Does uncertainty matter for the fiscal consolidation and capital intensity nexus?

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Does uncertainty matter for the fiscal consolidation and capital intensity nexus?*

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Abstract

The paper looks for non-linearities in the relationship between fiscal consolidation and capital intensity (capital per worker). To understand this nexus, we consider the broader state of the economy as it is represented by the degree of economic 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 capital intensity differs substantially. In the low uncertainty regime, fiscal tightening is either irrelevant or has a relatively small negative economic effect on the evolution of capital intensity. In the high uncertainty regime, the negative effect of fiscal tightening on capital intensity can be three times bigger in comparison to the effect 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.

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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 with reference to 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] When it comes to the assessment of austerity policies, the attention of policymakers is gathered to consumption, wages and unemployment with little focus on how austerity impacts the productive capacity of the economy. Recently Bardaka et al. (2021) endeavour to shed light on this direction by identifying the existence of more persistent austerity effects that are overlooked in the current literature. Accordingly, increases in the cyclically adjusted primary balance (CAPB) (i.e.fiscal tightening) in OECD countries are found to decelerate the rate of Total Factor Productivity (TFP) by 0.46% annually.

Two issues are raised here, first, austerity results in losses in the growth of potential output and second, little is known about the channels through which these losses emerge. Losses in potential output are the "dark matters" of austerity (Stiglitz, 2016) and a more systematic investigation is required to highlight possible misconceptions related to austerity policies. According to Ball (2014), the dynamics of austerity vary substantially with the country-specific idiosyncrasies. Countries with large losses of potential output are already in a bad growth trajectory due to the inherited weakness that is getting worse by the prolonged austerity. The long-term effects of austerity remain unexplored in the current literature and constitute the departure point of the present paper, whose key objective is to link how changes in discretionary fiscal policy weaken the accumulation of capital.

In the neoclassical growth framework, the capital-labour ratio is the main source of the level of income per capita. Policy changes in a fiscal context that affect the evolution of capital can cause long-term shocks in social welfare and the standards of living. The focus so far is only on the temporary effects of austerity on fiscal balances, which is an obvious limitation as it disregards the role of the government as an investor and the opportunity cost of the sacrificed public investment due to austerity. Spending cuts go beyond wages in the public sector, social transfers and benefits to

[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). More recent evidence Jordà and Taylor (2016) challenge the view of expansionary austerity revealing cumulative GDP losses that can be in the order of 3.5% during slumps.

cuts in infrastructure, public health and education that form the productive base of the economy.[2] Many advanced economies with high levels of debt mitigate the structural problem of low growth with strong fiscal adjustments. In circumstances of zero lower bound, fiscal consolidation is proved to be self-defeating as the reductions of deficits lead to lower potential output and a higher debt-to-GDP ratio (Fatás and Summers, 2018).

The key question emerging is how austerity decelerates investment, which undermines capital accumulation and the growth potential of the economy. To understand this link, we introduce a modelling approach that does not assume a monotonic relationship between fiscal consolidation and capital. Instead, we adopt a non-linear approach that searches for threshold effects between the two in accordance with the evolution of economic uncertainty in the country.[3] Our conceptual framework assumes an economy that operates below potential output with little space for monetary intervention due to zero lower bound and unwillingness to provide a quantitative stimulus (DeLong *et al.*, 2012). In this setup, fiscal policy is rendered as the only stabilizing mechanism of the investment sentiments in the economy. In our framework, the size of the multiplier effect from fiscal loosening depends on the regime of uncertainty that holds in the economy.

Economic uncertainty is a forward-looking and text-based measure that covers public domain discussions of socio-economic issues (Ahir *et al.*, 2018). Uncertainty is strongly counter-cyclical. When the economy is on its long-run trajectory path, uncertainty remains low, therefore fiscal consolidation works precautionarily by eliminating the need for larger fiscal contractions in the future. This argument becomes less appropriate when the economy is in a recession with a high level of uncertainty. In that case, private investment is already reduced and fiscal consolidation fuels the pessimism of the market, which leads to an even larger contraction of investment. Therefore, the regime of economic uncertainty drives differently the relationship between austerity and the capital-labour ratio.[4]

[2] Stiglitz (2016) argues that national account statistics do not include the missing capital and the output lost due to austerity in periods of economic downturns, which implies that the cost of austerity goes far beyond the calculations reported in conventional metrics. Certainly, fiscal contraction is not the only source of the low investment to GDP ratio over the last two decades in the OECD. See Eggertsson *et al.* (2021) for the role of monopoly power as another underlying factor of the sluggish investment.

[3] Similar empirical models have been proposed to study the non-linear debt effects on economic growth (see for instance Égert, 2015).

[4] Servén (2003) has assessed how exchange rate uncertainties impact private investment. Within our context, the sources of uncertainty can include many aspects from the economic and political spheres.

Following the previous discussion, the ultimate goal of the paper is to investigate whether the sign of the relationship between fiscal consolidation and capital intensity varies as the economy moves across different regimes of economic uncertainty. We use the newly assembled data of the World Uncertainty Index (WUI) of Ahir *et al.* (2018) for 27 OECD countries over the period 1996 to 2019 to estimate a dynamic panel specification of capital-labour ratio 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 separates the observations into discrete groups based on their level of uncertainty. The WUI variable splits the sample endogenously into two or more regimes as dictated by the data, and then we estimate the nexus of fiscal consolidation and capital intensity for the different regimes within a unified framework (Hansen, 1999, 2000).

The contributions of the paper are twofold. The first contribution of the paper is to offer a more systematic investigation of the long-term effects of fiscal consolidation that go beyond the obvious candidates of public debt, consumption and unemployment. In this respect, our paper introduces a new agenda with robust evidence for the existence of permanent (negative) effects in the productive capacity of 27 OECD economies due to fiscal tightening in periods of high economic uncertainty. The second contribution highlights the need for more flexible modelling approaches in capturing the non-linearities that underlie the relationship between government policy and economic activity. Our econometric approach offers flexibility in policy design away from the "one size fits all" norm, which is usually counter-productive without taking into account country-specific characteristics.

The *average* effect of CAPB on the growth rate of capital intensity is found to be negative. Nonetheless, this result jeopardizes the true nature of the relationship between the two variables when economic uncertainty is taken into account. In the regime of low uncertainty, fiscal consolidation is irrelevant for the capital-labour ratio. In the regime of high uncertainty, we found that fiscal contraction becomes harmful as the government is expected to play a more aggressive role in rectifying the negative market sentiments through fiscal stimulus and not otherwise. Within this context, fiscal policy should be viewed as a substitute to imperfect credit markets that behave reluctantly in periods of high uncertainty. Our paper questions the effectiveness of the austerity policies implemented in many Eurozone countries over the last ten years on the grounds of "missing capital", which is under-represented (if not completely ignored) when it comes to the evaluation of the austerity programs.

We organize the paper as follows: section 2 discusses the formulation of our hypotheses and the measurement of the uncertainty index, section 3 discusses estimation, inference and testing issues related to the threshold model, section 4 discusses results from the threshold model, section 5 shows the robustness analysis, and section 6 concludes the paper.

2 Fiscal Policy under Different Regimes of Uncertainty

The paper put forward two hypotheses, in periods of low economic uncertainty with high levels of business and consumer confidence, firms can obtain easily external finance. In a low uncertainty regime, fiscal loosening crowds out real private investment, which destabilizes the business environment and decelerates capital accumulation. The first hypothesis of the paper is specified as follows:

H1: *In a low uncertainly regime, fiscal expansion crowds out private investment leading to a lower growth rate of capital per worker.*

In a high economic uncertainty with negative deviations from the potential output, the crowding-out effect is less relevant. In periods of uncertainty with low actual output, private markets encounter various frictions that make them more reluctant to supply credit. In this scenario, recession persists if the government treats the low GDP growth rate as a structural issue that can be mitigated by fiscal contraction. In fact, this policy action generates hysteresis effects (the cyclical effect of lower output obtains more permanent features), while the economy falls into a negative loop with more pessimistic expectations and higher uncertainty. (DeLong *et al.*, 2012; Fatás and Summers, 2018).

In the high uncertainty regime, fiscal stimulus is the channel to get the economy out of the negative loop. We know that fiscal multipliers are larger in conditions of binding credit constraints (Corsetti *et al.*, 2012), which, in our context, implies that fiscal tightening is an inappropriate policy choice as it would hit disproportionately the investment decisions of firms dependent on external finance (Aghion et al., 2014). To sum up, fiscal consolidation in a highly uncertain environment pushes the economy towards a bad equilibrium. The second hypothesis of the paper is specified as follows: [5]

[5] The nexus between uncertainty and the capital-labour ratio works similar to the default uncertainty scenarios described in De Grauwe (2013). Given that the central bank is constrained by zero bounded interest rates (i.e. the case for most OECD countries), it is within the discretion of fiscal policymakers to break the chain of self-fulfilling expectations in periods of high economic uncertainty.

H2: *In a high regime uncertainty, fiscal policy should expand to break the chain of self-fulfilling expectations, restore the confidence of private investors and return the economy to the long-term trajectory with positive growth rates of capital per worker.*

Concerning the measure of economic uncertainty, the WUI index gathers information from 90 reports in each country that covers economic, financial, and political trends. The index is constructed by measuring the frequency of word "uncertainty" in these reports (i.e. number of times mentioned). To ensure cross-country comparability of the index, raw counts of the word are scaled over the total number of words in each report. Each country report is derived from the Economic Intelligence Unit (EIU) and it is written following a standardized five-step procedure.[6]

3 Data and methodology

In this section, we discuss our methodology and database. We postulate that uncertainty affects the fiscal consolidation and capital intensity nexus by separating the sample into two or more regimes. In particular, we embed a capital intensity growth 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 retrieved mainly from the Penn World Table, World Development Indicators and Ahir *et al.* (2018).

3.1 Specification

We specify the following equation:

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

where k_{it} is the growth rate of capital intensity (capital stock-labour ratio) in country i at year t; μ_i is an unobserved country-fixed effect; 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 k_{it-1} is the dynamic

[6] (i) A field expert drafts a report of the country, (ii) a country expert at the headquarters of EIU integrates the draft with her own 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 check 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.

feature of the model that captures the accelerator effect of investment, whereby past investments have a positive effect on future investments (Aivazian *et al.*, 2005).

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

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

where q_{it} is a country's uncertainty measure; and $1(.)$ is an indicator variable which takes the value of 1 if uncertainty is greater 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 capital intensity 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 from the moves of the business cycles.[7] In that respect, one must expect that endogeneity bias is not a concern. In fact, 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 growth rate of GDP per capita and the growth rate of government expenditure (not the level, as it is in our case) we are less worried about endogeneity between capital intensity and CAPB in our estimation.

The vector Z_{it-1} of additional controls includes lagged variables that potentially determine capital intensity growth. There is extensive literature on the determinants of economic growth or its sources such as capital intensity and total factor productivity. These covariates are human capital, financial depth, public infrastructure, institutions, trade openness, price instability and external factors (world GDP growth rate). To reduce potential endogeneity that commonly exists in empirical growth models between contemporaneous values of the control variables and the error term, we lag these controls by one year to ensure weak exogeneity.[8]

[7] 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).

[8] 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 with the use of instrumental variables, though this application is beyond the scope of the present paper.

3.2 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). Appendix A shows the sources and the definitions of variables used for estimating (2). The availability of data dictates the length of time span and the country coverage. Summary statistics of the variables used in the empirical part are provided in Appendix B.

3.3 Threshold regression model

We now turn to the specification of a threshold regression that identifies different regimes in the relationship between fiscal consolidation and capital per worker. Threshold models divide individual observations into classes based on the value of an exogenous observed variable.[9] 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. As our proposed model is dynamic, we use the maximum likelihood (ML) estimator within the context of a threshold model estimation following Ramírez-Rondán (2020). Our estimation framework proposes a first difference transformation of the endogenous variable, which is in our case, the lagged capital intensity growth.

We divide the observations into two regimes depending on whether the threshold variable q_{it} 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). For the identification of these coefficients, the elements of q_{it} (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_ϵ^2. The implementation of the threshold model in a dynamic context involves three steps: estimation, inference and testing. We now proceed with the first step.

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

3.3.1 Threshold and slope estimations

The generic model specified in (2) is dynamic, which implies 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).[10] We then have:

$$k_{it} - k_{it-1} = \kappa(k_{it-1} - k_{it-2}) + \beta_1(x_{it}1(q_{it} \leq \gamma) - x_{it-1}1(q_{it-1} \leq \gamma)) + \beta_2(x_{it}1(q_{it} > \gamma) - x_{it-1}1(q_{it-1} > \gamma)) + \epsilon_{it} - \epsilon_{it-1}. \tag{3}$$

Let $\Delta k_{it} \equiv k_{it} - k_{it-1}$, $\Delta x^*_{it} \equiv x_{it}1(q_{it} \leq \gamma) - x_{it-1}1(q_{it-1} \leq \gamma)$, $\Delta x^+_{it} \equiv x_{it}1(q_{it} > \gamma) - x_{it-1}1(q_{it-1} > \gamma)$, and $\Delta\epsilon_{it} \equiv \epsilon_{it} - \epsilon_{it-1}$, then with these notations equation (3) is equivalent to:

$$\Delta k_{it} = \kappa\Delta k_{it-1} + \beta_1\Delta x^*_{it}(\gamma) + \beta_2\Delta x^+_{it}(\gamma) + \Delta\epsilon_{it}. \tag{4}$$

The ML estimation of the dynamic panel linear model (4) 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[11] $t = 1$ is then given by $\Delta k_{i1} = \delta + v_{i1}$, where δ is an auxiliary external parameter.[12] 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 $\Delta k_i = (\Delta k_{i1}, \Delta k_{i2}, ..., \Delta k_{iT})'$ 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 distribution function of Δy_i is equivalent to (in logarithm):

$$lnL(\delta, \beta, \kappa, \gamma, \sigma^2_\epsilon, \omega) = -\frac{nT}{2}ln(2\pi) - \frac{n}{2}ln|\Omega| - \frac{1}{2}\sum_{i=1}^{n}\Delta\epsilon_i(\delta, \beta, \kappa, \gamma)'\Omega^{-1}\Delta\epsilon_i(\delta, \beta, \kappa, \gamma), \tag{5}$$

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

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

[12] Model (4) is not well defined for $t = 0$ since Δy_{i0} and Δx_{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.

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:[13] (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 (5), which is only an expression of γ:

$$lnL(\gamma) = -\frac{nT}{2}ln(2\pi) - \frac{n}{2}ln|\widehat{\Omega}(\gamma)| - \frac{1}{2}\sum_{i=1}^{n}\Delta\widehat{\epsilon}_i(\gamma)'\widehat{\Omega}(\gamma)^{-1}\Delta\widehat{\epsilon}_i(\gamma), \tag{6}$$

as $\Delta\widehat{\epsilon}_i(\gamma) = [\Delta k_{i1} - \widehat{\delta}(\gamma), \Delta k_{i2} - \widehat{\kappa}(\gamma)\Delta k_{i1} - \widehat{\beta}_1(\gamma)\Delta x_{i2}^{*}(\gamma) - \widehat{\beta}_2(\gamma)\Delta x_{i2}^{+}(\gamma), \dots, \Delta k_{iT} - \widehat{\kappa}(\gamma)\Delta k_{iT-1} - \widehat{\beta}_1(\gamma)\Delta x_{iT}^{*}(\gamma) - \widehat{\beta}_2(\gamma)\Delta x_{iT}^{+}(\gamma)]'$. (iv) Since function (6) 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 $\widehat{\beta}_2 = \widehat{\beta}_2(\widehat{\gamma})$.

3.3.2 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 test on $\widehat{\gamma}$. To test hypothesis H_0: $\gamma = \gamma_0$, the likelihood ratio test is to reject for large values of $LR(\gamma_0)$:

$$LR(\gamma) = nT\frac{S(\gamma) - S(\widehat{\gamma})}{S(\widehat{\gamma})}, \tag{7}$$

where $S(\gamma) = \sum_{i=1}^{n}\Delta\widehat{\epsilon}_i(\gamma)'\widehat{\Omega}(\gamma)^{-1}\Delta\widehat{\epsilon}_i(\gamma)$ is the minimum distance estimator, which 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,

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

we use the asymptotic distribution ξ, which has the following inverse:

$$c(\alpha) = -2ln(1 - \sqrt{1-\alpha}), \tag{8}$$

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 $c(\alpha)$.

3.3.3 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

$$k_{it} - k_{it-1} = \mu_i + \kappa(k_{it-1} - k_{it-2}) + \beta_1 x_{it} + \epsilon_{it}, \tag{9}$$

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

$$\Delta k_{it} = \kappa \Delta k_{it-1} + \beta_1 \Delta x_{it} + \Delta\epsilon_{it}, \tag{10}$$

The parameters κ and β_1 are estimated by maximum likelihood, yielding estimates $\widehat{\kappa}$, $\widehat{\beta}_1$, 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 likelihood ratio test of H_0 is based on:

$$F = nT \frac{S_0 - S(\widehat{\gamma})}{S(\widehat{\gamma})} \tag{11}$$

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.

4 Estimation and inference results

4.1 Linear model results

Table 1 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 intensity growth that capture accelerator effects.

Regarding the main variable of interest, fiscal consolidation, the statistically negative coefficient points to the existence of crowding out effects in accordance with the neo-classical view that views fiscal loosening as a discouraging factor of private investment that causes adverse effects in the cost of borrowing of the private sector. The magnitude of this coefficient does not vary much across different specifications indicating that a 1% decrease in fiscal consolidation leads approximately to a decrease in the capital-labour ratio by 10%.

Table 1: Estimation results of the linear model (no thresholds)

Dependent variable: Capital intensity growth	(1)	(2)	(3)
Fiscal consolidation	-0.098***	-0.099***	-0.099***
Economic policy Uncertainty index	(0.030)	(0.031)	(0.032)
Accelerator effect	0.606***	0.499***	0.496***
Lag of capital intensity growth	(0.074)	(0.087)	(0.085)
Financial depth	-	-0.001	-0.001
Domestic credit to private sector/GDP, in logs		(0.001)	(0.001)
Human capital	-	-0.022**	-0.022**
Index based on schooling and returns, in logs		(0.010)	(0.010)
Public infrastructure	-	0.022**	0.022***
Fixed and mobile lines per 100 people, in logs		(0.009)	(0.009)
Institutions	-	-0.025	-0.030
Average of 4 ICRG indicators		(0.135)	(0.134)
Trade openness	-	-0.009	-0.009
Export plus import to GDP, in logs		(0.005)	(0.005)
Price instability	-	0.140***	0.141***
CPI growth		(0.044)	(0.045)
World GDP growth	-	-	-0.013
Real GDP per capita % change			(0.054)
Number of countries	27	27	27
Time period	1996-2019	1996-2019	1996-2019
Negative log-likelihood	1016.377	989.639	981.591

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

Among other factors that matter for the capital-labour ratio in columns (2) and (3) are public infrastructure and price instability. The former highlights the contribution of the public sector in shaping the necessary productive base of the economy, while the latter captures broader macroeconomic conditions. A stable monetary environment becomes attractive to net savers that choose to invest in portfolios of domestic assets. Surprises in inflation are considered among the crucial factors of uncertainty and risk in investment decisions that impact the expected profitability of capital. Table 1 does not assign a significantly important role for trade openness (the sum of imports and exports to GDP) in capital accumulation in our sample. This is not surprised given that countries in our sample are already close to the technological frontier with limited scope for learning through trade (Blalock and Gertler, 2004; Delgado *et al.*, 2002).

Specification (3) shows substitution effects between human and physical capital, which indicate that the more skillful workers allow for less thus more efficient use of physical capital. More generally, increases in the abundance of human capital, ceteris paribus, reduce the total cost of this input and induce changes in the input mix of the production process (Oldekop *et al.*, 2020). Overall, results in Table 1 without controlling for threshold effects accords well with previous findings in the literature (see Grier, 2002).

It should be noted that the growth empirical literature usually takes five- or ten-year averages, since growth is based on the long-term relationship. We do not do so here for two reasons. First, unlike the GDP growth measure, the capital stock is calculated in the form of averages to smooth out variations caused by investment expenditures (perpetual inventory method); second, taking five- or ten-year averages drastically reduces our sample size.

4.2 Threshold effects

The first step is to test for the existence of a threshold effect in the model that relates capital intensity growth and fiscal consolidation using the F test of equation (11). This also involves estimating equation (2) and computing the residual sum of squares for the uncertainty threshold. We conduct the test for the existence of threshold effects using a sample of 27 OECD countries over 23 years between 1996 and 2019.[14]

The test for the existence of threshold effects is shown in Table 2. 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 23.707 and 12.877 with their corresponding bootstrap p-value of 0.017 and 0.077 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

[14] 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.

of uncertainty in the fiscal consolidation and capital intensity growth relationship.

Table 2: Tests for threshold effects

	Uncertainty threshold estimate	Test F	Bootstrap p-value	Critical values
Model without controls	0.866	23.707	0.017	$11.709^{1/}$ $16.516^{2/}$ $28.693^{3/}$
Model with controls	0.866	12.877	0.077	$12.117^{1/}$ $14.958^{2/}$ $20.160^{3/}$

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.

4.3 Threshold estimate and its confidence interval

The uncertainty threshold estimate in all specifications is 0.866, which implies the high precision of the estimation procedure. This value is higher than the mean, 0.729, and lower than the 0.75 percentile, 1.010; indeed, this value is placed at the 0.68 percentile, which means that 32% observations fall in the high uncertainty regime.

The second step is to compute the confidence intervals. The point estimate of the threshold and their asymptotic 90%, 95%, and 99% confidence intervals are reported in Table 3. The two categories of countries and periods indicated by the point estimate are those with "low uncertainty" and "high uncertainty". Moreover, the asymptotic confidence intervals for the threshold are moderately tight, indicating once again good precision regarding the nature of this division.

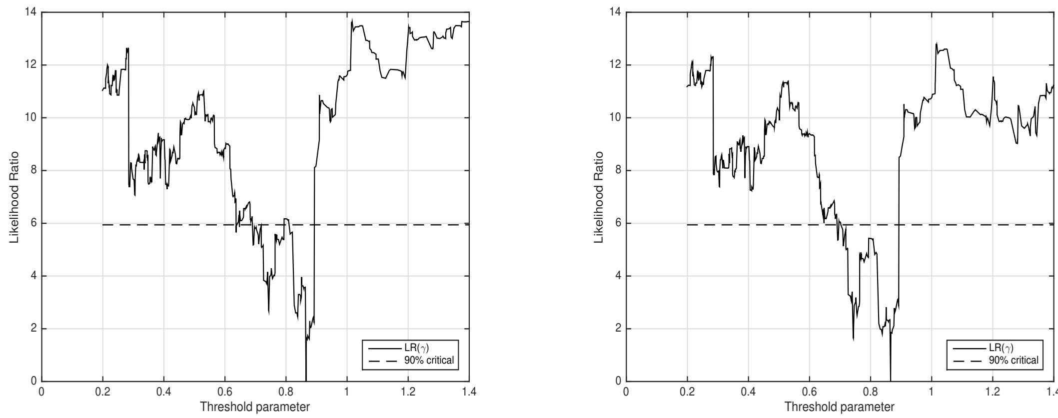
Table 3: Asymptotic confidence interval in threshold model

	Threshold	90% confidence interval	95% confidence interval	99% confidence interval
Model without control variables	0.866	[0.644; 0.892]	[0.304; 0.892]	[0.285; 0.963]
Model with control variables	0.866	[0.692; 0.892]	[0.406; 0.892]	[0.285; 1.350]

More information about the estimated threshold can be obtained by plotting the concentrated likelihood ratio function $LR(\gamma)$ of the estimate (see Figure 1). The function is minimized at zero for the estimated threshold value, $\widehat{\gamma} = 0.866$, in both models (with and without controls). The estimation procedure maintains a good level of precision, since the confidence interval, the set of values specified below the dotted line, is small.

Figure 1: Confidence interval construction for threshold

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



4.4 Slope estimation results

Turning to the estimates of a threshold model without control variables (column (1) in Table 4), the effect of fiscal consolidation on capital intensity growth varies between the two regimes. In countries with "low uncertainty" –less than 0.87– there is no statistically significant relationship between fiscal consolidation and capital intensity growth, while in "high uncertainty" countries the effect is significant.[15] Therefore, we conclude that there are two country regimes distinguished by the level of economic uncertainty within which fiscal consolidation has a different effect on capital intensity growth.[16]

The economic magnitudes of these estimates indicate that a percentage increase in fiscal tightening as it is expressed by CAPB (%GDP), decreases capital intensity growth by 0.193. The latter effect becomes slightly smaller when additional controls are used in the model. Comparing the size of the effect of fiscal consolidation between threshold and linear estimations (Table 1), the effect in the high uncertainty regime (within the range of 0.177 and 0.193) is nearly twice as much compared to the average effect found in the linear model (9.9%). From a policy-making point of view, neglecting the non-linearity underestimates considerably the negative impact of fiscal consolidation on the

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

[16] All regression in Table 4 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 that are expected to drive the relationship under investigation.

accumulation of capital. Regarding the remaining controls, the main drivers of capital intensity growth are public infrastructure and price stability, results identical to what is presented in Table 1.

Table 4: Maximum Likelihood (ML) estimates of the threshold model

Dependent variable: Capital intensity growth	(1)	(2)	(3)
Uncertainty threshold estimate ($\widehat{\gamma}$)	0.866	0.866	0.866
[90% Confidence Interval]	[0.644; 0.892]	[0.644; 0.892]	[0.644; 0.892]
Fiscal consolidation (Uncertainty $< \widehat{\gamma}$)	-0.066	-0.066	-0.064
Economic policy Uncertainty index	(0.044)	(0.042)	(0.043)
Fiscal consolidation (Uncertainty $\geq \widehat{\gamma}$)	-0.193***	-0.178***	-0.177***
Economic policy Uncertainty index	(0.063)	(0.058)	(0.058)
Accelerator effect	0.580***	0.502***	0.499***
Lag of capital intensity growth	(0.075)	(0.086)	(0.084)
Financial depth	-	0.000	0.000
Domestic credit to private sector/GDP, in logs		(0.002)	(0.002)
Human capital		-0.016	-0.016
Index based on schooling and returns, in logs	-	(0.011)	(0.011)
Public infrastructure	-	0.020***	0.020**
Fixed and mobile lines per 100 people, in logs		(0.007)	(0.007)
Institutions	-	-0.058	-0.064
Average of 4 ICRG indicators		(0.142)	(0.141)
Trade openness	-	-0.007	-0.007
Export plus import to GDP, in logs		(0.005)	(0.005)
Price instability	-	0.142***	0.143***
CPI growth		(0.041)	(0.041)
World GDP growth	-	-	-0.016
Real GDP per capita % change			(0.053)
Test for threshold effects (p-value)	0.017	0.047	0.077
Number of countries	27	27	27
Time period	1996-2019	1996-2019	1996-2019
Negative log-likelihood	1005.468	981.523	875.336

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.

4.5 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 5 provides information that sheds light to (i) and(ii). Based on the estimated uncertainty threshold, the model shows that 67.7% of the observations belong to the low uncertainty regime, while 32.3% belongs to the high uncertainty region.

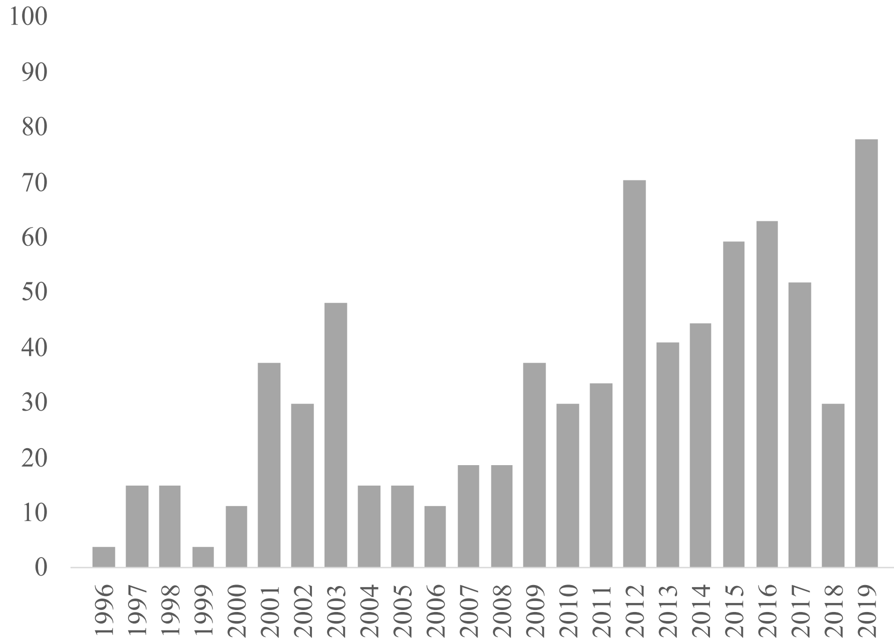
Table 5: Percentage of observations in each regime by country

Country	Low	High	Country	Low	High
Australia	79.2	20.8	Japan	79.2	20.8
Austria	75.0	25.0	Korea	50.0	50.0
Belgium	91.7	8.3	Netherlands	66.7	33.3
Canada	83.3	16.7	New Zealand	75.0	25.0
Czech Republic	66.7	33.3	Norway	75.0	25.0
Denmark	62.5	37.5	Poland	58.3	41.7
Finland	87.5	12.5	Portugal	58.3	41.7
France	75.0	25.0	Slovenia	70.8	29.2
Germany	66.7	33.3	Spain	50.0	50.0
Greece	70.8	29.2	Sweden	66.7	33.3
Hungary	62.5	37.5	Switzerland	66.7	33.3
Ireland	58.3	41.7	United Kingdom	50.0	50.0
Israel	62.5	37.5	United States	61.5	37.5
Italy	54.2	45.8	Full sample	67.7	32.3

Among the countries with half of their observations in the high uncertainty regime are Korea, Spain and United Kingdom followed by Portugal, Poland, Italy and Ireland with more than 40% in this regime. In contrast, Belgium, Finland, Australia, Canada and Japan have at least 80% of their observations in the low uncertainty regime. Regarding question (iii), figure 2 shows the time evolution of countries in the high uncertainty regime. Observations from this group are mostly 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 percentage of countries in this regime.

New Zealand has the lowest percentage of observations in the low uncertainty regime in 1996 (3.7%), while 21 countries in 2019 are placed in the high uncertainty regime with 77.8% of the observations. Although the uncertainty index is available until 2021,

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



we do not include this year due to lack of data in other variables.

5 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 (maximum likelihood vs. least squares estimations).

5.1 Least squares estimation

To ensure that previous results remain robust to alternative methodological approaches, this section shows results from some additional sensitivity tests. The first issue addressed is whether our results are robust if we apply an estimator other than ML. Hansen (1999) proposes a least squares (LS) threshold estimator for a static panel data model. Despite the obvious inconsistency of a LS estimator in a dynamic model with fixed effects, an appropriate transformation can still produce consistent and asymptotically independent estimate of the threshold parameter. We proceed with this transformation by eliminating the country-level fixed effect in equation (2):

$$k_{it}^{+} = \kappa(k_{it-1})^{+} + \beta_1(x_{it}1(q_{it} \leq \gamma))^{+} + \beta_2(x_{it}1(q_{it} > \gamma))^{+} + e_{it}^{+}, \tag{12}$$

where $k_{it}^{+} = k_{it} - T^{-1}\sum_{t=1}^{T} k_{it}$, $x_{it}1(q_{it} \leq \gamma))^{+} = x_{it}1(q_{it} \leq \gamma) - T^{-1}\sum_{t=1}^{T} x_{it}1(q_{it} \leq \gamma)$, $x_{it}1(q_{it} > \gamma))^{+} = x_{it}1(q_{it} > \gamma) - T^{-1}\sum_{t=1}^{T} x_{it}1(q_{it} > \gamma)$, and $e_{it}^{+} = e_{it} - T^{-1}\sum_{t=1}^{T} e_{it}$; 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

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

$$Y_i = \begin{bmatrix} k_{i1}^{+} \\ k_{i2}^{+} \\ \vdots \\ k_{iT}^{+} \end{bmatrix}; \quad \text{and} \quad e_i^{+} = \begin{bmatrix} e_{i1}^{+} \\ e_{i2}^{+} \\ \vdots \\ e_{iT}^{+} \end{bmatrix};$$

with this notation, the estimation procedure is quite similar to the case of the ML estimator. That is, 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 β_1, and β_2 are obtained by:

$$\widehat{\beta}(\gamma) = \Big(\sum_{i=1}^{n} X_i(\gamma)'X_i(\gamma)\Big)^{-1}\Big(\sum_{i=1}^{n} X_i(\gamma)'Y_i\Big), \tag{13}$$

where $\beta = (\beta_1, \beta_2)'$. Accordingly, the regression residuals for a given threshold parameter γ are given by:

$$\sum_{i=1}^{n} \widehat{e}_i^{+}(\gamma)\widehat{e}_i^{+}(\gamma). \tag{14}$$

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

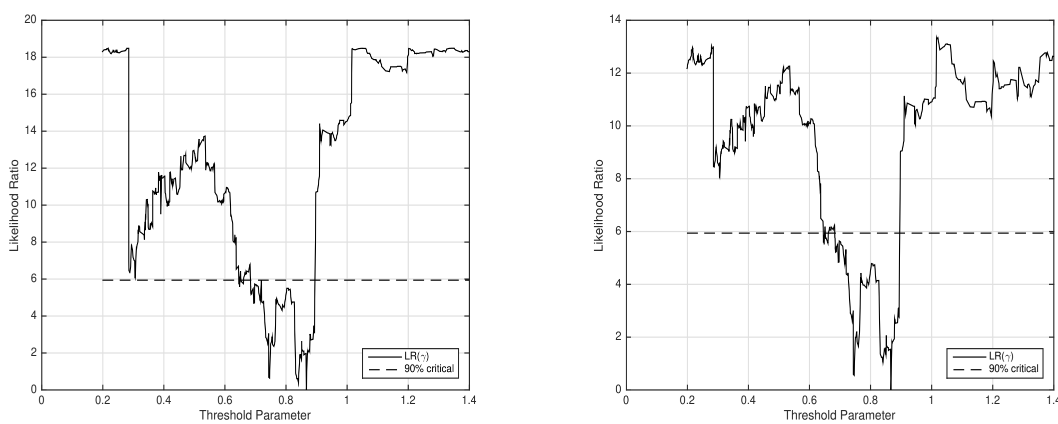
As in the ML estimator, the criterion function (14) is not smooth, thus the threshold parameter is estimated with the use of grids search across the uncertainty variable space. Once $\widehat{\gamma}$ is obtained, the slope coefficient estimates are subsequently obtained as: $\widehat{\beta}_1 = \widehat{\beta}_1(\widehat{\gamma})$ and $\widehat{\beta}_2 = \widehat{\beta}_2(\widehat{\gamma})$. With regards to the inference of the parameter estimates and testing for threshold effects, the steps are quite similar to the ML estimator shown before.[17]

Figure 3 shows the likelihood ratio for models with and without controls likewise the ML estimator in Figure 1. The value of the uncertainty threshold parameter from LS is estimated at 0.866, identical to the ML estimation with the 90% confidence interval to remain broadly the same. Therefore, we can conclude that the uncertainty threshold is robust between the two estimation methods.

Turning to the LS estimates in Table 6, results are similar to the baseline findings in 4, nonetheless, fiscal consolidation now affects negatively the growth rate of capital intensity in both uncertainty regimes. The economic size of this effect between regimes, though, varies substantially. Precisely, in the low uncertainty regime, the coefficient of the fiscal consolidation is within the range 0.067-0.075, while in the high uncertainty scenario the coefficient suggests that a percentage point increase in CAPB decreases the growth rate of capital intensity by 0.21 (column (1)). The low uncertain estimates of fiscal consolidation are below the average values of the linear model Table 4, while they are three times smaller than the coefficients of the high uncertainty regime. These findings confirm the main hypothesis of the paper that the nexus between fiscal policy and the accumulation process of capital is non-linear and varies with the degree of economic uncertainty in the country.

Figure 3: Confidence interval construction for threshold

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



Thereafter, fiscal loosening is relatively more detrimental when the country is within a region of high economic uncertainty. Regarding the remaining controls in the LS estimation in Table 6, the results do not change drastically from what Table 4 reports but trade openness decelerates the accumulation of capital per worker. This result

[17] We also refer to Hansen (1999) for further details.

Table 6: Least Squared (LS) Estimates of the threshold model

Dependent variable: Capital intensity growth	(1)	(2)	(3)
Uncertainty threshold estimate ($\widehat{\gamma}$)	0.866	0.866	0.866
[90% Confidence Interval]	[0.646; 0.893]	[0.646; 0.893]	[0.646; 0.893]
Fiscal consolidation (Uncertainty $< \widehat{\gamma}$)	-0.067*	-0.075**	-0.073**
Economic policy Uncertainty index	(0.038)	(0.033)	(0.033)
Fiscal consolidation (Uncertainty $\geq \widehat{\gamma}$)	-0.212***	-0.192***	-0.177***
Economic policy Uncertainty index	(0.051)	(0.048)	(0.058)
Accelerator effect	0.536***	0.465***	0.499***
Lag of capital intensity growth	(0.052)	(0.057)	(0.084)
Financial depth	-	0.000	0.000
Domestic credit to private sector/GDP, in logs		(0.002)	(0.002)
Human capital		-0.019*	-0.020*
Index based on schooling and returns, in logs	-	(0.011)	(0.011)
Public infrastructure	-	0.012	0.012
Fixed and mobile lines per 100 people, in logs		(0.009)	(0.009)
Institutions	-	-0.141	-0.151
Average of 4 ICRG indicators		(0.241)	(0.240)
Trade openness	-	-0.010**	-0.010**
Export plus import to GDP, in logs		(0.005)	(0.005)
Price instability	-	0.134***	0.135***
CPI growth		(0.038)	(0.039)
World GDP growth	-	-	-0.026
Real GDP per capita % change			(0.038)
Test for threshold effects (p-value)	0.020	0.017	0.030
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.

contradicts the conventional view that trade improves the efficiency of investment (Lee, 1995; Kim *et al.*, 2011). Given that the sample covers high-income countries, the content of trade is mainly labour-intensive imports from the developing world. These are non-durable goods that contribute less to national capital accumulation.[18]

[18] The literature finding 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

5.2 Estimated threshold location: testing for outliers

This subsection performs a test for 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 many times the estimated uncertainty thresholds fall within the 90% confidence interval of the baseline threshold found in section 3.3. This exercise rules out the possibility that outlier countries influence the threshold estimate.

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 exclude randomly two and three countries respectively from all possible combinations. Table 7 shows the results of these tests for the ML and LS estimators. The table indicates that no more than 8% of the sub-sample estimates fall out of the confidence interval across estimation methods, thus the estimated threshold of 0.86 for the degree of economic uncertainty used in Tables 4 and 6 is robust to sample changes. Therefore, we conclude that the estimate threshold is robust to alternative estimators and sub-sample changes. Overall, we can argue that present findings offer a very robust pattern about the non-linear effect of fiscal consolidation on capital intensity growth in a large sample of OECD countries.

Table 7: Robustness of the threshold estimate

% of threshold estimates that fall in 90% confidence interval		
	ML estimation	LS estimation
Leave-one country out	96%	100%
Leave-two countries out	95%	96%
Leave-three countries out	92%	94%

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

6 Conclusion

The present paper looks for asymmetries in the relationship between fiscal consolidation and capital intensity. The empirical findings of this underdeveloped area report evidence from an average relationship between discrete changes in fiscal policy and

countries. In our OECD sample, this scenario is of minor relevance.

economic outcome variables. Our paper departs from the current literature focusing, first on capital per worker that represents the capacity of the economy and its ability to generate growth and prosperity in the long-run. The main hypothesis tested is whether the effect of fiscal consolidation on capital intensity is always the same or there are exogenous conditions that can cause heterogeneous effects in the fiscal consolidation - capital intensity nexus.

To identify a non-linear relationship, we consider the level of economic uncertainty the key condition that drives the non-linear relationship between fiscal consolidation and capital intensity. The reason we employ this condition in our analysis is that in regions of low uncertainty financial markets are expected to function well, therefore fiscal loosening can crowd out private investment causing adverse effects in the accumulation of capital. In the high uncertainty region, though, fiscal loosening becomes a self-defeating prophecy trapping the economy in a regime where neither private nor public funds are available. This gloomy scenario is found to be 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 to GDP in a period of high economic uncertainty can decrease the growth rate of capital intensity by 0.185 units.

Our findings highlight the importance of the government sector as the investor of last resort in conditions of high economic uncertainty. Furthermore, our findings imply that the over-use of austerity can have multiple bad effects not only in the short run but more importantly, can undermine the growth prospects of the economy. Concerning the latter, our paper indicates that the productivity slowdown in OECD countries might be rooted, among other factors, in the fiscal tightening, which shrunk the productive capacity of the economy by reducing capital deepening, while a more stimulative action was expected.

The global pandemic, along with the new uncertainties raising (i.e. employment, global value chains, digitalization), has also amplified existing challenges (i.e. industrial sovereignty, foreign investment, public debt, climate change) towards a more sustainable development paradigm. To mitigate some of the above challenges, investment in new economic activities is required with the governments being the central pillar in this new process. 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. The way the global economy will recover and manage new and ongoing challenges after an unprecedented period of stagnation will determine the growth prospects and the standard of living in the OECD world in the years ahead. Understanding the role of fiscal policy in addressing these challenges can be an excellent objective for future research.

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A Data sources and definition of variables

Appendix A : Data sources and definition of variables

Variable	Definition	Source
Capital intensity growth	Log difference of capital stock at constant 2011 national prices (in mil. 2011US$) per employment.	Penn World Table.
Fiscal consolidation	Cyclically adjusted primary balance as percentage of potential GDP.	OECD and IMF data.
Uncertainty	World Uncertainty Index.	Ahir *et al.* (2018).
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	Log of the ratio of exports and imports to GDP.	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.

B Summary statistics

Appendix B : Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Capital intensity growth (%)	648	1.1	1.7	-2.7	11.5
Fiscal consolidation (%)	648	0.0	3.1	-26.1	9.7
Uncertainty (index)	648	0.7	0.5	0.0	4.7
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
World Interest rate (%)	648	3.0	2.0	0.6	6.9