Banks, climate risk and financial stability

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Abstract

Purpose – This paper aims to quantify the (syndicated) loan exposure to elevated environmental risk sectors of the banking system in the USA, EU, China, Japan and Switzerland at US$1.6tn and to highlight its importance, which ranges from 3.8 (USA) to 0.5 per cent (China) in terms of total national banking assets. The paper highlights the relevance of exploring prudential policy responses, including a harmonized taxonomy, statistical and reporting framework that could contribute to internalizing the negative externalities associated with climate risks by both banks and their supervisors. Among the prudential supervisory tools, credit registers facilitate the assessment of environmental risk drivers in “carbon stress tests.” This paper also presents a framework of analysis for the regulatory treatment of climate-related risks.

Design/methodology/approach – Similarly to Weyzig et al. (2014), this paper uses financial databases on the banks’ role as book runners for syndicated loans; that is, as the lead arrangers who also provide a large share of the actual lending. Loans are outstanding on December 31, 2014, and the paper assumes linear amortization of loans issued before that date and with maturity after that date. This study includes the largest banks from the above-mentioned countries with financial information available in SNL Financial and EU banks with financial information available in the ECB database on December 31, 2014. By assessing the relative share of the ten largest (or total reporting if less) banks’ exposure to each high environmental risk sector in relation to their total assets, these findings can be extrapolated across sectors in the respective country.

Findings – This paper quantifies the loan exposure to elevated environmental risk sectors of the banking system in the USA, EU, China, Japan and Switzerland in US$1.6tn, broadly in line with the findings of Battiston et al. (2017) and Weyzig et al. (2014). This paper also explores prudential policy approaches and tools. In addition to the lack of taxonomy of “brown” vs “green,” the paper identifies the limitations to assess the risks involved in the transition to a low-carbon economy: supervisory reports that do not make full use of the existing international statistical framework (e.g. EU COREP and FINREP); lack of harmonized reporting requirements of environmental risks; lack of credit registers as tools to perform carbon stress-testing; and supervisors’ governance framework that do not internalize environmental risks (e.g. proposed revision of the Basel Core Principles of Banking Supervision). As per the stress-testing, the paper presents two examples.

The paper presents a framework of analysis for the regulatory treatment of climate-related risks. The author identifies two critical elements of such framework if prudential regulation of environmental risks is to be considered: the consideration or not of climate risk as credit risk and the impact of environmental risks over probabilities of default over the entire business cycle.

Research limitations/implications – No internationally accepted “official” taxonomy of high environmental risk sectors exists. This paper uses Moody’s (2015a) classification of sectors according to their environmental risk exposure. This paper’s exposures do not reflect the real risk exposure of these institutions and the banking industry as a whole because, as explained in Page 6, these values are without regard to bilateral loans and guarantees and securitizations of loans; in the case of loans to power generation

The views expressed here are those of the author and do not necessarily represent those of Bank of Spain or the euro system. The author thanks Kern Alexander and Willem Pieter De Groen for their comments and support to an initial draft; Marco Bardoscia and all the participants of the IWFSAS Conference in Montréal (August 24-25, 2017), Seminar at the International Monetary Fund (February 27, 2018) and Seminar at Bank of Spain (April 27, 2018); and Martin Cihák, Carlos Perez and Hiroko Oura for their suggestions and Anna Gorris for her valuable contribution as research assistants. Any errors are the author’s.
companies, renewable sources are not excluding and, similarly, for the production of electric vehicles, loans are not excluded. Furthermore, this paper does not assess banks’ exposures to sovereigns subject to high environmental risks and bonds and equity issued by corporations operating in high environmental risk sectors.

**Practical implications** – Contribution to the present policy debate on how to regulate banks’ exposure to high environmental risk and how to manage the transition to a low-carbon economy.

**Social implications** – This paper can increase awareness of the banking sector transition risks to a low carbon economy.

**Originality/value** – This paper quantifies banks direct exposures to high environmental risk sectors using an ample definition of sectors exposed to environmental risk. The author suggests policy actions to assess the environmental risks. The author defines a regulatory framework for banks to internalize the negative externalities of environmental risks.

**Keywords** Environment, Governance, Regulation, Banking

**Paper type** Conceptual paper

1. Introduction
The need for decisive policy action on climate change is broadly acknowledged. Since 1979, international agreements have intended to increase awareness of climate change risks and the associated need to reduce greenhouse gas emissions. Most recently, the Paris Agreement was adopted at the Paris Climate Change Conference (December 2015) to strengthen the global response to the threat of climate change[1].

Financial policy and regulation are increasingly recognized as important dimensions of the transition toward a low-carbon economy that is consistent with the full implementation of the Paris Agreement[2]. On the one hand, the speed and the smoothness of the transition to a green economy and the adjustment costs could affect systemic financial risks. On the other hand, there is a growing recognition now that the inculcation of green guidelines and standards into bank lending, trading and investment practices is critical for achieving the core mandates of International Financial Organizations, such as the International Monetary Fund (IMF, 2015a) and the World Bank. Economic growth and financial development should aim to be economically, socially and environmentally sustainable (IMF, 2015b).

The contribution of this paper to the literature is threefold:

(1) It quantifies the (syndicated) loan exposure to elevated environmental risk sectors of the banking system in the USA, EU, China, Japan and Switzerland. To the best of the author’s knowledge, it is the first international comparison of banks’ loan exposures to high environmental risks. In contrast to Battiston et al. (2017), who use a network analysis of the exposures of all financial actors to all climate-relevant sectors of the economy and the exposures among financial actors themselves across several types of financial instruments, this paper focuses on banks’ direct exposures using Weyzig et al. (2014). Differences between Battiston et al. (2017), Weyzig et al. (2014) and this paper are described in Table I.

(2) It explores prudential policy approaches and tools: In addition to the lack of taxonomy of “brown” vs “green”, the paper identifies the limitations to assess the risks involved in the transition to a low-carbon economy: supervisory reports that do not make full use of the existing international statistical framework (e.g. EU COREP and FINREP); lack of harmonized reporting requirements of environmental risks; lack of statistical data bases and credit registers as tools to perform carbon stress-testing; and
supervisors’ governance framework that do not internalize environmental risks (e.g. proposed revision of the Basel Core Principles of Banking Supervision). As per the stress-testing, the paper presents two examples.

(3) It presents a framework of analysis for the regulatory treatment of climate-related risks. The author identifies two critical elements of such framework if prudential regulation of environmental risks is to be considered:

- the consideration or not of climate risk as credit risk; and
- the impact of environmental risks over probabilities of default over the entire business cycle.

The paper is divided into three sections in addition to this introduction. Section 2 explores the impact of the transition to a green economy on the banking system and quantifies the corporate exposures of the banking systems in the USA, EU, China, Japan and Switzerland to high environmental risks sectors. Section 3 presents the statistical frameworks for the classification of economic activities, which allow for the identification of economic activities exposed to elevated environmental risks. This section discusses the need for supervisory reporting to assess environmental risks. Also, this section presents approaches to a “carbon stress test” and a conceptual framework for potentially “new” prudential regulatory requirements to account for environmental risks. Section 4 concludes.
2. The impact of the transition to a low-carbon economy

The Financial Stability Board (2015a, 2015b) has classified climate-related risks into three broad categories: physical, liability and transition risks. The physical consequences of climate change extend beyond the direct impact of natural disasters. Physical risks also refer to the impact on insurance liabilities and the value of financial assets that may arise from climate-related events that damage property or disrupt trade. In the financial sector, these losses have consequences most immediately for the insurance and reinsurance sectors. Liability risks arise when parties who have suffered loss or damage from the effects of climate change seek compensation from those they hold responsible. In the financial sector, these losses have consequences most immediately for the insurance sector, but also extend more widely (e.g. to banks). Transition risks are the financial risks, which could result from the transition to a low-carbon economy. Changes in regulation, technology and physical risks could prompt a reassessment of the value of a large range of assets. The abruptness with which such re-pricing occurs could influence financial stability. In the financial sector, these losses have consequences most immediately for the banking and asset management sectors and also extend to the insurance sector[3].

Controlling climate change risks requires a decisive shift away from fossil fuel energy and related physical capital. At the same time, the long-term horizon of the commitment to reduce emissions (2030) and the costs of short-term action reduce the credibility of some existing commitments[4]. There are reasons why investors are less attracted to environmentally friendly projects. For example, the maturity mismatch is a particular constraint in financing environmental friendly projects because they have comparatively higher capital expenditure and considerable uncertainty exists regarding the future of technological innovation aimed at reducing carbon emissions (Weitzman, 2013). Against this background, there is considerable uncertainty about whether the shift to a low-carbon economy will be gradual and benign – or late and abrupt.

There are two scenarios for such a transition to a low-carbon economy, with different implications for financial stability in general and the banking sector in particular: First, a gradual and smooth transition to a low-carbon economy in which governments provide market certainty and markets provide reliable signals. Overall bank credit quality and the performance of investment portfolios would be resilient during the transition (Stern, 2008; Acemoglu et al., 2012). This scenario implies that policymakers intervene in one or more of the following ways:

- technology standards where regulators specify the technologies that potential polluters may adopt (e.g. emission limits); this is a centralized form of pollution control which is typically applied uniformly across emission sources due to administrative and enforcement costs;
- emission taxes as per unit of pollutant (prices)[5]; and
- quotas or transferable permits in a centralized government created market; an emission permit is a permission to pollute: Emission Trading System (ETS)[6].

Second scenario, although policymakers encourage reductions of emissions, the market signals for future investment are unclear. Newell et al. (2014) argue that the evolving nature of carbon markets and associated design changes imply that governments cannot provide market certainty, increasing the likelihood of a late and abrupt transition to a low-carbon economy. The consequences of an abrupt transition would be a sharp rise in energy costs; a severing of the energy supply; sudden depreciation of fossil reserves and economic obsolescence of investments and other capital stocks; and a downward revaluation of the
market value of firms according to their exposure to carbon-intensive resources and technology.

Such an adverse scenario could affect banks’ exposure to systemic risk via the following transmission channels:

1. GDP growth as a result of supply and/or demand disruptions caused by:
   - the adverse effects of direct environmental hazards (e.g. drought) or severe natural or man-made disasters (e.g. deforestation);
   - regulatory and other policy initiatives that seek to mitigate or prevent environmental hazards (e.g. carbon taxes); and
   - disruptive technological shocks related to the management of environmental risks (e.g. improvements in technology of solar panels);
2. direct exposure to high environmental risk sectors.
3. second round effects due to the financial system indirect exposures to carbon intensive assets and the global nature of climate change risks.

This paper focuses on banks’ direct exposure to economic sectors facing elevated environmental risks.

2.1 Banks’ exposure to environmental risks
In this section, the paper presents the involvement of the banking system in the USA, EU, Japan, China and Switzerland in loans issued to corporates in high environmental risk sectors as per Moody’s (2015b).

2.1.1 Methodology. Similar to Weyzig et al. (2014), this paper uses financial databases on the banks’ role as book runners for syndicated loans; that is, as the lead arrangers who also provide a large share of the actual lending[7]. Loans are outstanding on December 31, 2014, and the paper assumes linear amortization of loans issued before that date and with maturity after that date. This study includes the largest banks from the above-mentioned countries with financial information available in SNL Financial and EU banks with financial information available in the ECB database on December 31, 2014[8]. By assessing the relative share of the ten largest (or total reporting if less) banks’ exposure to each high environmental risk sector in relation to their total assets, these findings can be extrapolated across sectors in the respective country (USA, EU, China, Japan, Switzerland) to give an indication of the respective country banking system total loan exposure to high environmental risk sectors. Comparisons are limited by differences in accounting frameworks between countries.

2.1.2 Sources of data. In the absence of an internationally accepted taxonomy of “green” vs “brown” sectors, this paper uses Moody’s (2015b) classification of industry sectors with elevated exposure to environmental risks[9]:

- Mining – coal;
- Unregulated utilities and unregulated power companies;
- Power generation;
- Oil and gas: refining and marketing; independent exploration and production;
- Building materials;
- Chemicals – commodity;
- Steel;
Banks’ financial information is from SNL Financial for the non-EU banks and the ECB database for EU banks.

2.1.3 Results. Table II shows the total estimated value of outstanding syndicated loans to high environmental risk sectors as of December 2014. Note that these values are without regard to bilateral loans and guarantees, securitizations of loans, in the case of loans to power generation companies, without excluding renewable sources and, similarly, without excluding loans for the production of electric vehicles. The total estimated value of the outstanding loan exposures to high environmental risk sectors in the USA, EU, Japan and Switzerland account for about US$1.6tn. The highest exposures are to companies involved in the exploitation of oil and gas (32.5 per cent), power generation companies (27 per cent) and automobile manufacturers (13.2 per cent) as of December 2014. The remainder was financing chemicals, building materials, steel, unregulated utilities and mining (coal and metals).

The value of outstanding loan exposures to high environmental risk sectors accounts for approximately 3.8 per cent of the total assets of US banks; 1.4 per cent of the total assets of EU banks; 0.5 per cent of the total assets of Chinese banks; 2.2 per cent of the total assets of Japanese banks; and 2.1 per cent of total assets of Swiss banks. In the USA, the highest exposure of an individual institution is 6.1 per cent (PNC Financial Services Group, Inc.), while in the EU, the highest exposure of an institution is 8.7 per cent (Podravska Banka). In China, the highest exposure is 0.8 per cent (Bank of China Limited). In Japan, the highest exposure is 3.7 per cent (Mizuho Financial Group, Inc.). In Switzerland, the highest exposure is 3.4 per cent (Credit Suisse Group AG).

Table III shows total estimated value of outstanding syndicated loans to high environmental risk sectors in the EU countries as of December 2014. The UK shows the largest exposures.

The environmental risk assessment of bank exposures should go hand in hand with the understanding of the credit risk involved (e.g. type of lending instrument, whether revolving facilities vs project finance). Table IV shows the breakdown of corporate loan exposures by

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**Table II.**

<table>
<thead>
<tr>
<th>Sector</th>
<th>USA US</th>
<th>EU EU</th>
<th>China CN</th>
<th>Japan JP</th>
<th>Switzerland CH</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining: coal</td>
<td>7,490</td>
<td>12,601</td>
<td>3,543</td>
<td>4,165</td>
<td>678</td>
<td>28,477</td>
</tr>
<tr>
<td>Unregulated utilities and unregulated power companies</td>
<td>20,970</td>
<td>25,192</td>
<td>1,192</td>
<td>9,275</td>
<td>2,266</td>
<td>58,895</td>
</tr>
<tr>
<td>Power generation</td>
<td>120,979</td>
<td>201,931</td>
<td>23,547</td>
<td>79,976</td>
<td>14,819</td>
<td>441,251</td>
</tr>
<tr>
<td>Oil and gas: refining and marketing</td>
<td>199,107</td>
<td>215,285</td>
<td>14,470</td>
<td>83,903</td>
<td>20,581</td>
<td>533,346</td>
</tr>
<tr>
<td>Building materials</td>
<td>10,861</td>
<td>24,303</td>
<td>828</td>
<td>26,768</td>
<td>1,326</td>
<td>64,086</td>
</tr>
<tr>
<td>Chemicals-commodity</td>
<td>44,224</td>
<td>62,178</td>
<td>7,316</td>
<td>43,613</td>
<td>7,010</td>
<td>164,340</td>
</tr>
<tr>
<td>Steel</td>
<td>19,348</td>
<td>22,867</td>
<td>2,019</td>
<td>15,464</td>
<td>2,286</td>
<td>61,984</td>
</tr>
<tr>
<td>Mining-metals and other materials excluding coal</td>
<td>19,656</td>
<td>27,318</td>
<td>6,797</td>
<td>12,427</td>
<td>3,329</td>
<td>69,527</td>
</tr>
<tr>
<td>Automobile manufacturers</td>
<td>63,121</td>
<td>110,349</td>
<td>9,490</td>
<td>26,374</td>
<td>6,563</td>
<td>215,897</td>
</tr>
<tr>
<td>Total</td>
<td>505,755</td>
<td>702,024</td>
<td>69,202</td>
<td>301,964</td>
<td>58,858</td>
<td>1,637,802</td>
</tr>
</tbody>
</table>

**Source:** Thomson ONE Banker-Syndicated loans (bilateral loans are considered of marginal relevance). Exposure is expressed in value terms (million dollars)
<table>
<thead>
<tr>
<th>Sector</th>
<th>AT</th>
<th>BE</th>
<th>DE</th>
<th>DK</th>
<th>ES</th>
<th>FR</th>
<th>GR</th>
<th>UK</th>
<th>IE</th>
<th>IT</th>
<th>NL</th>
<th>PT</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unregulated utilities and unregulated power     companies</td>
<td>12.03</td>
<td>118.08</td>
<td>3,425.49</td>
<td>23.08</td>
<td>1,939.33</td>
<td>6,133.53</td>
<td>–</td>
<td>5,738.96</td>
<td>122.09</td>
<td>5,873.92</td>
<td>1,318.33</td>
<td>296.71</td>
<td>190.41</td>
</tr>
<tr>
<td>Power generation</td>
<td>1,578.14</td>
<td>3,988.81</td>
<td>48,932.43</td>
<td>386.21</td>
<td>17,084.40</td>
<td>35,803.99</td>
<td>165.50</td>
<td>59,640.84</td>
<td>2,967.57</td>
<td>15,861.63</td>
<td>8,812.26</td>
<td>2,134.36</td>
<td>2,992.56</td>
</tr>
<tr>
<td>Oil and gas refining and marketing</td>
<td>2,996.99</td>
<td>815.60</td>
<td>38,459.91</td>
<td>954.09</td>
<td>17,156.66</td>
<td>50,099.65</td>
<td>114.03</td>
<td>66,136.53</td>
<td>748.84</td>
<td>10,406.33</td>
<td>16,586.94</td>
<td>343.05</td>
<td>8,715.23</td>
</tr>
<tr>
<td>Building materials</td>
<td>977.75</td>
<td>359.90</td>
<td>5,033.99</td>
<td>487.83</td>
<td>4,012.99</td>
<td>14,891.52</td>
<td>159.75</td>
<td>4,380.39</td>
<td>241.83</td>
<td>2,097.18</td>
<td>1,063.66</td>
<td>102.08</td>
<td>504.07</td>
</tr>
<tr>
<td>Chemicals-commodity</td>
<td>969.20</td>
<td>449.17</td>
<td>20,424.07</td>
<td>40.41</td>
<td>3,436.27</td>
<td>10,209.47</td>
<td>16.07</td>
<td>16,867.66</td>
<td>704.80</td>
<td>4,281.69</td>
<td>2,947.04</td>
<td>875.41</td>
<td>937.37</td>
</tr>
<tr>
<td>Steel</td>
<td>602.20</td>
<td>131.26</td>
<td>6,987.46</td>
<td>234.02</td>
<td>1,258.91</td>
<td>4,348.49</td>
<td>–</td>
<td>4,582.15</td>
<td>91.60</td>
<td>2,278.79</td>
<td>1,583.37</td>
<td>97.14</td>
<td>672.04</td>
</tr>
<tr>
<td>Mining-metals and other materials excluding coal</td>
<td>164.40</td>
<td>285.61</td>
<td>2,630.23</td>
<td>6.39</td>
<td>1,814.52</td>
<td>8,438.98</td>
<td>–</td>
<td>10,319.33</td>
<td>–</td>
<td>1,394.75</td>
<td>1,425.39</td>
<td>–</td>
<td>103.82</td>
</tr>
<tr>
<td>Automobile manufacturers</td>
<td>4,456.74</td>
<td>281.33</td>
<td>47,626.01</td>
<td>825.39</td>
<td>5,313.57</td>
<td>12,685.93</td>
<td>3.43</td>
<td>21,955.07</td>
<td>339.01</td>
<td>11,903.62</td>
<td>3,201.39</td>
<td>46.39</td>
<td>1,671.23</td>
</tr>
<tr>
<td>Total</td>
<td>12,462.68</td>
<td>6,486.98</td>
<td>176,593.10</td>
<td>2,957.42</td>
<td>52,900.11</td>
<td>135,060.11</td>
<td>774.76</td>
<td>192,334.81</td>
<td>5,215.74</td>
<td>54,702.87</td>
<td>38,183.77</td>
<td>3,895.34</td>
<td>15,899.17</td>
</tr>
</tbody>
</table>

**Source:** Thomson ONE Banker. Countries not reporting data either to SNL or Thomson ONE Banker: Czech Republic, Estonia, Latvia, Luxembourg, Slovakia and Cyprus. Countries with no exposure to high environmental risk sectors: Finland, Lithuania, Malta, Romania and Slovenia. Other countries not included in the table that report exposures: Bulgaria ($195.58m Oil and gas); Croatia ($544.71m Power generation) and Hungary ($109.74m Power generation; $313.87m Gas and refining).
### Table IV.

Total value of outstanding loans by type of lending loans (million dollars) (USA, EU, China, Japan and Switzerland), December 2014

<table>
<thead>
<tr>
<th>Sector</th>
<th>Term loan multi loan facility</th>
<th>Revolving and overdraft facility, float rate nts.</th>
<th>Project finance</th>
<th>Bridge loan, capital and working capital facilities, acquisition finance</th>
<th>Trade finance</th>
<th>LT Debt (mezzanine, sub, coll) performance bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining: coal</td>
<td>16,091</td>
<td>10,665</td>
<td>–</td>
<td>199</td>
<td>1,522</td>
<td>–</td>
</tr>
<tr>
<td>Unregulated utilities and unregulated power companies</td>
<td>16,415</td>
<td>39,763</td>
<td>132</td>
<td>2,234</td>
<td>350</td>
<td>–</td>
</tr>
<tr>
<td>Power generation</td>
<td>159,515</td>
<td>266,330</td>
<td>2,120</td>
<td>6,462</td>
<td>6,150</td>
<td>122</td>
</tr>
<tr>
<td>Oil and gas: refining and marketing</td>
<td>173,461</td>
<td>337,735</td>
<td>–</td>
<td>15,774</td>
<td>5,350</td>
<td>140</td>
</tr>
<tr>
<td>Building materials</td>
<td>28,207</td>
<td>31,733</td>
<td>16</td>
<td>2,337</td>
<td>781</td>
<td>35</td>
</tr>
<tr>
<td>Chemicals-commodity</td>
<td>65,709</td>
<td>85,434</td>
<td>–</td>
<td>10,784</td>
<td>653</td>
<td>180</td>
</tr>
<tr>
<td>Steel</td>
<td>25,808</td>
<td>32,739</td>
<td>–</td>
<td>1,602</td>
<td>1,812</td>
<td>21</td>
</tr>
<tr>
<td>Mining-metals and other materials excluding coal</td>
<td>21,010</td>
<td>46,943</td>
<td>–</td>
<td>567</td>
<td>1,004</td>
<td>4</td>
</tr>
<tr>
<td>Automobile manufacturers</td>
<td>72,586</td>
<td>129,745</td>
<td>–</td>
<td>11,584</td>
<td>1,814</td>
<td>151</td>
</tr>
<tr>
<td>Total</td>
<td>578,801</td>
<td>981,087</td>
<td>2,269</td>
<td>51,543</td>
<td>19,436</td>
<td>654</td>
</tr>
</tbody>
</table>

**Source:** Thomson ONE Banker. Other loans not included in the Table are construction financing, Islamic financing and construction loans ($3.99bn) mostly to the chemical, building material and oil and gas sectors.
type of loan to high environmental risk sectors in the USA, China, EU and Japan as reported to Thomson ONE Banker in December 2014. The largest value by type of loan corresponds to revolving credit facilities, overdraft facilities and short and medium term floating rate notes (approximately 60 per cent of the total loan exposure). The value of revolving credit facilities in Table IV represents total committed amounts, not necessarily fully called upon. The typical maturity of revolving facilities is five years and they are often renewed, but many companies renegotiate their revolving credit facility every year (e.g. interest rates, fees). Term loans are next important in terms of value (approximately 35 per cent), followed by bridge loans and working capital and acquisition facilities (approximately 3 per cent), which are generally used for general corporate purposes. Trade finance, which is short-term and low-credit risk, accounts for approximately 1.2 per cent of the analyzed syndicated loans. High-credit-risk project finance[10] and senior unsecured long-term debt account for less than 1 per cent of total syndicated loans.

Banks will suffer because of the deterioration of the credit quality of loans. The same could happen to pension funds and insurance companies because of the asset repricing due to an abrupt transition to a low-carbon economy.

2.2 Second round effects
The sudden and disorderly re-pricing in a “hard landing” transition to a low-carbon economy could trigger systemically relevant second round effects. These could extend to the corporate bond and leveraged loan markets, reflecting uncertainty about the extent to which firms of other sectors of the economy could be affected directly or indirectly by the disorderly re-pricing (European Systemic Risk Board, 2016; Schoenmaker and Van Tilburg, 2016). We should bear in mind that, for the most part, corporations exposed to environmental risk also show high leverage ratios.

Not only banks but also other financial intermediaries (pension and insurance funds, investment funds and other credit institutions) have major direct exposures to high environmental risk sectors. Moreover, there are large indirect exposures of banks and other financial intermediaries to high environmental risk sectors (e.g. interbank obligations; pension fund holdings of equity shares of investment funds, bonds and bank loans; and investment funds holdings of equities and bonds), which could considerably increase the total exposure to environmental risks. Battiston et al. (2017) make an assessment of this indirect exposures for the euro area and conclude that pension funds have more indirect than direct exposures to climate risk.

3. What role for financial policy?
The overriding objective of financial policy is to safeguard financial stability and build resilience to shocks, wherever the shocks may come from[11]. Policymakers are encouraged to use a systemic approach to identifying, assessing and managing the potential risks that climate change could pose to financial stability. Policy action in response to the potential systemic risk involved in the transition to a low-carbon economy would ideally consider the following lines of action.

3.1 Fully harmonized statistical framework and disclosure
One of the most significant barriers for the development of environmental risk analysis is an internationally agreed taxonomy of green, neutral and brown assets (FSB, 2015 and EU High-Level Expert Group on Sustainable Finance, 2018). A reliable and fully harmonized statistical framework is a necessary condition for such taxonomy. To that end, it is vital that the various categories for classifying economic activities are interpreted uniformly.
In Europe, the NACE Rev 2 and, internationally, the International Standard Industrial Classification (ISIC) classification frameworks allow for the identification of economic activities exposed to environmental risk. For example, in the European Economic Association countries, the NACE Rev 2 classifies economic activities and subsectors of the economy and is directly linked to the ISIC of all economic activities as adopted by the Statistical Commission of United Nations (Rev 4)[12].

However, a good taxonomy and statistical classification method are not enough. Effective disclosure requirements for investors play a key role in improving governance by improving transparency regarding corporate involvement in unsustainable economic activities. Institutional investors are often questioning banks’ efforts to mainstream sustainability challenges into their business models and their strategies[13]. In this regard, the EU requires disclosure of non-financial information, referring, inter alia, “to environmental aspects such as renewable and/or non-renewable energy land and water use, air pollution, greenhouse gas emissions and the use of materials[14]”. The obligation to disclose applies only to large listed credit institutions and large listed insurance companies, which are parent undertakings of a large group, in each case having an average number of employees in excess of 500, in the case of a group on a consolidated basis. This obligation does not prevent Member States from requiring undertakings and groups’ disclosure of non-financial information other than that subject to this requirement by the Directive. In fact, there is a wide range of institutions covered by this disclosure requirement across European countries. Some countries have implemented the minimum requirements, but others, implicitly or explicitly, have included a number of other entities such as investment companies, large non-listed companies according to precise size criteria, state owned companies, pension funds, etc. Such reporting should be based on current best practices both at national and international levels[15]. The EU is drafting laws that will create a taxonomy, introduce disclosure obligations and, provide relevant low carbon and positive carbon benchmarks.

More recently, the Financial Stability Board (FSB) convened a public-private conference in London in September 2015 to enhance the understanding of the implications of climate-related issues for the financial sector and discuss the potential contribution of early regulatory action to address financial stability risks can make, in particular enhanced disclosures about carbon and related climate risks and exposures[16]. The FSB created the Task Force on Climate-related Financial Disclosures (TCFD), consisting of representatives from private financial institutions to assess what role voluntary disclosure of climate change risks can play in encouraging banks to disclose their climate change risks to regulators, investors, lenders and insurance underwriters. The TCFD delivered final recommendations to the G20 on climate-related financial disclosures adoptable by all organizations and a supplemental Guidance for the financial sector (including banks) in June 2017 (TCFD, 2017a, 2017b). The TCFD recommends that financial disclosures should be provided in banks’ mainstream or public financial fillings, with a strong focus on banks’ credit, liquidity, market and operational risks and opportunities related to transition to a lower-carbon economy. The TCFD also recommends that financial disclosures should be designed to provide relevant forward-looking information on financial impacts.

In the particular case of banks, this paper defends that the TCFD recommendations could be articulated via:

- supervisory reporting with focus on exposures to high environmental risk sectors; and
- performance of a “carbon stress test” as a forward looking exercise to assess the environmental risks.
3.2 Supervisory reporting and other prudential tools

This section explores the demands of supervisory reporting that allow for an accurate assessment of the environmental risks, which, in turn, would allow prudential supervisors to assess banks’ capital needs. This section focuses particularly on the experience of the EU and, in particular, the recent set up in the euro area. Successful prudential reporting rests on three pillars:

1. regular supervisory reports with granular information on economic activities exposed to elevated environmental risks and concentration risks;
2. banks’ assessment of their Internal Capital Adequacy Assessment Process; and
3. credit registers regularly requesting granular credit risk data.

3.2.1 Supervisory reporting (call reports) to assess the financial condition of banks and the sufficiency of own funds. Supervisory reports should allow an accurate assessment of credit exposure to sectors with elevated environmental risks. The analysis of large exposures to individual creditors with elevated environmental risk would demand granular information at the level of four digits in the NACE Rev 2 classification and four digits in the SIC Classification[17].

For example, in the EU common rule book for the regulatory requirements on equity capital[18], individual banking groups are required to submit harmonized, consolidated and IFRS consistent quarterly financial statements: FINREP (balance sheet and income statements including the breakdown of loan advances to non-financial firms) and COREP (own funds) do not require detailed information on credit exposure to assess the environmental risks. The NACE Rev 2 classification by sector (18 sectors and first two digits of NACE Rev. 2) is too broad[19]. In COREP, the reporting of large exposures to individual creditors also requires reporting by sector, which, is insufficient to identify large exposures to economic activities subject to environmental risk. If economists and prudential regulators want to give consideration to banks’ exposure to environmental risks, the call reports of EU banks would require revisions aimed at increasing the identification of economic sectors to the fourth level consisting of headings identified by a four digit numerical code (classes) of NACE Rev. 2.

3.2.2 Banks’ assessment of their internal capital adequacy. This is later assessed by their prudential supervisors, allows regulators to identify material risks and describe their management control. This should include environmental risks. Banks assess their regulatory capital requirements in the context of a stress test exercise under two plausible scenarios (baseline and stress). This exercise would encompass business risks associated with the transition to a low-carbon economy under various hypotheses of what impact such a transition could have on GDP growth (Section 3.4 presents the rationale behind the “carbon stress test”). At present, in the EU with the exception of the Dutch, banks generally do not assess the impact of risks involved in the transition to a low-carbon economy on their loan or bond portfolios. These portfolios are not regularly subject to shock simulations (e.g. sudden economic obsolescence of capital stocks, sudden revaluation of fossil fuel reserves), which would help assess the impact of environmental risk factors on banks’ portfolios and eventually on their profits and solvency[20]. Outside the EU, Chinese banks have assessed the impact of environmental risk factors on banks’ portfolios.

3.2.3 Statistical data bases and credit registers that regularly collect granular credit risk data from banks and other credit institutions. These databases are composed of detailed and individual pieces of information about instruments giving rise to credit risk, including classification of counterparties according to their economic activities and subsectors of the
economy exposed to elevated environmental risks. These databases can also provide important breakdowns and details, such as information on the structure (e.g. project finance) and risk patterns of credit granted by the financial sector (e.g. probabilities of default, impairments, maturity, currency, interest rates). In Section 3.4, this paper analyses the applicability of credit registers in stress-testing. For example, in the euro area, the ECB has launched a credit register called Anacredit, which fulfills the requirements to assess environmental risks[21].

3.3 Revision of the Basel Core Principles for effective banking supervision
The Basel Core Principles (BCPs) aim at promoting best practices in bank prudential regulation and supervision. The BCPs are used as a benchmark for assessing the quality of their supervisory systems and for identifying future work to achieve a common ground of sound supervisory practices[22]. The compliance assessment of BCPs is part of the regular financial sector stability assessments of the IMF and World Bank.

A comprehensive approach to an orderly transition to a low-carbon economy would require prudential supervisors of banks to internalize environmental risks in their governance systems and procedures and in the prudential framework. Hence, environmental aspects should be considered, for example, in frameworks for the risk assessment process of banks (e.g. risk management process that identify, measure, evaluate, monitor, report and control or mitigate concentrations of risk, including risks related to the transition to a low-carbon economy on a timely basis). For example, in the USA, the Office of the Comptroller of the Currency’s (Office of the Controller of the Currency, 2017) has issued guidelines for supervisors in connection with the supervision of banks “Oil and Gas Exploration and Production Lending”. These are guidelines on prudent credit, interest rate, liquidity, operational and reputational risks management.

Along these lines, it could be argued that the guidelines for assessors of the BCPs should be revised to require bank supervisors to consider environmental risk in their supervisory practices and in the prudential framework[23].

3.4 Carbon stress test for banks
European Systemic Risk Board (2016) and Schoenmaker and Van Tilburg (2016) argue that prudential regulators should run “carbon stress tests” to assess the impact of environmental risks on banks’ capital and profitability and simulate adverse scenarios consisting in a disorderly transition to a low-carbon economy. Hence, the importance of well-articulated models that provide a coherent and consistent framework for assessing to what extent environmental risks pose a challenge for financial stability.

“Carbon stress tests” run by banks can be an effective process by which management is informed about climate-related issues, monitors climate-related issues and assesses the short term impact of the risks related to the bank’s transition to a green economy (TCFD, 2017b, p. 23). Two approaches could be envisaged to assess the impact of environmental risk: first, environmental risk could be considered part of an integrated assessment of credit risk[24] and, second, environmental risk could be considered as a stand-alone risk separately from credit risk.

If environmental risk is considered part of an integrated assessment of credit risk, Figure 1 shows a stylized representation of the credit risk channel in a “carbon stress test”. Note that other channels include market and liquidity risks.

In addition to the shortcomings of the traditional stress-testing (e.g. models are based on historical experience and do not represent any “best guess” of the way the economy might evolve in the new circumstances (Čihák, 2007), environmental risks often materialize over a
long period of time and are typically non-linear. Furthermore, as argued by Battiston et al. (2017), climate policies (especially policy inaction) impact climate change as much as climate change impacts policies themselves. The intrinsic uncertainty emanating from this interdependence undermines the knowledge of the underlying probability distributions of asset returns, leading in particular to fat tails.

An example of a model to assess the sensitivity of loan credit quality, for each loan across loan portfolio categories, to changes in macroeconomic conditions and climate risks factors is as follows:

\[ NPL_i, t = \alpha_0 + \beta(\text{Climate factor})_{i,t} + \alpha_1 + NPL_i, t - 1 \]

\[ + \sum_{s=0}^{K} \beta F, t - s \text{ MACROF}, t - s + \epsilon_{i,t} \]  

Here, \( NPL_i, t \) stands for the logit transformation of non-performing loans as a ratio over total loans of credit institution \( i \) in year \( t \), \( \alpha_0 \) stands for the fixed-effect for credit institution \( i \), \( \beta \) gauges the specific climate factor \( i \) in year \( t \) and MACROF, \( t - s \) stands for macroeconomic factor \( F \), in period \( t - s \) (\( s \) is the time lag). The typical macroeconomic specifications include GDP growth and long-term interest rates, but could also include sector economic variables. The regression analysis would show the statistical significance of this environmental factor.

Moody’s (2015b) highlights three primary credit risk factors from carbon reduction policies for non-financial corporates: regulatory risks (e.g. the planned closure of all German nuclear generating stations in 2022); disruptive technology shocks that would have a negative impact on incumbents with limited capability to adapt their business models (e.g. impact of the US shale gas boom on coal producers); and direct costs such as the imposition of carbon taxes or purchase of carbon permits (e.g. carbon-emitting plants).

In this approach, correlations and common exposures are of secondary importance. This approach assumes that environmental risks are exogenous.

Alternatively, environmental risk could be envisaged as a stand-alone risk separately from credit risk, which could generate economic losses, which could be covered by

**Figure 1.** Stylized representation of the credit risk channel in a “carbon stress test”:
View of the way in which a shock might impact banks’ CAR and P&L

Source: Author’s analysis
environmental risk provisions or assigned specific environmental risk weights for the purpose of capital requirements.

An example of a model to assess the sensitivity of loan quality to environmental risk factors is as follows:

\[
ERL_i,t = \alpha_0 + \beta (\text{Climate factor})_{i,t}
\] (2)

Here, \(ERL_i,t\) stands for the logit transformation of environmental risk losses as a ratio over total loans of credit institution \(i\) in year \(t\), \(\alpha_0\) stands for the fixed-effect for credit institution \(i\), \(\beta\) gauges the specific climate factor \(i\) in year \(t\).

An example of climate risk factor for a particular sector/firm is the value of stranded assets due to new disruptive technologies or the value of penalties for failing to achieve CO2 targets \((\text{loss value due to climate risk})\) over profits before taxes of that particular sector/firm [25]:

\[
(\text{Climate factor})_{i,t} = \left(\frac{\text{loss value due to climate risk}}{\text{Profits before taxes}}\right)_{i,t}
\]

3.5 Is there a case for “new” prudential regulation?

If it is assumed that environmental risk is a stand-alone risk separate from credit risk, which could generate economic losses as presented in equation (2) above, three types of regulatory requirements could be envisaged: provisions, capital and limits to large exposures. Prudential regulation should only be introduced if it tackles a risk differential between “brown” vs “green” exposures.

If the impact of environmental risk does not have permanent impact on exposed creditors ability to repay through the economic business cycle, such losses would be covered with loan loss provisions, which would have a negative impact on banks’ after-tax profits. In the context of the IFRS9: \(LLP_e\) (environmental risk provisions) are added to \(LLP_{cr}\) (credit risk provisions).

If environmental risks have a permanent impact on exposed creditors ability to repay over the business cycle, prudential regulators could consider a revision of the minimum capital requirements (“Brown Penalizing Factor”). Such revision should be based on the carbon intensity of individual exposures via the increase of the asset risk weights. The “Brown Penalizing Factor” aims at curbing banks’ incentives to accumulate exposures subject to environmental risks. Indeed, it could be argued that large uncertainty exists about the particular quantification of the impact of the environmental risks, which makes the calibration of environmental risk weights difficult.

The subsequent increase in the minimum capital requirements associated with brown assets (including off balance sheet exposures) should cover any unexpected losses due to climate risks. However, higher capital requirements might not be sufficient to promote change in bank behavior and to absorb shocks due to abrupt transition to a low-carbon economy. More generally, Anguren et al. (2018) argue that higher capital requirements had a transitory impact on Spanish banks’ credit supply both in terms of quantity and composition. Banks were reducing the amount being granted. The authors also identify a change in the composition of banks’ portfolios compatible with risk reduction. These findings are relevant for the impact study of “brown” penalizing factors.

Regulators could also consider a revision of the regulatory framework of banks’ large exposures to brown assets. The goal of these measures is to place quantity-based or price-
based constraints (or a combination of both) on the amount of exposures to brown sectors/sovereigns with elevated environmental risk.

Regardless the empirical evidence of the distinctive character of environmental risks and its permanent impact on the increase of long-term probabilities of default, prudential supervisors should consider transparency requirements via enhancements to the Pillar 3 disclosure. For example, prudential requirements could include semi-annual disclosure requirements related to environmental risk exposures to corporates and sovereigns, as well as, if appropriate, their risk weights in line with the recommendations of the TCFD (2017b).

At present, most supervisory agencies in the G20 countries do not believe that minimum capital requirements (or prudential regulatory requirements in general) should be used to limit environmental risks (Alexander, 2014). Brazil, Mexico and China have begun to investigate under Pillar 1 of Basel III whether environmental risks are a material driver for credit and other types of financial risks. The EU High-Level Expert Group on Sustainable Finance (2018) has gone further and proposes a “Green Supporting Factor” or regulatory capital discount aimed at incentivizing bank lending to environmental sustainable projects[26].

Among practitioners, green loan covenants linked to sustainability external ratings are becoming common in syndicated loans. When the sustainability rating goes up, the margin decreases just a few basis points and vice versa. This mechanism should ideally be transparent and implies a (small) deviation from the overarching link of margins to creditworthiness[27]. In other instances, banks have committed to stop financing fossil fuel sources of energy[28].

4. Conclusions and policy reflections
The analysis of the financial stability implications of the potential climate change risks is still at an early stage. The banking sector is most immediately affected by the financial risks associated with the disorderly transition to a low-carbon economy, which could affect banks’ exposure to systemic risk both via impaired GDP growth and via banks’ exposure to elevated environmental risk assets. Banks are slowly growing aware of these considerations.

Following Weyzig et al. (2014) and Moody’s (2015b), this paper assesses the (syndicated) loan exposure to elevated environmental risk sectors of the banking system in the US, EU, China, Japan and Switzerland, which amounts to approximately USD 1.6 trillion as of December, 2014. The findings are broadly in line with those of Battiston et al. (2017) and Weyzig et al. (2014). The importance of the exposures in terms of total national banking assets highlights the relevance of exploring prudential policy responses.

In the short term, policy action should aim at better understanding the direct exposures to high environmental risk sectors. This requires an internationally harmonized taxonomy of green, neutral and brown assets and a full use of the existing harmonized statistical frameworks for the detailed identification of economic sectors. Furthermore, financial disclosures of exposures to environmental risks should be provided in banks’ mainstream or public financial fillings, particularly if banks regularly issue securities that trade in organized markets. Disclosures play a key role in improving governance.

Among the supervisory tools, this paper highlights the importance of credit registers as a tool that facilitates the assessment of environmental risk drivers in “carbon stress tests” formulated to assess the sensitivity of loan quality to changes in climate factors. Going forward, the identification and calibration of climate change risk factors and the calibration of their impact on creditors’ ability to repay should be matters of priority in future work on “carbon stress tests.” Only to the extent that environmental risks could permanently
increase long-term probabilities of default through the business cycle, regulators could consider a revision of banks’ minimum capital requirements and concentration risks. This is not proven as yet. Therefore, the focus should initially be on generating hard evidence through stock-taking, data collection and methodology development to reach a better understanding of environmental risks.

Last but not least, a comprehensive approach to an orderly transition to a low-carbon economy would require prudential supervisors and banks to internalize environmental risks in their governance systems.

This paper’s recommendations would contribute to make the June, 2017 recommendations of the Final Report of the Task Force on Climate –related Financial Disclosures (TCFD) to G20 countries operational.

Notes

1. United Nations Framework Convention on Climate Change (http://unfccc.int/paris_agreement/items/9485.php). Specifically, its objectives were to: (i) hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change; (ii) increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development; and (iii) to promote more consistent financial flows toward low greenhouse gas emissions and climate-resilient development.” http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf


4. As of August 2015, 26 countries and territories accounting for more than 55% of global GHG emissions have submitted Intended National Determined Contributions (INDCs) with a 2030 target year (2025 in the case of the US) (Morgan Stanley, 2015). However, power plants that use combustible organic material, as oil, coal, or natural gas can operate for up to 40 years and investment in alternative energy has been deterred by unexpected changes in its regulation (e.g. retroactive government plans to curb revenues of already operating projects in Bulgaria and Romania; retroactive changes of tariffs in Germany).

5. Countries adopting emission taxes include Mexico, Japan, Denmark, Finland, France, Norway, Portugal, Sweden, S. Africa (2017) and Chile (2018).

6. Jurisdictions undertaking carbon trading schemes include: the EU, California and China (merging seven regional pilots into a national ETS (2017)). The combined value of the regional, national, and subnational carbon pricing instruments in 2015 is estimated at just under US$50 billion globally, of which almost 70 per cent is attributed to ETSs and about 30 per cent to carbon taxes. The existing carbon prices vary significantly—from less than US$1 per tCO2 e to US$130 per tCO2 e. In 2015, the 85 per cent of emissions are priced at less than US$10 per tCO2 e, which is considerably lower than the price that economic models have estimated is needed to meet the 2°C climate stabilization goal, which according to CISL (2015) ranges from USD50 to more than USD300 per tCO2 e (World Bank, 2015).

7. Syndicated loans are considered the bulk of the bank financing to the high environmental risk sectors. This paper uses Thomson ONE financial database for syndicated loans.

8. We have excluded subsidiaries and branches of banks from foreign countries.

9. See Nieto (2017). Annex I shows NACE 2 Rev and SIC codes corresponding to economic activities with elevated environmental risk used in the loan classification. SIC is the classification used by Thomson One Banker for the syndicated loans.
10. Acknowledging that project finance may involve large risks for the environment, the Equator Principles were established in 2003 to provide banks with voluntary guidance for incorporating environmental and social risks into the bank’s assessment of credit and operational risks in large infrastructure investment projects. www.equator-principles.com/resources/equator_principles_III.pdf.


13. Transparency is just one dimension of banks’ good corporate governance. The Basel Committee’s Corporate Governance Guidelines for Banks adopted in 2015 include a number of key concepts that are directly aligned with the consideration and management of environmental and social issues; www.bis.org/bcbs/publ/d328.pdf


15. Union-based frameworks such as the Eco-Management and Audit Scheme (EMAS), or international frameworks such as the United Nations (UN) Global Compact, the Guiding Principles on Business and Human Rights implementing the UN ‘Protect, Respect and Remedy’ Framework, the Organisation for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises, the International Organisation for Standardisation’s ISO 26000, the International Labour Organisation’s Tripartite Declaration of principles concerning multinational enterprises and social policy, the Global Reporting Initiative, or other recognised international frameworks.

16. Following the London meeting, on 4 December 2015, the FSB created the Enhanced Disclosure Task Force (EDTF) consisting of representatives from private financial institutions to assess what role voluntary disclosure of climate change risks can play in encouraging banks to disclose their climate change risks to regulators, investors, lenders and insurance underwriters. (www.fsb.org/what-we-do/policy-development/additional-policy-areas/developing-climate-related-financial-disclosures/ and “Task Force on Climate Related Financial Disclosures: Phase I Report of the Task Force on Climate –Related Financial Disclosures” April, 1 (www.fsb-tcfd.org/phase1report/).

17. TCFD (2017b) supplemental Guidance for banks recommends disclosure of significant concentration of credit exposure to carbon-related assets (p. 24) broken down by industry, geography, credit quality and average tenor (p.26).


19. Agriculture, forestry and fishing, Mining and quarrying, Manufacturing, Electricity, gas, steam and air conditioning supply, Water supply, Construction, Wholesale and retail trade, Transport and storage, Accommodation and food service activities, Information and communication, Real estate activities, Real estate activities, Administrative and support service activities, Administrative and support service activities, Education, Human health services and social work activities, Arts, entertainment and recreation and Other services.
20. TCFD (2017b) supplemental Guidance for banks recommends to characterize banks’ climate related risks in the context of risk categories such as credit, liquidity, market and operational risks. At the time of writing, JP Morgan, PNC and UBS – have begun conducting environmental stress tests of their loan portfolios. Sixteen banks have been working with the UN Environment Programme Finance Initiative (UNEP-FI) to “develop scenarios that can be used to model climate risk in loan portfolios” (www.risk.net/risk-management/5380376/banks-begin-to-model-climate-risk-in-loan-portfolios).


22. See www.bis.org/publ/bcbs230.pdf. The BCPs were complemented a few years later by similar codes for the supervision of securities operations (IOSCO) and insurance supervision (IAIS).

23. See www.bis.org/publ/bcbs130.pdf. The Core Principles Methodology (2006) is used for assessments of compliance with the BCPs.

24. This has been the approach of rating agencies. Direct climate change hazards are, in general, not a material driver for credit ratings as yet (Moody’s, 2015a).

25. This model example assumes proportionality. In practice, as an example, European car OEMs failing to meet the EU 95g CO2/Km target by 2030 from 2016 levels could face penalties of up to €3.1 bn. (VW), €1.9 bn. (BMW), €1.5 bn. (Daimler), €2.3 bn. (Renault) and €1.4 bn. (PSA) (Morgan Stanley, 2017).


27. « Greener Pastures » IFR of the Year 2017.

28. For example, Société Générale, BNP and BBVA.

References


Further reading


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