

Wahl, Jack E.

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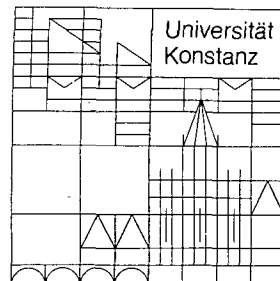
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Sonderforschungsbereich 178
„Internationalisierung der Wirtschaft“

Diskussionsbeiträge



Juristische
Fakultät

Fakultät für Wirtschafts-
wissenschaften und Statistik

Jack Wahl

**Informational Segmentation
in International Capital Markets**

W 113 (75)



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D-7750 Konstanz

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INFORMATIONAL SEGMENTATION IN INTERNATIONAL
CAPITAL MARKETS

Jack Wahl*

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ABSTRACT

The economic influence of barriers to international information acquisition and, hence, of informational segmentation in international capital markets depends heavily upon the prevailing level of risk aversion. We find that these barriers are likely to have second order economic impact only. Furthermore, improving international informational integration is likely to *increase all asset prices* when causing less heterogeneity of international subjective probability beliefs.

1. INTRODUCTION

This paper examines the economic importance of barriers to international information acquisition. Domestic investors planning to extend their portfolio with internationally traded assets will generally incur non-negligible additional information costs. Because the investors' information sets will include mainly knowledge and signals about their home national markets. International investors are therefore likely to possess different subjective probability beliefs. So an international economic setting is a good example for informational segmentation. On the other hand, the integration of EEC markets in 1992 and with that the aspect of increased informational integration furnishes motivation.

The paper develops an international Arrow-Debreu model with heterogeneous probability beliefs. It mainly explores the interaction between risk aversion and informational segmentation in international capital markets. This interaction is an important element determining the optimal portfolios of domestic and foreign investors. For the economic *impact* of a difference in subjective probability beliefs across investors is determined by the level of risk aversion. The level of risk aversion and the level of informational segmentation in the market also influence asset pricing. By aggregating the domestic and foreign investors' subjective probability beliefs a so-called market probability belief will be derived. Most interestingly, the *endogeneous* market probability distribution plays a crucial role with respect to the level of asset prices. It will be shown that the importance of international informational segmentation with respect to asset pricing is governed by the level of risk aversion via the market probability distribution.

The theoretical background of the paper comes mainly from consumption oriented asset pricing models: see, for example, Merton (1971), Kraus and Litzenberger (1975), Rubinstein (1977), Breeden (1979), Varian (1985), and Tschoegl and Wahl

(1987). The work of Varian (1985) also stimulated this research.

In Section 2 we establish the model. Section 3 examines the model's implications for optimal consumption and prices by introducing into the model a well-defined structure of informational integration levels. In Section 4 we investigate the implications for international asset pricing. Section 5 presents an example, and Section 6 briefly concludes the paper.

2. THE INTERNATIONAL ARROW-DEBREU MODEL

Assumptions

Assumption 1. We consider a two-date economy. All investors start with wealth in the form of given endowments of domestic and foreign consumption claims in the present date 0 and in the future states of nature at date 1. They maximize the expected utility of present and future consumption where the utility function is time-additive and exhibits constant proportional risk aversion.

Assumption 2. There exists a representative domestic and a representative foreign investor. The endowment of each investor consists of a state independent fraction of world consumption claims.

Assumption 3. Due to barriers to international information acquisition, the representative domestic and the representative foreign investor have different probability beliefs with respect to the occurrence of future states of nature. They behave purely as passive expected utility maximizers, i.e., they do not infer any information from market prices about the other investors' subjective probability beliefs.

Assumption 4. Apart from information costs all markets are perfect: there are no taxes, no transactions costs,¹⁾ and no restrictions on short sales. Also, all claims are perfectly divisible, all assets are marketable, and investors act as price takers.

Assumption 5. The financial assets' market is complete.

Assumption 6. The current spot rate and the random future spot rate of foreign exchange is exogenously given.

Most assumptions are standard assumptions of Arrow-Debreu models. Assumption 3 drives the main results of the paper by allowing for heterogeneous expectations among domestic and foreign investors.²⁾

Definitions

I	$\equiv$	the number of investors;
Z	$\equiv$	the number of future states of nature s at date 1 ($s=1,\dots,Z$);
S_0 (S_s)	$\equiv$	real foreign exchange present (future) spot rate (if state s occurs);
p_s	$\equiv$	price of one unit of consumption contingent on state s ($p_0 \equiv 1$);
Π_s	$\equiv$	endogenous "market probability" of state s ;
C_0	$\equiv$	present world consumption;
C_s	$\equiv$	future world consumption if state s occurs;
x_s	$\equiv$	payoff of an asset if state s occurs;
b_s	$\equiv$	market valuation factor if state s occurs;
v_x	$\equiv$	current market value of asset x ;
α, η	$\equiv$	fractions of world consumption ($0 < \alpha < 1, 0 < \eta < 1$);
c_0 (αC_0)	$\equiv$	investor's (endowment of) present consumption;
c_s (αC_s)	$\equiv$	investor's (endowment of) future consumption in state s ;
π_s	$\equiv$	investor's subjective probability that state s will occur;
u	$\equiv$	investor's utility function;
γ	$\equiv$	level of constant proportional risk aversion ($\gamma > 0$); ³⁾
τ	$\equiv$	positive parameter of time patience. ⁴⁾

The (real) spot rate is defined in units of domestic "currency" per unit of foreign

"currency".⁵⁾ Starred symbols shall refer to the foreign dimension. In addition, consumption will be indexed by d or f to denote the demand for domestic or foreign consumption state contingent consumption claims.⁶⁾

*Domestic Representative Investor's Decision Problem*⁷⁾

Each investor chooses an optimal portfolio of consumption claims that solves the following maximization problem:

$$\begin{aligned} & \text{MAX}_{\{c_0^d, c_0^f, c_s^d, c_s^f\}} \sum_{s=1}^Z \pi_s u(c_0, c_s) \\ & \text{subject to}^{8)} \quad c_0^d + \sum_{s=1}^Z p_s c_s^d = \alpha (C_0^d + \sum_{s=1}^Z p_s C_s^d), \\ & \quad \quad \quad c_0^f + \sum_{s=1}^Z p_s^* c_s^f = \alpha (C_0^f + \sum_{s=1}^Z p_s^* C_s^f), \end{aligned}$$

$$\begin{aligned} & \text{where}^{9)} \quad c_0 \equiv c_0^d + c_0^f S_0, \quad C_0 \equiv C_0^d + C_0^f S_0, \\ & \quad \quad c_s \equiv c_s^d + c_s^f S_s, \quad C_s \equiv C_s^d + C_s^f S_s \quad (s=1, \dots, Z), \text{ and} \\ & \quad \quad u(c_0, c_s) \equiv ([c_0^{1-\gamma} - 1] + \tau [c_s^{1-\gamma} - 1]) / (1-\gamma) \quad (s=1, \dots, Z). \end{aligned}$$

From the investor's optimization problem we find the following first-order conditions with respect to each decision variable:

$$\begin{aligned} (1a) \quad c_0^d: \quad c_0^{-\gamma} &= \lambda^d, \\ (1b) \quad c_0^f: \quad c_0^{-\gamma} S_0 &= \lambda^f, \\ (1c) \quad c_s^d: \quad \tau \pi_s c_s^{-\gamma} &= \lambda^d p_s \quad (s=1, \dots, Z), \\ (1d) \quad c_s^f: \quad \tau \pi_s c_s^{-\gamma} S_s &= \lambda^f p_s^* \quad (s=1, \dots, Z). \end{aligned}$$

λ denotes the Lagrange-Multiplier and, therefore, the marginal utility of wealth which depends on the origin of the consumption claim.

The optimality conditions (1a)-(1b) immediately give a fundamental relationship between prices and foreign exchange spot rates:

$$(2) \quad \frac{p_s^*}{p_s} = \frac{S_s}{S_0} \quad (s=1, \dots, Z),$$

i.e., the percentage difference in prices for a state- s consumption claim must be equal to the rate of change in the spot rate if state s materializes. Hence Equation (2) may be interpreted as an intertemporal law of one price. Since Arrow-Debreu prices are state dependent *discount* factors, a price difference due to a difference in currency denomination must be offset by the state dependent evolution of the spot rate.¹⁰⁾

Aggregation

Since the utility function is time-additive and every investor is endowed with the deterministic fraction α with respect to all consumption claims, in equilibrium the representative domestic investor holds exactly the endowment of present world consumption (see APPENDIX [A1]):

$$(3) \quad c_0 = \alpha C_0.$$

Hence the national fraction of present world consumption amounts to $\alpha C_0 \equiv \eta C_0$. The equilibrium fraction of future world consumption which is held by the representative domestic investor is state dependent, as international capital markets exhibit heterogeneous probability beliefs. We find (see APPENDIX [A2]):

$$(4) \quad c_s = \alpha \left(\frac{\pi_s}{\Pi_s} \right)^{\frac{1}{\gamma}} C_s \quad (s=1, \dots, Z),$$

where $\Pi_s \equiv (\eta \pi_s^{1/\gamma} + \eta^* \pi_s^{*1/\gamma})^\gamma$ defines the market probability belief (up to a standardization)¹¹⁾ and $\eta + \eta^* = 1$. Of course, with homogeneous probability beliefs in international capital markets, i.e., $\pi_s = \pi_s^*$ for all s , the separation¹²⁾ property of the underlying utility function implies that the representative domestic investor also holds a deterministic fraction of state dependent future world consumption. The equilibrium fraction then is equal to the endowed fraction α .

The first-order conditions (1a) and (1c) furnish the price relationship $p_s = \tau \pi_s \left(\frac{C_s}{C_0} \right)^{-\gamma}$. Inserting the equilibrium demand for consumption claims, i.e., Equations (3) and (4), we derive the equilibrium price function:

$$(5) \quad p_s = \tau \Pi_s \left(\frac{C_s}{C_0} \right)^{-\gamma} \quad (s=1, \dots, Z).$$

Hence prices of consumption claims contingent on state s are proportional to the market probability belief of state s . Note that the model also implies the equilibrium risk-free rate of interest: $R_F = (\sum_{s=1}^Z p_s)^{-1} - 1$.

3. INFORMATIONAL SEGMENTATION IN THE INTERNATIONAL ARROW-DEBREU MODEL

Consumption

The equilibrium demands for present consumption claims by the representative national investors are independent of any barriers to international information acquisition. This is due to the time-additivity of the underlying utility function. Hence we may restrict our attention to the demands for future consumption claims, which we derived in Equation (4).

We shall define barriers to international information acquisition by the degree of informational integration which international capital markets exhibit. Let π_s^0

denote the subjective probability belief of investors in a situation of homogeneous probability beliefs. On the other hand let π_s^e (π_s^{e*}) denote the subjective probability beliefs of the representative domestic (foreign) investor in a situation of heterogeneous probability beliefs. Then we define

$$(6) \quad \begin{aligned} \pi_s &\equiv \delta \pi_s^o + (1-\delta) \pi_s^e, \\ \pi_s^* &\equiv \delta \pi_s^o + (1-\delta) \pi_s^{e*}, \quad (s=1, \dots, Z). \\ 0 &\leq \delta \leq 1. \end{aligned}$$

δ represents the degree of informational integration: $\delta = 0$ implies total informational segmentation, $0 < \delta < 1$ implies partial informational segmentation, and $\delta = 1$ implies full informational integration of international capital markets. The latter scenario means that investors have identical information sets. As a result we obtain the case of homogeneous probability beliefs π_s^o ($s=1, \dots, Z$). An alternative interpretation of δ is a measure of information diffusion in the markets. Of course, $\delta = 1$ implies that prices are informationally efficient.

Consider first a given level of constant proportional risk aversion. Then the influence of the degree of informational integration on the international distribution of consumption claims is easily seen from the following relationship. It is derived from the equilibrium demand (4) of the representative domestic and the representative foreign investor:

$$(7) \quad \frac{c_s}{c_s^* S_s} = \frac{\alpha}{\alpha^*} \left(\frac{\pi_s}{\pi_s^*} \right)^{\frac{1}{\gamma}} = \frac{I^*}{I} \frac{\eta}{\eta^*} \left(\frac{\pi_s}{\pi_s^*} \right)^{\frac{1}{\gamma}}.$$

Equation (7) shows the distribution of consumption claims across investors: with increasing informational segmentation, holding other things equal, the difference in the national demands of consumption claims increases. For a decreasing δ

implies from Equation (6) that the *spread* in the probability beliefs of both international investors, i.e., $|\pi_s - \pi_s^*|$, increases. Of course, this distributional effect is the smaller, the more national endowments of consumption claims coincide.

A more interesting effect on the international distribution of consumption claims stems from the influence of the level of constant proportional risk aversion. Given a spread in probability beliefs, the spread in consumption claims among the representative domestic and the representative foreign investors is damped (enlarged) if the risk aversion level γ is higher (smaller) than one, i.e., the risk aversion level implied by logarithmic utility (which means $\gamma = 1$).¹³⁾ Of course, in general a change in the degree of informational segmentation will change the market probability belief. But notice that the market probability belief does not have any influence here, whatever the induced change in this measure is.

Now consider a given level of international segmentation ($\delta = \bar{\delta} < 1$). Then the following results apply:

$$(8) \quad \begin{aligned} \lim_{\gamma \rightarrow \infty} c_s &= \alpha C_s, \\ \lim_{\gamma \rightarrow 0+} c_s &= \begin{cases} 0 & \text{if } \pi_s < \pi_s^* \\ C_s & \text{if } \pi_s > \pi_s^* \end{cases} \quad (s=1, \dots, Z). \end{aligned}$$

Since in the limit of high proportional risk aversion we also have $c_s^* = \alpha^* C_s^*$, it follows that the exchange rate adjusted demands for consumption claims converge to demands which would hold in an equilibrium with homogeneous probability beliefs in international capital markets. Hence barriers to international information acquisition play no role in determining the optimal consumption anymore.

To describe the demand for claims in the limit of low proportional risk aversion let us define an optimistic investor with respect to a state of nature by the

one with the highest probability belief of the state in question. Then for a very low level of proportional risk aversion the optimistic investor will take almost all consumption claims of the state in question.

Since empirical research suggests that γ is at least 2^{14}) let us summarize the discussion in the following way:

PROPOSITION 1. With a sufficiently high level of constant proportional risk aversion the economic importance of information barriers in international capital markets is reduced: the influence of the degree of informational segmentation on the optimal portfolio decision of state contingent consumption claims becomes second order.

The intuition is as follows: Domestic and foreign investors may have different subjective probability beliefs. And these probability assessments are elements of the market probability belief. But with increasing risk aversion investors are more and more unwilling to exploit their own assessment and, hence, the difference in probability beliefs. Eventually they buy a fraction of aggregate consumption, choosing a portfolio of consumption claims as if they would assume the market assessment.

Proposition 1 reveals a difficulty in empirical research: by observing the international consumption demands we may not be able to distinguish between a "low" δ , i.e., a "high" degree of informational segmentation from a "high" γ , i.e., a "high" level of proportional risk aversion. This implies that similar exchange rate adjusted demand of consumption claims across countries may be due to high informational integration of international capital markets and/or due to the existence of a high proportional risk aversion in the international capital markets. It follows that we also have to consider the prices of claims in order to uncover the driving force of internationally similar demand.

Prices

We assume international partial informational integration, otherwise the market probability belief would be independent of the level of risk aversion as a result of homogeneous probability beliefs. Furthermore, note the following properties of the market belief: $\frac{\partial}{\partial \gamma} \Pi_s < 0$, $\lim_{\gamma \rightarrow \infty} \Pi_s = \pi_s^\eta \pi_s^{*\eta} > 0$ and $\lim_{\gamma \rightarrow 0_+} \Pi_s = \text{Max}(\pi_s, \pi_s^*) > 0$.¹⁵⁾ We therefore have the result:

$$(9) \quad \lim_{\gamma \rightarrow \infty} p_s = \begin{cases} 0 & \text{if } C_s > C_0 \\ \infty & \text{if } C_s < C_0 \end{cases}, \quad (s=1, \dots, Z).$$

$$\lim_{\gamma \rightarrow 0_+} p_s = \tau \text{Max}(\pi_s, \pi_s^*)$$

Hence if we observe that the exchange rate adjusted demand of consumption claims does not differ significantly across countries (besides the influence of endowments, of course), then given that $C_s >(<) C_0$ a "low" ("high") price indicates that risk aversion is at work and is harmonizing the international demand for consumption rather than informational integration. If the growth rate of world consumption is positive (negative) over all states of nature, then as an implication a "high" ("low") risk-free interest rate would suggest that the influence of risk aversion dominates that of information. As a benchmark the prices implied by logarithmic utility could be used.

We summarize the foregoing discussion in

Proposition 2. *Let the state dependent growth rate of world consumption be non-negative. Then if prices of state contingent consumption claims are sufficiently low, a similar exchange rate adjusted consumption demand across countries is then primarily the result of a high level of constant proportional risk aversion rather than due to a high degree of informational integration. The analogue holds for a sufficiently high risk-free rate of interest.*

In general the interaction of informational segmentation and risk aversion has to be investigated in order to have more precise results. This is the subject of the following.

Mean Preserving Spread

Let us now consider a carefully defined influence of increased informational integration on prices of consumption claims. We want to look at a "spread"¹⁶⁾ of the subjective probability beliefs of the representative domestic and the representative foreign investor which does not change the "average" probability beliefs over these investors. This is not unlikely given that investors receive the same additional news and/or learn about the information processing of other investors.

Let us consider a mean preserving probability spread (MPPS) across investors. For that purpose we introduce the following definition:

$$(10) \quad \Phi_s \equiv \eta \pi_s + \eta^* \pi_s^* \quad (s=1, \dots, Z).$$

Several things have to be noted here: (1) Φ_s is a weighted average across the representative domestic and the representative foreign investor's probability beliefs. The weights are given by the *countries'* endowed fraction of world consumption ($\eta + \eta^* = 1$). Hence Φ_s is identical with the market probability belief if a logarithmic utility function holds ($\gamma = 1$). (2) A MPPS implies that $\frac{\Delta \pi_s}{\Delta \pi_s^*} = - \frac{1 - \eta}{\eta}$. Hence a change in δ , i.e., in the level of informational segmentation, cannot induce probability changes that are independent of countries' endowments. Suppose that with increased segmentation the state- s probability belief of the representative foreign investor decreases. Then the state- s probability belief of the representative domestic investor will increase the more, the less endowed his country is. (3) Φ_s is independent of the level of informational integration. There-

fore $\Phi_s = \pi_s^o = \eta \pi_s^e + (1-\eta) \pi_s^e$ and $\pi_s^e < \pi_s^o < \pi_s^{e*}$ or $\pi_s^e > \pi_s^o > \pi_s^{e*}$. This follows from our Definition (6). Hence the "spread" in probability beliefs must take place "around" the probability beliefs of full informational integration.

The implications of MPPS for the market probability belief are best illustrated in a graphical way. The question is, how does the market probability belief react to changes in proportional risk aversion, if changes in informational segmentation follow a MPPS? From the properties of the market probability belief¹⁷⁾ we deduce the curvature of Figure 1.

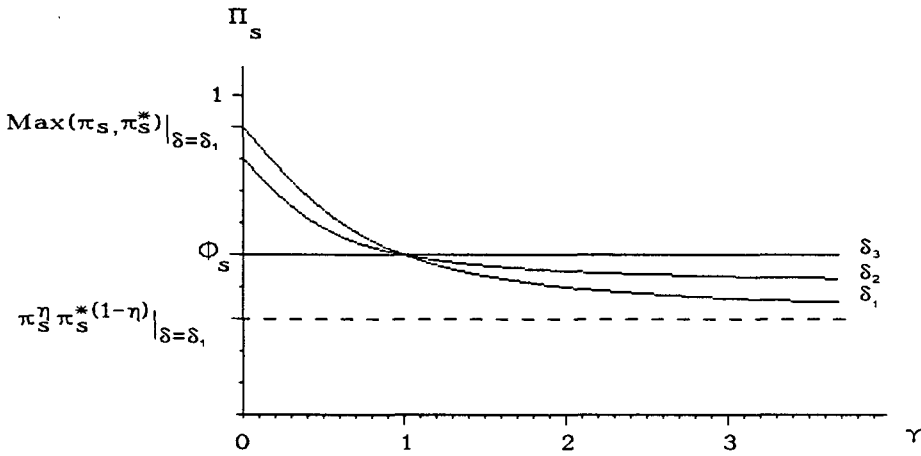


Figure 1. Effect of Risk Aversion ($\delta_1 < \delta_2 < \delta_3=1$) on the market probability belief

The figure confirms the noted reaction of the market probability belief to increased constant proportional risk aversion. Furthermore, if the risk aversion level is lower than the risk aversion level implied by logarithmic utility (i.e., $\gamma < 1$), the market probability belief will be the higher, the lower the informational integration is (i.e., the lower δ). On the other hand, higher risk aversion than logarithmic utility (i.e., $\gamma > 1$) produces a decreasing level of the market belief

when information dissemination is decreasing. This proves the following result:

Proposition 3. *Under a mean preserving probability spread across investors, the impact of a cutback of barriers to international information acquisition upon the market probability belief is the higher the more the proportional risk aversion differs from the one given by logarithmic utility.*

Finally we are interested in the effect of informational segmentation on the valuation of assets. The investigation will be based upon the above results.

3. IMPLICATIONS FOR INTERNATIONAL ASSET VALUATION

Asset Prices

Given an asset with state dependent payoff x_s ($s=1,\dots,Z$), we can evaluate this asset in terms of prices for state contingent consumption claims. Hence the asset's market value in equilibrium must be:

$$(11) \quad v_x = \sum_{s=1}^Z p_s x_s.$$

In a complete market we may immediately use the equilibrium price function (5) in order to get an explicit asset value function:

$$(12) \quad v_x = E_{\Pi}(bx),$$

where $b_s \equiv \tau \left(\frac{C_s}{C_0} \right)^{-\gamma}$ ($s=1,\dots,Z$) denotes a state-dependent market valuation factor. Given the underlying model the b -factor is some preference-adjusted growth of world consumption. Other things equal, this valuation factor is the higher, the higher is the investor's time patience or the lower the investor's risk aversion or the higher the growth rate of world consumption. More important, as E_{Π} signi-

fies, the expectation is taken with respect to the (non-standardized) market probability distribution.¹⁸⁾

Equation (12) reveals several important things: (1) In equilibrium the asset price depends upon world consumption and the market probability distribution. (2) The market probability distribution depends upon the international distribution of endowments and also upon the international distribution of subjective probability beliefs. (3) Since $E_{\Pi}(bx) = E_{\Pi}(b)E_{\Pi}(x) + \text{Cov}_{\Pi}(b,x)$ we have: the higher the *co-variance with respect to the market probability distribution* between the market factor and the asset's payoff, the higher is the market value of the asset.

Mean Preserving Spread

Changes in the level of informational segmentation in international capital markets induce changes in the market probability distribution. We will use a MPPS across investors to investigate the effect of such changes on the international asset valuation.

By referring to Proposition 3 we may immediately state the main result of the paper:

Proposition 4. *Let an increase in informational integration of international capital markets take the form of a mean preserving probability spread across investors. Then all asset prices will increase (decrease), if proportional risk aversion is higher (lower) than proportional risk aversion implied by logarithmic utility.*

Proof. $v_x = \sum_{s=1}^Z \Pi_s b_s x_s$. Since $\Pi_s(\delta_i | \gamma_{<1}^>) \geq \Pi_s(\delta_j | \gamma_{<1}^>)$ if $\delta_i > \delta_j$, and b_s, x_s are fixed for all s , we have $v_x(\delta_i | \gamma_{<1}^>) - v_x(\delta_j | \gamma_{<1}^>) > 0$. |

Foreign Exchange Rates

Let us now take the viewpoint of the representative foreign investor when evaluating the internationally traded asset. In equilibrium the asset's market value

reads:

$$(13) \quad v_x^* = \sum_{s=1}^Z p_s^* x_s^*.$$

Since we have a complete and perfect international capital market except for informational segmentation, in equilibrium we must have

$$E_{\Pi}(b^* x^*) S_0 = E_{\Pi}(b x^* S_1),$$

where S_1 denotes the risky foreign exchange spot rate at date 1, which can take the values S_s ($s=1, \dots, Z$). This in turn implies

$$(14) \quad E_{\Pi}\left[\left(b^* - b \frac{S_1}{S_0}\right) x^*\right] = 0.$$

Then in a complete market we find

$$(15) \quad \frac{b_s^*}{b_s} = \frac{S_s}{S_0} \quad (s=1, \dots, Z),$$

which is a fundamental relationship between market factors and foreign exchange spot rates. This relationship is similar to the one between prices and foreign exchange spot rates of Equation (2). Hence the spot rates only serve to convert payoffs and current market values which are denominated in foreign currency into domestic currency. It follows that spot rates do not have any independent economic influence on prices. This leads us to

Proposition 5. Let the Assumptions 1 to 6 hold. Then the existence of barriers to international information acquisition is not sufficient to give the foreign exchange spot rate any economic meaning besides that of a converting tool.

5. AN EXAMPLE

Let us consider an example of a MPPS. We will determine the implied international distribution of consumption claims and the asset's market value.

Assume two future states of nature. Let the subjective probability belief of state 1 in case of full informational integration be $\pi_1^O = .5$, in case of full informational segmentation let it be $\pi_1^e = .9$ domestically, and let it be $\pi_1^{e*} = .1$ in the foreign country. Let the domestic relative endowment be $\eta = .5$. Applying Definition (6) a MPPS then implies the within Table 1 listed probabilities for state 1 subject to level δ_k of informational integration.

	$\delta_1 = 0$	$\delta_2 = .25$	$\delta_3 = 1$
π_1	.9	.8	.5
π_1^*	.1	.2	.5
Φ_1	.5	.5	.5

Table 1. Subjective Probability Beliefs and MPPS

For example, given the level δ_2 of informational integration the subjective state-1 probability belief of the representative foreign investor equals .2. Furthermore, Table 1 shows that the international spread in subjective probabilities decreases when informational integration is increasing.

From Equation (7) we then find the relative demand of state-1 consumption claims adjusted for different endowments and adjusted with respect to the future spot rate, i.e., $\frac{\alpha^* c_s}{\alpha c_s^* S_s}$. Let $\alpha = .5 \alpha^*$. Depending on risk aversion and integration the international scattering of the demand is represented by the numbers of Table 2. For example, consider $\gamma = 2$. Then the international demand differs at most by a factor of 3. The higher the risk aversion, the less do barriers to international information acquisition influence the international spreading of consumption.

	$\delta_1 = 0$	$\delta_2 = .25$	$\delta_3 = 1$
$\gamma = .5$	81	16	1
$\gamma = 1$	9	4	1
$\gamma = 2$	3	2	1

Table 2. International Consumption Spreading

Let us finally analyze the asset price. Assume the risky payoffs $x_1 = \$100$, $x_2 = \$200$. Furthermore, let the market valuation factor $b_1(\gamma=1) = .8$ and $b_2(\gamma=1) = 1.25$. These data imply the equilibrium values v_x listed in Table 3.

	$\delta_1 = 0$	$\delta_2 = .25$	$\delta_3 = 1$
$\gamma = .5$	\$200.45	\$182.54	\$156.52
$\gamma = 1$	\$165.00	\$165.00	\$165.00
$\gamma = 2$	\$150.60	\$169.43	\$188.25

Table 3. Asset's Market Value

The calculated market values confirm the result that increasing informational integration will strictly lower the asset's price if and only if proportional risk aversion is less than one. The graphical representation of the asset pricing is shown in Figure 2.

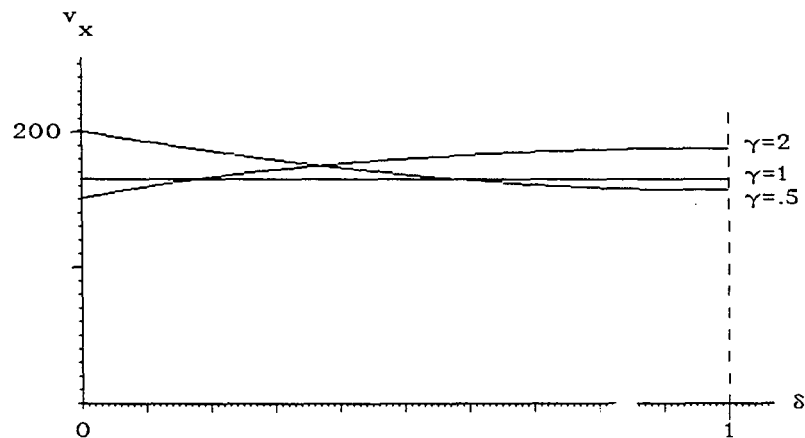


Figure 2. Asset's Market Value

6. CONCLUSION

In this paper we have analyzed an international Arrow-Debreu model. The model allows the implications of barriers to international information acquisition to be investigated.

In Proposition 1 we argue that the economic effects of barriers to international information acquisition cannot be evaluated without referring to the level of risk aversion which prevails in the market. The economic importance of these barriers decreases with increasing risk aversion.

The major conclusion of the paper is represented by Proposition 4. We show that an increase in informational integration is likely to *increase* asset prices. Of course, the effect depends on the information processing of the investors, given some additional news. Improving the condition of information dissemination such that informational integration of markets is improved, a mean preserving subjective probability spread across investors then implies that asset prices will decrease if and only if proportional risk aversion is not too *high*. The aversion benchmark is supplied by the logarithmic utility function, and markets seem to exhibit a higher level of proportional risk aversion.

There are several directions in which one could extend our model. One could generalize the assumption that investors' endowments are state *independent* fractions of world consumption. Allowing for state dependency would complicate the definition of a mean preserving probability spread across investors. For the implied information processing would depend on the equilibrium's adjustment to changes in informational integration. Or, besides barriers to international information acquisition other market imperfections could be introduced. So the foreign exchange market might play an independent economic role and not just deliver a converting instrument.

Finally, our results may help to clarify some new aspects of the theory of multinational enterprises. It is not at all obvious that these firms can be explained by internalization of information costs.¹⁹⁾ Since its shareholders' incentive to pay a premium for such a corporate policy depends on their risk aversion, the market will not compensate for this internalization if the level of risk aversion is sufficiently high.

NOTES

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- 1) By definition we separate transactions costs from information costs.
- 2) Positive information costs are one rationale of this assumption. Since our results do not depend on explicitly incorporating such a rationale we choose the more convenient formulation of informational barriers.
- 3) $\gamma \equiv -u''c/u'$; see Pratt (1964).
- 4) Strictly speaking τ is an ingredient of the time preference only.
- 5) For simplicity we set one unit of consumption equal to one unit of currency.
- 6) The reason for this will become clear from the definition of the investor's demand for international consumption.
- 7) The decision problem is identical from the foreign representative investor's point of view since we consider (real) consumption. Hence there is no currency illusion. See Laux and Schneeweiss (1972) for a discussion of the numeraire choice problem.
- 8) *Given the assumptions of the model* one could sum up both budget constraints. The opportunity set would not change. With our formulation, however, Equation (2) can be derived very easily from the first-order conditions.
- 9) Note that the summation across consumption claims is in real terms.
- 10) Equation (2) confirms a general non-arbitrage condition of perfect international markets. Consider a 1\$ state- s claim. This claim can be obtained either by

paying p_s or $p_s^* S_0/S_s$, which must be the same price in arbitrage-free international markets.

11) In general $\sum_{s=1}^Z \Pi_s \neq 1$.

12) See Mossin (1977, Chap. 7).

13) Notice that $\lim_{r \rightarrow 0} \frac{x^r - 1}{r} = \log x$ ($x > 0$).

14) This assessment is taken from Varian (1985, p.316).

15) See Mitrinovic (1970, p.74). Note that $\Pi_s(\gamma)$ is neither continuous nor differentiable at $\gamma=0$. However, this has no economic consequences since proportional risk aversion is strictly positive.

16) See Rothschild and Stiglitz (1970).

17) These are noted before Equation (9).

18) There is no point in standardizing the market probability beliefs in order to use the usual expectation operator.

19) See Ethier (1986).

APPENDIX

We check the aggregation results of Equations (3) and (4) by consistency tests.

Remark: $\eta + \eta^* = 1$, and $\Pi_s = (\eta \pi_s^{1/\gamma} + \eta^* \pi_s^{*1/\gamma})^\gamma$.

$$\begin{aligned} \text{[A1]} \quad C_0 &= c_0 I + c_0^* I^* S_0 \\ &= \alpha I C_0 + \alpha^* I^* C_0^* S_0 \\ &= \eta C_0 + \eta^* C_0^* I \end{aligned}$$

$$\begin{aligned} \text{[A2]} \quad C_s &= c_s I + c_s^* I^* S_s \\ &= \alpha I \left(\frac{\pi_s}{\Pi_s} \right)^{1/\gamma} C_s + \alpha^* I^* \left(\frac{\pi_s^*}{\Pi_s^*} \right)^{1/\gamma} C_s^* S_s \\ &= \eta \left(\frac{\pi_s}{\Pi_s} \right)^{1/\gamma} C_s + \eta^* \left(\frac{\pi_s^*}{\Pi_s^*} \right)^{1/\gamma} C_s^* \\ &= \eta C_s + \eta^* C_s^* I \end{aligned}$$

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