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Rational Herd Behavior and the Globalization of Securities Markets

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ABSTRACT

This paper shows that globalization of securities markets exacerbates the volatility of capital flows by strengthening incentives for herding behavior. This is a prediction of a mean-variance portfolio optimization model with imperfect information, in which investors acquire country-specific expertise at a fixed cost and incur variable reputational costs. The model produces equilibria in which incentives to confirm rumors decrease with globalization. Simulations based on equity markets data and country credit ratings suggest that herd behavior can induce large capital outflows from emerging markets.

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"If I may be allowed to appropriate the term speculation for the activity of forecasting the psychology of the market, and the term enterprise for the activity of forecasting the prospective yield of assets over their whole life, it is by no means always the case that speculation predominates enterprise. As the organisation of investment markets improves, the risk of the predominance of speculation does, however, increase. ...Speculators may do no harm as bubbles on a steady stream of enterprise. But the position is serious when enterprise becomes the bubble on a whirlpool of speculation." (J. M. Keynes, The General Theory of Employment, Interest, and Money, pp.158-159)

1. Introduction

In the aftermath of the Mexican crash of 1994, several emerging stock markets fell as investors "ran for cover," expecting that vulnerable countries like Argentina and Brazil, or even rising stars as Chile or Singapore, would be next in a series of currency crises. This "Tequila effect" is indicative of herd behavior by global investors.[1] Investors followed the "market" rather than take the time and expense to make their own assessments of each country's fundamentals, perhaps guessing that "market" portfolios embodied relevant information, or fearing the consequences of disagreeing with the "market" given the risk of massive losses resulting from currency collapses. A similar phenomenon, albeit at a smaller scale, appears to affect the stock markets of industrial countries and is reflected in the recurrent waves of optimism by institutional investors.[2]

The perceived high volatility of these speculative capital flows has resulted in some instances in the introduction of controversial capital controls, taxes, and other barriers to asset trading, which have gained popularity in the wake of Mexico's crisis. In Chile, for example, there are taxes and timing restrictions on inflows and outflows of short-term capital. Even at the New York Stock Exchange (NYSE), there are automatic trading halts that go into effect when stock prices fluctuate too much within a single trading session.[3]

The aim of this paper is to demonstrate that herd behavior is an outcome of optimal portfolio diversification that becomes more prevalent as securities markets grow. We define herding as a situation in which rational investors choose to react to a rumor regarding a country's asset return characteristics or its

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[1]Calvo and Mendoza (1996) review factual evidence of herding by holders of Mexican securities. Calvo and Reinhart (1995) provide statistical evidence of contagion effects in emerging markets.
[2]See the survey data analysis of contagion by word of mouth by Shiller and Pound (1986) and (1987).
[3]Three trading curbs were introduced at the NYSE in 1991. The "uptick-downtick" curb stops program trading (simultaneous transactions of at least 15 different stocks for $1 million or more) when the Dow Jones Industrial Average changes at least 50 points in a day. Additional curbs halt all trading for one hour (two hours) if the index falls 250 (400) points. In 1996 the "uptick-downtick" curb was activated nearly twice a week on average, by far the most times since the curbs were introduced. The higher-level halts have never been used.

"appropriate" share in the optimal portfolio. We use a basic framework of mean-variance portfolio diversification to show that two characteristics of imperfect information can produce equilibria in which incentives to assess the veracity of rumors weaken as capital markets grow. First, if there is a fixed cost of gathering and processing country-specific information, the expected utility gain made by paying this cost generally falls as the number of countries where wealth can be invested grows. Portfolio allocations also become more sensitive to changes in perceived asset returns as markets grow, and thus herd behavior is more likely to prevail and to produce larger capital flows in globalized securities markets. Second, if investors (or fund managers) face reputational costs that depend on the performance of their portfolios relative to the performance of a given market portfolio, in terms of their corresponding mean returns, there is a range of multiple equilibria inside of which investors rationally choose to mimic the market portfolio. When a rumor suddenly favors another portfolio within the herding range, all investors decide to "follow the herd." In this case, globalization exacerbates herding because the indeterminacy range widens as the market grows.

The finding that information frictions can lead to herding is well-known, since they are the basis of most optimizing models of herd behavior developed to date. What is less known is that, for given information frictions, incentives for herd behavior can grow stronger as markets grow. Thus, the first task of this study is to identify the conditions under which this perverse effect of globalization emerges. In addition, since the magnitude of this effect, and the actual shifts in portfolio allocations that herd behavior may induce, are also largely unknown, the second task of the paper is to examine the model's quantitative implications.

The quantitative analysis is based on historical data from equity markets and country credit ratings (CCRs). Equity-market measures of the mean and variance of country asset returns are viewed as information agents can acquire at no cost, while the detailed country expertise imbedded in CCRs is assumed to be costly. We identify two key empirical regularities in the credit ratings: (a) the ratings of both industrialized and least developed countries are very stable, reflecting the fact that new information does not alter significantly the perception of investment conditions in these countries, whereas the ratings of emerging economies are very volatile, and (b) information gathering generally leads to larger adjustments of the mean and variance of asset returns, compared to historical equity-market moments, for emerging markets that for OECD countries. Thus, the entry of emerging economies into the global market added investment opportunities for which historical equity-market data are not very informative of future asset returns. The model is calibrated to capture these stylized facts, and simulated to assess the magnitude of the maximum information costs agents would pay to verify a rumor, and how this maximum is affected by market growth.

The simulations show that realistic assumptions on the size of the world capital market, the mean and variance of asset returns, and the information updates provided by CCRs, are consistent with large capital flows driven by herd behavior. If the block of emerging economies is viewed as a segmented market, our analysis shows that investors will rationally choose not to assess the veracity of country-specific rumors if fixed information costs exceed 1/6 of the mean portfolio return prior to the emergence of a rumor. The expected utility gain of information gathering is a very steep decreasing function of the number of countries in the portfolio -- the full adverse effect of globalization on information gains is transmitted with about a dozen countries. When reputational effects are considered, there is a range of "market" portfolio shares, measuring about 2.5 percentage points, that supports herding equilibria even for small reputational costs. Simulations applied to Mexican data suggest that the model can rationalize capital outflows in excess of $15 billion triggered by rumors. Thus, herding may justify trading limits in domestic stock markets and the growing concern for the volatility of global capital flows.

Our model does not differentiate explicitly global capital markets from domestic stock markets. However, we view as the distinctive feature of global markets the fact that information frictions play a key role. This is consistent with the empirical regularities we identified in country credit ratings, and is also in line with the elaborate warnings that mutual funds give investors to highlight the special risks of global investing:

"These risks include: fluctuations in currency exchange rates, devaluation of currencies, imposition of withholding taxes, reduced availability in the U.S. of public information concerning non-U.S. issuers, future political and economic developments and the imposition of currency exchange regulations or other legal restrictions, and the fact that non-U.S. companies are not generally subject to the same type of regulatory practices and reporting standards applicable to U.S. companies. Moreover, many foreign securities may be less liquid than U.S. securities and their prices more volatile, and transactions costs are incurred in converting assets from one currency to another. Brokerage commissions and custody fees are also generally higher than for U.S. securities. In addition, with respect to certain

countries, there is the possibility of expropriation or nationalization of issuers of securities, confiscatory taxation, and limitations on the use or removal of monies or other assets" (Franklin Partners Funds, Prospectus, May 1, 1996, p.13)). The issues of concern to international investors are thus radically different from those that worry domestic investors, and the costs incurred in gaining an expertise at the same level of that typically acquired for domestic investment are much higher (see Frankel and Schmukler (1996)).

Keynes's (1936) classic analysis of "rational speculation," defined as "the activity of forecasting the psychology of the market," anticipated our work in predicting that speculation can be more pervasive in larger markets, as eloquently stated in the quotation that opens the paper. He also proposed other mechanisms that drive speculation -- sudden changes of opinion driven by mass psychology, perverse incentives of professional investors induced by information or reputational costs,[4] and changes in the confidence of lenders that finance speculators -- which have been the focus of the modern literature on herd behavior.[5] It is also worth noting that Keynes's negative views on speculation led him to favor capital market regulations, which our model also favors. However, we are aware, as was Keynes, of the complex trade-off between hampering speculation and introducing costly distortions when considering policies to restrain capital markets.

The rest of the paper is organized as follows. Section 2 analyses the relationship between herd behavior and the globalization of securities markets. Section 3 examines the quantitative implications of the analysis. Section 4 concludes with a discussion of normative issues.

2. Rational Herd Behavior in A Basic Framework of Global Portfolio Diversification

We study a global market consisting of J countries $(2 \leq J \leq \infty)$ and a large number of identical investors. The portfolio of the representative investor is to be divided between J-1 identical countries and a single country (Country i) which generally has different asset return characteristics. All countries but i pay asset returns that are perceived as i.i.d. processes with mean ρ and variance σ_j^2, which we refer to as the mean and variance of

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[4]Keynes (1936, p. 157) argued: "Investment based on genuine long-term expectation is so difficult to-day as to be scarcely practicable. He who attempts it must surely lead much more laborious days and run greater risks than he who tries to guess better than the crowd how the crowd will behave..."

[5]This literature provides the micro-foundations of herding justifying the information and reputational costs we assumed. See for example Scharfstein and Stein (1990), Bikhchandani et al. (1992), Banerjee (1992), and Morris and Shing (1995).

the "world portfolio." Country i pays expected return r^* with variance σ_i^2, which is correlated with the world portfolio according to a correlation coefficient η. The share of the portfolio invested in the J-1 countries is constant across each of them in equilibrium and is defined as θ. The investor's preferences are characterized by the following indirect expected utility function:

$$EU(\theta) = \mu(\theta) - \frac{\gamma}{2}\sigma(\theta)^2 - \kappa - \lambda(\mu(\Theta)-\mu(\theta)), \qquad \gamma,\kappa > 0. \tag{1}$$

γ is the coefficient of absolute risk aversion, μ and σ define respectively the mean and standard deviation of the portfolio as a function of θ, κ represents a fixed cost of acquiring country-specific information, and $\lambda(\mu(\Theta)-\mu(\theta))$ represents the reputational cost (benefit) of obtaining a mean portfolio return lower (higher) than the mean return of an arbitrary "market" portfolio Θ. The properties of λ are specified later.

The objective of this section is to show analytically that both information and reputational costs introduce frictions that reduce incentives for information gathering as the global market grows (i.e. as J rises). This is done more easily by isolating the effects of each cost on the design of optimal portfolios.

Fixed Costs of Gathering and Processing Country Specific Information

Consider first an initial equilibrium in which Country i is identical to the rest (i.e. $r^*=\rho$ and $\sigma_i=\sigma_j=\sigma$) and asset returns are uncorrelated (η=0), so that the investor allocates equal amounts of wealth across all countries. Assuming, without loss of generality, that he has one unit of wealth, the share of the portfolio invested in each country is $1/J$ and portfolio mean return and variance are ρ and σ^2/J respectively.

The investor then hears a rumor indicating that Country i's mean return is r, $r\leq\rho$, but its variance is still σ^2. The investor can acquire and process country-specific information at the fixed cost κ to assess the veracity of the rumor and update the mean and variance of Country i's returns. If the investor chooses not to pay the information cost, the portfolio choice involves J-1 countries with asset return moments ρ and σ^2, and Country i with the same variance but expected return r. If he pays the information cost, the characteristics of asset returns in the J-1 countries are unchanged, but the mean and variance of Country i returns are updated. For analytical tractability, we focus on the case in which the investor can learn the "true" return of Country i

with full certainty, and consider later in the numerical analysis the more general case in which he only learns updated values of the mean and variance of Country i returns.[6] Thus, the investor's priors are that by paying κ he may learn a new return r^I with zero variance. Before paying κ, however, the potential update of the return is itself a random variable drawn from a known probability distribution function (p.d.f.). Clearly, the investor will pay the information cost only if the expected utility obtained by gathering information, EU^I, exceeds that of remaining uninformed, EU^U (i.e. the net gain from information searching $S \equiv EU^I - EU^U$ must be positive).

Let θ^U and θ^I be the portfolio shares chosen by uninformed and informed agents respectively. Ignoring reputational costs, θ^U is chosen so as to maximize expected utility:

$$EU^U = \theta^U \rho + (1 - \theta^U) r - \frac{\gamma}{2}\left[\frac{(\theta^U)^2}{J - 1} + (1 - \theta^U)^2\right]\sigma^2. \tag{2}$$

The solution for their optimal portfolio is:

$$\theta^U = \left(\frac{J - 1}{J}\right)\left[1 + \frac{\rho - r}{\gamma \sigma^2}\right]. \tag{3}$$

Short positions are ruled out for simplicity. Thus, $\theta^U=1$ for $r \leq r^{min}$, where $r^{min} = \rho - (\gamma\sigma^2/(J-1))$, and $\theta^U=0$ for $r \geq r^{max}$, where $r^{max} = \rho + \gamma\sigma^2$. Note that as J goes to ∞, the interval of returns that supports internal solutions shrinks to $r^{max} - r^{min} = \gamma\sigma^2$.

For any rumor inside the interval $r^{min} < r < r^{max}$, expected utility valued at the maximum is:

$$EU^U = \left(r - \frac{\gamma}{2}\frac{\sigma^2}{J} + \frac{(\rho - r)}{2}\frac{J-1}{J}\left[2 + \frac{(\rho - r)}{\gamma \sigma^2}\right]\right) \tag{4}$$

Alternatively, if $r \leq r^{min}$, $EU^U = \rho - [\gamma\sigma^2/2(J-1)]$, and if $r \geq r^{max}$, $EU^U = r - \gamma\sigma^2/2$.

We examine next the portfolio problem of informed agents. Consider first the choice of an investor that paid κ and learned the realization r^I. State-contingent utility $U^I(r^I)$ is:

$$U^I(r^I) = \theta^I \rho + (1 - \theta^I) r^I - \frac{\gamma}{2}\left[\frac{(\theta^I)^2}{J - 1}\right]\sigma^2 - \kappa. \tag{5}$$

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[6] The numerical analysis will also allow for correlated asset returns and differentiated variances, as well as cases in which the ex ante mean return in Country i differs from the world return.

The optimal, state-contingent portfolio is:

$$\theta^I(r^I) = (J-1)\left[\frac{\rho - r^I}{\gamma\sigma^2}\right]. \tag{6}$$

Ruling out short sales, $\theta^I(r^I)=0$ if $r^I \geq \rho$, and $\theta^I(r^I)=1$ if $r^I \leq r_{min}^I$ where r_{min}^I is:

$$r_{min}^I = \rho - \frac{\gamma\sigma^2}{J-1}. \tag{7}$$

Note that r_{min}^I rises with J, and converges to ρ as J grows without bound. Thus, the interval that allows the portfolio of an informed agent not to be specialized shrinks to almost zero as the market grows infinitely large.

Let $F(r^I)$ and $f(r^I)$ denote the c.d.f. and p.d.f. of r^I. Expected utility of informed agents is:

$$EU^I = \int_{-\infty}^{\infty}\left[\theta^I(r^I)\rho + (1-\theta^I(r^I))r^I - \frac{\gamma}{2}\left[\frac{(\theta^I(r^I))^2}{J-1}\right]\sigma^2\right]f(r^I)dr^I - \kappa. \tag{8}$$

It is obvious that the fixed cost can be made sufficiently large so that S is negative, and hence agents would choose not to be informed. Less obvious is the fact that, under fairly general conditions, S is a decreasing function of J for any given κ. Thus, globalization reduces the incentives to gather country-specific information that would allow investors to avoid herd behavior. This result is established formally as follows:.

Proposition 1: *For any "pessimistic" rumor such that $r^{min} < r < r^{max}$ and $r \leq \rho$, and assuming that both F and f are continuously differentiable, the gain of acquiring country-specific information S is a decreasing function of J (i.e. $dS/dJ<0$) if the number of countries in the global market is at least $J > 1/[1-F(\rho)^{1/2}]$.*

Proof: State-contingent utility of informed agents (net of κ) takes the following values:

If $r^I \leq r_{min}^I$:

$$U^I(r^I) = \rho - \frac{\gamma}{2}\frac{\sigma^2}{J-1}. \tag{9}$$

If $r_{min}^I < r^I < \rho$:

$$U^I(r^I) = r^I + \frac{1}{2}\frac{(\rho - r^I)^2}{\gamma\sigma^2}(J-1). \tag{10}$$

If $r^I \geq \rho$:

$$U^I(r^I) = r^I. \tag{11}$$

Thus, for any rumor such that $r^{min} < r < r^{max}$, S is given by:

$$S = \left(\rho - \frac{\gamma}{2}\frac{\sigma^2}{J-1}\right)F(r^I_{min}) + \int_{r^I_{min}}^{\rho}\left[r^I + \frac{1}{2}\frac{(\rho - r^I)^2}{\gamma\sigma^2}(J-1)\right]dF(r^I) + \int_{\rho}^{\infty} r^I dF(r^I) - \kappa$$
$$- \left(r - \frac{\gamma}{2}\frac{\sigma^2}{J} + \frac{(\rho - r)}{2}\frac{J-1}{J}\left[2 + \frac{(\rho - r)}{\gamma\sigma^2}\right]\right). \tag{12}$$

Since $F(r^I)$ is continuously differentiable,

$$\frac{dS}{dJ} = \frac{\gamma}{2}\frac{\sigma^2}{(J-1)^2}F(r^I_{min}) + \int_{r^I_{min}}^{\rho}\frac{1}{2}\frac{(\rho - r^I)^2}{\gamma\sigma^2}dF(r^I) - \frac{\gamma}{2}\frac{\sigma^2}{J^2} - \frac{(\rho - r)}{2J^2}\left(2 + \frac{(\rho - r)}{\gamma\sigma^2}\right). \tag{13}$$

Setting $r^I = r_{min}{}^I$ in expression (13), it follows that:

$$\frac{dS}{dJ} \leq \frac{\gamma}{2}\frac{\sigma^2}{(J-1)^2}\left[F(\rho) - \left(\frac{J-1}{J}\right)^2\right] - \frac{(\rho - r)}{2J^2}\left(2 + \frac{(\rho - r)}{\gamma\sigma^2}\right). \tag{14}$$

Since $r^{min} < r \leq \rho$, it follows that $J > 1/[1-F(\rho)^{1/2}]$ is sufficient (although not necessary) for $dS/dJ < 0$.□

Expression (14) shows that there are two key determinants of the critical market size after which the gains of information gathering become a negative function of J. First, the position of the mean return of the world portfolio (i.e. ρ) in the distribution of Country i returns that agents expect to learn. For example, if f is symmetric and $E(r^I)=\rho$, $F(\rho) = 0.5$ and dS/dJ is negative with as few as 4 countries. If $F(\rho)$ is smaller (larger) than 1/2, which implies that $E(r^I)$ is larger (smaller) than ρ, the critical value of J falls (rises). This result has a natural intuition. If investors are "bullish" on Country i, in the sense that $E(r^I) > \rho$, the incentives to gather information begin to decrease with J for a smaller market than when investors are "bearish" on Country i. When costly information is *expected* to produce good news, incentives for acquiring it are weak.

The second key determinant of the critical value of J is the size of the rumor. If the rumor is very optimistic, in the sense that $r \geq r^{max}$, one can show that dS/dJ is always positive with an upper bound given by $dS/dJ = [\gamma\sigma^2/2(J-1)^2]F(\rho)$. At the other extreme, for very pessimistic rumors, in the sense that $r \leq r^{min}$, one can show that $dS/dJ \leq [\gamma\sigma^2/2(J-1)^2][F(\rho)-1]$, and thus dS/dJ is always nonpositive. Thus, there are rumors that are "too good to be true," so that the gain from information gathering always grows with the market, and there are rumors that imply such "bad news" that as the market grows the incentives to confirm them always decline. Pessimistic rumors inside the interval relevant for Proposition 1 play a similar role. Consider again the case in which f is symmetric. A pessimistic rumor such that $r^{min} < r < \rho$ implies that dS/dJ may be negative even if $F(\rho)$ is somewhat larger than 1/2 (i.e. with $r<\rho$, the critical value of J falls for any given $F(\rho)$). This is because expected utility of uninformed investors rises with the difference ρ-r. Thus, a bad rumor contributes to reduce the benefits of gathering information on Country i as the market expands *even if investors are bearish about Country i (i.e.* $E(r^J) < \rho$*).* [7]

Two important additional remarks. First, regardless of the size of the rumor and the values of $E(r^J)$ and ρ, the marginal gain of information gathering converges to 0 as J grows without bound. This is because in the limit, as $J\rightarrow\infty$, both r^{min} and $r_{min}{}^{I}$ converge to ρ, as a very large global market offers a virtually risk-free asset at the rate of return ρ. Thus, as the market grows infinitely large the gain of gathering country-specific information becomes independent of the size of the global market. Second, as J rises, not only are the incentives to gather information diminishing as J goes to infinity, but the impact of rumors on the allocation of investment funds to a single country by uninformed investors, relative to the initial allocations $1/J$, also grows without bound. This is because $-d\theta^U/dr$ converges to $1/\gamma\sigma^2$ in the limit as $J\rightarrow\infty$. Thus, an uninformed investor's response to a rumor results in larger proportional effects on capital flows as globalization progresses.

Reputational Effects

Consider now the effects of reputation and set κ=0. Reputational effects allow the model to produce herding as a result of multiple equilibria in optimal portfolio shares, and this has the advantage of making the response to rumors identified above more persistent. We have shown that incentives for paying a fixed information cost weaken as markets are globalized, and hence globalization makes it more likely that investors may react to rumors. Still, the effects of such reaction may be short-lived because whenever investors react

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[7]Note that there is also an area of optimistic rumors (i.e. $\rho<r<r^{max}$) for which the reverse is true. The last term in (14) is now positive, so $J>1/[1-F(\rho)^{1/2}]$ is necessary but not sufficient for $dS/dJ\leq 0$. dS/dJ may be positive even if $F(\rho)$ is somewhat smaller than 1/2 (i.e. with $r>\rho$, the critical value of J rises for any given $F(\rho)$).

to a rumor there is a sell off in the affected country's stock market, and the ensuing "price correction" can drive expected returns high enough to undo the effect of the rumor. There are, however, several reasons why a price correction may fail to undo the effects of rumors. For instance, if the correction is seen as triggering a very distortionary policy response that will cripple the economy, the stock market collapse can become part of a self-fulfilling crisis (see Calvo (1996) and Cole and Kehoe (1996)). Another reason are reputational effect, as shown below.

Investors, or mutual fund managers, face a variable reputational cost or benefit of obtaining mean portfolio returns that deviate from the mean return of an arbitrary world portfolio. These reputational effects are given by the cost function $\lambda(\mu(\Theta)-\mu(\theta))$, which satisfies the following properties:[8]

$$\begin{gathered}\lambda>0 \ \textit{if} \ \mu(\theta) < \mu(\Theta), \quad \lambda\leq 0 \ \textit{if} \ \mu(\theta) > \mu(\Theta), \quad \lambda(0)=0, \\ \lambda'\geq 0 \ \textit{with} \ \ \lambda'(x) > \lambda'(-x) \ \ \textit{for all} \ \ x = \mu(\Theta)-\mu(\theta) > 0 \\ \lambda''\leq 0. \end{gathered} \tag{15}$$

Hence, there is a reputational cost (benefit) when the mean return of the investor's portfolio is smaller (larger) than that of the market portfolio, and the marginal reputational cost exceeds the marginal reputational benefit. Thus, on the margin, the punishment for poor performance is larger than the prize for good performance. This specification is general enough to capture the case in which good performance goes unrewarded.

The problem of a global investor is to choose θ, given some Θ, so as to maximize:

$$EU(\theta) = \theta\rho + (1-\theta)r - \lambda(\mu(\Theta)-\mu(\theta)) - \frac{\gamma}{2}\left[\frac{(\theta\sigma_J)^2}{J-1} + ((1-\theta)\sigma_J)^2 + 2\sigma_J\sigma_i\theta(1-\theta)\eta\right]. \tag{16}$$

Since $\mu(\theta)=\theta\rho+(1-\theta)r$ and $\mu(\Theta)=\Theta\rho+(1-\Theta)r$, it follows that $\lambda(\mu(\Theta)-\mu(\theta))=\lambda((\Theta-\theta)(\rho-r))$. Note also that here we allow the variances of investing in Country i (σ_i^2) and in all J countries except i (σ_J^2) to differ, and asset returns are correlated according to the correlation coefficient η.

This portfolio optimization problem displays herd behavior in the sense that, for rumors that reflect a certain range of values of Θ, choosing $\theta=\Theta$ is optimal for a representative investor and is also a rational-

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[8]It is also assumed that $\lambda'(0)$ does not exist to capture the notion of fixed costs.

expectations equilibrium in which every investor in the global market selects the same portfolio. Within that range, a rumor calling for a different Θ results in a herding panic that induces all investors to re-optimize their portfolios and choose that new Θ.

The above result is interesting, but not all that surprising since the assumption that poor performance is punished relatively more than good performance provides an incentive to mimic market portfolios. We are more interested in a second result showing that in the presence of reputational effects it is again the case that globalization strengthens incentives for herding. The latter is implied by the fact that the range of optimal portfolio indeterminacy widens as the global market grows for a given reputational cost function. The two results are established in Propositions 2 and 3.

Proposition 2: *If in the neighborhood of the optimal portfolio θ^* corresponding to an investor free of reputational effects, the marginal reputational cost (gain) of deviating from the mean return of the market portfolio $\mu(\Theta)$ is sufficiently large (small), there exists a range of global, rational-expectations equilibria of individual portfolio allocations θ, such that investors optimally choose $\theta=\Theta$.*

Proof: We prove that, under certain conditions, the optimal response to a market portfolio Θ it to set $\theta=\Theta$ because $EU'(\theta)<0$ for $\theta>\Theta$ and $EU'(\theta)>0$ for $\theta<\Theta$. The proof is completed as follows:

(i) The first-order condition for maximization of (16) with respect to θ is:

$$\rho - r - \gamma\left[\frac{\theta\sigma_J^2}{J-1} - (1-\theta)\sigma_i^2 + \eta\sigma_J\sigma_i((1-\theta)-\theta)\right] - \lambda'(\cdot)(r-\rho) = 0. \tag{17}$$

(ii) Define $E\hat{U}'(\theta)\equiv\rho-r-\gamma[\theta\sigma_J^2/(J-1)-(1-\theta)\sigma_i^2+\eta\sigma_J\sigma_i((1-\theta)-\theta)]$ as the marginal utility of θ for an investor that does not face reputational effects, so $E\hat{U}'(\theta^*)=0$ at the optimum θ^*. Note that the second-order condition $E\hat{U}''(\theta)<0$ requires $\sigma_J^2/(J-1)+\sigma_i^2>2\eta\sigma_J\sigma_i$.

(iii) Given (ii), rewrite (17) as:

$$E\hat{U}'(\theta) - \lambda'(\cdot)(r-\rho) = 0. \tag{18}$$

(iv) The solution(s) to (17) will depend on the relative returns of Country i and the world portfolio. Clearly, if $r=\rho$ the solution θ^* will also be the unique solution for the model with reputational effects, and there is no herding behavior. Thus, the relevant cases are those in which r and ρ differ.

(v) Consider the case in which $r>\rho$ and assume an arbitrary market portfolio such that $\Theta\leq\theta^*$. Investors will not choose $\theta>\Theta$ if it implies $EU'(\theta)<0$. There are two options. First, if $\theta>\theta^*$ clearly $EU'(\theta)<0$ because

$E\hat{U}'(\theta)<0$, as implied by $E\hat{U}'(\theta^*)=0$ and $E\hat{U}''(\theta)<0$, and $\lambda'(\cdot)(r-\rho)>0$. Second, if $\Theta<\theta\leq\theta^*$, a necessary and sufficient condition for $EU'(\theta)<0$ is $\lambda'(\cdot)(r-\rho)>E\hat{U}'(\theta)$. Since with $r>\rho$ and $\theta>\Theta$ the investor would obtain a mean return smaller than that of the arbitrary market portfolio, this condition states that the marginal reputational cost of producing below-market returns needs to be "sufficiently large" in the vicinity of θ^* for equilibria with herding to exist. A similar condition ensures that investors will not choose $\theta<\Theta$ (i.e. $EU'(\theta)>0$ if $\theta<\Theta$). For such a θ, $\theta<\Theta\leq\theta^*$, and hence $E\hat{U}'(\theta)>0$. Thus, $EU'(\theta)>0$ if $E\hat{U}'(\theta)>\lambda'(\cdot)(r-\rho)$. Note that in this case the investor would be beating the market by setting $\theta<\Theta$, so this condition states that in the neighborhood of θ^* the marginal reputational gain of beating the market must be "sufficiently small" for herding equilibria to exist. Finally, note there can be no herding equilibria for $\Theta\geq\theta^*$ because the condition that $EU'(\theta)>0$ for $\theta<\Theta$ can never hold if $\theta^*\leq\theta<\Theta$. In this case, $E\hat{U}'(\theta)\leq 0$ and $\lambda'(\cdot)(r-\rho)>0$, so $EU'(\theta)<0$.

(v) An argument similar to (iv) shows that for $r<\rho$ there is a range of herding equilibria for some values of Θ in the region $\Theta\geq\theta^*$, if $E\hat{U}'(\theta)<\lambda'(\cdot)(r-\rho)$ for $\theta>\Theta$ and $E\hat{U}'(\theta)>\lambda'(\cdot)(r-\rho)$ for $\theta^*\leq\theta<\Theta$. In this case, there can be no herding equilibria in the range $\Theta\leq\theta^*$.□

Proposition 3. *The range of multiple equilibria, defined by the values of Θ in the interval $\theta^{ow}<\Theta<\theta^{up}$ for which Proposition 2 holds, widens as the global market grows (i.e. $\theta^{up}-\theta^{ow}$ is increasing in J).*

Proof: To simplify this proof we consider the case of a linear marginal reputational cost function $\lambda''(\Theta-\theta)=0$ and limit our attention to the case in which $r>\rho$, which are the assumptions adopted in the numerical exercise of the next section. Note that in this case θ^{ow} satisfies (17) for $\mu(\Theta)>\mu(\theta)$ and θ^{up} satisfies (17) for $\mu(\Theta)<\mu(\theta)$. The total differential of (17) implies that:

$$\frac{d\theta}{dJ} = \frac{\left(\frac{\gamma\theta\sigma_J^2}{(J-1)^2}\right)}{\gamma\left(\frac{\sigma_J^2}{J-1} + \sigma_i^2 - 2\eta\,\sigma J\sigma i\right)}. \tag{19}$$

The expression in the denominator of (19) corresponds to $-E\hat{U}''(\theta)$, and thus as long as the second-order condition stated in (ii) above holds, $d\theta/dJ$ is positive and increasing in θ. It follows therefore that as J rises both θ^{up} and θ^{ow} rise, and, since $\theta^{up}>\theta^{ow}$, θ^{up} rises more than θ^{ow}, so the range of multiple equilibria widens.□

The intuition for this result is simple. Given a marginal reputational cost invariant to J or θ, the growth of the global market can only affect the expected marginal utility of optimal portfolios in two ways. First, as J rises, the effective variance of the world fund $(\sigma_j^2/(J-1)^2)$ falls, and thus the marginal utility of θ rises. This effect is proportional to the portfolio share invested in the world fund, as shown in the numerator of (19). Second, the reduced variance of the world fund makes this asset more attractive relative to Country i securities, providing an incentive to increase θ, which in turn reduces marginal utility. The magnitude of this second effect is independent of θ because the rate at which marginal utility falls as θ rises is invariant to portfolio shares, as the denominator of (19) shows. Hence, the optimal portfolio shift induced by market growth is larger the larger the initial θ. Notice, however, that $d\theta/dJ$ is decreasing in J and converges to 0 as J goes to infinity because in a large market the world fund becomes virtually riskless. Thus, the positive effect of J on the indeterminacy range displays "diminishing returns."

Note that all portfolios inside the range of multiple equilibria are sub-optimal, except in particular cases in which the Pareto-efficient portfolio θ* is inside the indeterminacy range.[9] Thus, herd behavior is generally inefficient. Moreover, the existence of multiple optimal portfolios for a given pair of mean returns r and ρ implies that there can be capital outflows from Country i even in the absence of rumors country asset returns. This also implies that a price correction following a rumor about r may not prevent persistent herding.

A Comparison with Game-Theoretic and Contagion Models of Herd Behavior

The framework presented above considers a global market consisting of a large number of identical investors formulating simultaneous decisions. This differs from the sequential decision-making setup typical of game-theoretic models of herd behavior.[10] These models show that when information is incomplete, and the

[9]This is because θ* maximizes $E\hat{U}(\theta)$, and $EU(\theta)=E\hat{U}(\theta)$ whenever θ=Θ since $\lambda(0)=0$.

[10]Our analysis adopts some assumptions similar to those used in game-theoretic models. In Banerjee (1992) payoffs are discontinuous at the "true value" of asset returns, resembling the discontinuity of λ' at θ=Θ. Banerjee (1992) and Bikhchandani et al. (1992) require two sources of uncertainty (about outcomes and about signals), while in our model investors considering whether to pay the fixed information cost face uncertainty about asset return "fundamentals" and about potential updates of mean and variances of assets returns.

signals that transmit it are noisy, agents waiting in line to make a decision may imitate agents ahead of them, rather than use their own information (i.e. there are "informational cascades" that lead to herding).

Our framework can be easily incorporated into a sequential decision-making setting. Consider the case in which country-specific expertise can be acquired at a fixed cost. Assume a group of N investors, indexed $h=1,..N$, set to make portfolio choices in sequence. Each draws a noisy signal (i.e. a rumor) about r denoted r_h which cannot be observed by the other $N-1$ investors, although portfolio choices are public information. Whenever an investor pays the information cost, he learns the true value r^i. Start with the choice of the first investor in a small market. Assume Proposition 1 holds but $S>0$, so that he pays the information cost. In this case the initial rumor does not prevail. Consider now that the market grows, and hence S begins to decline until $S<0$. Now the first investor chooses not to pay for the information that would discredit the rumor. Moreover, assume that his signal is $r_1<r^{min}$, so that his portfolio choice is $\theta^{1}=1$. This conveys the information that $r_1<r^{min}$ to all investors after him. Given an initial negligible prior against Country i, if all investors after the first get signals $r_h>r^{min}$, for $h=2...N$, and if signals are of the same quality (as in the restaurants example of Banerjee (1992)), all investors go by the prior and choose $\theta=1$, disregarding their signals favoring Country i. The information cost is never paid and all investors hold the same portfolio reacting to the initial rumor.

A similar interpretation applies to the case with reputational effects, if they are viewed as the "sharing-the-blame" reputational effects that induce herding externalities in Scharfstein and Stein (1990). Assume again N investors in line to choose their portfolios observing the portfolios chosen by investors ahead of them, with the first one facing an arbitrary Θ. Each investor draws a piece of news at random that acts as a shift parameter in λ', so marginal costs are indexed by h for $h=1,..,N$. The λ'_hs are like the signals introduced in Banerjee (1992) or Bikhchandani et al. (1992), with the distribution of λ' defined to have positive (negative) support for $\theta>\Theta$ ($\theta<\Theta$). Under these conditions, there can be "informational cascades" in which the agents first in line may draw λ'_hs such that they choose Θ, thereby increasing the incentives for followers to also choose Θ. In some of these cascades everybody chooses Θ, and herd behavior dominates. Since for any λ_h the range of multiple equilibria in portfolio shares widens as J rises, a set of signals that supported an equilibrium without herding in a small market can produce an informational cascade with herding in a large market.

The contagion models examined by Shiller (1995) also have an interesting connection with our model. Contagion by word-of-mouth provides microfoundations for the determination of Θ or r, and for the process leading from one value of Θ to another within the range of herding equilibria. There is ample anecdotal evidence of word-of-mouth contagion in the spreading of rumors during the Mexican crisis. One dramatic example was the sharp fall of the peso in November 11, 1995, triggered by the rumors of a coup and the resignation of the finance minister, both of which originated in U.S. capital markets (see Calvo and Mendoza (1996)). The rumors were discredited by noontime, but the peso recovered only a small fraction of its losses. Survey data collected by Shiller and Pound (1986) and (1987) provides further evidence of word-of-mouth contagion among institutional investors in the United States.

3. Numerical Simulations

This section quantifies the predictions of the model derived in Section 2. The analysis is based on a benchmark calibration that reflects basic statistical properties of international asset returns and portfolio holdings. The objective is not to assess the model's ability to explain actual investment behavior, since it is well-known that the mean-variance model cannot explain several features of actual portfolio allocations, particularly the "home" bias of international portfolios (see Tesar and Werner (1994a)). The intent is simply to explore how plausible is herd behavior in the model because of the information frictions we proposed.

Benchmark Calibration and Stylized Facts

The benchmark calibration is designed to mimic two sets of stylized facts:

(A) Composition of global portfolios and statistical moments of asset returns:

The calibration determines a value of the coefficient of absolute risk aversion, γ, consistent with existing estimates of the mean and variance-covariance structure of asset returns, and data on net holdings of foreign equity by global investors, assuming a conventional mean-variance setup without information or reputational costs. The equation that relates γ to θ and the statistical moments of asset returns is derived by solving (17) for γ setting $\lambda'(\cdot)=0$. We plugged various estimates of the mean and variance-covariance structure of asset returns and the composition of global portfolios from different sources in the resulting expression, and concluded that plausible values of γ range between near 0 and $1/2$.[11] We chose the middle point $1/4$ for the benchmark calibration.

One example of the above calculations is as follows. Consider a two-country world consisting of the United States and "the rest of the world" as defined in Bohn and Tesar (1994).[12] This implies setting (1) $\rho=0.62$ percent and $\sigma_j=4.46$ percent, which are the mean and standard deviation of monthly excess returns on U.S. equity over the period January 1981-October 1993, (2) $r=0.69$ percent, $\sigma_i=5.41$ percent, and $\eta=0.462$, which are the "rest-of-the-world's" mean, standard deviation and U.S.-correlation of asset returns, measured in U.S. dollars and assuming unhedged currency risk, and (3) $\theta=0.964$, which reflects the average holdings of foreign equity by U.S. investors measured at less than 4 percent of their portfolios. These parameters imply $\gamma=0.004$. Note, however, that there are also several data combinations that produce negative values of γ, highlighting the weaknesses of the mean-variance model.

(B) Indicators of international information and their impact on asset return assessments

The best available measure of country-specific information is embodied in the country credit ratings constructed by international banks for their lending operations, and compiled and published every six-months, in March and September, by the *Institutional Investor.* We examined these CCRs to assess how much potential investors may find investment conditions to have changed in individual countries every time they gather new information. Figure 1 plots the time-series average of each country's CCR against the corresponding standard deviation, using all available data, which in most cases covers the period September, 1979 to March, 1996. Figure 2 is a similar plot that includes only OECD and Latin American countries.

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[11]See, for example, Bohn and Tesar (1994), Lewis (1995), and Tesar and Werner (1994b).

[12]Bohn and Tesar (1994) examined net purchases of foreign stocks by U.S. investors in 17 industrial countries (Australia, Austria, Belgium, Germany, Spain, France, Italy, Netherlands, Switzerland, the U.K., Ireland, Japan, Canada, Denmark, Finland, Norway, Sweden, and South Africa) and 4 emerging markets (Hong Kong, Mexico, Singapore, and Malaysia). They measured monthly excess returns in U.S. dollars relative to the U.S. Tbill, considering hedged and unhedged currency risk positions.

One key stylized fact that emerges from these Figures is that innovations to investment conditions at the semestral frequency are much larger in emerging markets than they are in either industrialized or least-developed economies. The variability of credit ratings is very low both in countries that represent "good risks" (i.e. those with average CCRs exceeding 80, as in the OECD) and in countries that are "bad risks" (i.e. those with CCRs lower than 20, as several countries in Sub-Saharan Africa), while the variability of CCRs is much higher in countries that represent "moderate risks" (i.e. emerging markets). Figure 3 provides additional evidence of this stylized fact by plotting the time series of the CCRs of the six largest Latin American emerging markets. Most of these countries had ratings exceeding 50 in September, 1979, and by March, 1996 only Chile showed a similar rating, after a dramatic decline to under 25 in 1985.

This evidence suggests that when asset trading restrictions among industrial countries were lifted in the 1980s, the newly-created global market consisted of countries of roughly similar risk quality, and where investment conditions are relatively uniform and stable over time. In contrast, the globalization of equity markets in the 1990s expanded to emerging markets where not only asset returns are intrinsically more risky, but where information gathered on economic, social, and political issues results in much larger innovations to credit ratings than in OECD countries. Thus, information changes dramatically in emerging markets, and hence may in principle be valuable to global investors. What is to be determined is whether a globalized market provides enough incentives for investors to pay for collecting and processing this information.

In order to proceed with the simulations, we need a framework for mapping the information of the CCRs into probability distributions from which updates of means and variances of asset returns are drawn by agents paying information costs. This mapping is derived from a framework proposed by Erb et al. (1996) to estimate the mean and variance of asset returns in 80 countries for which CCRs exist but equity markets do not. These authors examined the relationship between the mean and variance of asset returns and the information innovations measured by CCRs in countries with equity markets. Robust log-linear relationships were estimated and used to forecast means and variances of asset returns in countries *without* equity markets.

Erb et al. estimated panel regressions of the form $x_{ht+1}=\alpha^x+\beta^x Ln(CCR_{it})+u^x_{it+1}$, where x= the semestral mean (μ) or standard deviation (sd) of asset returns in country h. Thus, assuming that the distributions of updates of the mean and variance of asset returns are normal, the moments that fully describe these distributions are: $E[r^I]=\alpha^\mu+\beta^\mu E[Ln(CCR_i)]$, $E[\sigma_i^I]=\alpha^{sd}+\beta^{sd}E[Ln(CCR_i)]$, $\sigma_r^I=(\beta^\mu)^2VAR[Ln(CCR_i)]+\sigma^{\mu\,2}_{u}$, and $\sigma_\sigma^I=(\beta^{sd})^2VAR[Ln(CCR_i)]+\sigma^{sd\,2}_{u}$. Table 1 lists these moments for each country computed using the regression coefficients from Erb et al. and the actual CCR data. For countries with equity markets, the Table also lists the mean and standard deviation of returns based on historical market data reported by Erb et al.

The magnitude of the updates of the mean and variance of asset returns that this framework predicts is illustrated in Figure 4. This chart plots updates of the mean and standard deviations of returns based on the September, 1996 CCRs against each country's CCR. Since updates are measured as a difference relative to the corresponding statistical moment based on historical equity-market data, the chart includes only countries with equity markets. The chart shows that information gathering generally results in positive updates of mean returns and reduced estimates of the variability of returns. Emerging markets with CCRs between 20 and 70 yield larger upward adjustments in expected returns, and larger downward revisions in standard deviations of returns, while updates of the mean and variance of returns for OECD countries are generally small.

Note finally that although the *Institutional Investor* provides the CCRs at a trivial cost, these published ratings are not free information from the perspective of our model. CCRs are not costless at the relevant moment in which investors design portfolios and decide whether or not to pay information costs. These costs are incurred by the banks that generate individual credit ratings for lending decisions long before the *Institutional Investor* aggregates and publishes them. Banks act immediately on the information they collect and process, and their individual ratings only become partially public in the aggregate published ratings.

Fixed Costs and Disincentives for Information Gathering

The simulations proceed using the following expected utility function for informed agents:

$$EU^I - \kappa = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \theta^I(r^I,\sigma_i^I)\rho + (1-\theta^I(r^I,\sigma_i^I))r^I$$
$$- \frac{\gamma}{2}\left[\frac{(\theta^I(r^I,\sigma_i^I)\sigma_J)^2}{J-1} + ((1-\theta^I(r^I,\sigma_i^I))\sigma_i^I)^2 + 2\sigma_J\sigma_i^J\eta\,\theta^I(r^I,\sigma_i^I)(1-\theta^I(r^I,\sigma_i^I))\right] f(r^I)g(\sigma_i^I)dr^I d\sigma_i^I. \tag{20}$$

where f and g are normal probability distribution functions and $\theta^I(r^I,\sigma_i^I)$ is the optimal portfolio of an informed investor contingent on updates (r^I,σ_i^I). The simulations also consider an evenly-spaced grid of rumors about the Country i return, with 120 elements spanning the interval $[r^{min},r^{max}]$, and allow J to vary from 2 to 42 countries. The double integral in (20) is computed by Gauss-Legendre quadrature. Integration limits are adjusted gradually, starting from limits equal to $\pm 2\sigma_r^I$ and $\pm 2\sigma_\sigma^I$, until the double integral captures 98 percent of the joint cumulative distribution function of r^I and σ_i^I.

Case I.- Identical Ex Ante Returns and "Truth-Revealing" Information in the OECD

Consider first a case simplified to illustrate the theoretical results of Section 2 within the context of the relatively stable equity markets of OECD countries. This requires the restrictive assumptions that: (a) asset returns are uncorrelated ($\eta=0$), (b) ex ante the mean and variance of asset returns are the same in all countries ($r^*=\rho$ and $\sigma_i=\sigma_J$), (c) the information acquired at a fixed cost reveals the true Country-i asset return (i.e. $E[\sigma_i^I]=\sigma_\sigma^I=0$), and (d) the expected update of Country i's return equals the world return, $E(r^I)=\rho$. The values of ρ, σ_J, and σ_i^I are set to $\rho=15.31$ percent, $\sigma_J=22.44$ percent, and $\sigma_i^I=6.46$ percent. The first two moments are arithmetic averages of the annualized mean and standard deviation of monthly stock returns in U.S. dollars over the period 1979-1995 for OECD countries with "stable markets," and the third moment is an average of the estimates of σ_i^I listed in Table 1 for the same group of countries. OECD countries with "stable markets" include OECD members during the entire 1979-1995 period for which the standard deviation of returns did not exceed 30 percent. This excludes Greece, New Zealand, Portugal, and Turkey.

Figure 5 plots S, ignoring κ, as a function of J for values of the rumor equal to r^{min}, r^{max}, and the neutral rumor $r=r^*=\rho$. The chart confirms Proposition 1 and its implications for very pessimistic and very optimistic rumors. The utility gain of information gathering is generally decreasing in J for all moderate-to-pessimistic rumors, and increasing in J for a very optimistic rumor. S is decreasing in J even for $J<4$ in the neutral-rumor case because Proposition 1 establishes only a sufficiency condition. Note, however, that in this example investors facing pessimistic rumors ($r \leq \rho$) are willing to pay hefty fixed information costs exceeding 30 percent (in terms of mean portfolio return) if J=2. As J grows to include about a dozen countries, S falls sharply but still converges to a relatively large amount of nearly 4 percent. At 4 percent, information costs would have to be about 1/3 of the expected portfolio return before the rumor emerged (15.3 percent) in order to induce herd behavior. Still, this experiment shows that only 12 countries are required for the adverse effect of globalization on information gains to be in full force, and that this effect cuts information gains sharply.

Case II.- Identical Ex Ante Returns with OECD Information Updates

Next we strengthen the effects of the informational frictions by considering a case in which information cannot reveal true asset returns. We calibrate the experiment to "stable" OECD markets by computing arithmetic averages of the corresponding rows and columns of Table 1. This implies setting $E(r^j)=15.18$, $E[\sigma_i^j]=21.81$, $\sigma_r^j=6.46$, and $\sigma_\sigma^j=1.84$. We maintain the assumptions that ex ante all countries are perceived to be identical ($r^*=\rho$ and $\sigma_i=\sigma_j$) and that asset returns are uncorrelated. The first assumption is not too unrealistic for the group of countries considered, but the second is at odds with the data and hence is examined in more detail below.

Figure 6 plots the gains of information gathering for Case II. A comparison with Figure 5 shows that when information cannot reveal true asset returns, the gains of information gathering fall sharply. In the case of the neutral rumor r=r* (the middle panels of Figures 5 and 6), the gains of acquiring information decline from 31 to 1 percent for a market with 2 countries, and from about 4 to 0.1 percent in markets with more than 12 countries. A cost of 0.1 percent is only 0.6 percent of the ex ante mean return of the total portfolio ($r^*=\rho$=15.31), so in this circumstances investors are very reluctant to pay information costs to discredit rumors. In the presence of very pessimistic rumors in small markets, investors are still willing to pay large information costs -- r^{min} for J=2 is -110.6 percent, and in this case S exceeds 32 percent, as shown in the top panel of Figure 6. However, S is small even for mildly pessimistic rumors (a rumor that Country-i's return is

11 percent yields S=3.1 percent for J=2 and S=0.4 percent for J=12). Moreover, in a large market with at least 12 countries, S converges to less than 0.45 percent for any rumor $r^{min} \leq r \leq r^*$.

We consider next the fact that the correlation of asset returns in the OECD ranges from 0.3 to 0.6 (see Bohn and Tesar (1996), Lewis (1995) and Erb et al. (1996)). This is done by setting η=0.35.[13] Positive correlation yields even smaller gains of information gathering, with the value of S for r^{min} and J=2 falling from 32 to 22 percent. Note, however, that positive correlation between Country i and the world fund can bias the results against gathering information on Country i because of the implicit assumption that the asset returns of the J-1 countries in the world fund are uncorrelated, and hence provide better diversification opportunities. However, modifying the experiment to introduce correlation of asset returns across countries in the world fund at 0.35 does not alter the results significantly. Thus, taking into account the fact that returns across OECD countries are positively correlated strengthens disincentives to pay country-specific information costs.

Case III.- A Global Market with Emerging Economies and the OECD

This experiment modifies Country i so that it represents a typical emerging market. Investors know that the mean and variance of Country i returns based on historical equity market data differ from those of the J-1 OECD countries. Investors also know that the probability distributions of updates of the properties of Country i returns embody the distinctive features identified in Figure 4 and Table 1. In particular, the expected value and standard deviation of the distributions of updates of the mean and variance of Country i returns are calibrated to mimic the averages for the seven Latin American countries with equity markets in Table 1. This implies the following parameterization: $E(r^I)=33.12$, $E[\sigma_i^I]=34.57$, $\sigma_r^I=49.31$, $\sigma_\sigma^I=14.04$, $r^*=31.21$, $\rho=15.31$, $\sigma_i=50.03$, and $\sigma_f=22.44$. These parameters indicate that new information about Country i produces on average an updated mean return 2 percentage points larger than that based on equity-market data, and cuts on average the standard deviation of Country i returns by a factor of 0.69.

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[13]Given the means and variances of asset returns, and the value of γ, higher correlation coefficients would violate the second-order conditions of the optimization problems of informed and uninformed investors.

Figure 7 plots the information gains for $r=r^{min}$ (-110.6 percent), $r=\rho$, $r=r^*$, and an optimistic rumor such that $r^*<r<r^{max}$ (r=96.1 percent). A comparison with Case II shows that, in a global market with *J-1* OECD countries, the gains of acquiring information about Country *i* are larger if this country represents an emerging market than if it is another typical OECD market. For the neutral-rumor scenario ($r=r^*$), *S* ranges from 16 percent with 2 countries to about 7 percent with 10 or more countries. If the rumor is that r fell by about 16 percentage points to the level of the world return ρ, *S* ranges from 22 percent with $J=2$ to 7.5 percent with $J\geq 10$. In contrast, the gains obtained in Case II when $r=r^*=\rho$ ranged from 1.1 to 0.1 percent.

Considering that there are about a dozen stable OECD-type countries, this simulation predicts that, as the first emerging market is added to the global market, agents would be willing to pay fixed costs to discredit rumors up to about 7.5 percent in terms of mean portfolio return, which is slightly less than 1/2 of the initial expected portfolio return at 15.8 percent. Thus, rumors about a single emerging market would prevail only if information costs are relatively high. Note, however, that the gains of information gathering still fall sharply as the market grows. In the worse-case scenario in which $r=r^{min}$, the information gains when $J=2$ are more than four times larger than when $J=10$.

Case IV.- Segmented Emerging Markets

The global capital market includes several more emerging markets than stable OECD markets. Moreover, the growing set of emerging markets is often viewed as a group segmented from OECD markets. Thus, the question is not whether it is worthwhile to gather information about a single emerging economy in a market with *J-1* OECD countries, but whether it is rational to acquire information in a market where most of the *J-1* countries are also volatile emerging markets. To simulate this scenario, we consider a case in which all countries are identical emerging markets ex ante, with probabilistic parameters set to the averages of the Latin American countries with equity markets in Table 1. The resulting parameterization is: $E(r^J)=33.12$, $E[\sigma_i^J]=34.57$, $\sigma_r^J=49.31$, $\sigma_\sigma^J=14.04$, $r^*=\rho=31.21$, and $\sigma_i=\sigma_J=50.03$.

The information gains plotted in Figure 8 show that in this case rumors will prevail in a market with at least 10 countries if information costs exceed 5 percent, or 1/6 of the ex ante expected portfolio return (which is now 31.2 percent). Thus, herd behavior in response to rumors now becomes a more plausible outcome than in the case in which a single emerging market co-existed with a pool of OECD markets. Information gains still fall very sharply as the market grows, and the full effect of market growth on S is transmitted again with as few as 10 markets.

Case IV assumes that information gathering yields average updates of the mean and standard deviations of returns equivalent to 1.06 and 0.69 of the corresponding moments computed with historical equity market data, as indicated by the Latin American data. However, Figure 4 and Table 1 showed that the moments that describe the distributions of updates vary widely across countries. For instance, in the cases of Argentina, Colombia, Philippines, Taiwan and South Africa, information yields sharply lower expected returns than historical equity market statistics, while updates of the standard deviation vary from sharp reductions to moderate increases. In Colombia's case, for example, the average update of the mean return is 0.77 of the equity market forecast, while the standard deviation of returns is virtually the same with or without gathering information. Our model predicts that in this case the information gain for a neutral rumor $r=r^*$ is 7 percent if $J=2$. As the market grows to include 20 countries, information gains fall to about 0.5 percent for any rumor $r^{min} \leq r \leq r^*$. With the ex ante expected portfolio return at 31.2 percent, this implies that investors in a large global market will not pay information costs exceeding 1.6 percent of the ex ante portfolio return. The case of Indonesia provides a counter-example. Information gathered on Indonesia results in sharp upward updates of the mean return, while revisions to the standard deviation remain negligible as in Colombia's case. Since information yields much higher returns than the history of Indonesia's stock market, with about the same standard deviation, S reaches about 18 percent for any rumor $r^{min} \leq r \leq r^*$ with $J \geq 20$. Thus, investors are willing to pay up more than 1/2 of the ex ante portfolio return to learn about rumors affecting Indonesia.

The analysis thus far has focused on quantifying how information gains respond to globalization. It is also important to quantify the international capital flows that may take place in situations in which investors decide to react to market rumors. To gain an insight on this issue, we simulated the model setting parameters so that the J-1 countries represent again stable OECD markets and Country i is calibrated to Mexican statistical moments as reported in Table 1. In this scenario, if the fixed information cost exceeds 6.5 percent (or about 2/5 of the ex ante mean portfolio return of 15.4 percent), pessimistic rumors about Mexico would prevail. A rumor that reduces the expected return on Mexican equity from the equity market forecast of 22.4 percent to the level of the OECD mean return of 15.3 percent leads to a reduction in the share of the world portfolio invested in Mexico from 1.7 percent to 0.7 percent -- a reduction of 40 percent. According to the *Bolsa de Valores de Mexico* (the Mexican stock exchange), direct foreign holdings of Mexican equity amounted to \$38.3 billion by the end of April, 1997, and hence a 40 percent cut amounts to \$15.3 billion.[14] A large amount for a country where foreign reserves rarely exceed \$20 billion. For rumors that set r below 10 percent, the short-sale restrictions become binding and Mexican equity is eliminated from the portfolio, with a resulting capital outflow of the full \$38.3 billion.

Reputational Effects and Multiple Optimal Portfolios

The simulation exercises conclude with an analysis of reputational effects. We maintain the settings of the last example involving Mexico and the OECD. The reputational cost function takes the following form: $\lambda=\phi(\mu(\Theta)-\mu(\theta))$ with $\phi=15$ for all $\mu(\Theta)>\mu(\theta)$ and $\phi=0$ otherwise. The sensitivity of the results to the value of ϕ is examined later. The solution is illustrated in Figure 9. The solid, upward-sloping line is expected marginal utility without reputational effects as a function of the share of the portfolio invested in Mexico (i.e. $E\hat{U}'(1-\theta)$) in the case of a global market with 2 countries. The horizontal dotted lines represent the constant marginal reputational cost (gain) of producing below-market (above-market) mean returns (i.e.ϕ). The lower and upper bounds of the range of herd equilibria are delimited by the intersections of $E\hat{U}'(1-\theta)$ with the marginal cost and gain lines. If the world market calls any portfolio to the right (left) of the lower (upper) bound, Proposition 2 holds and the investor rationally chooses to mimic the market. The multiple equilibria range shows that, when $J=2$, the share of portfolio invested in Mexican fluctuates between 20.2 and 22.5 percent, or about 2.3 percentage points, as a result of herd behavior. Proposition 3 is illustrated in Figure 9

[14]The figure on the value of foreign holdings in Mexico's market was quoted in the Mexican newspaper *Reforma*, May 13, 1997, p. 1A, citing as source the Mexican stock exchange.

by adding more OECD countries. This shifts $E\hat{U}'(1-\theta)$ clockwise (to the crossed lines) and thus widens the multiple equilibria range. With 10 OECD countries the multiple equilibria range widens by about 1/2 of a percentage point, with the portfolio share invested in Mexico varying between 3.8 percent and 6.6 percent.

Note that the total reputational costs avoided by displaying herd behavior are small. When J=20, and assuming $\Theta=\theta^*$, the maximum reputational cost paid for choosing the largest θ within the herding range is 1/10 of the mean portfolio return. Thus, herd behavior can potentially induce large capital flows in and out emerging markets even in the presence of small reputational costs. The marginal reputational cost, however, is large in the sense that it represents the fact that the punishment for poor performance is equal to 15 times the difference between the mean return paid by the market and that paid by the investor's portfolio. Note also that, as shown in Section 2, the multiple equilibria range is increasing in J but does not grow without bound as J rises. The size of the indeterminacy range converges to about 2.8 percentage points as J approaches ∞.

Next we measure the capital flows triggered by reputational effects. Assume that the investors' total wealth corresponds to the holdings of foreign equity by U.S. investors. The latest *Benchmark Survey of U.S. holdings of Foreign Securities* conducted by the Treasury Department reports that by end-March 1994 the holdings of foreign equity by U.S. investors amounted to $566 billion. The model predicts that with $J=20$ the fraction of U.S. foreign equity invested in México fluctuates between 2.53 and 5.31 percent.[15] Thus, herding panics triggered by reputational effects can account for sudden capital flows in and out of México as large as $15.7 billion. If we add foreign investment in bonds, the total foreign security holdings of U.S. investors reach about $870 billion, and thus herding could account for Mexican capital flows of up to $24.2 billion. As noted earlier, in a country where foreign reserves normally amount to less than $20 billion, of which $10 billion are widely regarded as the desirable minimum (see Calvo and Mendoza (1996)), these flows can be an important determinant of vulnerability to balance-of-payments crises.

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[15]Interestingly, the Treasury's *Survey* estimates the U.S. holdings of Mexican equity at 6.2 percent of the total holdings of foreign equity by U.S. investors.

It also transpires from Figure 9 that the existence of reputational effects and the assumed properties of the function that captures them are necessary to produce herd equilibria. Without reputational costs the model has a unique and well-defined solution at the point where $E\hat{U}'(1-\theta)$ crosses the horizontal axis. A unique equilibrium would also prevail if the marginal reputational cost of below-market returns were equal to the marginal gain of beating the market. The discontinuity of λ' at $\theta=\Theta$ is also critical. If λ were a smooth upward-sloping function investors would choose a value of θ different from Θ and hence update the market portfolio until the market agrees on a portfolio so that $E\hat{U}'(\theta)=\lambda'(\theta=\Theta)=0$.

Figure 10 examines the sensitiveness of the results to changes in different parameters of the model: the marginal reputational cost and gain, ϕ, the correlation of asset returns, η, the coefficient of absolute risk aversion γ, and the variances of asset returns, σ_j and σ_i. The parameter variations are constrained to satisfy the second-order condition specified in Proposition 2. This analysis shows that the results are generally robust to parameter variations. Marginal costs in excess of 15 result in a larger range of herding equilibria, while lower values obviously reduce it. The opposite holds for values of the marginal gain. The herding range is maximized when there is no marginal gain to beating the market, and there is no herding if the marginal reputational cost and gain are equal. . A higher degree of risk aversion can reduce sharply the size of the herding range, but values of γ higher than 1/2 are grossly inconsistent with data on the composition of actual portfolios. For risk aversion coefficients between the benchmark value (1/4) and 1/2 the reduction in the herding range is modest, while the herding range widens considerably for risk aversion coefficients lower than 1/4. The correlation of returns does not affect noticeably the size of the herding range until it becomes unrealistically high The herding range is a declining function of the variances of asset returns in Country i and abroad. However, the effect of the variance of the world fund dissipates with as few as 10 countries, and the herding range narrows very slightly for values of σ_i above the Mexican estimates used in Figure 9 (i.e. 46.2 percent). For σ_i below 46 percent and $J=10$, the size of the herding range widens very rapidly as σ_i falls.

Despite the large capital flows that herd behavior can produce, herding does not appear to embody significant welfare costs. The welfare costs associated with herd behavior are illustrated in Figure 11, which plots the percentage change in consumption needed for a portfolio inside the multiple equilibria range to yield the same utility of a portfolio chosen in the conventional mean-variance model without reputational effects (i.e. θ^*). These calculations make use of the model's direct utility function: $E\text{-}exp(-\gamma C)$. The welfare costs never exceed 2.5 percent, and for portfolio share variations of 100 basis points around the first-best optimum the costs are actually smaller than 1/4 of a percentage point. Moreover, since $E\hat{U}(\theta)$ and θ^* are invariant to λ, it follows that variations in the marginal reputational cost do not alter the latter result -- although of course lowering the marginal cost narrows the range of herding equilibria.

4. Concluding Remarks

This paper proposes a basic model of international portfolio diversification with incomplete information in which the globalization of securities markets reduces incentives for information gathering, and hence produces high volatility in capital flows as a result of optimal herd behavior. This occurs because: (a) globalization generally reduces the gains derived from paying fixed costs for country-specific information, and (b) in the presence of reputational effects, globalization widens the range of portfolios inside of which investors find it optimal to mimic arbitrary market portfolios. These results are derived analytically, and numerical simulations are conducted to estimate the potential magnitude of the capital flows they can produce.

The analysis suggests that the global economy is inherently more volatile than a world economy with limited capital mobility. This naturally raises the question of whether globalization is necessarily welfare improving, and suggests that the merits of abolishing capital controls may deserve further consideration. Leaving aside well-known, albeit controversial, theories that illustrate the benefits of global diversification, resulting from risk-sharing and consumption-smoothing (see Mendoza (1991) and Tesar (1994)) there are potentially important welfare costs induced by herd behavior. For instance, we showed that in the presence of reputational effects, optimal portfolios are generally Pareto inefficient. Our simulations showed, however, that these inefficiencies produce negligible welfare costs in a basic model in which all agents are global investors. In this ideal world, the welfare consequences of a herding panic that causes a balance-of-payments crisis in any single country are the same for all investors, whether they reside in that country or not.

The potential for volatile capital flows to impose substantial welfare costs in small open economies increases significantly if one departs from the idealistic world inhabited only by global investors. Consider, for example, the case of a typical developing country that depends on capital inflows to finance imports of consumer and capital goods, and uses the latter as inputs to produce tradable and nontradable goods. Agents in this economy may be divided into a group of "domestic workers," who derive income only from labor services and cannot use global capital markets to insure themselves against income fluctuations induced by capital flows, and another group of "world citizens" with their wealth and income globally diversified. In this environment, a herding panic can be devastating for "domestic workers," particularly those that produce nontraded goods. For these costs to be significant, however, the structure of the economy has to be carefully modelled, as is well-known that welfare costs of country-specific risk implied by limited world asset trading in pure consumption-smoothing models are trivial (see Mendoza (1991)).[16]

Another vehicle by which global market volatility can induce large social costs is through distortions that lead to self-fulfilling crises. Following Calvo (1995), there may be situations in which, if the ability of a government to roll-over its debt seems to be compromised by a sudden run on its securities in the global market, agents may expect that current fiscal adjustment may need to be so large in order to pay for maturing debt that it will cripple the economy and affect adversely future government revenues. The latter could justify the expectation that the government will default, and thus beliefs about default would be self-fulfilling.

We started the paper by quoting Keynes's observation that large markets are prone to be more influenced by speculation than small markets, and, in light of our findings and the above policy discussion, we feel compelled to end the paper by quoting Keynes again:

> *"When the capital development of a country becomes a by-product of the activities of a casino, the job is likely to be ill-done...It is usually agreed that casinos should, in the public interest, be inaccessible and expensive (Keynes (1936), p. 159).*

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[16]This applies only to models in which growth and fluctuations are unrelated. If volatility affects growth, the gains of diversification can be large (see Obstfeld (1994) and Mendoza (1997)).

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Table 1. Country Credit Ratings and Asset Returns: Summary Statistics

	Country Credit Ratings		Moments Describing PDFs of Updates of Asset Return Distributions 1/				Equity Market statistics	
			PDF of Mean Return		PDF of std. dev.			
	Mean	std. dev.	E(r)	sd (r)	E(sd)	sd (sd)	r 2/	sd 3/
Afghanistan	8.98	1.11	61.59	20.00	54.80	5.70		
Albania	12.17	1.59	55.25	19.88	50.30	5.66		
Algeria	43.06	12.43	29.61	50.73	32.06	14.45		
Angola	13.99	2.94	52.58	30.77	48.40	8.76		
Argentina	32.69	14.33	36.06	61.46	36.65	17.50	41.10	91.70
Australia	77.03	8.75	16.58	17.72	22.81	5.04	15.50	26.30
Austria	84.14	1.66	14.61	3.12	21.40	0.89	13.30	24.90
Bahrain	54.74	3.38	23.64	9.78	27.83	2.78		
Bangladesh	18.01	3.55	47.26	30.15	44.62	8.59		
Barbados	35.60	2.84	32.68	12.82	34.25	3.65		
Belarus	16.55	2.11	48.79	18.90	45.70	5.38		
Belgium	78.46	3.77	16.09	7.49	22.46	2.13	17.50	21.00
Benin	16.05	0.80	49.32	7.90	46.08	2.25		
Bolivia	15.11	6.67	52.54	70.03	48.37	19.94		
Botswana	44.08	5.55	28.30	20.96	31.14	5.97		
Brazil	35.72	10.54	33.30	41.35	34.69	11.78	33.80	63.10
Bulgaria	36.80	11.65	33.15	57.32	34.58	16.32		
Burkina Faso	17.03	0.45	48.06	4.14	45.18	1.18		
Cameroon	29.47	7.40	37.27	42.45	37.51	12.09		
Canada	86.17	4.06	14.13	7.40	21.06	2.11	9.90	19.30
Chile	41.16	12.28	30.56	50.16	32.75	14.28	24.70	31.90
China	62.02	6.23	21.10	15.96	26.01	4.54	9.20	79.30
Colombia	44.51	8.63	28.30	29.53	31.14	8.41	36.60	31.30
Congo	15.39	1.56	50.27	15.61	46.76	4.45		
Costa Rica	23.15	8.92	43.02	57.55	41.60	16.39		
Croatia	16.08	2.89	49.55	27.37	46.24	7.80		
Cuba	13.37	6.49	54.92	62.43	50.06	17.78		
Cyprus	42.32	6.71	29.24	24.73	31.81	7.04		
Czech Republic	52.57	5.90	24.57	17.89	28.48	5.09		
Czechoslovakia	51.66	5.16	24.92	15.77	28.73	4.49		
Denmark	73.58	2.86	17.43	6.05	23.41	1.72	15.60	20.00
Dominican Republic	19.36	5.83	46.15	42.48	43.83	12.10		
Ecuador	28.71	11.62	38.50	55.48	38.39	15.80		
Egypt	29.84	5.04	36.61	27.53	37.05	7.84		
El Salvador	10.89	4.52	59.02	61.49	52.98	17.51		
Estonia	23.88	2.84	41.11	18.54	40.24	5.28		
Ethiopia	9.67	2.24	60.40	34.62	53.96	9.86		
Finland	75.22	3.26	16.97	6.93	23.08	1.97	13.40	27.10
France	85.77	3.64	14.22	6.76	21.13	1.93	14.40	23.20
Gabon	32.23	4.78	34.92	23.81	35.85	6.78		
Georgia	8.98	1.39	61.63	22.31	54.84	6.35		
Germany	90.28	0.60	13.13	1.05	20.35	0.30	14.30	22.10
East Germany	53.58	6.42	24.21	20.01	28.23	5.70		
West Germany	94.31	1.71	12.22	2.83	19.70	0.81	14.30	22.10
Ghana	26.59	3.09	38.86	19.72	38.65	5.62		
Greece	51.55	5.35	24.97	15.61	28.77	4.45	8.30	37.40
Grenada	8.66	1.30	62.43	22.68	55.40	6.46		
Guatemala	16.15	3.39	49.59	32.16	46.28	9.16		
Guinea	13.70	0.36	52.62	4.22	48.43	1.20		
Haiti	8.36	0.99	63.09	18.70	55.87	5.33		

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			PDF of Mean Return		PDF of std. dev.			
	Mean	std. dev.	E(r)	sd (r)	E(sd)	sd (sd)	r 2/	sd 3/
Honduras	13.78	2.44	52.81	28.58	48.56	8.14		
Hongkong	69.11	4.43	18.77	9.88	24.36	2.81	24.30	33.50
Hungary	47.65	5.48	26.64	17.20	29.95	4.90	2.50	38.20
Iceland	54.50	2.42	23.72	6.96	27.88	1.98		
India	46.15	4.33	27.27	15.40	30.41	4.39	16.50	29.20
Indonesia	50.45	3.89	25.38	12.36	29.06	3.52	6.50	30.70
Iran	21.62	6.37	43.94	46.73	42.26	13.31		
Iraq	21.73	15.55	47.44	102.52	44.74	29.19		
Ireland	67.26	4.29	19.33	10.05	24.76	2.86	14.60	21.90
Israel	37.36	6.87	31.93	27.87	33.72	7.94		
Italy	75.02	2.90	17.02	6.07	23.12	1.73	15.50	27.40
Ivory Coast	27.24	10.28	39.59	57.38	39.16	16.34		
Jamaica	18.64	3.78	46.55	30.48	44.11	8.68		
Japan	94.07	1.90	12.27	3.20	19.74	0.91	17.20	25.00
Jordan	32.50	7.55	35.13	39.72	36.00	11.31	9.60	17.50
Kazakhstan	18.08	1.15	46.85	10.36	44.32	2.95		
Kenya	30.33	6.01	36.33	28.72	36.84	8.18		
North Korea	5.55	1.59	41.82	164.11	40.75	46.73		
South Korea	63.49	6.04	20.59	15.11	25.66	4.30	16.10	30.30
Kuwait	59.83	9.36	22.01	25.85	26.66	7.36		
Latvia	21.82	1.93	42.94	13.94	41.54	3.97		
Lebanon	14.75	6.50	53.02	69.29	48.71	19.73		
Liberia	12.07	8.26	58.20	76.64	52.40	21.83		
Libya	33.09	10.21	34.95	42.66	35.87	12.15		
Lithuania	21.01	2.11	43.75	15.78	42.12	4.49		
Luxembourg	84.45	1.08	14.53	2.03	21.35	0.58		
Malawi	17.32	2.23	47.86	18.86	45.04	5.37		
Malaysia	64.90	5.85	20.13	14.48	25.33	4.12	16.20	27.10
Mali	16.73	0.77	48.44	7.47	45.46	2.13		
Malta	60.68	1.51	21.45	3.93	26.27	1.12		
Mauritius	30.26	9.62	37.06	50.85	37.36	14.48		
Mexico	43.49	14.02	29.36	46.79	31.89	13.33	22.40	46.20
Morocco	30.80	6.71	36.11	33.60	36.69	9.57		
Mozambique	9.02	2.27	61.93	37.30	55.05	10.62		
Myanmar	14.67	2.21	51.38	22.86	47.55	6.51		
Nepal	23.48	1.19	41.36	7.99	40.42	2.28		
Netherlands	87.78	1.27	13.72	2.29	20.77	0.65	18.70	17.90
New Zealand	68.78	5.15	18.88	11.64	24.44	3.32	18.30	54.60
Nicaragua	7.15	2.16	67.16	47.52	58.76	13.53		
Nigeria	28.63	14.07	39.27	68.67	38.94	19.56	14.60	27.60
Norway	82.58	4.36	15.02	8.31	21.70	2.37	10.00	25.00
Oman	50.14	2.29	25.46	7.28	29.12	2.07		
Pakistan	26.91	3.80	38.69	23.56	38.53	6.71	18.40	24.10
Panama	29.25	9.17	37.76	50.69	37.86	14.44		
Papua New Guinea	37.60	4.31	33.12	78.69	34.56	22.41		
Paraguay	32.89	6.91	34.69	31.41	35.68	8.94		
Peru	21.98	10.57	44.94	72.89	42.96	20.76	39.10	41.00
Philippines	30.32	9.18	36.83	45.08	37.20	12.84	41.70	36.80
Poland	22.73	10.67	44.29	75.87	42.50	21.61	93.30	90.30
Portugal	58.29	6.75	22.43	18.36	26.96	5.23	30.50	43.70

Table 1. Country Credit Ratings and Asset Returns: Summary Statistics

	Country Credit Ratings		Moments Describing PDFs of Updates of Asset Return Distributions 1/				Equity Market statistics	
			PDF of Mean Return		PDF of std. dev.			
	Mean	std. dev.	E(r)	sd (r)	E(sd)	sd (sd)	r 2/	sd 3/
Qatar	54.95	2.86	23.55	7.96	27.76	2.27		
Romania	30.81	9.80	36.57	47.01	37.02	13.39		
Russia	19.76	1.70	45.00	12.91	43.01	3.68		
Saudi Arabia	64.73	8.19	20.25	19.48	25.41	5.55		
Senegal	20.05	3.38	44.89	24.37	42.93	6.94		
Seychelles	17.10	4.71	48.72	42.66	45.65	12.15		
Sierra Leone	9.02	3.84	62.66	51.85	55.56	14.76		
Singapore	78.36	2.41	16.10	4.84	22.47	1.38	15.50	25.40
Slovakia	33.40	2.87	34.01	13.16	35.20	3.75		
Slovenia	33.69	9.21	34.53	46.54	35.56	13.25		
South Africa	45.80	11.23	27.95	38.63	30.89	11.00	37.50	24.50
Spain	71.24	4.58	18.13	10.38	23.91	2.96	16.00	23.80
Sri Lanka	25.94	3.55	39.43	20.91	39.05	5.96	6.30	33.50
Sudan	7.64	3.00	66.00	50.31	57.94	14.33		
Swaziland	21.86	4.77	43.27	33.01	41.78	9.40		
Sweden	78.83	3.16	15.99	6.30	22.38	1.80	23.00	24.00
Switzerland	94.31	1.86	12.22	3.11	19.70	0.88	14.80	19.00
Syria	22.35	5.74	42.92	35.27	41.53	10.04		
Taiwan	73.81	4.75	17.39	10.30	23.38	2.93	31.60	50.50
Tanzania	12.55	3.90	55.27	43.33	50.31	12.34		
Thailand	56.79	4.69	22.91	12.94	27.30	3.69	21.90	26.90
Togo	16.68	0.76	48.51	7.34	45.50	2.09		
Trinidad & Tobago	41.34	10.81	30.18	41.10	32.47	11.70		
Tunisia	41.79	4.86	29.40	18.62	31.92	5.30		
Turkey	34.01	11.18	35.12	67.36	35.99	19.18	41.30	71.50
U.S.S.R.	62.00	10.52	21.38	33.01	26.22	9.40		
Uganda	6.67	2.76	69.05	54.87	60.11	15.63		
Ukraine	16.88	2.19	48.39	19.68	45.42	5.61		
United Arab Emirates	59.15	2.43	22.00	6.51	26.66	1.85		
United Kingdom	87.53	1.84	13.78	3.33	20.81	0.95	16.50	21.20
United States	92.96	3.92	12.53	6.66	19.93	1.90	15.40	14.80
Uruguay	33.39	5.16	34.20	24.04	35.33	6.84		
Uzbekistan	14.83	0.80	50.98	8.25	47.26	2.35		
Vietnam	22.77	5.49	42.52	38.18	41.25	10.87		
Venezuela	43.30	13.38	29.33	42.97	31.87	12.24	20.80	45.00
Yugoslavia	27.97	14.06	41.15	101.78	40.27	28.98		
Zaire	8.14	1.55	63.91	31.18	56.45	8.88		
Zambia	12.01	2.99	55.91	35.61	50.77	10.14		
Zimbabwe	25.36	3.62	39.93	23.32	39.40	6.64	14.50	34.90

1/ Based on regression coefficients from Erb et al. (1996) as explained in the text.
2/ "r" is the annualized arithmetic mean return from monthly data in U.S. dollars, unhedged (from Erb et al. (1996).
3/ "sd" is the standard deviation of r, also from Erb et al. (1996).

Figure 1

Variability of Country Credit Ratings

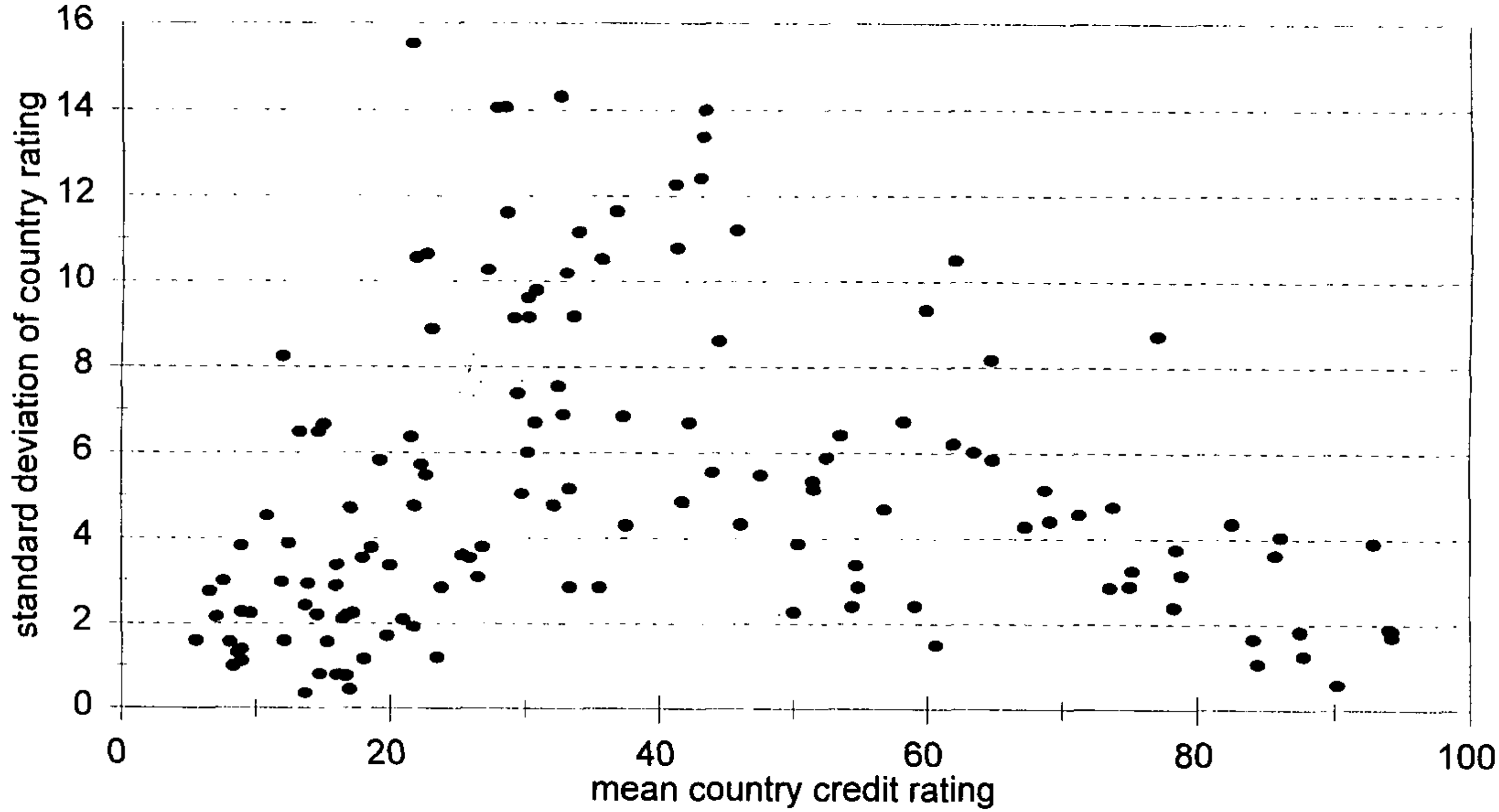


Figure 2
OECD and Latin American Ratings

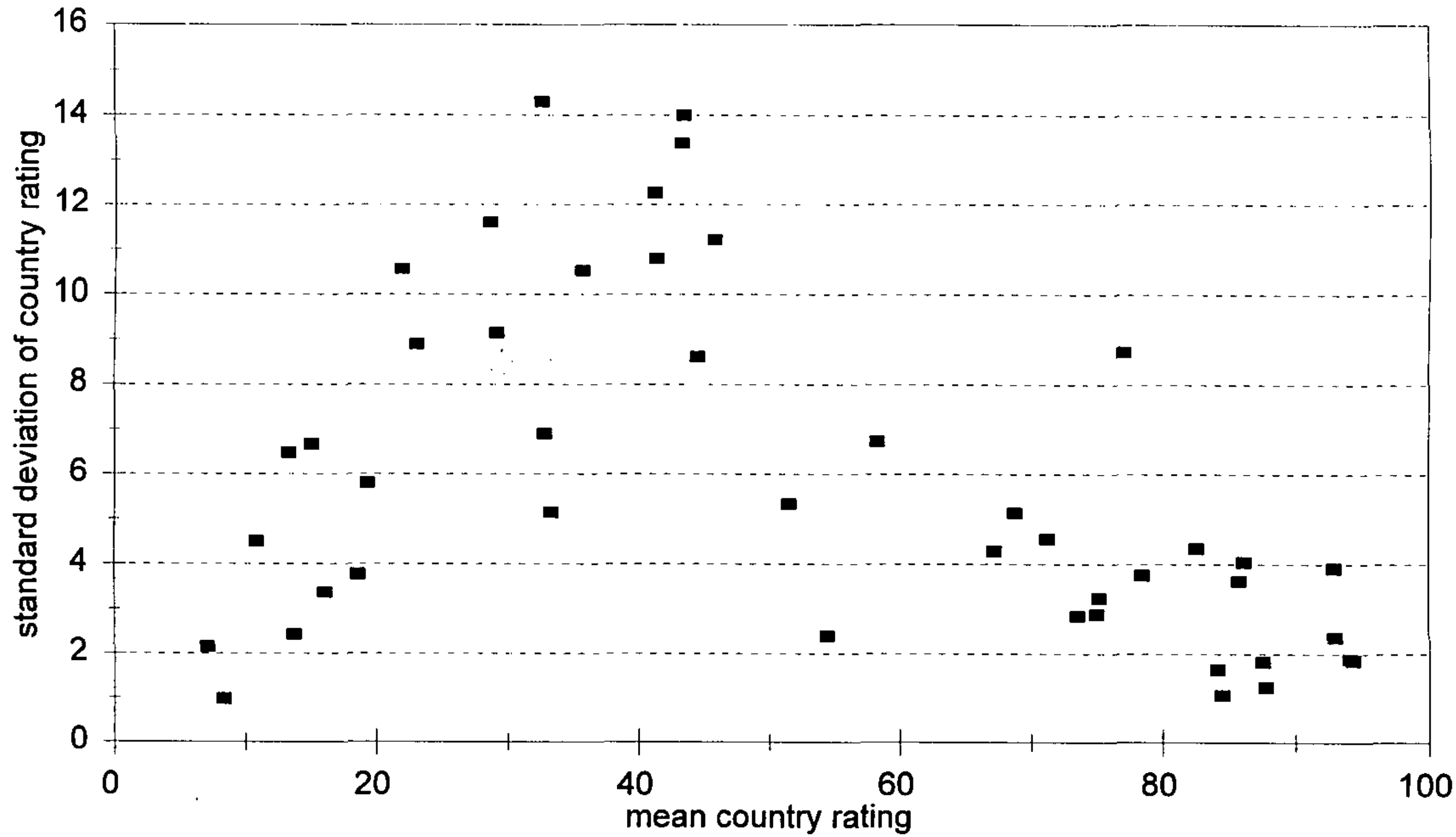


Figure 3

Time Series of Latin American Ratings

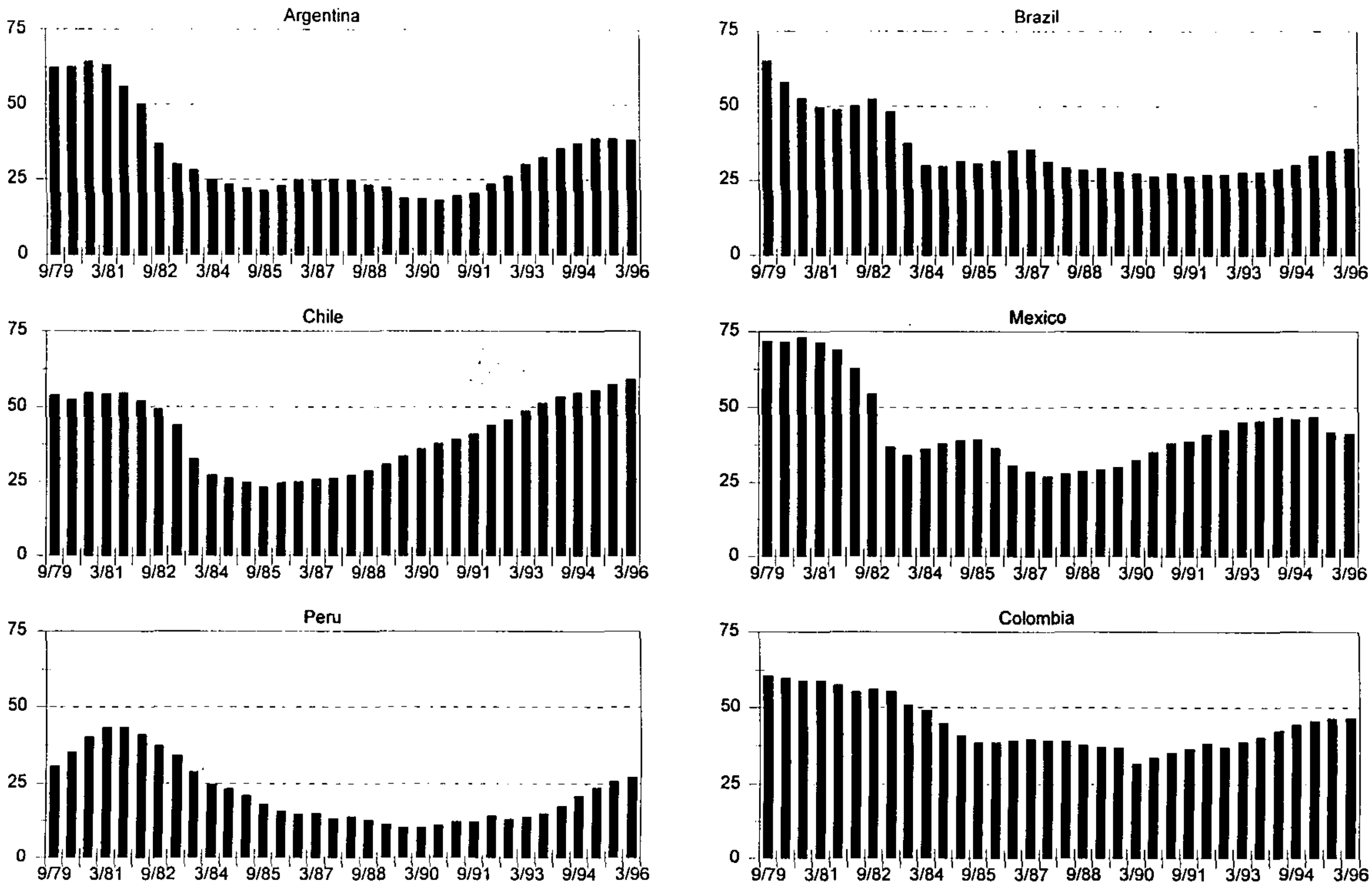


Figure 4

Updates of Asset Returns Statistics

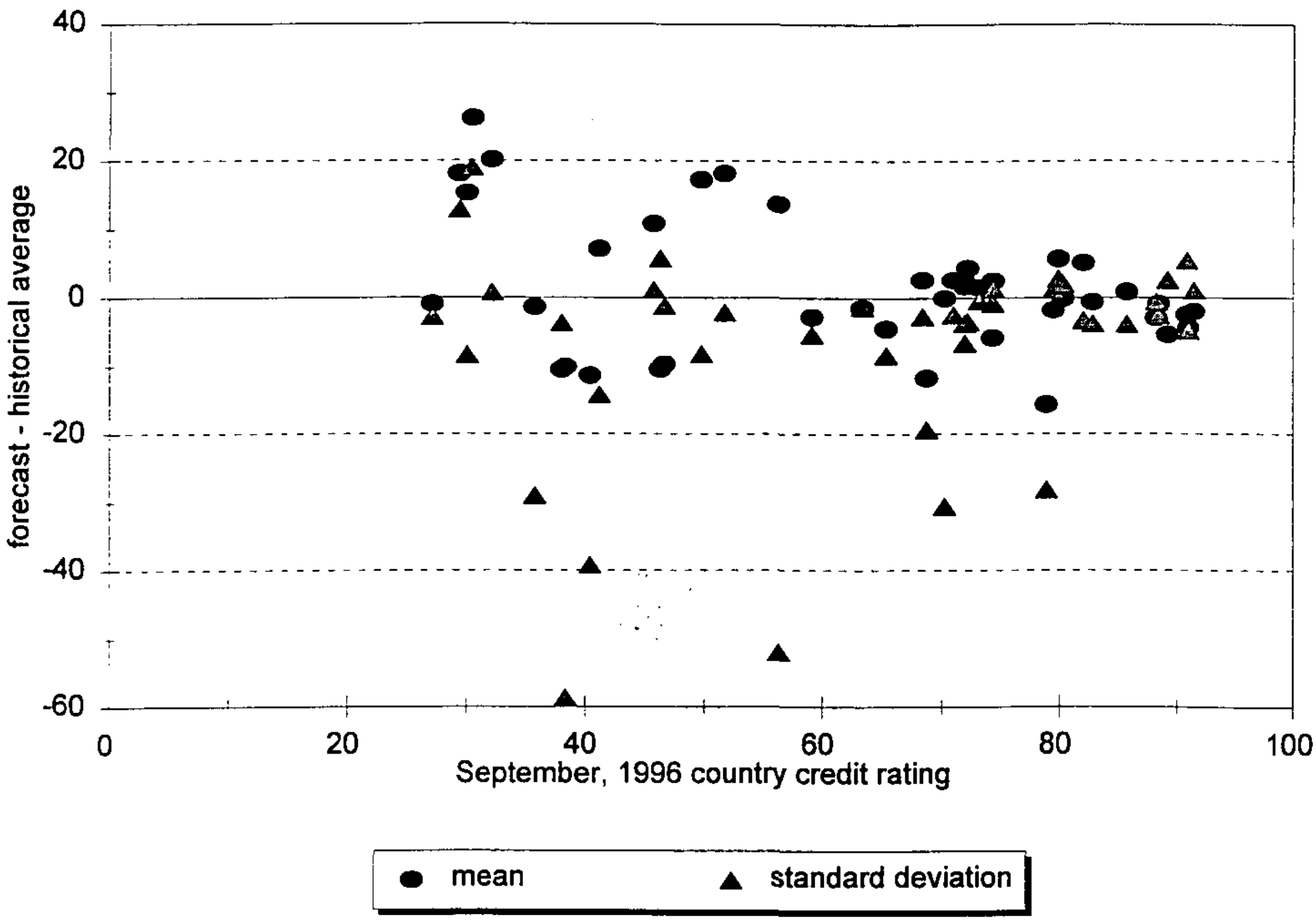
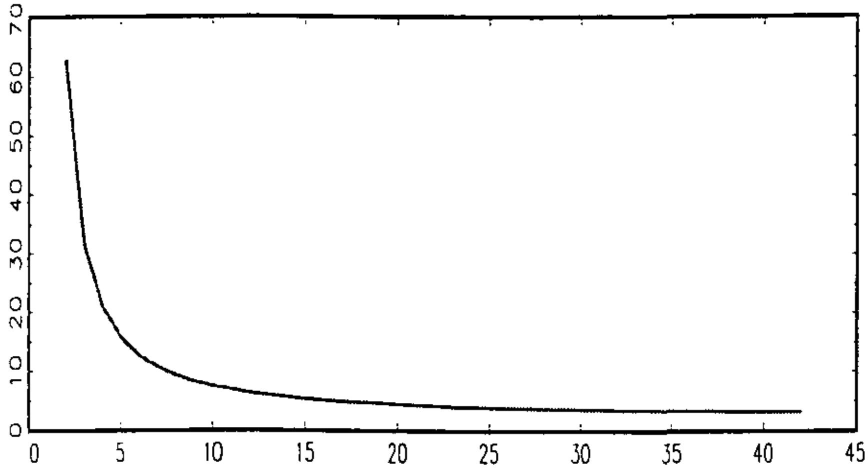


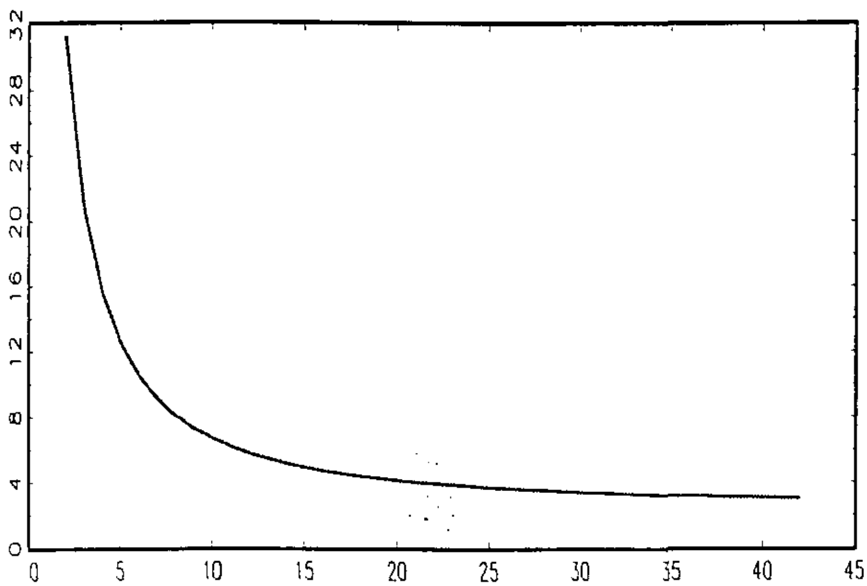
FIGURE 5

NET GAINS OF INFORMATION GATHERING AND MARKET SIZE: CASE I

Smallest Rumor



Rumor equal to World Mean Return



Largest Rumor

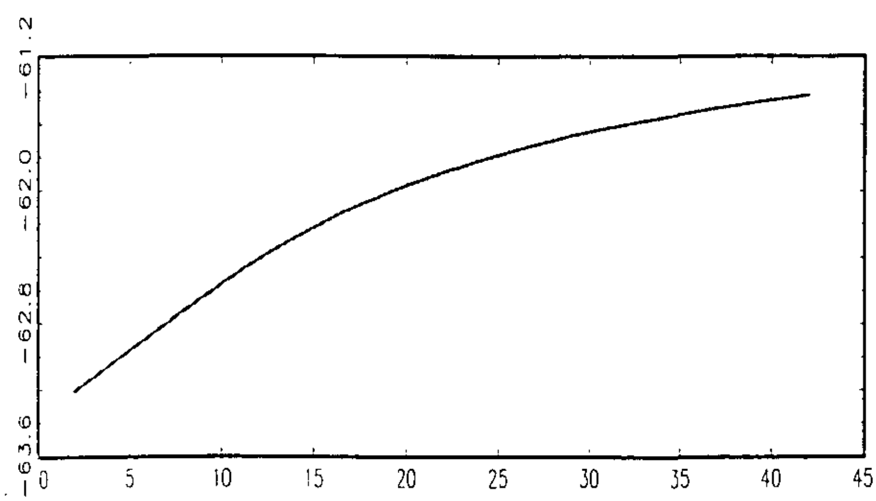


FIGURE 6

NET GAINS OF INFORMATION GATHERING AND MARKET SIZE: CASE II

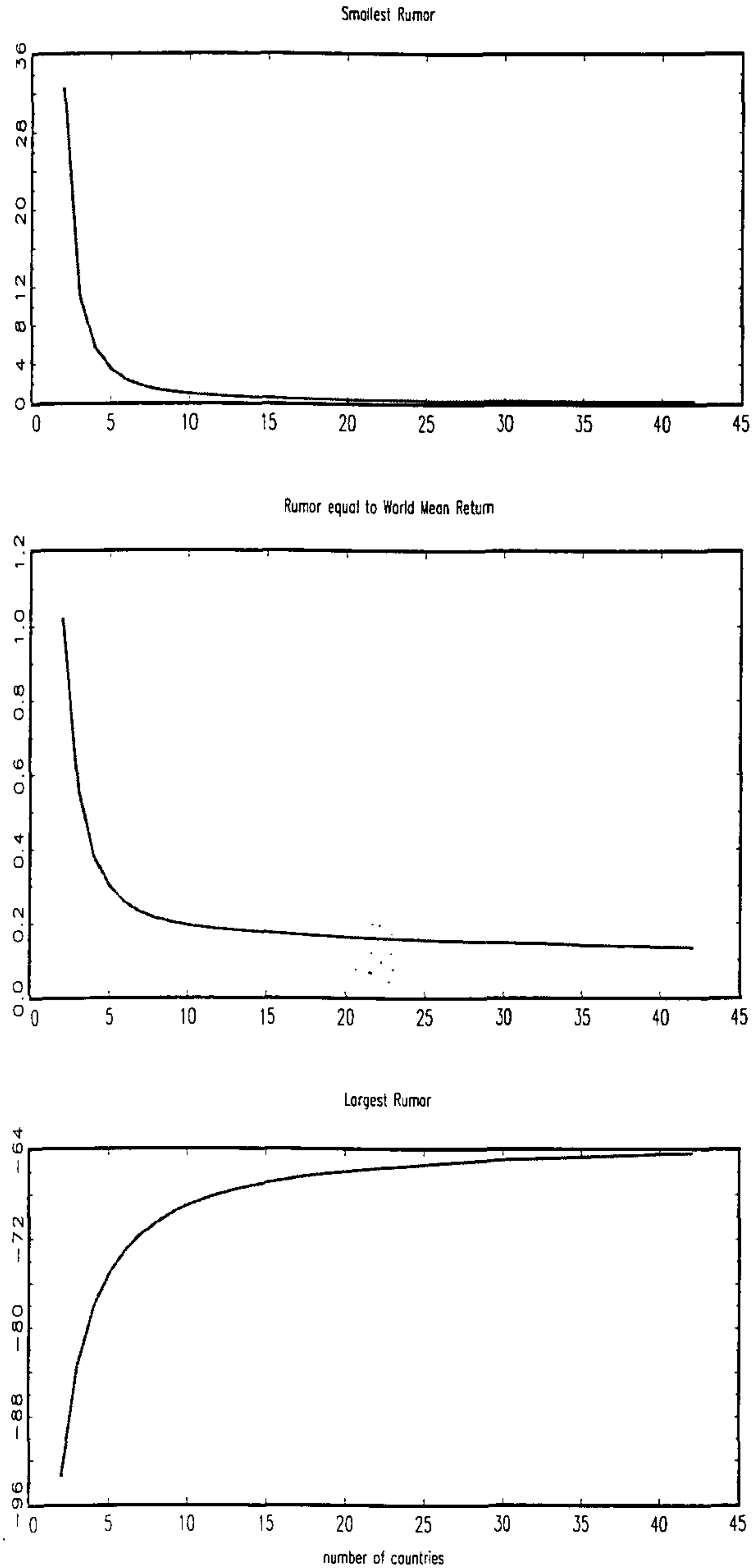


Figure 7

NET GAINS OF INFORMATION GATHERING AND MARKET SIZE: CASE III

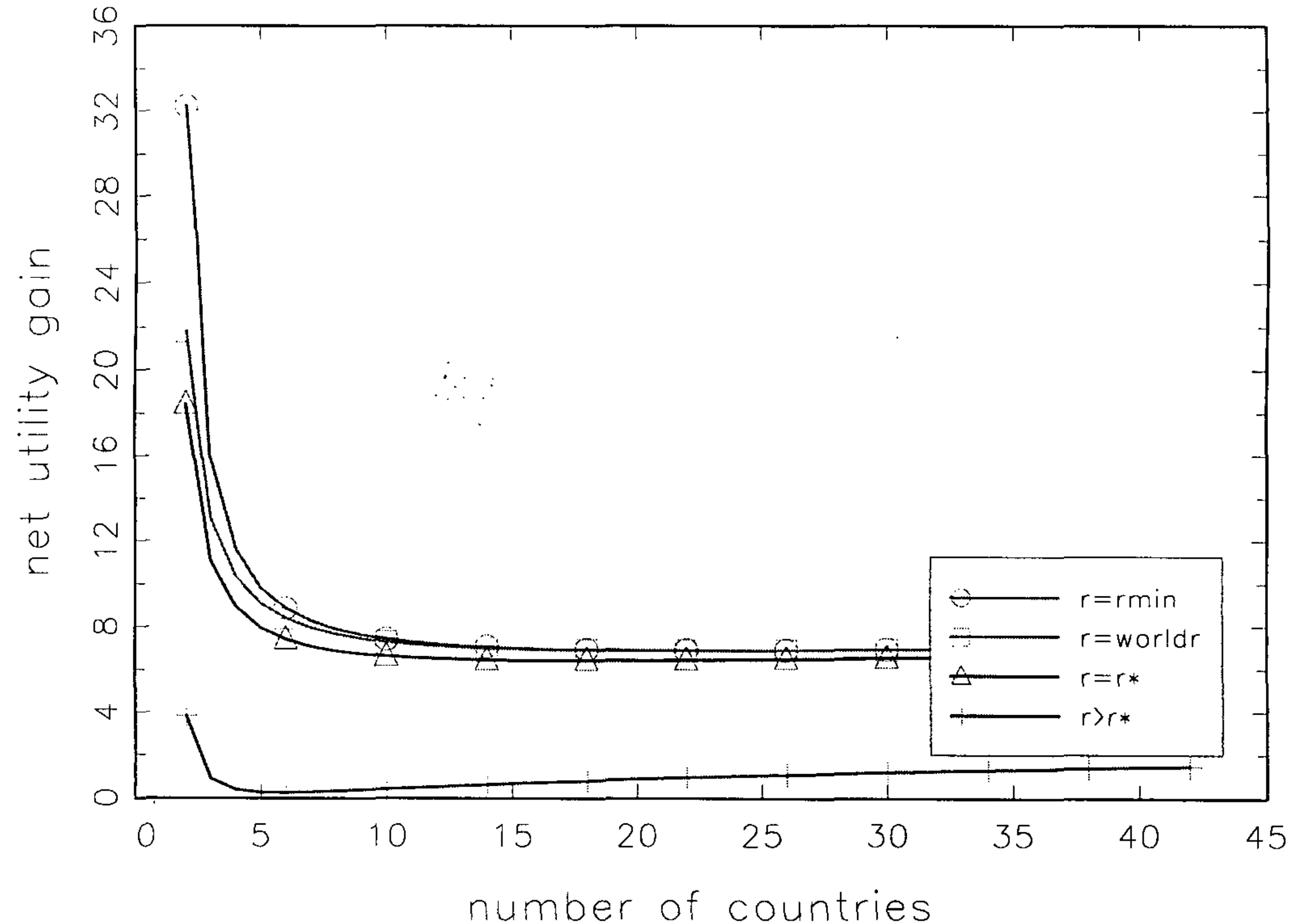


Figure 8

NET GAINS OF INFORMATION GATHERING AND MARKET SIZE: CASE IV

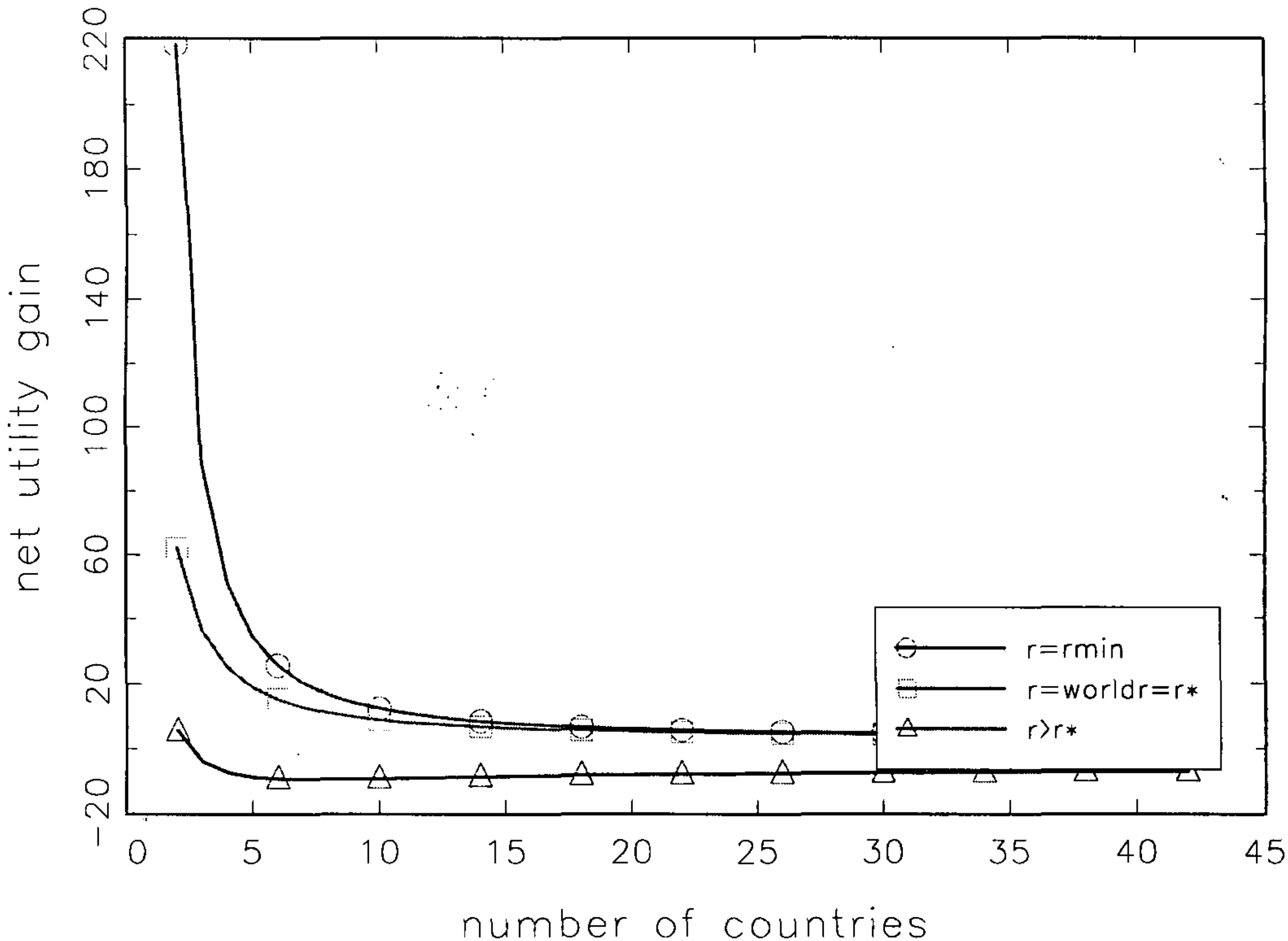


Figure 9. The Range of Multiple Optimal Portfolios in the Presence of Reputational Effects

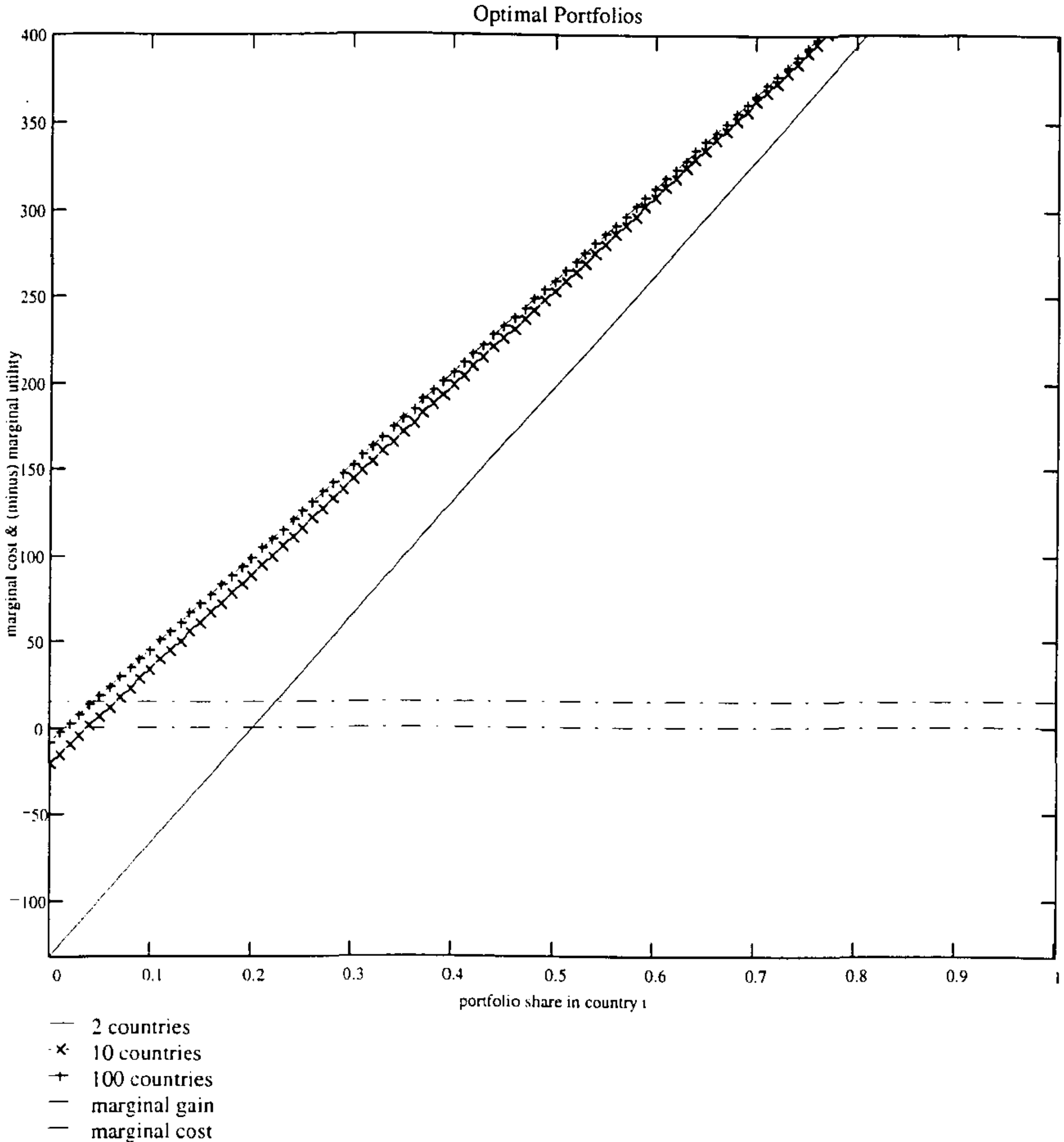


Figure 10. Size of the Range of Multiple Optimal Portfolios for Alternative Parameter Values

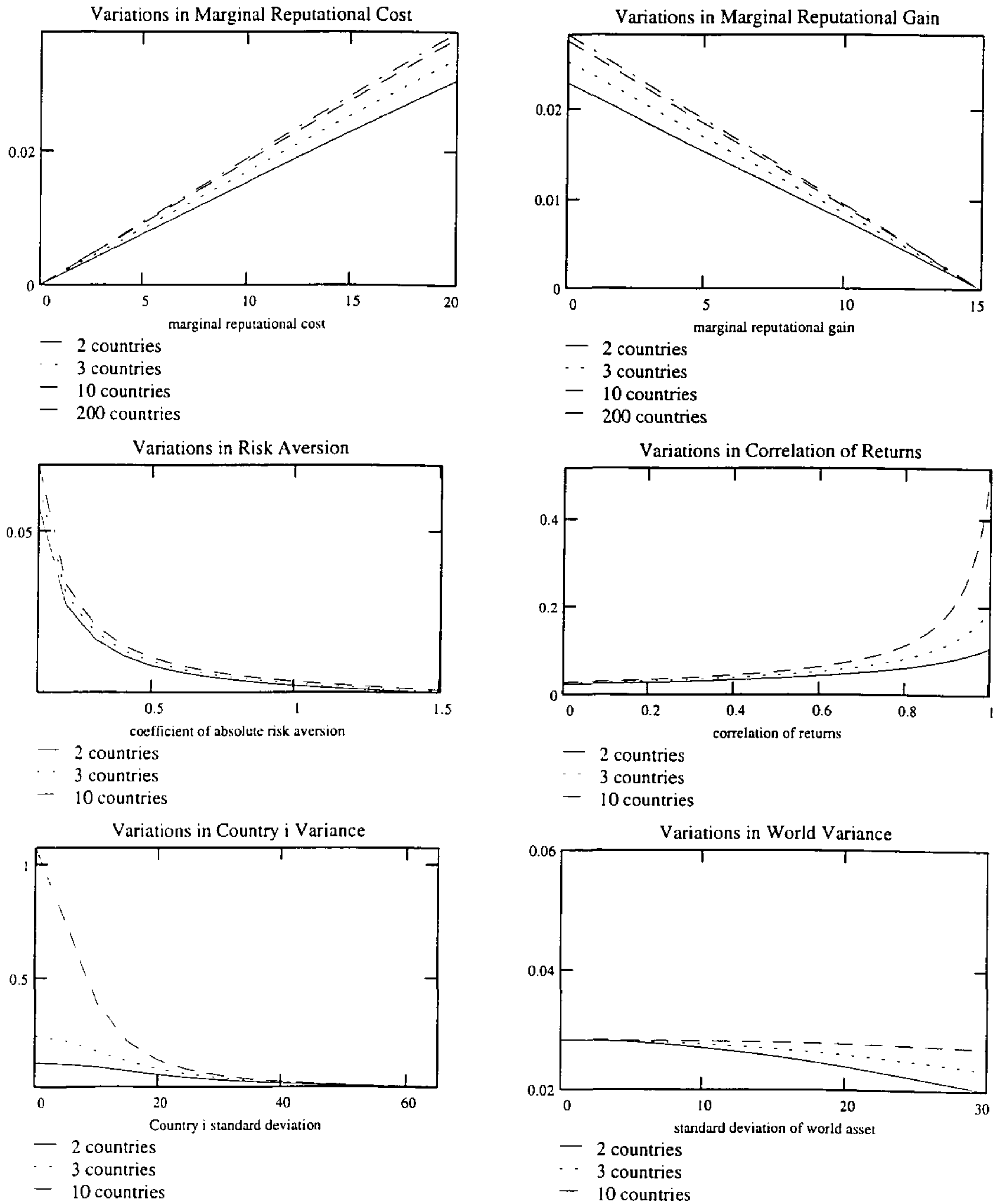


Figure 11. Welfare Costs of Herd Behavior