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Vilen Lipatov

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Abstract

In framework of Rochet and Tirole (2011), I allow for partial merchant internalization and study how MIT threshold is related to levels of inter-change fee that maximize various components of social welfare. I find that cost absorption on the side of issuers and merchant heterogeneity each bias MIT threshold upward from TUS maximizing level.

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Vilen Lipatov
Compass Lexecon Brussels / Belgium
vilenl@gmail.com

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1 Introduction

In antitrust cases as well as in regulation, the Merchant Indifference Test (MIT), based on the idea of merchants' avoided costs, is figuring prominently. For example, MasterCard, after an antitrust case run by the European Commission (EC), adopted a methodology that takes into account the MIT logic. Börestam and Schmiedel (2013) state that MIT-based method of setting interchange fee (IF) seems currently a preferred approach in determining an efficient level of IF. The European Commission has prepared a proposal (European Commission 2013) that is based on a methodology of computing the intra-EEA interchange fee (IF) based on this idea (European Commission 2014).

In economic literature, the concept was carefully analyzed by Rochet and Tirole (2002, 2011), Rochet and Wright (2010), Wang (2010), among others. It is often desirable, for an antitrust authority or a regulatory body, to have a feeling of how MIT threshold level may be related to the IF level that maximizes welfare and its various components.

Rochet and Tirole (2011) provide a useful benchmark in this regard. In particular, the authors focus on the case whereby merchants internalize the benefit to buyers completely (which means that they accept card whenever the joint benefit to them and to consumers exceeds the cost to merchants), whereas buyers do not care about the benefit to merchant (so they choose the card only when their own benefit exceeds their cost).

Under merchant internalization and perfect pass through (an increase in costs of insurers and acquirers is transferred one-to-one into an increase in the price of card payment for buyers and sellers, correspondingly), the same interchange fee (IF) maximizes consumer surplus (CS) and profit of merchants (and hence also the total user surplus TUS). It turns out that this level of IF is exactly the one that makes merchants indifferent between accepting cash and accepting card. At MIT threshold level, the price of payment cards for consumers internalizes the usage externality, reflecting the costs and benefits that merchants face, not only the cost of issuing banks. The incentives of consumers and merchants are then perfectly aligned and the TUS is maximized.

Wright (2012) revisits this framework to establish a robust result that, under full internalization, the IF level set by a card platform always exceeds both TUS- and welfare-maximizing levels. This is because the platform, roughly speaking, counts the surplus of card users twice (directly and via merchant internalization), therefore biasing the fee structure against merchants. My results are consistent with the findings of Wright (2012) and complement them: He does not discuss the welfare implications of setting IF at MIT threshold which is the focus of my paper.

My main result is that partial internalization shifts TUS-maximizing level of IF down from the MIT threshold as long as merchants are characterized by cost absorption and imperfect pass on. This result is robus to a number of modifications to the benchmark setting, such as imperfect pass on of issuers, acquirers and merchant heterogeneity.

2 Benchmark setup

Following Rochet and Tirole (2011), I assume a continuum of consumers with total mass normalized to one. Each has inelastic demand for the card good that brings her net utility $u - p$ The retailers are not modelled explicitly, but the unit cost of the card good is γ. Transactions by card are additionally subject to fees: $p_B = c_B - a + m$ from the buyer to her issuer and $p_S = c_S$ from the merchant to her acquirer. Correspondingly, c_B and c_S stand for issuer's and acquirer's (constant) marginal cost. The interchange fee is denoted by a and various levels of it marked with superscripts are summarized in Appendix A. The issuers' margin is denoted by m; the acquirers are perfectly competitive. The consumer's convenience cost of paying by cash is a random variable $\mathbf{b}_B$ with a cumulative distribution H that satisfies standard regularity conditions to generate well-behaved continuously differentiable functions throughout. The convenience cost of paying by card is normalized to zero. The demand for card payment corresponding to this distribution is then $D_B(p_B) = 1 - H(p_B)$.

Unlike Rochet and Tirole (2011), I do not model individual acceptance decision of the merchants explicitly, but assume that in imperfectly competitive symmetric equilibrium all the merchants take cards as long as their profit is positive. The reason for that may be the classic "business stealing" effect, whereby each merchant is afraid to lose customers to competitors if not accepting cards. In particular, the industry of retailers is characterized by imperfect competition with a profit margin $n : \mathbb{R}_+ \to \mathbb{R}$ implicitly defined by

$$\begin{aligned} n(p(\Gamma)) \quad &= \quad p(\Gamma) - \Gamma, \\ \Gamma \quad &: \quad = \gamma + p_S D_B(p_B) + b_S (1 - D_B(p_B)) . \end{aligned}$$

Γ is thus generalized marginal cost to merchant. The merchant's convenience cost of paying by cash is b_S.

In the benchmark setting, I make the following assumptions:

Assumption 1. Merchant internalization is partial and there is cost absorption in the retail industry (n is strictly decreasing).

Assumption 2. Merchants are homogenous (b_S does not vary across merchants).

Assumption 3. There is a perfect pass through in banking ($dp_B/da = -dp_S/da = -1$).

Assumption 4. n' exists and is strictly increasing, $n'\left(p\left(a^{CS}\right)\right) < k(0)$ (k is defined in Appendix B).

The first assumption is crucial[1], as with full internalization we are back in the setting of Rochet and Tirole (2011) with all their results applying, in

[1] Cost absorption seems to be more plausible in the context of retail competition, but clearly the analysis could also be made for the case of cost amplification (n is strictly increasing) on the side of merchants. This would reverse the finding that $a^T < a^{CS}$.

particular that tourist test threshold maximizes both CS and RP, and thus also TUS, $a^{RP} = a^{TUS} = a^{T} = a^{CS}$. The second and third assumptions are self-explanatory; the third assumption is technical - it assures that the margin n does not go to zero too quickly with an increase in merchant discount.

Proposition 1 *Under assumptions 1-4, the ranking of interchange fee levels is as follows:*

$$a^{RP} < a^{TUS} = a^{T} < a^{CS} < a^{m}.$$

Proof. *The proof is left to Appendix B.* ■

Regarding the equality in the ranking above, note that the TUS can be expressed by the same formula as in Rochet and Tirole (2011). Correspondingly, it has the same maximizer. This is not surprising, because price is just a transfer and with inelastic demand its change does not create any deadweight loss. However, this level of IF will not maximize both CS and RP any more. Retailers, because they cannot pass on an increase in IF to consumers fully, will face higher costs.as a result of such an increase. Because of cost absorption, this cost increase will bring lower profit, making the retailers prefer a lower IF. Consumers, to the opposite, will prefer higher IF, because the decrease in card fees is not fully offset by the corresponding increase in the price of the good (cost absorption results in imperfect pass-on).

The cards system that maximizes bank profits puts as high interchange fee as possible that is still compatible with merchant acceptance: the "choke-off" level of maximal interchange fee is implicitly defined by zero-profit condition for the retailers. If the profit margin does not decrease too fast, as assured by Assumption 4, the level of IF that maximize bank profits is sufficiently high to exceed the one at which the CS is maximized.

3 Modifications

In this section, I relax some of the assumptions made in the benchmark setting and amend the ranking of IF levels accordingly. I first look at imperfect pass-on in banking and then discuss the case of heterogeneous merchants.

3.1 Variable issuer margin

Consider relaxing Assumption 3 to accommodate the case when the issuers' margin is variable. Formally, introduce the following assumptions:

Assumption 3A. There is a perfect pass through on the acquirers' side and cost absorption on the issuers' side $(m'(p_B) < 1, dp_S/da = 1)$.

We also need to modify the technical Assumption 4 to insure that the function n does not go to zero too fast in the modified setting:

Assumption 4A. n' exists and is strictly increasing, $n'\left(p\left(\max\left\{a^{CS}, a^{T}\right\}\right)\right) < k(0)$ (k is defined in Appendix B).

This brings us to the following proposition:

Proposition 2 *Under assumptions 1,2,3A and 4A, the ranking of interchange fee levels is as follows:*

$$\begin{array}{ll} a^{RP} < a^{TUS} < a^{T} < a^{CS} < a^{m}, & \frac{1}{1-m'} > \frac{D_B(p_B)}{1-n'}; \\ a^{RP} < a^{TUS} < a^{CS} < a^{T} < a^{m}, & \frac{1}{1-m'} < \frac{D_B(p_B)}{1-n'}. \end{array}$$

Proof. *The proof is left to Appendix C.* ■

Imperfect pass-on on the issuers' side shifts the TUS maximizing IF level down from MIT threshold, because lower IF leaves less profit for banks and thus more surplus for users. By the same token, higher IF leaves less profit for retailers and more surplus to consumers. Depending on the relative strength of pass-on, the CS maximizing level is either above MIT threshold (if the decrease in merchants' profit from higher IF is more than sufficient to compensate the decrease in TUS), or below it (if the increase in merchants' profit is more than compensated by the increase in TUS). In particular, the latter case results with full merchant internalization and imperfect pass-on on the issuers' side.

3.2 Heterogeneous merchants

In this subsection, I assume that merchants differ in their convenience costs of handling cash relative to card. Accordingly, I modify Assumption 2 to have

Assumption 2A. Merchants are heterogeneous ($\mathbf{b}_S$ is distributed according to cdf G).

Analogously to Rochet and Tirole (2011), I implicitly define MIT threshold level of IF as satisfying

$$p_S = \frac{\int_{b_S^0}^{+\infty} y dG(y)}{1 - G(b_S^0)}, \tag{1}$$

where b_S^0 stands for the convenience benefit of the merchant who is indifferent between accepting and rejecting cards. At MIT threshold, the merchant discount must be equal to the average convenience benefit of all the merchants who accept the card.

All the retailers with $b_S > b_S^0$ will accept the cards, whereas all other retailers will reject them. Thus, the measure of $D_S(b_S^0) = 1 - G(b_S^0)$ of retailers will be accepting the cards. The threshold level is determined by zero-profit condition

$$p_S D_B(p_B) + b_S^0 (1 - D_B(p_B)) = p(\delta) - \gamma, \tag{2}$$

where $\delta := \gamma + p_S D_B(p_B)$ and for consistency all the cash-only retailers get zero profit.[2]

[2] Clearly, zero level of profit is just a normalization without loss of generality. Suppose, cash-only merchants are characterized by some positive profit level A. Then we redefine the indifferent between cash and card merchant as $p_S D_B(p_B) + b_S^0 (1 - D_B(p_B)) = p(\delta) + A - \gamma$, and the rest of the analysis goes through with appropriate modifications.

Note that the definition of function n needs to be altered in order to accommodate merchant heterogeneity. In particular, the markup varies across firms as b_S varies: $n(p, b_S) = p(\delta) - \delta - b_S(1 - D_B(p_B))$. Further, I put the following technical condition on function $p(\delta)$ that formalizes the idea that, with less than full internalization, the merchant requires higher convenience benefit in order to accept the card:

Assumption 5. $p(\delta) - \gamma > p_S + \left(p_B - \frac{\int_{p_B}^{+\infty} x dH(x)}{D_B(p_B)}\right)(1 - D_B(p_B))$.

Intuitively, this condition ensures that the retailer surplus from sale by card $p - \gamma - p_S$ is higher than the utility cost of cash transactions.

In this setting, I can formulate the following proposition:

Proposition 3 *Under assumptions 1,2A, 3 (or 3A), 5, and sufficiently weak pass-on in the retail industry, the following inequality holds*

$$a^{TUS} < a^T.$$

Proof. *TUS can be written, up to a constant, as*

$$\int_{b_S^0}^{+\infty} \int_{p_B}^{+\infty} (x + y - c - m)\, dH(x) dG(y),$$

where $c = c_B + c_S$ is the total marginal cost of card transaction. In Appendix D, I show that the FOC to TUS maximization problem can be written as

$$\begin{aligned} & h(p_B)\frac{dp_B}{da}\left(-\int_{b_S^0}^{+\infty} ydG(y) + (c + m - p_B)\, D_S(b_S^0)\right) \\ & + g(b_S^0)\frac{db_S^0}{da}\left(-\int_{p_B}^{+\infty} xdH(x) + \left(c + m - b_S^0\right) D_B(p_B)\right) \\ & \qquad - m' D_S(b_S^0) D_B(p_B)\frac{dp_B}{da} = 0. \end{aligned} \tag{3}$$

At $a = a^T$, the first line is equal to zero, because of (1) and the fact that $p_S + p_B = c + m$ (the latter is simply writing down the banks' profits per transaction). The last term is either zero (under Assumption 3) because of perfect pass-through or negative (under Assumption 3A) because of cost absorption ($m' < 0$, $\frac{dp_B}{da} < 0$).

The second line would be equal to zero at $a = a^T$ if instead of b_S^0 we used another cut-off level, $\hat{b}_S$, defined as

$$\hat{b}_S = p_S + p_B - \frac{\int_{p_B}^{+\infty} xdH(x)}{D_B(p_B)}. \tag{4}$$

Looking at $\hat{b}_S$, we can see that this is the cut-off level of convenience benefit in a situation characterized by full merchant internalization. In this paper, I *consider less than full internalization, that is why it must be that $b_S^0 > \hat{b}_S$, which is ensured by Assumption 5. Under this assumption, the term in brackets in the second line of the FOC is negative at $a = a^T$ (formally, $-\int_{p_B}^{+\infty} xdH(x) + (c + m - b_S)\, D_B(p_B)$ is decreasing as a function of b_S).*

In appendix D, I show formally that the derivative $\frac{db_S^0}{da}$ is positive if the pass on is sufficiently weak. Intuitively, this is because with sufficient cost absorption RP is decreasing in IF and once profit is decreased, only merchants with relatively high levels of b_S will be able to afford accepting cards, so the threshold b_S^0 will go up. Thus, the whole second line of the FOC is negative at $a = a^T$. Together with nonpositivity of the last line and zero of the first line, this proves the statement of the proposition. ■

As we can see, merchant heterogeneity introduces yet another upward bias to the MIT threshold away from TUS maximizing level in the situation with imperfect pass on and partial merchant internalization. This is because while, at MIT level, merchant discount is equal to average convenience benefit of all the merchants accepting cards, at TUS maximizing level, the sum of merchant discount and card fee are equal to the sum of the convenience benefit of the indifferent merchant and the average convenience benefit of the consumers. Since average convenience benefit of accepting merchants is higher than that of the indifferent merchant, MIT level is biased upwards from TUS level.

4 Conclusion

I have formally shown that partial internalization introduces a wedge between levels of IF that maximize CS or RP, on one side, and MIT threshold level, on the other side. Cost absorption in the issuers' industry and merchant heterogeneity are two sources of downward bias in MIT threshold relative to TUS-maximizing level. The results indicate that the recent efforts by, e.g. European Commission, to cap IF at the MIT threshold level are justified on efficiency grounds and may be conservative.

The approach can be extended to analyse welfare maximizing level of IF and cost amplification in banking industry.

5 Appendix A

We adopt the following notation regarding the interchange fee levels:

a^T	tourist test threshold
a^{TUS}	TUS maximizing level
a^{RP}	RP maximizing level
a^{CS}	CS maximizing level
a^m	bank profit maximizing level

6 Appendix B

The consumer surplus is

$$CS = u - p - p_B D_B(p_B) - \int_{-\infty}^{p_B} x dH(x), \tag{5}$$

where u is the consumer utility and p is the price of the card good. A retailer's profit is

$$RP = n(p(\Gamma)) = p - \Gamma, \tag{6}$$

and the banks' profits are

$$\pi_B = m(p_B) D_B(p_B).$$

TUS is then

$$\begin{aligned} TUS &= CS + RP = u - p_B D_B(p_B) - \int_{-\infty}^{p_B} dx H(x) - \Gamma \\ &= u - p_B D_B(p_B) - \int_{-\infty}^{p_B} x dH(x) - \gamma - p_S D_B(p_B) - b_S (1 - D_B(p_B)). \end{aligned}$$

After getting rid of the constant $u - \gamma - b_S$, we get

$$(b_S - p_B - p_S) D_B(p_B) - \int_{-\infty}^{p_B} x dH(x), \tag{7}$$

the same formula as in Rochet and Tirole (2011). Consider the first derivative with respect to interchange fee (and use Assumption 2):

$$(p_B + p_S - b_S) D_B'(p_B) + p_B h(p_B).$$

Since $h(p_B) = -D_B'(p_B)$ by definition, the first order condition can be written as

$$p_S = b_S,$$

which is equivalent to putting IF at MIT threshold. This proves that $a^{TUS} = a^T$

For the retailers, the first derivative of (6) is

$$n'(\Gamma) \left[D_B(p_B) - (p_S - b_S) D_B'(p_B) \right].$$

At the MIT threshold ($p_S = b_S$), this becomes $n'(\Gamma) D_B(p_B)$, which is unambiguously negative because of cost absorption, $n'(\Gamma)$. Since the first derivative is decreasing by the second order condition, the RP maximizer is to the left of MIT threshold. This proves that $a^{RP} < a^T$.

For the consumers, the first derivative of (5) is

$$-\frac{dp}{da} + D_B(p_B) + p_B D_B'(p_B) + h(p_B). \tag{8}$$

Note that in the present formulation $dp/da < 1$, whereas with full internalization $dp/da = 1$. A partial internalization thus represents an upward shift in the first derivative of CS as compared to the full internalization. The resulting CS maximizer is therefore above the MIT threshold. This proves that $a^T < a^{CS}$.

The card system that maximizes bank profits puts as high interchange fee as possible that is still compatible with merchant acceptance: the "choke-off" level of maximal interchange fee is implicitly defined by

$$\bar{p}_S D_B(p_B) + b_S (1 - D_B(p_B)) = p(\Gamma(\bar{p}_S)) - \gamma.$$

The exact level will crucially depend on the properties of function n and, in particular, on its zero point, $n(p) = 0$. The condition $a^{CS} < a^m$ is equivalent to $n\left(p(a^{CS})\right) > 0$, because $n(p)$ is decreasing and

$$\frac{dp}{da} = \frac{1}{1-n'}\left(D_B(p_B) + (b_S - p_S)\, D'_B(p_B)\right) < 0 \tag{9}$$

at $a = a^{CS}$, because $b_S < p_S$ at $a > a^T$.

Define a mapping $k : n \to n'$. Since n is decreasing, if n' is increasing, this mapping is a decreasing function, so $n\left(p(a^{CS})\right) > 0$ is equivalent to $n'\left(p(a^{CS})\right) < k(0)$, which is guaranteed by Assumption 4. This proves that $a^{CS} < a^m$.

An alternative equivalent condition can be derived from (8) using (9) and written as

$$n' < \frac{p_B - 1 + p_S - b_S}{\frac{D_B(p_B)}{D'_B(p_B)} + p_B - 1},$$

evaluated at $a = a^{CS}$.

7 Appendix C

When the issuers' margin is decreasing, the derivative of TUS with respect to IF,.equal to the derivative of (7), is

$$\left(-D_B(p_B) + (b_S - p_B - p_S)\, D'_B(p_B) - p_B h(p_B)\right) \frac{dp_B}{da} - D_B(p_B)\frac{dp_S}{da}. \tag{10}$$

Since $p_B = c_B + m - a$, $dp_B/da = \partial p_B/\partial m * m' * dp_B/da + \partial p_B/\partial a = m' dp_B/da - 1$. Thus, $(1 - m')\, dp_B/da = -1$ or $dp_B/da = -1/(1 - m')$. Hence, also taking into account the definition of h, we can write (10) as

$$\left(-D_B(p_B) + (b_S - p_S)\, D'_B(p_B)\right) \frac{1}{1-m'} - D_B(p_B).$$

At $a = a^T$, this becomes

$$-D_B(p_B)\left(\frac{1}{1-m'} + 1\right),$$

which is negative by the cost absorption on issuers' side, $m' < 0$. Becasue the first derivative of TUS is decreasing, this proves that $a^{TUS} < a^T$.

The reasoning from the previous section applies when analysing the IF levels that maximize CS and RP. Thus, with cost absorption on the issuers' side it is still true that $a^{RP} < a^{TUS} < a^{CS}$. This establishes that $a^{RP} < a^T$.

To see how a^T compares to a^{CS}, consider the derivative of CS with respect to IF:

$$-\frac{dp}{da} - \left(D_B(p_B) + p_B D_B'(p_B) + h\left(p_B\right)\right)\frac{dp_B}{da}.$$

At $a = a^T$, $d\Gamma/da = D_B(p_B)$, so $dp/da = d\Gamma/da + n'dp/da$ and $dp/da = \frac{d\Gamma/da}{1-n'} = \frac{D_B(p_B)}{1-n'}$. That is, we have, at this level,

$$-\frac{D_B(p_B)}{1-n'} + \left(D_B(p_B) + p_B D_B'(p_B) + h\left(p_B\right)\right)\frac{1}{1-m'}.$$

We know that at $a = a^T$, $dp/da = 1$ (this follows from evaluating (8) in the full internalization case) and thus

$$D_B(p_B) + p_B D_B'(p_B) + h\left(p_B\right) = 1,$$

so the derivative above is equal to

$$\frac{1}{1-m'} - \frac{D_B(p_B)}{1-n'}.$$

Clearly this is positive whenever $\frac{1}{1-m'} > \frac{D_B(p_B)}{1-n'}$ and negative otherwise (we neglect the knife-edge case of equality here). Together with the fact that the first derivative of CS is decreasing in IF, this proves the statement that

$$\begin{array}{ll} a^T < a^{CS}, & \frac{1}{1-m'} > \frac{D_B(p_B)}{1-n'}; \\ a^{CS} < a^T, & \frac{1}{1-m'} < \frac{D_B(p_B)}{1-n'}. \end{array}$$

Finally, the bank profits under cost absorption are monotonically increasing in a (both m and demand for card services are increasing), so the level of IF chosen by the card system is the same as in the previous section. The same logic applies to show that, under Assumption 4A, $\max\left\{a^{CS}, a^T\right\} < a^m$.

8 Appendix D

8.1 FOC

Rewrite TUS solving integrals whenever possible to get

$$Merchantheter\left(1-G(b_S^0)\right)\int_{p_B}^{+\infty} x dH(x) + \left(1-H(p_B)\right)\int_{b_S^0}^{+\infty} y dG(y) - (\gamma+m)\left(1-G(b_S^0)\right)\left(1-H(p_B)\right).$$

Now, take the derivative with respect to a keeping in mind that b_S^0 and p_B depend on a, to get (3).

8.2 Assumption 5

Here we show that Assumption 5 implies $b_S^0 > \hat{b}_S$.

Note that (2) can be rewritten as

$$b_S^0 = \frac{p(\delta) - \gamma - p_S D_B(p_B)}{1 - D_B(p_B)}.$$

Because the right-hand side is decreasing in b_S, b_S^0 is uniquely determined. Using (4), $b_S^0 > \hat{b}_S$ can be written as

$$\frac{p(\delta) - \gamma - p_S D_B(p_B)}{1 - D_B(p_B)} > p_B + p_S - \frac{\int_{p_B}^{+\infty} x dH(x)}{D(p_B)}.$$

Rearranging, we have

$$p - \gamma > p_S + \left(p_B - \frac{\int_{p_B}^{+\infty} x dH(x)}{D(p_B)} \right) (1 - D_B(p_B)),$$

the condition assumed.

Clearly, for consistency we also need that $b_S^0 < p_S$, otherwise we are in uninteresting situation where merchants would choose to accept cards even without any internalization. the condition can be written as

$$p - \gamma < p_S.$$

Because $p_B < \frac{\int_{p_B}^{+\infty} x dH(x)}{D(p_B)}$ by construction, the condition of Assumption 5 describes a non-empty set.

8.3 $\frac{db_S^0}{da}$

To support the claim about the derivative $\frac{db_S^0}{da}$, consider a merchant with convenience benefit b_S. Its profit is

$$p(\delta) - \gamma - p_S D_B(p_B) - b_S (1 - D_B(p_B)) = 0,$$

Perform a standard comparative statics exercise with respect to a and b_S:

$$\frac{db_S}{da} = \frac{1}{(1 - D_B(p_B))} \left[(p'(\delta) - 1) \left(D_B(p_B) + p_S D'_B(p_B) \frac{dp_B}{da} \right) + b_S D'_B(p_B) \frac{dp_B}{da} \right]$$

This is negative whenever

$$(p'(\delta) - 1) \left(\frac{D_B(p_B)}{D'_B(p_B) \frac{dp_B}{da}} + p_S \right) + b_S < 0,$$

i.e. if $p(\delta)$ is sufficiently flat (exhibits sufficient cost absorption) at MIT level. This proves that, for sufficiently weak pass on, $\frac{db_S^0}{da} < 0$.

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