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The Case of Sweden

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About Mistra Financial Systems

Mistra Financial Systems is a Mistra-funded research program that aims to investigate changes needed to make financial systems more conducive to social and environmental sustainability. Mistra Financial Systems is hosted at Misum (the Mistra Center for Sustainable Markets) at the Stockholm School of Economics. Program partners include Swedish House of Finance, The Royal Institute of Technology, The Royal Swedish Academy of Sciences, Stockholm Environment Institute, Gothenburg University, Vienna University, Kingston University and the ICMA Centre at Henley Business School. The views expressed in MFS Working Papers represent that of the authors and not necessarily all partners of Mistra Financial Systems nor Misum in its role as program host.

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The Inquiry into the Design of a Sustainable Financial System has been initiated by the United Nations Environment Programme (UNEP) to advance policy options to improve the financial system's effectiveness in mobilizing capital towards a green and inclusive economy—in other words, sustainable development. Established in January 2014, it published the first edition of 'The Financial System We Need' in October 2015, with the second edition launched in October 2016. The Inquiry's mandate currently extends to the end of 2017, with work focused on deepening and taking forward its findings.

More information on the Inquiry is available at: *www.unepinquiry.org* and *www.unep.org/inquiry* or from: Ms. Mahenau Agha, Director of Outreach *mahenau.agha@unep.org*.

Finance and Innovative Investment in Environmental Technology: The Case of Sweden*

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Abstract

This report discusses how financing difficulties can affect private sector innovation investments in environmental technology applied to the Swedish setting. Innovative investments are often intangible, the outcomes are highly uncertain, and information asymmetries between entrepreneurs and outside investors are potentially severe. These factors make external finance costly and drive investment in environmental technology below its socially desirable level. Recent evidence from the literature on financing and innovation suggests that financing constraints on innovation are likely economically significant. Therefore, policies and financial developments that affect the availability of finance can have important effects on economy-wide rates of environmental technology innovation.

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1 Introduction

Policy makers from close to 200 nations met in Paris in 2015 and agreed to hold the increase in global average temperature well below 2°C above pre-industrial levels (The Paris Agreement).[1] The transition needed in order to reach this goal and embark on a more sustainable path of economic growth represents a significant challenge (e.g., Nordhaus (2007a); Stern (2007)). In this report, we emphasize the role of the financial sector in facilitating investments in environmental technology, with a particular focus on the financing of innovative investments.

There are several reasons to think that the social returns from innovation investments in environmental technology are much higher than the private returns. In particular, innovations that improve resource efficiency, generate cleaner production technologies, and help mitigate environmental degradation offer potentially substantial positive benefits that spill well beyond the boundaries of the firms (and even countries) in which they originate. As a consequence, there is extensive interest from both policy makers and economists in designing policies that move economy-wide rates of environmental technology innovation closer to socially optimal levels (e.g., Arrow et al. (2009) and Hall and Helmers (2013)).

The economics literature emphasizes two main reasons for underinvestment in innovation. The first is that because of weak or incomplete intellectual property protection, firms do not appropriate all of the returns to innovation, causing the social returns to innovative investments to be substantially higher than the private returns (e.g., Hall (1996); Hall, Mairesse, and Mohnen (2010)). The second reason for underinvestment is that intangble, innovative investment is prone to capital market imperfection. In particular, limited collateral value

[1] In order to be compatible with this goal, the cumulative carbon emmisons between 2011-2050 must be limited to about 1,100 gigatonnes of carbon dioxide (Meinhausen et al. (2009)).

and asymmetric information between investors and firms can sharply curtail access to external finance, keeping innovative investment well below the level that would prevail under perfect capital markets (e.g., Arrow (1962); Hall (2002)).

The purpose of this report is to discuss an important factor that can lead to underinvestment in environmental technology innovation: financing difficulties that raise the cost of external funds and keep environmental innovations below even privately optimal levels in a world with no financing frictions.[2] There are strong theoretical reasons to think that financing frictions will limit investment in environmental innovation, particularly the more novel and uncertain investments by newer and smaller firms. Further, recent empirical evidence on financing constraints for investment in research and development (R&D) and innovation more broadly suggests that the economic importance of these frictions may be large (Hall and Lerner (2010)). If so, access to capital markets and the availability of early-stage financing can play a key role in determining the nature and extent of environmental innovation. We provide a discussion of this in section 2.

We also address the role of innovation in the financial sector which has the potential to reduce financing costs and mitigate financing frictions, thus facilitating the transformation of the economy to meet the current environmental challenges. We discuss the theoretical role of the financial sector in capital allocation toward innovation together with a framework where we highlight the role of financial sector innovation

[2]In economic theory a frictionless market is a financial market without transaction costs. Friction is a type of market incompleteness. More specifically to the topic of innovation investment in environmental technology, these frictions include: i) agency costs such as large asymmetric information problems arising from the difficulties educating potential investors when projects involve cutting-edge science, ii) limited collateral value stemming from the intangible nature of such investments, and iii) pronounced costs of financial distress given the large fraction of market values accounted for by future growth options (e.g., Brealey and Myers (2000)). These frictions imply that both the extent and the nature of a country's financial market development can influence the investment landscape for sustainable technologies.

in section 3. This section also includes a presentation of the Swedish financial sector and its evolution over time. Sweden has a well-developed financial system with a strong and improving infrastructure for early stage financing of risky and entrepreneurial firms. An important role for the financial sector to play is facilitating access to finance for new firms that can exploit new technologies and ultimately speeding up the transition toward a sustainable economy.

An important implication of the discussions in sections 2 and 3 is that the financial sector responds to the conditions in the real economy. It is therefore important to understand how the Swedish environmental sector is structured and also what policies in both finance and environmental related areas that are in place. Sweden has come a long way in the transition toward a sustainable economy and has been able to sustain growth while lowering its carbon footprint (e.g., Andersson and Lovin (2015)). We describe Sweden's environmental and environmental technology sectors as well as the policy landscape in section 4. We conclude the report with a summary and conclusion section.

2 Finance and innovation investment in environmental technology

2.1 Underinvestment and innovation

Arguments for public policies designed to promote additional investment in environmental technology typically emphasize two (related) characteristics of environmental innovations (e.g., Hall and Helmers (2010)). The first characteristic is that technological knowledge spills across firms. This lack of complete appropriability reduces private incentives to invest and drives down the privately optimal level of

innovative activity (e.g., Arrow (1962); Grossman and Helpman (1991)). The second characteristic is that many environmental technology innovations have the properties of classic public goods with potentially large social benefits – e.g., cleaner air and water for individuals who do not purchase the technology. Indeed, the positive benefits may even spill well beyond the country in which the technology was developed. Together, these characteristics suggest that the social returns from private investment in environmental innovation can be much larger than the private returns, and that the socially optimal level of innovative investment may be well above the privately optimal level.[3] The objective of public policies like strong intellectual property protections and tax subsidies for R&D on environmentally sustainable technologies is to address these characteristics and move the privately optimal level of investment closer to the social optimum.[4]

2.2 Financing constraints and innovation investment in environmental technology

Private investment in environmental innovation can also fall below the social optimum because imperfections in capital markets keep some firms from reaching even the privately optimal level of investment.

[3]We are not aware of any estimates of the magnitude of underinvestment in environmental innovation per se. But Jones and Williams (1998) examine innovative investment more generally and conclude (p. 1121) that the "optimal R&D spending as a share of GDP is more than two to four times larger than actual spending." Other studies that report high social returns from private innovative investment include Griliches (1992) and Hall et al. (2010).

[4]Note, however, that policies designed to address the appropriability issue (e.g., patent protections) can potentially limit the diffusion and use of the technology, thereby reducing the positive external spillovers and social benefits arising from the public good aspects of the innovation. Hall and Helmers (2010) consider this issue as it relates to the development of climate change technologies and conclude that "the presence of both environmental and knowledge externalities implies that IP may not be the ideal and cannot be the only policy instrument to encourage innovation in this area...".

This 'financing constraint' problem arises from the fact that firms and entrepreneurs with insufficient internal capital to fully fund all innovative investment opportunities may find it costly (or even prohibitive) to raise funds externally. If the rate of return required by outside investors exceeds the cost of internal funds (the rate of return an investor using their own funds would require), then some firms will underinvest in developing new environmentally beneficial technologies relative to the privately optimal level in a world of no financing frictions.

There are several reasons to expect that firms and entrepreneurs may face a particularly steep cost of obtaining external funds for innovation investment in environmental technology. First, as with most types of technologically intensive innovative efforts, asymmetric information problems between the firm and potential suppliers of finance are likely severe. The information asymmetries arise not only from the complexity and inherent riskiness of the innovative investment being undertaken, but also because firms have strong incentives to protect proprietary information from competitors and maintain secrecy even from potential suppliers of funds. These information problems lead to classic adverse selection and moral hazard problems, increasing the rate that firms must pay to obtain external funds, if they are able to raise external funds at all (Kamien and Schwartz (1978); Stiglitz and Weiss (1981); Myers and Majluf (1984)).

Second, a large component of innovative investment is intangible (e.g., wage payments to scientists and engineers) and therefore provides little or no collateral for securing outside financing. Third, the transaction costs associated with raising external funds can be substantial, particularly in the case of public securities issues by smaller firms (e.g., Lee, Lochhead, Ritter, and Zhao (1996)).

Taken together, these factors highlight the potential for firms interested in funding new environmental innovations to face a sizeable difference between the cost of internal funds and the rate of return

required by external investors. It is also important to point out that size of this 'wedge' between the cost of internal and external funds may differ substantially across different types of firms (and across different types of innovation investments in environmental technology). In particular, asymmetric information problems and limited tangible assets likely make the cost of raising external funds especially high for smaller, younger, and otherwise more risky firms. Since these are also the groups of firms most likely to depend on external funds at the margin – i.e., they have insufficient internal funds to fully fund their investment opportunities – the 'financing constraint' channel for underinvestment in environmental technology innovation may work primarily through newer and smaller businesses. Similarly, financing considerations may be most relevant for environmental technology investments that are more novel, uncertain, and require primarily intangible inputs.

2.3 Financial contracting: Debt vs equity

Not only is environmental innovation subject to potentially severe financing constraints, but there are several reasons to think that it might also be sensitive to the type of funding available from external investors.

In particular, absent government loan guarantees and other policies that encourage debt financing (and perhaps even with such policies) there are several reasons to expect that firms face a limited supply of debt for funding the more risky and intangible environmental technology innovations: i) debt contracts are poorly suited to funding risky investments with uncertain and volatile returns (Stiglitz (1985)), ii) collateral is particularly important for risky firms that seek to obtain debt finance (Berger and Udell (1990)), iii) the costs of financial distress can be especially severe for firms engaged in R&D-intensive efforts (Opler and Titman (1994)), and iv) the potential for moral hazard is particularly pronounced when innovative firms raise debt financing since

they should have more scope for channeling the borrowed funds to high risk projects.

Supporting the idea that firms may have difficulty securing debt to fund innovation, a large empirical literature documents a negative link between leverage and R&D spending across firms (e.g., Bradley, Jarrell, and Kim (1984), Titman and Wessels (1988), Fama and French (2002), Hall (2002), and Hall and Lerner (2010)).

As Brown, Fazzari, and Petersen (2009) discuss, equity finance has several advantages over debt when financing risky, innovative activity, perhaps the most important advantage being that equity holders fully participate in upside returns. Public stock issues can provide substantial capital infusions for innovative investment, but information and transaction costs associated with public issues can be high (in some cases prohibitively so) (e.g., Myers and Majluf (1984)).

The costs of raising private equity (such as venture capital) may be substantially smaller than with public stock issues, particularly for risky start-up firms, in part because private equity investors can have information advantages due to industry expertise and repeated or staged financing (see, e.g., Gompers and Lerner (2004)). Consistent with these ideas, recent studies identify a strong connection between innovative activity and both public equity issues (e.g., Brown et al. (2009)) and private equity infusions (e.g., Kortum and Lerner (2000)).

Thus, despite non-trivial transaction and information costs associated with external equity issues, equity is likely the most relevant (marginal) source of external funding for risky investments in environmental technology innovations. As we discuss below, a key implication from this discussion is that the availability (and cost) of external equity is likely an important determinant of the level of private sector investment in environmental technology.

2.4 What do we know about the empirical importance of financing constraints for private sector investments in environmental technology innovation?

We are not aware of any studies that empirically evaluate, specifically, how innovative investment in environmetnal technology responds to the availability of finance.[5] However, recent evidence on the impact of financing constraints on innovation more generally are at least suggestive that the ideas discussed above are empirically relevant (see Hall (2002) and Hall and Lerner (2010) for surveys of this literature). For example, early studies by Hall (1992) and Himmelberg and Petersen (1994), and more recent studies by Brown et al. (2009), find a strong positive connection between internal funds and R&D investment in U.S. firms, as expected if firms face financing constraints.

In addition, Brown et al. (2009) document a positive relation between external equity issues and young-firm R&D investment. A key finding in Brown et al. (2009) is that while financial effects are concentrated in young firms, the effects are sufficiently large to matter for aggregate levels of R&D investment. More broadly, Brown, Martinsson, and Petersen (2013) examine a large sample of firms across 32 countries and find that better access to stock market financing is associated with substantially higher long-run rates of R&D investment at the firm-level. Furthermore, the Brown, Martinsson, and Petersen (2012) study finds that stock market development is particularly important for

[5]The role of climate change and environmental technology innovation is not a well researched area in finance. There is a small but fast growing literature on the implications on asset pricing from climate change (e.g., Andersson, Bolton, and Samama (2016), Bansal, Kiku, and Ochoa (2015), Hong, Li, and Xu (2016), Kruger (2015)) which we do not directly address. Hjort (2016) provides an extensive literature review on the broader topic of capital markets and climate change. This report focuses instead on the corporate financing decision and its impact on innovation investments in environmental technology.

R&D investment in younger and smaller firms, the firms most likely to depend on costly external finance at the margin, and that credit market development has no impact on R&D levels.

Overall, the evidence from this literature strongly suggests the following: i) financing constraints appear to limit innovative investment, even in countries with highly developed capital markets, ii) the availability of external equity financing has a much stronger effect on innovative activity than does the availability of debt financing, and iii) access to external equity is especially important for innovative investment in younger and smaller firms.

To the extent that innovative investment in environmental technology suffer from the same financing difficulties that plague innovative investments more generally, this literature suggests that financial considerations likely have an economically important impact on the level and extent of investment in environmentally friendly technologies, particularly the level of such investment by new enterprises.

3 Financial infrastructure, innovation and the real economy

3.1 The role of the financial market for the real economy

There is a large literature on how and why financial development affects economic growth (see Levine (2005), for a survey of the evidence). There is by now relative consensus that a higher level of financial development facilitates economic growth (e.g., King and Levine (1993); Levine (1997); Rajan and Zingales (1998)). Levine (2005, p. 869) emphasizes five aspects where the financial sector should theoretically have real economic effects: i) information production on possible investments and

allocating capital, ii) monitoring of investments after providing finance, iii) managing risk, iv) pooling savings, and v) easing the exchange of goods and services. One particularly important role when we consider the financing of private sector investment in environmental technology innovation is the capital allocation channel (point i above).

There is a rich literature in financial economics on determinants of financial development with a particular focus on the capital allocation mechanism. This report specifically focuses on the capital allocation in Sweden with respect to investment in new, risky innovation investments in environmental technology. As discussed in the introduction and section 2 such investments are arguably prone to underinvestment due to financing frictions (e.g., Hall (2002)).

3.2 Evolution of the financial sector over time

Around the world, the financial sector has seen significant deregulation over the last three decades (Abiad and Mody (2005)). There is a large literature on financial market liberalization reforms with a majority of evidence pointing toward a positive impact from liberalization on capital allocation and ultimately on economic growth (e.g., Bekaert, Harvey, and Lundblad (2005); Gupta and Yuan (2009)).

We plot the development of financial reform with the well-used index from Abiad, Detragiache, and Tressel (2010) for a sample of developed countries (dashed line) and Sweden (solid line) in Figure 1. There is a clear increase in the reform index over time. But, there is also considerable variation over time. The cumulative change in financial reform as expressed by the reform index during the 1970s is 18%. During the 1980s the reform index increases by 62%, and in the 1990s the increase is around 28%.

The financial systems prior to the deregulations in the 1980s and 1990s were characterized by extensive government control. These control

mechanisms had a direct impact on corporate financing, such as deciding which firms and industries banks could lend to and at what rates. For example, prior to the banking sector reforms in France in 1985, lending was centralized to the Treasury to the extent that: "*... the French banking industry was so heavily regulated that interest rates played almost no role in the allocation of capital..*" (Bertrand, Shoar, and Thesmar (2007) (p. 602).

While Sweden follows the same trend as other OECD countries it is well below average in the 1970s. There is some activity in the first few years of the 1980s (see Englund (1990) for a discussion). For instance, Sweden abolished its tax on stock market trading in 1979 as well as removing various price and interest rate ceilings in 1978-1980. However, Sweden deregulated its credit market substantially in 1985 by removing, for instance, ceilings on both quantities and prices (interest rates) on loans. The financial reform index jumps by 67% during 1985-1987 and Sweden all of a sudden goes from having a relatively regulated financial market to one of the least regulated ones. This resulted in a jump in bank lending to GDP from 78% in 1985 to 91% in 1986 (Englund, p. 388, 1990).

The causes and consequences of Sweden's rapid financial market deregulation of the 1980s is well beyond the scope of this report. But it is an important factor in Sweden's development as a market economy since then. Sweden's financial system today is by most measures a market-based system comprising a highly sophisticated resource allocation system that facilitates Sweden's seemingly rapid adoption of information technology as well as environmental technologies.

3.3 Sweden's financial system

Sweden is a market based financial system. The academic literature usually distinguishes between bank based and market based financial

systems. Continental Europe and Japan are considered mostly bank based while the Anglo Saxon countries are market based (e.g., Allen and Gale (2000)). What this means is that in a market based financial system resource allocation is carried out via arm's length financing in market places trading financial assets (securities) and not based on relationships in banks.

Whether a country is market or bank based is usually measured by taking the ratio of the degree of market based financing and degree of bank based financing. In their seminal paper, Beck and Levine (2002) measure this with the natural logarithm of the ratio of stock market liquidity (relative to GDP) and bank credit going to the private sector (relative to GDP). We present the evolution of this ratio for Sweden in Figure 2. Over the entire 1980s, Sweden's financial system is more bank-based (the ratio is consistently below zero). In fact, it is not until 1994 that stock market based financing exceeds bank based financing. Market based financing is more volatile and records peaks just around the pinnacle of the dotcom bubble.

The ratio in Figure 2 can be high because of a very low level of banking finance and not necessarily reflect lots of market based financing.[6] We therefore plot three of the most commonly used measures of stock market development, and thus proxies for access to equity financing in Figure 3. The numerator of the financial structure measure is stock market value traded and measure the total shares traded on the stock market exchange relative to GDP (solid line in Figure 3) and captures the liquidity of the stock market. This measure is around 1% of GDP in 1980.

The deregulation of the stock market in 1980 allowing foreign investors to invest more freely helped boost liquidity in the stock market. But liquidity measured as the value of traded stock on the stock exchange

[6]Data underlying Figures 2-4 is from the World Bank and described in Beck, Demirguc-Kunt, and Levine (2000) and Beck and Demicguc-Kunt (2009).

relative to GDP was still just 6% in 1990. From the early and mid-1990s the liquidity of the Swedish stock market starts increasing rapidly and reaches a peak in 2001 of 143% relative to GDP. Higher values in market based financing is not simply cyclical, when the stock market bottomed in 2003 following the burst of the IT bubble, stock market value traded was 84% relative to GDP. The highest value is found in 2008 at 170% relative to GDP.

Sweden is more market based than most other European countries apart from the UK. Figure 4 plots stock market value traded over GDP for the US, UK, Germany and Denmark. Sweden is quite far below the two Anglo Saxon countries but also quite far above the major Continental European economy (Germany) and a Continental European country similar to Sweden's institutional setting (Denmark). Average stock market value traded in the US and UK over the last decade is 260% and 170% respectively. Sweden's average is 125%. For the two Continental European countries in Figure 4, Germany and Denmark, the average is 80% and 64% respectively.

The measures we have discussed so far are proxies that supposedly capture a country's financial system structure. While bank based financing is suitable for some types of economic activity market based financing is better suited for other activities. Bank based financing are usually viewed as the most efficient way of financing investments in established technologies whereas market based financing is better used for investments in novel and risky technologies (e.g., Allen and Gale (1999)). It is therefore instrumental to have access to market based equity capital in order to fund investments in new and unproven technologies such as environmental technology.

The measures we have discussed in Figures 2-4 represent broad based measures and are not always straightforward to link to investments in new and risky technologies. But, having a deep and liquid stock market, such as Sweden has, is an absolute prerequisite for having supply of the

more direct sources of financing to entrepreneurs.

First, in order to have a vibrant market for initial public offerings (IPO) there needs to be a deep and liquid stock market in order to absorb new listings. Second, when there is an exit market for seed investors via a vibrant IPO market there is a possibility for venture capital (VC) to thrive (Black and Gilson (1998)). Also, the size of a country's VC market tends to be highly correlated with the depth and liquidity of its stock market (Jeng and Wells (2000)). And, third, with a developed VC market there is the possibility for angel investors to thrive. Having a developed market for supply of equity financing has been shown to support investments in new and risky technologies whereas bank based financing is unimportant (e.g., Brown et al. (2013); Hsu, Tian, and Xu (2014)).

Sweden's financial infrastructure is consistent with the above mentioned stylized facts. As we discussed, Sweden has a market based financial system with a deep and liquid equity market. In Figure 5, we summarize the information from a study by Kim and Weisbach (2008) on international IPO proceeds and focus on a set of developed countries. IPO activity is highly cyclical and we therefore present the total amount of IPO proceeds normalized by GDP across 21 developed countries over Kim and Weisbach's sample period (1990-2003). Sweden has the second largest IPO market (in relation to its economy size) of the sample countries. During the 14-year period Sweden has 90 IPOs totaling over $10 billion. Relative to its economy's size, Sweden's IPO market exceeds both the US and UK's according to Kim and Weisbach (2008).

As discussed above, based on Black and Gilson (1998), it is crucial to have a deep stock market and vibrant IPO market in order to sustain a VC market. Lerner and Tag (2011) compares Sweden's VC market with the US and other developed countries. More specifically, in their figure 4 (Lerner and Tag, p. 167, 2011) they show that Sweden's VC market (as

a percentage of GDP) is the sixth most developed. Hong Kong, the US and Israel's VC markets are in a size class of their own. Singapore and Canada also have slightly larger VC markets than Sweden. But from a global context Sweden's VC market is highly developed and underscores how competitive Sweden's financial infrastructure is and how well suited it is to facilitate the financing of new and risky technologies.

Finally, although there is considerably scarcer evidence on the angel financing market, we find a generally consistent view with IPO and VC markets. In market based financial systems there is also more angel investing. Cumming and Zhang (2016) summarize angel investing around the world. Although their sample does seem a bit skewed toward the North Americas, it still seems clear that in the countries with deep stock markets, vibrant IPO and VC markets there is also a relatively strong market for angel financing (table II, p. 44, Cumming and Zhang (2016)). Sweden along with the other Nordic countries have about 20 angel investor deals per one million populations. This lags most Anglo Saxon countries but is well above Continental European countries such as France and Germany with about 8 deals per one million populations.

Overall, Sweden has a market based financial system. This implies that Sweden has a deep and liquid stock market. Sweden also has a relatively large market for IPOs, VC capital and angel investing. In other words, Sweden is relatively well positioned to facilitate the transition toward environmentally sustainable technologies via its financing mechanism. Next, we link the discussion on Sweden's financial infrastructure to innovation in the financial sector.

3.4 Equity finance and risky new technologies: the role of innovation in the financial sector

As we have discuss above, there are several reasons why it might be difficult to finance risky technologies with debt, including: i) large

information asymmetries between firms and investors, ii) returns to such investments are often skewed and highly variable, and iii) such investments has little collateral value. While all three characteristics of investments in risky technologies impede the use of debt finance, the last two need not apply to equity finance. Equity holders share in the upside returns and thus skewness and variability need not be a problem; in contrast, the very nature of the debt contract is not well suited for risky investments since creditors share only in the low returns associated with failure. Furthermore, collateral is not relevant for equity finance whereas banks almost always require risky firms to post collateral to obtain debt finance (e.g., Berger and Udell (1990)). These reasons imply that investment in new and risky technologies is dependent on equity finance.

Therefore, we need to have innovation and progress in how the financial market provides equity financing to fund these new and risky technologies. At a first glance, the growth of internet and smartphones has transformed several services such as financial services.

Theoretically, it is the technological improvements in the financial system that improves the supply of external equity financing that will facilitate innovation investment in environmental technology. Such improvements can be in the form of direct technical change.

A fitting example is the creation of *Optionsmäklarna* (OM) in 1984 serving as both the first options exchange in Sweden and the first exchange ever to enable remote trading and one of the first electronic exchanges globally. Being able to trade shares electronically improves liquidity and facilitates a deeper stock market and therefore serves to add to the crucial infrastructure of equity financing for risky technologies.

Broader developments such as improvements in corporate transparency and disclosure of information which lowers the cost of capital for risky investments is crucial (e.g., Lev (2004)). The link between corporate disclosures and cost of capital is one the most well

established in accounting and finance. Also, improvements to the legal protection of minority shareholders and preventing self-dealing of corporate insiders is another example that can drive down the cost of equity capital and boost the supply of risk willing capital. The important law and finance literature provide strong support that legal protection of minority investors has a strong impact on the cost of capital (see La Porta, Lopez-De-Silanes, and Shleifer (2008)) for a survey).

To formalize the role of technical change and innovation in the financial system we draw from Merton and Bodie (1995) and their functional approach to financial market development. They differentiate between the functions of the financial market rather than the institutions. The function we are most interested in is the funding of new technologies. Over time there have been different institutions performing this task but the function is the same: providing enough equity capital to the entrepreneurs exploiting the risky technologies that improve our welfare.

In their model, the evolution of the financial system is described by an innovation spiral in which organized markets and intermediaries compete with each other in a static sense. In a recent paper, Laeven, Levine, and Michalopoulos (2015) show that technological innovation (such as environmental technology) eventually stops unless financiers keep innovating. They focus on the role of innovation among financiers when it comes to screening entrepreneurs. If financiers do not innovate and improve, e.g., screening processes, cost of capital will not go down with the eventual implication that innovations in risky technologies grind to a halt and economic growth stops.

More recently, high-tech start-ups have entered the financial sector space trying to disrupt traditional financial services (see, e.g., Philippon (2016)).[7] These firms are categorized as the Financial Technology

[7]Philippon (2016) views Fintech as a response to the fact that financial services

(Fintech) sector.[8] There is no established definition of Fintech, but following the definition of Accenture[9] there are three distinct categories: i) *Servicing the long tail* which consists of providing financial services to firms previously excluded from the financial market, ii) *Reducing transactions costs* which mostly involves improvements in the payment systems, and iii) *Crowdfunding and microfinance platforms* covering supply of external finance to individual entrepreneurs or ventures.

The creation of OM (which later became OMX and now is a part of NASDAQ-OMX), discussed above, would constitute a fintech company today. Theoretically, it is the third category of Fintech that likely plays a role in supplying equity capital to entrepreneurs in the market for new and risky technologies.[10]

Sweden and the Nordics are in the forefront of business and investment activities in the Fintech sector.[11] This success is mostly driven by Fintech start-ups located in Stockholm, which is second only to London when it comes to funding of Fintech start-ups in the EU. But, we argue that by focusing too much on technological development in the finance sector to fund the new and risky technologies risks us taking a too narrow perspective in the transition toward innovations in

is relatively expensive which would explain why many entrants seek to enter the industry. More specifically, he discusses the rise of Fintech as a response to inefficiencies in the financial system (Philippon (2015) discusses these inefficiencies). He particularly emphasizes that end users of financial services do not seem to have benefitted from adoptions of information technologies.

[8] A recent report from PricewaterhouseCoopers estimate that funding in Fintech start-ups exceeded $12.2bn in 2015 from around $5.6bn in 2014.

[9] *The Boom in Global Fintech Investment – A new growth opportunity for London*, Accenture Report 2014.

[10] Crowdfunding is a relatively new form of financing allowing the "Crowd" to invest by lending or purchasing equity (Schwienbacher and Larralde (2012)). The phenomenon has started while individuals (retail investors) have provided small amounts of debt to other individuals or businesses in return for an interest rate. However, in recent years, pre-purchase and equity crowdfunding has attracted attention of policy makers and investors.

[11] http://techcrunch.com/2016/04/08/fintech-dominates-nordic-startup-investments/report

environmental technology. First of all, an important part of Fintech can only be viewed as, at best, indirectly affecting the financing of the crucial technologies we need. Large parts of the Fintech industry, in Sweden and elsewhere, involves technical solutions for consumer payments and therefore cannot be viewed as a source of equity capital for innovaiton investments in environmental technology (see Table A.1 for a list of Fintech start-ups in Sweden).

In sum, it is innovation in the financial sector that drives toward the goal of greater economic efficiency by reducing transactions costs that is needed. We proceed in the next section and discuss some policy initiatives and look ahead.

4 The Swedish policy landscape

Here we discuss what policies and initiatives that can be considered important drivers of Sweden's development when it comes to facilitating financing of innovative investments in environmental technology. We begin by discussing broad policies in place before and then we present policy efforts aimed to stimulate the supply of equity financing toward firms investing in risky technologies. We begin the section by presenting an overview of Sweden's environmental performance and the environmental technology sector.

4.1 Sweden's environmental technology sector

When discussing environmentally related economic activities it is important to make one particular distinction. This report deals primarily with facilitating equity capital financing for innovative investments in environmental technology. Environmental technology is not necessarily technology developed in the environment sector. The environment sector is defined by *Statistics Sweden* (SCB (2016)) as

follows:

"*The environment sector includes operations that produce goods and services that measure, prevent, limit, minimize or remediate environmental damage to water, air and soil as well as problems related to waste, noise and ecosystems. This also includes cleaner technologies and goods and services that reduce environmental risks to minimize emissions and resource consumption*" (SCB (2016, p. 9)).

Firms innovating in environmental technology are a subset of the firms in the environment sector. Instead many firms outside the environment sector innovate and invest in environmental technology. Based on the Community Innovation Survey for 2006-2008, the most common innovation in the environmental technology area in Sweden dealt with reducing energy use in production ((SCB (2016, p. 32)).

We present information of the size and evolution of the Swedish environment sector in Table 1. In 2014, there were about 16,000 establishments in the environment sector gainfully employing about 71,000 workers. The total turnover of the sector is about 220 billion Swedish Krona. Turnover is up by about 50% while number of establishments has increased by around 30% and number of workers around 12% during 2003-2014.

The Swedish government agency Vinnova produced a report in 2013 specifically mapping the environmental technology sector in Sweden (Vinnova (2013)). According to Vinnova (2013), the environmental technology sector comprised around 2,700 establishments in 2011. This is considerably fewer than the almost 16,000 enterprises in the environmental sector that same year (Table 1). About two thirds of the enviornmental technology enterprises from Vinnova's study are also included in the environment sector (see Figure 2 in (SCB, 2016)).

4.2 Broad based policies

The environmental technology sector in Sweden can benefit from a comparatively extensive system of policy instruments put in place aiming to reduce emissions of greenhouse gases.[11] The climate policy relies strongly on marked-based approaches, complemented by regulations, climate-related investment subsidies, targeted support to research and development (R&D), as well as information-based instruments. In particular, energy and carbon dioxide taxes are important instruments in Sweden's climate policy.

The extensive energy agreement struck on June 10 in 2016, between five left and right–wing parties making up 75% of the Swedish Parliament, is a good example of the broad based support for an environmentally sustainable society. The agreement's overall goal is 100% renewable electricity production in Sweden by 2040. By, 2045 Sweden should have zero net emissions of greenhouse gases and then embark on a path toward having negative net greenhouse gas emissions. The agreement is extensive and the first of its kind to be struck across parties of different ideologies and therefore expected to last. In very broad terms the agreement consists of adjustments of taxes and subsidies, funding of research as well as the role of access to finance.

Sweden has a relatively long tradition of taxing activities that have an environmental impact. We plot in Figure 6 the tax revenue from enviornmentally related taxes per capita expressd as 2010 purchasing power adjusted USD. Sweden is eighth among OECD countries.

[11] The two sub sections describing the policy landscape in Sweden in terms of broad based polices and financial policies aim to provide a description on the different policies available and not necessarily promoting them. There is a large academic literature on the usefuleness of various public sector programs aimed to boost supply of finance and/or boost entrepreneurship in general. It is beyond the scope of this report to analyze the potential efficacy of the different polices. There is a considerable academic literature on the role of such public sector interventions (see e.g., Lerner (2009)).

Denmark and Luxemboug are in a class of their own.

Next we focus explicitly on the composition of environmentally related taxes within Sweden in Table 2. First, we note that the total amount of enviornmentally related taxes in Sweden is stable at around 76-80 billion SEK per year over the last six years. About half of all tax revenue come from the household sector and the rest from businesses. Table 2 distinguishes between five different environment taxes based on the *Environmental Accounts* maintained by *Statistics Sweden*. The two largest sources of tax revenue from the five sectors are electricity taxes and carbon dioxide taxes. The other three enivornmentally related taxes are energy taxes, sulphur taxes and vehicle taxes.

Finally, in Figure 7 we plot the total amout of direct environmental subsidies provided each year. The average value of environmental subsidies is around 7 billion SEK per year over the last 15 years. The largest component which is subsidized is typically so called natural resource related subidies. The fastest growing area of environment subsidies is the part of the foreign aid budget going to combat climate change, making up almost half of all direct environmental subsidies in 2015. Based on our helicopter perspective analysis of fiscal instruments aimed at affecting the use of sustainable production technologies it is clear that Sweden prefers taxes over subsidies. Annual tax revenues from environment taxes is 10 times higher than what is paid out in subsidies.

Overall, Swedish fiscal policy takes an active role in affecting the pricing of resources which affects the firm's investment desicion. We next turn to Sweden's policy initatives aimed at stimulating access to finance.

4.3 Current landscape of financial policies

Sweden has an extensive and well developed system of government support for funding new and innovative ventures. In 2015, there was a government commission proposing the launch of a new fund with the goal of supplying equity capital to the parts of the financial eco system most affected by the above discussed market failures as well as streamlining some of the existing policy support functions (SOU (2015)).

Sweden's policies for supply of external financing is well established in the financial economics theory of market failures. It is important not to provide government handouts which can crowd out private financing. Therefore, most support programs demand a reasonably high interest rate or cost of capital as well as the requirement of co-financing public funds with private capital. The discussion below builds on the extensive summary of Sweden's financial policy landscape provided in the above mentioned government commission report (SOU (2015)).

Sweden provides billions of Swedish Krona (SEK) in support each year with the aim to mitigate the market failures associated with companies with short track records to finance new, and innovative investments. Most of the public capital requires exact matching of private funds which means even larger increases in the supply of equity capital. *Almi Företagspartner AB* is one of the most important actors. It is fully government owned and has 16 regional subsidiaries. Almi's mandate is broad and consists of supplying debt and external equity capital to new companies as well as a general advisory capacity. The core goal is to support companies with high growth potential while there are no sector limitations. The most relevant part of Almi for the supply of equity capital for innovative investments in environmental technology is *Almi Invest AB* which is its private equity company and was formed in 2009. The total financing supplied by *Almi Invest AB*, including matched private funds, in 2014 was 193 investments totalling SEK 750

million. The total private equity holdings was 1.5 billion SEK and 375 portfolio companies.

Sweden has a long tradition of public-private partnerships. *Norrlandsfonden*, formed in 1961, and *Industrifonden*, formed in 1979, are among the earliest initiatives. The latter of the two is a useful example of the changing mandate and modernization of Swedish support functions for supplying finance to the private sector. At its inception, *Industrifonden* was supposed to support predominantly large and established companies with loans and export initiatives. After Sweden's entry in to the European Union (EU) in 1995 the fund had to change its mandate and focus on small and medium sized enterprises (SME) due to the restrictions of the State Aid Rules. Nowadays, *Industrifonden* provides finance which requires matching with private capital and investments are typically in high tech sector companies. New investments in 2014 was about half of that of *Almi Invest AB*.

The supply of initiatives aimed at expanding capital to new and innovative technologies increases further in the aftermath of the financial crisis. The Swedish government launched *Fouriertranform AB* in 2008 and *Inlandsinnovation* in 2010. *Fouriertranform AB*'s initial mandate was to assist in the transformation of the auto industry after the bankruptcy of the automaker SAAB. Nowadays, *Fouriertranform AB* is formed as a venture capital company investing in and financing of companies in R&D-intensive new ventures. The focus of its investments is on early stage financing around 30-300 million SEK. *Inlandsinnovation* is a regional private equity fund focusing on the hinterland of the north of Sweden.

Together with the specific private equity funds mentioned above, Sweden also has a well developed infrastructure of government agency support of early stage innovation in the private sector. *Vinnova* is Sweden's innovation agency with a mission to "*promote sustainable growth by improving the conditions for innovation, as well as funding*

needs-driven research". *Vinnova*'s annual budget is around 2.5 billion SEK with about 20% going to support innovation-driven growth in SMEs.

Relevant to the financing of clean tech initiatives in the private sector is the mandate of the *Swedish Energy Agency* aimed to supply (private sector matched) early stage financing to commercialization projects in the renewable energy segment. Finally, Sweden has an extensive network around its universities. Since 1994, Sweden's universities was allowed to form holding companies to facilitate the commercialization of its research. There has also been a development around most major universities of so called incubators and the creation of science parks. Incubators and science parks have been developed since the 1990s and their chief purpose is to supply professional services and general coaching to entrepreneurs.

The Swedish government is launching two new funds within the EU structural funds program. The first is a broad based VC-fund aimed to supply early stage financing to newly formed high tech companies. The second initiative, more closely aligned with the financing of environmental technology, is called the *Green fund*. The fund is supposed to make direct investments related to climate, renewable energy and energy-efficiency. The plan is to make investments in about 50 companies.

The perhaps most extensive proposal for reform (for some time in Sweden) when it comes to policy for supply of equity capital to risky and new companies is the proposition of a new public, state-owned fund. This fund should be set up in order to invest *with* private capital in venture capital funds. This new fund should also act as the holding company in a new investment structure.[8] The principal objective of the new state-owned fund is to co-finance early stage venture capital

[8] *En fondstruktur för innovation och tillväxt*, Government report from the commission of state-based financing, Stockholm, 2015 (SOU 2015:64).

investments in new and small innovative Swedish companies with high growth potential. Another important goal is to contribute to the overall financial eco system in Sweden. The overall aim to fund new and small entrepreneurial funds is supposed to be carried out via the so called *Microfund*. The above mentioned *Green fund* is to be transfered to this new fund structure. There is also a suggestion of a so called demonstrator fund which should alleviate investments by new firms in production-scale facilities. Also, the commission identifies a need for a loan guarantee system aimed at securing access of small enterprises to bank financing. The name suggestion of the proposed fund-in-fund structure is *Fondinvest AB*. Finally, the proposal involves additional funding to the relevant support facilities around government sponsored entrepreneurial financing such as *Almi Invest* and *Vinnova*.

5 Summary and conclusion

This report discusses the potential for financing constraints to limit private sector innovative investment in environmental technology. There are strong theoretical reasons to expect that information and transactions costs will drive a wedge between the cost of internal and external finance, particularly for firms and innovations that are more novel and less transparent. If external finance is costly, innovative investment in firms with insufficient internal resources to fully fund investment will be below the private optimum in a world with no financing frictions.

Given the positive spillovers likely associated with innovation in environmental technology, financing constraints can thus push private investment even further below the socially optimal rate. In addition, to the extent that investment in new environmental technology innovation is often intangible and the outcomes are uncertain, equity is likely the most relevant source of funding for new investment. As a consequence,

rules, regulations and financial developments that affect the supply of external equity (from both private venture capitalists and public stock markets), as well as tax policies on internal and external equity finance, can have important effects on the extent to which firms and entrepreneurs engage in environmental technology innovation.

Our starting point in this report is to focus on market failures stemming from that firms do no appropriate all returns to investment in environmental technology innovation. However, there is reason to suspect that there are additional aspects to consider surrounding the transition toward an environmentally sustainable economy relative to other forms of R&D activity and innovation. There is a growing and important academic literature on the implications of the transition to clean technologies for long-run economic growth (e.g., Acemoglu, Akcigit, Hanley, and Kerr (2014); Acemoglu, Aghion, Bursztyn, and Hemous (2012); Golosov, Hassler, Krusell, and Tsyvinski (2014)). An important takeaway from this literature is that there is likely a slow process to transition from dirty to clean production technologies because it invovles deep transformations in our energy and economic systems. In other words, there exist a so called strong path dependence that needs to be re-directed (Aghion, Hepburn, Teytelboym, and Zenghelis (2014)). For example, Acemoglu et al. (2014) emphasize that dirty technologies start out from an advanced position relative to cleaner production technologies which further slows down the transition. This difference in starting point is evident as global subsidies to clean energy amounts to around US$100 billion globally in 2014 compared to subsidies totaling US$600 billion to (dirty) fossil fuels (GCEC (2014)).

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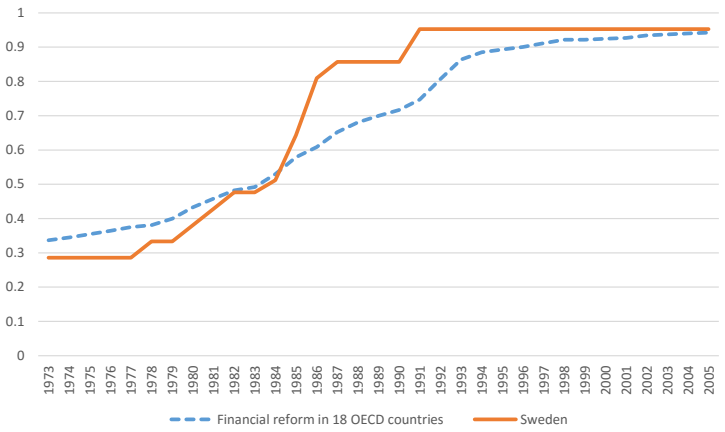

Figure 1. Financial reform in high income countries and Sweden, 1973-2005.

Average value of Financial reform across 18 OECD countries and Sweden. Financial reform is an index of the following seven indicators: i) credit controls and excessively high reserve requirements (Credit controls), ii) the presence of specific lending rates or specific ceilings or floors for the lending rates (Interest rate controls), iii) regulators often maintain control over capital allocation by restricting the entry into the financial system of new domestic banks or other entities (Entry barriers), iv) the degree of supervision in the banking sector (Supervision), v) direct ownership of banks (Privatization), vi) the restrictions on international financial transactions (Capital account), and, the final sub-component captures government policies used to encourage or restrict the development of securities markets (Market policies). Each of the seven sub-components is graded between 0 and 3, with 3 indicating full financial reform, so the aggregate score subsequently varies between 0-21 for each country-year. The overall score is normalized between zero and one. (Sources: Author's own calculations based on Abiad et al., 2010).

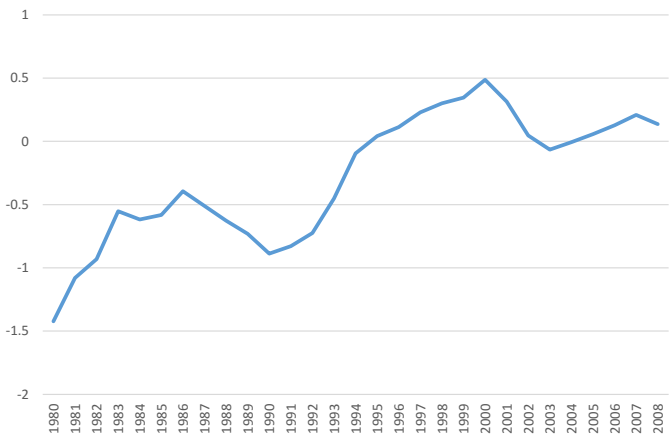

Figure 2. Financial structure Sweden, 1980-2008.

Logarithm of the ratio stock market value traded over GDP and private credit by deposit money banks over GDP. (Sources: Author's own calculations based on Beck and Levine (2002) and Beck, Demirgüç-Kunt and Levine, 2000; Beck and Demirgüç-Kunt, 2009)

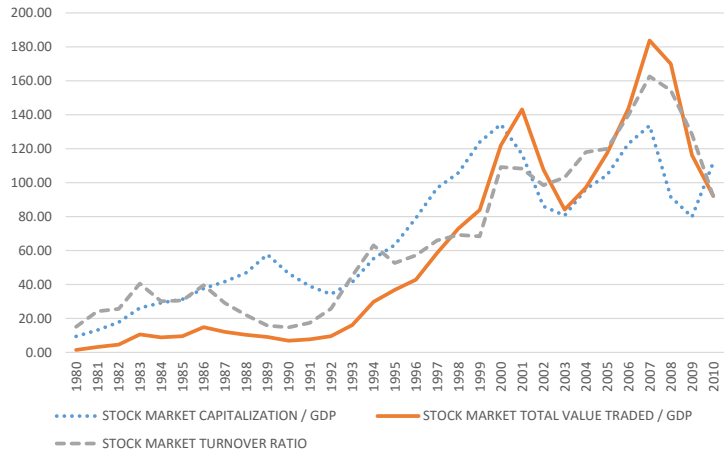

Figure 3. Stock market development in Sweden, 1980-2010.

Stock market value traded/GDP is the total shares traded on the stock market exchange to GDP (solid line), Stock market capitalization/GDP is the value of listed shares to GDP, and Stock market turnover ratio is the ratio of the value of total shares traded to average real market capitalization (Sources: Beck, Demirgüç-Kunt and Levine, 2000; Beck and Demirgüç-Kunt, 2009).

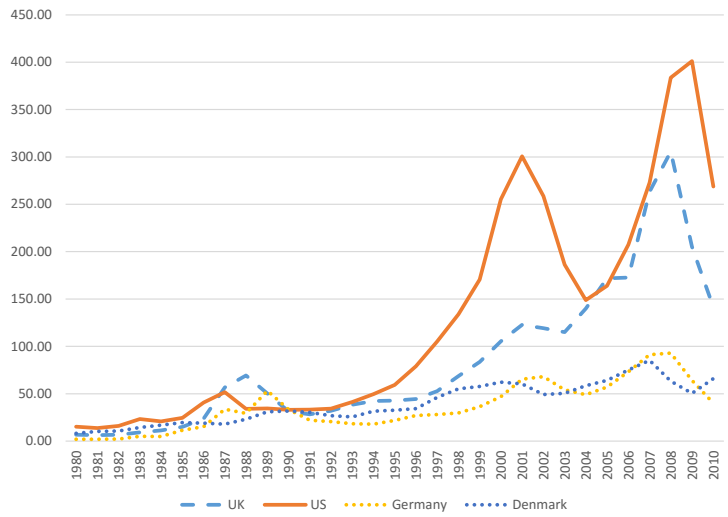

Figure 4. Stock market development in the US, UK, Germany and Denmark, 1980-2010.

Stock market value traded/GDP is the total shares traded on the stock market exchange to GDP for the US (solid line), the UK (dashed line) and Germany and Denmark (dotted line) (Sources: Beck, Demirgüç-Kunt and Levine, 2000; Beck and Demirgüç-Kunt, 2009).

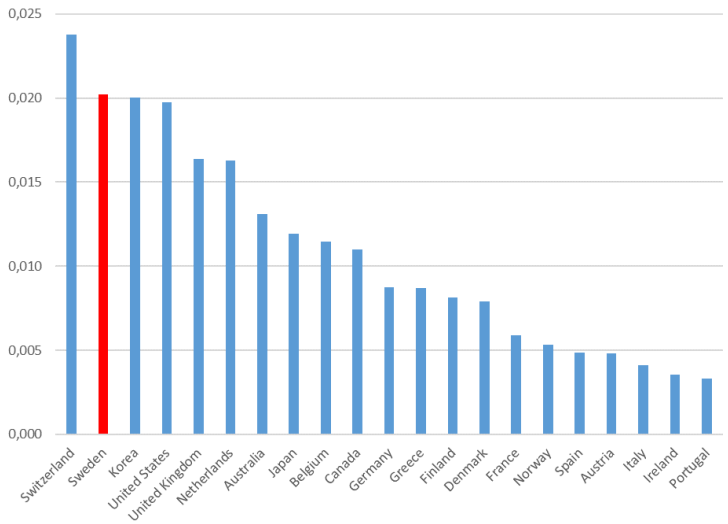

Figure 5. Value of initial public offerings divided by GDP, 1990-2003.

Total value of proceeds from initial public offerings (IPO) divided by GDP across developed countries during 1990-2003. (Sources: Author's own calculations based on Kim and Weisbach, 2008).

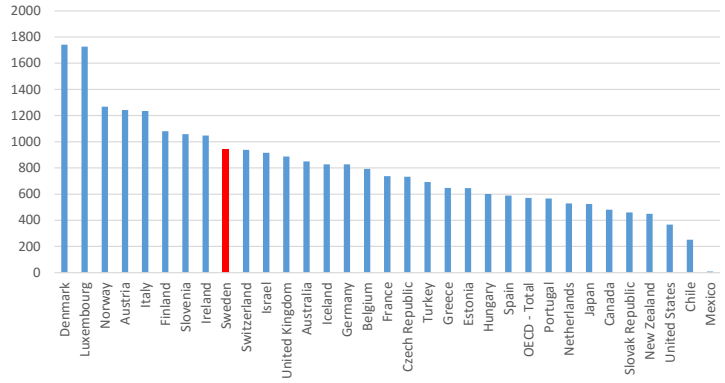

Figure 6. Environment related tax revenue per capita, 2014.

(Source: OECD).

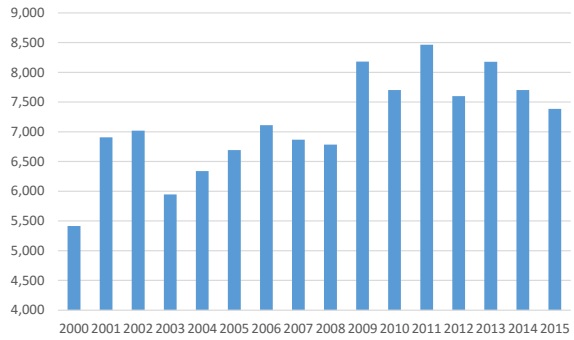

Figure 7. Total direct environmental subsidies (MSEK), 2008-2013.

(Source: Statistics Sweden).

Table 1. Overview, environmental sector in Sweden, 2003 to 2014

Number of establishments, turnover, export and gainfully employed

(English)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*	2013	2014
Establishments	12 344	12 372	13 307	13 615	14 302	14 764	15 194	15 960	15 821	16 807	16 434	16 136
	149	156	176	197	210	246	221	239	248	225	222	220
Turnover (million SEK)	037	301	343	987	679	925	292	581	450	723	393	281
Export (million SEK)	23 749	25 734	29 660	31 974	36 625	47 614	41 186	38 379	40 819	40 790	37 061	37 013
Gainfully employed, total	63 376	66 505	68 769	69 894	72 579	74 081	71 813	71 253	70 832	72 097	71 980	71 339
of which Women	*14 644*	*15 320*	*16 179*	*16 784*	*17 594*	*18 437*	*17 888*	*17 689*	*17 651*	*18 354*	*18 387*	*18 346*
of which Men	*48 731*	*51 184*	*52 590*	*53 109*	*54 984*	*55 644*	*53 925*	*53 564*	*53 181*	*53 743*	*53 593*	*52 993*

* Number of establishments increase 2012, due to changes in the definition of what is considered an active establishment.

Table 2. Environmental taxes by type and sector (million SEK),

2008-2013 (Source: Statistics Sweden)

	Total environment related taxes (million SEK)					
Aggregated Industry classification NACE Rev.2	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agriculture, forestry and fishery	3 407	3 499	3 769	3 914	3 874	3 823
Mining	208	181	213	224	265	229
Manufacturing	3 171	3 096	3 073	3 195	3 617	3 434
Electricity, gas and hot water supply, etc.	2 974	3 399	4 060	3 565	3 523	3 410
Construction	3 602	3 790	3 989	3 934	4 259	4 530
Transport	9 206	8 826	9 735	9 754	9 869	9 763
Other services	10 914	11 029	11 033	10 855	10 860	11 014
Public sector	2 917	3 064	3 173	2 971	2 981	3 009
Households and non-profit institutions	39 986	41 820	42 399	39 821	39 716	39 710
Total	76 385	78 704	81 444	78 233	78 964	78 922
	Energy taxes (million SEK)					
Aggregated Industry classification NACE Rev.2	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agriculture, forestry and fishery	939	992	1 059	1 244	1 298	1 431
Mining	34	31	33	50	53	40
Manufacturing	578	609	498	733	696	655
Electricity, gas and hot water supply, etc.	350	404	549	631	597	579
Construction	1 044	1 100	1 117	1 192	1 258	1 350
Transport	2 886	2 875	3 160	3 522	3 516	3 647
Other services	2 342	2 428	2 351	2 370	2 324	2 369
Public sector	303	314	310	314	312	310
Households and non-profit institutions	11 114	11 469	11 075	10 358	9 858	9 517
Total	19 590	20 222	20 152	20 414	19 912	19 898
	Carbon dioxide taxes (million SEK)					
Aggregated Industry classification NACE Rev.2	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agriculture, forestry and fishery	1 816	1 822	2 003	1 999	2 085	2 082
Mining	136	111	128	121	128	92
Manufacturing	1 878	1 733	1 756	1 639	1 656	1 469
Electricity, gas and hot water supply, etc.	1 155	1 488	1 946	1 468	1 306	1 246
Construction	1 872	1 920	2 036	1 953	2 113	2 108
Transport	5 675	5 284	5 891	5 585	5 635	5 245
Other services	2 738	2 815	2 877	2 739	2 775	2 707
Public sector	453	478	490	444	431	410
Households and non-profit institutions	10 047	10 422	10 203	9 416	9 108	8 690
Total	25 770	26 073	27 330	25 364	25 237	24 049
	Sulphur taxes (million SEK)					
Aggregated Industry classification NACE Rev.2	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agriculture, forestry and fishery	0	0	0	0	0	0
Mining	5	3	5	2	2	1
Manufacturing	14	9	9	7	7	2
Electricity, gas and hot water supply, etc.	42	28	35	22	21	10
Construction	0	0	0	0	0	0
Transport	0	0	0	0	0	0
Other services	0	0	0	0	0	0
Public sector	0	0	0	0	0	0
Households and non-profit institutions	0	0	0	0	0	0
Total	61	40	49	31	30	13

Table 2. Environmental taxes by type and sector (million SEK), 2008-2013

(continued)(Source: Statistics Sweden)

	Electricity taxes (million SEK)					
Aggregated Industry classification NACE Rev.2	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agriculture, forestry and fishery	8	10	13	11	20	21
Mining	27	28	39	43	73	86
Manufacturing	500	533	609	628	1 064	1 088
Electricity, gas and hot water supply, etc.	1 388	1 434	1 486	1 402	1 553	1 521
Construction	263	297	333	315	317	340
Transport	366	368	371	359	356	398
Other services	4 413	4 401	4 421	4 436	4 462	4 685
Public sector	1 979	2 097	2 195	2 034	2 053	2 103
Households and non-profit institutions	10 723	11 518	12 571	11 958	12 692	13 228
Total	19 667	20 686	22 038	21 186	22 590	23 470

	Vehicle taxes (million SEK)					
Aggregated Industry classification NACE Rev.2	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agriculture, forestry and fishery	644	675	694	660	471	289
Mining	6	8	8	8	9	10
Manufacturing	201	212	201	188	194	220
Electricity, gas and hot water supply, etc.	39	45	44	42	46	54
Construction	423	473	503	474	571	732
Transport	279	299	313	288	362	473
Other services	1 421	1 385	1 384	1 310	1 299	1 253
Public sector	182	175	178	179	185	186
Households and non-profit institutions	8 102	8 411	8 550	8 089	8 058	8 275
Total	11 297	11 683	11 875	11 238	11 195	11 492

Table A.1- List of Fintech startups in Sweden

Company	Fintech category	Investment ($)	Founded	No. Rounds
Tink	Personal finance	$14.17M	2012	2
Lendify	Crowdfunding	$2.39M	2014	1
Fundedbyme	Crowdfunding	$1.44M	2011	2
Safello	transaction	$968k	2013	3
BehavioSec		$8.19M	2007	3
Trustly	Transaction	$28.75M	2008	1
iZettle	Transaction	$244.04M	2010	9
Klarna	Transaction	$291.33M	2005	6
Toborrow	Crowdfunding	$2.74M	2013	2
Qapital	Personal finance	$6.6M	2012	4
Flattr	Transaction	$2.43M	2010	2
Billhop	Transaction	Undisclosed	2011	5
Klirr	Personal finance	-	2015	0
Knc Miner	Transaction	$32M	2013	3
Lifeplan	Personal finance		2008	
Allopass	Transaction	-	1991	-
Qliro	Transaction		2014	
Betalo	Transaction	$1.2M	2011	1
Tessin	Crowdfunding	$1.79M	2014	2
Nordkap	Personal finance	Undisclosed	1999	1
Depos	Transaction	$0.1M	2013	1
Nowo	Personal finance	$2.2M	2014	1
4T Sverige	Transaction	-	2013	-
Shareville	Personal finance	-	2010	-