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Do Economic and Financial Development Mater for Environmental Degradation?

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Abstract: The differences in financial development between advanced countries are pronounced. It has been observed, both theoretically and empirically, that these differences in countries' financial systems are a source of comparative advantage and trade. The framework in which differences in financial development are an endogenous determinant of environmental degradation is only appropriate if we believe that a country's financial system is endogenously, it will in turn be influenced by trade and foreign direct investment (FDI). The analysis of environmental Kuznets curve (EKC) is one of the most controversial hypotheses examining the interactions between economic growth and environmental degradation. The logic of EKC analyses is rather appealing. In the first stages of economic growth (industrialization stage) natural resources are degraded intensively and environmental pollution grows rapidly [1]. In this paper, we examine the effect of economic and financial development on the environmental quality in North region. The results indicate financial development increase environmental quality. Also, the EKC shows the inverted-U relationship between GDP per capita and CO_2 emission per capita.

JEL Classification: O44, G15.
Key words: Environmental kuznets curve · Financial development · Economic development

INTRODUCTION

The environmental Kuznets curve (EKC for short) is referred to as the hypothesis that the relationship between environmental degradation and per capita income exhibits an inverted-U shape. The logic of the EKC relationship is rather intuitive. In early stages of industrialization, pollution grows rapidly because high priority is given to increasing material output and people are more interested in income than environment. In the later stage, however, as income rises, the willingness to pay for a clean environment increases by a greater proportion than income, regulatory institutions become more effective for the environment and pollution level starts declining. The inverted-U relationship reveals that economic growth could be compatible with environmental improvement. Since the early 1990s, heated debates have been made on the EKC hypothesis and plenty of empirical studies support the inverted-U relationship. The reader is referred to, e.g., Borghesi [2], Dinda [3], He [4] for overviews and comparisons on the EKC.

Note that most of the theoretical papers succeed only to illustrate an inverted-U-shape pattern and few of them shows an N-shaped pattern. It is therefore required to develop sophisticated models that are flexible enough to explain the actual environment-income relationship and to predict how the environmental quality will evolve in future with in a unified framework. Such theoretical models supported by ample empirical studies can be useful for environmental policy makers, because the evolution of pollution is linked not only with a development path or economic growth, but also with policy response [5, 6].

Since heated debates occurred on the EKC hypothesis, a plenty of empirical studies support the inverted-U relationship of the pollution level with respect to per capita income, although some other papers are skeptical about the hypothesis. In addition, some researches found that the relationship is not of an inverted-U shape, but of an N shape, meaning that the environmental degradation starts increasing again after a decrease to a certain level.

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A large number of econometric studies have been made to test the emergence of the EKC in a wide variety of income- based environmental degradation. Typically, most of such researches employ reduced-form models in which the environment-income indicator is a quadratic or cubic function of income. For example, consider the following cubic model:

$$Y_{it} = \alpha_i + \beta_1 X_{it} + \beta_2 X^2_{it} + \beta 3 X^3_{it} + \beta_4 Z_{it} + \varepsilon_{it} \quad (1)$$

where Y is an environmental indicator, X is income, Z is an other variable that is influential on environmental degradation and e denotes an error term. Here, while t stands for time, i represents a local area such as a country, a province, a city or another type of authority that is responsible for environmental policies. The parameters β are to be estimated from data.

Also, financial development may play a deterministic role in the environment. Greater financial sector development can facilitate more financing at lower costs, including for investment in environmental projects. The ability to raise such financing may be especially important for governments-at the local, state and national levels, since much of environmental protection will be a public sector activity. It, however, also applied to the investment of private firms in required environment- protecting activities. Furthermore, it has been found that better governed firms are more willing to consider environmental considerations. As such, through improved governance, financial sector development can spur greater environment [7].

In this framework, a vast number of studies evidence that capital markets rewards firm with superior environmental performance trough a higher valuation of firms' share. As it is pointed out in Lanoie *et al*. [8] the regulators have recently embarked on a deliberate strategy to release information to markets and communities regarding firms' environmental performance in order to enhance incentives for pollution control. Moreover, they find that capital markets react to the release of information and that large polluters are affected more significantly from such release than smaller polluters. The same results have been found in Dasgupta *et al*. [9], who have shown that capital markets in Argentina, Chile, Mexico and the Philippines do react negatively by decreasing the firms' capitalization to citizens' complaints targeted at specific firms and positively to the announcement of rewards and recognition of superior environmental performance.

Dasgupta *et al*. [9] argues that the environmental regulators in developing countries may explicitly harness financial market forces by introducing structured programs of information release on firms' environment. This indicates that well-developed financial system may provide enough incentive for firms to lower their CO_2 emission. Dasgupta *et al*. [9] examine the reaction of investors to the publication of the lists of companies that fail to comply with national environmental laws and regulations in Republic of Korea. They find that enterprises appearing on these lists have experienced a significant decline in their market valuation. Therefore, financial sector development is likely matter for environmental performance.

Subset of Financial Development Variables: Several studies highlighted the importance of capital markets as a main pillar of financial development. Hamilton [10], Klassen and McLaughlin [11] and Lanoie *et al*. [8] found evidence that capital markets reward firms with higher environmental performance and penalize firms with poor environmental performance, the potential reaction of capital markets may explain that the pollution haven hypothesis has so far not found empirical support. This argument suggests that the more-developed financial capital markets are likely to enjoy a better environmental quality than that of a country with less-developed capital markets [9]. Consequently, we used stock market value added as an indicator of capital markets across countries under consideration. At the same time, the literature has recognized the importance of FDI impact in the environmental performance [12, 13]. The literature on competitiveness and environmental policy generally supposes that the introduction of more stringent environmental regulations is potentially harmful for the productivity and competitiveness of domestic firms facing higher production costs. More stringent environmental regime imposes new cost elements on the firm; this affects the firm's productivity and competitiveness in product markets. This would lead to delocalization of production towards countries with a relatively lower burden of environmental regulation, to the so-called pollution havens ([14, 15], among others). In the context of FDI, it means that a firm would relocate when the abatement cost at home increases above the level abroad, everything else held the same, or when the abatement cost abroad decreases, while the level at home remains unchanged. This can be called the *relative abatement cost problem*. The countries with relatively more lax environmental

regimes have a comparative advantage in their competition for foreign direct investment, turning these countries into pollution havens. In policy terms, the existence of such an effect - or even the perception of the existence of such an effect - may have a 'chilling effect' undermining the incentives for national policymakers to adopt more stringent environmental policies. As a consequence, governments may introduce policies that are less stringent than is optimal. Analogously they may be tempted to adopt protectionist policies (such as border tax adjustments) in 'exposed' sectors where regulations are stringent. However, the impact of FDI on environmental degradation is controversial. Eskeland and Harrison [16] use a panel data set on US outbound direct investment to four countries and found little support for the pollution haven hypothesis. Also, they found foreign plants are significantly more energy efficient and use cleaner types of energy than the domestic-owned plants. Wang and Yanhong [17] find similar results in a study examining firm level pollution discharge in more than 1000 firms in China. Liang [18] found a negative correlation between FDI and air pollution, suggesting that the overall effect of FDI may be beneficial to the environment. This finding supports the argument that FDI in developing countries are more likely to act as conditional factor for advanced and cleaner, environmental technologies. On contrary, Xing and Kolstad [19] report a positive association between the amount of sulfur emissions in a host country and inflows of US FDI in heavily polluting industries.

Similarly to Creane *et al*. [20], we use deposit money bank assets bank to GDP as determinant of financial development. Yet, one of the banking system development indicators is the capital account liberalization process which usually increases the efficiency level of the financial system by weeding out inefficient financial institutions and creating greater pressure for a reform of the financial infrastructure [20, 21]. Klein and Olivei [22] find that capital account liberalization is statistically significant for financial development and economic growth in a cross-section study over 1986-1995. They argue that the countries with open capital accounts had significantly a greater increase in financial development in contrast with countries presenting account restrictions. Moreover, Frankel and Rose [23] find that openness is at least as least as likely to help the environment, for a given level of income, as to hurt it. Therefore, such an improvement in financial infrastructure, based on the openness of capital account, may contribute to the efficient technological use and, therefore affect not only the financial development itself but the environmental degradation as well.

Control Variables of Financial Development: Trade openness is regarded as an important factor in financial development by some previous studies [24]. Thus, its impacts should be controlled. The ratio of the sum of commodity exports and imports to GDP is estimated as trade openness variable (%of GDP). Rajan and Zingales [25] as well as Huang and Temple [26] find the expected positive relationship between trade openness and financial development, at least in countries open to capital flows, which provides some support for the interest group theory of financial development. However, trade openness might affect financial development through channels other than easing the opposition of incumbent political and economic elites.

Rajan and Zingales [25] suggested that incumbents' opposition to financial development might become weaker when an economy was open to both trade and capital flows. Since there are the same capital account restrictions in all the regions of China, them a in regional difference in financial openness can be reflected by the indicator of foreign direct investment. Although this indicator is not perfect, it is the best one that is available. Thus, the total foreign direct investment divided by the gross fixed capital stock is estimated as the FDI variable (%).

Baltagi *et al*. [24] address an empirical question of whether trade and financial openness can help explain the recent pace in financial development, as well as its variation across countries in recent year. Their finding, which only provides a partial support to the Rajan and Zingales hypothesis, suggests that trade and financial openness are statistically significant determinants of banking sector development. However, these two studies have only focused on the one-way relationship running from financial/trade openness to financial development, but have not yet reveal this relationship in opposite way. In addition, in these two cited researches, the relationship between financial development and openness has only been examined in models without the financial crisis variable. The fact is that the appearance of financial crisis may change the nature of relationship between financial development and financial/trade openness. Therefore, needless to say introducing a financial crisis variable in estimated models should be asked for in the empirical researches.

An increase in FDI lowers set-up costs (for technology adaptation) and raises the return on assets. This leads to an increase in saving and so a higher growth rate in consumption and output. This effect will be greater the higher the level of technology in a country, i.e. the better the financial system is developed.

According to there search of Baltagi *et al*. [24], the interaction term between trade and FDI is also introduced as the third control variable. It is used here to test the simultaneous openness hypothesis of Rajan and Zingales [25], who suggest that simultaneous opening of both trade and capital accounts, will have a larger positive impact on financial development than opening one of them.

Our Model: I estimate a system of simultaneous equations, in which CO_2 emission per capita and financial development are endogenously determined by country-specific characteristics. This system approach takes into account the endogeneity of financial development.

I estimate a two-equation system using 1980-2011 panel data for the 4 euro-Mediterranean developed countries, France, Italy, Greece and Spain. Data are obtained from the World Bank's 2012 World Development Indicators' (WDI's) on-line WDI 2012. For the first equation I assume that CO_2 emission per capita and financial development are joint products, produced by country-specific factors: GDP per capita, GDP per capita squared, GDP per capita cube, the variable of ratio of deposit money bank asset to GDP as financial development index.

To conserve notation I suppress time and country subscripts in describing the model. The joint Financial Development function is:

$F(CO_2$ emission per capita, Financial Development) = G (GDP, GDP^2, GDP^3, Financial Development)

I invert the relation F()=G() to obtain the financial development function: Financial Development = (OP, FDI/K, OP*FDI), which represents the relation between financial development and the variables of trade openness, FDI/gross fixed capital stock and the interaction between trade openness and the degree of foreign direct investment.

The Estimation and Results: We estimate the system of simultaneous equations using fixed and/or random effects of panel data specifications. Panel data analyses offer different ways to deal with the possibility of country-specific variables. Fixed Effect (FE) model is a suitable estimation approach that treats the level effects as constants, whereas Random Effect (RE) model is suitable to capture the level effect. It should be mentioned that RE model treats the level effects as uncorrelated with other variables, while FE model does not. In this analysis we estimate both FE and RE models. Statistically, fixed effects are always a reasonable thing to do with panel data (they always give consistent results) but they may not be the most efficient model to run. Random effects will give you better P-values as they are a more efficient estimator, so you should run random effects if it is statistically justifiable to do so. The Hausman test checks a more efficient model against a less efficient but consistent model to make sure that the more efficient model also gives consistent results.

Fixed effects regression is the model to use when we want to control for omitted variables that differ between cases but are constant over time. But, random effects be used when some omitted variables may be constant over time but vary between cases and others may be fixed between cases but vary over time. Estimating multiple regressions on panel data is often complicated by heteroskedasticity and serial correlation and an OLS estimator produces biased, inaccurate estimates of parameters.

First, I test the stationarity of variables in the model. Unit root tests are traditionally used to test for the order of integration of the variables or to verify the stationarity of the variables. The traditional Augmented Dickey-Fuller (1979) (ADF) technique has become well-known to test for the time series' unit root. To test for the panel unit root, a number of such recent developments has also appeared in the literature, including: Levin, Lin and Chu (LLC test) [27]; Im, Pesaran and Shin (IPS test) [28]; Maddala and Wu [29]; Choi [13]; and Hadri [30]. From among these different panel unit root tests, the LLC test and the IPS test are the most popular. Both of these tests are based on the Augmented Dickey-Fuller (ADF) principle.

The LLC test assumes homogeneity in the dynamics of the autoregressive (AR) coefficients for all panel members. Concretely, the LLC test assumes that each individual unit in the panel shares the same AR(1) coefficient, but allows for individual effects, time effects and possibly a time trend. Lags of the dependent variable may be introduced to allow for serial correlation in the errors.

Table 1: Variables Stationarity Tests

	Levin, Lin and Chu- Test		Im, Pesaran and Shin W-stat -Test	
Variables	Statistic	Prob	Statistic	Prob
Inflow FDI_{it}	-17.27130	0.0000	-2.31230	0.0000
$GDPP_{it}$	-12.58240	0.0000	-5.15130	0.0001
GDP_{it}^2	6.57204	0.0002	-7.49820	0.0000
GDP_{it}^3	-3.15131	0.0000	-3.87846	0.0001
Financial $Development_{it}$	-6.57092	0.0000	-4.45390	0.0000
OP_{it}	-2.83630	0.0000	-2.63468	0.0042
FDI_{it}	-5.64450	0.0000	-5.53130	0.0000
K_{it}	13.08590	0.0000	8.77670	0.0000
OP_{it}	3.49670	0.0000	3.71630	0.0000

Table 2: the Determinants of Co_2emission per Capita for 4 Euro-mediterranean Countries

Variables	Fixed Effect	Random Effect(1)
C	-3.36e+09 (-0.35)	-1.34e+10 (-1.37)
GDP_{it}	363727.3* (2.27)	361936.4** (2.50)
GDP_{it}^2	-4.80e+09* (-3.92)	-2.03e+09** (-2.68)
GDP_{it}^3	5.66e+10* (4.14)	-5.46e+10* (-0.77)
Financial $Development_{it}$	-593.0016 (-0.30)	-8501162* (-4.93)
R^2 (overall)	0.4128	0.7858
Groups	4	4
Number of observation	186	186
Wald Test	256.94	137.17
Prob > chi2	0.0000	0.0000
Hausman Test(2)	$\chi^2(4)= 107.58$	
Prob > chi2	0.0000	

Note: T-statistics are shown in parentheses. Significance at the 99%, 95% and 90% confidence levels are indicated by *, **and ***, respectively.

(1) The acceptation of model by the Hausman test

The IPS test is more general than the LLC test because of allowing for heterogeneity in dynamic panel. Therefore, it is described as a "Heterogeneous Panel Unit Root Test". It is particularly reasonable to allow for such heterogeneity in choosing the lag length in the ADF tests when imposing uniform lag length is not appropriate. In addition, the IPS test allows for individual effects, time trends and common time effects. Based on the mean of the individual Dickey-Fuller t-statistics of each unit in the panel, the IPS test assumes that all series are non-stationary under the null hypothesis. The results show that all variables are stationarity at level in the region (Table 1).

Our results show that GDP per capita has positive effects on CO_2 emission per capita, but GDP per capita squared and financial development variable decrease CO_2 emission per capita (Table 2).

The results indicate the inverted-U EKC in the region. That is, in early stages of industrialization, pollution grows rapidly because high priority is given to increasing material output and people are more interested in income than environment. In the later stage, however, as income rises, the willingness to pay for a clean environment increases by a greater proportion than income, regulatory institutions become more effective for the environment and pollution level starts declining.

CONCLUSIONS

While most empirical studies have focused on the effects of economic growth on environmental performance, this paper also addressed the impact of financial development on environmental degradation. The level of environmental quality in a country is primarily determined by its financial development and income level. In this paper, the relation between economic development, financial development and environmental quality is examined in 4 euro-Mediterranean developed countries using two-equation system during the period 1980-2011. The results show that the region's EKC is inverted-U, judging by the signs and significance per capita GDP and its squares. In addition, while the majority of the existing research is focused on consequences of economic growth on environmental degradation, we show that financial development might play a determinant role for environmental disclosure in developed economies.

Our findings show that financial development is associated with decline in CO_2 per capita emissions. In this sense, it is note worthy that the government can help the banks by establishing a strong policy framework that creates long-term value for greenhouse gas emissions reductions and consistently supports the development of new technologies that lead to a less carbon-intensive economy.

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