The crucial role of financial intermediation in the transition to a green economy

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Abstract

Do brown or green assets have a higher average return? Answering this question is challenging since most funds are intermediated. Their true returns are not easily observable. Examples include borrowing and lending relationships with green companies made possible by institutional investors such as banks and investment funds. This paper develops a theory of green banking. It proposes a precise definition of greenwashing in financial markets. Greenwashing is a practice used to disguise true returns. The model shows that greenwashing arises when competition for funds is high, and the market is not heterogeneous enough. It worsens the financial conditions for green companies.

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1 Introduction

This paper develops a theory of green banking. Recently, many investors are willing to contribute to the transformation of the economy and society by reallocating their funds to green companies. Their motives for socially responsible investing (SRI) are manifold, including growing concern about environmental issues, regulation, and financial returns. At the same time, however, companies are using environmental, social, and corporate governance (ESG) disclosure as a way to appeal to investors, a practice often suspected of greenwashing.

Green banking implements these considerations into financial intermediation. Central to this is how financial intermediaries ensure they remain credible in claiming to be interested in the transition to a green economy. There are two problems involved. First, there must be an advantage relative to direct investment in green companies – e.g., because of lower monitoring costs and better diversification (Diamond, 1984). Second, like companies, intermediaries can engage in greenwashing. Investors participating in green banking activities are willing to forego returns in exchange for improving the economic conditions for green companies. The green intermediary will absorb some of this willingness in order to maximize profit. How much he can absorb depends on the heterogeneity of the market (Maskin and Riley, 1984).

This paper focuses on greenwashing committed by intermediaries. It fleshes out a decisive aspect of it. Greenwashing as a situation in which more competition for green investors might lead to worsening the financial conditions for green companies. Funders are heterogenous in income (and also risk averters) and do not know the average return of investing in companies, they rely on financial intermediaries. Financial intermediaries compete for borrowed funds and invests them into companies.

In the model two financial intermediaries compete for funds. The default rate for brown and green assets is a result of financial intermediation between borrowers and lenders. The financial intermediaries can decompose investment opportunities into two portfolio extremes: green, which inheres the lowest risk-return profile, and brown, which inheres the highest risk-return profile. This reallocation influences the risk and return of all companies. The model clarifies, when two financial intermediaries compete for deposits, there is an intermediary who will never greenwash but reveal himself as an institutional investor with a high risk-return profile (such as an investment fund). From that, depositors can infer that the other intermediary offering a low deposit rate must be greener.

The existence of a brown intermediary – who admits to not being interested in a transition to a green economy – plays a crucial role since depositors need a reference point. Whenever a brown intermediary exists, green depositors sort themselves

consistently into the green intermediary. But the segmentation is bounded. The green intermediary may exploit this self-selection mechanism to greenwash, i.e. he shows a preference for green companies whereby its main goal is a low deposit rate. To measure the masquerade of the green intermediary as being interested in the transition to a green economy, the counterfactual is a setting without deposit market competition. In a setting without deposit market competition depositors cannot make a green-brown comparison. Thus, this aspect of greenwashing does not exist.

In the following section, the model of banking competition for endogenously differentiated deposit supply is introduced. Section 3 characterizes the portfolio choices. Section 4 shows that intermediation is profitable whenever the intermediaries specialize on different market segments. Section 5 assesses the probability of green washing. Section 6 concludes.

2 Model Setup

The role and scale of intermediaries are not predetermined in the model. Intermediaries merely transform illiquid assets (the borrower's future repayment) into liquid ones (deposits). They have to make consecutive decisions. At the first stage, each intermediary needs liquidity. They compete for borrowed funds, i.e. they attract funds by choosing a deposit rate. The choice problem facing a intermediary is to determine its optimal scale, i.e., the amounts of both deposits and capital to issue. At the second stage, they invest all funds in a risky loan portfolio. The choice problem now facing a intermediary is to determine its optimal risk-return, i.e., the optimal allocation of this asset pool over the available risky asset set. Thus, how much an intermediary invests in brown and green companies is endogenously determined by the model setup. The balance-sheet identity of intermediary $i \in \{B, G\}$ reads:

$$l^i = d^i + k^i, \tag{1}$$

to where the LHS is the use of funds – the volume of a risky portfolio l^i – and the RHS is the source of funds: deposit funds of quantity d^i and own funds of quantity k^i.

To focus on maturity transformation, the balance-sheet identity (1) should be understood in a causal sequence. Financial intermediaries cannot simply finance green companies without first acquiring the necessary funds. If a financial intermediary were to lend funds without first raising new deposits, double-entry bookkeeping would show that the intermediary is at a loss; its equity must always equal its assets minus its liabilities. Asset–liability mismatch or failing to follow generally accepted accounting principles would never attract new depositors, but tend to lead to bank

runs instead. Without a corresponding deposit on the liability side of its balance sheet, the intermediary could quickly become illiquid or insolvent. Thus, it is essential for financial intermediaries to first acquire deposits before they can lend funds to green companies.

Use of funds. The intermediaries face a risk, return, and scale decision. The portfolio rate of return may be described as in Repullo (2013) by a two-point random variable:

$$r_L^i = \begin{cases} e^i(2 - p_i), & \text{with probability } p_i, \\ 0, & \text{with probability } (1 - p_i). \end{cases}$$

Assume there are two kinds of loan portfolios: a brown portfolio full of dirty companies and a green one, where the green portfolio inheres a lower risk-return profile than the brown portfolio ($p^B \leq p^G$ and $e^G \leq e^B$). Thus, e^i measures the profitability but also the ecological footprint of the investment. While the structural difference $e^B - e^G \geq 0$ is a constant, given by the technology in the industry, intermediaries implicitly decide whether to fund dirty or green companies by choosing p^i. Since p^i is a choice variable and both e^i are given, the cost of capital for green companies can become different from non-green companies. The expected portfolio rate of return of both kinds of loan portfolios is

$$p^i \cdot e^i(2 - p^i) + (1 - p^i) \cdot 0. \tag{2}$$

The portfolio distributions follow the usual risk-return properties of asset markets: predictability goes hand in hand with profitability (values of e^i). Whenever an intermediary invests in high risks (i.e. chooses low p^i), he must be more interested in companies with high profitability but unpredictable outcome. Contrary, an intermediary who invests in low risks (i.e. chooses high p^i) must be interested in funding ESG-friendly companies. Note that this setup uses the concept of stochastic dominance. Similar to Stiglitz and Weiss (1981) the intermediaries create the expected portfolio rate of return by themself. Increasing the cost of capital for companies pushes the distribution functions of the loan portfolio rate of return to higher success realizations but also to more default realizations. There is no assumption that the expected portfolio rate of return of the two kinds of loan portfolios has to be different. Financial intermediaries are concerned about the rate of return they receive on their loan portfolio. By investing their funds financial intermediaries' decision influence the companies' cost of capital. The companies' cost of capital influences the riskiness, i.e. which rate of return is realized. Thus, the expected portfolio rate of return is endogenous.

Source of funds. Assume depositors are aware of another component beside the deposit rate, e.g. the ecological footprint. Then the depositors' decision-making corresponds to the one in similar setups like Shaked and Sutton (1982). In the following depositors' preferences are represented by the same utility function, but they are heterogenous in income, θ. Thus, they can be sorted in increasing order on an interval ranging from $\theta = \underline{\theta}$ to $\theta = \bar{\theta}$, that is $\underline{\theta} \leq \theta \leq \bar{\theta}$, each one can be indexed by its θ.

There is one depositor per unit distance of θ, and each depositors' decision solves $\max_i U\left(r_D^i/\theta - e^i\right)$. A depositor with income θ depositing at intermediary i obtains interest income r_D^i on his deposit but some are aware of the ecological footprint, i.e., they perceive disutility if the deposit is used for financing carbon-intensive industries (brown technologies). It will be seen that this leads to an asymmetric market structure where two kinds of financial intermediaries emerge: a brown intermediary who invests in dirty companies and a green one, where the green intermediary offers a lower deposit rate and is safer than the brown intermediary.

This captures the idea that some depositors are interested in socially responsible investing and avoid intermediaries who invest in brown but profitable companies. Let the ecological footprint caused by intermediary i be ordered in terms of increasing depositors' marginal utility of income. Then there are θ such that a depositor with this income level is indifferent. A depositor indifferent between intermediary G and the emission, interest-free and riskless storage of his deposit under the mattress, is located on this interval at:

$$0 = \frac{r_D^G}{\theta} - e^G, \qquad \Rightarrow \theta_G = \frac{r_D^G}{e^G}. \tag{3}$$

There is also an θ such that a depositor with income level θ_B is indifferent between depositing at intermediary B or G:

$$\frac{r_D^B}{\theta} - e^B = \frac{r_D^G}{\theta} - e^G, \qquad \Rightarrow \theta_B = \frac{r_D^B - r_D^G}{e^B - e^G}.$$

Comparing θ_G and θ_G shows a complementary relationship between the two indifferent depositors. For intermediary B to stay in the market, he must also increase r_D^B, its deposit rate, whenever intermediary G increases r_D^G. Intermediary G profits depend on $\underline{\theta}$, which can be interpreted as a participation constraint for the first depositor to engage in financial intermediation rather than direct investment. For the sake of tractability, this participation constraint is outside the model. Whenever it is too costly for depositors to search for green investment opportunities themselves, at least the green intermediary is active. Whenever search costs rise further, the green intermediary makes profits. But if there are profits, another intermediary will enter the market. Whenever there are two intermediaries demanding deposits, $d^i > 0$, and

investing them, $l^i > 0$, the indifferent depositors can be sorted, $\underline{\theta} \leq \theta_B \leq \theta_G \leq \bar{\theta}$.

The deposit supply functions for the brown intermediary B and the green intermediary G read:

$$d^B = \frac{\theta_B - \underline{\theta}}{\bar{\theta} - \underline{\theta}} = \frac{r_D^B - r_D^G - \underline{\theta}(e^B - e^G)}{(\bar{\theta} - \underline{\theta})(e^B - e^G)}, \tag{4}$$

$$d^G = \frac{\theta_G - \theta_B}{\bar{\theta} - \underline{\theta}} = \frac{r_D^G e^B - r_D^B e^G}{(\bar{\theta} - \underline{\theta})(e^B - e^G)}. \tag{5}$$

The deposit supply follow the usual properties of a participation constraint. There is a positive relationship between the interest rate paid on deposits and the number of depositors that are willing to hold their funds in those intermediaries. However, e^i, the ecological footprints, are relevant. When choosing its intermediary, a depositor trades off less socially responsible investing with a higher deposit rate. In contrast to location models, here the cross elasticity is asymmetric. Both intermediaries are not perfect substitutes for each other. There are spillovers from intermediary G to intermediary B and vice versa. E.g., if e^G increases, i.e. intermediary G invests more in green companies, deposit supply for intermediary B also increases.

Intermediation. For simplicity, both intermediaries are protected by limited liability – i.e. if their portfolio defaults, they only lose their own funds, the deposits are insured. The intermediaries maximize: $p^i \left[e^i(2 - p^i)l^i - r_D^i d^i\right] - r_K k^i$, where $p^i =$ *probability weight*, $r_D^i =$ *interest rate on deposits*, and $r_K^i =$ *rate of return of an alternative* are endogenous variables. Using the balance-sheet identity (1), and being aware that in a Modigliani-Miller world the opportunity costs of own funds should be the same as the expected rate of return of the risky portfolio (2), $r_K^i \stackrel{!}{=} p^i e^i (2 - p^i)$, profit of intermediary i can then be expressed as:

$$\pi^i = p^i \left[e^i(2 - p^i) - r_D^i\right] d^i,$$

since $l^i - k^i = d^i$. Written in this form, the maximization problem is less complex. The expression in brackets measures the intermediation margin in yield spreads, which is the expected spread between the success rate of return of the asset side $e^i(2 - p^i)$ and the cost rate of the liability side r_D^i. It is multiplied by the probability of success p^i and the scale of intermediation d^i.

In a perfectly competitive market, yield spreads would adjust in a way that the intermediation margin becomes zero. In this model setup there is imperfect competition for funding among intermediaries for two main features. First, some but not all depositors are willing to contribute to the transformation of the economy and society. They are willing to forego returns in exchange for improving the economic conditions for green companies. But there is no kommon knowledge about the

economic conditions, who is green and who is brown. Second, risk, return, and scale of green economic activities are endogenous. Its funding is made possible by a small number of large financial intermediaries through the interest rate they pay to attract funds, $d^i = d^i(r_D^i)$, as defined in the deposit supply functions (4) and (5).

3 Portfolio choices

Are financial intermediaries interested in funding green firms? Differentiating the profit functions with respect to p^i shows:

$$\frac{\partial \pi^i}{\partial p_i} = [e^i(2 - p^i) - r_D^i - p^i e^i]d^i,$$

and implies the first-order condition:

$$e^i(2 - p^i) - r_D^i = p^i e^i. \tag{6}$$

The portfolio choices of the intermediaries depend on the intermediation margin between the profitability of the investments (the borrower's future repayment) and the funds owed by the intermediaries (depositors). Solving the first-order condition for p^i, shows what risk-return profile the intermediaries will choose: $p^i = 1 - \frac{r_D^i}{2e^i}$. The lower the intermediation margin, the more the intermediaries are interested in funding companies with high profitability but unpredictable outcome – which are the brown ones. The region where a financial intermediary will never fund green companies is $r_D^i > 2e^i$ and he will never fund dirty companies whenever $r_D^i = 0$. But there is no point restricting attention to these extreme cases, the intermediaries will choose $0 < p^i < 1$, i.e. prefer a mixed portfolio including brown and green companies; otherwise either $p^i(r_L^i l^i - r_D^i d^i) - r_K^i k^i \geq 0$ is violated – the intermediary burns his own funds – or $r_D^i > 0$ is violated – all depositors will start to search for green investment opportunities themselves and there is no need for financial intermediation.

A financial intermediary will only be active, $d^i > 0$, if the returns from intermediation cover its opportunity costs. Consequently, whenever $r_D^i > r_K^i$, deposits are too costly. Since the alternative is a direct investment into the portfolio, $r_K^i \stackrel{!}{=} p^i e^i(2-p^i)$, the necessary and sufficient condition for financial intermediation is $r_D^i \leq r_K^i$ or

$$r_D^i \leq \frac{2}{1+\sqrt{2}} e^i,$$

which confirms $\frac{2}{1+\sqrt{2}} e^i < 2e^i$; instead of burning his own funds, an intermediary prefers not to become an intermediary, $d^i = 0$, in the first place. When certainty is absent, i.e. $p^i > 0$ is fulfilled, this also implies there must be opportunity costs,

$r_K^i > 0$. Whenever it is costly to supply own funds and there is no need for it, e.g. no capital requirements, intermediaries rely entirely on deposit funds, $k^i = 0$. Thus, one can restrict attention to balance sheet positions where own funds are not involved, $l^i = d^i$. This echoes the definition of a financial intermediary: middlemen between two market sides.

Thus, weather financial intermediaries are interested in funding green firms depends on how much profit they can make by financial intermediation. One has to look at the deposit rate the financial intermediaries will choose.

4 Deposit Market Competition

When choosing the deposit rate at the first stage of the game, intermediaries consider the effect of their deposit rate decisions on the portfolio choice, set at the second stage. By backward induction the profit of intermediary becomes $\pi^i = (p^i)^2 e^i d^i$. Setting the marginal profit equal to zero and solving for each choice variable, r_D^i, shows the reaction functions:

$$r_D^B = \frac{2}{3}\left(e^B + r_D^G + \underline{\theta}(e^B - e^G)\right), \qquad r_D^G = \frac{2}{3}\left(e^G + \frac{e^G}{e^B} r_D^B\right). \tag{7}$$

Intermediary i's best response on the deposit rate of its competitor depends on the characteristics of the loan portfolios, the combinations of e^B and e^G. Since $e^G/e^B < 1$, intermediary G is less aggressive than intermediary B. The deposit rates align if the ratio increases to 1 – e.g., if the brown portfolio loses profitability or the green portfolio gains profitability. The profitability of the green and the brown portfolio may differ. Thus, there might be a difference in deposit rates:

$$\Delta r_D \equiv r_D^B - r_D^G = \frac{2}{3}\left(r_D^G - \frac{e^G}{e^B} r_D^B + (1 + \underline{\theta})(e^B - e^G)\right).$$

Intermediation is not profitable under symmetric portfolios, $e^B - e^G = 0$. It is well known that price competition with homogenous products leads to a perfectly competitive market outcome. Whenever the asset market is homogenous, the difference in deposit rates vanishes. Both intermediaries compete to a deposit rate where there is no intermediation margin left. Then the deposit rate equals an intermediary's opportunity costs of direct investing in the risky portfolio, $r_D^i = \frac{2}{1+\sqrt{2}} e^i$. They will not earn a sufficient intermediation margin to cover opportunity costs.

Intermediation is profitable whenever the intermediaries specialize on different market segments. By carving out profitable niches they de-homogenize markets (Scholtens and van Wensveen, 2003). Here intermediaries specialize by their portfolio-choice and deposit-rate combinations. This segments the deposit market.

5 Greenwashing

No deposit market competition. To assess the relevance of deposit market competition for greenwashing consider the case without deposit market competition. Whenever there is just one intermediary, there could be an incentive for him to greenwash. Suppose that, for some reason, intermediary G increases r_D^G to the point where all potential depositors between $\underline{\theta}$ and θ_G deposit at intermediary G, i.e. $\theta_B \leq \underline{\theta}$ or $d^B = 0$. At first glance, it may seem that dirty companies will be defunded and a transition to a greener economy will occur, since intermediary B has no deposit supply and thus is not able to fund dirty companies. However, the crucial issue is that as intermediary G expands its scale, it may revise its role as a green intermediary and adjust its investment strategy. It may become optimal for intermediary G to increase p^G, i.e. invest in a portfolio with a higher risk-return profile, which includes more dirty firms, in order to maximize profits. As a result, more dirty companies may receive funding overall, while the financial conditions for green companies worsens. Whether or not this is going to happen depends on how financial intermediation works.

To see this, suppose the brown intermediary is not in the market, $\theta_B \leq \underline{\theta}$ i.e. $d^B = 0$. The problem of a monopolistic intermediary who might offer his service to both green and brown depositors:

$$\begin{aligned} \max_{r_D^M} \quad & \pi^M := p^M \left[e^M(2 - p^M) - r_D^M \right] \frac{\theta_M - \underline{\theta}}{\bar{\theta} - \underline{\theta}}, \\ s.t. \quad & e^M(2 - p^M) - r_D^M = p^M e^M, \end{aligned} \tag{IC}$$

where $\theta_M = r_D^M / e^M$ is – analogous to expression (3) – the marginal depositor who is indifferent between the monopolistic intermediary and the emission, interest-free and riskless storage of his deposit under the mattress.

The monopolistic intermediary maximizes his profit subject to an incentive constraint (IC). The incentive constraint accounts for the portfolio choice and is similar to (6). The intermediary will offer a deposit rate of $r_D^M = (1 + \underline{\theta})e^M 2/3$ and is supplied with $(2 - \underline{\theta})/3$ of the deposit market of size $\bar{\theta} - \underline{\theta}$. He invests the funds into a portfolio which yields $(4 + \underline{\theta})e^M/3$ and defaults at least one out of three times, $p^M = (2 - \underline{\theta})/3$. The expected intermediation margin is $(2 - \underline{\theta})/3[(4 + \underline{\theta})e^M/3 - (1 + \underline{\theta})e^M 2/3] = (2 - \underline{\theta})^2 e^M/9$ per every depositor he has attracted. Although the intermediary could attract more depositors, it is not optimal to further increase the deposit rate, since the intermediation margin will also decrease.

Also, it is not optimal for the intermediary to increase his intermediation margin by specializing more on green depositors. Committing to fund more green companies

– that is a greener portfolio with a lower risk-return profile – is not credible since the portfolio is chosen after the depositors made their deposit decision.

Deposit market competition. Solving (7) for r_D^i yields the equilibrium deposit rates:

$$r_D^{B*} = \frac{2e^B}{9e^B - 4e^G}\left(3e^B + 2e^G + 3\underline{\theta}(e^B - e^G)\right),$$
$$r_D^{G*} = \frac{2e^B}{9e^B - 4e^G}\left(5e^G + 2\underline{\theta}(e^B - e^G)\frac{e^G}{e^B}\right).$$

To ensure that r_D^i and d^i are non-negative, this equilibrium can only exist whenever $0 < \underline{\theta} < 2$ and $e^G \leq 2/3e^B$.[1] Which confirms $r_D^{B*} - r_D^{G*} \geq 0$, since $e^B - e^G \geq 0$. The difference in deposit rates in this equilibrium is positive and can be expressed as: $\frac{2e^B}{9e^B - 4e^G}\left(3 + \underline{\theta}\left(3 - 2\frac{e^G}{e^B}\right)\right)$. In this equilibrium, the intermediaries choose:

$$p^{B*} = \frac{3\Delta e}{9e^B - 4e^G}(2 - \underline{\theta}), \qquad p^{G*} = \frac{3\Delta e}{9e^B - 4e^G}\left(3 - \underline{\theta}\frac{2}{3}\frac{e^G}{e^B}\right),$$

where $\Delta e \equiv e^B - e^G$. Thus, the green intermediary has a stronger inclination towards funding green firms, while the brown intermediary prefers risky and profitable companies, $0 < p^B \leq p^G < 1$. However, as the level of heterogeneity in the asset market decreases, both intermediaries become less interested in funding green companies. In fact, as Δe decreases, both intermediaries will fund more dirty companies. Conversely, in the limit where $\Delta e \to \infty$, the green intermediary will specialize in funding green companies and choose safer but less profitable options. This would result in the safest portfolio $p^G = 1$. On the other hand, the brown intermediary's behavior in this limit depends on $\underline{\theta}$, and is such that $\lim_{\Delta e \to \infty} p^{B*} = (2 - \underline{\theta})/3$, which is the same a monopolistic intermediary would choose.

When two intermediaries compete for green investors, some may conclude that there's no incentive for greenwashing. After all, it seems that it would never be optimal for intermediary B to fund green companies when intermediary G is also present. Intermediary B can only offer a higher r_D^B if it has a high risk-return profile, which would only be possible if it actually invested in profitable, and therefore brown, companies. There's no point in funding riskier but less profitable companies and offering a high r_D^B at the same time. Depositors can thus consistently infer that the intermediary offering higher deposit rates must be the brown one, while the one offering lower deposit rates must be the green one.

However, how can financial intermediaries demonstrate their commitment to a green economy and attract green depositors? The problem is that without a

[1] For example, this condition is satisfied when $\underline{\theta} = 1/3$, $e^B = 2$, and $e^G = 1$.

competitor, an intermediary can't make credible commitments to invest in green companies. This creates an incentive to greenwash, pretending to be interested in ESG when the main goal is actually a low deposit rate. There are three cases to consider. In the first, intermediation is greener without a competitor. Both intermediary G and B fund more dirty companies than a monopolistic intermediary, $p^B \leq p^G \leq p^M$. In the second case, a monopolistic intermediary would fund more green companies than a brown but not a green intermediary, $p^B \leq p^M \leq p^G$. In the third case, competition would lead to greener investments, $p^M \leq p^B \leq p^G$.

To determine the level of greenwashing, it's necessary to consider how green an intermediary is without a brown intermediary. Only the first scenario suggests that greenwashing increases due to competition for green investors. Compared to a monopolistic intermediary, the green intermediary finances more dirty companies. However, competition in the second and third cases reduces greenwashing, and at least one intermediary becomes greener as a result of competition for green investors.

In the absence of intermediary B, the monopolistic intermediary would choose a portfolio $p^M \in [(2-\underline{\theta})/3, 1]$. When the market is homogenous and the difference Δe is small, the first case applies, and more competition for green investors leads to worse financial conditions for green companies because the monopolistic intermediary would have funded more green companies than a green intermediary subject to competition. When the difference is large, the second case applies, and the opposite is true: competition for green investors improves the financial conditions for green companies. The third case never occurs.

For intermediate differences in Δe, it depends on whether $\underline{\theta}$ is above or below a certain threshold. For low values of $\underline{\theta}$, the first case applies, while for high values, the second case applies. Therefore, to answer the question of whether competition for green investors leads to less greenwashing, the answer is that it only does so when Δe is high. The more heterogeneity there is in the asset market, the less greenwashing there will be. However, when there isn't enough heterogeneity in the market, more greenwashing can be expected.

Figure 1 summarizes. The heterogeneity in the asset market explains wether one can expect greenwashing. While both intermediaries are more interested in funding green firms the more heterogeneity in the asset market is, the green asset ratio of a monopolistic intermediary remains constant. The more differences there are between green and dirty companies, the less likely it is that the intermediaries are greenwashing. The green intermediary specializes on funding green firms while the brown intermediary approaches the green asset ratio a monopolistic intermediary would choose. However, if this structural difference with respect to observable factors such as the ecological footprint or the technology in the industry vanishes, the more greenwashing is to be expected.

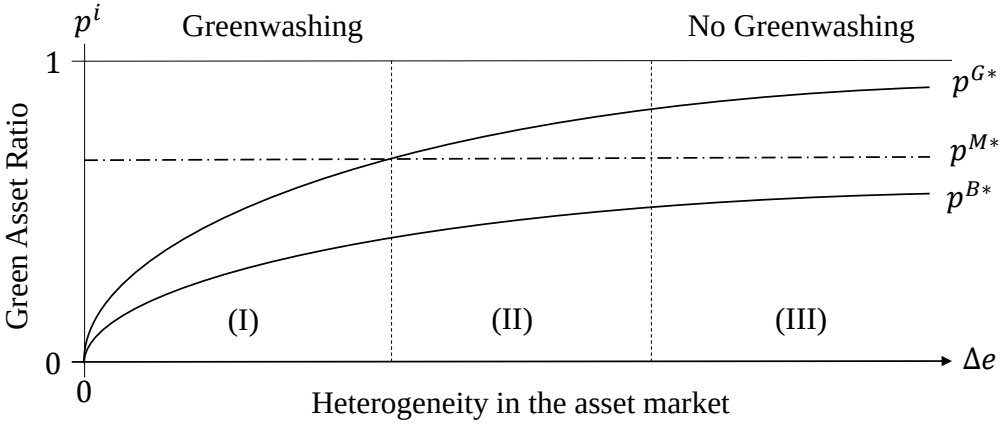

Figure 1: The Level of greenwashing in financial markets.

There are three regions. They distinguish the severity of greenwashing in financial markets and are determined by how the p^i, which may also be interpreted as the green asset ratio (GAR), of the two intermediaries performs in comparison to a monopolistic intermediary. In region (I) the green asset ratio of both intermediaries is lower than a monopolisitc intermediary would choose. This corresponds to, $p^B \leq p^G \leq p^M$, the first case. Greenwashing then is a result of competition for green investors. The green intermediary performs worse than a monopolisitc intermediary. For $p^B \leq p^M \leq p^G$, there are two regions. In region (II) the green asset ratio of the green intermediary outperforms the monopolisitc intermediary. But compared to a monopolistic intermediary, both intermediaries still finance more dirty companies than green ones. In this region competition for green investors also does not improve the financial conditions for green companies. In region (III) greenwashing does not occur. Only in this region, i.e. if the heterogeneity in the asset market is high enough, competition would improve the financial conditions for green companies. The regions are of practical relevance. Region (I) and (II) are situations in which more competition for green investors might lead to worsening the financial conditions for green companies.

The findings suggest that the combination between competition for funds and the level of heterogeneity in the asset market is a cause for greenwashing commited by financial intermediaries. Although both intermediaries have an interest in funding some green companies, the green asset ratio of a monopolistic intermediary is under certain circumstances higher.

6 Conclusion

Greenwashing is not only a problem in the context of ESG disclosure. The model setup presented in this paper assumes that neither the funder nor the financial

intermediary knows the true environmental impact of the companies they invest in exactly. The main assumption was that there is a structural difference: investing in a brown portfolio full of dirty companies or a green one, where the green portfolio inheres a different risk-return profile than the brown portfolio. By choosing the portfolio intermediaries implicitly decide whether to fund dirty or green companies and thus having an impact in the transition to a green economy. This approach allows for remaining agnostic about whether brown or green assets have a higher average return.

The purpose of this paper is to investigate the role of financial intermediation in the transition to a green economy. Financial intermediaries such as banks und investment funds are not unconstrained in this regard. Although they influence the expected portfolio rate of return by supplying funds, they can only supply funds if they themselves have been provided with funds, which come from depositors. Financial intermediaries attract new funds by increasing their deposit rate. The puzzle is, how financial intermediaries ensure they remain credible in claiming to be interested in the transition to a green economy. The model has several policy implications and raises concerns about the true impact of green banking.

Firstly, financial intermediation does not always result in greenwashing. The more distinct the differences between green and dirty companies, the less likely intermediaries are to engage in greenwashing. Greenwashing only occurs when competition is fierce and there are not enough green investment opportunities. In such cases, more dirty companies are financed, resulting in a worse situation than that of a monopolistic intermediary.

Secondly, green assets do not necessarily have to have low expected returns because there are investors willing to finance them and accept lower returns. Often, funds are mediated by banks or investment funds. These financial intermediaries maximize profits, and in doing so, they attract investors who enjoy funding green companies. For credibly attracting them, financial intermediaries need a brown intermediary who invests in brown and risky companies and offers a high return to everyone who provides funds. Thus the amount of greenwashing committed by intermediaries depends on a reference point. It cannot be an equilibrium if every financial intermediary specializes in being green. What makes the present mechanism interesting is the idea that the existence of a brown intermediary could, under certain circumstances, prevent greenwashing and improve the transition to a green economy.

Thirdly, policymakers need to ensure that there is a sufficient degree of transparency in observable factors, such as the ecological footprint and technology in the industry, to prevent the likelihood of greenwashing. However, in situations where the green asset ratio of both intermediaries is lower than that of a monopolistic intermediary, policymakers need to be cautious about promoting competition for

green investors, as it may lead to worsened financial conditions for green firms.

Moreover, in the transition to a green economy policymakers should aim to promote heterogeneity in the asset market and encourage financial intermediaries to specialize in financing green companies. However, as the model has shown, if the asset market lacks heterogeneity or a sufficient level of transparency is too costly, policymakers can improve the financial conditions for green firms through regulation. Regulation can decrease competition, resulting in higher capital costs for dirty companies and reduced profitability of brown assets for financial intermediaries in comparison to green assets.

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