze how often the estimated uncertainty thresholds fall within the 90% confidence interval of the baseline threshold found in Section 3. This exercise rules out the possibility that outlier countries influence the threshold estimate. Note that, when testing, we use the model that includes all the control variables.

For the "leave-one country out" sub-sample, there are only 27 possibilities since there are 27 countries in the sample. For the "leave-two countries out" and "leave-three countries out" sub-samples, we take 200 draws which randomly exclude two and three countries from all possible combinations. Table 8 shows the results of these tests for the LS and ML estimators. The table indicates that no more than 5% of the sub-sample estimates fall out of the confidence interval across estimation methods, thus, the estimated threshold of 0.39 for the degree of economic uncertainty used in Tables 5 and 7 is robust to sample changes. Therefore, we conclude that the estimated threshold is robust to alternative estimators and sub-sample changes. Overall, we can argue that current findings offer a very robust pattern of the non-linear effect of fiscal consolidation on investment in a large sample of OECD countries.

Table 8: Robustness of the threshold estimate

% of threshold estimates that fall in 90% confidence interval		
	LS estimation	ML estimation
Leave-one country out	100%	100%
Leave-two countries out	99%	100%
Leave-three countries out	95%	98%

Note: for the leave two and three countries out tests, we used 200 draws from all possible combinations in each sample.

5 Conclusion

This paper looks for asymmetries in the relationship between fiscal consolidation and investment, where we consider uncertainty as the main catalyst that interferes in the interplay between both variables. The empirical findings of this underdeveloped area report evidence of an average relationship between discrete changes in fiscal consolidation and economic outcome variables. We depart from the current literature by focusing on investment, which represents the capacity of the economy and its ability to generate growth and prosperity in the long-term. We argue that the effect of fiscal consolidation on investment varies with the degree of economic uncertainty.

Economic uncertainty is used in our analysis because when uncertainty is low, financial markets are expected to function well and fiscal loosening can adversely affect capital accumulation in these regions. However, the effect of fiscal tightening on the economy is self-defeating in periods of high uncertainty, trapping the economy into a loop where neither private nor public funding is available. This gloomy scenario is relevant in the sample of 27 OECD countries for the period 1996-2019. This finding remains robust across alternative estimation methods and sub-samples, suggesting that a percentage point increase in CAPB as a share of potential GDP (fiscal tightening) can decrease investment by 0.33 units in periods of high uncertainty.

Our findings highlight the importance of the government sector as the investor of last resort in high uncertainty scenarios. Furthermore, our results imply that overusing austerity can have multiple harmful effects in the short-term and, more importantly, undermine the economy's growth prospects. Regarding the latter, our paper suggests that the productivity slowdown in OECD countries is most likely the result of fiscal tightening, which lowered capital deepening and reduced the economy's productive capacity.

The financing of fiscal loosening could be relevant, as it today creates expectations for higher debt that might increase interest rates discouraging private investment in the future, but it can be offset by future lump-sum taxes leaving debt unaffected (Eggertsson, 2006). Thus, debt dynamics are not expected to play a significant role due to Ricardian equivalence, as any debt accumulated due to expansionary fiscal policy can be repaid mainly through higher growth rates in the future. However, it will be interesting to see empirically how the effects of fiscal policy on sovereign spreads and/or debt interact with uncertainty, this could shed light on an additional underlying mechanism of the differential effects of uncertainty on the fiscal consolidation-investment relationship. We leave this analysis for future research.

The global pandemic, along with old (i.e. industrial sovereignty, foreign investment, public debt, climate change) and new challenges (i.e. global value chains, digitalization), calls for a more sustainable development paradigm. An ideal natural experiment is to apply the policy lessons of the current framework to guide the role of fiscal policy under weak investor sentiment like the period immediately after the COVID-19 pandemic. Following an unprecedented period of stagnation, the recovery and handling of new and ongoing challenges will determine growth prospects and living standards in the OECD. Understanding the role of fiscal policy in addressing these challenges can be an excellent objective for future research.

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