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Capital Flow Controls, International Asset Pricing, and Investors' Welfare: A Multi-Country Framework

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ABSTRACT

This paper investigates the impact of capital flow restrictions on the pricing of securities, on the optimal portfolio composition for investors of different nationalities, and on their welfare. Under capital flow controls, the equilibrium price of a security is determined jointly by its international and national risk premiums, and investors acquire nationality-specific portfolios along with a market-wide proxy for the world market portfolio. Removal of investment barriers generally leads to an increase in the aggregate market value of the affected securities, and all investors favor a move toward market integration. Introduction of different types of index funds in the world market generally increases world market integration and investor welfare.

IN RECENT YEARS, THE international capital markets have undergone numerous important changes that have increased the international linkage of national markets. These changes include the creation of "national" index funds (e.g., Mexico, Korea, Taiwan, India, France, and Scandinavia) and selective liberalization (e.g., Brazil, India, Korea, Sweden, and Japan). Despite their potential impact on the national economies and global finance, it is not clear what consequences these integrating changes entail. For example, is welfare increased by allowing cross-border investment that is restricted to purchasing the entire national portfolio, of which the national index fund is a class? Unfortunately, with the exception of Subrahmanyam (1975a), who studies the pricing and welfare effects of fully integrating, heretofore completely segmented markets, other international asset pricing models that incorporate capital flow restrictions (for instance, Black (1974), Stulz (1981b), Lessard et al. (1983), Errunza and Losq (1985), Cooper and Kaplanis (1986), and Eun and Janakiramanan (1986)) analyze the pricing but not the welfare effects of investment barriers. To analyze systematically the welfare implications of various structural changes in the current market environment, this paper follows the lead of Subrahmanyam and recasts the analysis in two important respects:

(i) Since today's capital markets are neither completely segmented nor fully

* Faculty of Management, McGill University and ESSEC, Paris, respectively. Professor Losq passed away prior to publication of this paper. This work is dedicated to the fond memories of Etienne Losq, who enlightened me and all others he touched with his brilliant understanding of financial economics and his wisdom about life in general. The authors wish to thank Bernard Dumas, Don Lessard, Arthur Moreau, Lemma Senbet, Bruno Solnik, René Stulz, Marty Subrahmanyam, and anonymous referees of this Journal for valuable suggestions. Financial support of SSHRC is gratefully acknowledged.

integrated, the paper develops a model of "mild" segmentation based on stylized representation of barriers to portfolio capital flows. The model allows analyses of the effects of imposing new restrictions, of removing old restrictions, and of issuing new securities such as national funds.

(ii) The paper uses an N-country instead of a two-country model to capture the multilateral structure of security returns. As shown in Section III, in a number of cases, a multi-country model leads to significantly different valuation and welfare results compared to those yielded by an otherwise identical two-country model and allows analysis of partially integrative changes in the world market structure.

Section I of the paper presents the one-period multi-country mean-variance model. Section II analyzes the impact of capital flow restrictions on the pricing of securities and on the optimal portfolio holdings for investors of different nationalities. Under mildly segmented market structure, the equilibrium price of a security is determined jointly by its international and national risk premiums, and investors acquire nationality-specific portfolios along with the best available proxy for the world portfolio. Section III considers the valuation and welfare effects of various changes in the market structure. Removal of investment barriers generally leads to an increase in the aggregate market value of the affected securities, and all investors favor a move toward market integration. Introduction of different types of index funds in the world market generally increases world market integration and investor welfare. Finally, Section IV of the paper summarizes the main results.

I. The Model

A. Market Structure

Although restrictions on portfolio investment take a wide variety of forms and may correspond to different degrees of stringency, their representation in a formal model has to be sufficiently stylized to permit tractability. It is in such a spirit that the international capital market is viewed as comprised of two regions:

1. the *core* of the market, consisting of all those securities which can be traded by any investor, independently of his or her nationality (it consists of the freely tradeable part of all peripheral markets plus the whole of the unrestricted central market).
2. the *periphery* of the market, consisting of N different segments such that no investor can trade in more than one segment.

Correspondingly, we assume the existence of $(N + 1)$ classes of investors, each class having access to a different subset of securities. The first class characterizes investors with access only to securities in the core of the market, while the last N classes consist of investors who can trade in the securities of a given peripheral segment and the core of the market.

To summarize, the model is built on an explicit formalization of investment barriers. No cross-investment between segments in the periphery is permitted, and investors in the core are denied access to securities in all the peripheral segments.[1] Note that this assumption of asymmetric absolute barrier is most appropriate for capital markets of less developed countries (LDCs). As in Errunza and Losq (1985), we assume that LDCs are better able to enforce capital inflow restrictions than capital outflow restrictions. We take the extreme position that capital outflow controls are so ineffective that they can be ignored on the first approximation. See Figure 1 for a diagrammatic representation of the models used by previous researchers and of the proposed model.

B. Technical Assumptions

(A1) Except in that there is no equal access, the international capital market is perfect and frictionless.

(A2) There exists a commodity price index common to all investors and used by these investors to convert nominal prices into real prices. We thus rule out the presence of real—but not of nominal—exchange risk.

(A3) All investors have the same one-period horizon.

(A4) The end-of-period real prices of all securities conform to a multivariate normal distribution. Note that these prices are identical to the liquidating returns of the firm.

(A5) Each investor's utility function is of the negative exponential type. It amounts to regarding the coefficient of absolute risk aversion as fixed. This assumption could be dispensed with for the pricing and portfolio composition results (Section II); however, it is needed to obtain comparative statics results (Section III).

(A6) Each investor can freely lend and borrow at the same real rate of interest, which is exogenously fixed. This assumption avoids the complications entailed by the zero-beta portfolio; further, it guarantees that differences in pricing across market segments correspond to differences in rewards to risk bearing.[2]

(A7) The core of the market is incomplete, in the sense that it does not offer the same diversification opportunities as the market as a whole. We thus characterize a world where investment barriers have a real impact, i.e., deprive some investors of diversification opportunities.

II. Pricing and Portfolio Composition

A. Notation

- Subscript 0 identifies the core of the market and subscript I ($I = 1, \cdots, N$) the Ith peripheral segment.

[1] Prohibitive barriers to cross-investments among peripheral segments differentiates this N-country model from the two-country model of Errunza and Losq (1985) and leads to more general results. Our model can also be contrasted with that of Mayers (1972). For example, if there is a representative agent in the periphery, that agent has to bear the market risk of the periphery, which is a nontraded asset. Hence, that agent behaves like the agent with nonmarketable wealth in the Mayers model.

[2] The assumption of same real rate of interest in an international market where significant barriers exist is questionable. Interestingly, in a situation where the riskless rates of interest vary across countries, Subrahmanyam (1975b) shows that the integration of capital markets is Pareto-optimal for quadratic, exponential, and logarithmic utility functions.

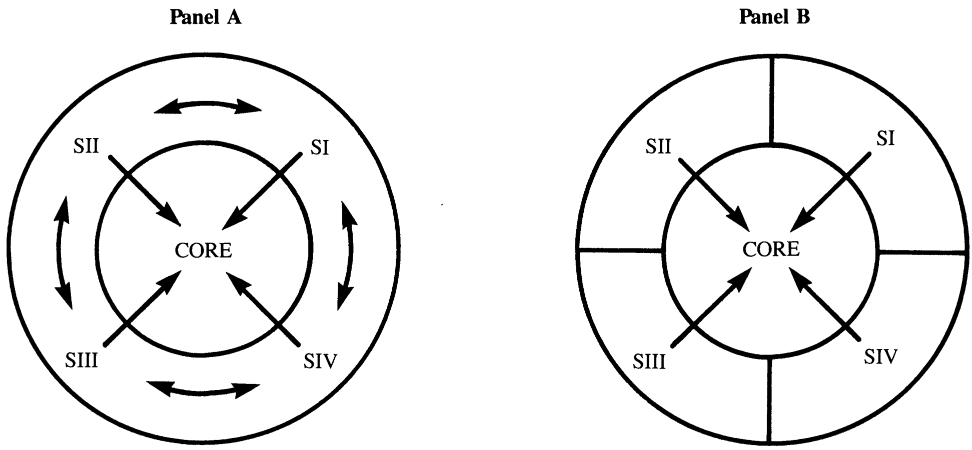

Figure 1. Market structure. Panel A: Two-country framework used by Black (1974), Stulz (1981b), Lessard et al. (1983), and Errunza and Losq (1985) to analyze the pricing effects of unidirectional capital flow restrictions. The one-way barrier (core to periphery) takes the form of taxes in Black, Stulz, and Lessard et al. and complete prohibition in Errunza and Losq. Note that peripheral segments SI, $\cdots$, SIV are effectively integrated. Panel B: Multi-country framework used in this paper to analyze the valuation and welfare implications of structural changes in the capital market. The core consists of all those securities which can be traded by any investor, whereas in the periphery the investors can trade only in their own segment. Note that peripheral segments SI, $\cdots$, SIV are effectively segmented and that core investors cannot invest in peripheral segments.

- P denotes the price of a security and an underline a vector; thus, the vectors $\underline{\tilde{P}}_I$, $\underline{\bar{P}}_I$, and $\underline{P}_I$ represent the future, expected future, and current prices of the securities in the Ith segment of the market, respectively.
- A (respectively, A^I) represents the aggregate absolute risk-aversion coefficient for the entire investing population (respectively, for the investors in the Ith segment of the market). By definition, we must have

$$\frac{1}{A} \equiv \sum_{I=0}^{N} \frac{1}{A^I}. \tag{1}$$

- R denotes one plus the real rate of interest.

B. Notional and Derived Market Portfolios

Although legal restrictions on foreign portfolio investments generally prevent investors from acquiring the world market portfolio, investors can reap some diversification benefits by constructing a portfolio of core securities that is "as close" as possible to the world market portfolio. Such a "notional world market portfolio" serves as the best substitute and is labeled as the M^s portfolio. Formally, the composition of the M^s portfolio is given by the vector $\underline{M}^s$, solution of the minimization problem:

$$\operatorname{var}(\tilde{M} - \underline{M}^s\underline{\tilde{P}}_0) \equiv \min_{\{\underline{x}\}} \operatorname{var}[\tilde{M} - \underline{x}\underline{\tilde{P}}_0\}. \tag{2}$$

The definition of the M^s portfolio implies that there is no portfolio of core securities that is more highly correlated with the world market portfolio (Dhrymes (1974), Theorem 2, p. 24). Further, no correlation exists between $\tilde{\underline{P}}_0$ and $\tilde{M} - \underline{M}^s\tilde{\underline{P}}_0$. Next, we define a "derived" world market portfolio, M^h, comprised of (i) a long position in the world market portfolio and (ii) a short position in the M^s portfolio. The M^h portfolio bears no correlation with any of the core security. We can decompose the end-of-period aggregate market value of all of the existing securities into two orthogonal components:

$$\tilde{M} \equiv \tilde{M}^s + \tilde{M}^h. \tag{3}$$

In a similar way, one can define a M_I^s and a M_I^h portfolio for each of the N "national" market portfolios of the periphery:

- $\underline{M}_I^s$ such that $\text{var}[\tilde{M}_I - \underline{M}_I^s\tilde{\underline{P}}_0] \leq \text{var}[\tilde{M}_I - \underline{x}\tilde{\underline{P}}_0]$ for any x;
- $\tilde{M}_I^h \equiv \tilde{M}_I - \tilde{M}_I^s$ with $\tilde{M}_I^s = \underline{M}_I^s\tilde{\underline{P}}_0$ and $\text{cov}[\tilde{M}_I^h, \tilde{\underline{P}}_0] = 0$.

Further,

$$\tilde{\underline{M}}^s \equiv \textstyle\sum_{I=1}^N \tilde{\underline{M}}_I^s + \tilde{\underline{M}}_0, \tag{4}$$

and

$$\tilde{M}^h \equiv \textstyle\sum_{I=1}^N \tilde{M}_I^h. \tag{5}$$

The M_I^h portfolios play a crucial role in the analysis; indeed, as the formal results of this section will show, investors in the Ith national segment attempt to minimize their exposure to the risk embedded in the Ith national market portfolio (which only they can hold) by short selling the best substitute portfolio they can construct out of core securities. However, because the core of the market itself is incomplete, exposure to national market risk cannot be completely eliminated by such a process; the residual risk, embedded in the M_I^h portfolio, will thus have to be priced by the market at equilibrium.

PROPOSITION: *Given the market structure defined in Section I, equilibrium in the international capital market is characterized by the following*:

(*a*) *Core securities are priced as if there were no investment barriers*:

$$R\underline{P}_0 = \bar{\underline{P}}_0 - A\ \text{cov}[\tilde{\underline{P}}_0, \tilde{M}]. \tag{6}$$

(*b*) *The prices of securities in the Ith peripheral segment are set according to two types of systematic risks*:

$$R\underline{P}_I = \bar{\underline{P}}_I - A\ \text{cov}[\tilde{\underline{P}}_I, \tilde{M}^s] - A^I\text{cov}[\tilde{\underline{P}}_I, \tilde{M}_I^h]. \tag{7}$$

(*c*) *An investor h in the core holds a fraction* $\left(\dfrac{A}{A^h}\right)$ *of the* M^s *portfolio.*

(*d*) *An investor in the Ith peripheral segment holds a fraction* $\left(\dfrac{A}{A^I}\right)$ *of the* M^s *portfolio as well as the* M_I^h *portfolio.*

Proof:[3] The traditional method of proof involves the following steps: (1)

[3] The proof is similar to that in Eun and Janakiramanan (1986).

specify the optimal portfolios as a function of to-be-determined risk premia; (2) use the equilibrium conditions to determine these risk premia; and (3) characterize the optimal portfolios at equilibrium. The proof presented here skips step (1) and, thus, some rather tedious algebraic developments. It directly shows that, given the set of postulated risk-return relationships for the different segments of the market (Parts (a) and (b) of the Proposition) and of the postulated portfolio compositions for the different categories of investors (Parts (c) and (d)),

- there is equality between supply and demand for each security and, further,
- each investor finds it optimal to hold his or her assigned portfolio.

(i) With the portfolio allocation proposed in Parts (c) and (d) of the Proposition, the existing supply of securities—and not more than the existing supply—is held by the aggregate population of investors. For the securities in the Ith peripheral segment ($I = 1, \cdots, N$), this condition is satisfied by construction since these securities are held in totality and exclusively by only the local investors. Core investors are not allowed to trade in peripheral segments. Specifically, an investor in the Ith peripheral segment holds a fraction $\left(\frac{A}{A^I}\right)$ of the M^s portfolio as well as the M_I^h portfolio. Thus, his or her demand for the securities of the Ith segment are embedded in the M_I^h portfolio, which consists of a long position in the market portfolio of the Ith segment, i.e., the M_I portfolio, and a short position in the best proxy of the M_I portfolio available in the core, i.e., the M_I^s portfolio. Thus, the demand = supply condition for the periphery is satisfied. For the core securities this condition is satisfied as shown below:

	Demand from Investors			
	In the core	In the Ith segment	Aggregate Demand	Aggregate Supply
Long Position (+)	$+\left(\frac{A}{A^0}\right)\underline{M}^s$	$+\left(\frac{A}{A^I}\right)\underline{M}^s$	$\sum_{I=0}^{N}\left(\frac{A}{A^I}\right)\underline{M}^s$	$= \underline{M}_0$
Short Position (−)	0	$-\underline{M}_I^s$	$-\sum_{I=1}^{N} \underline{M}_I^s$	

(ii) The next step of the proof involves the following argument: given the lack of super risk premia in the core (Part (a) of the Proposition), core investors—who would hold the fraction $\frac{A}{A^0}$ of the M portfolio in the absence of investment barriers—find it optimal to hold the fraction $\left(\frac{A}{A^0}\right)$ of the M^s portfolio (Part (c) of the Proposition). For an investor h in the core, the optimality condition is that the risk premium on any core security, $\underline{\bar{P}}_0 - \underline{P}_0 R$, be equal to h's absolute risk-aversion coefficient, A^h, times the induced risk, $\mathrm{cov}[\underline{\tilde{P}}_0, \tilde{W}^h]$. If h holds the fraction $\left(\frac{A}{A^0}\right)\left(\frac{A^0}{A^h}\right)$ of the M^s portfolio, then the induced risk reduces to $\left(\frac{A}{A^h}\right)\text{cov}[\tilde{\underline{P}}_0, \tilde{M}^s] = \left(\frac{A}{A^h}\right)\text{cov}[\tilde{\underline{P}}_0, \tilde{M} - \tilde{M}^h]$, which simplifies to $\left(\frac{A}{A^h}\right)\text{cov}[\tilde{\underline{P}}_0, \tilde{M}]$ because of the lack of correlation between $\tilde{M}^h$ and $\tilde{\underline{P}}_0$. Since pricing is such that $A\text{cov}[\tilde{\underline{P}}_0, \tilde{M}] = \overline{\underline{P}}_0 - \underline{P}_0 R$, the optimality condition is thus verified for core investors.

(iii) Since peripheral investors represent the only source of demand, the local securities will have to offer a super risk premium as an inducement for the national investing population to hold them. This creates an excessive exposure to national risk, a negative consequence that can be partially mitigated by short selling the best proxy of the M_I portfolio available in the core, i.e., the M_I^s portfolio. Finally, investors in the periphery would also take advantage of the diversification benefits available in the core, i.e., to hold a fraction of the M^s portfolio.

According to Part (d) of the Proposition, for any investor h of the Ith segment, $(I: 1, \cdots, N)$, the only random component of his or her future wealth is given by $\left(\frac{A^I}{A^h}\right)\left[\frac{A}{A^I}(\tilde{M} - \tilde{M}^h) + \tilde{M}_I^h\right]$. For securities in the core, the induced risk, $\text{cov}[\tilde{\underline{P}}_0, \tilde{W}^h]$, is thus equal to $\frac{A}{A^h}\text{cov}[\tilde{\underline{P}}_0, \tilde{M}]$ because of the lack of correlation between core securities and the "derived" market portfolios, M^h and M_I^h. Since $A\text{cov}[\tilde{\underline{P}}_0, \tilde{M}] = \overline{\underline{P}}_0 - \underline{P}_0 R$, the requisite optimality condition holds.
The h investor is also willing to hold the securities in the Ith segment; indeed, for these securities, the induced risk is $\left(\frac{A^I}{A^h}\right)\text{cov}\left[\tilde{\underline{P}}_I, \left(\frac{A}{A^I}\right)\tilde{M}^s + \tilde{M}_I^h\right]$, that is, $\left(\frac{1}{A^h}\right)(A\text{cov}[\tilde{\underline{P}}_I, \tilde{M}^s] + A^I\text{cov}[\tilde{P}_I, \tilde{M}_I^h])$, which simplifies into $(A^h)^{-1}(\overline{\underline{P}}_I - \underline{P}_I R)$ according to Part (b) of the Proposition. The optimality condition is thus again satisfied. Q.E.D.

III. Valuation and Welfare Effects of Changes in Market Structure

A. Complete Integration

The consequences of removing all investment barriers can be summarized as follows:

(a) Prices of the core securities would not be affected.
(b) For $N = 1$, the aggregate market value of peripheral securities would go up. For $N > 1$, the aggregate market value of peripheral securities would be likely to go up but may go down.
(c) Investors in the core would unambiguously benefit from market integration. Their welfare gain is an increasing function of var $\tilde{M}^h$.

(d) If individual investors in the Ith peripheral segment initially held the same portfolio (of peripheral securities), then they would unanimously favor market integration, and their welfare gain would be an increasing function of var $\tilde{M}^h$ and a decreasing function of var $\tilde{M}_I^h$.

A.1. *Price Effects of Market Integration*

For the special case of only one peripheral segment ($N = 1$), the aggregate market value of the peripheral securities would go up following market integration.[4] Increases in peripheral security prices increase the demand for core securities, exactly counterbalancing the initial downward shift in demand created by the removal of investment barriers. Thus, the valuation of the core securities is not affected.

With more than one peripheral segment ($N > 1$), market integration might result in a decrease in the aggregate market value of the securities of a given peripheral segment. This is because the impact of market integration on the prices in a given segment also depends on the structure of returns in the other peripheral segments.[5]

Peripheral securities with a positive national risk coefficient and an insignificant correlation with all securities outside its national market would be favorably affected by market integration.[6] Indeed, for such securities, the only impact of market integration would be to lower the market price of (national) risk from A^I to A, a decrease which corresponds to the expansion of the investing population with access to the security. For the impact on price to have an unambiguously negative sign, the security would need to have an insignificant or negative national risk coefficient, a zero correlation with the core securities, and a positive correlation with the securities in the other peripheral segments.[7] Of course, to find such a security in the "real" world might prove to be a difficult endeavor.

[4] If $N = 1$, $\tilde{M}^h = \tilde{M}_1^h$, so that $\tilde{M}^s = \tilde{M} - \tilde{M}_1^h$; aggregating equation (7) over the peripheral segment then yields $RM_1 = \bar{M}_1 - A\,\text{cov}[\tilde{M}_1, \tilde{M}] - (A^1 - A)\text{cov}[\tilde{M}_1, \tilde{M}_1^h]$. After integration, the pricing equation becomes $RM_1 = \bar{M}_1 - A\,\text{cov}[\tilde{M}_1, \tilde{M}]$, so that the increase in M_1 is given by $R\Delta M_1 = (A^1 - A)\text{cov}[\tilde{M}_1, \tilde{M}_1^h] = (A^1 - A)\text{var}\,\tilde{M}_1^h \geq 0$.

[5] When $N > 1$, the pricing equation (7) can be rewritten $R\underline{P}_I = \underline{P}_I - A\,\text{cov}[\underline{\tilde{P}}_I, \tilde{M}] - (A^I - A)\text{cov}[\underline{\tilde{P}}_I, \tilde{M}_I^h] + A\,\text{cov}[\underline{\tilde{P}}_I, \sum_{J\neq I}\tilde{M}_J^h]$, so that the impact of market integration on pricing is given by $R\Delta\underline{P}_I = (A^I - A)\text{cov}[\underline{\tilde{P}}_I, \tilde{M}_I^h] - A\,\text{cov}[\underline{\tilde{P}}_I, \sum_{J\neq I}\tilde{M}_J^h]$. After aggregation over the peripheral segment I, this equation becomes $R\Delta M_I = (A^I - A)\text{var}[\tilde{M}_I^h] - A\,\text{cov}[\tilde{M}_I^h, \sum_{J\neq I}\tilde{M}_J^h]$. While the first term on the right-hand side is necessarily positive, the second can be negative and of larger magnitude, with the consequence that $\Delta M_I < 0$. For example, if $\text{cov}[\tilde{M}_I^h, \sum_{J\neq I}\tilde{M}_J^h] > 0$ and $A \gg A^I - A$, such a result would obtain; in contrast, if $\text{cov}[\tilde{M}_I^h, \sum_{J\neq I}\tilde{M}_J^h] \leq 0$, market integration would necessarily result in $\Delta M_I > 0$.

[6] If $\tilde{P}$ denoted the end-of-period price for such a security in segment I, the following conditions would hold: $\text{cov}[\tilde{P}, \tilde{M}^s] \simeq 0$ (no significant international risk), $\text{cov}[\tilde{P}, \tilde{M}_I^h] \simeq \text{cov}[\tilde{P}, \tilde{M}_I] > 0$, and $\text{cov}[\tilde{P}, \tilde{M}] \simeq \text{cov}[\tilde{P}, \tilde{M}_I]$, so that the change in price brought upon by market integration would be given by $R\Delta P \simeq (A^I - A)\text{cov}[\tilde{P}, \tilde{M}_I] > 0$.

[7] The second equation of footnote 5 gives us ΔP, the change in the security's price: $R\Delta P = (A^I - A)\text{cov}[\tilde{P}, \tilde{M}_I^h] - A\,\text{cov}[\tilde{P}, \sum_{J\neq I}\tilde{M}_J^h]$. Unless some additional assumption is made regarding the respective sizes of the $(A^I - A)$ and A coefficients, ΔP can be unambiguously negative (or null) only if $\text{cov}[\tilde{P}, \tilde{M}_I^h] \leq 0$ and $\text{cov}[\tilde{P}, \sum_{J\neq I}\tilde{M}_J^h] \geq 0$.

A.2. Welfare Effects

This section examines welfare effects only as they pertain to shareholders. Core investors would benefit from access to new risk-reducing diversification opportunities without any adverse effect on the market value of their initial portfolio holdings. For these investors, the more incomplete the core of the market, i.e., the less adequate the M^s portfolio as a proxy for the world market portfolio, the higher the benefit of market integration.[8] Since it was assumed at the outset that the core of the market was not complete by itself (i.e., var $\tilde{M}^h > 0$), all investors in the core are strictly better off following market integration, independently of the composition of their initial portfolio holdings.

Unfortunately, such an ex ante unanimity result cannot be generalized to investors in the periphery without additional assumptions. Indeed, the existence of investment barriers gives the investors in the Ith segment a comparative advantage, the ability to invest in the Ith national market portfolio, whereas other investors must be content with an imperfect substitute (the M_I^s portfolio); $\mathrm{var}(\tilde{M}_I - \tilde{M}_I^s) = \mathrm{var}\ \tilde{M}_I^h$ measures the extent of this comparative advantage, which explains why this particular variable has a negative effect on the welfare gain from market integration.[9]

In order to obtain a unanimity result, one has to assume that the investors in a given peripheral segment I initially hold the same portfolio of peripheral securities, i.e., the Ith national portfolio. In that case, the diversification benefits of market integration outweigh the sum of the two other effects: the price effect, which may be favorable or unfavorable, and the negative effect from loss of exclusive access to the securities in that (Ith) segment.[10] In the more general case where the initial holdings of peripheral securities would differ across investors in the same segment, it is conceivable that some investors would not favor

[8] For investors in the core, var $\tilde{W}^0$ is equal to $\left(\frac{A}{A^0}\right)^2$ var $\tilde{M}^s$ before integration and to $\left(\frac{A}{A^0}\right)^2$ var $\tilde{M}$ after integration; consequently, since marketable wealth is not affected, $\Delta UI^0 = \frac{1}{2}\left(\frac{A^2}{A^0}\right)(\mathrm{var}\ \tilde{M} - \mathrm{var}\ \tilde{M}^s) = \frac{1}{2}\left(\frac{A^2}{A^0}\right)\mathrm{var}\ \tilde{M}^h > 0$.

[9] For investors in the Ith peripheral segment, var $\tilde{W}^I$ is equal to $\left(\frac{A}{A^I}\right)^2 \mathrm{var}(\tilde{M}^s) + \mathrm{var}(\tilde{M}_I^h)$ before integration and to $\left(\frac{A}{A^I}\right)^2$ var $\tilde{M}$ after integration; consequently, $\Delta\ \mathrm{var}\ \tilde{W}^I = \left(\frac{A}{A^I}\right)^2 \mathrm{var}\ \tilde{M}^h - \mathrm{var}\ \tilde{M}_I^h$. It follows that, in the general case, the increase in the utility index is given by $\Delta UI^I = \frac{1}{2}\left(\frac{A^2}{A^I}\right)\mathrm{var}\ \tilde{M}^h - \frac{1}{2}A^I \mathrm{var}\ \tilde{M}_I^h + \Delta W^I$, with ΔW^I positive or negative. The first term measures the effect of expanded diversification opportunities and is positive; the second term captures the effect of removing the advantage of exclusive access to the Ith segment and is negative; the third term represents the wealth effect and may be positive or negative.

[10] The wealth effect ΔW^I can be inferred from equation (7): $R\Delta W^I = R\Delta M_I = -A\ \mathrm{cov}(\tilde{M}_I, \tilde{M}^h) + A^I \mathrm{var}\ \tilde{M}_I^h$. This in turn implies that $\Delta UI^I = \frac{1}{2}\left(\frac{A^2}{A^I}\right)\mathrm{var}\ \tilde{M}^h + \frac{1}{2}A^I \mathrm{var}\ \tilde{M}_I^h - A\ \mathrm{cov}(\tilde{M}_I^h, \tilde{M}^h) = \left[\frac{1}{2A^I}\right]\mathrm{var}(A\tilde{M}^h - A^I\tilde{M}_I^h) \geq 0$.

market integration. However, a system of side payments could be used to restore unanimity in favor of market integration.

B. Removal of Investment Barriers Between Two Peripheral Segments

Removal of investment barriers between peripheral segments I and J would allow investors of the two segments to hold each other's true market portfolio rather than the best substitute. In the absence of a strong and positive correlation between $\tilde{M}_I^h$ and $\tilde{M}_J^h$, the national risk premium for both segments would decrease, resulting in an increase in the aggregate market value of the securities in the two segments.[11] It is clear from Section II that such a change would not affect the international risk premium of any security. It would also not affect the national risk premium of any security outside the two segments (I and J) under consideration. Note that this type of partial integration brought about by dismantling of controls, for example, within an economic region cannot be analyzed in a two-country framework.

C. Introduction of a Worldwide Index Fund in the Core

Assume that a financial intermediary creates a new core security with end-of-period market value equal to $\epsilon\tilde{M}$, where ϵ is arbitrarily small. Such a change will cause a *discrete* shift in pricing.

For $N = 1$:

Prior to the introduction of the worldwide index fund, only peripheral investors had access to all securities. The new fund provides core investors the opportunity of holding the world market portfolio and effectively integrates the world market. The increase in the aggregate market value of all the securities is given by

$$\Delta M = (A^I - A)\text{var}\ \tilde{M}^h > 0. \tag{8}$$

For $N > 1$:

Although the introduction of a worldwide index fund is no longer sufficient to ensure complete integration, the national risk premium will on average be positive. This is because no investor can play the role of arbitrageur; the expected return on the (unfeasible) worldwide market portfolio could remain higher than the expected return on the worldwide index fund, since the differential could not be arbitraged away.

D. Introduction of a National Index Fund in the Core

Such a change is equivalent to the creation of a new security with end-of-period market value equal to $\epsilon\tilde{M}_I$, where ϵ is arbitrarily small. It would cause the national risk premium to disappear for all of the securities in the Ith peripheral

[11] The change in the national risk premium for the Ith market would be $A^{I+J}\text{cov}[\tilde{M}_I^h, \tilde{M}_I^h + \tilde{M}_J^h] - A^I\text{cov}[\tilde{M}_I^h, \tilde{M}_I^h] = A^{I+J}\text{cov}[\tilde{M}_I^h, \tilde{M}_J^h] - (A^I - A^{I+J})\text{var}\ \tilde{M}_I^h$, where $A^{I+J} \equiv \left[\frac{1}{A^I} + \frac{1}{A^J}\right]^{-1} < A^I$. The national risk premium would therefore decrease if the correlation between $\tilde{M}_I^h$ and $\tilde{M}_J^h$ were either negative or positive but small.

segment. The international risk premium might increase or decrease, depending on the correlation structure of the returns. The introduction of the national index fund results in $(\tilde{M}_I^s)^* = \tilde{M}_I$ and $(\tilde{M}_I^h)^* = 0$, where the asterisk denotes the post-integration value of the variables. The national risk premium is thus eliminated, and the change in the international risk premium is given by $A\text{cov}[\tilde{M}_I, (\tilde{M}^s)^*] - A\text{cov}[\tilde{M}_I, \tilde{M}^s] = A\text{cov}[\tilde{M}_I, \tilde{M}] - A\text{cov}[\tilde{M}_I^s, \tilde{M}] = A\text{cov}[\tilde{M}_I^h, \tilde{M}^h]$. The net effect on M_I is thus

$$R\Delta M_I = A^I \text{var}\,\tilde{M}_I^h - A\,\text{cov}[\tilde{M}_I^h, \tilde{M}^h] = (A^I - A)\text{var}\,\tilde{M}_I^h - A\,\text{cov}[\tilde{M}_I^h, \textstyle\sum_{J\neq I}\tilde{M}_J^h],$$

which is necessarily positive if $N = 1$ and likely to be positive if $N > 1$ and either $A^I - A \gg A$ and $\text{cov}[\tilde{M}_I^h, \sum_{J\neq I}\tilde{M}_J^h] > 0$ or $\text{cov}[\tilde{M}_I^h, \sum_{J\neq I}\tilde{M}_J^h] \leq 0$. Note that this type of partial integration cannot be appropriately characterized in a two-country framework.

The introduction of such a national index fund would be favored, ex post, by every investor because such a change cannot reduce their investment opportunity set.

E. Introduction of a National Fixed-Income Security in the Core

If access to the market for fixed-income securities in the Ith peripheral segment is limited to the local investors, then the real expected rate of return on these securities is determined in accordance with the pricing relationship (7) of the Proposition; it should be equal to the real rate of interest plus the international risk premium plus the national risk premium. In contrast, if these fixed-income securities were traded in the core, the national risk premium would be zero and the international premium could be higher or lower, depending on the correlation between the exchange rate and the M^h portfolio. Let us call $\tilde{X}$ (respectively X) the end-of-period (respectively beginning-of-period) value of the local currency in terms of some numeraire such as the U.S. dollar and, for simplicity, assume away inflation in the U.S. The real return on the fixed-income security would thus be $R_I \dfrac{\tilde{X}}{X}$, where R_I is the local rate of interest plus one. If the fixed-income security were available only to the local investors, then at equilibrium $R_I E\left[\dfrac{\tilde{X}}{X}\right] = R + AR_I\text{cov}\left[\dfrac{\tilde{X}}{X}, \tilde{M}^s\right] + A^I R_I\text{cov}\left[\dfrac{\tilde{X}}{X}, \tilde{M}_I^h\right]$. If the security were available in the core, then the new equilibrium value for the nominal interest rate would be given by $R_I' E\left[\dfrac{\tilde{X}}{X}\right] = R + AR_I'\text{cov}\left[\dfrac{\tilde{X}}{X}, \tilde{M}\right]$. Consequently, $\left(\dfrac{R}{R_I'}\right) - \left(\dfrac{R}{R_I}\right) = A\text{cov}\left[\dfrac{\tilde{X}}{X}, \tilde{M}^h\right] + A^I\text{cov}\left[\dfrac{\tilde{X}}{X}, \tilde{M}_I^h\right]$. Thus, if the value of the local currency were positively correlated with the M_I^h portfolio and negatively or not significantly correlated with the M^h portfolio, then the equilibrium nominal rate of interest for the fixed-income securities would be lowered by the introduction of those securities in the core. Again note that this type of partial integration cannot be appropriately characterized in a two-country framework.

IV. Conclusion

This paper investigates the impact of capital flow restrictions on the pricing of securities, on the optimal portfolio composition for investors of different nationalities, and on their welfare. It shows that selective barriers to entry can result in a mildly segmented market structure where the equilibrium price of a security is determined jointly by its international and national risk premiums. From the viewpoint of investors, capital flow controls make it impossible to hold the world market portfolio, forcing them to acquire nationality-specific portfolios along with a market-wide proxy for the world market portfolio.

Removal of investment barriers would generally lead to an increase in the aggregate market value of the securities affected by such a change, and ex post all investors would be in favor of a move toward market integration since such a market structure would allow maximum reduction of risk via international diversification. Partial removal of barriers between two peripheral segments would be likely to increase aggregate market value of the securities in the two segments. Finally, the introduction of different types of index funds in the barrier-free (core) segment of the market would generally increase world market integration and investor welfare.

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