By what way women on corporate boards influence corporate social performance? Evidence from a semiparametric panel model

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How do women on corporate boards influence corporate social performance? Evidence from a semiparametric panel model

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HIGHLIGHTS

- When endorsing a semiparametric panel model, the relationship between women on corporate boards (WOCB) and corporate social performance (CSP) is nonlinear and inverted *U*-shaped.
- Gender diversity, organizational learning, as well as pluralistic regulation all engender a critical impact on CSP.
- When board feminization grows, the organizational rules and the governance practices change, benefiting decision-making and stimulating CSP.
- When a WOCB's threshold-value is reached, the positive marginal impact of board feminization on CSP decreases.
- A gender diversity endogenization is achieved when the threshold value is exceeded.

ABSTRACT

A range of empirical studies have investigated the impacts of board feminization on corporate social performance (CSP), achieving contradictory results. The present article endorses an innovative semiparametric approach to test and capture the nonlinear relationship between women on corporate boards (WOCB) and CSP. The evidence shows that a sociological diversity, an organizational learning, as well as a pluralistic regulation all play critical influences on CSP. Board feminization tends to enrich board's cognitive diversity and to improve governance practices, benefiting decision-making and stimulating CSP.
Nonetheless, when a threshold value is achieved, the positive marginal impact of board feminization on CSP declines when WOCB increase. This decreasing marginal utility can be explained by a (progressive) gender diversity endogenization.

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Keywords: corporate governance, women on corporate boards, corporate social responsibility, corporate social performance, diversity.
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HIGHLIGHTS:

- Our semiparametric panel model shows that the relationship between WOCB and CSP is nonlinear, rather than linear.
- Feminization of the board contributes to the enrichment of its decision-making.
- But the positive marginal impact of board feminization on CSP decrease while WOCB's representation grows.

ABSTRACT

Given the contrasting empirical results of the literature, the question of the influence of the presence of women on corporate boards of directors (WOCB) on the corporate social performance (CSP), we revisit this problem by developing a semi-parametric approach to capture the non-linear effects of this relationship. The results show that sociological diversity, organizational learning, and pluralistic regulation all play critical roles in CSP. Feminization of the Board successfully helps to the enrichment of its decision-making by increasing the total cognitive, knowledge, and skill diversity. Nonetheless, when a threshold value is achieved, the positive marginal impact of Board feminization on CSP declines while WOCB grows, implying a diminishing marginal utility.

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1. Introduction

How women on corporate boards (WOCB) influence corporate social responsibility (CSR) and, ultimately, corporate (CSP) is a subject of major importance (e.g. Kirsch, 2018), as, on the one hand, companies are increasingly integrating environmental, societal and governance issues into their corporate policy (e.g., Ioannou and Serafeim, 2012) to meet stakeholders' various expectations (e.g., Clarkson, 1995) and, on the other hand, WOCB may significantly influence CSP (Byron and Post, 2016).

Although WOCB are an important area of research (e.g. Kirsch, 2018), little is known regarding WOCB's effect on CSP. Our assertion is based on two observations. First, to date, the relationship between WOCB and firm financial performance has been studied extensively, as evidenced by Post and Byron's (2015) meta-analysis. Apart from that, few studies investigate the relationship between WOCB and non-financial performance such as CSP (Byron and Post, 2016, Rao and Tilt, 2016). Second, the existing empirical literature has yielded mixed results. For instance, Francoeur et al. (2019) or Dang et al. (2021) document a positive relationship between WOCB and CSP. Conversely, Husted and de Sousa-Filho (2019) or Zahid et al. (2020) found a negative relationship. Finally, Boulouta (2013) or Manita et al. (2018) do not report any significant relationship. Accordingly, the issue of WOCB's effect on CSP remains to be resolved (Bruna et al., 2021, Dang et al., 2021).

If the contrasting empirical results regarding WOCB-CSP relationship can be explained by the differences in terms of national institutional systems (Grosvold and Brammer, 2011), time windows (Campbell and Vera, 2010), social performance measures (Post and Byron, 2015) or estimation methods (Đặng et al., 2020), we argue, following Ali et al. (2014) or Joecks et al. (2013), that the current literature insufficiently considers the fact that the WOCB-CSP relationship may not be linear. This article relies upon de Luis-Carnicer et al.'s (2008) theoretical perspective, grounded in the "Resource-Based-View (RBV) of the firm". They hypothesize that a firm's performance will be stronger within a gender balanced board of directors. In essence, the RBV (McWilliams and Siegel, 2001, McWilliams et al., 2006, Russo and Fouts, 1997) considers that companies engaging (and effectively engaged) in CSR develop a set of unique intangible resources such as human capital (Surroca et al., 2010), know-how (Teece, 1980), corporate culture (Barney, 1986) and reputation (Hall, 1992). These intangible resources outweigh the short-term costs associated with and lead to long-term economic advantage or value for shareholders. Within RBV framework, female directors may facilitate cooperation, problem solving or information's dissemination (see also Hillman et al., 2007). Likewise, Appold et al. (1998) find that corporate reputations is reinforced by the visible presence of WOCB. This is due to their symbolic value, whether inside or outside the organization (Burke, 2000). Consequently, de Luis-Carnicer et al. (2008) propose a curvilinear relationship, an inverted U-shaped relationship between WOCB and FP. For example, numerous works support the RBV perspective (Barney, 1991, Barney, 2001). Liu (2018) shows that companies, achieving a critical mass of female directors (three or more) experience significantly less environmental lawsuits, because of a higher risk avoidance induced by an enriched, kaleidoscopic and critical perspective. Cook and Glass (2018) find that solo and token female director is unable to significantly influence corporate strategy, reshape corporate governance practices as well as effectively (and positively) impact CSP.

We therefore rely upon de Luis-Carnicer's et al. (2008) assumption from the RBV view of the firm. Accordingly, we formulate the hypothesis that firm performance (appreciated, from case to case, in terms of returns, idiosyncratic risk mitigation, CSP lower variability, …) will be increased by a social (in that case, gender-focused) diversification of the board. In a gender balanced board, the cognitive and skill diversity, doubled by a "pluralistic regulation", grounded in an "ethics of discussion" (combining alterity recognition and quest for acceptable even if precarious and local consensus among players), will encourage a respectful, fair, open-minded but contrapuntist dialogue among board members. That will contribute to improve, upgrade and even operationalize both inclusive and efficient practices within the corporate bodies as well as in the overall management of the firm and its stakeholders' dialogue. Based on RBV theory, de Luis-Carnicer et al.'s (2008, p.586) assumption: increasing gender-diversity engenders more suitable and valuable outcomes because of "different and complementary competencies to the task of management".

This study uses the semi-parametric panel fixed-effects model developed by Baltagi and Li (2002). This method does not impose any *ex-ante* restriction on the shape of WOCB-CSP relationship curve. The latter is not specified by a prior functional form, but it lets the data infer the form of the relationship, leading to more accurate inferences between WOCB and CSP in a non-linear framework. Baltagi (2013) and Hsiao (2014) provide a fine overview of parametric panel data analysis. To avoid the strong restrictions imposed by that model, non-parametric (e.g. Henderson et al., 2008) or semi-parametric panel data models (Baltagi and Li, 2002, Li and Stengos, 1996) have been shaped to address potential functional form misspecification (Desbordes and Verardi, 2012). Summarizing, because Baltagi and Li's (2002) does not assume any *a priori* parametric functional form between WOCB and CSP, we can therefore determine the form of the WOVCB-CSP relationship curve, freely of any misspecification bias.

The purpose of this paper is therefore to investigate a potential nonlinear relationship between WOCB and CSP using Baltagi and Li's (2002) semiparametric panel fixed effects regression model to reconcile and explain the existing contrasting empirical results.

2. Methods

2.1. Sample

We use a sample of companies listed on the 2018 Fortune 1000 between 2004 to 2018 (Cruz et al., 2019, Johnson and Greening, 1999). However, to distinguish from existing studies (e.g., Boulouta, 2013, Francoeur et al., 2019), we focused on companies ranked from 501 to 1,000. We exclude financial and utility firms due to their specificities (e.g., Dang et al. 2021; Cheng et al. 2021) and firms with insufficient or incomplete data. This resulted in an unbalanced panel data set of 384 firms and 3,016 firm-year observations.

2.2. Variables

A firm's CSP is measured via Refinitiv ESG scores (e.g., Albuquerque et al., 2020, Habermann and Fischer, 2021). This database is widely used in finance and CSR literature (e.g., Bae et al., 2021, Dyck et al., 2019). In essence, a firm's CSP is assessed by Refinitiv via three pillars (Refinitiv, 2021): environmental (E, via resource use, emissions and innovation); social (S, via workforce, human rights, community and product responsibility) and governance (G, via management, shareholders and CSR strategy). Each pillar has sub-categories with industry-specific weightings. This score ranges from 0 (min.) to 100 (max.). Consequently, Refinitiv's ESG scores accurately reflects CSP (Wood, 1991).

Campbell and Mínguez-Vera (2008) and Ben-Amar et al. (2017) suggest that that the larger the board size is, the greater of likelihood of female directors is. Thus, the representation of WOCB should be correlated with board size. We consider board size as an instrument for WOCB.

To save space, Table 1 provides an overview of the variables and their definitions as they are commonly used in the literature (e.g., Boulouta, 2013, Dang et al., 2021, Francoeur et al., 2019).

[Place Table 1 here]

2.3. Estimation technique

The model to be estimated can be written as a special case of the more general model:

$$y_{it} = \rho\, y_{it-1} + x'_{it}\, \Upsilon + g(z_{it}) + \mu_i + \varepsilon_{it} \quad [1]$$

where y_{it} denotes the outcome of interest (*CSP*), z_{it} denotes the variable of interest (*WOCB*), x_{it} is a vector of control variables (see Table 1), μ_i is an individual effects capturing individual time unvarying heterogeneity, and ε_{it} the usual two-sided error term.

Baltagi and Li (2002) propose to differentiate the model in order to get rid of individual effect, or:

$$\Delta y_{it} = \rho\, \Delta y_{it-1} + \Delta x'_{it}\, \Upsilon + g(z_{it}) - g(z_{it-1}) + \Delta\varepsilon_{it} \quad [2]$$

These authors propose to use nonparametric sieve regression methods (Hansen, 2014) in order to approximate the unknown function $g(z_{it})$. Put differently, $g(z_{it})$ is approximated by $p^K(z_{it})\,\delta$ where $p^K(z_{it})$ is the vector of the first K terms in an infinite sequence of known functions of z_{it}, i.e. $[p_1(z_{it}), p_2(z_{it}), \ldots]$, and δ is a vector of K unknown parameters to be estimated. By definition, a natural approximation is provided by regression splines (Eubank, 1999).

Then, $g(z_{it}) - g(z_{it-1})$ can be approximated by $[p^K(z_{it}) - p^K(z_{it-1})]\,\delta$. Let $p^K(z_{it}, z_{it-1}) = [p_1(z_{it}) - p_1(z_{it-1}), p_2(z_{it}) - p_2(z_{it-1}), \ldots, p_K(z_{it}) - p_K(z_{it-1})]$. Eq. [2] can be written as:

$$\Delta y_{it} = \rho\, \Delta y_{it-1} + \Delta x'_{it}\, \Upsilon + p^K(z_{it}, z_{it-1})\,\delta + \Delta\varepsilon_{it} \quad [3]$$

Thereafter, we will denote by P the matrix we get by stacking the vector $p^K(z_{it}, z_{it-1})$, time t running first and then individual i. Thus, in matrix form Eq. [3] becomes:

$$Y = \rho\, Y_{-1} + X\,\Upsilon + P\,\delta + E \quad [4]$$

where Y is a vector with typical element Δy_{it}, Y_{-1}, a vector with typical element Δy_{it-1}, X, a matrix with typical line $\Delta x'_{it}$, and E, a vector with typical element $\Delta\varepsilon_{it}$.

Let $M = P(P'P)^{-1}P'$ and $\widetilde{A} = MA$. Then pre-multiplying Eq. [4] by M, we get:

$$\widetilde{Y} = \rho\, \widetilde{Y}_{-1} + \widetilde{X}\,\Upsilon + P\,\delta + \widetilde{E} \quad [5]$$

as $MP\,\delta = P(P'P)^{-1}P'P\,\delta = P\,\delta$. Then, subtracting Eq. [5] to Eq. [4] gives:

$$Y - \widetilde{Y} = \rho\,(Y_{-1} - \widetilde{Y}_{-1}) + (X - \widetilde{X})\,\Upsilon + (E - \widetilde{E}) \quad [6]$$

Estimates of parameters ρ and δ can be obtained applying OLS to Eq. [6]. But, by construction, differentiating equations such as Eq. [1] generates endogeneity as $E(\Delta y_{it-1} | \Delta\varepsilon_{it}) \neq 0$. Baltagi and Li (2002) propose an instrumental variable (IV) semiparametric estimation method to deal with that endogeneity issue. Assume that there exist a set of instrumental variables W that includes X and whose dimension is larger than those of vector. Then estimates of parameters ρ and δ in Eq. [6] can be recovered using 2SLS. As for the choice of instrumental variables, we follow Anderson and Hsiao (1982) who propose to use y_{it-2} or/and Δy_{it-2}.

The nonparametric part $g(z)$ in Eq. [1] can be estimated by $\hat{g}(z) = p^K(z)\,\hat{\delta}_{IV}$ where $\hat{\delta}_{IV}$ is given by:

$$\hat{\delta}_{IV} = (P'P)^{-1}P' \,(Y - \hat{\rho}_{IV}\, Y_{-1} - X\,\hat{\Upsilon}_{IV}) \qquad [7]$$

Notice that an estimator of the marginal effect of z, or the derivative of $g(z)$ with respect to z, can be obtained by deriving the estimator $\hat{g}(z)$ with respect to z, i.e., $\hat{g}'(z) = p^{K'}(z)\,\hat{\delta}_{IV}$.

The estimator presented above will be inconsistent if z_{it} is endogenous. Following Blundell and Powell (2003) in the context of semiparametric regression models, the commonly chosen approach to tackle the endogeneity issue in the nonparametric part is to adopt a control function approach. The control function approach is an instrumental variable approach. Thereby, if an instrument w_{it} is available and such that $z_{it} = \xi_i + w_{it}\,\eta + v_{it}$, and we assume that $E(\varepsilon_{it} \mid z_{it}, v_{it}) = \psi\, v_{it}$, Eq. [1] becomes:

$$y_{it} = \rho\, y_{it-1} + x'_{it}\,\Upsilon + g(z_{it}) + \mu_i + \psi\, v_{it} + \omega_{it} \qquad [8]$$

with the error term $\omega_{it} = \varepsilon_{it} - \psi\, v_{it}$ being now uncorrelated with the endogenous explanatory variable (EEV) z_{it} as a consequence of this control function approach. Eq. [8] can be consistently estimated by first estimating the residual term $\hat{v}_{it}$ in $z_{it} = \xi_i + w_{it}\,\eta + v_{it}$, and, second, by replacing v_{it} by $\hat{v}_{it}$ in Eq. [8]. The standard first stage F-statistic can be used to assess the strength of the instrument and testing that $\psi = 0$ amounts to a test for the endogeneity of the EEV z_{it}.

3. Results

The empirical results are reported in Table 2.[1] We consider the two cases where WOCB is or is not endogenous (columns (1) and (2), respectively). Whatever the considered model, the lagged variable CSP_{t-1} has been instrumented using CSP_{t-2} and ΔCSP_{t-2}. Diagnostic tests suggest that these instruments cannot be considered as weak, and are appropriate. Moreover, results show that the chosen instrument for *WOCB*, i.e. board size, is a strong and valid instrument. The *F*-statistic is large (54.94) and significantly bigger than 10.0, Staiger and Stock's (1997) critical value for assessing instrument strength. Finally, the parameter associated to the estimated residual $\hat{v}_{it}$ in the column (2) of Table 2 is significantly different from zero, which allows us to conclude on the endogeneity of *WOCB*. This is consistent with previous studies such as Boulouta (2013) or Dang et al. (2021).

Consistent with Wintoki et al. (2012) or Dang et al. (2021), we find that CSP_{t-1} is positively and significantly correlated (at the 1% level) to CSP, suggesting that past-CSP influence current CSP. Our finding suggest WOCB-CSP relationship should be considered in a dynamic perspective (Wintoki et al., 2012).

The estimated nonparametric WOCB-CSP relationship is presented in Fig. 1. The relationship seems more like an inverted U-shaped, where curve grows gradually bending, whether WOCB is considered as endogenous or not. Notice that the curve is significantly higher when WOCB is endogenous. This result therefore indicates that WOCB-CSP relationship should be considered as nonlinear.

Although Fig. 1 informs us on the nonlinear shape of the WOCB-CSP relationship, it is interesting to have a clearer measure about the impact of an increase of WOCB on CSP value. Fig. 2 presents then the estimated derivative of the WOCB-CSP relationship, which might be interpreted as the WOCB's marginal effect on CSP (dotted curves represent the corresponding 90% confidence intervals). For instance, the estimated curve shows that CSP will increase by 0.4 when WOCB increases from 0, in the case WOCB is endogenous (red curve). This mar-

[1] To preserve space, we do not present the descriptive statistics and correlations as there was nothing in particular to note. However, there are available upon request to the authors.

ginal effect decreases whereas WOCB increases, and there is an inflection for WOCB values around 20 to 30 (just after 20 if there is no endogeneity and around 25 if there is endogeneity) and then a stabilization pathway, whatever WOCB is considered as endogenous or not. This result regarding the general shape of the marginal effect of WOCB on CSP is consistent with the result showing a U-inverted shape for the WOCB-CSP relationship itself. It should also be noted that considering endogeneity of WOCB generates estimated marginal effects (red curve) that are greater than those obtained when there is no endogeneity (blue curve). This results can be expected as not considering endogeneity can lead to negative bias for the estimator without endogeneity; for example, because of omitted variable bias (e.g. Adams, 2016). Nevertheless, this difference becomes insignificant when WOCB exceeds 25% and the marginal effect becomes indistinguishable from zero for WOCB values greater than 38%, mainly due to data scarcity when WOCB exceeds this threshold.

[Place Table 2 here]

[Place Fig. 1 here]

[Place Fig. 2 here]

4. Conclusion

Theoretically and empirically grounded, this article the revisit the WOCB-CSP relationship for a sub-sample of Fortune 1000 companies. The present article offers main valuable outputs to academia, policymakers and corporate strategists. First, based on de Luis-Carciner et al.'s (2008) "RBV of the firm", we find that the WOCB-CSP relationship exhibits a non-linear curve as show. Consistent with Bruna et al. (2021), our findings confirm the key-role of sociological diversification, organizational learning and pluralistic regulation on CSP. Board's feminization effectively contributes to enrich CG decision-making, through an upgrade of the overall board cognitive, knowledge and skill diversity.

Second, the study contributes both to theory and decision-making by investigating how board feminization affects CSP. That way, it fills a gap in the CG-CSP literature (Harjoto and Jo, 2011, Rao and Tilt, 2016). Not being descriptive like the bulk of the existing literature (Campbell, 2007), this paper specifically examines how WOCB shape CSP, rather than firm's financial performance as investigated in many papers (Byron and Post, 2016, Orlitzky et al., 2003). In other words, the article offers an empirical look on the connectedness dynamics among CSR pillars and levers (e.g., feminization of women boards, ethics and inclusive governance…) and enhances the understanding of board gender diversity impact on CSR policy efficiency.

Finally, this research innovates endorsing the semi-parametric panel fixed-effects model from Baltagi and Li (2002). As previously explained, Baltagi and Li's (2002) approach does not assume any *a priori* parametric functional form between WOCB and CSP or *ex ante* restriction regarding the shape of WOCB-CSP relationship curve; that way, it offers the opportunity to determine the form of the WOCB-CSP curve, freely of any misspecification bias.

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Table 1
Definition of control variables.

Variable	**Definition**
WOCB	The number of female directors divided by the total number of directors
Firm size	The natural logarithm of total assets (*FSIZE*)
Firm performance (ROA)	Income before depreciation divided by total assets (return on assets, *ROA*)
Leverage	The ratio of total debt to total assets (*LEV*)
R&D	Research and development divided by sales (*R&D*)
Missing	Dummy variable equal to 1 if R&D expenses are unavailable on the Refinitiv database (Duru et al., 2016).
Board independence	The proportion of outside – non-executive – directors on the board (*BINDEP*)

This table defines the variables used in the empirical analysis. The source of the data is Refinitiv.

Table 2
Estimation results.

Variables	WOCB not endogenous	WOCB endogenous
	(1)	(2)
CSP_{t-1}	**0.6536*** (0.0804)**	**0.4838*** (0.0935)**
Firm size	1.0519 (1.0325)	0.4159 (0.9713)
ROA	0.1258 (2.9042)	-0.1075 (2.6628)
Leverage	4.6182 (2.7584)	4.4909 (2.52841
R&D	0.0445 (1.8119)	-0.1728 (1.6623)
Missing	0.7251 (1.7519)	1.4984 (1.6274)
Board independence	**0.2095*** (0.0317)**	**0.2592*** (0.0337)**
Auxiliary regression residuals	-----	0.4636*** (0.1587)
Diagnostics for instrumental variables choice for CSP_{t-1}:		
Weak instruments (*p*-value)	80.253 (<0.0001)	49.810 (<0.0001)
Wu-Hausman (*p*-value)	151.252 (<0.0001)	61.360 (<0.0001)
Sargan (*p*-value)	8.719 (0.0128)	6.142 (0.0464)
Diagnostics for instrumental variable choice for WOCB:		
F-statistics (H_0: Board size coefficient = 0 in auxiliary regression)	-----	54.942

Following Wintoki et al. (2012), we assess instruments' strength (or weakness) by implementing a F-test of joint significance of instruments in first stage regression of 2SLS, using Cragg and Donald's (1993). Then, we use the Wu–Hausman (Hausman, 1978, Wu, 1974) test for endogeneity, and, finally, we implement the Sargan test for over-identifying restrictions as proposed by Arellano and Bond (1991). The asterisks ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Figure 1
Estimated nonparametric relationship between CSP and WOCB.

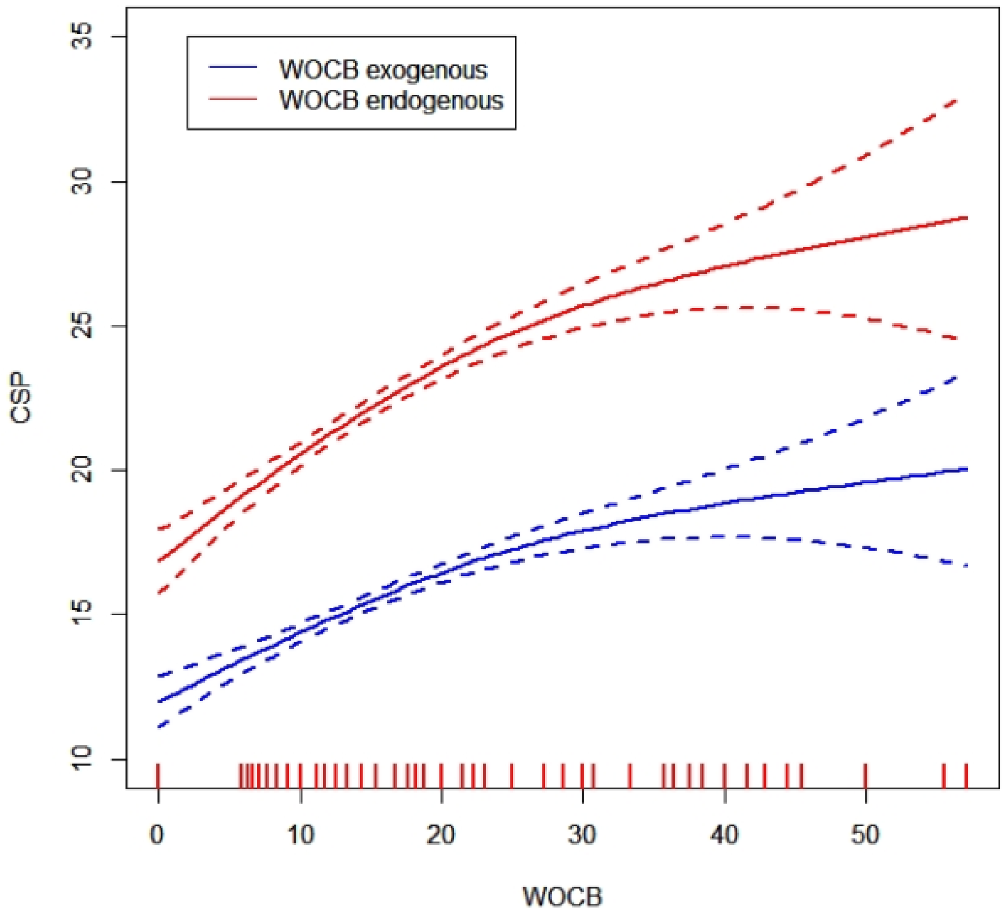

Figure 2
Estimated derivative