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THE MODERATING EFFECTS OF FDI ON THE RELATIONSHIP BETWEEN DEMOCRATIC INSTITUTIONS AND CO2 EMISSIONS

Abstract:

This study aims to examine the direct effects of foreign direct investment (FDI) on the host-country environment. More specifically, how FDI moderates the relationship between democratic institutions and anthropogenic carbon dioxide emissions in a panel of 80 democratic nations during the period 1992-2018. The author uses the System Generalized Method of Moments, first difference and system estimators, which allows for the control for present reverse causality and endogeneity in the research design. For robustness checks, I use the cross-sectional dependence and Driscoll-Kraay robust errors panel regression method. Robust evidence is found in support of the pollution halo hypothesis, in a way that carbon dioxide emissions fall. The findings suggest that FDI moderates the relationship between several varieties of democratic institutions and carbon dioxide emissions.

Keywords:

FDI, Environmental impact, Anthropogenic emissions, Democratic institutions, Pollution halo, STRIPAT, GMM, Fixed effects

JEL Classification: Q01, Q58, Q56

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INTRODUCTION

According to the United Nations Democracy Fund, the global debate on democracy is increasingly marked by distrust of democratic institutions and elected representatives (UN, 2022). UN's Sustainable Development Goals (SDGs Goal 16) recognize that human rights, the rule of law, good governance, and peace and security are crucial for sustainable development (UN, 2015b). Under the Paris Agreement, governments have committed to limiting temperature increase to well below 2°C above pre-industrial levels and continuing efforts to reduce anthropogenic emissions in the atmosphere. The achievement of this objective will require halving global emissions by 2030 and reaching net zero carbon emissions by 2050 and all gases around 2070, with negative emissions thereafter (UN, 2015a). The challenges faced by democracies to formulate and put in place effective responses to climate change to respond to the needs of the current and future generations are bigger thanever.

A large body of theoretical and empirical literature has been produced, over the past decade, within the sub-field of the relationship between FDI and its impact on the environment by assessing the impact of environmental regulations on the location choice of FDI, and the impact of FDI on the emissions of different greenhouse gases and environmental spillovers related to the foreign activities of multinationals (Cole et al., 2017). There is a conspicuous body of literature which focuses on features of environmental quality and from observations of FDI (Cole & Elliott, 2005). In addition, there is the literature from the Porter hypothesis coupled with the pollution halo effect where FDI from technologically advanced countries may bring with it new technologies and cleaner methods of production, and hence help to clean the environment (Ambec et al., 2013). This stream of literature contrasts with the pollution haven hypothesis where multinationals relocate 'dirty' industries from the developed regions to developing regions and is associated with a low level of environmental regulation implying a transfer of carbon dioxide emissions (Cole & Neumayer, 2004). Moreover, the voluminous body of literature that is very much concerned about the direct effects of FDI on the natural environment is inconclusive at best, if not without any flimsy foundations (Stern, 2004).

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The motivation of this study is to contribute to a deeper understanding of whether the presence of FDI result in environmental improvements in host countries. Not much attention has been paid to the analysis of the moderating effects of FDI on democracy, and their effects on the host country's environment. It is important to assess whether FDI interacts with the environment, but also if its interaction with democracy is capable of improving the quality of the environment, or if FDI is putting a threat instead. International business research presents many potential ways to expand the understanding of how FDI affects the natural environment. In this sense, two research questions guide this study:

(1) How FDI along with democracy affect carbon dioxide emissions in host countries?
(2) How such, if any effect, does FDI has a moderating effect on democratic institutions and the environment?

The present study rests on and builds from what is by now a strand of literature that investigates how inbound foreign capital flows affect climate change. One potential contribution of this study arises from the measurement of the extent to which FDI, and democratic institutions explain the variability of greenhouse gas emissions outcomes in host countries. The study demonstrates a recipient country's direct effect on the level of emissions. FDI may induce larger beneficial effects on the environment, in a way that FDI reduce emissions. Hence the findings led support to the halo hypothesis in democratic nations. Improving democracy and attracting foreign investors can bring benefits in terms of climate change mitigation.

This hypothesis is further supported as FDI emerges as a type of investment that is less harmful to the environment when it interacts with several varieties of democratic institutions. Therefore, policymakers should be more aware of the nature of foreign investments and determine whether they carry “dirty” or “clean” production processes. This is the type of FDI that matters to guarantee sustainable development alongside environmental conservation. Host government policies should target “green” FDI and offer generous incentive packages to improve the quality of the environment. In existing theoretical and empirical literature, little guidance is available on whether FDI would have

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a greater effect on the environment of the host country, and how such, if any effect, FDI constitutes a moderator between democratic institutions and the environment.

LITERATURE REVIEW

The literature cites numerous studies that study the effects of FDI on economic growth of the host country, and about how domestic investment itself affects the flows of FDI. From a theoretical point of view, there appear to be several channels in which domestic investment might positively influence the business decisions of investments made by foreign firms. One way is through agglomeration effects and inter-firms' externalities which create linkages between domestic and foreign investors. Research has shown that good public infrastructure has proven to be a positive locational determinant of FDI inflow (Asiedu, 2006). The literature acknowledges that multinationals generate positive externalities for host countries (Alfaro et al., 2010). FDI stimulates domestic investment, and the contribution of FDI to growth is further enhanced by its interactions with sound macroeconomic policies and institutional stability (Makki & Somwaru, 2004).

FDI exerts a positive contribution to economic development from its role as a channel of transfers for general knowledge, specific technologies in production and distribution, industrial upgrading, and has been found to create many externalities (Osano & Koine, 2016). Firms establish affiliates abroad because they exploit their techno-technological advances that allow them to be competitive and successful abroad. Some empirical studies have highlighted that technological spillovers might have a positive impact on factor productivity of domestic firms and employees if human resources are capable of making effective use of the technology introduced by foreign firms (Kokko, 1994). Multinationals have a stronger financial capability to introduce new methods of production and management, and in this way have sought to affect economic development and modernization, income growth and employment, and other economic and social aspects of host countries (Sageder & Feldbauer-Durstmüller, 2019). The public sector potentially plays a decisive role in creating and strengthening a country's location advantages through supplying public goods and services, educating the labour force, and defining and implementing economic policies (Dunning & Narula, 2003).

The increasing importance of multinationals and their FDI activities is often considered to be an engine of growth (Balasubramanyam et al., 1999). This benefit can come at a cost to the environment. FDI can reduce the negative effects on the host country environment through environmentally friendly practices and boost domestic businesses through different spillover channels (Görg & Strobl, 2001). These spillovers arise because foreign firms in general bring with them some sort of firm-specific assets which allow them to compete and be successful abroad (Markusen, 1995). Foreign firms possess specific knowledge and ownership, hence a competitive advantage compared to their domestic counterparts (Dunning, 1980). Such competitive capabilities among foreign companies may not only be viewed as a prerequisite for investing abroad, but those competitive factors are to gather, explore, and exploit based on the use of new knowledge in response to changing boundaries of the firm (Cantwell & Narula, 2001). Certain properties of knowledge capital also imply a preference for transferring technologies internally within the firm, rather than through arm's-length markets. Multinational enterprises derive more benefits from multi-plant economies of scale in comparison to their domestic counterparts (Pfaffermayr, 1999).

The empirical evidence whether foreign firms are environmentally friendlier than their domestic counterparts has, to date, been rather mixed. Multinationals are typically larger than domestic firms which enables them to undertake a greater degree of research and development and hire the most qualified employees (Spencer, 2008). These firms implement codes of responsible business conduct, and environmental guidelines and regulations (Kolk et al., 1999). Studies that have looked at the FDI originating from high-regulation developed countries, and that have dealt with the effects of regulation, plant-level management policies, and other factors on environmental compliance, suggest that foreign ownership has no statistically significant impact on manufacturing plants' emissions (Dasgupta et al., 2000). Foreign ownership is a statistically significant determinant of the adoption of several environmental management practices (Albornoz et al., 2014). Firms can absorb environmental knowledge and experience, directly or indirectly, through forward links with suppliers, backward links with customers, or horizontal links with competitors (Albornoz et al., 2009). Foreign-owned plants are

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more likely than domestic plants to adopt and implement environmental management certification (Zhu et al., 2012).

Competition to attract FDI creates opportunities for multinationals to diffuse best environmental corporate management practices from their countries-of-origin to countries hosting their foreign operations (Prakash & Potoski, 2007). Firm-level panel data on waste discharge from Vietnam demonstrates that foreign firms are actually more proactive in acquiring environmental certification to improve the firm's performance in terms of waste control, and increases its welfare and productivity level (Ni et al., 2019). The cost of environmental regulation does not influence the international location of polluting industries in developing countries as a result of offshoring production since relatively clean stages of the production process are being transferred to developing countries with lax environmental regulations, while polluting segments remain in the U.S. where strict environmental controls are enforced (Clark et al., 2000). Transnational linkages accelerate the international spread of environmentally beneficial or superior innovations and, therefore, lead to improvements in environment efficiency (Perkins & Neumayer, 2008). Foreign capital is good for the environment, mainly through a halo induced effect in countries with low to average capital-to-labour ratio but not too lax environmental regulation (Zugravu-Soilita, 2017).

METHODOLOGY

EMPIRICAL MODEL

Following the literature, the Stochastic Impacts by Regression on Population, Affluence and Technology (hereafter, STRIPAT) model is used to empirically investigate the relationship between democracy and CO2 emissions (Yao et al., 2020). The STIRPAT model is based on the IPAT (Influence, Population, Affluence, and Technology) mathematical identity, which offers a flexible framework for hypothesis testing without imposing a rigid proportionality in the functional relationship between the variables (Rosa & Dietz, 1998). This equation has been widely used in research related to climate change assessments, specifically energy-related carbon emission studies. The IPAT framework provides a readily identifiable common ground (Chertow, 2000).

The STRIPAT model avoids potentially spurious regressions involving nonlinear transformations of nonstationary variables. It allows for the possibility that elasticities are significantly different across development levels. Moreover, this approach relaxes the restriction, in contrast to what is assumed in much of the EKC literature, that elasticity of carbon emissions with respect to the population size is not larger than unity (Menz & Welsch, 2012). The reformulation of the IPAT accounting identity becomes an additive linear regression model, which facilitates hypothesis testing, and can be expressed in the following manner:

$$I = \alpha P^b A^c T^d e \tag{1}$$

where, the dependent variable is *I* and it refers to the measure of environmental impact. The explanatory variables are *P*, *A* and *T* which are respectively population, affluence and technological factors. The intercept term is given by α, whereas *b*, *c* and *d* are the parameters to be estimated which can be interpreted as elasticities of their respective variables. The estimated coefficients then represent the environmental elasticity of each impact factor (York et al., 2003). Finally, *e* denotes the error term. This equation is augmented with FDI, democratic institutions, and control variables, and all variables are expresses in logarithmic form.

VARIABLES AND DATA

The dependent variable (I) in this study is the commonly used proxy for climate change. This variable is the national production-based carbon dioxide emissions measured in metric tons per capita and is obtained from the CAIT database managed by the World Resources Institute. Metric tons of carbon dioxide emissions have been converted to units of carbon dioxide by multiplying them by 3.667 (the ratio of the mass of carbon to that of carbon dioxide).

Affluence (A) is proxied with per capita real income (gross domestic product in constant 2011 US$) and population (P) is the population size, measured by total number of persons based on the de facto definition of population with mid-year estimates. The impact of population is a key impact factor on

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the environment. An increase in population is likely to increase energy consumption and resource usage, which puts pressure on the environment. Hence, a positive sign is hypothesized between affluence and the measure of environmental impact. Affluence, or economic activity per person, is one of the most important drivers in explaining the dynamics and variation of carbon dioxide emissions. The relationship between economic growth and environmental quality is an important one at different income levels. A positive sign is expected among those two variables.

The impact of technology (T) is approximated using a measure of energy intensity necessary to support economic activity. Technological factors represent everything that affects the environment that is not population or affluence, and it plays a crucial role in sustainable development. This variable controls for the effects of technological change on carbon dioxide emissions and may serve as a proxy for substitution of polluting fossil fuels with clean energy. Energy intensity is a measure that is used to assess the energy efficiency of a particular economy, and it is measured by the total energy use (kg oil equivalent) divided by income (measured in constant 2005 US dollars), indicating how well the economy converts energy into monetary output. The smaller the energy intensity ratio is, the lower the energy intensity of a particular country. Decreasing energy intensity then reflects a higher degree of overall efficiency of economic activities in terms of energy consumption which ultimately leads to reductions of emissions. The data are obtained from the World Bank World Development Indicators online database. FDI is the ratio of the sum of inward and outward FDI stock over GDP in current US dollars. FDI data is retrieved from UNCTAD database. In the robustness checks, FDI is replaced by the KOF globalization index provided by KOF Swiss Economic Institute. I use the financial globalization, de jure indicator which captures investment restrictions, capital account openness, and international investment agreements.

Energy intensity is computed as energy use (kg of oil equivalent) per 1000 US dollars GDP (constant 2017 PPP). Renewable energy and non-renewable energy are electricity production from renewable sources (hydro, solar, wind) and non-renewable sources (oil, gas, coal) respectively. Trade openness is computed as the ratio of total merchandise imports and exports dived by GDP in current

US dollars. Financial development is the ratio of domestic credit to private sector in percentage of GDP. Industrial sector output includes construction and is measured as the value added of that sector in percentage of GDP. Service sector output is computed as the sectoral value added in percentage of GDP.

The varieties of democratic institutions range on a continuous scale from 0 to 1, with 1 being the highest possible measure of either of the 5 high-level democracy varieties. Electoral democracy measures the core value of democracy (Coppedge et al., 2011). Liberal democracy emphasizes the importance of protecting civil rights and liberties, strong rule of law, and an independent judiciary, and effective checks and balances that, together, limit the exercise of executive power (Coppedge et al., 2015). Participatory democracy includes aspects of active participation by citizens in electoral and non-electoral processes (Coppedge et al., 2018). Egalitarian democracy measures material and immaterial. This kind of democracy is achieved when rights and freedoms of individuals are protected equally across all social groups, resources are distributed equally across all social groups, and groups and individuals enjoy equal access to power (Sigman & Lindberg, 2015). Deliberative democracy focuses on the process by which decisions are reached in the political process (Coppedge et al., 2011).

The data on democracy is retrieved from the University of Gothenburg, V-Dem Institute version 12 dataset archive. This multidimensional and disaggregated dataset is collected through the Varieties of Democracy (V-Dem) project which provides an overview of the state of democracy worldwide. V-dem provides conceptually unique measures of democracy. V-Dem data is derived from an expert survey of more than 3000 country experts from around the world, with on average 5 experts rating each indicator. The data availability, quality, and reliability are assured by the coding of the data based on input from at least five separate country exports for each year and country.

Appendix Table 1 provides a summary of descriptive statistics of both the dependent variables and the explanatory variables. The dataset comprises 80 countries democratic nations. (Australia, Austria, Belgium, Canada, Chile, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Slovenia, South Korea, Spain, Sweden, Switzerland, United Kingdom, United States of America, Uruguay, Burkina Faso, Liberia, Madagascar, Bolivia, El Salvador, Ghana, Haiti, India, Indonesia, Kenya, Lesotho, Mongolia, Nepal, Nicaragua, Nigeria, Philippines, Senegal, Sri Lanka, Tunisia, Ukraine, Zambia, Albania, Argentina, Armenia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Colombia, Costa Rica, Dominican Republic, Ecuador, Georgia, Guatemala, Mexico, Moldova, Namibia, Panama, Paraguay, Peru, Romania, Serbia, South Africa, Suriname). I use the dataset of political regimes to classify the countries as democratic nations (Boix et al., 2012).

ECONOMETRIC METHODS

The advantage of using panel data is that it provides a large number of data points, thereby increasing the degrees of freedom and reducing possible collinearity among the independent variables. Dynamic panels models are more suitable for investigating dynamic phenomena such as carbon dioxide emissions. In the evaluation of the factors that drive emissions, some determinants may have a potentially endogenous character, and, for this reason, it is important to control for possible endogeneity problems and unobservable heterogeneity among explanatory variables of the empirical model. If this assumption is taken into consideration, there may be correlations between some of the coefficients of the explanatory variables and the error terms that influence the estimated coefficients. Hence, to circumvent this problem, this study employs the Blundell-Bond dynamic system Generalized Method of Moments (“system GMM”) estimator (Blundell & Bond, 1998).

The dynamic panel data estimator addresses the limitations of the Arellano–Bond first difference GMM by allowing the use of lagged differences of the dependent variable as instruments for equations in levels and the lagged levels of the dependent variable as instruments for equations in first differences (Arellano & Bond, 1991). The difference GMM method transforms the regressors, which include the dependent variable, through differentiation, thus eliminating the fixed effects of the model, which could cause endogeneity. The system GMM, on the other hand, has the advantage of adding orthogonality conditions relative to the model in levels, and therefore increasing the efficiency of the estimation. This increase of efficiency is due to the fact that variables at lagged levels are weak instruments, and the estimation of a system with variables at lagged levels and first differences avoids using these instruments.

The system GMM method requires some additional necessary conditions that assure that the instruments are not correlated with fixed effects. In order to improve efficiency and achieve identification compared to the "difference GMM" estimator, I use nonlinear moment conditions (Ahn & Schmidt, 1995). The extra moment conditions can help to overcome the problem of weak instruments of the difference-GMM estimator when the autoregressive coefficient approaches unity. The Ahn and Schmidt two-step estimator with predetermined covariates and collapsed instruments is also robust to deviations from mean stationarity, a situation that would invalidate the system-GMM approach. The degrees-of-freedom adjustment is made to the variance-covariance matrix and small sample t and F statistics are reported. Moreover, the Windmeijer finite-sample standard error correction is computed for estimators with and without nonlinear moment conditions (Windmeijer, 2005).

The validation of the GMM estimation results implies the performance of postestimation diagnostic tests such as the Arellano-Bond test for absence of serial correlation in the first-differenced errors, and the Sargan-Hansen J-test of the overidentifying restrictions. GMM estimation results are subject to autocorrelation tests, such as the Arellano-Bond tests for the first order AR(1) and second order autocorrelation of the first-differenced residuals AR(2). The Sargan-Hansen difference test is employed for the overall model evaluation. The Arellano- Bond test accounts for the finite-sample Windmeijer (2005) correction when computing the test statistic. To obtainunbiased estimators, the null hypothesis of non-autocorrelation in the first lag of the model error term in differences of the AR(1) could be rejected but not the hypothesis for the null hypothesis of the test AR(2) test (non-autocorrelation in the second lag). The absence of AR (2) implies that it is appropriate to use lagged values as instruments. The Hansen-Sargan difference test of the overidentifying restrictions with two-step moment functions (and 2-step weighting matrix) aims at analyzing the validity of the instruments. The instruments are valid when the null hypothesis of overidentifying restrictions (of the instruments' validity) of this test is not rejected. For robustness checks, I use the fixed effect estimator with Driscoll and Kraay standard errors approach (Driscoll & Kraay, 1998).

RESULTS

In this section the environmental, I analyze the effects of population, affluence, technological factors, FDI, and democratic institutions on CO2 emissions obtained from the GMM framework for the panel of democratic countries. The direct effects of FDI on the environment are presented in Table 1 which contains the static models, and in Table 2 for the dynamic models. The moderating effects of FDI on CO2 emissions are shown in Table 3 reports the results of the static models and direct effects of FDI. The moderating effects presented in Table 4 are obtained with dynamic models. Robustness checks are presented in Tables 5 to 8. I will present and discuss the findings globally.

The broad consistency of the methodological approach is confirmed in all groups of countries. The various diagnostic tests confirm the consistency of the GMM estimates since they are successfully passed throughout all model specifications. The first-order serial correlation test results and the second-order serial correlation test results indicate that together the null hypothesis of no autocorrelation of order 1 and of order 2 are not rejected. What this suggests is that the assumption of no serial correlation in the differenced residuals is satisfied in all econometric models. The Sargan diagnostic tests of overidentifying restrictions indicate that the instruments are not correlated with the error term. These diagnostics would support the validity of the instruments, and the results are robust in terms of passing these standard tests. The lagged dependent variable that relates past levels of CO2 emissions to ongoing CO2 emissions is always positive and usually statistically significant in the regression equations. This means that CO2 emissions lagging one period would affect CO2 emissions after the current period. These conclusions hold whether the model specification is dynamic (GMM) or static (Driscoll-Kraay), and for both models with direct effects and moderating effects. And, in the robustness checks in the alternative specifications that test the same hypothesis.

We can observe that population size has an adverse effect on CO2 emissions. Its coefficient has always the expected sign and is statistically significant. The estimated elasticities of emissions to the population are close to unity. This evidence suggests that if population increases, this will likely worsen CO2 emissions. This evidence suggests that demographic factors exerts a significant and direct effect on CO2 emissions. The impact of population size on CO2 emissions is less pronounced in the dynamic models and this is confirmed by the robustness checks.

The estimated elasticities of emissions to income per capita are always positive and statistically significant among model specifications. Overall, an increase in income significantly increases emissions, and this effect is more pronounced in developing countries. For developed countries, the estimated coefficient presents a smaller range of values while for developing countries, the estimated coefficient is larger. This suggests that the impact of income per capita on carbon emissions is slightly higher in the least developed countries compared to more developed ones.

The energy variables present all the expected signs and are statistically significant at conventional levels of statistical significance. The results suggest that energy intensity has a positive effect on CO2 emissions. The estimated coefficients of CO2 emissions to energy intensity are larger in the static models, while in the alternative models they present a smaller range of values across all specifications. The estimated coefficients for renewable and non-renewable energy have the correct sign and the strong mitigation effect of renewable energy on CO2 emissions is larger than the augmenting effect of non-renewable energy on CO2 emissions. The elasticity of CO2 emissions to energy intensity, renewable and non-renewable energy is inelastic, while population and income per capita indicate a moderately elastic relationship. Overall, an increase in energy intensity indicates a highest (lowest) energy efficiency loss in association with an augmentation in emissions.

The control variables are not always statistically significant, but they seem to present to correct signs across all model specifications. The estimated elasticity obtained with the GMM and Driscoll-Kraay models indicates a pronounced reduction in CO_2 emissions when FDI increases. The results indicate that a 1% increase in FDI would result in a 0.02% decrease in emissions in this sample. The findings support the proposition of the pollution halo hypothesis. FDI has a direct negative impact upon CO_2 emissions and is statistically significant at the 1% level. The elasticity of the interaction terms is larger than those registered for the direct effects of FDI while strongly supporting the pollution halo effect. The findings support the proposition that FDI is likely to contribute to reduce CO_2 emissions when it interacts with several varieties of democratic institutions.

The democracy indicators have a positive and direct effect on CO_2 emissions, and interestingly the varieties of democratic institutions present a negative effect on CO_2 emissions when moderated by FDI. The results indicate that the coefficients of all democratic institutions are statistically significant at conventional levels of significance. They have high magnitudes and are likely to raise CO_2 emissions and worsen the quality of the environment. Thus, the conclusion to be drawn from this analysis is that the moderating effects of FDI on democratic institutions is important. Judging from the strength of this link, it can be argued that FDI and democracy are advantageous for the environment. The sensitivity analysis further strengthens these results.

Prior research has shown that democracies exhibit stronger commitments to mitigate climate change and, generally, emit less carbon dioxide than non-democratic regimes (Povitkina, 2018). The environmental benefits of democracy seem to be higher in conjunction with FDI. The benefits of democracy for climate change mitigation are better exploited in the presence of FDI that helps the capacity of democratic governments to reach climate targets and exercise pro-environmental behavior which may lead to good environmental outcomes. Keeping institutional quality is crucial to reducing CO_2 emissions in countries indexed as the most freedom of press countries because they are able to inform the public about environmental problems and expose environmental issues as political problems (Riti et al., 2021). Environmentally aware people are more likely to make pro-environmental decisions in their daily lives and to vote for parties that address environmental issues in their programs. Strong civil rights protect individuals from the tyranny of the state which is an inherent weakness to majority rule. High levels of active participation and commitment by citizens in civil society are also more likely to pressure governments in adopting transparent and well designed (value-based) policies (Lægreid & Povitkina, 2018). The possibility of public deliberation on environmental problems allows pro-environmental arguments to be put forward and to take into account citizens' preferences beyond elections (Baber & Bartlett, 2018).

The results suggest that democratic institutions can be improved, either for their unique value or in strengthening the relations between them, and with FDI without adverse effects on the environment. The Sustainable Development Goals promote the trust of democratic institutions, processes and elected representatives by demonstrating that democracy is a global good for people (Glass & Newig, 2019). I argue that environmental challenges in a global context do not provide an excuse for governments to weaken democratic institutions to attract FDI.

The findings validate the hallo hypothesis. This suggests that FDI possess advanced technological capabilities that can be transferred to host countries, and foreign investors increase their engagement in foreign locations in the local integration of several related technologies to pursue their technological excellence (Zander, 1997). The probability of conducting green R&D in foreign markets increases with the host country's stringency of environmental regulation, market size and green R&D intensity (Noailly & Ryfisch, 2015). The results might also indicate that FDI possesses a high level of technical efficiency, hence this accelerates the development and international diffusion of environmentally good practices and low-emissions innovations when interacting with democratic institutions. Generally, companies that have mastered technology transfer within multinationals manage it as a basis for competitive advantage and for strategic reasons too (Byun & Wang, 1995).

CONCLUSION

The empirical investigation has contributed to enrich the debate on the relationship between FDI, democracy, and climate change. This study finds that FDI and democracy contribute to improving the quality of the environment in host countries. This paper has further analyzed the direct environmental impact of FDI and democratic institutions using a dataset of 80 democratic nations along the period 1992-2018. The findings highlight that FDI has a significant direct effect in mitigating climate change. The results have given credence to the pollution halo hypothesis induced by foreign capital. In so doing, this study has contributed to the debate on the FDI-democracy-environment linkage which is centered around whether increased international capital in the world economy is good or detrimental for the environment. This debate is based around two opposing hypotheses that support each line of argument. The pollution haven hypothesis posits that increases in FDI deplete natural resources and harm the environment, especially in developing countries. Conversely, the pollution halo hypothesis posits that FDI could be beneficial for the environment through the transfer of green or energy efficient technologies that would curb environmental emissions.

Inferences from the results based on dynamic and static panel data models highlight the underlying direct and mitigating effects of FDI on the environment. This study validates the halo hypothesis by demonstrating a negative and persistent direct effect and moderating effect of FDI on the environment. Foreign investments may induce larger beneficial effects on the environment when taking into account democratic institutions. These results indicate that FDI could potentially mitigate climate change with high levels of democracy. FDI can transfer their clean state-of-art technologies to host countries that those countries are missing to help them improve their environment. Governments should be aware of improving democracy and the nature of foreign investments and determine whether they carry “dirty” or “clean” production processes. It is important for host countries to ensure that in attracting FDI, they approve policies that will subject FDI to an environmental impact assessment. They can justify generous and efficient use of fiscal or financial incentives to foreign investors and promote their economy without neglecting the pressure of production activities on the environment.

It is important that countries should call for governmental responsibility to enact environmental policies that promote FDI. FDI seeking to move international production activities abroad should only be moving with any clean technology. In this way, the critical role of FDI in aiding democracy and economic development can make a more meaningful contribution to the advancement of best practices in investment promotion and environmental best practices in achieving sustainable development practices.

Although this study contributes to filling a gap in the literature, it is important to note that it does not explain why some democratic institutions perform better than others in association with FDI. Thus, the research design is able to provide empirical evidence on how some democratic institutions can evolve in reducing environmental pressure when moderated by FDI. This study has allowed us to better understand possible trade-offs and the choices faced by countries in dealing with environmental action. Regarding the limitations of this study, future research could consider performing studies on non-democratic nations and controlling for the level of income heterogeneity.

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Table 1
Static estimation results of direct effects

	Model 1	Model 2	Model 3	Model 4	Model 5
Population	1.000***	0.998***	0.999***	0.994***	1.004***
	(0.024)	(0.024)	(0.025)	(0.024)	(0.024)
Income per capita	1.013***	1.012***	1.005***	1.009***	1.013***
	(0.038)	(0.038)	(0.037)	(0.038)	(0.038)
Energy intensity	0.879***	0.877***	0.875***	0.875***	0.878***
	(0.041)	(0.041)	(0.040)	(0.041)	(0.042)
Trade openness	0.010	0.010	0.003	0.009	0.012
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Industrial sector output	0.110***	0.110***	0.114***	0.112***	0.115***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)
Service sector output	-0.085	-0.085	-0.085	-0.078	-0.079
	(0.055)	(0.056)	(0.057)	(0.057)	(0.056)
Financial development	0.140***	0.140***	0.140***	0.138***	0.139***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
FDI	-0.022***	-0.022***	-0.022***	-0.023***	-0.022***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Electoral democracy	0.074***				
	(0.024)				
Liberal democracy		0.045***			
		(0.015)			
Participatory democracy			0.084***		
			(0.021)		
Egalitarian democracy				0.083***	
				(0.023)	
Deliberative democracy					0.041**
					(0.016)
Intercept	-11.487***	-11.450***	-11.360***	-11.345***	-11.589***
	(0.636)	(0.642)	(0.647)	(0.624)	(0.661)
Observations	1291	1291	1291	1291	1291
F-test	511.33***	479.35***	468.59***	515.22***	499.11***
Within R^2	0.734	0.734	0.735	0.735	0.734

Note: Driscoll-Kraay (1998) standard errors in parentheses. Two-tailed tests. *** p<0.01, ** p<0.05, * p<0.1.

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Table 2
Dynamic estimation results of direct effects

	Model 1	Model 2	Model 3	Model 4	Model 5
Lagged CO2 emissions	0.276***	0.285***	0.280***	0.289***	0.287***
	(0.075)	(0.074)	(0.079)	(0.075)	(0.075)
Population	0.745***	0.720***	0.733***	0.718***	0.731***
	(0.091)	(0.092)	(0.096)	(0.089)	(0.096)
Income per capita	0.689***	0.679***	0.677***	0.667***	0.690***
	(0.092)	(0.094)	(0.093)	(0.095)	(0.093)
Energy intensity	0.589***	0.567***	0.568***	0.551***	0.564***
	(0.097)	(0.105)	(0.104)	(0.103)	(0.102)
Trade openness	0.024	0.025	0.017	0.026	0.018
	(0.027)	(0.028)	(0.029)	(0.028)	(0.029)
Industrial sector output	0.168**	0.159**	0.171**	0.169**	0.179**
	(0.069)	(0.071)	(0.068)	(0.069)	(0.075)
Service sector output	0.111	0.102	0.111	0.113	0.118
	(0.130)	(0.132)	(0.130)	(0.131)	(0.141)
Financial development	0.042	0.041	0.040	0.044	0.043
	(0.027)	(0.027)	(0.026)	(0.026)	(0.027)
FDI	-0.028**	-0.029**	-0.029**	-0.027**	-0.030**
	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)
Electoral democracy	0.229***				
	(0.070)				
Liberal democracy		0.167**			
		(0.079)			
Participatory democracy			0.193**		
			(0.077)		
Egalitarian democracy				0.171*	
				(0.088)	
Deliberative democracy					0.164**
					(0.082)
Intercept	-8.710***	-8.185***	-8.307***	-8.121***	-8.625***
	(1.572)	(1.661)	(1.681)	(1.574)	(1.628)
Observations	1262	1262	1262	1262	1262
Sargan-Hansen test (p-value)	0.304	0.287	0.306	0.283	0.293
AR(1) test p-value	0.000	0.000	0.000	0.000	0.000
AR(2) test p-value	0.494	0.457	0.439	0.450	0.497

Note: Results are based on first-difference transformation and Ahn-Schmidt (1995) non-linear moment conditions with absence of serial correlation and homoskedasticity, two-step estimation, and Windmeijer (2005) corrected standard errors shown in parentheses. The Sargan-Hansen tests the validity of the overidentifying restrictions with 2-step moment functions and 2-step weighting matrix. AR(1) and AR(2) tests are the Arellano-Bond tests for the first order and second order autocorrelation of the first-differenced residuals. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3
Static estimation results of moderating effects

	Model 1	Model 2	Model 3	Model 4	Model 5
Population	1.002***	1.000***	0.999***	1.002***	1.000***
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Income per capita	1.004***	1.001***	1.003***	1.004***	1.002***
	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)
Energy intensity	0.875***	0.875***	0.876***	0.876***	0.875***
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Trade openness	0.016	0.016	0.016	0.016	0.015
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Industrial sector output	0.135***	0.140***	0.136***	0.135***	0.137***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Service sector output	-0.064	-0.062	-0.065	-0.065	-0.063
	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)
Financial development	0.140***	0.140***	0.140***	0.141***	0.140***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
FDI x Electoral dem.	-0.017***				
	(0.003)				
FDI x Liberal dem.		-0.015***			
		(0.003)			
FDI x Participatory dem.			-0.016***		
			(0.003)		
FDI x Egalitarian dem.				-0.017***	
				(0.003)	
FDI x Deliberative dem.					-0.016***
					(0.003)
Intercept	-11.608***	-11.571***	-11.562***	-11.620***	-11.567***
	(0.708)	(0.712)	(0.717)	(0.706)	(0.715)
Observations	1291	1291	1291	1291	1291
F-test	392.97***	380.91***	389.05***	394.95***	384.33***
Within R^2	0.731	0.731	0.731	0.731	0.731

Note: Driscoll-Kraay (1998) standard errors in parentheses. Two-tailed tests. *** p<0.01, ** p<0.05, * p<0.1.

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Table 4
Dynamic estimation results of moderating effects

	Model 1	Model 2	Model 3	Model 4	Model 5
Lagged CO2 emissions	0.318***	0.319***	0.319***	0.316***	0.318***
	(0.066)	(0.067)	(0.065)	(0.066)	(0.066)
Population	0.712***	0.715***	0.713***	0.721***	0.712***
	(0.100)	(0.100)	(0.099)	(0.100)	(0.098)
Income per capita	0.682***	0.685***	0.686***	0.692***	0.683***
	(0.089)	(0.088)	(0.088)	(0.088)	(0.088)
Energy intensity	0.452***	0.455***	0.452***	0.455***	0.454***
	(0.115)	(0.114)	(0.114)	(0.113)	(0.113)
Trade openness	0.060**	0.060**	0.064**	0.063**	0.062**
	(0.026)	(0.026)	(0.026)	(0.026)	(0.027)
Industrial sector output	0.102	0.103	0.098	0.095	0.096
	(0.062)	(0.062)	(0.062)	(0.063)	(0.062)
Service sector output	0.042	0.042	0.042	0.039	0.039
	(0.121)	(0.122)	(0.120)	(0.123)	(0.119)
Financial development	0.041	0.042	0.041	0.041	0.042
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
FDI x Electoral dem.	-0.056***				
	(0.021)				
FDI x Liberal dem.		-0.056***			
		(0.020)			
FDI x Participatory dem.			-0.058***		
			(0.021)		
FDI x Egalitarian dem.				-0.060***	
				(0.021)	
FDI x Deliberative dem.					-0.057***
					(0.020)
Intercept	-7.861***	-7.996***	-7.943***	-8.082***	-7.877***
	(1.828)	(1.823)	(1.803)	(1.818)	(1.778)
Observations	1262	1262	1262	1262	1262
Sargan-Hansen test (p-value)	0.204	0.199	0.199	0.201	0.206
AR(1) test p-value	0.000	0.000	0.000	0.000	0.000
AR(2) test p-value	0.466	0.463	0.165	0.481	0.457

Note: Results are based on first-difference transformation and Ahn-Schmidt (1995) non-linear moment conditions with absence of serial correlation and homoskedasticity, two-step estimation, and Windmeijer (2005) corrected standard errors shown in parentheses. The Sargan-Hansen tests the validity of the overidentifying restrictions with 2-step moment functions and 2-step weighting matrix. AR(1) and AR(2) tests are the Arellano-Bond tests for the first order and second order autocorrelation of the first-differenced residuals. *** p<0.01, ** p<0.05, * p<0.1.

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Table 5
Robustness checks for static estimation results of direct effects

	Model 1	Model 2	Model 3	Model 4	Model 5
Population	1.162***	1.164***	1.173***	1.145***	1.167***
	(0.072)	(0.073)	(0.074)	(0.071)	(0.075)
Income per capita	0.597***	0.600***	0.590***	0.590***	0.604***
	(0.028)	(0.028)	(0.028)	(0.027)	(0.028)
Non-renewable energy	0.069***	0.070***	0.070***	0.070***	0.070***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Renewable energy	-0.092***	-0.092***	-0.090***	-0.090***	-0.092***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Trade openness	0.046	0.045	0.037	0.042	0.048
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)
Industrial sector output	-0.028	-0.028	-0.027	-0.030	-0.017
	(0.065)	(0.065)	(0.066)	(0.065)	(0.066)
Service sector output	-0.068	-0.068	-0.067	-0.066	-0.065
	(0.211)	(0.211)	(0.213)	(0.210)	(0.209)
Financial development	0.056**	0.058**	0.062**	0.057**	0.053**
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
FDI	-0.177***	-0.178***	-0.178***	-0.173***	-0.179***
	(0.038)	(0.038)	(0.038)	(0.038)	(0.039)
Electoral democracy	0.152***				
	(0.034)				
Liberal democracy		0.090***			
		(0.021)			
Participatory democracy			0.124***		
			(0.031)		
Egalitarian democracy				0.180***	
				(0.036)	
Deliberative democracy					0.086***
					(0.025)
Intercept	-4.741***	-4.808***	-4.860***	-4.365***	-4.931***
	(0.541)	(0.578)	(0.584)	(0.522)	(0.616)
Observations	1574	1574	1574	1574	1574
F-test	1277-86***	1219.03***	1245.12***	1261.71***	1281.25***
Within R^2	0.680	0.679	0.680	0.682	0.677

Note: Driscoll-Kraay (1998) standard errors in parentheses. Two-tailed tests. *** p<0.01, ** p<0.05, * p<0.1.

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Table 6
Robustness checks for dynamic estimation results of direct effects

	Model 1	Model 2	Model 3	Model 4	Model 5
Lagged CO2 emissions	0.340***	0.352***	0.353***	0.297***	0.357***
	(0.071)	(0.059)	(0.074)	(0.097)	(0.057)
Population	0.585***	0.583***	0.572***	0.657***	0.579***
	(0.086)	(0.080)	(0.094)	(0.107)	(0.103)
Income per capita	0.478***	0.453***	0.449***	0.459***	0.477***
	(0.057)	(0.065)	(0.069)	(0.055)	(0.066)
Non-renewable energy	0.032**	0.030**	0.028**	0.032**	0.027**
	(0.015)	(0.012)	(0.013)	(0.013)	(0.012)
Renewable energy	-0.047**	-0.050**	-0.047***	-0.047**	-0.044**
	(0.019)	(0.019)	(0.017)	(0.019)	(0.018)
Trade openness	0.044	0.049	0.033	0.035	0.051
	(0.048)	(0.053)	(0.054)	(0.053)	(0.059)
Industrial sector output	0.202*	0.211*	0.224*	0.218*	0.256*
	(0.119)	(0.120)	(0.125)	(0.113)	(0.134)
Service sector output	0.065	0.096	0.083	0.184	0.108
	(0.178)	(0.184)	(0.208)	(0.162)	(0.223)
Financial development	0.090**	0.107**	0.112***	0.095**	0.082**
	(0.035)	(0.044)	(0.040)	(0.041)	(0.036)
FDI	-0.182***	-0.188***	-0.177***	-0.188***	-0.195***
	(0.047)	(0.056)	(0.053)	(0.066)	(0.055)
Electoral democracy	0.670**				
	(0.302)				
Liberal democracy		0.468**			
		(0.185)			
Participatory democracy			0.515**		
			(0.207)		
Egalitarian democracy				0.591**	
				(0.283)	
Deliberative democracy					0.480**
					(0.194)
Intercept	-1.768	-1.881	-1.642	-2.360	-2.212
	(1.727)	(1.594)	(1.818)	(1.941)	(1.934)
Observations	1531	1531	1531	1531	1531
Sargan-Hansen test (p-value)	0.345	0.265	0.248	0.324	0.287
AR(1) test p-value	0.025	0.023	0.026	0.005	0.031
AR(2) test p-value	0.113	0.058	0.099	0.065	0.119

Note: Results are based on first-difference transformation and Ahn-Schmidt (1995) non-linear moment conditions with absence of serial correlation and homoskedasticity, two-step estimation, and Windmeijer (2005) corrected standard errors shown in parentheses. The Sargan-Hansen tests the validity of the overidentifying restrictions with 2-step moment functions and 2-step weighting matrix. AR(1) and AR(2) tests are the Arellano-Bond tests for the first order and second order autocorrelation of the first-differenced residuals. *** p<0.01, ** p<0.05, * p<0.1.

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Table 7
Robustness checks for static estimation results of moderating effects

	Model 1	Model 2	Model 3	Model 4	Model 5
Population	1.220***	1.228***	1.220***	1.227***	1.223***
	(0.075)	(0.075)	(0.075)	(0.076)	(0.076)
Income per capita	0.639***	0.639***	0.645***	0.660***	0.632***
	(0.030)	(0.031)	(0.030)	(0.033)	(0.031)
Non-renewable energy	0.071***	0.071***	0.070***	0.071***	0.071***
	(0.009)	(0.010)	(0.009)	(0.010)	(0.010)
Renewable energy	-0.092***	-0.092***	-0.093***	-0.090***	-0.093***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Trade openness	0.020	0.016	0.022	0.033	0.010
	(0.034)	(0.033)	(0.033)	(0.033)	(0.033)
Industrial sector output	-0.005	-0.004	-0.015	-0.026	-0.003
	(0.068)	(0.069)	(0.068)	(0.068)	(0.070)
Service sector output	-0.075	-0.079	-0.094	-0.089	-0.078
	(0.192)	(0.192)	(0.191)	(0.193)	(0.191)
Financial development	0.033*	0.029	0.028	0.023	0.032
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
FDI x Electoral dem.	-0.004***				
	(0.000)				
FDI x Liberal dem.		-0.004***			
		(0.000)			
FDI x Participatory dem.			-0.005***		
			(0.001)		
FDI x Egalitarian dem.				-0.006***	
				(0.001)	
FDI x Deliberative dem.					-0.004***
					(0.000)
Intercept	-6.654***	-6.768***	-6.582***	-6.742***	-6.656***
	(0.755)	(0.770)	(0.755)	(0.764)	(0.777)
Observations	1574	1574	1574	1574	1574
F-test	655.27***	668.85***	710.49***	750.52***	635.68***
R^2	0.671	0.672	0.671	0.676	0.671

Note: Driscoll-Kraay (1998) standard errors in parentheses. Two-tailed tests. *** p<0.01, ** p<0.05, * p<0.1.

Table 8
Robustness checks for dynamic estimation results of moderating effects

	Model 1	Model 2	Model 3	Model 4	Model 5
Lagged CO2 emissions	0.446***	0.442***	0.451***	0.445***	0.460***
	(0.059)	(0.062)	(0.060)	(0.060)	(0.058)
Population	0.578***	0.577***	0.574***	0.583***	0.558***
	(0.061)	(0.061)	(0.070)	(0.062)	(0.068)
Income per capita	0.579***	0.596***	0.599***	0.610***	0.567***
	(0.105)	(0.109)	(0.110)	(0.107)	(0.100)
Non-renewable energy	0.029*	0.026*	0.026*	0.028*	0.026*
	(0.016)	(0.014)	(0.014)	(0.015)	(0.014)
Renewable energy	-0.058***	-0.059***	-0.056**	-0.057***	-0.061***
	(0.019)	(0.020)	(0.023)	(0.021)	(0.021)
Trade openness	0.128*	0.121*	0.141*	0.137**	0.123**
	(0.067)	(0.068)	(0.076)	(0.068)	(0.061)
Industrial sector output	0.097	0.052	0.069	0.047	0.080
	(0.136)	(0.133)	(0.136)	(0.126)	(0.122)
Service sector output	-0.001	-0.043	-0.043	-0.061	-0.035
	(0.183)	(0.195)	(0.196)	(0.215)	(0.201)
Financial development	0.118**	0.102**	0.110**	0.097*	0.106**
	(0.046)	(0.051)	(0.053)	(0.055)	(0.049)
FDI x Electoral dem.	-0.008***				
	(0.002)				
FDI x Liberal dem.		-0.009***			
		(0.002)			
FDI x Participatory dem.			-0.012***		
			(0.003)		
FDI x Egalitarian dem.				-0.011***	
				(0.002)	
FDI x Deliberative dem.					-0.009***
					(0.002)
Intercept	-4.558***	-4.258***	-4.441***	-4.352***	-4.139***
	(1.263)	(1.289)	(1.327)	(1.287)	(1.265)
Observations	1531	1531	1531	1531	1531
Sargan-Hansen test (p-value)	0.966	0.934	0.934	0.971	0.978
AR(1) test p-value	0.043	0.042	0.036	0.041	0.042
AR(2) test p-value	0.100	0.099	0.095	0.099	0.094

Note: Results are based on first-difference transformation and Ahn-Schmidt (1995) non-linear moment conditions with absence of serial correlation and homoskedasticity, two-step estimation, and Windmeijer (2005) corrected standard errors shown in parentheses. The Sargan-Hansen tests the validity of the overidentifying restrictions with 2-step moment functions and 2-step weighting matrix. AR(1) and AR(2) tests are the Arellano-Bond tests for the first order and second order autocorrelation of the first-differenced residuals. *** p<0.01, ** p<0.05, * p<0.1.

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Appendix

Appendix Table 1
Descriptive statistics

Variables	Mean	Standard deviation	Minimum	Maximum
CO_2 emissions	18.52	1.974	13.45	23.78
Population	16.29	1.549	12.47	21.03
Income per capita	8.839	1.460	5.318	11.63
Energy intensity	4.685	0.473	1.493	6.898
Non-renewable energy	3.386	1.691	-6.357	4.605
Renewable energy	2.949	1.607	-4.773	4.605
Industrial sector output	3.231	0.269	1.177	3.954
Service sector output	4.008	0.190	2.883	4.383
Financial development	4.100	0.347	2.137	4.584
FDI	-1.272	1.861	-6.294	4.939
FDI (robustness checks)	4.048	0.387	1.961	4.603
Electoral democracy	-0.404	0.354	-2.025	-0.076
Liberal democracy	-0.641	0.531	-3.016	-0.110
Participatory democracy	-0.819	0.454	-3.058	-0.217
Egalitarian democracy	-0.689	0.490	-2.900	-0.128
Deliberative democracy	-0.622	0.479	-3.411	-0.118