Competition, Regulation and Integration In International Financial Markets

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In International Financial Markets

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Introduction and Abstracts

Chapter I - Derivative Market Competition: OTC Markets Versus Organized Derivative Exchanges

Chapter II – Crisis Resolution and Private Sector Adaptation

Chapter III - European Equity Market Integration: Cyclical or Structural?

Introduction and Abstracts

Chapter I - Derivative Market Competition: OTC Markets Versus Organized Derivative Exchanges

Recent regulatory initiatives in the United States have again raised the issue of a "level regulatory and supervisory playing field" and the degree of competition globally between over-the-counter (OTC) derivatives and organized derivative exchange (ODE) markets. This chapter models some important aspects of how an ODE market interrelates with the OTC markets. It analyzes various ways in which an ODE market can respond to competition from the OTC markets and considers whether ODE markets would actually benefit from a more level playing field. Among other factors, such as different transaction costs, different abilities to mitigate credit risk play a significant role in determining the degree of competition between the two types of markets. This implies that a potentially important service ODE markets can provide OTC market participants is to extend clearing services to them. Such services would allow the OTC markets to focus more on providing less competitive contracts/innovations and instead customize their contracts to specific investors' risk preferences and needs.

Chapter II – Crisis Resolution and Private Sector Adaptation

Efforts at crisis resolution that succeed in reducing potential inefficiencies and instability in the international financial system are in the interest of both the private and the public sector. Unlike in the domestic context, in the international context, in the absence of clearly established rules of the game, the approaches adopted toward crisis resolution, and the extent to which they are interpreted by market participants as setting a precedent, can have profound implications for the nature and structure of international capital flows. The key conclusion of this chapter is that recent experiences with payment suspensions and bond restructurings are limited as guides to determining the future success or failures of these initiatives, as the private sector most likely has adapted in order to minimize any unwanted public sector involvement.

Chapter III - European Equity Market Integration: Cyclical or Structural?

Reviewing the empirical evidence of equity market integration in the European Union, the chapter finds a significant increase in the importance of global sector factors for a number of industries. Unlike most past studies, which only covered developments during the bull market of the late nineties, the results presented in this chapter suggest that the degree of Euroland equity market integration has declined gradually following the bursting of the TMT bubble. This seems to suggest that the findings of previous studies that Euroland equity markets were nearly fully financially integrated is worth revisiting. There are, however, several good reasons to believe that the structural factors driving European equity market integration have yet to play themselves out fully. Institutional investors both outside the Euroland area and within have substantial untapped capacity to take on Euroland exposures and invest additionally in Euroland equities.

Chapter I
Derivative Market Competition: OTC Markets Versus Organized Derivative Exchanges[1]

I. INTRODUCTION

"..This is a critical time for all U.S. futures exchanges. Our continued viability is being seriously threatened by two sources of competition—over-the-counter derivatives and foreign futures exchanges."[2]

"..It is no secret that the combined onslaught of globalization, Over-the-Counter (OTC) competition, and technological advancement, have put enormous pressure on traditional futures exchanges. Indeed in some quarters, there is a growing belief that the good days for traditional exchanges is behind them."[3]

The recent global surge in the use of various forms of financial derivatives utilizing a range of different markets and counterparties highlights the importance of further understanding how different types of derivative markets compete with and complement each other. This understanding is vital as most of the recent spectacular growth has taken place through an increase in the use of OTC derivatives (over-the-counter, lightly supervised and self-regulated derivatives.)[4] Many organized derivatives exchange markets (liquid, supervised, and regulated) have argued that they are at a comparative disadvantage to OTC derivatives markets, highlighting, in particular, the lack of a level playing field as the regulatory and supervisory regimes differ. From a supervisor's

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[1] The author wishes to thank Clas Bergstroem, Bankim Chadha, Peter Englund, Todd Smith, Matthew Spiegel, Staffan Viotti, an anonymous referee, and seminar participants at the International Monetary Fund and the Stockholm School of Economics for helpful comments. Any remaining errors are those of the author.

[2] Patrick H. Arbor, the former Chairman of the Chicago Board of Trade (CBOT). Quotation taken from his testimony before the Risk Management and Specialty Crops Subcommittee of the (U.S.) House Agriculture Committee, April 15, 1997.

[3] Speech delivered at the 2000 Canadian Annual Derivatives Conference by Leo Melamed, chairman emeritus of, and senior policy advisor to, the Chicago Mercantile Exchange.

[4] OTC markets are by no means unregulated, but rather self-regulated. Industry associations such as International Swaps and Derivative Association (ISDA) provide the OTC markets with standard legal contracts for most types of instruments. This paper assumes, not unreasonably, that this self-regulation gives the OTC market a significant cost advantage over organized exchange markets. For more information, see *www.isda.org*.

perspective the trend toward the increased use of OTC derivatives, potentially at the expense of exchange-traded derivatives, raises systemic risk issues given the concentration of OTC derivatives among a few market participants and their lack of transparency. Following a string of crises related to the use of OTC derivatives (most recently involving Enron, but previously Long-Term Capital Management, Metallgesellschaft, etc.), recent discussion among supervisors has focused increasingly on whether OTC derivatives should be more closely supervised, regulated, and whether investors need to set aside more capital when trading OTC. This chapter analyzes several aspects of the interrelationship between the organized derivatives exchange markets and the OTC derivatives markets, and the degree to which the different markets' micro structure impacts on their operation. It will also address the issue of whether organized derivatives exchange markets actually stand to gain from reducing the OTC market's risk aversion through various vehicles, including insisting on a level regulatory playing filed.

In contrast to the highly standardized (and generally cleared) contracts offered by traditional organized derivatives exchange markets (ODEs), OTC derivatives can be individually customized to an end-user's risk preference and tolerance (see Schinasi and others (2000)). Although nearly two-thirds of the actual OTC derivatives traded are of a fairly simple contract structure (for example, a fixed for floating interest rate swap), their terms are still individually determined and highly flexible. One leading industry group defines OTC derivatives as contracts that are "executed outside of the regulated exchange environment whose values depends on (or derives from) the value of an underlying asset, reference rate or index."[5] [6] Clearly, the difference between an ODE derivative and an OTC derivative may involve not only where they are traded but also how. In the United States much attention has centered on pure OTC derivatives that are privately negotiated between large institutional investors and broker/dealer banks. To minimize definitional problems, this chapter will focus on some characterized extremes (see Table 1 for definitions).

Table 1. Definition of Different Derivative Markets

	Standardized	Not Standardized
Cleared, regulated	ODE markets, such as, CBOE, CBOT, and Eurex.	Tailor-made clearing
Not cleared, self-regulated	International Currency and Swap market	Pure OTC derivatives

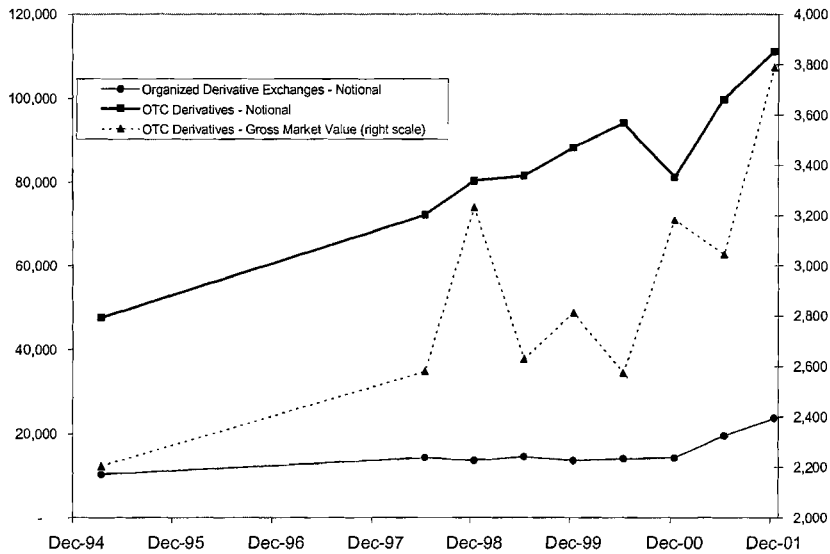
The heightened importance of the OTC derivatives markets has been a fairly recent phenomenon. By the end of 2001, the size of the global OTC market derivatives was by

[5] Group of Thirty (1993). The Group of Thirty is a group established in 1978, which is a private, nonprofit, international body composed of very senior representatives of the private and public sectors and academia.

[6] CFTC (1998).

any measurement huge and growing rapidly (see Figure 1 and BIS (2002)).[7] Since the first triennial survey was completed by the Bank for International Settlement (BIS) in 1995, the notional amount of OTC derivatives outstanding (adjusted for double counting) has increased by more than 130 percent, and by the end of 2001 the global amount exceeded US$110 trillion.[8] Presently, most OTC derivatives are either related to interest rates (70 percent) or foreign exchange (15 percent). Other types of OTC derivatives linked to equities or commodities account for less than 3 percent. While the notional value of OTC derivatives outstanding is significant, their gross market value or "replacement" value, that is, what the derivatives would be worth if they were marked to market, has increased far less and ranges between 3 and 5 percent of the notional value. Nonetheless, this implies that the market value of all OTC derivatives reached US$3.8 trillion by the end of 2001.

Figure 1. Evolution of Global Derivatives Market
(In US$ billion)



While the outstanding notional value of OTC derivatives grew, the corresponding use of ODE derivatives remained predominantly flat at US$14 trillion. However, aggressive monetary policy easing by the U.S. Federal Reserve in 2001, triggered a wave of renewed

[7] The economic importance of the global derivatives market can not be overstated. As a comparison, as noted in Schinasi and others (2000), world GDP reached US$31 trillion and global net capital flows totaled US$394 billion in 1999.

[8] See BIS (2002). The notional value of the OTC derivatives outstanding has been adjusted for double counting and other well-known measurement problems.

hedge demand by many market participants leading to sharp increases in the use of both ODE and OTC derivatives. By the end of 2001, the share of ODE derivatives in the total amount of derivatives outstanding reached 17 percent. To a certain extent, the limited growth in the notional value of ODE derivatives masks substantial competition between different ODE markets. By now famous examples include the rise of the EUREX market (see Schinasi and others (2000)) at the expense of the LIFFE regarding the trading of futures on German treasury bonds.

ODE contracts can generally be split into two main groups in terms of the notional value outstanding: 90 percent are interest rate derivatives and 9.8 percent are linked to equities. Around 60 percent of these derivatives are traded in the form of options while the remainder involves futures. Moreover, as pointed out by Cuny (1995), even ODE markets have been highly innovative in launching new contracts that are more highly customized to their end users' needs. While perhaps only a quarter of the new contracts "succeed," innovation continues to be an important strategy to counter the growth in the use of OTC derivatives. Of course, another strategy is to enhance the ODE market's experience and comparative advantage with respect to the clearing of transactions, thereby assisting OTC markets in mitigating counterparty credit risk. From a regulator's perspective, the increased clearing of OTC derivatives could help address the problems associated with the concentration of credit risk among the handful of large international banks that are involved in the vast majority of OTC transactions.[9]

OTC and ODE derivatives markets can both complement and compete with each other. For instance, the major broker/dealers of OTC derivatives frequently rely on a liquid ODE market to dynamically hedge their market risk. Conversely, organized futures and derivatives markets in the U.S. face competitive pressure from OTC markets, which are offering fairly similar contracts but are unburdened by regulatory and supervisory oversight. To a certain extent, competition between OTC derivatives and ODE derivatives is determined by the structure of the contracts and the types of risk the end users need to hedge. Hence, it may be useful to analyze how ODE markets can increase their comparative advantage in highly standardized and liquid derivatives while also providing clearing services for OTC derivatives.

In trying to analyze how ODE markets can respond to the threat posed by OTC derivatives, more research is needed to model the interrelationship between these markets. While it is a potentially relevant area for future regulation initiatives, very little research has so far been done on this topic.[10] Rather, the main focus of the security design literature has been on competition between different stock exchanges or ODE markets. This chapter takes a first step in analyzing inter-derivative market competition in a multiple contract setting and draws some policy conclusions regarding how competition

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[9] For the second quarter of 2002, seven commercial banks accounted for 96 percent of the total notional amount of derivatives held by the U.S. banking system (estimated at US$50 trillion; see OCC, 2002). OTC derivatives accounted for 90 percent of the total, and the remainder was in the form of ODE contracts.

[10] An exception is Kroszner (1999).

affects the contracts issued by the two markets, their transaction costs, and whether or not ODE markets would benefit from reducing OTC market risk aversion and investors' counterparty risk concerns while trading OTC. The main findings of this chapter are that the two derivative markets can co-exist in equilibrium while exploiting their comparative advantages. Interestingly, the most useful approach for ODE markets to deal with the competitive threat posed by OTC markets is to lower transaction costs, target high variance risks that remain to be hedged, and introduce mechanisms that can help reduce the counterparty credit risk exposure the OTC market faces. This could be achieved, for example, by providing customized clearing services, which would allow the OTC market to better target those investors with particular types of risks.

The remainder of this chapter is structured in the following manner. First, a brief overview of the literature is provided. Section III is devoted to the model and begins with deriving the chapter's theoretical framework on the basis of the previous security design literature. In the model provided, the ODE market can launch only one contract, while the OTC market can launch as many as it wishes. A key contribution involves extending the relatively straightforward innovation modeling framework for the ODE market to a market with a different structure. Sections III.A and III.B then apply the model for each market's optimal contract and transaction cost, and analyze the respective impact on trading volume, competition, and risk diversification are analyzed in the second section (a numerical example is provided in the appendix). This section also discusses the degree to which the model takes into account credit risk related costs for the investors and the OTC market, and the effect of this credit risk on market competition. After a discussion of the comparative statics of the model in Section IV, Section V discusses some potential policy lessons that could be drawn. The chapter ends with some conclusions and proposes some avenues for further research. The first appendix discusses some of the model results in the context of various numerical examples, while the second appendix analyzes the United States as an example for some of the regulatory and supervisory challenges facing OTC derivatives compared to ODE derivatives.

II. Literature Overview

Duffie and Jackson (1989) introduced a useful modeling framework to address issues of optimal financial innovations and transaction costs in an incomplete market setting. In this strand of the literature, an innovation is defined as the best additional contract given previous contracts. This contract/innovation/derivative is optimal if it spans the largest possible section of a previously unspanned portion of the incomplete market. In reality, however, markets will always be incomplete, due to the risks that can never be hedged by a financial instrument. The original model by Duffie and Jackson has been extended in at least two main directions. Tashjian and Weissman (1995) used the approach to analyze a futures exchange that can launch several contracts and how it affected trading volumes. Clearly, the futures market will always design the next new contract in such a way that it is likely to generate the highest additional revenue for the exchange, i.e., it will target those investors that have the highest unfilled demand for hedges weighed by their risk aversions. Cuny (1995) enhanced the original model by taking into account the role of liquidity in the design of the optimal contract and the effect of competition between multiple exchanges over time. These extensions have been further generalized in a variety of papers as discussed by the useful surveys completed by Duffie (1992) and Duffie and Rahi (1995).

More recent approaches analyzing multiple exchange competition have brought a variety of different modeling frameworks to the concepts of innovations, competition, etc. Santos and Sheinkman (2001), for example, ask whether competition between organized exchanges lead to excessively low standards in terms of the guarantees/collateral traders have to provide to transact. The authors argue that it has been claimed that the nature of market competition triggers a race for the bottom to maximize trading volume by requiring few performance guarantees/collateral. However, Santos and Sheinkman show, in the context of a two period model (which allows for default among traders but not for them to trade in multiple markets) that the use of guarantees/collateral is indeed constrained efficient in a competitive setting. Interestingly a monopolistic exchange would design its securities and guarantees in such a way that actually less collateral is provided than in a competitive setting. Moreover, the authors argue that the race to the bottom argument is not borne out in empirical research and that the experience with self-regulation is pretty robust with the exception for potentially extreme events (for example, the 1987 stock market crash).

Rahi and Zigrand (2004) analyzes the issue of market competition and financial innovation from the point of view of arbitrageurs/speculators. Rather than assuming, as is common in the literature, that exchanges design the innovations/contracts, Rahi and Zigrand argue that profit seeking agents that trade on the exchanges play an important role in the ultimate design of a financial contract. For example, an arbitrageur/speculator is not only interested in potentially hedging some random endowment but also to identify mispricings or provide liquidity and generate trading profits. These arbitrageurs/speculators differ from the typical investor by their ability to trade across multiple exchanges. The authors assume that investors predominantly interested in hedging their endowments are limited to their "local" exchange. The resulting security design game is driven by the arbitrageurs in terms of what assets are available for trading. Hence, the model developed in their paper derives an endogenously incomplete set of financial assets in the context of segmented markets. What is of particular interest is that Rahi and Zigrand's model explains why many of the financial innovations actually seen in the real world are in many times redundant, i.e., they could have been created through a combination of previously existing assets. This result predominantly reflects the role arbitrageurs/speculators play across markets and their focus on trading profits rather than maximizing trading volume and the socially optimal level of hedge.

The more recent approaches have, as discussed above, shed more light on the various aspects on who is responsible for launching the innovation, and whether or not market competition could have potentially less attractive side effects. This chapter takes the competition dimension in a new direction by analyzing how two different types of derivative exchanges compete and what are some of the tentative policy lessons that can be concluded from some of the model's implications.

III. The Model

The model developed in this chapter will base itself mostly on the Tashjian and Weissman two-period model. New contracts will be of a very stylized form and a zero interest rate is assumed. While the ODE market is limited to one contract and acts as an intermediary for transactions, the OTC market can issue as many customized contracts as

needed as long as it is willing to take the offsetting position to that of the agent. In the original security design literature, short sales presented a problem (see Allen and Gale (1994)), since it allowed all agents to replicate a potentially new contract without costs. The model developed here has no short sale restriction for either the ODE contract or the customized OTC contracts. Short sales are allowed as long as all the trading takes place through one of the markets. An important difference between the ODE and OTC market is, however, that the OTC market will hold positions of its own.

In game theoretic terms, the model developed represents a game between a single ODE market and a single OTC market. Both markets will simultaneously offer contracts to a group of agents/investors. Risk averse investors (hedgers and speculators depending on their initial risky endowments and risk tolerances) will buy or sell a contract depending on how attractive the contract is. The key difference between the two different contracts is that the OTC contract can be customized to various degrees to hedge an investor's idiosyncratic risk, something the standardized ODE contract cannot do. At the subsequent time period the risky payoffs are realized and the game ends. Note that it is not a zero sum game, but there is a maximum volume that can be traded because the number of agents in the economy and their endowments are finite. The pareto optimal equilibrium is reached by choosing a set of contracts that maximizes transaction volume and hence the amount of risk transferred. However, non-zero transaction costs, the OTC market's risk aversion, the agents' credit risk aversion, and the less than perfect competition between the two markets will ensure that global trading volume is less than pareto optimal. Only two markets are analyzed, making the resulting game fairly simple and tractable. Treating the OTC market as a single concentrated marketplace, which makes the decision of what contract to launch at what price is another simplifying assumption. In reality OTC markets (see Schinasi and others, 2000, for a detailed description) are more of a loose global network of large banks, where the vast majority of transactions are conducted between a handful of large participants.

A. Basic Design

The construction of the basic version of the model will begin with the derivation of the agents' optimal demands for the different markets' contracts. Knowing these demands, they can then be aggregated across all the agents in the economy. These aggregated demands are the central variables in the markets' maximization problems. The motivation for customization being the key difference between the two markets is that OTC market participants generally view the ability to off-load highly idiosyncratic risks as one of the key advantages of going to the OTC market.[11] Moreover, small and medium investors with other transactional motives play, even on the ODE markets, a very small role.[12]

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[11] Which is indeed the most frequently cited reason to use the OTC markets, the OCC attributes the rapid growth in OTC derivatives to "banks clients' increasing use of customized solutions for risk management problems" (OCC, 1999).

[12] They reportedly constitute about 4 percent of volume traded on NYSE. Their insignificant presence is also valid on the major derivative exchanges (not agricultural commodities though).

There are, of course, a number of additional market differences that are relevant, such as the ability to transact in relative anonymity on ODE markets, while the regulatory oversight and potential capital charges can be lower with transactions on OTC markets. These considerations, while relevant, are not directly addressed in this chapter, but will be revisited somewhat later on.

There are, in this model setting, K agents, where each individual agent k has its individual constant risk aversion, r_k. An agent is endowed, in some numeraire of consumption goods, with a random number of two risky future payoff vectors (assets) m and e_k.[13] The first asset is the "systematic" part, m, (with a risky pay-off related to, for example, economy wide risks that all agents could face) and the second part is agent k's "idiosyncratic" risk, e_k (with a risky payoff related to, for example, non hedgeable basis risk or exposure to individual risks not common with other agents). Here, x_k^m denotes the endowment of risky asset m, for a given agent k, and x_k^e is the endowment of risky asset e_k. Systematic risks and idiosyncratic risks are assumed to be uncorrelated. The total endowment for an agent is equal to:

$$x_k = x_k^m m + x_k^e e_k$$

The variance of this endowment is:

$$Var(x_k) = Var(x_k^m m) + Var(x_k^e e_k) = (x_k^m)^2 Var(m) + (x_k^e)^2 Var(e_k) \qquad (1)$$

For simplicity, it is assumed that the variance of the idiosyncratic risks are the same across agents, i.e., $Var(e_k)$ is equal to $Var(e)$ and $Cov(e_i, e_j)$ is equal to zero.

Risk averse agent k has the choice of hedging his initial risky endowments by buying or selling the ODE derivative contract, with the random payoff f_{ODE}, and/or the OTC derivative, with random payoff $f_{k,OTC}$. The amounts agent k chooses to buy or sell, are denoted by $y_{k,ODE}$ and $y_{k,OTC}$. For each unit he buys or sells in the ODE market he has to pay a transaction cost of T_{ODE}. The OTC market does not charge a transaction cost as such, but rather generates revenues from the price offered to the agent (in the form of a bid/ask spread depending on whether the agent is buying or selling). Hence, the price agent k has to pay or receive are determined in equilibrium and are denoted by P_{ODE} and $P_{k,OTC}$. Since the OTC contract is customized for each individual agent it can be broken into its constituent parts, i.e., the risks that are being hedged against. Hence, it assumed that $f_{k,OTC} = f_{k,OTC}^m + f_{k,OTC}^e$ and that the agents demand for the OTC contracts is $y_{k,OTC} = y_{k,OTC}^m + y_{k,OTC}^e$ at a price of $P_{k,OTC} = P_{k,OTC}^m + P_{k,OTC}^e$. Given the presence of two

[13] As is standard in the literature, and for simplicity, we assume that there is no initial endowment of some non-risky asset.

financial markets, agent k is maximizing his utility by maximizing the next periods' payoff taking into account his risk aversion in the form of a mean variance type utility function subject to some individual level of risk aversion and with normally distributed payoffs.[14] To capture an important difference between OTC markets and ODE markets and the fact that transactions in the ODE market are cleared, agents that transact in the OTC market face additional credit risk aversion c_k for the exposure they face towards the OTC counterparty

$$U_k(x_k) = E(w_k) - r_k Var(w_k) - c_k Var(w_k^{OTC})$$

Agent k's maximization function is hence constructed by substituting k's pay-off function, i.e., w_k, into the utility function.

$$\max_{y_{k,ODE}, y_{k,OTC}} U_k(x_k + y_{k,ODE}(f_{ODE} - P_{ODE}) + y_{k,OTC}(f_{k,OTC} - P_{k,OTC}) - |y_{k,ODE}| T_{ODE}) \qquad (2)$$

Plugging (2) into the agent's mean-variance utility expression, the optimal demand of each contract will depend on how well the contract's payoff hedges *k's* risky endowments, which is determined by the contract's covariances. In the case of the ODE market, its contract can, by assumption, only hedge the systematic risk, which means that:

$$Cov(x_k^e e_k, f_{ODE}) = 0$$

$$Cov(x_k, f_{ODE}) = Cov(x_k^m m, f_{ODE})$$

After some derivation, the optimal volume bought or sold by a certain agent k in market ODE is equal to:[15]

$$y_{k,ODE} = \frac{1}{2r_k Var(f_{ODE})} \begin{bmatrix} -2r_k Cov(x_k^m m, f_{ODE}) - 2r_k y_{k,OTC}^m Cov(f_{ODE}, f_{OTC}^m) \\ + E(f_{ODE}) - P_{ODE} + \alpha_{k,ODE} T_{ODE} \end{bmatrix} \qquad (3)$$

Similarly, the amount bought and sold of the OTC contract addressing m-risk can be expressed by the below expression:

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[14] Maximizing a standard mean variance utility function with normally distributed pay-offs is equivalent to maximizing a negative exponential utility function exhibiting constant absolute risk aversion.

[15] The derivation of the individual's optimal volume is relatively straightforward and more details are provided by Tashjian and Weissman (1995) or Duffie and Jackson (1989). As is standard in the literature, no specific budget constraint is assumed in period 0 and agents do not default on their future payment. For a relaxation of the latter assumption please see Santos and Scheinkman (2001).

$$y^{m}_{k,OTC} = \frac{1}{2(r_k + c_k)Var(f^{m}_{OTC})}\begin{bmatrix} -2r_k Cov(x^{m}_{k} m, f^{m}_{OTC}) - 2r_k y_{k,ODE}\, Cov(f_{ODE}, f^{m}_{OTC}) \\ + E(f^{m}_{OTC}) - P^{m}_{OTC} \end{bmatrix} \tag{4}$$

While the demand for OTC contract hedging an individual's idiosyncratic risk can be shown to equal:

$$y^{e}_{k,OTC} = \frac{1}{2(r_k + c_k)Var(f^{e}_{k,OTC})}\left[-2r_k Cov(x^{e}_{k} e_k, f^{e}_{k,OTC}) + E(f^{e}_{k,OTC}) - P^{e}_{k,OTC}\right] \tag{5}$$

The optimal demand expressions in (3), (4), and (5) show that an agent's demand to buy and sell the ODE and the OTC contracts depends on the variances of the contracts' payoffs, the covariances of the agent's risky endowments with the respective contracts, and the covariances between the contracts. Moreover, the risk aversion of the agent to risk ,in general, and OTC-risk, in particular, the expected return of the contracts, and the price of the contracts also play a role. Of course, the higher the transaction cost of the ODE contract the less it will be in demand.

Further analyzing (3) the first two terms in the main bracket are referred to as the "hedging component", and the last two terms are referred to as the "speculative component" (based on Tashjian and Weissman, 1995). The first term of the "hedging component" has the effect of whether an individual agent tends to have a positive or negative demand for the contract, if the contract is positively correlated with the agent's positive endowment he tends to have a negative demand (i.e., supply). The second "hedging" term captures the effect of competition with the OTC contract hedging m-risk. The more the two competing contracts are correlated, and if the agent has already hedged some of his risk using the other contract, his absolute demand for the other contract is less. In the case of the ODE market, the premium/discount ($E(f_{ODE}) - P_{ODE}$) in the third term relates to how the equilibrium price of the contract encourages "speculators" to provide additional demand or supply to clear the market (i.e., to ensure that the net supply in equilibrium is zero). For example, in some cases there might be an imbalance between the agents interested in selling the ODE contract and the agents interested in buying it. In those cases the premium has to be increased to induce an increased supply from agents with a low risk aversion, which allows them to take on additional risk by supplying the contract and to be compensated for it by the premium. The agents that provide this additional supply in the ODE market (or demand if the imbalance is reversed) can be interpreted as "speculators." Finally the last term in equation (3) captures the effect of transaction costs on agents' willingness to transact in the ODE market's contract. If agent k has a negative risky endowment, he is likely to go long in the ODE contract. As a result $\alpha_{k,ODE}$ is equal to -1 and the transaction cost has a negative effect on the *k's* final demand for the contract.

Turning to the OTC market, the role of the speculator is being played by the OTC market itself. Hence, since the counterpart is always the OTC market, that market will set the price that optimizes the market's return for each individual agent. However, its pricing

power in the case of m-risk is limited by the competition effect provided by the ODE market, and the agents' counterparty credit risk aversion.

B. The Markets' Maximization Problems

The two markets are assumed to be interested in maximizing their risk-adjusted revenue. In the case of the ODE market the risk-adjusted revenue is simply the absolute volume traded in the chosen contract times the chosen transaction cost, since this market does not take positions of its own. In the case of the OTC market, revenue is generated by the premium/discount charged by the market times the number of contracts adjusted for the riskiness of the net position incurred by the OTC market. Each market can, of course, choose the structure of the contract it offers and, when relevant, the transaction cost or price associated with it. Any contract's structure is defined by the contract's pay-off.

The ODE Market's Maximization Problem

Following the definitions in (3), the optimal individual demand for each contract is aggregated across all agents to derive the total volume traded in the ODE market. Multiplying this volume with the transaction cost per trade results in the revenue maximization expression for the ODE market.

$$\max_{f_{ODE},T_{ODE}} R_{ODE}(f_{ODE},T_{ODE}) = T_{ODE}V_{ODE}(f_{ODE},T_{ODE}) \tag{6}$$

How much the competition affects the revenue of the ODE market depends on how much the participating agents in the ODE market also trade in the OTC market. The model allows for agents to transact in both contracts simultaneously. It is clear that the total volume traded in each market will be a function of how good that market's launched contract is at fulfilling the agents' needs and at what costs. The total volume traded in the ODE market is defined as:

$$V_{ODE}(f_{ODE},T_{ODE}) = V_{ODE} = \sum_{k\in K}\left|y_{k,ODE}\right| = 2\sum_{k\in L_{ODE}} y_{k,ODE} \tag{7}$$

The volume expression states that the amount traded in the ODE contract is equal to two times the volume bought by the agents going long on the contract.[16] When aggregating the agents' optimal demands, see equation (3), over all the agents, and knowing that the net volume traded is equal to zero, the equilibrium price P_{ODE} can be solved:

$$P_{ODE} = E(f_{ODE}) + \frac{1}{\sum_{k\in K} 1/r_k}\begin{pmatrix} -2\sum_{k\in K} x_k^m Cov(m, f_{ODE}) \\ -2\sum_{k\in K} y_{k,OTC}^m Cov(f_{k,OTC}^m, f_{ODE}) + T_{ODE}\sum_{k\in K}\frac{\alpha_{k,ODE}}{r_k} \end{pmatrix} \tag{8}$$

[16] Demand equals supply in equilibrium so the total transaction volume is equal to two times the demand.

Substituting P_{ODE} into the volume equation by those buying the ODE contract, i.e., into $\sum_{k \in L_{ODE}} y_{k,ODE}$ (where L_{ODE} represents the agents going *long* the ODE contract), and using equation (7) the gross volume traded in the ODE contract can be derived as:

$$V_{ODE} = \frac{2 \frac{1}{\sum_{k \in L_{ODE}} 1/r_k} \times \frac{1}{\sum_{k \in S_{ODE}} 1/r_k}}{\left(\frac{1}{\sum_{k \in L_{ODE}} 1/r_k} + \frac{1}{\sum_{k \in S_{ODE}} 1/r_k} \right) Var(f_{ODE})} \left[\begin{array}{l} \left(\frac{\sum_{k \in S_{ODE}} x_k^m}{\sum_{k \in S_{ODE}} 1/r_k} - \frac{\sum_{k \in L_{ODE}} x_k^m}{\sum_{k \in L_{ODE}} 1/r_k} \right) Cov(m, f_{ODE}) - T_{ODE} - \\ \left(\frac{V_{OTC}^{S,m}}{\sum_{k \in S_{ODE}} 1/r_k} - \frac{V_{OTC}^{L,m}}{\sum_{k \in L_{ODE}} 1/r_k} \right) Cov(f_{k,OTC}^m, f_{ODE}) \end{array} \right] \tag{9}$$

Following Tashjian and Weissman's (1995) approach and notation, equation (9) can be substantially simplified using the definitions presented in Table 2.

Table 2. Definition of Key Constants

Symbol	Definition	Explanation
γ_j^L	$\sum_{k \in L_j} \frac{1}{r_k}$	Aggregated risk tolerance for agents going long (L) in market j.
γ_j^S	$\sum_{k \in S_j} \frac{1}{r_k}$	Aggregated risk tolerance for agents going short (S) in market j.
w_j^L	$\sum_{k \in L_j} x_k$	Aggregated endowments for agents going long (L) in market j.
w_j^S	$\sum_{k \in S_j} x_k$	Aggregated endowments for agents doing short (S) in market j.

Hence, the equilibrium ODE contract price, equation (8), and the ODE trading volume, equation (9), can be rewritten as:

$$P_{ODE} = E(f_{ODE}) + \frac{1}{\gamma^S + \gamma^L} \left(-2(w_{ODE}^S + w_{ODE}^L) Var(m) - 2V_{OTC}^{m,net} Var(m) + (\gamma^S - \gamma^L) T_{ODE} \right) \tag{10}$$

$$V_{ODE} = \frac{2\gamma_{ODE}^L \gamma_{ODE}^S}{(\gamma_{ODE}^L + \gamma_{ODE}^S) Var(f_{ODE})} \left[\begin{array}{l} \left(\frac{w_{ODE}^S}{\gamma_{ODE}^S} - \frac{w_{ODE}^L}{\gamma_{ODE}^L} \right) Cov(m, f_{ODE}) - T_{ODE} + \\ \left(\frac{V_{OTC}^S}{\gamma_{ODE}^S} - \frac{V_{OTC}^L}{\gamma_{ODE}^L} \right) Cov(f_{k,OTC}^m, f_{ODE}) \end{array} \right] \tag{11}$$

In equation (10), $V_{OTC}^{m,net}$ refers to the net volume traded in the OTC contract hedging m-risk. Moreover, as stated in equation (11), and similar to the results of Duffie and Jackson (1989), the gross volume traded in the ODE market is a function of the covariance of the contract offered by the ODE market and the m-risk, the variance of the ODE contract, the risk tolerance weighted aggregate endowments, i.e., what in the literature is called the *endowment differential*, the volume of OTC contracts hedging m-risk, the covariance between the ODE contract and the OTC contract, and the transaction cost.

The endowment differential is commonly interpreted as a measure of hedging demand. The higher the absolute risky endowments of those agents interested in transacting in a contract the more interesting it is for the market to design a contract specifically for that group. The weighting with risk tolerances is done to capture the fact that if agents have, on average, a very low risk tolerance, the market can exploit this need to hedge by charging a higher transaction cost. The endowment differentials are derived from aggregating the agents' aggregate contract demand expressions. Each differential will always be positive and partitioned into two parts. First, the aggregate risky endowment of those who sell (S) the contract (weighted by their risk-tolerances) and second, the aggregate risky endowment of those who buy (L) the contract (weighted by their risk-tolerances). The more risk averse a partitioning, the more the market can earn on the partition by altering the contract design to fit that partition's needs. This would allow the market to increase the transaction costs substantially. Asymmetry in risk tolerances will also affect the equilibrium price if there are speculators that for a certain compensation provide additional supply of the revenue optimizing contract. In this case a partition with generally high endowment and low risk tolerance will face two costs, first a higher transaction cost and second the cost of inducing speculators to provide them with the necessary contract through a higher equilibrium clearing price.

The gross volume traded in the ODE market is maximized when the contract offered by the ODE market has a correlation of 1 with the m-risk, i.e., $f_{ODE} = m$, and a transaction cost of zero.[17] Applying the conclusion regarding the optimal ODE contract into the individual agent's demand for the ODE contract, equation (3) can then be rewritten as:

$$y_{k,ODE} = -x_k^m - y_{k,OTC}^m + \frac{E(f_{ODE}) - P_{ODE} + \alpha_{k,ODE} T_{ODE}}{2r_k Var(m)} \qquad (12)$$

As a result, the total volume traded in the ODE market (equation (11)) can be simplified into equation (13).

$$V_{ODE} = \frac{2\gamma_{ODE}^L \gamma_{ODE}^S}{(\gamma_{ODE}^L + \gamma_{ODE}^S)} \left[\left(\frac{w_{ODE}^S}{\gamma_{ODE}^S} - \frac{w_{ODE}^L}{\gamma_{ODE}^L} \right) + \left(\frac{V_{OTC}^{m,S}}{\gamma_{ODE}^S} - \frac{V_{OTC}^{m,L}}{\gamma_{ODE}^L} \right) Cov(f_{k,OTC}^m, f_{ODE}) - \frac{T_{ODE}}{Var(m)} \right] \qquad (13)$$

[17] As stated in Duffie and Jackson (1989), Proposition 1. See the previous table for a definition of the parts of the endowment differential.

The variable of choice for the ODE market is, therefore, only the transaction cost that maximizes the ODE market's revenue. Clearly, trading volume is maximized with a transaction cost of zero, the socially optimal solution if there would be only one market, since risk is shared to the largest extent possible across agents. In a single market setting, the ODE market would, of course not, choose such a transaction cost since its revenue would also be zero. Hence, the ODE market faces the following maximization problem (by substituting equation (13) into equation (6)):

$$\underset{T_{ODE}}{MAX}\ T_{ODE}\frac{2\gamma_{ODE}^{L}\gamma_{ODE}^{S}}{(\gamma_{ODE}^{L}+\gamma_{ODE}^{S})}\left[\left(\frac{w_{ODE}^{S}}{\gamma_{ODE}^{S}}-\frac{w_{ODE}^{L}}{\gamma_{ODE}^{L}}\right)+\left(\frac{V_{OTC}^{m,S}}{\gamma_{ODE}^{S}}-\frac{V_{OTC}^{m,L}}{\gamma_{ODE}^{L}}\right)Cov(f_{k,OTC}^{m},f_{ODE})-\frac{T_{ODE}}{Var(m)}\right] \tag{14}$$

Maximizing equation (14) the ODE market faces a trade-off between the revenues stemming from an increase in the transaction cost and the resulting decrease in trading volume. Moreover, the introduction of inter-market competition results in a particular and new shape to how transaction costs affect a market's revenue. Solving the maximization problems in (14) for the optimal transaction cost yields equation (15).

$$T_{ODE}^{*}=\frac{Var(m)}{2}\left[\left(\frac{w_{ODE}^{S}}{\gamma_{ODE}^{S}}-\frac{w_{ODE}^{L}}{\gamma_{ODE}^{L}}\right)+\left(\frac{V_{OTC}^{m,S}}{\gamma_{ODE}^{S}}-\frac{V_{OTC}^{m,L}}{\gamma_{ODE}^{L}}\right)Cov(f_{k,OTC}^{m},f_{ODE})\right] \tag{15}$$

The optimal transaction costs for the ODE market is increased by a higher variance of the underlying risk it hedges, i.e., given that agents are risk averse they are more willing to pay a higher cost for their hedges. Similarly, the larger the absolute value of the risk weighted endowments of those that trade in the ODE market, the greater the potential for the ODE market to charge a higher transaction cost. As expected, equation (15) also shows that competition with the OTC contract that hedges m-risk, limits the optimal transaction cost charged by the ODE market (since the parenthesis with the volume of OTC contracts traded sums to a negative number). Plugging, the optimal transaction costs into equation (14) generates the following revenue function for the ODE market:

$$R_{ODE}=T_{ODE}\frac{\gamma_{ODE}^{L}\gamma_{ODE}^{S}}{(\gamma_{ODE}^{L}+\gamma_{ODE}^{S})}\left[\left(\frac{w_{ODE}^{S}}{\gamma_{ODE}^{S}}-\frac{w_{ODE}^{L}}{\gamma_{ODE}^{L}}\right)+\left(\frac{V_{OTC}^{m,S}}{\gamma_{ODE}^{S}}-\frac{V_{OTC}^{m,L}}{\gamma_{ODE}^{L}}\right)Cov(f_{k,OTC}^{m},f_{ODE})\right] \tag{16}$$

The OTC Market's Maximization Problem

The derivation of the ODE markets revenue function was relatively straightforward, since the ODE market only functions as an intermediary taking no positions of its own and charges an up front transaction cost. However, as shown in equation (16) the ODE markets' revenue depends on the design of the OTC contract hedging m-risk and the amount that agents already hedge in the OTC market. A key addition of this chapter is the introduction of a competing market that has a different structure than the traditional ODE market. As noted earlier, the OTC market will take positions of its own and therefore it is to a certain extent playing a role similar to the speculator in the ODE market case. The

OTC market's objective is to optimize risk-adjusted revenues rather than revenues per se, i.e., it is assumed that the OTC market maximizes a mean-variance type utility function similar to that of the agents, but with risk aversion r_{OTC}. Of course, there is a limit to how much market risk the OTC market can take on. This limit, which could be seen as the maximum value-at-risk an institution is prepared to take, or its net exposure in aggregate to market risk, puts a constraint on how much total risk the OTC market can hedge. Given this constraint the OTC market has an incentive to exploit those agents who have a particular high risk aversion and/or a high level of idiosyncratic risk endowment that can only be hedged through a customized contract. It is, therefore, assumed that the OTC market maximizes the following mean-variance utility function:

$$U_{OTC}(w_{OTC}) = E(w_{OTC}) - r_{OTC}Var(w_{OTC}) \qquad (17)$$
$$\text{s.t. } w_{OTC} \leq \Omega$$

In the above utility expression w_{OTC} expresses the net revenue expected by the OTC market from providing the various contracts to the interested agents. The total market exposure the OTC market can take on is limited by some arbitrary amount Ω. If Ω is sufficiently low compared to hedging demand among the agents the market exposure constraint will be binding.[18] Assuming, that the OTC market offers one contract to hedge agents' m-risk, and up to K different customized contracts to hedge an agent's e_k-risk, w_{OTC} would take the following form:

$$w_{OTC} = \sum_{k\in K} y^m_{k,OTC}\left(P^m_{k,OTC} - E(f^m_{k,OTC})\right) + \sum_{k\in K} y^e_{k,OTC}\left(P^e_{k,OTC} - E(f^e_{k,OTC})\right) \qquad (18)$$

The OTC market's maximization problem could be expressed as in equation (19).

$$\max_{P^m_{k,OTC}, P^e_{k,OTC}, f^m_{k,OTC}, f^e_{k,OTC}} U_{OTC} = \sum_{k\in K} y^m_{k,OTC}\left(P^m_{k,OTC} - E(f^m_{k,OTC})\right) + \sum_{k\in K} y^e_{k,OTC}\left(P^e_{k,OTC} - E(f^e_{k,OTC})\right) -$$
$$- r_{OTC}\left(\left(\sum_{k\in K} y^m_{k,OTC}\right)^2 Var(f^m_{k,OTC}) + \sum_{k\in K}\left(y^e_{k,OTC}\right)^2 Var(f^e_{k,OTC})\right) \qquad (19)$$

subject to:

$$\sum_{k\in K} y^m_{k,OTC}\left(P^m_{k,OTC} - E(f^m_{k,OTC})\right) + \sum_{k\in K} y^e_{k,OTC}\left(P^e_{k,OTC} - E(f^e_{k,OTC})\right) \leq \Omega$$

To solve equation (19), a lagrangian function is set up and the lagrange multiplier is used (λ_k) for agent k, assuming that the budget constraint is binding for the OTC market when supplying a contract to that particular agent. The variance part of equation (19) treats m-

[18] An alternative budget constraint, which would be more closely related to a value-at-risk type set up, could be to put an upper limit on the variance of the OTC market's total market exposure. Such a limit would, however, unnecessarily complicate the subsequent derivation without much additional insight.

risk differently to e-risk. The formulation captures that the OTC market can net out m-risk by taking offsetting positions, but e-risk is individual to each agent and can therefore not be netted similarly. Hence, regarding m-risk it is the net variance that matters for the OTC market. While equation (19) looks fairly complex it can be substantially simplified by carrying over the conclusions regarding the optimal contract design from the ODE market, i.e., the optimal contract is the contract that hedges the agents' risk the closest.[19] This implies that the optimal contracts for the OTC market are given and what remains to do is to solve for the optimal contract prices and the resulting OTC market risk-adjusted revenue.

$$f^m_{k,OTC} = f^m_{OTC} = m \text{ and } f^e_{k,OTC} = e_k$$

It is also assumed that while the idiosyncratic risks and their expected pay-offs would be different across the agents, the variance of these pay-offs would be the same, i.e.:

$$Var(f^e_{k,OTC}) = Var(e_k) = Var(e)$$

As a result of these definitions, the demand functions for the OTC contracts, see equations (4) and (5), can be rewritten as:

$$y^m_{k,OTC} = \frac{1}{2(r_k + c_k)Var(m)}\left[-2r_k x_k Var(m) - 2r_k y_{k,ODE} Var(m) + E(f^m_{OTC}) - P^m_{k,OTC}\right] \tag{4'}$$

$$y^e_{k,OTC} = \frac{1}{2(r_k + c_k)Var(e)}\left[-2r_k x^e_k Var(e) + E(f^e_{k,OTC}) - P^e_{k,OTC}\right] \tag{5'}$$

Substituting the revised demand expressions (including the expression for $y_{k,ODE}$, which is also a function of $P^m_{k,OTC}$) into (19), the optimal prices for the OTC market regarding the contracts f^m_{OTC} and $f^e_{k,OTC}$ can be derived.

$$\begin{aligned} P^m_{k,OTC} &= E(f^m_{OTC}) + 2Var(m)\left(c_k y^m_{k,OTC} + \frac{r_{OTC}}{1-\lambda_k}\sum_{k\in K} y^m_{k,OTC}\right) \\ &= E(f^m_{OTC}) + 2Var(m)\left(c_k y^m_{k,OTC} + \frac{r_{OTC}}{1-\lambda_k} V^{m,net}_{OTC}\right) \end{aligned} \tag{20}$$

$$P^e_{k,OTC} = E(f^e_{k,OTC}) + 2Var(e)\left(r_k + c_k + \frac{r_{OTC}}{1-\lambda_k}\right) y^e_{k,OTC} \tag{21}$$

[19] This fairly straightforward result was shown in more detail and discussed in an earlier version of this paper, but was left out in the current version for the sake of brevity. The derivation is available from the author upon request.

As can be seen from equations (20) and (21), the price the OTC market chooses is basically the expected value of the contract's pay-off plus a premium/discount, which is directly related to the variance of the underlying risk, the number of contracts bought by the agent, and the agents' extra risk aversion for trading in an OTC contract. Contrary to the ODE market, where there is one price at which everybody trades, the OTC market can customize its price for each individual agent. In the case of the contract hedging m-risk, the price also reflects the OTC market's net position. If the demand by agent k reduces the OTC market's net exposure to m-risk it will quote that agent a more favorable price (last term in equation (20)). Correspondingly, if agent k increases the net exposure of the OTC market, the premium charged to the agent will increase.

Due to the competition between the two markets there is an upper bound for the price the OTC market can charge for its f^{m}_{OTC} contract, which is equal to the price in the ODE market plus the transaction cost T_{ODE}. To further exemplify how the OTC market sets the price, consider the case where the OTC market wants to buy an m-risk contract from an agent, the market has to then compensate the agent for the counterparty risk, represented by c, which the agent is assuming by transacting with the OTC market. If the agent would have sold the same amount of the ODE contract, the counterparty risk would not be present given the clearing function the ODE market provides.

The prices of the contracts are also related to the lagrangian λ_k when the constraint is binding and reflects the choice of the OTC market of taking on m-risk through the sale or purchase of a contract hedging m-risk or whether it makes more sense for the OTC market to use its finite capacity for market risk to sell or purchase the customized contract hedging the idiosyncratic risk. The relevant lagrangians for the OTC contract hedging m-risk and the one hedging e-risk can be derived by solving (20) and (21) with respect to λ_k and setting them equal to each other.[20] The revised price for the OTC contract hedging m-risk becomes:

$$P^{m}_{k,OTC} = E(f^{m}_{OTC}) + 2Var(m)\left(c_k y^{m}_{k,OTC} + \frac{V^{m,net}_{OTC}}{y^{e}_{k,OTC}}\left[P^{e}_{k,OTC} - E(f^{e}_{k,OTC}) - 2Var(e)(r_k + c_k)\right]\right) \quad (22)$$

While the price for the $f^{e}_{k,OTC}$ contract becomes:

$$P^{e}_{k,OTC} = E(f^{e}_{k,OTC}) + 2Var(e)y^{e}_{k,OTC}\left(r_k + c_k + \frac{1}{V^{m,net}_{OTC}}\left(P^{m}_{k,OTC} - E(f^{m}_{OTC}) - 2Var(m)c_k y^{m}_{k,OTC}\right)\right) \quad (23)$$

[20] The derivation for the λ_ks assumes that the OTC market ranks the agents and their demand to transact by the profitability each transaction generates for the market. At some point, i.e., Ω, there is a limit for the OTC market to take on extra risk. At that limit and for that particular agent affected at that limit, λ_k is different from zero and affects the pricing decision for both the contract hedging m-risk and that hedging e-risk.

At the point at which the total market exposure constraint Ω is binding, the prices of the contracts offered by the OTC market for a particular agent will reflect the potential revenue of instead offering a unit of the alternative contract to that agent or another agent who could generate a higher marginal net revenue (the second term of equation (22) and the third term in the parenthesis of equation (23)). For example, the OTC market's pricing decision for the contract hedging m-risk would be affected upwards by the per unit return for the best additional transaction hedging e-risk. An additional effect from supplying an extra contract hedging m-risk at the margin would be that it could lead to a greater risk exposure for which the OTC market would wish to compensate itself for. A similar set of arguments holds for the price of the contract hedging e-risk, when it is being priced in the presence of a binding exposure constraint.

Having determined the optimal prices charged by the OTC market for each contract offered to a specific agent, the prices can be substituted into equation (19) for each agent k resulting in the total utility of the OTC market. Also relevant, however, is the amount of m-risk related contracts traded in the OTC market. This amount has to be derived in order to fully understand the driving factors of the market competition and volume traded in the ODE market (see equation (13)). The first step is to substitute the expression for $y_{k,ODE}$ into (4'). Together with substituting in the price equation of (20), the new equation is subsequently solved regarding the optimal demand for $y^{m}_{k,OTC}$:

$$y^{m}_{k,OTC} = -\frac{r_{OTC}}{(1-\lambda_k)2c_k} V^{m,net}_{OTC} - \frac{1}{4c_k Var(m)}\left[E(f_{ODE}) - P_{ODE} + \alpha_{k,ODE} T_{ODE}\right] \quad (24)$$

From equation (10) it is known that the premium/discount for the ODE contract is equal to:

$$\Delta_{ODE} = E(f_{ODE}) - P_{ODE} =$$
$$= -\frac{1}{\gamma^S + \gamma^L}\left(-2(w^S_{ODE} + w^L_{ODE})Var(m) - 2V^{m,net}_{OTC} Var(m) + (\gamma^S - \gamma^L)T_{ODE}\right)$$

Hence, the net volume traded in the OTC contract hedging m-risk is derived by substituting the above expression into (24), while summing over all agents assuming that those agents buying the ODE contracts would, if they transact at all in the OTC market, also buy f^{m}_{OTC} contracts.[21] The net volume transacted in f^{m}_{OTC} is equal to:

[21] This is not a key assumption, but reduces somewhat the notation necessary to derive the final model. Hence, it is indeed possible that speculators providing much needed liquidity in the ODE market could offset some of their exposure in the OTC market, which would imply that the partitions buying ODE contracts and OTC contracts hedging m-risk are not necessarily the same. Relaxing the assumption would also raise the interesting question of whether speculators in the ODE market are actually hurt by the introduction of an OTC market.

$$V_{OTC}^{m,net} = \sum_{k \in K} y_{k,OTC}^{m} = V_{OTC}^{m,L} + V_{OTC}^{m,S}$$

As shown above, the net volume traded is simply the volume of those agents buying the f_{OTC}^{m} contract and the others who are selling it.

$$\begin{aligned}
V_{OTC}^{m,L} &= \sum_{k \in L_{m,OTC}} y_{k,OTC}^{m} = -\frac{r_{OTC}}{2}(V_{OTC}^{m,L} + V_{OTC}^{m,S}) \sum_{k \in L_{m,OTC}} \frac{1}{(1-\lambda_k)c_k} - \frac{(\Delta_{ODE} - T_{ODE})}{4Var(m)} \sum_{k \in L_{m,OTC}} \frac{1}{c_k} \\
V_{OTC}^{m,S} &= \sum_{k \in S_{m,OTC}} y_{k,OTC}^{m} = -\frac{r_{OTC}}{2}(V_{OTC}^{m,L} + V_{OTC}^{m,S}) \sum_{k \in S_{m,OTC}} \frac{1}{(1-\lambda_k)c_k} - \frac{(\Delta_{ODE} + T_{ODE})}{4Var(m)} \sum_{k \in S_{m,OTC}} \frac{1}{c_k} \\
V_{OTC}^{m,net} &= -\frac{r_{OTC}(\Gamma_{OTC}^{L,*} + \Gamma_{OTC}^{S,*})}{2}(V_{OTC}^{m,L} + V_{OTC}^{m,S}) - \frac{(\Gamma_{OTC}^{L} + \Gamma_{OTC}^{S})\Delta_{ODE}}{4Var(m)} + \frac{(\Gamma_{OTC}^{L} - \Gamma_{OTC}^{S})T_{ODE}}{4Var(m)}
\end{aligned} \tag{25}$$

Solving equation (25) for the net volume traded in the OTC contract hedging m-risk, while defining $\Gamma_{OTC}s$ as the sum of the different buy and sell partitions' tolerance to OTC credit risk, and whether or not the market exposure constraint is binding, the net volume expression can be expressed as in equation (26).[22]

$$\begin{aligned}
V_{OTC}^{m,net} &= \\
&= \frac{1}{\begin{pmatrix} 2(\gamma^S + \gamma^L) + r_{OTC}(\Gamma_{OTC}^{L,*} + \Gamma_{OTC}^{S,*})(\gamma^S + \gamma^L) \\ + (\Gamma_{OTC}^{L} + \Gamma_{OTC}^{S}) \end{pmatrix}} \begin{bmatrix} -(w^S + w^L)(\Gamma_{OTC}^{L} + \Gamma_{OTC}^{S}) + \\ + \dfrac{(\Gamma_{OTC}^{L}\gamma^S - \Gamma_{OTC}^{S}\gamma^L)}{Var(m)} T_{ODE} \end{bmatrix} \\
&= \frac{1}{\Pi_{OTC}^{m}} \left[-(w^S + w^L)(\Gamma_{OTC}^{L} + \Gamma_{OTC}^{S}) + \frac{(\Gamma_{OTC}^{L}\gamma^S - \Gamma_{OTC}^{S}\gamma^L)}{Var(m)} T_{ODE} \right]
\end{aligned} \tag{26}$$

Knowing the net volume traded in the OTC markets allows for the derivation of the gross volume by noting that:

$$V_{OTC}^{m,gross} = V_{OTC}^{m,L} - V_{OTC}^{m,S}$$

Similarly, the volume of those buying and selling the OTC contract hedging m-risk has, as previously noted, an impact through the competition dimension on the amount transacted in the ODE contract (see equation (13)). While, a later section will discuss in more detail the key comparative statics of the model conclusions, equation (26) demonstrates that the higher the OTC market's or the agents' risk aversions are towards (i.e., the lower the OTC markets risk tolerance, r_{OTC}, the smaller the γ s, and the higher

[22] Note that if there is no constraint on the OTC market's ability to take on risk, or if it is not binding, $\Gamma_{OTC}^{L,*} + \Gamma_{OTC}^{S,*}$ would be equal to $\Gamma_{OTC}^{L} + \Gamma_{OTC}^{S}$.

the agents credit risk aversion, c_k) trading OTC contracts the less will be traded OTC and demand is shifted to the ODE market. On the flip side, the higher the transaction cost in the ODE market, the more hedging demand will shift to the OTC market and trigger an increase in trading volume in its m-risk contract. Interestingly, the higher the variance of the underlying risk the lower is the volume traded in the OTC contract hedging m-risk. This is so, since the agent's aversion towards trading the OTC contract is directly related to the underlying variance and therefore its credit risk. Hence, a nice result of the model is that it shows that trading on a market where the contracts are cleared and where there is no counterparty risk is especially attractive for agents' with higher risk endowments.

The total volume traded of $f^e_{k,OTC}$ is much more straightforward to derive, since there is no competition dimension. By substituting the optimal price of the OTC contract hedging e-risk (equation (21) into the agent's optimal demand expression (equation (5')) the trading volume in $f^e_{k,OTC}$ would be equal to:

$$y^e_{k,OTC} = -\frac{(1-\lambda_k)r_k x^e_k}{2(1-\lambda_k)(r_k + c_k) + r_{OTC}}$$

The total volume traded in the OTC contract hedging e-risk is derived by simply summing the above expression across all agents[23], i.e.,

$$V^e_{OTC} = V^{e,L}_{OTC} - V^{e,S}_{OTC} = \sum_{k \in L_{e,OTC}} y^e_{k,OTC} - \sum_{k \in S_{e,OTC}} y^e_{k,OTC} =$$

$$= -\sum_{k \in L_{e,OTC}} \frac{(1-\lambda_k)r_k x^e_k}{2(1-\lambda_k)(r_k + c_k) + r_{OTC}} + \sum_{k \in S_{e,OTC}} \frac{(1-\lambda_k)r_k x^e_k}{2(1-\lambda_k)(r_k + c_k) + r_{OTC}} \qquad (27)$$

Equation (27) shows the effect of summing individually customized contracts across all the K agents. Given that volume traded by each agent is linked to each individual's risk and credit risk aversions and endowment of their own idiosyncratic asset, it is hard to simplify (26) much further. There is a potential intra-OTC market competition dimension, which is related to the constraint on the OTC market's total market exposure discussed earlier (the link, for example, affects the price of the OTC contract, see equation (23)). Depending on whether or not the constraint is binding for the marginal OTC contract hedging m-risk or e-risk, a relaxation of the constraint could have an impact on the transaction volume in the ODE market. This relationship is discussed in more detail in the next section.

As noted earlier, contrary to the ODE market, the OTC market does not maximize revenue, but risk adjusted utility. Hence, after the optimal prices for the two types of contracts the OTC market offers each agent have been determined, and the corresponding

[23] The volume traded is a positive number since those agents' with a negative endowment tend to buy the OTC derivative, i.e., $V^{e,L}_{OTC}$ is positive.

transaction volumes derived, they can be plugged back into the original utility function of the OTC market (equation (19)). To reduce the notation below, the variance constraint is briefly assumed to be not binding. This allows the following expression for the utility function of the OTC market.

$$\begin{aligned} U_{OTC} &= U^{m}_{OTC} + U^{e}_{OTC} = \\ & Var(m)\left(2\sum_{k\in K} c_k (y^{m}_{k,OTC})^2 + r_{OTC}\left(V^{m,net}_{OTC}\right)^2 \right) + \\ & + Var(e)\left(2\sum_{k\in K} c_k (y^{e}_{k,OTC})^2 + 2\sum_{k\in K} r_k (y^{e}_{k,OTC})^2 + r_{OTC}\sum_{k\in K} (y^{e}_{k,OTC})^2 \right) \end{aligned} \tag{28}$$

IV. Comparative Statics and Model results

An important driving factor in the model is that the OTC contract can also hedge risks that the ODE contract can never address. This asymmetry provides interesting competition questions. For example, what is the volume traded in the ODE market in equilibrium, which market will have the lowest price/transaction cost, and how much does competition increase/lower the socially optimum volume of trading? Since in optimum both markets offer contracts that are perfectly correlated with the underlying risky endowments, the main channel of competition is the cost of completing each transaction more broadly. As a result, the optimal transaction cost expression for the ODE market has evolved in comparison to the previous literature, while the OTC market competes by price and discrimination between agents.

A. Comparative Statics

Increased competition, through a higher trading volume in the OTC market's contract hedging m-risk, will decrease the level of the ODE market's optimal transaction cost. Hence, in a non-competitive setting, where there is only one monopolistic financial market providing only contracts hedging m-risk, the optimal ODE transaction cost would be higher (see appendix for some numerical examples). For the OTC market, however, the choice is whether to use its scarce capacity to take on risky positions that are related to m-risk or whether it should only focus on providing a hedge against e-risk.

Table 3. Comparative Statics of The Model

	r_k	c_k	r_{OTC}	T_{ODE}	$Var(m)$	$Var(e)$	$V_{OTC}^{m,net}$
$y_{k,ODE}$	-	..	..	-	-	..	..
$y_{k,OTC}^{m}$	$sign(V_{OTC}^{m,net})$	?	$-sign(V_{OTC}^{m,net})$	+	-	..	-
$y_{k,OTC}^{e}$	-	+	+	..	..	..	..
T_{ODE}	-	..	..	..	+	..	..
P_{ODE}	-	..	..	+	-	..	-
$P_{k,OTC}^{m}$	..	+	?	+	?	..	+
$P_{k,OTC}^{e}$	?	+	+	..	..	+	..
$V_{OTC}^{m,net}$	..	$-sign(V_{OTC}^{m,net})$	$-sign(V_{OTC}^{m,net})$	?	?	..	..
V_{ODE}	?	+	+	-	+	..	..
$V_{OTC}^{m,gross}$	..	?	-	+	-	..	-
R_{ODE}	?	+	+	?	-	..	..
U_{OTC}	+	-	-	+	-	+	?

Note: (..) implies that the comparative static is not relevant. (+) implies that an increase in a row heading causes an increase in the column heading. (-) implies that an increase in a row heading causes a decrease in the column heading. (?) implies that the sign is ambiguous and depends on the parameter values.

In the model developed in the earlier sections, the OTC market has an obvious advantage in that it can hedge an orthogonal risk that the ODE market can never capture with its contract. Hence, in the absence of competition, the OTC market would provide the optimal contracts for both types of risks. An implication of this competition is that the ODE market's transaction costs, e.g., exchange and clearing fees, have to respond to the presence of a competing market and be reduced. Hence, the ODE market competes, all else being equal, through lower transaction costs. However, the relationship between the different markets' transaction costs also depends on the structure of the endowments of the agents. Moreover, in a related decision, the OTC market has to decide to what an extent it wants to act as a "speculator" and take a net positive/negative position in m-risk ($V_{OTC}^{m,net}$). The fact that it is willing to provide "liquidity" by helping to address any supply/demand imbalances in the endowment of the m-risk asset means that the price at which agents transact in the ODE market actually declines. In the absence of this "speculator" function, the price at which the ODE market clears is higher (if it is assumed that there is a net negative endowment of m-risk) than if some of the excess demand for hedge is covered through the OTC market.

Turning to the comparative statics in more detail, as can be seen in the table above, the higher the underlying variance of m-risk the higher the optimal transaction cost and trading volume and hence revenue for the ODE market. Hence, standardized derivatives hedging endowments of a high variance are of particular attraction to the ODE market facing a competitive threat from the OTC market. For the OTC market the relationship between the variance of m-risk and trading volume is negative. This partly reflects, for a constant ODE transaction cost, the credit risk aversion agents face when transacting in the

OTC market. Moreover, the OTC market's own risk aversion plays a role and affects the utility negatively of providing a contract hedging m-risk. An interesting result of the model is that the bid/ask spread the OTC market charges for the contracts hedging m-risk is in the optimum the same as the transaction cost of the contract offered by the ODE market.[24] If there was no competition from the ODE market, however, both the optimal demand for the OTC contract hedging m-risk and the bid/ask spread would be different (see below, modifies equation (24)).

$$y_{k,OTC}^{m,nocomp} = -x_k^m \frac{r_k}{r_k + 2c_k} - V_{OTC}^{m,net} \frac{r_{OTC}}{(1-\lambda_k)(r_k + 2c_k)}$$

If it is assumed that the risk and credit aversions of the agent going long the OTC contract hedging m-risk are the same as those of the agent going short the contract the bid/ask spread in a non-competitive setting is equal to:

$$P_{L,OTC}^m - P_{S,OTC}^m = \frac{2Var(m)c}{r+2c}\left(x_S^m - x_L^m\right) \text{ where } \left(x_S^m - x_L^m\right) > 0$$

This bid/ask spread, depending on the gross endowments of the two agents going long versus short can be bigger or smaller than the ODE market optimal transaction cost in a competitive setting.

Turning to the variance of e-risk, the effect of a higher variance is the reverse of what it is for the OTC market in terms of m-risk. The intuitive reason for this result is that the OTC market is exploiting its monopoly power as much as possible in the e-risk market. Since it is the sole provider of an instrument to hedge the idiosyncratic risk, it can ask a high price for that service. Of course, a side effect of entering into a lot of fairly rewarding contracts hedging agents' individual e-risk is that the variance of those positions quickly add up and do not net out in the same sense as the positions the OTC market enters into regarding m-risk (where it is the net position that matters for the OTC market's own risk aversion). If the OTC market has a high level of risk aversion it would shift more of its exposure and transaction volume to the contract hedging m-risk than to the contract hedging e-risk. For example, if the OTC market's risk aversion is very high it can still transact in the m-risk market, while setting its net exposure to zero. Of course, the side effect in this case would be that the equilibrium price charged by the ODE market

[24] Assume two agents, one that wants to buy the OTC contract hedging m-risk and one that wants to sell the contract. The bid/ask spread is derived by subtracting the price charged by the OTC market to the seller from that charged to the buyer. By substituting in the agents optimal demand/supply it turns out that the optimal bid/ask spread that the OTC market charges is the transaction cost charged by the ODE market. Hence, as the transaction cost in the ODE market is increased it is optimal for the OTC market to follow suit, i.e., it chooses to not compete on price. This argument assumes that the endowment of the agent trying to sell m-risk and that of the agent buying m-risk is the same with the signs reversed. Also they must have the same risk aversions and the exposure constraint has to be non-binding.

increases since the OTC market would not play any market maker function by assuming net risk. In such a setting, the OTC market may therefore be unwilling to transact in any OTC contract hedging e-risk or only at such a high cost that agents do not want to hedge these risks (see the appendix for a quantification of this example). Such an outcome, driven by high OTC market risk aversion, would have fairly large negative welfare effects.

B. Additional Model Results

So far the downside of customization has not been discussed in detail. Customization leads to an accumulation of credit risk, because neither the agents nor the OTC market can normally hedge their credit (or counter party) risk. Accumulating credit risk is clearly costly to the agent and the issuing OTC market. In the case of the ODE market, however, credit risk is managed with through the clearing system. Agents transacting in the OTC markets do not generally have access to such clearing facilities. Therefore, it is reasonable to assume that in the case of the OTC markets, the more customized a contract is, and the higher its market value, the larger the subsequent credit risk exposure faced by the agent and the issuer. Customization also limits the possibility of a resale if the counterparty defaults. However, in the global OTC interest rate and foreign exchange swap markets, recently evolving bilateral and multilateral netting arrangements are potentially an efficient way to decrease the credit risk faced by a single participant.

Regardless of the ways in which the agents transacting in the OTC market try to mitigate their credit risk exposure, the maximum possible unhedgeable loss to the agent, i.e., the number of contracts multiplied by the contract's payoff, will be a key variable in the agents' utility functions. In general, agents (as well as the OTC market) have to set aside capital against their net OTC counterparty exposure; in the case of international banks it would depend on the maximum loss according to the traditional BIS rules. Setting aside capital is costly, since it is not generating as much return as it could. Therefore, credit exposure incurs a cost for the issuing bank or organization. Several ODE markets are starting to offer successful ways for reducing the credit risk costs faced by the OTC markets by offering them tailor made clearing services.[25] This fairly recent strategy exploits the ODE markets' long experience with clearing. According to a recent BIS (1998) publication, several additional derivatives exchanges have recently announced the set up of clearing facilities for less exotic OTC contracts.

In the model developed in this chapter, some of the costs of customization are modeled by including the OTC market's general risk aversion (r_{OTC}) and the agents' specific individual credit risk aversion, c_k. Increased levels of credit risk aversion among agents have a direct negative effect on their demand for OTC contracts. Given the presence of competition in the case of the OTC contract hedging m-risk, a change in the credit risk

[25] Several clearing houses have been set up recently to clear fairly standardized OTC transactions, e.g., Brazil BM&F, Sweden's OM's Tailor Made Clearing, and the London Clearing House's Swapclear. For more information see BIS (1998) and the President's Working Group on Financial Markets (1999).

aversion parameter does not change the OTC market's optimal bid/ask spread, which is still equal to the ODE market's transaction cost, but rather affects transaction volume. Similarly, the price spread for agents' hedging their e-risks, while having similar endowments and risk aversions, is also unchanged. Hence, the transaction demand for OTC contracts is rapidly affected negatively and the effect is especially pronounced for the OTC contracts hedging e-risk, given the higher marginal utility which the OTC market derives from this market due to its monopolistic position. The ODE market, however, clearly stands to gain from the loss in competitive pressure from the OTC market and both ODE market revenue and volume would respond positively. The overall utility of the agents trying to hedge their risks suffers, however, since the positive effect of market competition on prices and transactions costs is eroded.

One remaining and related variable requiring analysis is the importance played by the market risk exposure restriction Ω and its interplay with the other key variables, such as overall risk and credit risk aversions. Equation (19) illustrates how the OTC market's ability to accumulate market risk is limited. Depending on the size of the limit, this restriction will force the OTC market to make a decision between providing OTC contracts hedging m-risk or e-risk. In essence, this constraint implies that the OTC market has to rank each potential transaction by the utility it creates and then select the contracts that provide the highest utility, whether they are hedging m or e-risk. If Ω is set high enough, i.e., the constraint is largely non-binding, then $\lambda_k = 0 \forall k$ and the OTC market can maximize freely (as is assumed in the numerical examples in the appendix). The more interesting case is when the constraint is sufficiently binding and the OTC market's risk aversion is high. In such a scenario, the market is now maximizing within the constraint and will provide mostly contracts hedging m-risk. If, however, the constraint was binding in the context of low OTC market risk aversion, the OTC market would largely only have provided contracts hedging e-risk. These results are, however, largely driven by the assumptions made with respect to the associated parameter values for the constraint and the risk aversions. All the same, they demonstrate that when assuming an economically binding constraint, the lower the OTC market's risk aversion, the more it will provide hedge for those agents with e-risk. This also means that in the case of the ODE market, and as noted in equation (14) and (16) and Table 3, its trading volume and revenue will increase when the risk aversion for the OTC market declines.[26] If, however, the risk aversion of the OTC market is very high while the budget constraint is non-binding it is possible that small changes in the risk aversion will have no significant impact on the degree of competition with the ODE market. This is the case, when as above, the OTC market decides to take a near net zero position in contracts hedging m-risk.

[26] This can be easily seen from a comparative static sense by setting the γ s equal to each other. In that case, the gross volume traded in the OTC contract hedging m-risk directly decreases overall ODE trading volume, optimal transaction cost, and, as a result, ODE revenue.

V. Analysis and Policy Implications

The first implication of the model is that introducing an interrelationship between two different derivatives markets, fundamentally changes the behavior of both the ODE market and the OTC market. The new contracts launched by each market, and their transaction costs, now have to take into account the competitor's response. For the ODE market, the optimal contract is still of the classic Duffie and Jackson (1989) type, i.e., strictly geared towards hedging systematic risk. However, the ODE market's optimal transaction cost now reflects a competition dimension. A second implication is that the optimal transaction costs and prices for both markets are critically dependent on the agents' initial endowment structure. Moreover, an ODE market competes preferably with transaction costs, while the OTC market selects to launch an OTC contract hedging m-risk at a price that in the optimum situation does not outcompete the ODE market. Hence, in equilibrium, both contracts will face some demand and both play a useful role in maximizing the transaction volume, lowering monopoly rents, and increase the degree of socially optimal hedging.

The model also recognized the counterparty credit risk, stemming from the costs of customization, leading to some interesting implications. Increased credit risk aversion among agents decreases the demand for customized OTC contracts and reduces the beneficial impact on the agents of introducing competition between markets. Moreover, the interrelationship between the OTC market's risk aversion and its market exposure constraint is such that a reduction in risk aversion may allow the OTC market to focus more on providing agents with a hedge for their e-risk rather than hedging their m-risk. This leads to an important insight, i.e. an ODE market has at least three options for responding to the competitive threat posed by the OTC markets. Firstly, it can decrease its transactions costs. Secondly, it could target only endowments with a very high variance. Thirdly, it could reduce the cost to the OTC market of customizing OTC instruments by providing efficient clearing services thereby reducing the OTC markets overall risk exposure. The third option is in line with recent initiatives by several ODE markets of introducing tailor made clearing services for some OTC contracts. This means that the rapid growth of OTC markets does not need to necessarily be a threat to those ODE markets that are quick to adapt by providing clearing services thereby growing with the OTC markets. However, there are other alternatives for the OTC market. Kroszner (1999) discusses an alternative mechanism, the so called derivative product company (DPC), through which participants in the OTC markets can limit counterparty risk. DPCs are generally separately capitalized special purpose vehicles with a high credit rating and are set up by one of the international banks. A significant share of the international banks' OTC transactions are already channeled through DPCs, (see Kroszner (1999) for a more detailed discussion), ensuring that any counterparty risk for the bank is with the DPC and that of the end-user is with the DPC as well. While the DPC approach mimics to a certain extent a clearing structure, it does not net credit risk exposure for the bank. Its main use has rather been to ensure that international banks with a relatively low rating can still take part in the OTC market through these special purpose vehicles. As a result, the use of DPCs has diminished over the last few years as banks have attained a higher credit rating.

Perhaps any corporate entity could potentially provide clearing services without being in an ODE market itself. Perhaps this is true, but existing ODE markets are likely to both benefit from significant first mover advantages and the fact that clearing is a business

with large economies of scale. Hence, there seems to be significant, if increasingly tapped, potential for ODE markets to evolve into clearing specialists, off loading and effectively managing the risks taken by OTC markets. From a supervisory perspective such a development should be rather welcome, since the authorities' main concern has been the systemic stability of the OTC market as a whole (see Schinasi and others, 2000). In the U.S. (see appendix II) voices have recently been raised for the regulation of the OTC markets and the deregulation of the ODE markets. This chapter suggests that in addition to trying to deregulate themselves faster, ODE markets have other avenues to evolve their businesses, and supervisors could support the expansion, and spinning off, of their clearing businesses (perhaps) through regulatory incentives.

VI. Conclusions

The model presented in this chapter addresses the issue of the interrelationship between two different markets, the ODE market and the OTC market. During the last few years, competition between these markets has grown more intense and ODE markets are actively seeking alternative strategies to come to grips with the OTC markets. These include increased innovation, lower transaction costs, lobbying for the leveling of the regulatory and supervisory playing field, and launching clearing facilities for certain types of OTC contracts.

This chapter models the main differences between these two markets as being differences in the type of risk against which they can provide a hedge, their different risk aversions, and their ability for handling the agents' credit risk. The contracts considered are generally of a forward type that can either hedge systematic risk (m-risk) or an agent's idiosyncratic risk (e-risk). The modeling framework introduced is an extension of the incomplete markets financial contract model originally developed by Duffie and Jackson (1989).

It is argued in the chapter that OTC and ODE derivatives markets can both complement and compete with each other. For example, the large broker/dealers of OTC derivatives frequently rely on a liquid ODE market to dynamically hedge their market risk. Conversely, organized futures and derivatives markets in the U.S. face competitive pressure from OTC markets, which are offering fairly similar contracts but are largely unburdened by regulatory and supervisory oversight. To a certain extent, competition between OTC derivatives and ODE derivatives is determined by the structure of the contracts and the type of risk end users want to hedge. Hence, it may be useful to analyze how ODE markets can increase their comparative advantage in highly standardized, high variance, and liquid derivatives while also providing clearing services for OTC derivatives. In attempting to analyze how ODE markets can respond to the threat posed by OTC derivatives more research is, of course, needed to model the interrelationships between these markets. Although potentially a relevant area for future regulation initiatives, very little research has yet been done on this topic. Rather, the main focus of the security design literature has been on competition between different stock exchanges or ODE markets.

This chapter takes a first step in analyzing inter-derivative market competition in a multiple contract setting. The main findings of this chapter are that the two derivatives markets can co-exist in equilibrium while exploiting their comparative advantages.

Competition is also clearly welfare enhancing and offers a better outcome for the agents trying to hedge their m-risk or e-risk than in any single market setting. This result is shown to hold true even in a setting where the OTC market can issue multiple contracts, while the ODE market is limited to only one. Interestingly, to decrease competitive pressures, it is sometimes in the interest of the ODE markets to help reduce the OTC markets' risk aversions. For example, in a U.S. setting (discussed in Appendix II) the ODE markets could refrain from lending their support to an increase in regulatory pressure on OTC markets, potentially increasing the cost to the OTC market of offering customized contracts. Instead, the most useful approach for ODE markets could be to deal with the competitive threat posed by OTC markets by lowering their transaction costs, targeting high variance assets, and introducing mechanisms that could help reduce the counterparty credit risk which the OTC market takes on when transacting with counterparties. The latter could be achieved, for example, by providing customized clearing services, which would allow the OTC market to better target those investors with particular types of idiosyncratic risks.

For further research purposes, an empirical paper quantifying some of the assumptions made in this chapter would be very beneficial. While it is clear that competition between the two market types is intense both in the United States and globally, from the ODE markets' perspective, there are no studies comparing the transaction costs of similar OTC and ODE derivatives. The lack of research in this area can probably be attributed to the difficulty of collecting transaction data for the OTC markets that tends to be of a proprietary nature.

In summary, this chapter could serve as useful background material for understanding the competitive market microstructure between the two different market types. Consequently, it can serve as a first attempt to improve our understanding of the relationship between two very important derivatives markets. Therefore, it is hoped that this chapter will help inform policy discussions concerning the reform and regulation of ODE and OTC markets, especially in the United States, and elsewhere.

APPENDIX 1. NUMERICAL EXAMPLES

This section presents a simple example of an economy consisting of 14 agents, deriving the optimal transactions costs and the optimal OTC market behavior. The example will show how the markets' revenues are affected by changes in transaction costs, risk aversions, and agents' endowments. The numbers and agent types are adapted from Tashjian and Weissman (1995).

Setup

The setup is the following, all the agents have the same risk aversion,

$$r_k = 0.1, k = 1,...,14$$

and the same aversion to credit risk (this will be changed in some examples), i.e.,

$$c_k = 0.1, k = 1,...,14$$

Each agent is either endowed with either m or e_k, or a combination of both. The two endowment types are uncorrelated, and

$$Var(m) = 1$$
$$Var(e_k) = 2$$

The variances are chosen in such a way that the idiosyncratic risk has a higher variance.

Table A.1. Initial Endowments for Each Agent of the Systematic Asset and the Idiosyncratic Uncorrelated Asset

Agent	Endowment of m	Endowment of e_k
1	50	0
2	-100	0
3	0	50
4	-30	-100
5	30	30
6	-30	-30
7	30	30
8	-30	-30
9	30	30
10	-30	-30
11	30	30
12	-30	-30
13	30	30
14	-30	-30

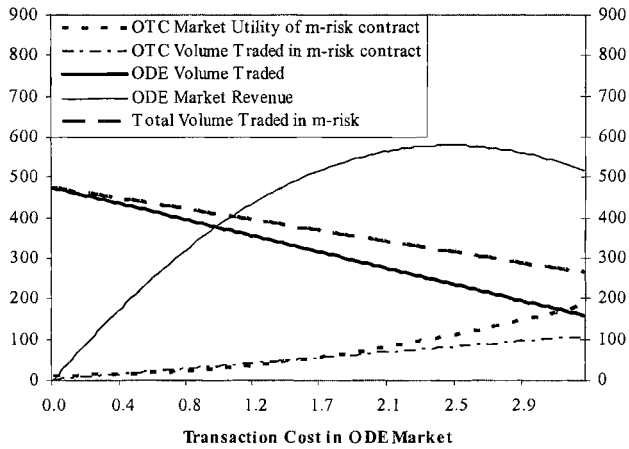
The presented endowments do not net to zero when summed. This guarantees that, while the net supply of any ODE contract has to be zero, the OTC market plays a useful role in acting almost as a speculator by providing some of the supply to close the overall

demand/supply imbalance in contracts hedging m-risk. However, taking a net position is risky for the OTC market and it is assumed that it is risk averse with $r_{OTC} = 0.05$. To avoid discontinuities in the figures it is also assumed that agents are sufficiently risk averse not to play the role of a speculator and take positions that are of the same sign as their initial endowments. Hence, all agents, with the exception of the OTC market, are trading to hedge themselves.

Optimal ODE Market Transaction Cost

Figure A.1. shows the relationship between ODE market's revenue and volume versus its choice of transaction cost. Initially a higher transaction cost more than offsets the decline in trading volume by generating higher per contract revenues. This works up to a certain point, as more and more agents choose to instead transact in the OTC market (the increase in trading volume of the OTC contract hedging m-risk) or reduce their overall hedging demand (total volume traded in m-risk declines throughout).

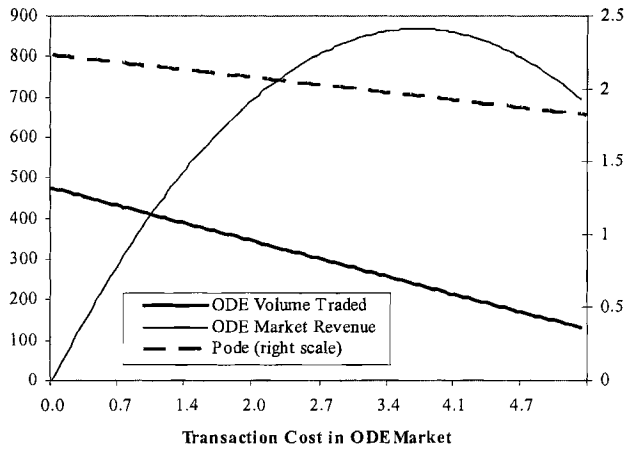
Figure A.1. Optimal ODE Market Transaction Cost



A higher transaction cost in the ODE market also allows the OTC market to increase the spread it charges agents to take the offsetting long/short positions. As noted in the comparative static section, the spread the OTC market charges is in optimum equal to the transaction costs charged by the ODE market. Hence, gradually both volume and revenue increases for the OTC market (volume increases linearly while utility rises more quickly). In this example the ODE market would choose a transaction cost of slightly below 2.5 to maximize revenues. The choice would mean that some transactions hedging m-risk are completed in the OTC market, since prices can be customized in that market as well. Hence, rather than to set a transaction cost low enough such that there are no transactions in the OTC contract hedging m-risk the ODE market has some room to maneuver thanks to that trades in that market does not suffer from credit risk and that the market is risk neutral.

In the absence of an OTC market, Figure A.2 shows that the optimal transaction cost would be substantially higher at around 3.5. Since, the speculative position taken by the OTC market is no longer available, the price to clear the ODE market is also higher than in the case of competition.

Figure A.2. Optimal ODE Market Transaction Cost If No Competition



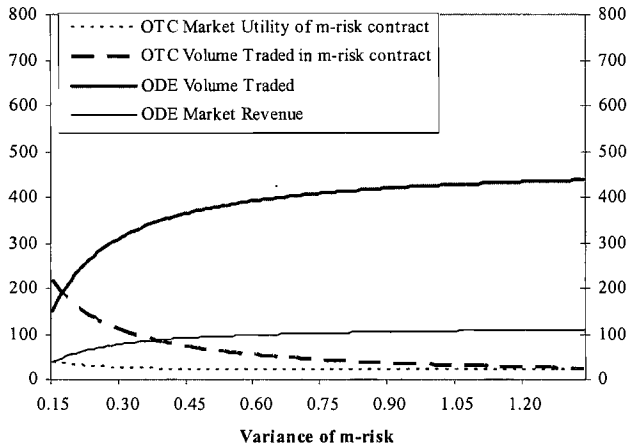
As a result, the total volume traded is therefore higher in a scenario in which there is competition between the two markets, since the ODE market has to lower its transaction cost to compete more effectively.

Implications of Changing the Variance of m-risk

It was argued in the comparative statics section that the higher the variance of m-risk the less beneficial it is for the risk averse OTC market to compete for transactions. To a certain extent this finding, while generally true, is subject to the assumption that there are no speculators with the exception of the OTC market itself.

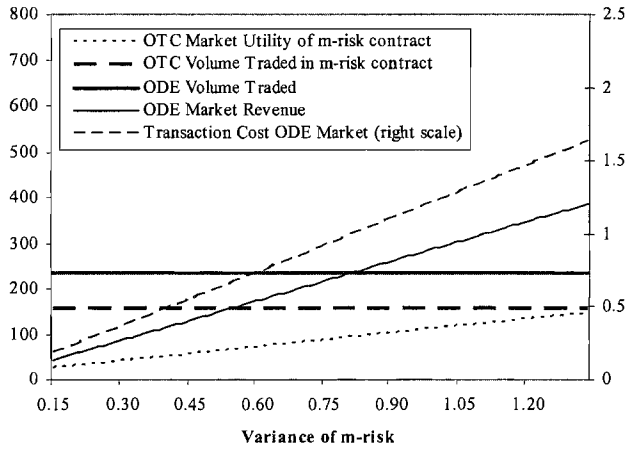
Figure A.3. shows that the trading volume in the OTC contract hedging m-risk is strictly decreasing as the variance of m-risk increases. Meanwhile, for the ODE market the reverse is true and both revenue and the agents' hedging demand in the form of their trading volume is strictly increasing with the variance of m-risk. While it is true that if the variance of m-risk is zero there is no transaction demand whatsoever for either contract, in this example since there is a fixed ODE transaction cost set at 0.25, the variance therefore has to be above some minimum positive level to generate any demand for the ODE contract. In the case of the OTC market, since it doesn't charge a transaction cost per se but rather a bid/ask spread, it can still provide some hedge even if the variance of m-risk is very low. For figure A.3. the ODE market transaction cost is held constant, but according to the modeling framework the ODE market would, of course, respond to lower m-risk variance by lowering its own transaction cost and still generate some revenue.

Figure A.3. Effect of Changing the Variance of m-risk



By adapting to the lower variance of m-risk, the ODE market can ensure that there is still some trading in the ODE contract (Figure A.4.). Only gradually will the ODE market raise its transaction costs, while still ensuring the same level of trading volume. Since the OTC markets optimal response is to set its bid/ask spread to the ODE market's transaction costs, its trading volume is also constant. Interestingly, and different to figure A.3. and the comparative static section, the OTC market's utility from offering a OTC contract m-risk now increases with the variance of m-risk (since higher variance increases the ODE market's optimal transactions costs, which allows the OTC market to widen its bid/ask spread.

Figure A.4. Effect of Changing the Variance of m-risk while allowing T_{ODE} to Change

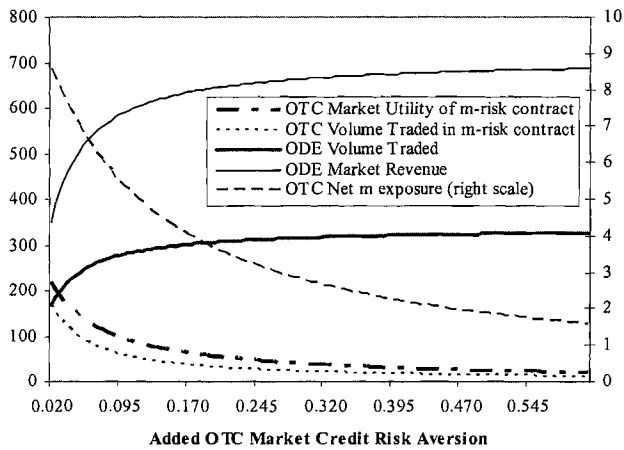


Implications of the Credit Risk Aversion Dimension

The implications of including a credit risk dimension can be exemplified in the context of redoing the earlier numerical examples. From the analysis in the modeling section it would be expected that the higher the agents' credit risk aversion the less they would like to trade in OTC contracts hedging m- or e-risk.

The reasoning above, with respect to agents' credit risk aversion is shown in figure A.5. The trading volume in the OTC contract hedging m-risk declines rapidly as agents react to the higher implicit cost due to their increasingly costly credit risk exposure. Simultaneously, the revenue and trading volume generated in the ODE market increases with a higher level of agent credit risk aversion, due to that market's ability to net out credit risk through its clearing system. In light of the earlier discussion of transaction costs, a side effect of higher credit risk aversion, is that the OTC market is less effective as a competitor. Hence, the ODE market's optimal transaction cost increases and the total endowment of m-risk that is hedged declines. This implies that the higher credit risk aversion has welfare implications from a pareto perspective, since it decreases the aggregate trading volume and thereby reduces the total utility for the agents. Another similar effect, is that the higher credit risk aversion also reduces the OTC market's willingness to act as a speculator by taking on net exposure. As shown in the figure the net supply of contracts hedging m-risk declines rapidly.

Figure A.5. Effect of Changing Credit Risk Aversion



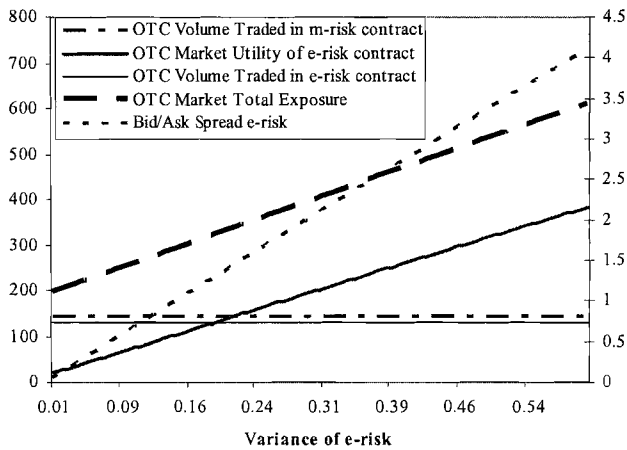
Implications of Changing the Variance of e-risk and the OTC Markets Risk Aversion

The previous examples have focused on the interactions between the OTC market and the ODE market, but have left the trading volume of customized contracts hedging each individual's unique e-risk unaddressed (Figure A.6.). Taking into account the endowment

structure of the agents' e-risk, the individual demand and supply functions are easier to derive since they don't depend on the ODE market.

If the variance of e-risk is equal to 0.0 then, as shown in equation (5') the optimal demand for a contract hedging e-risk is not determined by the model. Of course, the realistic answer is that for very low levels of variance of e-risk, agents are only interested in hedging themselves if the cost of doing so is very low. The bid/ask spread the OTC market charges an agent that is going long versus short the e-risk OTC contract is, therefore, very small for low levels of e-risk, but increases linearly thereafter. Similar to a monopoly exchange in an ODE market setting, the OTC market uses its pricing power (or the general cost to transact) to extract the maximum amount of revenue from the agents wanting to hedge their e-risk rather than trying to maximize the amount of e-risk hedged.

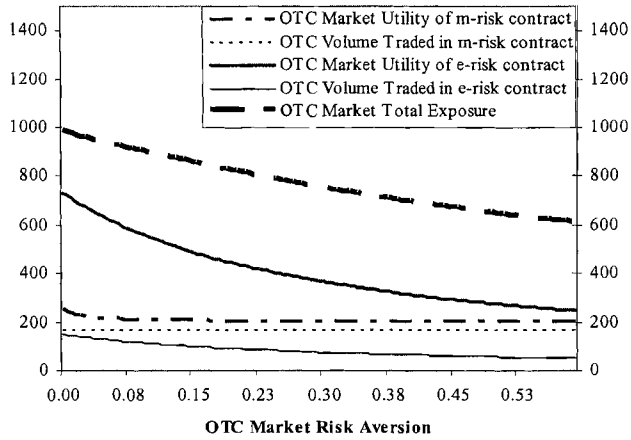
Figure A.6. Effect of Changing the Variance of e-risk



A key difference between providing OTC contracts hedging m-risk and those hedging e-risk is that, while the variance of the m-risk contracts largely net out, the variance of the e-risk contracts do not. The more transactions the OTC market engages in regarding contracts hedging e-risk the more it accumulates market risk, since there is no netting. The OTC market's risk aversion, r_{OTC}, has, therefore, a much bigger impact on the OTC market's willingness to provide hedges against individual agents' e-risk.

Figure A.7. shows that when the underlying variance of e-risk declines the utility of providing a hedge against it also declines for the OTC market. Also note, that the effect on the utility derived from hedging m-risk is much less sensitive to changes in the OTC market's risk aversion, due to the assumption that the m-risk variance is largely netted out and that the variance of the e-risk is higher. It is clear that the OTC market is much more efficient when its risk aversion is well below that of the agents, whose endowments it is trying to hedge.

Figure A.7. Effect of Changing the OTC Market's Risk Aversion

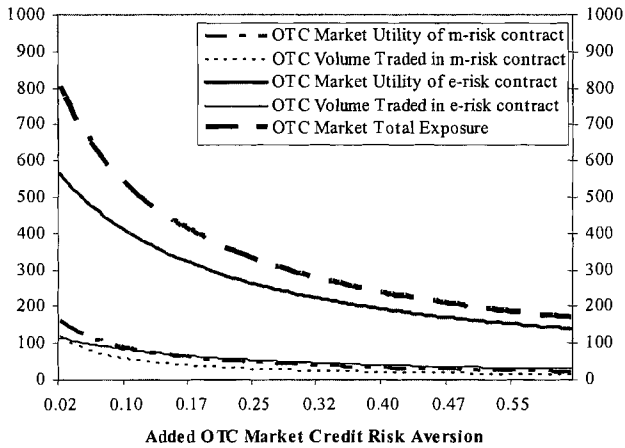


Exposure Limits, Credit Risk Aversion and the Demand for e-risk hedge

As noted in the OTC market's utility expression there is a limit to the maximum market risk exposure (Ω in equation (19)) the OTC market can take on. This assumption, as noted earlier, intends to capture that there is some credit risk for the OTC market as well when it assumes a lot of market risk based on the bid/ask spread it charges agents times the volume it transacts with these agents. Figures A.6. to A.8. all show the total exposure generated by the OTC market selling/buying contracts in an unconstrained fashion ($\lambda_k = 0$). Of course, if an overall constraint is introduced and the market exposure of the OTC market exceeds this limit, the OTC market would have to discriminate between agents and only provide hedges to those agents adding the highest marginal utility. Depending on the variance of e-risk and m-risk and the agents' and the OTC market's risk aversions, this may result in that either an OTC contract hedging m-risk or one hedging e-risk ends up being constrained and therefore not offered. The effect on the ODE market depends on what contract is constrained at the margin. If its is a contract hedging m-risk then there would be an impact.

Moreover, the demand for e-risk hedged by agents is also affected by their credit risk aversion. Similar to the OTC contract hedging m-risk, increased credit risk aversions among agents have a large impact on the utility the OTC contracts generated by providing hedges. The volume of OTC contracts traded that hedge e-risk is not affected as much, since rather than reducing the transaction volume the OTC market first reduces the bid/ask spread at which the agent can transact.

Figure A.8. Another look at the effect of Changing Credit Risk Aversion



APPENDIX 2. REGULATORY AND SUPERVISORY TREATMENT OF OTC VERSUS ODE DERIVATIVES IN THE UNITED STATES

The United States has some of the largest and most innovative OTC issuers, while also being home to some of the world's largest ODE markets. Regulatory agencies, such as the Commodity Futures Trading Commission (CFTC), have generally been cognizant of the potential competitive and systemic challenges posed by the OTC markets. However, rather than deregulate the ODE markets, much initial discussion dealt with tighter regulation and oversight of OTC markets.

The state of regulation globally with respect to OTC swaps and derivatives has been uncertain ever since the birth of the OTC market.[27] In the U.S., laws governing futures transactions were last substantially revised in 1974, establishing the Commodity Exchange Act (CEA) and the CFTC (see ISDA, 1999, and President's Working Group, 1999). These laws were never sufficiently revised to provide the OTC market with regulatory certainty, and the specter of CFTC regulatory oversight remained, threatening the legality of existing swap agreements and OTC derivatives. The illegal aspect originated when the CEA explicitly banned off-exchange "futures" contracts without defining clearly what a "futures" contract was. Therefore, the lack of clarity of the CEA was used by disgruntled investors, after losing substantial amounts of money due to an OTC transaction, to claim that the transaction was illegal to begin with, thereby potentially nullifying the transaction and recovering their losses. A further result of the legislation was that when the American organized derivatives exchange markets, such as the CBOT and the CME, started to seriously feel the competitive pressure from the OTC market, they lobbied the CFTC to take action on OTC derivatives based on the CEA (see Schinasi and others, 2000).

OTC market participants' sensitivities were further heightened when the CFTC in 1987 started investigating commodity swaps originated by Chase Manhattan. No enforcement was done but this move and some follow-up efforts forced much of the U.S. OTC market off-shore in response, stifling innovation and increasing costs. Pressure was subsequently brought to bear on the CFTC by the U.S. Treasury, the Federal Reserve and industry groups, such as ISDA, to exempt some Swaps from the CEA and CFTC oversight, subject to certain eligibility criteria. The resulting "Swaps Policy Statement" stated that "at this time most swap transactions, although possessing elements of futures or options contracts, are not appropriately regulated as such under the [CEA] and regulations." A swap was hence considered safe from the CEA if certain criteria were satisfied. While a significant percentage of OTC swaps satisfied these criteria at the time, new OTC derivative innovations again caused an increase in regulatory uncertainty. Regulators (see President's Working Group, 1999) after being increasingly concerned about the systemic risk posed by OTC derivatives, became aware that the list of criteria did not cover all relevant OTC derivatives and that these criteria also directly discouraged the use of clearing systems in part to ameliorate the systemic risk concerns. After another round of court cases, which tried to define the difference between a futures contract and a forward contract, the U.S. Congress finally decided to act in 1992, and amended the CEA with the adoption of the Futures Trading Practices Act. The Act provided increased legal certainty

[27] A brief review is given below, but for a detailed discussion see ISDA (1999) and President's Working Group (1999).

by allowing and expecting the CFTC to exempt OTC contracts from CEA regulation, especially the exchange-trading requirement, without first determining whether the contract was subject to the CEA to begin with. This was a major step forward for the OTC market and the CFTC adopted early 1993 a broad exemption for swap agreements and other OTC derivatives, as long as they were conducted by "eligible swap participants." [28] [29] Furthermore, to be exempted, the OTC contract had to be customized and not traded on or through a "multilateral transaction execution facility" (MTEF).

A conscious omission was not to give the CFTC the power to exempt OTC derivatives based on individual securities.[30] In addition, the outstanding issue of whether swap contracts and other OTC derivatives were actually subject to the CEA was never settled. In 1998, the CFTC issued a comment letter on a regulatory action and a concept release (see CFTC (1998)), which were widely interpreted as a move to increase regulation and CFTC supervision of the OTC market. This caused some concern because it would almost by necessity increase the transaction costs and perhaps cause the OTC market to move again offshore. Market participants, especially those trading in non-exempted securities, such as equity swaps, credit swaps and emerging market debt swaps, reacted negatively and the Treasury, the Federal Reserve, and industry groups pushed Congress to impose a stay on the CFTC.[31] It was clear that the OTC market had developed fast, and old definitions and exemptions were no longer adequate, hampering more efficient developments and innovations. Furthermore, ODE markets were increasingly pressing the CFTC for their own regulatory relief and a level playing field. In the aftermath, Congress gave the key regulatory agencies, through the so called President's Working Group on Financial Markets, the task to present reforms that would address the OTC markets' key concerns and take steps to reduce systemic risk. The regulatory agencies' findings led quickly to the passing of the Commodity Futures Modernization Act (CFMA) by end-2000. The main changes implied by the CFMA were:[32]

- Various clarifications of the legal certainty of OTC transactions, noting that all existing ones are legal, and new ones will be exempt from the CEA to a much larger extent.

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[28] Swaps and OTC derivatives were not exempted from anti-fraud and anti-manipulation regulation.

[29] For a definition see ISDA (1999), but basically "eligible swap participants" are financial corporations and high net worth individuals, i.e., not the broad public.

[30] Other than exempt securities, such as government bonds. The agreement that restructured the scope of the CEA and its relationship to the Securities and Exchange Commission was called the Shad-Johnson Accord.

[31] Securities that were not exempted and fell on the borderline of the Shad-Johnson Accord.

[32] See page 2 of the report for a summary.

- The exclusion from the CEA for electronic trading systems, the MTEF criteria, as long as participants are sophisticated enough. This exemption is open, as well, for existing organized derivative exchange markets, as well as for OTC markets, opening up for professional actors' markets in futures trading.

- Eliminate impediments in current law for the clearing of OTC transactions, as long as the clearing organization is sufficiently supervised.

- Single-stock futures may be allowed, which was seen as a boon for futures exchanges.

The objective of the new law was to make sure that regulatory certainty led to a reduction in transaction costs in many OTC market segments, that special purpose vehicle structures be eliminated, or substantially simplified with a drop in legal cost, and off-shore transactions can be brought back on-shore. Furthermore, increased certainty would allow OTC markets to develop instruments that previously were not offered, as their legal bases were not clear. In relation to the model developed in this chapter, such a regulatory reform should lead to less competition between the market types, as OTC markets would be freer to specialize in their comparative advantage. Hence, as would be predicted, most ODE markets initially welcomed the initial report (see Chicago Board of Trade, Chicago Mercantile Exchange, New York Mercantile Exchange press release, 1999) and eventual passing of the CFMA law. However, ODE markets remained disappointed since the CFMA, in their view, left the non-level regulatory and supervisory playing field broadly intact. In fact, ODE markets have continued to support regulatory efforts to increase the disclosure requirements for OTC participants, and proposals to expand regulation of the OTC markets were once again recently proposed in the U.S. Senate.[33]

Again, from the competition viewpoint of the model developed in this chapter, ODE markets could gain from the CFMA and should support further deregulation of the OTC market. Moreover, setting up clearing facilities or introducing OTC like instruments on their own exchanges could be a successful strategy to enhance in turn the OTC market's capability to take on highly customized/idiosyncratic risk.[34] Leveling the playing field by deregulating the ODE markets remains an outstanding issue, where new initiatives could decrease transaction costs and subsequently increase overall trading volume. However, the ODE markets' role in price discovery and the federal agencies' interest in protecting end-users of ODE derivatives make any deregulatory initiatives hard to enact. Broadly speaking, the CFMA codified the limited regulatory and supervisory oversight of OTC markets, while ODE markets continued to be regulated and supervised by the CFTC. However, the CFTC takes increasingly a largely sanguine view on the competitive pressures facing its ODE markets from others abroad as well as from OTC markets. In a recent report (CFTC (1999)), the agency noted that the global competitiveness of U.S.

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[33] In September 2002, U.S. Senators Harkin and Lugar proposed expanded regulation of the OTC markets. The federal regulatory and supervisory agencies quickly issued a strong statement against such initiatives.

[34] CBOT's recent decision to launch an interest rate swap contract is one example of a likely successful strategy.

futures markets remained high and not a real source of concern, a view clearly not widely shared outside the regulatory and supervisory communities.

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Chapter II
Crisis Resolution and Private Sector Adaptation*

I. Introduction

Private Sector Involvement (PSI) has been an integral part of all crisis resolution efforts, and is not new. At the time of resolution of the Latin American sovereign debt crisis of the 1980s, for example, the official community had many of the same objectives it has today, limiting the size of official packages, reducing moral hazard in the private sector's lending decisions, and restoring the external viability of the country in crisis. Some (for example, see Dooley, 1994) see the lending preceding the debt crisis of the 1980s as raising charges of moral hazard.

By the late 1980s, however, the improved financial positions of major international banks (as measured by their developing country loan exposures relative to their capital) and the continuing poor economic performance of many emerging markets led to the adoption of the Brady plan which involved substantial write-downs (measured in net present value (NPV) terms) of developing country syndicated loans. Indeed, the losses experienced by banks on medium-term syndicated lending to developing countries in the 1980s are regarded as a key factor in the decision of banks to shift away from syndicated lending to sovereigns toward shorter-term interbank lending in the 1990s. Large official financing packages in the 1990s, starting with Mexico (1994–95) and then in Asia (1997), were also seen by many observers as increasing the private sector's expectation of being rescued should it be confronted by an imminent credit event. This sentiment likely peaked in the run-up to the Russian default in August 1998 as the country was widely viewed as "too-big-or too-nuclear-to-fail" and would therefore receive the support of the official community no matter what.

Others have seen the crises of the 1980s and 1990s as arising out of a much more complex set of macroeconomic and financial factors and have argued that there needs to be a more nuanced view of the extent and potential sources of moral hazard. It has also been argued that moral hazard in the international financial system can potentially arise from a number of sources including: the official safety net that underpins all banking systems and the lending activities of international financial institutions (IFIs).

The official safety net underpinning the banking system is typically designed to ensure the overall stability of the domestic financial system and to protect the domestic payments system. It is widely recognized that the knowledge that a bank is "too big to fail" can lessen the incentives to impose both market and managerial discipline. Domestic bank bail-outs costing the sovereign the equivalent of 10-20 percent of GDP have not been

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* The views expressed in this paper are those of the author only and do not necessarily represent those of the International Monetary Fund. The paper updates and expands on an earlier version published in IMF Staff Papers in 2001 by Gabrielle Lipworth and the author.

uncommon and clearly have an impact on the expectations for future bail-outs by the domestic banks as well as the expectations of international banks providing financing to domestic banks.

While the moral hazard effects of the official safety net underpinning national banking systems are a constant feature of the global financial system, the potential moral hazard effects of lending by IFIs will be influenced by both the scale and timing of such lending. As noted above, market participants regard such lending as having had its most significant effect on creditors' expectations during the run-up to the Russian default in August 1998. Nonetheless, there remains considerable disagreement between those that see lending by IFIs as having a "first-order" effect in creating moral hazard and those that view such lending as having a much smaller and episodic effect.[35] Whatever the conclusion on the likely significance of moral hazard arising from official international support to countries facing external financing difficulties, the fact is that the scale of such support is limited. When there is a meaningful risk that a country may be insolvent and therefore incapable of timely repayment of emergency official assistance, the official community typically refrains from providing such assistance except on the condition that other claims against the country be rescheduled and written down to an extent that assures that emergency official assistance can be repaid. These are situations where, like it or not, the creditors of a country's debtors (its sovereign, its banking system, or its private sector) will unavoidably be "involved" in the resolution of the country's financial difficulties. More broadly, when a country faces a huge outflow of capital that threatens to swamp that country's own resources plus any plausible level of emergency assistance from the official community, and when efforts to resolve the crisis through policy adjustments, limited official assistance, and a spontaneous restoration of confidence fail, the creditors of that country will also face "involvement" in the resolution of that country's financial difficulties on terms and conditions not contemplated in their credit instruments. In these situations, private sector involvement in crisis resolution is, and always has been, a fact of life.

In designing and implementing policies concerning private sector involvement, the official sector has—and is perceived in private markets to have—several, not necessarily consistent, objectives. One is burden sharing. Because of concerns about moral hazard and other reasons, the official community wants to keep its emergency support limited. It also wants to assure that private creditors play—and are seen to play—an appropriate role in resolving crises. When losses need to be absorbed—especially in situations of insolvency—the official sector wants to assure that private creditors do not escape by imposing losses they should bear onto others. A second broad objective is limiting the damage done by the crisis, both to the country primarily involved and to the world economy more generally. Sometimes, especially in cases of insolvency, this may again mean that creditors should absorb losses (also part of burden sharing). It also means, especially in cases of illiquidity, seeking to restore external viability and market access as rapidly as possible following the resolution of a crisis—something that may not be facilitated by efforts to impose substantial losses on creditors. The third broad objective of the official community is to preserve integrity and reasonable efficiency in the functioning of international credit markets. This means that debtors should not be allowed

[35] See Lane and Philips (2000).

to escape from servicing their obligations when they have the capacity to do so. It also means that creditors who undertake risks should expect to see those risks sometimes materialize into actual losses.

These policies also interact dynamically, as the private sector reacts to the policies of the official sector for future financing flows and the official sector, in turn, adapts its policies. Sovereign debt restructurings are repeated games and while addressing the current crisis the official sector is already affecting the conditions of the next debt crisis. This phenomenon is clearly apparent in the evolution of international credit arrangements over the past two decades. Medium term loans from large syndicates of commercial banks to developing country sovereigns and public sector entities were a dominant form of international capital flows before the debt crisis of the 1980s. An important part of the mechanism that the official sector used to deal with that crisis, involved the concerted rollover and subsequent restructuring and write-down (in present value terms) of syndicated bank loans. Bonded debts of affected sovereigns generally escaped restructuring on the grounds that the amounts were small and that these instruments (held by widely diversified creditors) were difficult to restructure. The market adapted (see again Dooley (1994) or Cline (1995)). Medium-term syndicated bank loans to developing country sovereigns largely disappeared in the 1990s. Banks shifted to interbank loans of much shorter maturity. International borrowing by sovereigns took predominantly the form of bonded debts. The shifts in the form of international credit flows posed new challenges in efforts to resolve the financial crises of the 1990s. Lenders to emerging markets were either thousands of individual bond holders whose actions were difficult to concert, or banks with short-term facilities that could easily "cut and run" in a crisis. Mechanisms for private sector involvement in the crises of the 1990s have adapted to these new realities.

The fact that the private sector will adapt, taking losses or gains on existing debt while changing the level or structure of its future lending, to the official sectors' policies and practices with respect to private sector involvement is not necessarily negative. For example, although unwelcome to potential debtors, policies that raise the cost and diminish the availability of international credits to some emerging market borrowers may be desirable if they reflect a more appropriate pricing of risks and serve properly as a deterrent to imprudent borrowing, i.e., reduce debtor moral hazard. Policies that encourage longer-term securitized borrowing (which is presumably limited by available collateral) may contribute to the avoidance of more efficient resolution of crises, since such loans are hard to restructure. Longer-term loans are likely to be less dangerous in a potential crisis than an equivalent volume of short-term loans; and creditors who believe that they have secure collateral should be less prone to panic than those that do not. On the other hand, a country that has already encumbered most of its liquid assets and a good deal of its future export earnings may find itself in a very difficult situation in the event of a financial crisis.

The point is that in considering various policies and practices with respect to private sector involvement, it is critical to be aware of how the private sector is likely to adapt to these policies and practices and to the difficulties or opportunities that these reactions will generate. The analysis in this chapter is based on some fairly simple observations and assumptions of the behavior of creditors and debtors in the context of sovereign debt restructuring. It takes as given that sovereign debtor moral hazard, i.e. the possibility of a strategic default, is a key concern for a creditor's lending decision and the analysis

presented here tries to fill a gap in earlier policy papers' focus on solely creditor moral hazard.

The next section will discuss the relevant literature. The subsequent section presents a framework that examines how a sovereign debtor and a private sector creditor value debt and therefore how they are likely to be impacted when key variables change, such as the cost of default and the recovery value, as they may have done in the context of the recent official sector crisis resolution initiatives. Two forms of impact will be discussed, first how future lending will be affected as the debtor and creditor adjusts to a new equilibrium and second how already existing debt will be affected in their price. The assumption of debtor moral hazard and strategic default is not critical. The third section will discuss an extension of the simple model in which the presence of two different types of creditors affects the sovereign's default decision even without assuming that the sovereign could decide not to service its debt even if it is able to. The fourth section discusses how the modeling frameworks developed can be used to analyze how private creditors will adapt to recent official community initiatives with regards to debt payment suspensions, such as standstills. The fifth section addresses how the private sector is likely to adapt to the recent string of successful bond exchanges. It is argued that the conclusion that sovereign bonds will be as easy to restructure in the future, as they have been recently, is premature, as it does not take into account the fact that private sector creditors will adjust their expectations and lending instruments going forward. The chapter ends with some conclusions and raises the question whether the private sector is already adapting to the recent official sector crisis resolution initiatives.

II. Relevant Literature

Contrary to the literature surrounding corporate bankruptcy, the key distinction of sovereign bankruptcy has generally been that sovereigns can not be liquidated, i.e. creditors, once bankruptcy has occurred, can not take over the running of the country. Of course, this has not always been the case, but the days of gunboat diplomacy[36] and custom house seizures by national armies on behalf of that nations' bankers are hopefully long behind us. The notion of sovereign bankruptcy is hence a difficult one. A country is in theory always solvent, since it probably can raise taxes to such a level that it can pay off most levels of debt. This may, however, be politically infeasible leading to a collapse of the government or to a decision not to service the country's debt even though it would be theoretically possible. A debt liquidity crisis is another possibility. A country facing a large repayment of foreign currency debt may be forced to default, since it may not have a sufficient amount of foreign currency reserves and may not be able to borrow more. In such a circumstance the market failure stems from that the market frequently is unwilling to lend to an otherwise solvent country facing a liquidity crisis. Hence, what started as a pure liquidity crisis can gradually transform itself into a more fundamental solvency crisis. Another important difference compared to the corporate debt literature is that there is no bankruptcy court that can discipline, enforce seniority, and control debtors and

[36] Bulow and Rogoff (1989b) notes that between 1902 and 1930 the United States intervened on behalf of creditors in several Latin American countries suffering from debt crises. In the nineteenth-century, England intervened in Egypt and France intervened in Turkey to ensure debt collection.

creditors alike, leaving the topic of sovereign debt restructuring almost entirely in the hands of the involved parties, i.e. the sovereign and its creditors. A potential third party, i.e. the official community, usually represented by the IMF, has frequently been introduced in the literature to solve the potential "market failures" common to sovereign debt restructuring by either providing a carrot or a stick and indirectly playing the role of bankruptcy court.

The academic literature surrounding the issue of sovereign debt restructuring has a fairly long history and can be broadly divided into three stages. The first stage can be represented by Eaton and Gersovitz's (1981) seminal paper, which in a way was the trigger of the modern sovereign debt literature and has served as its basis ever since. In their paper, Eaton and Gersovitz formally analyzed the incentives a sovereign has to repay its creditors and noted that their could be instances when, even though the sovereign was able to repay its debts, it was not willing to do so. This, so called, debtor moral hazard reflected the very essence of being a sovereign country, but creditors would naturally have to guard against this risk by either charging a higher up front premium, designing some enforcement mechanism that would ensure repayment, demand up front collateral, or not lend at all. Since sovereign lending undoubtedly occurs, Eaton and Gersovitz argued that the reason sovereign countries repay their debts is because of their need to smooth consumption over time and that capital market access is critical for achieving that. This incentive hinged fundamentally on the assumption of an infinite time model. Bulow and Rogoff (1989a) demonstrated that in any finite time model consumption smoothing would not provide enough of an incentive for sovereign lending[37]. Eaton, Gersovitz, and Stiglitz (1986) provide a succinct overview of the early literature on sovereign debt restructuring, while Cline (1995) provides a very useful overview of the first two stages of the modern sovereign debt literature.

The debt crises of the 1980s served as an important impetus for the second stage of related literature on sovereign debt restructuring. Bulow and Rogoff (1989a and 1989b) developed path breaking work on multi-period models on sovereign debt restructuring and discussed what type of enforcement mechanism creditors, mostly international banks, would require to lend to a sovereign. Bulow and Rogoff considered a country's reputation as a potential disciplining device, but noted that the worst creditors could do to punish the defaulting sovereign debtor would be to not allow it to borrow from them again. This would generally be insufficient and possibly time inconsistent. As a result, other better disciplining devices would be needed to support sovereign lending. Such devices would have to be different from imposing punishment ex-post, since, according to Bulow and Rogoff, in a dynamic model such punishments would prove to be inefficient for both creditors and debtors alike, since they could both benefit from forbearance. If creditors could only punish debtors ex post, the creditors' disciplining devices would only define how future benefits would be shared, i.e. determine the creditors' threat value, but would in optimum never be put into effect. The availability of trade credit was identified by Bulow and Rogoff as one potential device that would ensure that the bargaining post-default would be tilted towards the creditors' interests. Trade credits was at the time

[37] In effect Bulow and Rogoff showed that in a finite time model it was always optimal for the sovereign to default in the last period and therefore private creditors would not lend in the preceding period no matter what.

perhaps a natural choice of a possible disciplining mechanism, since most of the sovereign loans outstanding where held by the same international banks that also extended trade credit. After the Brady deals were concluded and bond financing took over this is no longer directly the case[38] and other disciplining devices must be sought by creditors holding bonded debt.

The third and current stage of the academic literature is a result of the series of sovereign crises and defaults in the late nineties and early in the twenty-first century. The official sector, through a series of initiatives, has also spurred academic interest in this topic with ideas ranging from the introduction of collective action clauses in sovereign bond contracts, via official payment standstills, to, most recently, a formalized sovereign debt restructuring mechanism (SDRM)[39]. Moreover, this stage took direct advantage of the related research completed in the corporate finance field. As a result of the liquidity crises facing a number of Asian countries, a series of papers examined the role the official sector, i.e. the IMF, could play in stemming such financial crises by playing the international version of a lender of last resort. These papers were mostly focused on the role played by creditor moral hazard, i.e. how are lending decision impacted by the possibility that international creditors are bailed out by the international official community in a crisis. This focus was natural given the series of large "bail-out" packages granted by the IMF to crisis stricken Asian countries.

Various open economy versions based on the classical Diamond and Dybvig model were developed to capture key features of sovereign liquidity crisis. Chui, Gai and Haldane's (2000) paper is one example in which the authors allow for debtors to be of a varying degree of solvency and hence either more or less vulnerable to a rush for the exits by creditors. There is also an issue of creditor coordination, where their lack of coordination could trigger a liquidity crisis. Moreover, the worse the quality of the intermediate signal received by creditors, the more likely are they to rush for the exit even if the underlying fundamentals do not warrant such a decision ex post. Premature runs do generate large efficiency losses for the country in question. To prevent such efficiency losses Chui, Gai, and Haldane discuss the various options open to a borrowing country including the role of domestic monetary policy (it is detrimental to follow an active interest rate defense), debt and liquidity management (akin to buying insurance to avoid a liquidity crisis), and capital controls (the efficiency losses are mitigated only at very high capital exit taxes, such as payment standstills). Prasanna, Hayes and Song Shin (2000) follow a similar approach, but introduce the IMF (or some other official sector organization) as a sort of arbiter and verifier between the creditors and debtors to reduce the inefficiency costs

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[38] Trade credits may, however, still be indirectly impacted by a sovereign default, since the creditor's assessment of the debtor's riskiness clearly increases and the threat of the imposition of capital outflow controls become very real. Other flows that are similarly impacted are the corporate sector's access to financing and the willingness by foreigners to invest long-term in the country. Argentina's recent experience is a powerful example.

[39] A less ambitious proposal than a fully fledged international bankruptcy court, which subsequently has been put on indefinite hold. See IMF(2000a), Roubini (2000) and Roubini and Setser (2003) for an overview of the various issues surrounding the series of official sector initiatives.

associated with strategic defaults. Hence, their paper straddles the papers focused on creditor moral hazard and those focusing on debtor moral hazard. In their model, official sector participation as a "whistle blower" is strictly welfare increasing. This is even true when there is a certain degree of uncertainty on behalf of the official sector in discriminating between a bad-luck default and a strategic default. All that is needed for welfare to be enhanced is that the official sector is better at distinguishing between the two types of default than the private sector.

Dooley (2000) takes a different approach to the recent creditor moral hazard driven literature on liquidity crises and runs. He argues that not sufficient attention has been paid to debtor moral hazard issues and the role played by ex-ante disciplining mechanism. Hence, Dooley (2000) goes back to an earlier strand of the debt restructuring literature by Bulow and Rogoff and bases his model on Bolton and Sharfstein's (1996) two-period model, which does not assume a bankruptcy court[40]. Bolton and Sharfstein directly address the issue of strategic defaults in which a firm could default because management has diverted resources to themselves (perks) instead of servicing its debt. Creditors protect themselves by taking over the firm if default occurs and change management. This is, however, not the optimal response if the default occurred due to bad luck where efficiency losses are incurred if the firm is liquidated by the creditors and its assets sold to a "second best" user of these assets. Since, the creditors can not distinguish between a bad luck default and strategic default ex-ante, i.e. cash flows are observable but not verifiable, they have to choose a debt structure involving multiple creditors to lower the incentive for strategic default. However, too many creditors should be avoided since it reduces the value of the firm post-default and makes bad luck defaults too costly. Bolton and Scharfstein therefore argue that different types of debtors would use different types of optimal debt structures. A low quality firm would try to have as few creditors as possible, to maximize its liquidation value, since strategic defaults are less likely. A high quality firm would, however, seek to have many creditors to decrease the perceived strategic default incentives for incumbent managers. If a bankruptcy court is introduced similar to the US Chapter 11, Bolton and Sharfstein argue that creditors would have an incentive to adapt, since strategic defaults would be more attractive for the debtor. Hence, the inefficiency stemming from too frequent liquidation would increase or creditors would seek debt that is harder to restructure.

In the sovereign context, Dooley (2000) argues that the most likely and credible disciplining device to avoid strategic defaults is to generate large output losses for a sovereign debtor following a default. These output losses would stem from that debt contracts are ex-ante and endogenously designed to be hard to restructure. Other mechanisms, that would impose a penalty following a default, but would be subject to the creditors' implementation ex post are not credible, since, as argued, by Bulow and Rogoff (1989b) they would never be used. As a result, making contracts hard to restructure forms a necessary part in binding the creditor ex-ante to impose a penalty, which may be inefficient to implement ex-post. Due to the loss associated with default, regardless of type, Dooley (2000) argues that ex-ante efficiency is improved.

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[40] Similar arguments based on the recent sovereign bond restructurings can also be found in IMF(2000a).

As discussed by Zettelmeyer (2003), Dooley's (2000) model helps in explaining why the present international financial architecture exits and raises the bar in terms of official intervention. The creditor moral hazard based literature identifies a whole host of inefficiencies, but does not usually address why these inefficiencies exist to begin with. Implicitly it assumes that these inefficiencies are a result of historical accidents. As a result, official intervention has to improve efficiency ex-ante and not ex-post, i.e. the official community has to show that the disciplining devices currently used, such as the output losses, are too costly in efficiency terms and that there are simpler ways to reduce these costs. Therefore, the most recent literature, such as Bolton and Skeel (2003), focuses on the role *de jure* and *de facto* seniority can play in reducing the need for protracted debt restructurings. This literature argues that if a sort of absolute priority rule could be enforced, perhaps with the assistance of the official community, much could be gained from making sovereign debt restructuring ex-ante more efficient. Unfortunately, these papers generally downplay the changes needed in the institutional and legal environment to implement absolute priority rules and seniority and are unlikely to provide much guidance on the present drivers of sovereign lending.

III. Determinants of Debt Restructuring: A Model

Consider, the simplest two-period sovereign borrowing model. A sovereign debtor has the choice to borrow an amount D, from an international lender, either in the form of bonds or loans, and invests in a risky project with an uncertain return of r_p. If r_p exceeds the coupon, c, which is what the sovereign is obligated to pay on the debt, the sovereign can service his debt and avoid default. However, if the return on the risky project is less than the required debt service, the sovereign has to enter a default, which is costly to both the debtor and the creditor, and in default the creditor instead only receives the recovery value RV instead of c. The recovery value is commonly defined as the expected present value of the future debt service that the instrument in default is expected to generate for the creditor, for example, through the issuance of an exchange bond at some point in the future with a reprofiled or lower debt service schedule. Clearly, the recovery value following default will not only be affected by the future debt servicing capacity of the debtor but also by the respective bargaining strength of the creditors of a particular instrument vis-à-vis the debtor as well as other creditors. The recovery value in default will vary from one debt instrument to another. Some debt instruments are collateralized with foreign currency assets(preferably located abroad) and designed in such a way that should default occur, the recovery value is very high (an example would be bonds collateralized by future export revenue flows).

A. The Sovereign Debtor

If strategic default is allowed for, the debtor's decision function becomes slightly more complex. Now, even if the sovereign does have the money to repay, i.e., the "ability to pay", he will only repay, i.e., "willingness to pay", if by doing so he can avoid an excessively costly default. In other words, the net benefit of servicing his debt has to be larger than the benefit from a strategic default. If this is not the case no lender will ever extend credit to a sovereign, since default is a certainty. Modeling wise one can express the sovereign's decision, given that $r_p > c$, to service his debt, $\Pi = 1$, as,

$$r_p - c > r_p - RV - \lambda$$

Therefore, a strategic default will be avoided as long as the cost, λ, which is instrument specific, together with the recovery value, are larger than the interest rate on the loan, i.e.,

$$RV + \lambda > c \quad (1)$$

Note that the suggested description in (1) breaks-up the cost of default for a debtor in two parts. First, the recovery value, which directly benefits the creditor, and second λ, which is a pure loss and benefits no one in particular. As discussed earlier, many different motivations and specifications have been proposed with regards to λ. This cost from default could include reputational costs, losing market access for both trade and long-term financing, being a target of costly litigation, and the experience of output losses while in default due to a lack of foreign capital for investments. The output loss will naturally be greater the longer the country is in default and this time period is under the control of the creditor and debtor when the original loan contract is drawn up. For the creditor the importance of the contract's renegotiation ease is a function of both the value of other disciplining devices and whether the cost of renegotiating his contract is materially different from the cost of renegotiating other contracts, i.e., in a multi debt contract setting, the debtor will default on the least costly debt first.[41]

In a world where strategic default is possible, but there is an associated cost to default, the utility function of a sovereign borrower is denoted U_s and the probability of a good outcome and hence the ability to pay is denoted p,

$$U_S = p(r_p > c)\left[\Pi(r_p - c) + (1-\Pi)(r_p - RV - \lambda)\right] + (1 - p(r_p > c)(r_p - RV - \lambda) \quad (2)$$

Unfortunately, in the real world as well as in many theoretical models (see Dooley (2000)) a lender can often only observe the default itself and not really the reasons behind the decision. Since, in some states of the world, the outcome of the investment may be low enough to actually infringe on the recovery value for the creditor,[42] it is in creditor interest to distinguish between "bad-luck" defaults, where preferably the default cost is zero to maintain as high a recovery value as possible, and strategic defaults, where the default cost should be very high to discourage them. Since a distinction is not possible, by assumption, a creditor would have to impose a default cost, by for example making the debt contract hard to restructure leading to large output losses, irrespective of whether the default occurred due to the inability to pay or the unwillingness to pay.[43]

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[41] See below.

[42] This assumes that in a bad-luck default $r_p - \lambda - RV \geq 0$ and hence $RV = r_p - \lambda$, which may be equal to zero if λ is large enough and the outcome bad enough, otherwise.

[43] As argued in the literature discussion, other authors have suggested that the IMF, or some other multilateral institution, could play the role of an outside monitor that could distinguish between bad-luck defaults and strategic defaults. The IMF could signal what type of default had occurred by lending-into-arrears and thereby, at least partly, offset the cost of default for the debtor, in that state of the world, and lead to a higher recovery value for the creditor ex-post, leading to a lower coupon ex-ante.

B. The Creditor

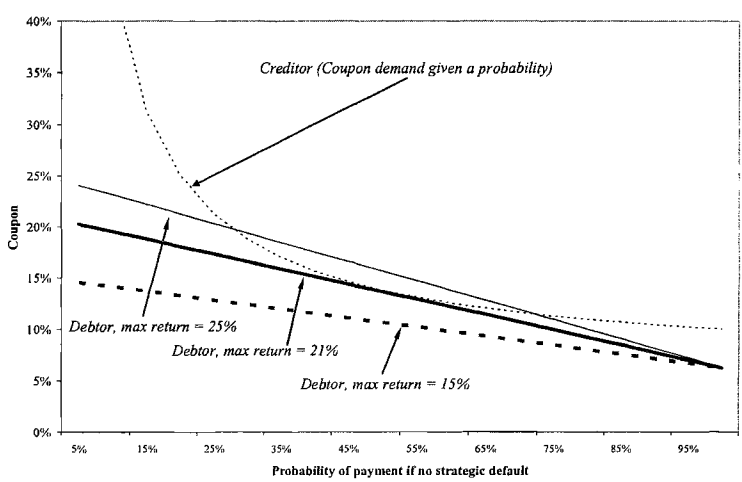
For any risk-neutral creditor any debt contract, irrespective of whether it is a loan or a bond, is valued by ex-ante depending on (i) the probability of default by the debtor on that contract; (ii) the recovery value if the default occurs; and (iii) the maturity, principal and coupon paid on the debt if the debtor does not default. This can be expressed as, in a two period model as,

$$(1+r_f) = \frac{P_{t+1}}{P} = \frac{E(D_{t+1})}{D} = \frac{p(r_p > c)(1+c)D + (1-p(r_p > c))(1+RV)D}{D}$$

$$r_f = p(r_p > c)c + (1-p(r_p > c)RV \qquad (3)$$

Here, r_f simply reflects that on a risk-adjusted basis a creditor, through an anti-arbitrage argument, expects to earn a yield of at least the risk-free rate. However, comparing (2) and (3) the inter-relationship between the two expressions are through the coupon rate. If the coupon is high, the probability of non-payment will increase and the creditor will have to charge an even higher coupon up-front to compensate himself. Given some assumption about the probability distribution, an equilibrium coupon and probability of payment can easily be derived, but the resulting coupon has to be compatible with the strategic default constraint presented in equation (1) to represent a true achievable equilibrium.

Figure 1. Creditor's and Lender's Supply and Demand Coupons



C. The Equilibrium Coupon

To derive the equilibrium coupon rate it is assumed that r_p is uniformly distributed between $r_{\min}$ and $r_{\max}$. Therefore the probability that r_p is larger than the coupon rate is simply,

$$p(r_p > c) = \frac{r_{\max} - c}{r_{\max} - r_{\min}} \qquad (4)$$

Given a certain probability, (4) can also be rearranged in terms of the coupon that is compatible with such a payment probability for the debtor.

$$c_{debtor} = r_{\max} - p(.)(r_{\max} - r_{\min}) \qquad (5)$$

Similarly, by manipulating equation (3), for the creditor, the coupon compatible with a certain repayment probability is equal to,

$$c_{creditor} = RV + \frac{r_f - RV}{p} \qquad (6)$$

An equilibrium coupon is obtained when $c_{creditor} = c_{debtor}$. There is however no guarantee of an equilibrium, as it depends on the parameter values chosen[44] (see figure 1).

At the point(s) where the coupon demanded by the creditor (supply) intersects the line that is compatible with the debtor's fundamental coupon paying ability (demand) an equilibrium is reached. However, if the repayment probability is reduced, by a reduction in for example the maximum return to 15 from 21 percent, as shown in figure 1, no equilibrium is possible and no lending would occur. Algebraically the equilibrium coupon solves the following equation.

$$c_{eq}^2 - (r_{\max} + RV)c_{eq} + r_f(r_{\max} - r_{\min}) + RVr_{\min} = 0 \text{ where,}$$

$$c_{eq} = \frac{(r_{\max} + RV)}{2} \pm \sqrt{\frac{(r_{\max} + RV)^2}{4} - r_f(r_{\max} - r_{\min}) - RVr_{\min}} \qquad (7)$$

As depicted in figures 1 and 2, for some parameter values, there may be two equilibrium coupons. In those cases it is clear that for the debtor the lower coupon dominates the higher coupon outcome, to maximize his utility and minimize the probability of an actual default (the lower path in figure 2).

D. Cost of Default and the Equilibrium Coupon

Any equilibrium outcome will have to satisfy the no-strategic default condition, which depends on λ and RV, as shown in figure 2. A "true" equilibrium, to avoid a strategic default, has to be below the line described by the sum of the recovery value and the cost of default.

Figure 2 indicates[45] that there is a non-negative cost of default that is a necessary requirement for any equilibrium with risky lending to occur. A zero cost of default, i.e.,

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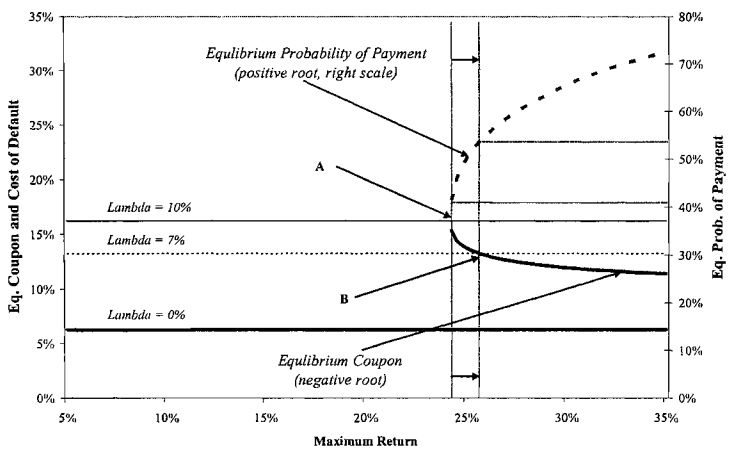
[44] The chart depicts the supply and demand coupons and probabilities of payment, given a risk-free rate of 10 percent, a minimum return from the project of 2.5 percent and a recovery value of 6.25 percent.

λ =0 percent, would only be compatible with a 10 percent coupon and a constant recovery rate that is equal to the risk-free rate, i.e., the creditor would generate a 10 percent return no matter if there was a strategic default or not. Hence, if the cost of default is low, only the relatively "safe" projects, i.e., sovereign debtors, would in equilibrium receive financing. Projects that are risky would not receive any funding, as the coupon that the creditor would need to charge the debtor, to compensate for the risk, would encourage the debtor to enter into a strategic default. However, as the cost of default increases, for example with λ =7 percent and the equilibrium shifts to B, riskier projects are able to receive some funding. Their equilibrium repayment probability will have to be at least 53 percent in this equilibrium for financing to occur. If the cost of default is increased even further to λ = 10 percent and hence equilibrium A, the riskiness of the projects that can actually be financed in equilibrium is increased and the required probability of repayment reaches its global minimum, with these parameter values, of 41 percent. As all risky projects are positive NPV projects, the increased availability of financing is welfare enhancing.

Figure 2. Equilibrium Coupon, probability of payment and the Maximum Return



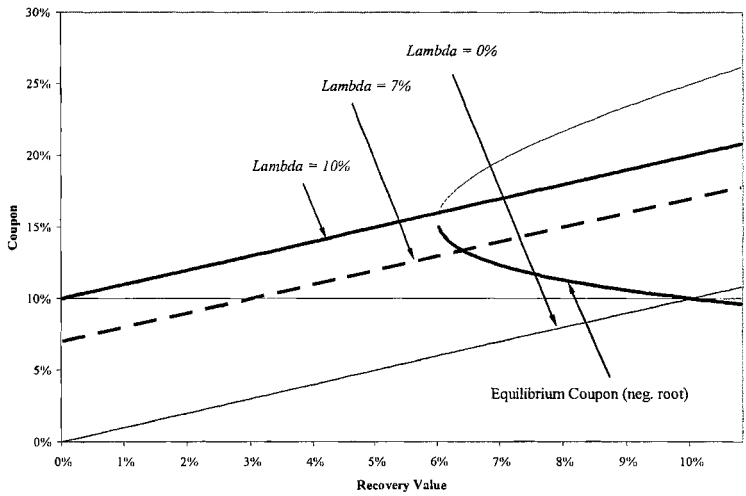
Moreover, as indicated in the figure, as well as their being a minimum cost of default, to allow risky projects, there is also a maximum cost of default. When λ is larger than 10 percent, in this example, no benefit is gained from opening up the opportunity of financing additional new risky projects. Instead welfare is lost, to the detriment of both the debtor and in some states the creditor, since if there is a bad-luck default a larger socially inefficient cost is incurred.

E. Probability of Payment and the Recovery Value

[45] Using the following parameter values, a risk-free rate of 10 percent, a minimum return from the project of 2.5 percent, and a maximum return of 25 percent.

A remaining question is how the equilibrium probability of payment relates to the recovery value. As shown in figure 3, using equation (7)'s negative root, the equilibrium coupon is strictly decreasing with the recovery value on a particular debt instrument.

Figure 3. Equilibrium Coupon, Strategic Default Costs and Recovery Value



Similarly to the derivation of the equilibrium coupon , the equilibrium payment probability can be derived from,

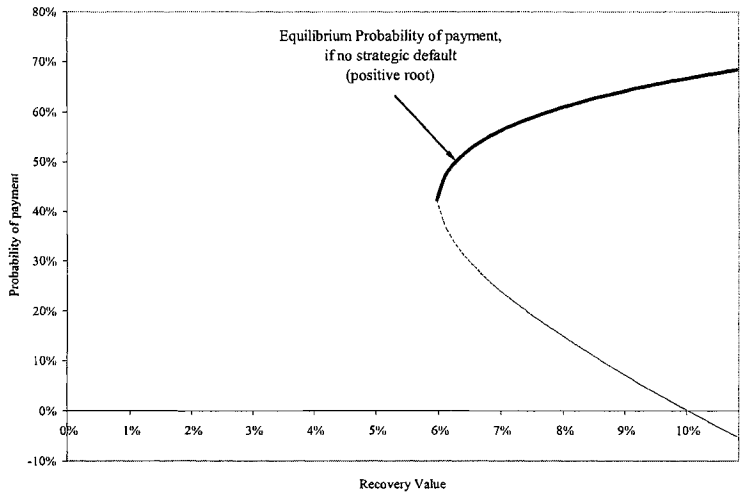
$$(r_{\max} - r_{\min})p_{eq}^2 - (r_{\max} - RV)p_{eq} + r_f - RV = 0$$

Solving for p where,

$$p_{eq} = \frac{(r_{\max} - RV)}{2(r_{\max} - r_{\min})} \pm \sqrt{\frac{(r_{\max} - RV)^2}{4(r_{\max} - r_{\min})^2} - \frac{r_f + RV}{r_{\max} - r_{\min}}} \qquad (8)$$

Plotting the equilibrium payment probability in a figure (see figure 4) it is clear that the higher the recovery value the higher is the probability of payment, since the coupon the creditor demands in equilibrium can be lowered. If default would occur, abstracting from the possibility of a strategic default, a debt instrument with a higher recovery value would be preferable to the creditor and he would feel more comfortable with extending credit to risky projects. For example, the use of collateral to back a new loan to sovereign, would in this model actually increase the probability that the sovereign remains solvent, as his debt service burden would decrease.

Figure 4. Equilibrium Probability of Payment and Recovery Value



F. Effect on Secondary Market Price of Already Existing Debt

While the equilibriums derived and discussed above reflect the effects of changes in key variables on newly contracted debt, already existing debt will also post significant price changes with changes in RV and λ. If for example the debt instrument under consideration is near the strategic default frontier and the cost of default is reduced, that particular debt instrument would see its price fall from its par value to its recovery value (RV), despite that the fundamental repayment probability of the sovereign remains unchanged.

In the case of changes in RV, it would affect the price of the debt instrument by re-arranging equation (3) to,

$$P_t = \frac{E(\hat{D}_{t+1})}{(1+r_f)} = \frac{p(r_p > c)(1+c)D + (1-p(r_p > c))(1+RV_0 + \Delta RV)D}{(1+r_f)}$$

where RV_0 represents the old equilibrium recovery value and ΔRV the change in recovery value. The impact on the price of the existing debt instrument by changing the recovery value can then be simply expressed as,

$$\Delta P = \frac{(1-p(r_p > c))\Delta RV}{(1+r_f)} \qquad (9)$$

with a positive price change if the recovery value increases and a negative price change (a loss to the creditor) if the recovery value is reduced.

G. Implications

When considering recent initiatives to enhance PSI in crisis resolution, it could be worthwhile to consider how these initiatives affect the debt instrument specific recovery value and cost of default. For creditors, being able to discipline debtors is therefore a crucial aspect of international debt flows. If the cost of default is lowered, there may be an effect on the availability and structure of the future financing provided by creditors, i.e., they will adapt. Moreover, it would cause sharp price falls for those debt instruments and debtors, for which the cost of default frontier was binding.

As figure 2 shows, the decision on whether, for example, to make a debt contract easier to restructure, and hence reduce the cost of default, depends on whether the cost of default is already seen as too high and hence a reduction would on net reduce welfare losses, or if the cost of default is in an intermediate area, in the above example between 0 and 10 percent, where it is binding and actually reduces the amount of risky lending. A reduction in the cost of default in this case would reduce the lending to risky borrowers, while less risky debtors would be unaffected by small enough changes in the cost of default.

Moreover, if default costs are very high, only countries that suffer from extreme bad luck and are in very bad shape will default. By definition this means that the average recovery value for all creditors will be very low. If, on the other hand, default costs are low, such that debtors with plenty of spare debt servicing resources choose to default, recovery values for a while will be higher, as the debtor and creditor can agree on a debt service profile that could be serviced at a higher level than in the case of a truly bankrupt debtor defaulting. An implication, therefore, from the framework presented here is that if enhanced PSI in crisis resolution means the net lowering of the costs of default, and lending occurs with the cost of default in the intermediate area, recovery values following default should be expected to go up and not down.

It should also be noted at the outset that if creditor moral hazard plays an important role in world capital markets it will also affect the key parameters for the debtor. Multilateral financing packages that include no private sector involvement, and hence maintain creditor moral hazard in the system, will lower the cost of default for the country (by mitigating output losses), lower the probability of default (an up-front lower interest can be charged by the creditor as he has some "insurance"), and increases the recovery value if default still occurs. Therefore, initiatives that increase the cost of default and reduce the recovery value, may be optimal in a world where the level and structure of financing flows has already been impacted by creditor moral hazard. However, if the creditor moral hazard inherent in the global financial system is believed to be limited there is less room to make the argument that the creditor's position needs to be weakened, as the current state most likely already reflects an equilibrium outcome with debtor moral hazard but limited creditor moral hazard.

What the model therefore shows is that the balance between creditor and debtor "rights" is a subtle one and great care needs to be taken to not shift the balance too far in either direction. Moreover, whether the current cost of default in the international capital markets is in the intermediate area or too high, would critically determine whether efforts to reduce a debtor's default costs would increase or decrease welfare.

IV. Extending the Model: Private Sector Adaptation

In the simple model introduced in the previous section, there is little scope for the private sector to adapt, i.e. change from an easier to restructure debt instrument to one that is harder to restructure. Rather the private sector creditor's decision is a simple one, to lend or not to lend and at what price. Drawing on recent experiences, the later sections will argue that private sector creditors have shown, or will show, a remarkable ability to adapt to changed circumstances if the perceived cost of default incurred by a sovereign debtor changes. To put the below discussion on a somewhat firmer footing the previous section's model is expanded to include two forms of debt, e.g., sovereign bonds and sovereign loans. A key outcome of the model extension is that the importance of the, for some unattractive, key assumption of strategic defaults, i.e. that a country would not be willing to pay in some states of the world, even though it is able to, can be relaxed. Instead, the assumption is replaced by that in some states of the world a sovereign debtor may not have enough resources to service both types of debt. Hence, it would have to choose, which type of debt to service. Clearly, if one type of debt is inherently costlier to restructure, the debtor is less willing to default on that particular debt instrument and will continue to service it as long as it is able to.

A. Model Extension

Consider, the model introduced in section II, but now assume that a sovereign debtor can finance the project through both loans, share of γ, and bonds, share of $1-\gamma$. An investor will in equilibrium, taking into the probability of default on the bond, charge a coupon of c_B, while a bank would charge a coupon of c_L. Furthermore, it is assumed that both bonds and loans have the same recovery value (RV) for the creditors, but the cost of defaults (λ_B and λ_L) are different for the two instruments. Reflecting the common belief in the market, and in the absence of embedded collective action clauses in dollar-denominated (New York law) sovereign bond issues, λ_B is typically larger than λ_L. However, the cost of default both in terms of λ_B, λ_L and RV is a function of the amount defaulted on, i.e. related to γ[46]. As a result of the above assumptions, the probability of paying the two debt instruments would affect the sovereign's utility function in equation (2) in the following way:

$$
\begin{aligned}
U_S^{'} &= p(r_p > \gamma c_L + (1-\gamma)c_B)\left[r_p - \gamma c_L - (1-\gamma)c_B\right] + \\
&+ p(\gamma c_L + (1-\gamma)c_B > r_p > \gamma c_L)\begin{bmatrix} r_p - \Pi^{'}(\gamma c_L + (1-\gamma)(RV+\lambda_B)) \\ -(1-\Pi^{'})((1-\gamma)c_B + \gamma(RV+\lambda_L)) \end{bmatrix} \\
&+ p(\gamma c_L > r_p > (1-\gamma)c_B)\left[r_p - \gamma(RV+\lambda_L) - (1-\gamma)c_B\right] \\
&+ p((1-\gamma)c_B > r_p)\left[r_p - \gamma(RV+\lambda_L) - (1-\gamma)(RV+\lambda_B)\right]
\end{aligned}
\tag{10}
$$

[46] This assumption is the same as in Eichengreen, Kletzer, and Mody (2003). See this reference for a more detailed discussion of the trade-offs related to the choice of how default costs relate to the amount of debt defaulted upon.

As can be seen in equation (10), the probabilities implicitly assumes that $\gamma c_L > (1-\gamma)c_B$, i.e. the weighted coupon payments are higher on the loans than on the bonds. This would hold as long as:

$$\gamma > \frac{c_B}{c_L + c_B} \quad (11)$$

The second line of equation (10) reflects the choice a sovereign would face between paying either the loan or the bond, when it lacks the resources to service both (note this is quite different then assuming that a country would strategically default on all debt). Similar to the original model, the choice is reflected by a dummy variable Π', which is equal to 1 if the sovereign decides to default on the loan first, which it would do if the following expression holds:

$$r_p - \gamma(RV + \lambda_L) - (1-\gamma)c_B > r_p - \gamma c_L - (1-\gamma)(RV + \lambda_B) \text{ i.e.,}$$

$$\gamma > \frac{c_B - RV - \lambda_B}{c_L - RV - \lambda_L + c_B - RV - \lambda_B} = \frac{R_B}{R_L + R_B} \quad (12)$$

Equation (12) states that if the share of loans held by the sovereign exceeds the relative return from defaulting on the bond (the sovereign would save R_B if it defaults on the bond) divided by the total return from defaulting on both bonds and loans equally weighted, a sovereign would default on the loan before defaulting on the bond[47]. Hence, since $R_L > R_B$, i.e. the return from defaulting on the loan is in equilibrium always larger than the return from defaulting on the bond, since a loan creditor has to protect himself from the lower cost of default by charging a higher coupon (if the ratio is less then 0.5). Therefore, if the share of loans is fairly large it is more attractive for the sovereign to default on the loan first and the bond second (as long as the weighted coupon payments of the loans are higher than on the bonds). Assuming that the inequality in equation (11) holds, reflecting that the initial share of loans in a sovereign's debt is significant, the probabilities for the default on bonds and loans can be derived and the full utility function be presented. Assuming the same uniform probability distribution for r_p as in the basic model, the probabilities are:

$$p(r_p > \gamma c_L + (1-\gamma)c_B) = \frac{r_{\max} - \gamma c_L - (1-\gamma)c_B}{r_{\max} - r_{\min}}$$

$$p(\gamma c_L + (1-\gamma)c_B > r_p > \gamma c_L) = \frac{\gamma c_L - (1-\gamma)c_B}{r_{\max} - r_{\min}}$$

$$p(\gamma c_L > r_p > (1-\gamma)c_B) = \frac{(1-\gamma)c_B - r_{\min}}{r_{\max} - r_{\min}}$$

$$p((1-\gamma)c_B > r_p) = \frac{(1-\gamma)c_B}{r_{\max} - r_{\min}}$$

[47] Similar to the basic model it is assumed that R_L and R_B are larger than zero.

By substituting these probabilities into the sovereign debtor's revised utility function and maximizing with respect to the share of loans chosen, i.e. γ, the below expression is derived:

$$\gamma = \frac{r_{\min}(\lambda_B - \lambda_L) - r_{\max}(c_B - c_L) + c_B(2R_B - R_L)}{2(c_L R_L + 2c_B(R_B - R_L))} \qquad (13)$$

To maximize his utility a sovereign debtor will choose a γ (share of loans) that is positively related to the attractiveness of the project (the larger the difference $r_{\max} - r_{\min}$ the larger the probability that the return will exceed the coupon for any constant coupon and $r_{\min} > 0$) and the coupon a debtor has to pay for the bond, i.e. the higher the bond coupon the more a debtor will use loan financing.

The key objective of this model extension is to explore the relationship between the share of loans held by a sovereign and the cost of default on bonds (λ_B). It was implicitly argued in the introduction that due to private sector adaptation if the cost of default on bonds is reduced there will be relatively less demand for bonds and more for loans. In the model extension this relationship can be evaluated by taking the partial derivative of γ with respect to the cost of default on bonds, i.e.,

$$\frac{\partial \gamma}{\partial \lambda_B} = \frac{r_{\min} + 2c_B(\gamma - 1)}{2(c_L R_L + 2c_B(R_B - R_L))} \qquad (14)$$

which can be shown to be negative, i.e., $\partial\gamma / \partial\lambda_B < 0$, as long as $\gamma < 1 - r_{\min} / 2c_B$ (the partial derivative threshold) and the share of loans is below the ratio expressed in equation (12)[48]. Hence, even this simple model extension shows that the share of loans, i.e. the sovereign borrower's adaptation to a change, strictly increases with an increase in the cost of default on bonds.

B. Numerical Example

Expanding on the numerical example of earlier sections, assume that the sovereign can choose between bond financing and loan financing. Keeping the coupon of bonds and loans both constant (assume $c_B = 10\%$ and $c_L = 13\%$), a recovery value of 2.5 percent, a cost of default on the loans of 0 percent, and $r_{\max}$ and $r_{\min}$ as before, equation (13) would evolve as suggested in figure 5.

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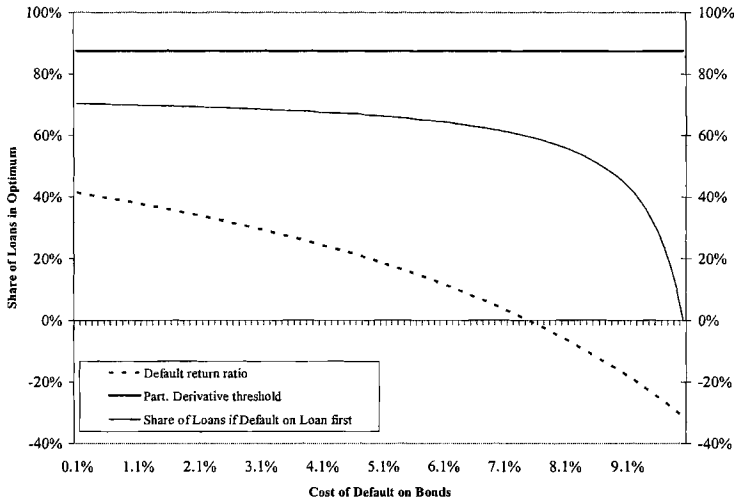
[48] Please note that it is assumed that the relative coupon payments on loans are higher than on bonds, and that the debtor would default on loans first. Reversing the last assumption would still yield a similar expression and the same conclusions. The partial derivative would, however, be negative as long as $\gamma' < 1 - r_{\min} / 4c_B$.

Figure 5. The Share of Loans in Optimum and the Cost of Default on Bonds



As expected, and as long as the share of loans in optimum is below the partial derivative threshold, the share of loans will be declining as the cost of default on bonds increases. This is a non-linear relationship reflecting that the bonds become increasingly attractive to the sovereign debtor (as well as the private creditor, especially if we allow the coupon paid on the bonds to adjust when the probability of default is reduced) as the cost of default on bonds increases. If the cost of default of bonds decreases, the impact on the share of loans is clearly positive, as the two instruments become more similar. However, how much the share of loans would increase depends on how large the cost of default on bonds was initially. If it was quite large (above 9 percent in the example) the impact would be quite significant, but if it was small, the share of loans would hardly change. Note that in this example, the loan and bond coupon is kept constant and the default probabilities as well. Hence, since the sovereign would find it more attractive to first default on the loan (and the coupon is constant) it will prefer the loan to the bond even when the cost of default on the bond is similar to that on the loan, i.e. the share of loan is at its highest 70 percent rather than 50 percent. In the next section, the model findings will be used to put into context the ongoing policy discussion relating to sovereign crisis prevention and resolution.

V. Debt Payment Suspensions: Private Sector Reaction and Adaptation

During a financial crisis the capital outflows from a country may be so overwhelming and broad-based, reducing the country's foreign exchange reserves, that there is no time to enter into negotiations on how to restructure the debt, and a suspension on debt payments and other capital transactions, including the freezing of domestic bank deposits, may have to be announced. While the outflows can originate in the corporate sector, a massive outflow may lead to the socialization of the debt in order to salvage the local financial system as well as avoiding the wholesale bankruptcy of a country's corporate sector. In such a situation a sovereign will be faced with the decision, which debt payments he wishes to suspend first, a pecking order of debt, and for what amount of time. As

discussed in the previous section, this default decision will depend on the relative costs of defaulting on some debts and not others. Moreover, the sovereign needs to consider; how comprehensive should the suspension be; which asset classes will be affected (e.g. bonds, loans, equity, domestic or external, etc.); will the suspension be voluntary or coercive; is it intended to be done with the implicit sanctioning of the official community; and what are the implications of the suspension for future market access. Therefore, the coverage and magnitude of debt payments suspended can vary between delaying one payment on Paris Club debt, leaving the external private sector debt intact, to the full scale imposition of capital controls, declaration of a corporate and sovereign standstill and the freezing of bank deposits. The private sector creditors will react and adapt to all these decisions for which debt payments are suspended, both ex-ante and ex-post.

Unilateral suspensions of domestic or foreign debt payments form a natural, but unwanted part, of all debt restructuring. They are and have been a fact of life for debt instruments. Frequently, the actual time it takes for a sovereign or a corporate to launch a restructuring offer for either its bonds or loans, means it may have to actually enter default and risk collateral damage doing so, before a successful restructuring has been completed. Collateral damage could in this case result in an inability to borrow internationally and domestically, the trigger cross-default clauses with the debtor losing control over the debt restructuring process, a grab race for assets prompting a fire sale, loss of investor and domestic confidence, collapse in the secondary market value of the debt, disruptive litigation and a broad-based rush to the exit triggering large capital outflows by both domestics and foreigners. These potential side effects of entering into default, by declaring a unilateral suspensions, have led a number of observers both in the official and academic community (See Eichengreen, 2000 and Miller and Zhang, 2000 for overviews) to suggest a more predictable framework to manage suspensions, taking as an example the US corporate bankruptcy context. There have been many suggestions.[49] Some of them are: the setting up of an international bankruptcy court replicating US chapter 11 protection for sovereign debtors; giving the IMF the right to declare a stay on litigation and declare temporary payment suspensions; or to officially, explicitly or implicitly, sanction debt payment suspensions by allowing the IMF to lend into private sector arrears.

While all of these proposals take the current state of play with potentially damaging ad-hoc payment suspensions as given, few of the recent studies consider that for some types of creditors, as noted in the literature overview, there is an advantage of having an unpredictable and uncontrolled payment suspension procedure in place, as it increases the debtor's cost of default. Furthermore, few observers have considered what is the potential impact on the structure and level of international capital in a world where the official sector is increasingly willing to sanction debt payment suspensions.[50] As indicated in the modeling section, a more orderly framework for payment suspensions may have a similar effect on private sector adaptation, as that of reducing the cost of default in figure 2. Whether a more orderly framework will be welfare increasing or welfare reducing clearly depends on whether one believes that the current cost of default imposed on debtors is

[49] See IMF (2000b) for a brief overview.

[50] Some exceptions are IMF(2000a) and IMF (2000b).

beyond the range where more risky projects can receive new financing if the cost of default is increased. Hence, the actual experience to date is analyzed in more detail next.

A. Issues Regarding Orderly Payment Suspensions

The advantage of payment suspensions for the debtor in crisis, at least in theory, is that they can lock in both foreign and domestic private sector capital in a given country for a limited time period by restricting net capital outflows. From the official community's point of view the main policy challenge has been viewed as being whether and how payment suspensions should be officially sanctioned and whether a predictable framework for their imposition is needed. There are several variables that will affect the impact of more frequent payment suspensions:

Can Payment Suspensions be Voluntary?

It is likely that payment suspensions will have the least effect on the future structure of international capital flows if they are voluntary, i.e., forbearance by a certain creditor group in return for some "sweetener". The inherent problem with the voluntary approach is that it is similar to raising new money. If a country only suffers from a temporary debt service hump and asks some creditors to forego debt service payments during that hump in order for a larger debt service payment later, the debtor could instead issue a new bond rather than declare a payment suspension for a certain creditor. Hence, sovereign debtors will not declare a payment suspension in cases where they are facing a pure liquidity problem, as raising new debt is a realistic option and a better choice. There would be, for example, no reputational loss or risk that the debtor opens himself up to litigation threats etc.

If market access has been lost, and a payment suspension may be the only option, it is hard to see how it can be completely voluntary. At a minimum there is at least a need for a credible threat of default to encourage some creditors to agree to a payment suspension. In a situation when solvency concerns are important as well as liquidity concerns, the value a debtor can offer a creditor in a voluntary payment suspension negotiation would be through arbitrarily making that creditor's claim *de facto* senior to that of other creditors.[51] Hence, the sweetener needed to reach a voluntary agreement with one creditor group will in this scenario occur at the expense of another creditor group. However, this is analogous to either issuing secured debt or very short-term debt. Voluntary payment suspensions also allow for the asymmetric treatment of creditors with limited potential ramifications down the road. Partially-voluntary, or coercive payment suspensions may have to be comprehensive across all, at least, foreign currency creditors, whether domestic or senior, in order to avoid the creation of new seniority structures.

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[51] For example, in return for its forbearance, a creditor will either receive ancillary business if it is a bank, or have its claim's obligor status be upgraded to that of the sovereign rather than that of a corporate (see for example the description of the Korean crisis experience in IMF (2000a)).

Coordination Problem?

In the cross-border emerging corporate borrowing context voluntary payment suspensions have been quite common for both bonded debt and syndicated lending. The presence of a well-established bankruptcy procedure and creditor protection, in order to avoid asset stripping, makes voluntary payment suspensions more credible and easier to negotiate. In the sovereign context there is no bankruptcy court and it is therefore natural to expect that voluntary payment suspensions will be harder and costlier to negotiate. The direct costs of reaching a payment suspension agreement with a group of creditors will both depend on the maturity of their claims and how other creditors are being dealt with.

- Longer-term creditors will be unwilling to agree to a payment suspension if their forbearance is being used to bail out shorter-term creditors. Unlike the 1980s where the long-term and short-term creditors were the same group of banks and could be more easily coordinated, the current creditor dispersion will make coordination much harder. Moreover, the very nature of the causes of the crisis will have an effect on the feasibility of reaching a payment suspension agreement. For example, longer-term creditors may be more willing to accept a pause in debt service if they believe that the pause will be used to enact reforms that increase the likelihood of better debt service performance in the future. However, to agree, these longer-term creditors will ask for some sort of sweetener. The attractiveness of the sweetener, however, will be a function of whether the country is illiquid or insolvent, i.e., depend on the magnitude of the creditor concession required. In cases where the size of the sweetener demanded by creditors to agree to a voluntary payment suspension is larger than the country's medium-term debt servicing capacity, a voluntary payment suspension could not be arranged unless it is expected that the "residual", the gap between the sweetener and the debt service capacity not covered, is supplied by a third party, for example the official community.

- Furthermore, the size of the sweetener is likely to be affected by the comprehensiveness of the payment suspension. If only long-term investors are asked to participate, for the implicit benefit of the short-term investor, then the sweetener will most likely be upsized to reflect this.

- Shorter-term creditors will be costlier to convince to participate voluntarily in a payment suspension. In situations where this group of investor is fairly small, they will face the decision of either running now and receive the full par value of their claims, or running later and either receiving a recovery value (because there exists a possibility that the sovereign will be in default even after the agreed to payment suspension period ends) or the par value plus some sweetener. Hence, short-term creditors could potentially agree to a payment suspension if the sweetener is large enough, and contrary to longer-term creditors, the present value of the sweetener offered has to exceed the par value of the short term credit.

What if Payment Suspensions are Not Voluntary?

Partially voluntary or coerced non-comprehensive payment suspensions are more likely to have an impact on the future structure and level of international debt flows, since, by definition, various groups of creditors are more or less likely to be amenable to moral suasion or coordination. If, for example, one group of creditors is more likely to be

successfully subject to moral suasion and hence convinced to participate in a payment suspension for a non-voluntary sweetener, that creditor group is likely to adapt and in the future make sure to reduce its vulnerability by either charging a higher fee up front, i.e., incorporating the moral suasion risk in its initial lending decision, or reduce the amount of capital it actually lends and thereby its exposure (similar to the analysis behind figure 2). Hence, a partially voluntary payment suspension may be successful in resolving one particular crisis, but may soon loose its usefulness as an instrument, since credit flows are likely to be increasingly channeled through the creditor groups that are less amenable to moral suasion.

In a worst-case-scenario, where a sovereign debtor is insolvent, and broad based capital flight is occurring, the debtor may have no other choice than to resort to declare a unilateral payment suspension in this exceptional case. Extending the scope of payment suspensions to most private creditor groups as well as freezing, in this example, bank deposits, may both give some breathing space to the sovereign debtor as well as avoiding an asymmetric treatment of creditors. Thus, making the payment suspension comprehensive would close all potential capital outflow channels and treat all private creditors symmetrically. By not favoring one asset class over another, this approach limits the incentives for the private creditors affected by the payment suspension to create senior debt further down the road.

Should Some Private Creditors be Treated as Senior?

Arguments have been made that some private sector creditors should receive preferential treatment when a payment suspension is imposed. Notably this discussion has focused on trade credits or new money extended to the sovereign during a crisis. However, the experience of the 1980s provides some useful examples on how the private sector will adapt if certain debts are treated preferentially. The example of the 1980s restructuring experiences' impact on sovereign syndicated lending was already mentioned above. Another lesson from the 1980s was the fact that in many cases trade financing was excluded from loan renegotiations and hence creditors and debtors had a natural incentive to structure future general purpose credits in the form of trade credits (see Buchheit, 1991). With respect to new money the motivation for treating them as senior is often said to be that it is in all creditors' interest to make sure that the country can still get access to capital in order to limit the output losses that occur during the crisis. This is not necessarily true. As mentioned in the modeling section, output losses may be the only effective disciplining device creditors have available to ensure re-payment. New money shifts the bargaining strength somewhat towards the debtor. Hence, it is not clear whether all private creditors necessarily favor the approach of making new money senior.[52]

B. Payment Suspensions and the Composition of Cross-Border Debt Flows

As mentioned above partially voluntary or coercive payment suspensions that are not comprehensive, i.e., one creditor group is treated more favorably than another, are very likely to lead to a change in the composition and level of debt financing flows to

[52] See for example the heated discussion on this issue in the context of the SDRM debate, for example, Roubini and Setser, 2003.

emerging markets in the future. While this primarily impacts the recovery value of affected debt instruments, some have argued that a benefit of more frequent imposition and official sanctioning of payment suspensions is that it would make short-term debt less attractive and long term debt more attractive. This line of reasoning assumes that the incentives of longer maturity debt are more similar to those of the sovereign debtor as well as those of the official community. For example, temporary payment suspensions on only short term debt could perhaps still allow the sovereign to service its long term debt. Unfortunately, however, when a country starts moving towards a crisis situation the maturity of its debt stock will most likely shorten because:

- Foreign creditors will almost by definition be unwilling to take long-term exposure towards the country as previously long-term debt falls due.

- This unwillingness by foreign creditors to extend new long-term credit will lead to an upward sloping yield curve, making long-term borrowing for the country very costly. This would encourage a shift by the debtor to borrow through shorter-term instruments. As creditors increasingly offer shorter-term loans at increasingly higher interest rates, the yield curve of the sovereign is likely to widen out as well as flatten. Eventually, when a debt service interruption becomes imminent, the yield curve of the sovereign debtor will invert, with markets pricing in a very high risk of default in the short end.

- A payment suspension on debt amortizations, where the sovereign still makes interest payments, may lead to default on longer-term bonds or loans that are amortizing or to the non-payment of principal of initially long-term debt that matures within the payment suspension period. In such cases, the payment suspension could trigger cross-default clauses on other longer-term debt as well. Longer-term creditors will then have to decide whether they want to accelerate their debt and be treated similarly to the short-term creditors in the resolution, or if they want to keep their acceleration option open as long as their debt is still being serviced. Shorter-term creditors may also demand, as a condition to agree to a restructuring, that longer-term creditors are brought to the negotiation table.

C. Implications

If officially sanctioned, the resulting higher likelihood of a payment suspension, and thereby the reduction in both the cost of default and perhaps also the recovery value, may encourage a shift in the maturity structure of debt toward the shorter end of the spectrum, as creditors move to protect themselves. This can be done, for example, by providing financing only in the overnight market, to ensure a withdrawal before a payment suspension becomes operational. Hence, if the main benefit of having more orderly and officially sanctioned payment suspensions is to reduce the reliance on short-term debt, it is worth noting that it may create the reverse result, encouraging creditors to lend at even shorter maturities to ensure that they get their money out. Indeed, one interpretation of the 1980s debt crisis resolution is that a similar dynamic was at work when bank lending shifted, following the resolution of the crisis, from mainly medium- and long- term maturities to short term interbank debt. Maturities shorter than that of interbank lines would severely restrict the ability of a payment suspension from being effective. In the next section, the experience with sovereign bond restructurings are analyzed.

VI. Bond Exchanges and Private Sector Adaptation

Facing a situation where a payment suspension, whether comprehensive or not, looks likely, a sovereign debtor could try to approach its bondholders to discuss reprofiling the bond payments to avoid the actual imposition of a payment suspension and a subsequent default. As discussed before, truly voluntary agreements will be uncommon as true liquidity crisis situations will be hard to distinguish from solvency ones and the outcome of any bond restructuring or reprofiling discussion after market access has been lost will be determined by the credibility of the sovereign's default threat. During the few years there have been defaults on both sovereign eurobonds as well as Brady bonds[53] and bond exchanges of defaulted or nearly defaulted bonds have been completed by Pakistan, Ukraine, Ecuador and Russia.[54]

The ease and success of the recent bond exchanges have surprised many. The reason for the surprise was that eurobonds and Brady bonds were believed to be technically hard to restructure both for legal reasons (for example, requiring unanimity and due to the threat of litigation) and for practical reasons (for example, the identification and coordination of thousands of bondholders). It may be too early to draw conclusions about the applicability of recent bond exchanges for future bond restructurings, however, because the cost of default, λ, may have been lower than expected and creditors will seek new forms of debt instruments with a higher λ and/or RV, shifting emerging market borrowing and lending decisions to a new equilibrium where financing may be reduced or more costly. Moreover, the impact on already issued bonds will also reflect a certain adaptation to the new circumstances of lower or higher λ or RV. For example,

- Private creditors will adjust upwards their price at which they are willing to participate in future bond exchange if recent experience is viewed as indicating that emerging market bond recovery value estimates were too low. As shown in equation (9) a higher RV would increase the price of existing debt making it harder to offer large sweeteners (arguably what is currently a key concern in Argentina's ongoing negotiations with its private sector creditors currently). For future lending decisions a higher recovery value will according to the model reduce in equilibrium the probability of default, for the same debtor, and would be beneficial for both debtors and creditors, as more risky sovereign debtors would receive financing.

- While the success of recent bond exchanges has put into question creditors' cost of default estimates, i.e., the cost of default may be lower than previously anticipated, a more broad based introduction of collective action clauses or the use of exit

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[53] As several authors have pointed out, for example Eichengreen (1999) and Petas and Rahman (1999), defaults on international bonds have been frequent historically speaking, especially in the 1930s. In 1999, Ecuador was the first sovereign to default on both eurobonds and Brady bonds. Subsequently, there have been sovereign bond defaults in Ivory Coast and Argentina. Uruguay's recent distressed sovereign debt swap was clearly completed against a credible default threat and involved significant NPV losses for private creditors.

[54] As discussed in IMF (2000a).

amendments may reduce the cost of default even further. However, recent successful litigation (e.g. Elliot and Peru), could indicate that the threat of litigation has perhaps also been underestimated and may actually make bond exchanges more costly in the future and work in the opposite direction to the initiatives of making bonded debt easier to restructure. Again Argentina's success or failure on this front, given its aggressiveness towards all its creditors, could settle this debate.

- Private creditors are likely to adapt the structure of their lending vehicles in ways such that restructuring and creditor coordination may be more difficult in the future. As argued in the model extension, sovereign loans could also increase in importance, as the relative advantage bonds face is gradually eroded.

In the next sub-section the impact on existing sovereign bondholders of the recent experiences of easier than expected bond exchanges will be discussed. Changes in recovery value and cost of default estimates by these bondholders will have a key bearing on whether bond restructurings will be as easy to complete in the future. Following this discussion and using the basic model as a background, the second subsection will discuss the impact of both collective action clauses, exit amendments and the renewed litigation threat on both existing bonds and the future lending/borrowing equilibrium. The last subsection will go further towards reflecting over how the bondholders could adapt in a new equilibrium by changing the structure or terms of their lending.

A. Impact on Outstanding Bonds and Bond Restructurings

In evaluating bond exchanges, different investor groups will have different reaction functions. Mark-to-market investors, having borne the full brunt of the fall in secondary market price of the to-be-exchanged bonds, tend generally to compare the NPV value of the exchange offered (at some discount rate) to the current market price of the to-be-exchanged bonds and with the recovery value of not participating in the exchange. In the simplest case, if the NPV of the exchange bond is higher, taking into account the likelihood of the exchange succeeding and the haircut in terms of a potential debt write-off, then the holder of the to-be-exchanged bond has an incentive to tender his bonds in the exchange. This is the way most fund managers would rationally respond. For commercial banks a similar response function is less likely, as they generally do not mark-to-market all of their investment portfolios, but a reasonable approximation. The response function of retail investors is much more uncertain as their tender decision may be based less on a NPV comparison then on whether or not they have to participate in a debt write-off.

Market Reactions to Recent Bond Exchanges

									(in percent)			
	Date of Default	Exchange Announced	Exchange Completed	Listing Price	Price 1-day after default	Price 1-week before annount	Price 1-week after annount	Price at completion	Face value write-off	Completion / listing price	Post-annount / pre-annount price	Completion / pre-annount price
Pakistan												
6% USD 2002 eurobond	no Default	11/15/99	12/6/99	100.0	...	58.3	60.4	63.6	0	-36	4	9
Ukraine												
16% DEM 2001 eurobond	1/20/00	2/4/00	4/7/00	100.0	50.0	55.5	67.0	81.5	0	-19	21	47
Russia												
Prins	12/2/98	2/11/00	8/17/00	57.8	6.5	18.5	24.4	32.0	-38	-45	32	73
Ians	6/2/99	2/11/00	8/17/00	67.2	10.0	21.1	25.0	32.8	-33	-51	19	55
Ecuador												
Brady Par Bond	11/28/99	7/27/00	8/11/00	27.4	35.8	35.5	39.5	39.5	-60	44	11	11
Brady Discount Bond	8/28/99	7/27/00	8/11/00	47.0	34.4	37.0	46.7	46.7	-42	-1	26	26
Brady PDI Bond	2/28/00	7/27/00	8/11/00	27.0	23.5	25.3	30.5	30.5	-22	13	21	21

Note: Bonds presented are not all of those restructured. Prices are ask and includes accrued interest, when bond is in default. For Pakistan accrued interest is estimated.
Default is the date of the first missed coupon payment, except in the case of Ukraine, where the default reflects the missed amortization on its Oct-2000 eurobond.

The recent successful bond exchanges have involved some form of sweetener (see table above). For example, the post-announcement price has been 10-30 percent higher than the pre-announcement price, with the exception of Pakistan. In Russia, the sweetener was enhanced with the upgrade in the obligor to that of the sovereign. Large sweeteners have in many cases also reduced the incentive, for at least mark-to-market bondholders, to litigate, since capturing the sweetener provides an immediate gain while the outcome from litigation is uncertain and time consuming.

The limited experience to date with external bond exchanges, required that several key parameters of the debt pricing equation presented in equation (3) and the cost of default were "guesstimated". For example, the recovery value had without much empirical basis consistently been estimated at 18-20 cents on the dollar for sovereign eurobonds. If the recovery value is actually much higher, for example close to the average recovery value in the US high-yield sector (47 cents on the dollar with an average 2.1 years for collection[55]), market prices of bonds that were in default would shoot up, as reflected in equation (9), to reflect the new revised estimate of recovery values. It may be that low recovery value estimates were one reason why prices post-announcement could credibly be substantially higher than prices pre-announcement in all the recent bond exchanges with the exception of Pakistan. In Pakistan, however, the actual number of bondholders were limited and fairly well known in advance and the high share of locally connected investors reduced the necessary size of the sweetener.

In addition to the size of the sweetener, enhancing recovery values further is the speed of curing the default (this would also reduce the cost of default to the debtor, so the net effect in equilibrium may be ambiguous). The experience from recent bond exchanges suggest that they were completed much faster-than-expected (1-2 years compared to the lost decade of the 1980's debt restructurings), and in one case the exchange was even completed before the actual default occurred (Pakistan). Bond exchanges are, however, not guaranteed to succeed and significant deal risk may remain even after they are announced, but overall the probabilities of success for the recent exchanges once announced have been very high,[56] partly reflecting the large mark-to-market gains inherent in the offers for tendering bondholders (again see table).

Recent exchanges, such as the one in Ecuador and Ukraine, have taken a "carrot" and "stick" approach to encourage bondholders to tender into the exchange. The adaptation of private creditors' expectations of recovery will make it more difficult to offer similar carrots (i.e., large mark-to-market gains) in the future. For example, if the recovery value following default is now believed to be consistently higher than before, secondary market

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[55] Rappoport (2000) and Rappoport and Xu (2000) for a much more detailed discussion on the sensitivity of emerging market and U.S. high-yield bonds to default probability, recovery value and other assumptions.

[56] This can be determined by looking at the differential between the price of the new exchange bond when-issued (basically forward contracts on the new bond) and the price of the old to-be-exchanged bond. A small differential implies that investors believe the exchange will succeed. When-Issued markets existed in all the four bond exchanges.

prices will actually not fall as low as they did, for example in the Russian case, and hence offering as attractive a sweetener may not be credible from a debt-service capacity point of view. Therefore, it remains to be seen whether the experience with recent bond exchanges are useful in determining whether future bond exchanges will be equally successful. These bond exchanges have, however, managed to very successfully address some of the issues with regards to the technical aspects of how to restructure sovereign bonds that were unknown before. By doing so, these exchanges have firmly pierced the "halo" that was previously believed to surround eurobonds and Brady bonds. It remains to be seen whether the private sector adapts by switching into harder to restructure lending instruments.

B. Cost of Default, Legal Innovations and the Threat of Litigation

The recent bond exchanges by Ecuador, Pakistan, Russia and Ukraine are generally regarded as successful in terms of having obtained a high degree of investor participation while avoiding creditor litigation. The keys to success of the voluntary exchanges have been the sweeteners provided. As discussed above, when the market adjusts its expectations for recovery values it will become more difficult to offer such sweeteners in the future and the threat of litigation may increase. The experience of recent bond exchanges and their success, together with the official community initiatives to increase the prevalence of collective action clauses[57] (CACs) raise the question whether these events have an impact on the cost of default and how it will affect the future emerging market borrowing/lending equilibrium.

Collective Action Clauses and Exit Consents

As discussed in IMF (2000a) the actual usefulness of CACs in bond exchanges to date has been limited.[58] For example, it appears to have been less difficult than anticipated to

[57] The clauses, commonly referred to as CACs are: a majority action clause (allowing a qualified majority of bondholders to bind a minority); a sharing clause (stating that any funds received through, for example, litigation by one bondholder, have to be shared with the other bondholders based on their share of the outstanding bond); and a collective representation clause (allowing a trustee, for example, to represent bondholders, facilitating majority actions). CACs can facilitate creditor-debtor negotiations, since they reduce both the threshold needed for achieving a restructuring agreement (the majority action clause) and the potential threat of litigation from "holdout" creditors (reducing their incentive to litigate through the sharing clause). Bonds issued under English law typically include CACs. These clauses are not regularly contained in bonds issued under New York law.

[58] Empirical work, however, suggests collective action clauses tend to reduce the cost of borrowing for some borrowers. See for example, Eichengreen and Mody (1999), and for a more critical assessment Becker, Richards and Thaicharoen (2000). Recent experience of issuing dollar-denominated New York law eurobonds has had mixed results. As discussed by Eichengreen, Kletzer, and Mody (2003), the experience to date with Mexico's and Brazil's CAC bond issues have indicated some secondary market premium (related to the reduced cost of default), but it remains to be seen if it will be sustained, and perhaps return when a country with CACs again approaches a sovereign debt crisis.

organize and locate individual bondholders and to offer them an exchange. Moreover, the value of CACs as a threat to encourage bondholders to tender in an exchange seems secondary. As discussed earlier, it was the large carrot (sweetener) that clinched the exchange deals rather than the stick. However, there is at least one example of CACs being used as a stick. Ukraine dealt with potential holdout creditors within the context of its voluntary exchange offer by making use of the CACs embedded in three of the four affected bonds, after a substantial majority had agreed to the exchange. Experience would therefore suggest that the main usefulness of CACs is that they effectively limit litigation, while exit consents[59] (introduced for the first time in Ecuador's bond exchange, see appendix 1, 2. Gertner and Scharfstein (1991) discuss exit consents in the US corporate context) can be used to increase the success and ease of any bond restructuring.

However, the more widespread use of both CACs and exit consents have the potential of reducing the cost of default for the debtor, increasing the possibility of a strategic default, with a subsequent shift in the lending/borrowing equilibrium (from A to B in figure 2). Again, similarly to the discussion made in the payments suspension section, the actual outcome on the level of financing flows will depend on whether the preceding cost of default was binding or not. For example, if creditor moral hazard is ignored, and if the cost of default would be binding, and allow for the maximum of amount of financing to emerging market sovereign in equilibrium (in figure 2 this would be consistent with a λ=10 percent) any reduction in the cost of default would lead to a reduction in financing available to more risky emerging market sovereigns thereby reducing welfare. As more than 60 percent of the J.P. Morgan EMBI+ benchmark index is compromised by issuers below investment grade it is likely that these are also the debtors most sensitive to changes in the cost of default. The impact on flows to emerging markets could be substantial. Note, however, that this effect, according to the simple model would not show up in the spreads or coupons the debtors have to pay. If strategic default is becoming increasing likely for a debtor, no creditor would extend financing at any realistic interest rate. Moreover, higher-quality debtors would be unaffected. In terms of empirical evidence, see IMF (2000c) there are some evidence that currently bond financing to emerging market sovereigns remain ample, and only the lowest, for example single-B minus creditors, are facing some rationing in the market.

The Litigation Threat

One of the major deterrents to creditor litigation has been the difficulty of attaching sovereign assets. First, many assets can quickly be hidden if the sovereign believes them to be at risk. Second, US case law suggests it may be difficult to attach significant assets even in the case of a favorable ruling. However, the prevailing belief that litigation

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[59] The use of exit consents is a strategy that, similarly to CACs, can be employed to provide the stick in a bond exchange and induce bondholders to participate in the exchange by changing key non-payment terms and thereby reducing the value of the old bond after the exchange has been completed. The main advantage of exit consents is that they can be used in bonds that otherwise would require unanimity to change any of their payment terms, and they can thereby replicate some of the features of CACs. Exit consents in a sovereign NY-law bond were first used in Ecuador. See Buchheit & Gulati (2000) for a very insightful discussion.

remained a rather limited threat, may change because of the recent success of Elliott Associates in its case against Peru (see appendix 3).

If sovereign litigation as an alternative becomes feasible and economical for creditors, they will have a further tool to counteract any reduction in the cost of default. Surprisingly, as visible in figure 2, the subsequent increase in the cost of default may for some parameter values be welfare enhancing. Some litigation may therefore be a good thing, depending on what the overall cost of default is, and may put a limit to other forms of creditor adaptation, by changing the form of the lending instrument.

C. Changing the Structure of the Eurobond Market

In the same way creditors adapted to the restructuring experiences of the 1980s by changing the structure of their lending vehicles through increasing the cost of default or reducing their lending by charging a higher interest rate up front, following the recent bond exchanges, there may be incentives for private sector creditors to again adapt in such a way to avoid the shift to a low financing equilibrium (point B in figure 2). Increasing the seniority of the lending instruments, by increasing λ or RV, also has a value to avoid default or to have an improved claim in a restructuring situation. A creditor can increase the seniority of his claim in a number of ways, either through requesting up-front collateral, private or public sector guarantees or changing the ownership and voting structure of the creditor (many more are possible):

- As mentioned in the introduction, there may be an increased demand among creditors for lending vehicles that are collateralized by the borrower with cash flows or real assets that can be captured outside the debtor country's borders and hence could easily be transferred into the control of the creditors in the event of a default. The two main types of collateral that a sovereign could pledge would be its foreign exchange reserves or future export revenues[60] of its state-owned companies, such as oil or telecom. By definition the amount of collateral available to be easily pledged limits the use of collateralized borrowing for the debtor. While there is a significant amount of quasi-sovereign collateralized bonds outstanding, to date none of these collateralized bonds have been restructured. Specifically, it is uncertain how one would actually go about restructuring these bonds and ask the creditor to take a significant haircut. In the case of Pakistan, one eurobond that was not involved in the restructuring was a government guaranteed Pakistani Telecom bond, which was collateralized by the future export earnings on incoming international telephone calls. According to Standard & Poor's (S&P 1999) the structure of the Pakistani Telecom bond showed the resiliencies of these types of transactions and if default would occur recovery values will be very high as creditors can access the collateral, which is usually placed in an off-shore trust.

[60] Rating agencies assign future flow securitizations substantially higher ratings (up to four notches in some cases, see S&P, 1999) as the political and transfer risk of these types of debt are mitigated by their structure. In emerging markets, major examples of issuers using future flow securitizations are PdVSA and PEMEX (Venezuela's and Mexico's oil companies).

- An alternative would be lending guaranteed by either official or private insurance entities. For example, by making its lending conditional on the presence of a World Bank "policy-based guarantee" a lender should be able to make himself more immune to risks of unwanted PSI. Argentina, for example, issued policy-based-guarantee bonds in October 1999 and Colombia is considering raising part of its financing in 2001 through the use of such World Bank guaranteed bonds. Other public guarantee programmes such as the IFC's B-loan program, and that of other IFIs, effectively extend the preferred creditor status of these institutions to private creditors. In such cases, it is unclear how these bonds would be restructured. After the experience of Argentina default, where some of these bonds were restructured regardless of the guarantee, the attractiveness of IFI backed instruments have decreased.

- The use of collateralized borrowing is largely limited to corporations and could be relevant to the sovereign in the case of large export oriented state-owned companies, which the sovereign can use for its borrowing purposes. Hence, there would be incentives to find additional ways of lending money where the security from trying to avoid PSI stems from how the lending transaction is structured. It would, for example, be possible to repackage bonds and loans through the use of collateralized-bond-obligations (CBOs) or collateralized-loan-obligations (CLOs) and separate the legal ownership of the debt instrument, and hence the power to vote to participate in a debt exchange, from the stream of payments accruing, in such a way that it would be extremely difficult to find a representative of the actual creditor lender with the right to decide on participation in the exchange on behalf of the CBO/CLO. The point is not that it would be impossible to restructure a CBO and CLO, but that it is more difficult, adding to the cost of default for the debtor if he decided to default on debt instruments which are predominantly held by CBOs and CLOs.

The above are some of the potential adaptations that bondholders could opt for. The simplest one is of course to increase the borrowing cost for the debtor. However, it may be in both the creditors' and sovereign debtors' interests to race up the seniority ladder in order for more debtors to find cheaper financing and for the creditors to protect themselves. It is unclear whether such a seniority race is in the interest of official creditors, both bilateral and multilateral.

VII. Implications and Conclusions

Efforts at crisis resolution that succeed in reducing potential inefficiencies and instability in the international financial system are in the interest of both the private and the public sector. In the absence of clearly established rules of the game, the approaches adopted toward crisis resolution, and the extent to which they are interpreted by market participants as setting a precedent, can have profound implications for the workings of the international financial system and the nature and structure of international capital flows.

A key lesson from the 1980s is that as particular lending instruments are involved in restructurings, the private sector will seek out new instruments that increase the probability of repayment and are insulated from restructurings. The large-scale restructuring of syndicated bank loans in the aftermath of the 1980s debt crisis, while leaving eurobonds untouched, provided an important impetus to the use of the international bond market for emerging market borrowers. The experience with concerted interbank rollovers in Korea, Indonesia, and Brazil have shed some light on how the

private sector will adapt to an increase in the frequency of payment suspensions. The expectation by the market that this will be the case will likely lead at least some international banks to cut their lines and run early in the face of an imminent crisis.

Experience following the most recent string of crises has firmly pierced the halo surrounding international bonds. This experience with bond restructurings will likely lead bondholders to update their estimates of key variables, such as the cost of default and the recovery value, making recently successful bond exchanges less useful as predictors of the success or failure of future bond exchanges. A key question about the welfare effects of recent official sector crisis resolution initiatives is whether the current cost of default is too high, and welfare can be gained by reducing it, or it is in the intermediate region where a reduction would lead to a loss in welfare. Moreover, it is natural to expect that, as bond restructurings become more common, private sector creditors will increasingly try to structure debt such that it is harder to restructure, for example, by issuing securitized or guaranteed debt or adopting investor holding structures that are difficult to negotiate with.

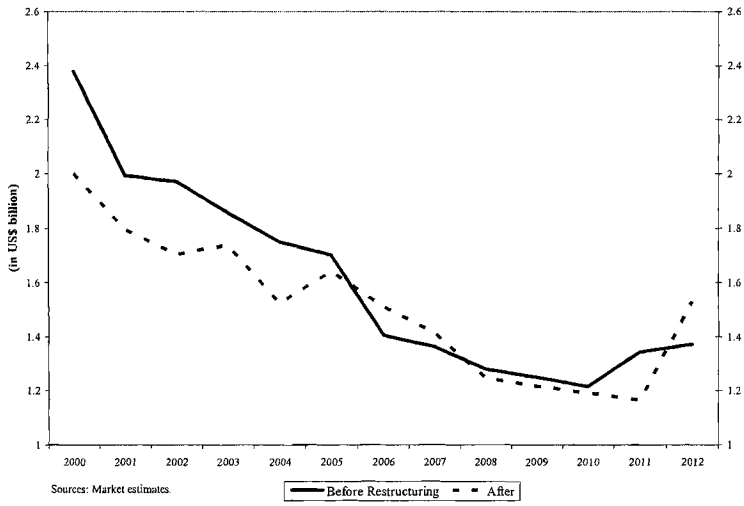
Such private sector adaptation to official sector crisis resolution initiatives, as discussed above, may not be costless and will either lead to increased borrowing costs for the debtor or to more short term and rigid debt structures, as the sovereign debtor tries to offset increases in borrowing costs by agreeing to borrow through ever more advanced and renegotiation proof structures. Either way, the net effect on emerging market capital flow may be negative, especially for the lowest quality sovereign borrowers.

The ongoing sovereign debt restructuring in Argentina is probably the event that will determine the direction for international debt lending to emerging markets and the threat of litigation for years to come. An unduly messy outcome, which looks increasingly likely given delays, will again raise calls for the intervention by the official community to resolve perceived market failures. Perhaps, even the recently shelved SDRM proposal will be dusted off. If this happens, this chapter hopefully can serve a role in cautioning reinvigorated policy makers to keep private sector adaptation in mind and revisit whether the main problem is too low sovereign default costs or too high.

APPENDIX 1. OVERVIEW OF THE ECUADOR BOND EXCHANGE[61]

On September 28, 1999, Ecuador became the first sovereign to default on a Brady bond after the expiration of a 30-day grace period. It can be argued that the crisis had been long in the making and reflected internal political problems aggravated by external shocks, such as the "El Niño" weather phenomenon. At the time of the default Ecuador's external bonded debt consisted of collateralized Bradys (Pars and Discounts) with an outstanding amount of $3.1 billion, uncollateralized Brady (Past-Due-Interest, PDIs) amounting to $2.8 billion and a stock of $0.5 billion of dollar-denominated eurobonds.

Figure A.1. Ecuador: Debt Service Profile



In July, 2000, the authorities launched its exchange offer, offering to exchange the defaulted bonds for about $4 bn in new bonds and about $1 bn in cash (accrued interest and principal collateral). Similar to Russia, the exchange offer involved a significant debt write-off (haircut relative to Par) of 40.6% even exceeding that of Russia (which gave as a sweetener an upgrade in obligor). Some bondholders could choose between exchanging their defaulted bonds into, either an amortizing 30-year eurobond with a step-up coupon from 4% to 10% or, to a certain extent, an amortizing 12-year eurobond with a 12% coupon in return for an extra 35% haircut. In contrast to the principal collateral, interest collateral was used to pay accrued interest. As one of many interesting features, the exchange offer discriminated between Brady bonds and the shorter-term eurobonds, where no initial debt write-off was asked for. Moreover, eurobonds did have a priority in switching to the 12-year eurobond. This option was designed as being valuable and a cap was set for the 2012 issue size implying that none of the Par and Discount holders would receive the shorter-maturity bond. The PDI bond, reflecting relative historical price

[61] Updates description of the Ecuador exchange in IMF(2000a), for the description of other exchanges please see IMF(2000a).

performance, was treated differently compared to other uncollateralized Brady debt (the IEs) and eurobonds, which were not initially subject to a debt write-off.

In the end, approximately 97% of bondholders accepted the exchange offer partly due to the cash sweeteners but also because of the use of exit amendments discussed in appendix 3. While many investment banks continue to question Ecuador's debt sustainability (see Roubini, 2000), the exchange did provide some breathing space for the sovereign. Debt service payments are, however, expected to come back to pre-exchange levels by 2005.

APPENDIX 2. INNOVATIONS IN THE ECUADOR BOND EXCHANGE[62]

The Ecuador bond exchange included many innovations, compared to the other bond exchanges, in order to make the exchange successful for bonds that were subject to NY-law. Especially challenging was the question of how the sovereign could limit the potential of future litigious activity from any potential hold-out creditors and encourage large majority of bondholders to tender. The solution proved to be a clever use of cash sweeteners (see appendix 1), exit consents, and principal reinstatement clauses.

Exit Consents

The exchange offer is the first example of the use of "exit consent" amendments in a sovereign bond context (a "poisoning the well behind you" strategy) to make it less attractive for hold-out creditors to remain in the old bond and not tender. Such changes to non-payment terms of the old bonds only required a 51%-75% majority of agreeing bondholders, while any change of the payment terms, under NY-law, would have required unanimity. Tendering bondholders agreed to when "exiting" the old bond to: strip away cross-default and cross-acceleration provisions to the new bonds (the new bonds include a cross-acceleration clause but it cannot be triggered by continued defaults on the old bonds); reduce liquidity of the old bonds by delisting them; change negative pledge clauses; limit attachment possibilities of debt service made on the new bond; and more. In addition, Ecuador changed clauses in the old bonds allowing it to not extinguish tendered bonds if necessary, such that hold-outs cannot reverse exit amendments and cannot accelerate the old bonds.

Principal Reinstatement

As an additional sweetener to those investors who received the 2030 exchange bond in return for the Brady Par, Discount and PDI bonds (37% of PDI bondholders did not receive any 2012 eurobonds) the bond documentation included a principal reinstatement feature, which in the event of default would reinflate the principal by up to 30 percentage points (if default occurred in years 1-3, 20 percentage points if it occurred in years 4-6 and 10 percentage points if it occurred in years 7-10) and thereby mitigate some of the haircut relative to par imposed on the tendering bondholders today (Par 60%, Discount 42% and PDI 22%). Given the significant default probability of Ecuadorian eurobonds following the exchange the reinstatement feature did provide some value (a market estimate put the value of this feature at about 11% of the market price of the 2030 eurobond in August), but is based on the belief that any future restructuring will be based on the nominal value of the defaulted bonds rather than the market value or some other measure.

[62] References for this appendix is Buchheit and Gulati (2000) and Lindenbaum and Duran (2000).

APPENDIX 3. BACKGROUND ON ELLIOTT ASSOCIATES VERSUS PERU[63]

On Friday the 29th of September 2000, Peru announced it would pay Elliott Associates (Elliott) in full its $58.4 million claim, in order for the sovereign to make a $80 million coupon payment overdue on some of its Brady bonds (with the grace period expiring October 7). Against a backdrop of domestic turbulence, more than three years of legal proceedings, and with restraining orders having been served to the paying agent as well as several other banks and the two major clearing houses, Peru had no credible alternative but to pay Elliott.

Elliott, a well-known distressed debt investor and having won a similar case with respect to Panama, initially bought during early 1995 $20.7 million in nominal value sovereign guaranteed defaulted bank loans and paid $11.7 million. The purchase decision followed a favorable court decision involving another distressed debt investor, Pravin Banker, and a Peruvian bank. After deciding not to participate in Peru's Brady deal of October 1996 Elliott decided to immediately go to court in order to try to attach payments that were being transferred from Peru to the New York Fed in order to purchase the collateral necessary for the Brady deal. This strategy failed and several years of legal challenges followed. On October 20th 1999, and after a ruling by a lower court, which had dismissed Elliott's claim that its purchase of Peruvian debt had *not* been "with the intent and sole purpose to sue", a US appeals court on ruled in favor of Elliott and reversed the lower court's decision. Legally, Elliott effectively managed to revoke the use of the "Champerty" doctrine defense[64], making it easier for future distressed debt investors (i.e. vulture funds) and other creditors to sue a government and attempt to attach its assets.

On June 22nd, 2000, Elliott was awarded a judgment order against Peru and could start seeking to attach assets. The September 7 coupon payment was the first payment after the judgment and Elliott sought and was granted restraining orders for the fiscal agent Chase as well as for several other banks and Euroclear and Cedel (after having received a favorable restraining order judgment from a Belgian Appeals court). For the sovereign, at this point, time ran out before it could challenge the restraining orders and it paid Elliott on October 4, 2000. All-in-all Elliott made profits of $46.7 million, minus legal fees, or about a 400% on its original investment 4.5 year earlier.

Lindenbaum and Duran (2000) draw the following lessons from the Elliott case:

- "Champerty offers little protection for sovereign debtors, supporting the perception that a ruling in favor of creditors is relatively easy to obtain."

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[63] This appendix is based on several of the legal documents surrounding the case as well as a summary analysis by Lindenbaum and Duran (2000).

[64] Under section 489 of the New York Judicial law a creditor is forbidden to acquire debt "with the intent and for the purpose of bringing and action or proceeding thereon", see Lindenbaum and Duran (2000).

- "The threat of attaching bond coupons is credible." Ecuador's exchange bonds are, however, trying to protect themselves from some aspects of the Elliott risk. Notably, Ecuador uses a Trustee (creditor's agent) rather than a fiscal agent (debtor's agent) making any transfers to the trustee the property of the creditor rather than that of the debtor, making attachment more difficult.

- "Sovereigns are unlikely to be able to bypass orders of attachment in the location of the fiscal agent by paying coupons via a branch office, especially on existing bonds."

In the end, the applicability of the Elliott versus Peru case will not be clear until other creditors follow in Elliott's footsteps and clarify some of the outstanding legal ambiguities that are outside the scope of this chapter to discuss. It is fair to say, however, that the case has led to increased investor interest into the legal details of their debt contracts.

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Chapter III
European Equity Market Integration: Cyclical or Structural? [65]

I. Introduction

The interdependence between international financial markets have become increasingly evident during the last several financial crises, TMT (technology, media, and telecom) bubble, and European Monetary Union. Such integration has made it increasingly challenging for portfolio managers to seek out diversification opportunities and has raised the question on whether traditional investment techniques such as country-based investing should give way to global industry based investing. However, financial integration, loosely defined, can stem from at least two different sources. First, and the one most often thought about, is a common investor base. International institutional investors benchmarked to certain global equity indices, such as the Morgan Stanley Capital International[66] (MSCI) index family, own stocks in different countries and evaluate them relative to a common benchmark. Such common ownership sets the stage for co-movements, especially in crises, as investors may be forced to liquidate positions to meet end-investor withdrawals. It thereby risks increasing the co-movement between different countries and sectors. A second potential source of increased financial integration is the degree of internationalization of corporations. Multi-national corporations with large overseas sales can be as sensitive to overseas market developments as to developments in their home market. In this latter context it would be reasonable to expect country factors to slowly decrease and sector factors to gradually grow in importance in tune with long-run factors, such as the globalization of trade and service. This may be of particular relevance in the European Monetary Union, where regulatory initiatives and equity market competitions has widely been seen as increasing equity market integration. In the context of increased global integration it would become increasingly costly for an institutional investor to retain the traditional home bias, given results in an under-representation of certain sectors relative to the global portfolio and hence reduces diversification opportunities on top of not being diversified across countries.

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[66] According to MSCI (www.msci.com) 90 percent of international equity assets in the U.S. are benchmarked to MSCI indices. A similar dominance seems to hold in Asia, while around two-thirds of European fund managers use the index. Clearly, the creation of international benchmarks to evaluate performance has been one important supporting factor to the increased internationalization of institutional investor portfolios.

The degree of equity market integration and the relative importance of country factors relative to sector factors have been debated in several papers throughout the latter part of the 1990s. A clear tendency towards increased equity market integration in the European Union was identified. However, such developments were also observationally equivalent to the global Tech, Media, and Telecom (TMT) bubble, where investors sought out and treated TMT companies largely the same regardless of location. The purpose of this chapter is to revisit and update the degree of equity market integration[67] among the European Monetary Union (EMU) members using an improved and more intuitive approach compared to the recent literature and a more updated dataset. The methodology used estimates various sector's sensitivities to country and global sector factors, and is hence immediately useful for traditional portfolio analysis, rather than the approaches used in some of the literature, which evaluate the share of the overall variance of a stock or a sector that can be explained by country and global sector factors. In addition, the chapter tries to determine the roles played by the global bull market and structural factors, such as the introduction of the euro and the roles played by foreign international and European institutional investor in explaining the increased integration observed in the recent literature. The main focus is on the equity markets in the European Monetary Union countries, but the chapter also explores whether the integration trends observed are exclusive to the EMU countries or are also reflective of developments in the broader European Union. The more recent data series captures changes in index methodology, the move to free-float indices, and whether or not only the tech, media and telecom (TMT) sectors saw a broad based increase in the degree of integration. Moreover, the chapter describes and discusses the how the more intuitive approach measuring equity market integration compares to alternatives in the literature.

Using both average correlations and cross-section time-varying "beta" analysis the empirical results show a sharp increase during the late nineties in the importance of sector compared to country factors.[68] The methodology used to estimate the time-varying sensitivities solves for the specification errors present in some other papers and provides for estimates of the sector and country sensitivities that are immediately translatable into relevant portfolio management statistics for institutional investors. The observed increase in "so called" equity market integration predates (perhaps in anticipation of) the introduction of the euro and shows a remarkably steady rise throughout 1999. In fact, just before the burst of the tech bubble in March/April 2000, sector factors within the EMU were as important as individual country factors. However, confirming the cyclical nature of the observed equity market integration, the bursting of the bubble led to a consistent relative decline in the importance of sector factors. This argues that there still remains substantial scope for further structural equity market integration within the EMU and, to an extent, past high levels of integration was a cyclical phenomenon. Despite the bursting of the Tech and subsequent Telecom bubbles, sectors such as Energy and Telecom remain

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[67] As argued by Danthine *et al* (2000) the integration of EMU candidate countries foreign exchange, bond, and money markets preceded the actual launch of the euro. The core countries of a future EMU were already perfectly anticipated by early 1997 with no real uncertainty regarding additional candidates existing after January 1998.

[68] The reference to betas could potentially lead to some confusion compared to the meaning of the term in the asset pricing literature. In line with the relevant literature, a similar terminology will still be used but it is important to note that what is actually meant is the sensitivity coefficient to country versus sector effects.

still in 2002 largely global industries. Surprisingly the chapter finds that the Tech sector never played the role of a truly global sector. This likely reflects the clear dominance of the U.S. Tech sector relative to that of Europe and that the equity returns of many of the smaller Tech firms in the U.S. are more driven by country specific fundamentals.

The structure of the chapter is as follows: The next section will provide a brief literature review of the different approaches taken to discuss the amorphous concepts of financial or equity market integration and places the empirical approach taken here in to context. In section III, the roles and importance of the international non-European and European institutional investors are discussed together with the scope for further equity market integration stemming from the gradual rebalancing of their portfolios to decrease their current home-bias. Section IV discusses the data used in the chapter for the empirical section. While section V discusses the use of an average correlation approach to estimate the degree of equity market integration, section VI compares the methodology used by other recent papers to estimate time-varying sensitivities with that used in this chapter. The section also argues that the methodology developed avoids a fairly important specification errors problem, especially if sector data is used rather than individual firm data. In the next section, section VII, the robustness of the observed increase in equity market integration is evaluated regarding the choice of countries and time periods. The chapter ends in section VIII with a brief summary, some conclusions, and a few suggestions for further research.

II. Financial Market Integration in the Literature

Throughout the 1990s the academic literature has debated financial market integration from both macroeconomics and financial economics perspectives. At least four broad strands can be distinguished. First, international macroeconomics has studied interest parity conditions to test for integration of money and bond markets, and analyzed the degree of capital account liberalization in countries to help determine the degree of integration. The macro literature has also tried to quantify the benefits to countries through increased international financial integration, such as improving the global allocation of capital and helping countries to better share risk and reduce consumption volatility (see Kose *et al*, 2002, for an overview). This literature has highlighted that increased financial integration also increases countries' vulnerability to shocks, i.e. contagion, and has argued that developing countries in particular should avoid prematurely liberalizing their capital accounts to potentially destabilizing capital flows.

A second, more financial economics based strand, has taken a capital flows perspective on financial integration and has studied the behavior of international investors and the share of their foreign asset holdings relative to what would be optimal in an optimizing portfolio context. These studies have consistently found strong evidence of a home bias, as documented by Tesar & Werner (1995), which is incompatible with financial market integration having run its full course even in developed markets. The reasons for the home bias include transaction and informational costs and have generated a large literature of their own. Updating Tesar and Werner's estimates, Warnock (2002) shows that initial estimates of home bias were probably upward biased, since foreign equity holdings data were underreported. He argues, however, that there still remains substantial scope for further financial integration driven by more optimal portfolio allocations. For example, Warnock notes that while 50 percent of equities in a world portfolio are non-

U.S., the share of foreign equities held by U.S. investors has remained relatively stable at 10-11 percent since the mid-nineties.

A third strand of the literature has based test of financial market integration on an international capital asset pricing model, see, for example, Bekaert and Harvey (1995) or Campbell *et al* (1997) for overviews.

The last strand is a modification of the third and uses various time-series techniques, such as correlation, cointegration, VAR, or multi-period regression analysis, to study the time-varying nature of financial market integration. Advantages of these techniques are that they easily map into pragmatic considerations for fund managers that are used to CAPM-like frameworks to optimize their portfolio performance. Ayuso & Blanco (1999) has, however, questioned whether these techniques actually measure financial integration or only financial linkages. Comparing standard time series measures of financial integration across countries with the result of these measures if they are applied to the New York stock exchange, the authors argue that finding significant increases in financial integration could simply reflect a few outliers, such as the 1987 stock crash. Hence, econometric results of integration do not necessarily show that the equity markets studied are from an economic point of view more integrated. While less relevant for a portfolio manager, Ayuso & Blanco's critique is a useful caution and potentially relevant from a policy perspective[69].

The cross-market correlation based literature has been among the most straight forward and have been much used to analyze issues related to stock market crashes and financial contagion (see Forbes & Rigobon (2002) for a critical discussion of some pitfalls with this analysis). Solnik, Boucrelle & Le Fur (1996) found in their study, for example, that during the last 37 years, the level of correlation between the world's major stock markets has been increasing. The authors conclude that this indicates that the markets have become more financially integrated. Another interesting result was that even though correlations between key markets were low during normal times, they jumped up in times of crisis. This is a major problem for an investor following a correlation and country based risk diversification strategy, since the expected diversification benefit is not realized during crisis. Hence, what looked like a well-diversified portfolio frequently is not. Solnik *et al* concludes that even though correlations have increased steadily, there still exist significant benefits from international diversification. Applying correlation analysis to the European Union countries in the run-up to monetary union, Beckers (1999) argued that the gradual increase in correlation between EU equity markets would be boosted by the removal of exchange rate risk. For active portfolio managers, however, Beckers argued that EMU would increase the challenges to add value and that tighter integration would increase the overall risk of institutional investor portfolios as diversification benefits are strongly eroded.

Another approach has been to use cointegration techniques to find long-run relationships between equity markets in different countries. These studies have been focused on analyzing whether stock market linkages during normal times fundamentally change

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[69] The authors note that the policy implications of finding tighter cross-country linkages differ significantly if these linkages are driven by greater information globalization rather than greater integration, since the former maybe far more automatic .

during a crisis or some other discreet event. Taylor & Tonks (1989) largely started the literature with their analysis of the impact of the abolition of U.K. exchange controls on the degree of integration between U.K. stock markets and other developed markets. Since then, a number of papers have dealt with the October 1987 stock market crash (Arshanapalli and Doukas (1993), Chan and Lai (1993), and Ma (1993)). This fairly successful empirical approach has often been used to determine the direction of causality using granger-type tests. Arshanapalli and Doukas, for example, found evidence that the U.S. stock market had a considerable impact on stock markets in France, Germany, and the U.K., but not the other way. Other studies also frequently found evidence of a number of cointegration relationship between both developed and developing equity markets (see Masih and Masih (1997) and Chen *et al* (2002) for an application to Latin American equity markets) and have highlighted the importance of the US equity markets in being the originator of many shocks that have subsequent ripple effects. Within Europe, cointegration studies frequently identified Granger-causality running in both directions indicating a tight links between especially European Union equity markets (see Nystedt (2000) and Ahlgren and Antell (2002) for recent examples).

A robust alternative to analyze the gradual change in the importance of country factors relative to the industry sector factors was pioneered by Roll (1992). Using a limited dataset, but an econometrical technique based on Fama & MacBeth's (1973) classical method for testing asset pricing models, Roll argued that global industry factors could explain up to 40 percent of the variation in individual country equity indices. Such a high explanatory power was seen as equivalent to a high degree of financial integration across developed equity markets, since country specific factors, unrelated to the industrial make-up of a country, played a much smaller role than previously expected in the literature.

Following up on Roll, Heston and Rouwenhorst (1994) pointed out that Roll's data limitations had led to an overestimation of sector effects and therefore the degree of equity market integration. Using an indirect estimation technique to identify separate country and sector factors and using firm level data from 12 European countries between 1978 to 1992, Heston and Rouwenhorst found that the difference in industrial structure across country could only explain around 1 percent of the variance of country excess returns. Hence, country factors, it was argued even in Europe in the early 1990s, far dominated any industry effects. Heston and Rouwenhorst use of individual stock data and their econometrical techniques were subsequently applied by a number of other authors on a variety of time periods and with a wider set of countries (see, for example, Beckers *et al* (1996) or Griffin and Karolyi (1998)). These studies generally confirmed Heston and Rouwenhorst's findings, but with an important exception being Western Europe, where a clear trend towards increased financial integration through increased sector importance was consistently documented.

The run-up to the introduction of the euro in January 1999 sparked a series of new studies analyzing the importance of sectors versus countries with a special application to Western Europe. Using broadly the same methodology, but varying datasets, Rouwenhorst (1998), Cavaglia *et al* (2000), and Baca *et al* (2000) all found evidence of sector effects gaining in importance in the European Union. Baca *et al* showed that sector and country factors were now of roughly equal importance raising an important issue whether or not international institutional investors should base their diversification strategy on developed country sectors rather than countries. Cavaglia *et al* (2000), for example, showed that diversification across industries generated more risk reduction than a similar country-

based diversification strategy. They, therefore, argued that home bias could be more costly in a more financially integrated world. Using an unfortunate example, from an ex-post point of view, Cavaglia *et al* (2000) demonstrated that an institutional investor investing predominantly in United Kingdom, which has a very small share of tech firms, would loose out both in a country and sector sense, compared to investors holding the global equity market portfolio where the tech sector played a more important role.

Using a different methodology, based on time-varying betas estimates from observable data series, Urias *et al* (1998) confirmed the sharp increase in the importance of sectors in explaining stock returns in the run-up to the euro. By early-1998 capitalization weighted sector and country betas were of broadly equal significance, with sector betas likely to increase further looking ahead. As a result, Urias *et al* also argued that institutional investors should adopt a more regional or pan-European investment approach going forward. However, in sectors that are likely to be more dominated by country factors, such as defense, country analysis should not be discouraged.

The advent of the euro was seen as strengthening the argument of increased equity market integration in the European Monetary Union. Increasingly, investment banks and institutional investors structured their operations around a sector basis rather than a country basis. The tech, media, and telecom (TMT) sectors were the darlings of investors all over the world sparking large capital flows to emerging equity markets, where sector considerations were still generally dominated by country factors. The surge in interest for TMT stocks regardless of where they were located spurred tighter integration among a wide series of different equity markets. A recent study by Brooks and Del Negro (2002) argued that much of the increase in equity market integration can at the global level be explained by the bull market, but find that at a regional level within Europe there are signs that increased financial integration reflects more structural factors, such as the introduction of a common currency. More recent research has sought to update the technique used by this strand of the literature by introducing regime switching features, such as Catão & Timmerman (2003). The regime switching approach is successful in identifying a high and a low volatility regime. As could be expected, sector factors increase in importance during times of high volatility, possibly reflecting common global shocks such the oil shock of the 1970s and the boom and bust of the TMT sector. In addition, Catão & Timmerman confirm the findings of the earlier literature that industry factors have increased in significance during the late 1990s. Another approach has been to explain in more detail the role played by global factors on an individual firm level rather than on a sector level, since shocks to this factor affect multinationals differently, which have a large share of sales abroad, than corporates, which are focused mostly on a domestic market (Cavaglia *et al* (2001) and Brooks & Del Negro (2003)). Brooks & Del Negro (2003), for example, find a significant relationship between firms that operate internationally and their sensitivity to global shocks and argue that part of the decline in importance of country factors observed in the earlier literature reflects that firms have become increasingly international, especially in the 1990s. Therefore, the importance of country factors has decreased more for those countries that have a large share of multinational firms.

III. EUROLAND AND INTERNATIONAL INSTITUTIONAL INVESTORS

OECD (2001) defines the term institutional investor to include insurance companies, pension funds and other private investment funds, including mutual funds. As shown in

table A.1, the growth of institutional investor assets under management has been spectacular across the OECD with assets under management increasing from around 97 percent of GDP or US$23 trillion in 1995 to more than 140 percent of GDP or US$36 trillion in 1999. The average annual growth rate within the OECD during this period was a spectacular 11 percent per year, partly reflecting the late nineties' bull market. Nonetheless, institutional investor assets remain fairly concentrated, with the United States, Japan, and the United Kingdom increasing their share of total OECD assets under management from 75 percent in 1995 to 76 percent in 1999. Within the European Union, EMU member have generally a lower asset to GDP ratio than other European Union members do. This largely reflects large differences in the degree of both pension reforms and liberalization of institutional investor regulation (see Lanoo (1996)). No noticeable change can yet be detected in the data regarding any impact of the EMU on assets under management. The surge in assets under management tapered of quite significantly in 2000, reflecting the much more difficult market situation, and should have remained on a declining trend during the past two years despite significant new inflows.

Table 1. Institutional Investor Breakdown

	Insurance Companies		Pension Funds		Investment Funds	
	1995	1999	1995	1999	1995	1999
European Union	50%	47%	22%	20%	28%	33%
EMU	52%	44%	13%	11%	35%	46%
United Kingdom	45%	49%	42%	38%	13%	14%
Japan	70%	67%	19%	20%	11%	12%
United States	29%	23%	43%	40%	28%	37%

Source: OECD (2001)

Akin to a chicken and egg problem, the countries with the largest market capitalization relative to GDP also show the largest relative importance of institutional investors (see table A.2). This relationship has spurred regulators, especially in the European Union, to see what could be done to spur further growth in the importance of institutional investors. The introduction of the euro is expected to play a direct role in increasing the importance, competition and diversification possibility of Euroland based institutional investors. At present, see table 1, 44 percent of EMU institutional investor assets are held by insurance companies, only 11 percent by pension funds, and the remainder by investment funds. These shares have not changed dramatically after the first year of the euro and remain substantially different to the large role played by pension funds in the U.K. and U.S.

Table 2. Asset Restrictions on Pension Funds and Life Insurers

	Pension Funds				Life Insurers			
	Equities	Bonds and Loans	Foreign Assets	Currency Matching	Equities	Bonds and Loans	Foreign Assets	Currency Matching
Germany	Max 30%	-	Max 20%	80%	Max 30%	-	Max 20%	80%
France	-	Min 50%	-	No	Max 65%	-	Max 20%	No
Italy	P	P	P	33%	Max 20%	-	Max 20%	80%
U.K.	P	P	P	No	-	-	Max 20%	No
Japan	Max 30%	Min 50%	Max 30%		Max 30%	-	Max 30%	
U.S.	P	P	P		Max 20%	-	Max 20%	

Note: P indicates that the prudent man rule applies.
Source: Davis and Steil (2001) and Adjaoute and Danthine (2002)

Institutional investors across the European Union remain subject to fairly tight investment restrictions. The 2001 Lamfalussy report identified a number of areas where there remained significant scope to increase regulatory integration in the treatment of institutional investors[70]. Such efforts would allow for increased cross-border competition to manage assets within the EU. During 2002, significant progress was reached regarding a "single passport" for pension funds and an EU wide use of the "prudent man rule" instead of the investment restrictions currently in place (see table 2). While both reforms are important, a wider use of the prudent man rule, after a transition period where investment restrictions are gradually relaxed, could lead to a substantial increase in both cross-border and equity investment. However, since many of these restrictions seem not to have been binding, change is likely to be gradual rather than rapid. For example, as shown in table 3, foreign asset holdings by German pension funds were far below the regulatory maximum and while more updated data is not yet available, the investment restrictions are unlikely to be currently binding.

[70] For a critical discussion of securities and market regulation in the aftermath of the Lamfalussy report see Niemeyer (2001).

Table 3. Institutional Investor Investment in Foreign Assets

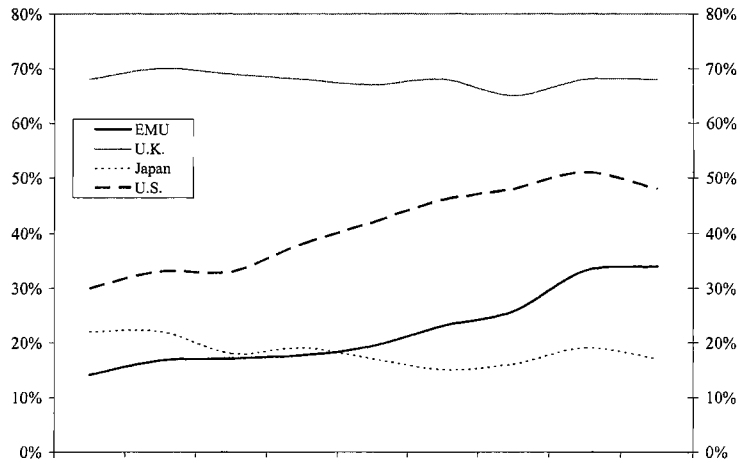
	Pension Funds		Insurance Companies		Mutual Funds	
	1994	1998	1994	1998	1994	1998
EU						
EMU						
Austria	20%	...	...	...	...	...
Belgium	35%	...	...	...	...	...
France	5%	5%	0%	0%	...	14%
Germany	6%	7%	...	0%	...	29%
Italy	5%	0%	...	0%	...	0%
Netherlands	17%	...	6%	...	...	...
Spain	5%					
Other						
Denmark	7%	...	5%	...	...	...
Sweden	12%	...	...	...	...	...
U.K.	30%	18%	15%	13%	...	33%
Japan	7%	18%	...	9%	...	22%
U.S.	10%	11%	...	1%	...	...

Source: Lannoo (1996), Davis (1996), and Davis and Steil (2001)

As the equity bull market took hold equity holdings by Euroland institutional investors showed some increase towards the latter half of the nineties. A sharper increase (see figure 1) occurred in 1999, after the introduction of the euro, reflecting both the decrease in currency risk to diversify to other markets, but also the outperformance of stocks in many institutional investor portfolios. The high share invested by U.K. based institutional investors under their prudent man rules is without comparison in the OECD. While it unlikely, and perhaps not desirable, that equity investments by Euroland institutional investors would reach such levels as seen in the United Kingdom,[71] it is worthwhile to note that a reallocation of their portfolios to the level invested by US institutional investors could generate additional investment into the equity markets of nearly US$150 billion.

[71] In the context of the broad based equity market decline, since March/April 2000, the share of equity investment by U.K. institutional investors should have declined significantly. However, data that is more recent is currently unavailable.

Figure 1. Institutional Investors: Share Invested in Equities



Source: OECD: 2001

There remains, therefore, significant scope for further investments in to the equity markets by both European based and other institutional investors. Such investments could set the stage for further equity market integration both within the EMU and between regions. As seen in table A.2, European equity markets account for broadly 25 percent of the world equity market capitalization. Only 10-20 percent of U.S. and Japanese pension fund assets are invested abroad, implying significant future potential for foreign institutional investor interest in EMU equity markets. Of course, some of these inflows could be offset by the rebalancing of EMU based institutional investors to include more non-euroland assets. Given the smaller asset base of Euroland institutional investors and its concentration among more conservative insurance companies, US or Japanese inflows are likely to in the medium-term more than offset European portfolio outflows.

Another factor arguing that there remains significant scope for further investor-led financial integration is the predicted sharp growth in assets managed by benchmarked European institutional investors. Most EU countries have yet to adopt significant pension reforms. De Ryck (1998), for example, estimates that between 1998 and 2008 pension fund assets will increase ten times. This increase is seen as a natural reply to the demographic developments in the EU countries and the need to create a funded and credible pension system. Moreover, pension funds are in general long term investors, which should make it possible for them to increase the share of assets held in the form of equities once the current bear market is deemed to have bottomed. Hence, Euroland-based insurance companies and pension funds are likely to play a very important role in increasing the level of integration between European equity markets in the future, especially if recent regulatory initiatives to create a level regulatory playing field across the European Union is indeed enacted.

IV. Data

The data used for the subsequent sections analyzing the average correlation of sectors and countries and time-varying sensitivities are based on Dow Jones World Stock dollar-

denominated Sector and Country Indices and market values (DJWI, see also Griffin and Karolyi (1998), who use the same index provider). Coverage starts in January 1992 and by December 2002 DJWI included 2,362 stocks in 22 developed countries, representing approximately 95 percent of both European stock market capitalization and that of other countries. In terms of sectors, DJWI divides stocks into 10 global sectors, 66 industries and an additional 45 sub-industries. For the purpose of this chapter, daily data starting in January 1996 and ending in April 2002 is used (a total of 1,646 observations by sector and country).

Country coverage focuses naturally on the European Union and the US (see tables A.3 and A.4) and has been further limited to those countries that have indices in at least three out of the ten global sectors. As a result, smaller European countries such as Portugal, Greece, Luxembourg, Belgium, Ireland and Austria, have been excluded because of their lack of consistent sector coverage. The excluded markets account for no more than 5 percent of European Union market capitalization (see table A.2) or less than 1 percent of global equity markets.

The choice between using dollar or local currency indices has been much debated in the literature, and suffice to say the choice depends on what is the objective of the study. Given the focus of this chapter on institutional investors, the choice of using dollar return reflects a pragmatic consideration that most institutional investors are benchmarked against a dollar-denominated version of an equity index such as the MSCI or DJWI. Therefore, as also argued by Davis and Steil (2001), many investment funds and some other institutional investors do generally not hedge their equity investments[72]. None of the findings presented below change materially if local currency indices are used. Moreover, in the run-up to the introduction of the euro, as noted earlier, EMU candidate currencies were already very much aligned, as investors had anticipated the currency union through convergence plays in both foreign exchange and bond markets.

V. Average Sector and Country Correlations

Correlation studies are probably the most intuitive way to analyze equity market integration (see for example Beckers (1996)). In addition to their simplicity, correlation studies have an immediate link to optimal portfolio composition theory and is easily understood and useful for portfolio managers. Studying the time-varying nature of the correlation between two stock indices or other financial assets has also frequently been used by studies analyzing contagion during financial crises (see Forbes and Rigobon (2002)). Using some of the methods discussed in the financial contagion literature (see IMF (2001)), the relative importance of sector effects compared to country effects are shown by calculating the average correlation across sectors and the average correlation across countries within Euroland. To generate a time-series of correlation coefficients an 80-day window was selected to compute the correlations. The choice of window is arbitrary, but as argued in IMF (2001) an 80-day window is wide enough to not generate too much noise, while still reacting to changes such as sudden shocks where correlations

[72] Davis and Steil (2001) also state that investments in the bond markets are frequently hedged. However, these markets also offer several dollar-based bonds by a variety of issuers. This reduces the overall need to hedge by an investor evaluated against a dollar-benchmark.

surge. Arguably, given that financial integration is a longer run process, a longer window can be chosen[73] or a trend can be added to the average correlation series after estimation. Also similar to some contagion studies, the chapter takes the unweighted average of pair-wise correlations, rather than weighting them with their respective market capitalizations. This is done to not unduly bias correlation estimates upward. If, indeed, a set of countries or sectors are getting more closely integrated, i.e. they have a higher average correlation, the unweighted average assigns to small countries or sectors the same weight as to larger ones. If the unweighted average correlation still shows evidence of increasing, it can be argued that the level of integration is indeed more broad based. The relevance of unweighted average correlations is especially significant in the present situation where two countries, i.e. Germany and France, account for more than 50 percent of the total market capitalization analyzed.

In specific terms the average country correlation was calculated in the following way using logged daily returns.

$$\bar{\rho}_t^C = \frac{\sum_{i \neq j} \rho_{i,j}^C}{\sum_{i=1}^{N} i}$$

Where $\rho_{i,j}^C$ is the correlation for a given time period between country i and j, and N is the number of countries being analyzed. The metric, hence, first summarizes the lower and upper triangle of the correlation matrix, but excludes the diagonal of ones. This sum is then divided by the number of entries in the correlation matrix (again minus the entries in the diagonal) resulting in the average country correlation, $\bar{\rho}_t^C$ for period t. Computing the average sector correlation is similar, but needs one additional step.

$$\bar{\rho}_t^S = \frac{\sum_{k=1}^{K} \sum_{i \neq j} \rho_{i,j}^k \Big/ \sum_{i=1}^{N} i}{K}$$

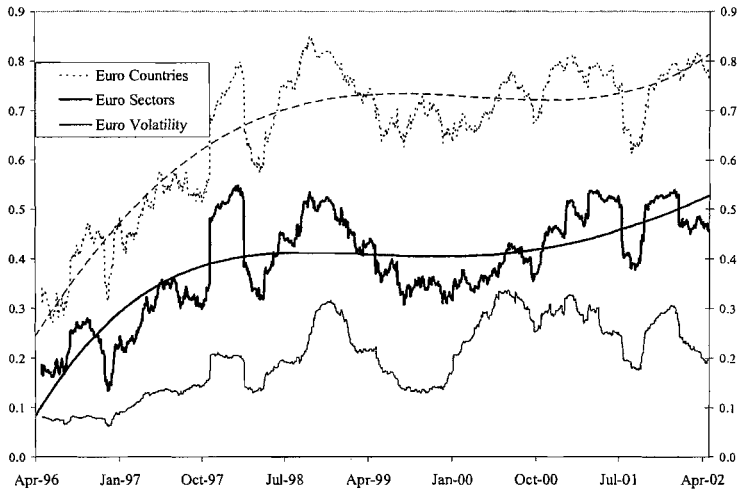
First, using the same methodology as for countries, the average correlation for sector k is calculated for a given time period t by summing the pair-wise correlations between those sectors in the N countries . Given that we analyze ten sectors, ten average sector correlations are generated, which are then simply averaged in the second step to the average sector correlation $\bar{\rho}_t^S$. Hence, when the average sector correlation increases, it means that average correlation for at least one particular sector, say, for example, technology, has increased. Again using an unweighted average at each step ensures that no upward bias is introduced in the calculation due to a few dominating sectors.

Applying these methodologies on the six countries selected from the euro-area, the results are consistent with increasing equity market integration throughout the late nineties. Analyzing figure 2 and making use of the fitted trend lines, it seems that the run-up to the introduction of the euro was a period in which average correlations, and hence

[73] Freimann (1998), for example, uses a 5-year rolling window of monthly returns to calculate average correlations. This paper simply fits a fourth order polynomial trend line, to demonstrate a similar effect.

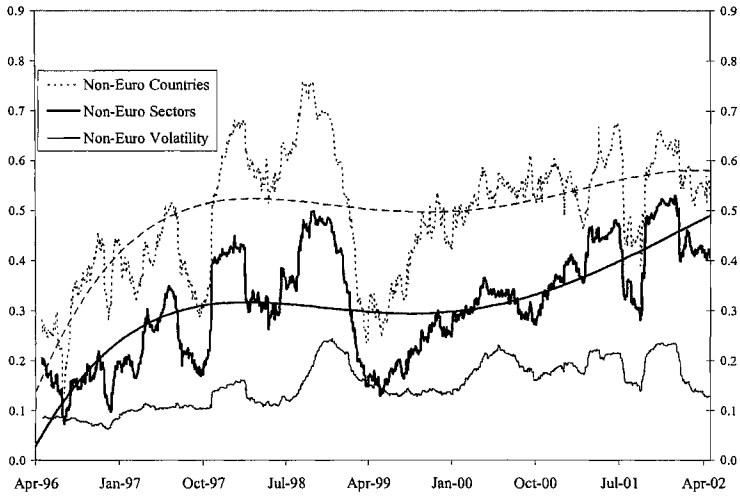
integration, were increasing rapidly for both country and sectors. Following the launch of the EMU, both sector and country correlations stabilized and only recently, despite the bear market, have they shown an increase. In terms of the relative importance of sector versus country effects in Euroland, correlations between countries have been consistently higher than that for sectors. There is also no clear sign of the sector average correlation closing the gap. Moreover, Solnik *et al's* (1996) findings that correlations increase as the volatilities of the underlying indices increase are confirmed. Such sporadic increases in average correlations should not be interpreted as a sign of short term financial integration, rather, as argued by Forbes and Rigobon (2002), such increases should be expected due to the definition of correlations and can relatively easily be corrected for in pair-wise correlations. Instead of correcting for it in the average correlation calculations, the correlation figures show the 80-day volatility of the computed DJWI Euroland and other indices.

Figure 2. Euroland Average Correlations



The average correlation concept can also be used to analyze the degree of co-movements between those EU countries that did not yet join the EMU. Given that it is only three countries and their sectors that can be analyzed, the sample is rather limited for a robust correlation study. Figure 3, nonetheless, shows the results of the average correlation methodology as applied to the U.K., Sweden, and Denmark.

Figure 3. Non-euroland Unweighted Average Correlations



Compared to the Euroland average calculations, the non-euroland average correlations are uniformly lower, indicating that the level of integration between the non-euroland countries is much less than that for the Euroland countries. This is not unexpected given the lack of any obvious linkages between the U.K., on the one hand, and Denmark plus Sweden on the other. Indeed, running pair-wise correlations between Sweden or Denmark with the Euroland equity indices[74] shows a closer relationship. While clearly the non-Euroland countries should not be treated as a group, it is worth noting that the relative importance of sector average correlations has been growing steadily during the last two years.

The discussion above pointed out some of the weaknesses of using average correlations to determine the degree of financial integration. Moreover, the sector average correlation measure, as used above, may have a systematic upward bias from only using Euroland sectors in its estimation. Hence, a "more correct" measure of the role played by sectors should include more of a global sector concept, where non-euroland and non-EU sector indices are also included in the estimation. Moreover, the correlation analysis can by its very nature not give a sense of the strength of the identified relationships to changes in the underlying sector or country factors. It is to address these factors and to link integration estimates more closely to the recent literature, that the next section calculates time-varying sector and country sensitivities.

[74] Not separately reported here. Estimates are available upon request. Some of the higher correlations detected between Sweden, for example, and the Euroland may reflect a relative exchange rate effect. While the Swedish crown is tightly implicitly linked to the euro, the British Pound is still a much more actively traded and volatile currency.

VI. TIME-VARYING SECTOR AND COUNTRY SENSITIVITIES

To address some of the short comings of the previous, more simplistic, correlation analysis, this chapter uses broadly the same methodological framework as Urias *et al* (1998) and Ametisova *et al* (2002) to estimate time-varying global sector and country sensitivities. As noted previously, this approach differs from that used by Heston and Rouwenhorst (1994) and related literature in so far as it uses directly observed index values in the estimation of their, so called, betas. The papers based on Heston and Rouwenhorst's methodology rather analyze the share of an individual stock's return variance that can be explained by global, country, and sector factors and hence do not generate the type of sensitivity coefficients that could be directly used in portfolio analysis, as suggested by Urias *et al* and Ametisova *et al.* As noted earlier, while both strands of literature uses the word "beta" to describe their coefficient estimates, none of them are strictly similar to the beta concept used in the classic asset pricing literature. Hence, a similar terminology is used in the next few sections, but to avoid direct confusion we use γ s instead of β s and what is estimated are rather sensitivities than traditional betas.

In addition, using observable indices rather than an orthogonalization procedure eases the interpretation and usability of the results, but may instead lead to severe multi-colinearity problems between country and sector indices. Urias *et al*, however, notes that some orthogonalization procedures risk biasing the sensitivity factor estimates depending on what factor is computed first. Hence, they decided to accept the less precise estimates of sensitivities that are generated by highly correlated factors.

Compared to Roll (1992) and Heston and Rouwenhorst (1994), this chapter also covers more global sectors, such as the health, technology, and telecom sectors that were not separately reported in the early nineties (index coverage started in 1996). However, to keep the country selection as broad as possible and make inferences about large industry grouping, the estimation of sensitivities based on individual sub-groups or individual stocks is avoided. Choosing only a few global sectors biases the estimates against finding any significant sector sensitivities, since, as argued by Griffin and Karolyi (1998), such a choice may not generate enough cross-sectional variation to distinguish between country- and sector sources. Since such a potential bias runs against what the chapter is trying to identify it may indeed be useful to keep the global sector approach to avoid spurious results[75]. In line with Griffin and Karolyi and Cavaglia *et al* (2000) individual stock return data is avoided, since the availability of individual country sector indices and their market capitalization allow the identification of sector and country effects without going down to an individual firm level. In fact, in the context of their methodology, Griffin and Karolyi show that basing factor estimates on group indices rather than individual securities is computationally equivalent, but simpler. Contrary to most other studies, however, this chapter estimates its sensitivities based on daily return data. A higher data frequency allows for more statistical precision, but at the cost of increasing the bias induced by non-synchronous trading hours, which, as discussed by Griffin and Karolyi, is more significant the higher the observation frequency is. However, by excluding Japan

[75] Unfortunately basing sensitivity estimates on ten global sector groupings makes it impossible to apply Griffin and Karolyi's interesting technique to divide sectors into tradables and non-tradables.

from the data sample (less than 10 percent of global stock market capitalization in 2002) the bias stemming from non-synchronous trading hours is mitigated. An alternative correction could have been to look at bi-daily returns (see Baig and Goldfajn (1998) for a discussion of these effects).

Specifically, the below two factor model is estimated on a one-year (225 business days) rolling window for each sector in each Euroland country. Global sector indices also include, as noted earlier, market weighted returns of non-euroland countries and the U.S.

$$R_{k,t}^{C} = \alpha_i + \gamma_{k,t}^{S} f_{k,t}^{S} + \gamma_{k,t}^{C} f_{k,t}^{C} + \varepsilon_{i,t} \qquad (1)$$

In this model, the continuously compounded return on sector k in country C at time t is denoted $R_{k,t}^{C}$ and is explained by two sources of risk, the sector risk sensitivity, $\gamma_{k,t}^{S}$, and the country risk sensitivity $\gamma_{k,t}^{C}$. To estimate these sensitivities and reduce the multi-colinearity problems inherent in the approach, this chapter introduces an important innovation. The logged sector returns, $f_{k,t}^{S}$, for the global sector k is based on a customized index, which explicitly excludes country C's contribution to the global sector index. Likewise, the country return index $f_{k,t}^{C}$, which measures country specific effects, excludes the contribution made by that country's sector k. Thus, each individual sector in each individual country is regressed on a global sector return, which excludes that country's contribution, and on a country return series, which excludes that particular sector's contribution. The use of these customized indices improves on the sensitivity estimation methodology and helps in avoiding the specification errors problem present in the approach taken by Urias *et al* and Ametisova *et al*, where the regression specifications suffer from that the specific sector, or stock in their case, shows up on both the right- and left-hand side of the regression. While it may be argued that the specification error problem is more severe when sector indices are used rather than individual stocks, it may be worthwhile to recall that stocks such as Nokia reflect nearly all of their sector's market capitalization and also a large share of that particular country's market capitalization. Appendix 2 discusses in more detail the biased sensitivity estimates and inconsistency introduced by not correcting for the specification error. Moreover, due to the use of customized indices, more efficient sensitivity estimates can be generated since there is no ex-ante multi-colinearity between sector indices and country indices (nonetheless heteroskedasticity is corrected for by using White standard errors).

Given that 10 sectors are being studied in six countries, there are sixty estimations of the two factor model for each of the 1,421 periods[76]. Moreover, there are ten customized versions of each global sector and country index. The error terms in equation (1), $\varepsilon_{i,t}$ are generally well behaved (see table A.5.) and are assumed to be uncorrelated with the sector and country return indices. As could be expected, however, the return do show signs of being non-normally distributed and therefore adjusted t-statistics are used in the determination of the significance levels of the sensitivity estimates (see Urias *et al* for a more detailed discussion of the statistical properties underlying the two factor model).

[76] The original number of observations is 1,645, which are then reduced by the initial size of the estimation window, i.e. 225 days.

To generate a time-series of aggregate weighted Euroland sector sensitivities and country sensitivities, the $\gamma_{k,t}^{S}$ and $\gamma_{k,t}^{C}$ are weighted by the daily market capitalization of the $R_{k,t}^{C}$ index. Specifically the following calculations are done for each time period.

$$\gamma_t^{S,W} = \sum_{i=1}^{6} w_{i,t} \sum_{k=1}^{10} w_{k,t}^{i} \gamma_{k,t}^{S,i}$$

$$\gamma_t^{C,W} = \sum_{i=1}^{6} w_{i,t} \sum_{k=1}^{10} w_{k,t}^{i} \gamma_{k,t}^{C,i}$$

In the above expressions, $w_{k,t}^{i}$ indicates the weight of sector k in country i. The weighted average of the sector sensitivities in country i are then additionally weighted using w_t^is, which correspond to country i's weight relative to the Euroland portfolio. The same calculation is done to generate the average weighted country sensitivity $\gamma_t^{C,W}$. To determine the impact of the large individual weights of some specific global sectors or countries on the degree of equity market integration, it is also important to analyze the unweighted averages of sector and country sensitivities for each period t, i.e.:

$$\gamma_t^{S,UW} = \frac{\sum_{i=1}^{6} \sum_{k=1}^{10} \gamma_{k,t}^{S,i}}{60}$$

$$\gamma_t^{C,UW} = \frac{\sum_{i=1}^{6} \sum_{k=1}^{10} \gamma_{k,t}^{C,i}}{60}$$

Here, $\gamma_t^{S,UW}$ and $\gamma_t^{C,UW}$ refer to the unweighted sector and country sensitivities respectively.

The results of applying the above methodology and weighting schemes on the data and estimating a time series of weighted and unweighted sector and country sensitivities are shown in figure 4[77].

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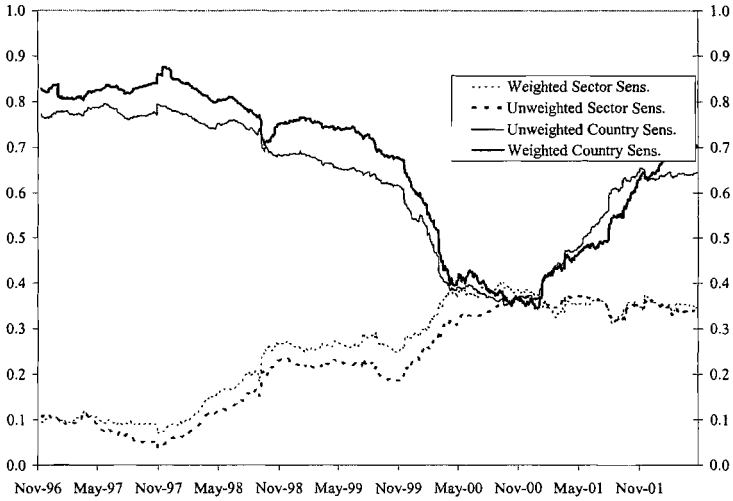
[77] While not separately reported both sector and country sensitivities are significantly different from zero for the vast majority of regressions (using standard White heteroskedasticity-consistent standard errors and covariance). An exception is in the beginning of the sample for the sector sensitivities, which due to their near zero coefficient estimates could not be said to be statistically different from zero. Table A.5. shows example regression outputs for three typical regressions for the German financial index. It is worthwhile noting that the R-squared of the regressions oscillated between 40 to 70 percent. There is also evidence of some sporadic modestly positive serial correlation in the residuals (see, for example, Durbin-Watson statistics in the sample regression outputs). Moreover, given the definition of the aggregated sensitivities, sector and country sensitivities nearly almost sum to one by construction.

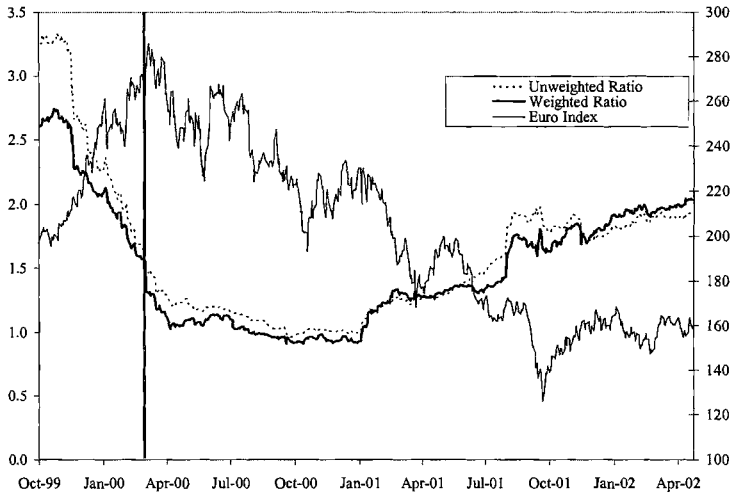
Figure 4. Sector versus Country Sensitivities



Throughout the latter part of the nineties sector factors steadily increased in importance, while the importance of country factors declined significantly. Similar to the findings by Rouwenhorst (1998), Baca *et al* (2000), and Cavaglia *et al* (2000) sector factors are found to have reached equal importance to country factors by late 1999. Moreover, the use of unweighted sensitivities show that some of the increase in equity market integration observed in the previously cited literature may stem from a few large sectors and countries. While briefly having exceeded country sensitivities in importance on a weighted basis by the end of 2000, on an unweighted basis sector sensitivities never exceeded country sensitivities. However, the broad trend observed in the increase in the importance of sector sensitivities holds regardless of whether weighted or unweighted sensitivities are used.

What is striking is that the importance of sector sensitivities stopped rising at the peak of Euroland stock markets (March 2000) and has been fairly stable since then despite the subsequent bear market. The continued moderate decline in country sensitivities throughout 2000 seems to indicate that a possible third factor, not part of the two factor model, was at work pressing for tighter Euroland integration in conjunction with the sharp world-wide equity market decline. The path of country sensitivities since 2000 gives support for the view that some of the increase in equity market integration observed in Euroland during the 1999 was the product of the global bull market. Figure 5, zooms in on the time period in question and presents the ratio of the country sensitivity divided by the sector sensitivity. A ratio of one implies that they are of equal importance. This ratio declined rapidly as the stock market boom continued throughout the first two months of 2000, but abated and later reversed as Euroland equity markets entered a period of sustained decline. Compared to the results presented by Brooks and Del Negro (2002), following the sell-off, sector sensitivities remained stable while the importance of country sensitivities increased significantly. This seems to indicate that following the bursting of the TMT bubble, individual country factors regained some of their importance in the decision process of portfolio managers.

Figure 5. Ratio of Country to Sector Sensitivities and the Euroland Index



Figures A.3 and A.4 in the appendix show individual sector performance. Most sectors show a similar pattern of sector versus country factors as the overall figures presented above. During 2000, the weighted sector sensitivities actually came to dominate country sensitivities in Basic Materials, Consumer Non-Cyclicals, Financials, and to a lesser degree Health sectors. These developments were mostly reversed once the bear market took hold. What is interesting with these observations is that the increase in importance of sector factors on an aggregate level was not only driven by the TMT sector, but also seemed to have been reflecting a more broad based development. Moreover, in some sectors country factors continue to be of less importance than the global sector factors. Hence, Energy and Telecom seem to have become truly global industries with country factors playing a reduced role, which strengthens the case for sector based investment strategies in these industries.[78] Somewhat surprisingly, the DJWI technology sector does not show any high level of integration throughout the sample. While sector sensitivities increased throughout the period studied, country sensitivities remained far more dominant. This may reflect the disadvantage of the capitalization weighting procedure. The market capitalization of Euroland technology stock was less than a tenth of the market capitalization of U.S. technology stocks. Hence, the dominance of country sector sensitivities may simply reflect that the global sector sensitivities were unduly influenced by the inclusion of U.S. technology firms. However, it remains to be seen whether the increased relative importance of sector factors can be shown to be statistically significant, whether the suggested increase in equity market integration reflects a Euro-area only phenomena, and whether the results derived from constructing global sector indices differ markedly from the results by using Euro-only sector indices. The next section deals with these issues in more detail.

[78] The energy sector findings may reflect that companies in this sector tend to be sensitive to a common underlying commodity price such as oil or gas. Hence, a close link within energy companies across borders is not altogether surprising.

VII. Robustness of Results and Impact of the Euro?

To determine whether the results shown in figure 5, i.e. the increased relative importance of sector factors, are statistical significant the model expressed in equation 1 is expanded to include two dummy variables. The first dummy tests whether there has been a significant change in either the sector or the country sensitivities following the introduction of the euro. The second dummy allows a similar test, following the peak of the global equity market bubble in 2000. While the choice of starting point for the first dummy is rather straightforward, the timing of the second dummy is more open to question. We will turn to this issue a little bit later in this section. Including the dummy variables, the regression equation for each individual countries' sector index becomes:

$$\begin{aligned} R_{k,t}^{C} &= \alpha_i + \gamma_{k,t}^{S} f_{k,t}^{S} + \gamma_{k,t}^{C} f_{k,t}^{C} + \gamma_{k,t}^{Euro,S} f_{k,t}^{S} D_{Euro} + \gamma_{k,t}^{Euro,C} f_{k,t}^{C} D_{Euro} + \\ &+ \gamma_{k,t}^{Bear,S} f_{k,t}^{S} D_{Bear} + \gamma_{k,t}^{Bear,C} f_{k,t}^{C} D_{Bear} + \varepsilon_{i,t} \end{aligned} \tag{2}$$

Hence, for each sector the significance of the introduction and the subsequent bear market can be tested for by checking whether the γ^{Euro} s and γ^{Bear} s are statistically significant from zero. *A priori*, it would be expected that the sector sensitivities show an increase, while the country sensitivities show a decrease. For the bear market dummy we would expect to either find no change or a reversal of the results observed with the introduction of the euro. Given that we are analyzing broadly 10 sectors in 6 countries, a summary statistic is hard to construct. Hence, the table below shows the equally and market weighted share of the sectors that showed a significant change.

Table 4. Significance of Dummy Periods

	Introduction of the Euro 1/	Start of the Bear Market 2/
Equally weighted		
Sector Betas		
Increase	32%	19%
Decrease	1%	5%
Country Betas		
Increase	5%	12%
Decrease	68%	15%
Value weighted		
Sector Betas		
Increase	34%	15%
Decrease	3%	3%
Country Betas		
Increase	3%	8%
Decrease	82%	13%

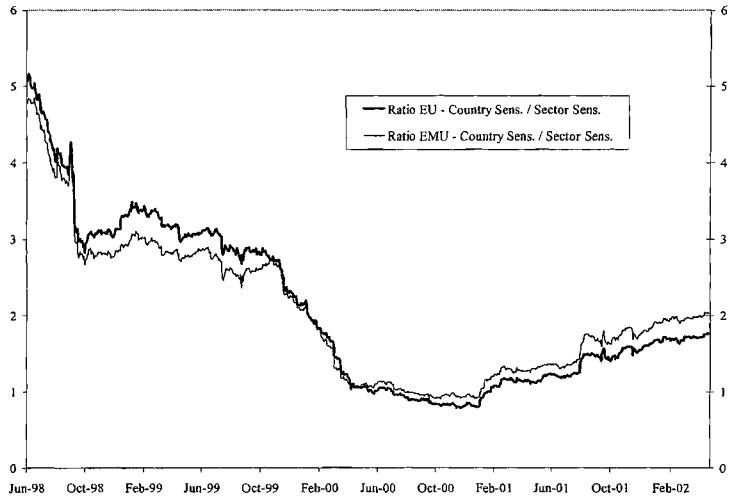
1/ January 1, 1999.
2/ March 7, 2000.

In table 4 the broad tendencies shown in figure 4 are statistically confirmed. Following the introduction of the euro (without saying that this was the ultimate cause – it could also have been the bull market), 34 percent of sector sensitivities shows a statistically significant increase (on a value weighted basis), while only 3 percent showed a decrease. The country sensitivities changed even more radically, and if weighted, 82 percent of country sensitivities declined over the post-euro introduction period. Regarding the bear

market the net effect is less convincing than what could be deduced from figure 4. A smaller share of sector sensitivities continued to post significant declines, while for country sensitivities the picture was more mixed. This is partly a result of the time period chosen for the dummy (post March 7, 2000). As can be seen in figures 4 and 5 the country sector sensitivity continued to decline until the end of 2000 before being reversed as a strong renewed sell-off in January 2001 affected the country versus sector sensitivity ratio positively indicating a decline in equity market integration.

In the previous section, the increased relative importance of sector factors were shown to be to a large extent statistically significant after the introduction of the euro. However, by extending the set of countries in the analysis to include the non-Euro European Union countries (Denmark, Sweden, and United Kingdom) while retaining the same global sector definition a new broader equity market integration ratio can be computed for the European Union.

Figure 6. Equity Market Integration Ratio – EU versus EMU



Comparing the ratio for the whole of the European Union with that of the EMU countries a very similar picture emerges. This is further indication that the underlying reasons driving the increase in sector sensitivities relative to country sensitivities was more global in nature, i.e. the TMT boom. Taking into account that the standard error of each individual sensitivity estimate is around 0.05 on average, the two ratios would not be statistically different from each other. Hence, the level of equity market integration found in the EMU is hardly unique and even though a large decline of the ratio was observed following the introduction of the euro it is unlikely that structural factors such as the common currency dominated as a reason.

Part of the reason for why there is no large difference between the two ratios charted in figure 6 is that they were calculated relative to a global sector index, which already included the other major non-euro EU equity markets as well as the United States. If the euro had a significant impact on the degree of equity market integration within the euro members, it is possible that this would be more clearly shown by using euro sector indices

rather than global sector indices. Hence, by excluding the non-euro countries from the sector indices the country and sector sensitivities are re-estimated to show to what an extent the conclusion regarding higher equity market integration changes.

Figure 7. Global Sector Versus EMU Sector Sensitivities

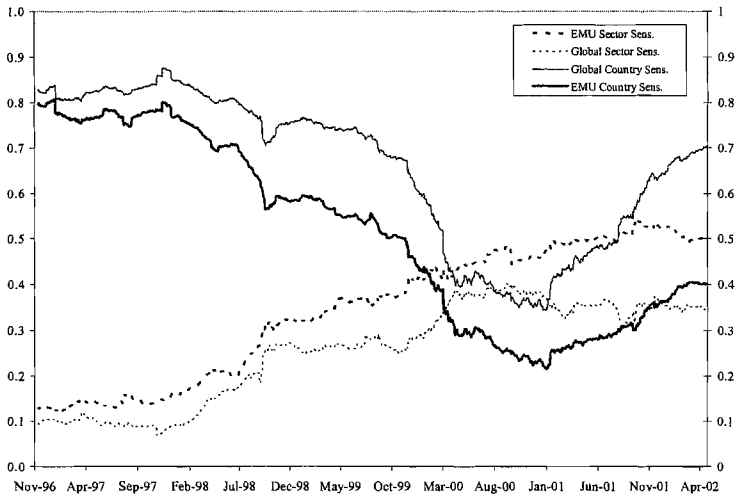


Figure 7 (or figure A.1 for an alternative presentation) confirms that sector sensitivities are generally larger and country sensitivities are generally smaller when a EMU-only sector index is used. The difference between the two methodologies in measuring equity market integration is relatively large (compare for example with the non-significant difference in figure 6). Moreover, while the ratio, if the global sector indices are used, clearly increases following the end of the equity market bubble, within the euro-area, using the EMU sector indices, the ratio stays relatively flat. Hence, it may be concluded that global factors, such as the TMT bubble, drove the increased importance in sector factors across the European Union. This largely cyclical factor was reversed after the global equity market started its downturn. However, within the euro-area the sector factors as measured by the EMU-only sector index retained their importance arguing that some structural factors have driven these equity market together. Unfortunately, the actual statistical significance of the two different index methodologies is difficult to measure, but the conclusion is one that argues that the increased equity market integration frequently observed by other authors may simply reflect the TMT bubble, and other factors such as the role played by institutional investors in the euro-area, while present, have yet to fully play themselves out.

VIII. Summary and Conclusions

Reviewing the empirical evidence of equity market integration in the European Union the chapter finds a significant increase in the importance of global sector factors for a number of industries. Unlike most past studies, which only covered developments during the bull market of the late nineties, the results presented in this chapter suggest that the degree of Euroland equity market integration has declined gradually following the bursting of the TMT bubble. This seems to suggest that the findings of previous studies that Euroland

equity markets were nearly fully financially integrated is worth revisiting. While there is a clear tendency through most of the sample period of an increase in the importance of global sectors in explaining the performance of individual country sector indices, some of this tendecy seems to be explained by the world wide bull market at the time.

There are, however, several good reasons to believe that the structural factors driving European equity market integration have yet to play themselves out fully. Institutional investors both outside the Euroland area and within have substantial untapped capacity to take on Euroland exposures and invest in equities. Moreover, necessary Euroland pension reforms are likely to increase the importance of EU-based instiutional investors, which can only benefit further equity market integration in the years ahead. Moreover, the streamlining of EU-wide regulation and the use of common "passports" for institutional investors will most likely benefit markets throughout the EU and lead to more effective asset management competition and a growth in market capitalizations as more risk capital becomes available for tapping.

The implications for portfolio managers of this study is more ambigous. Clearly, sector based investment strategies should form a natural part of any portfolio managers bottom-up and top-down stock selection. This is especially important when considering investments in the Telecom and Energy sectors, which both seem to have already become truly global industries. The behavior of other industries during the bull market and the dominance of global sectors during certain periods seem to suggest that the level of Euroland equity market integration has both a cyclical and structural component that has to be kept in mind by the portfolio manager and fitted with his investment horizon. As shown by the correlation studies, the degree of diversification provided by one particular investment strategy shifts over time, for example, during global sell-offs diversifying across sectors may provide some additional benefits. Future research could further explore the link between regulatory initiatives, the gradual reduction in home bias among instiutional investors, and European equity market integration, to determine what initiatives are more worthwhile from a regulatory perspective. Moreover, to shed further light on the importance of structural versus cyclical factors, it could be interesting to explore whether the current batch of EU candidate countries share a similar experience in increased equity market integration with the EU as Euroland markets experienced in the late 1990s.

APPENDIX 1. KEY TABLES AND FIGURES

Table A.1. Financial Assets of Institutional Investors (USD billions)

	1995		1999			2000	
	Assets	in % of GDP	Assets	in % of GDP	Avg. Annual Growth Rate	Assets	in % of GDP
European Union	6,118	71%	9,833	115%	12%	...	...
EMU	3,920	56%	6,083	91%	11%	5,827	96%
Austria	82	35%	135	64%	12%	93	49%
Belgium	161	58%	239	95%	10%	133	58%
Finland	64	49%	112	88%	14%	94	78%
France	1,230	79%	1,696	117%	8%	1,732	133%
Germany	1,113	45%	1,529	73%	8%	1,507	81%
Greece	15	13%	47	37%	29%	32	28%
Ireland	...	...	...	...	...	...	...
Italy	361	33%	1,078	91%	27%	1,055	98%
Luxembourg	11	60%	23	114%	18%	...	...
Netherlands	641	155%	799	201%	6%	781	211%
Portugal	42	39%	54	47%	7%	51	48%
Spain	201	34%	370	61%	15%	350	62%
Other	2,198	141%	3,750	199%	13%	...	...
Denmark	119	66%	163	94%	8%	...	...
Sweden	265	107%	322	128%	5%	387	161%
United Kingdom	1,815	160%	3,265	224%	15%	...	...
Japan	4,323	82%	5,040	112%	4%	...	...
United States	11,240	153%	19,279	209%	13%	19,451	199%
Total OECD	23,083	97%	36,147	144%	11%	27,342	107%

Source: OECD (2001)

Table A.2. Market Capitalization of Key OECD Equity Markets (in US$ billion)

	1995		1999		2000	
	Capitalization	in % of GDP	Capitalization	in % of GDP	Capitalization	in % of GDP
European Union	3,571	41%	9,054	106%	8,472	107%
EMU	1,994	28%	5,720	86%	5,420	90%
Austria	33	14%	33	16%	30	16%
Belgium	102	37%	184	73%	182	80%
Finland	44	34%	349	273%	294	245%
France	500	32%	1,497	104%	1,447	111%
Germany	577	23%	1,432	68%	1,270	68%
Greece	17	14%	197	156%	107	95%
Ireland	26	39%	69	72%	82	86%
Italy	210	19%	728	62%	768	72%
Luxembourg	30	168%	36	182%	34	177%
Netherlands	287	69%	695	174%	640	173%
Portugal	18	17%	68	59%	61	57%
Spain	151	26%	432	72%	504	90%
Other	1,577	101%	3,334	177%	3,052	166%
Denmark	58	32%	105	61%	112	71%
Sweden	173	69%	373	148%	328	137%
United Kingdom	1,347	119%	2,855	196%	2,612	182%
Japan	3,545	67%	4,463	99%	3,157	66%
United States	6,918	94%	16,733	182%	15,214	156%

Source: Federation of International Stock Exchanges (www.fibv.com) and OECD (2001)

Table A.3. Coverage and Time Period of Indices and Market Values

	Country	Basic Materials	Consumer Cyclicals	Consumer Non-Cyclicals	Energy	Financials	Health	Industry	Technology	Telecom	Utilities
EMU											
Finland	96-02	96-02	96-02	96-02	Jan 96-Aug 98	96-02	96-02	96-02	Jan 96-Sep 02	Jun 99-April 02	Jan 99-April 02
France	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	Dec 97-April 02	96-02
Germany	96-02	96-02	96-02	96-02	Jan 96-Sep 00	96-02	96-02	96-02	96-02	Jan 97-April 02	96-02
Italy	96-02	Jan 96-Sep 00	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02
Netherlands	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	...
Spain	96-02	96-02	96-02	96-02	96-02	96-02	April 00-April 02	96-02	Jan 02-April 02	96-02	96-02
Non-EMU EU											
Denmark	96-02	...	96-02	96-02	...	96-02	96-02	96-02	96-02	96-02	...
Sweden	96-02	96-02	96-02	Jul 96-April 02	...	96-02	96-02	96-02	96-02	Jul 96-April 02	Jan 96-Sep 00
U.K.	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02
U.S.	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02	96-02

Table A.4. Market Values at End-Period (in US$ billions)

	Country	Basic Materials	Consumer Cyclicals	Consumer Non-Cyclicals	Energy	Financials	Health	Industry	Technology	Telecom	Utilities
EMU	2,314.3	116.8	350.5	161.3	280.6	634.1	103.5	204.7	157.2	174.0	131.6
Finland	118.6	19.1	1.3	1.5	4.4	2.9	2.8	85.7	5.0	3.9	1.4
France	721.6	25.0	153.7	53.7	110.7	137.4	74.4	65.5	51.3	18.6	31.3
Germany	515.5	57.0	90.8	17.3	16.6	139.1	22.8	19.1	85.6	35.8	48.0
Italy	286.9	0.4	25.7	1.8	40.9	128.5	0.7	15.7	1.8	54.9	16.9
Netherlands	441.3	13.9	69.0	80.6	116.4	129.9	1.6	6.9	14.5	8.5	0.0
Spain	230.4	1.8	10.0	6.4	12.6	96.3	1.2	11.8	4.0	52.3	34.0
Non-EMU EU	2,165.5	84.8	247.2	212.5	298.9	579.7	265.4	192.4	43.4	165.7	78.4
Denmark	43.8	0.0	0.2	2.4	0.0	11.6	10.2	14.1	1.4	3.9	0.0
Sweden	146.1	3.2	23.0	8.1	0.0	41.2	3.9	38.9	22.5	5.3	2.9
U.K.	1,975.6	81.6	224.0	202.0	298.9	526.9	251.3	139.4	19.5	156.5	75.5
U.S.	11,142.9	280.4	1,603.8	968.2	709.1	2,251.6	1,564.1	1,279.4	1,704.3	420.2	361.8
Total	15,622.7	482.0	2,201.5	1,342.0	1,288.6	3,465.4	1,933.0	1,676.5	1,904.9	759.9	210.0

Table A.5. Example Regression Output

Dependent Variable	Log German Financials Index		
Regression	(1)	(2)	(3)
Start:	1/1/1996	1/1/1996	1/1/1999
End	4/22/2002	12/31/1998	4/22/1999
Number of Obs.	1645	785	861
Constant	0.00	0.00	0.00
Standard Error	0.00	0.00	0.00
T-Statistic 1/	(-0.22)	(-0.07)	(-0.50)
Sector Sens.	0.33	0.20	0.36
Standard Error	0.03	0.04	0.05
T-Statistic 1/	(9.62)	(4.85)	(7.90)
Country Sens.	0.52	0.84	0.41
Standard Error	0.03	0.03	0.03
T-Statistic 1/	(17.26)	24.55	(12.80)
R-squared	0.48	0.66	0.41
Adjusted R-squared	0.48	0.66	0.41
S.E. of regression	0.01	0.01	0.01
Sum squared resid	0.22	0.06	0.15
Log likelihood	5009.65	2624.17	2510.94
Durbin-Watson stat	1.87	1.66	1.90
Mean dependent var	0.00	0.00	0.00
S.D. dependent var	0.02	0.01	0.02
Akaike info criterion	-6.09	-6.69	-5.83
Schwarz criterion	-6.08	-6.67	-5.81
F-statistic	758.14	757.79	302.21
Prob(F-statistic)	0.00	0.00	0.00

1/ White Heteroskedasticity-Consistent Standard Errors & Covariance

Figure A.1. Global Sector Versus EMU Sector Sensitivities

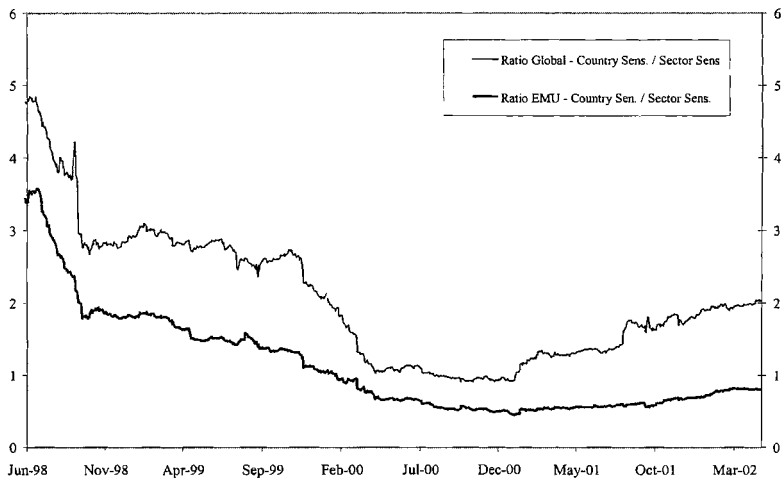


Figure A.2.

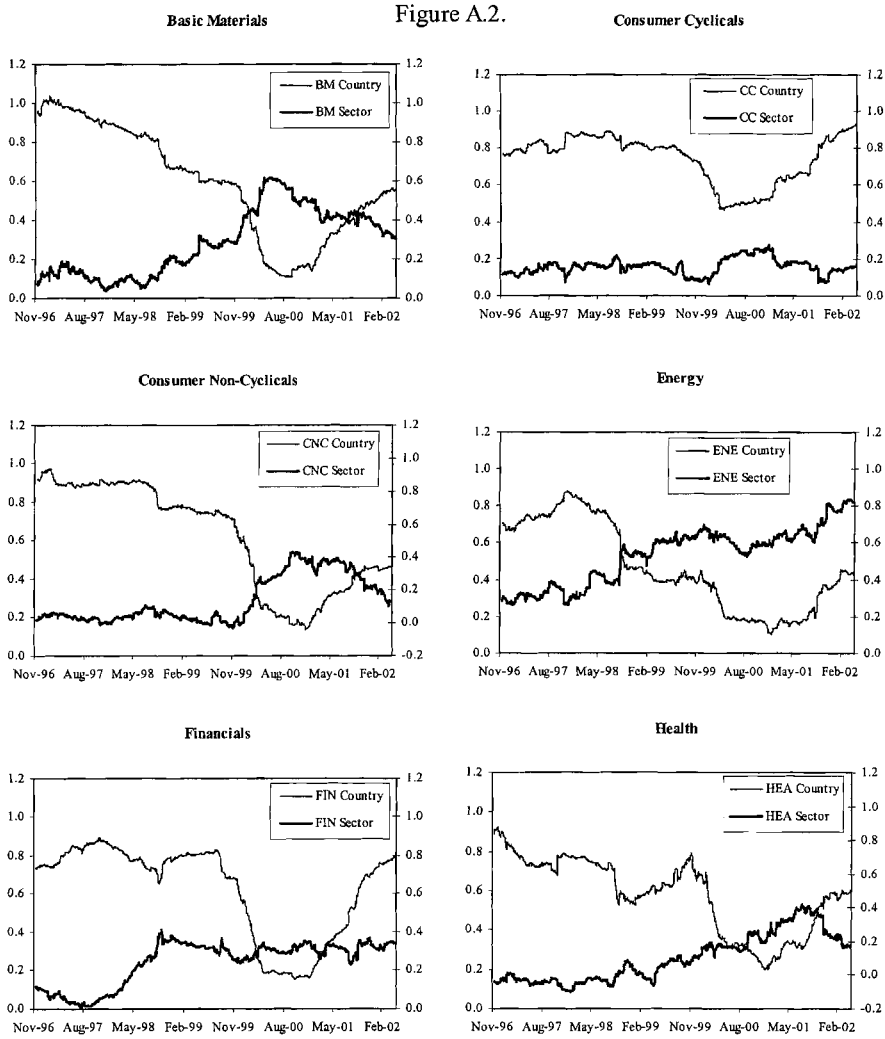
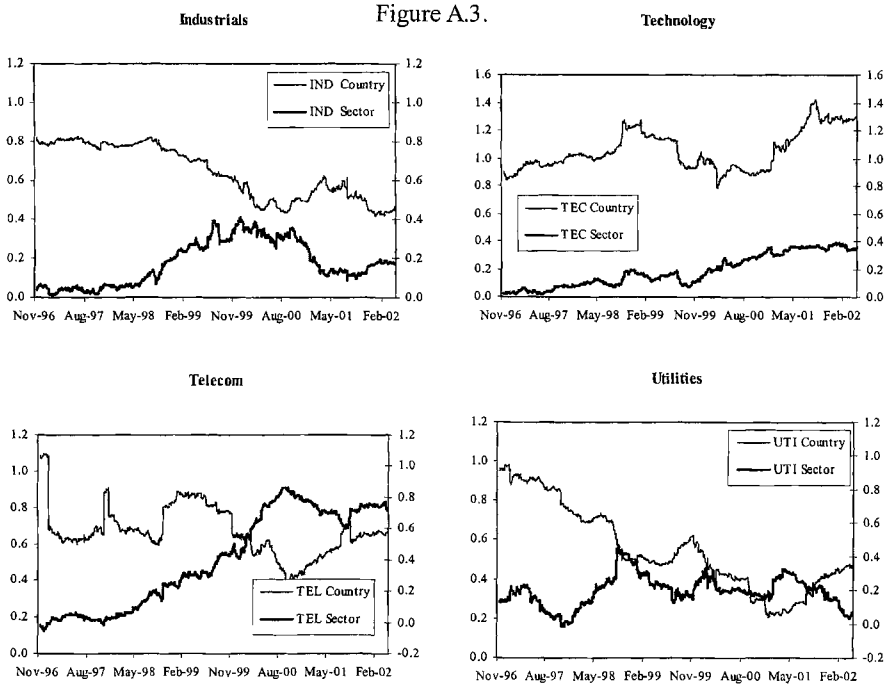

Basic Materials
BM Country
BM Sector
Consumer Cyclicals
CC Country
CC Sector
Consumer Non-Cyclicals
CNC Country
CNC Sector
Energy
ENE Country
ENE Sector
Financials
FIN Country
FIN Sector
Health
HEA Country
HEA Sector
Nov-96 Aug-97 May-98 Feb-99 Nov-99 Aug-00 May-01 Feb-02

Figure A.3.


Industrials
IND Country
IND Sector
Technology
TEC Country
TEC Sector
Telecom
TEL Country
TEL Sector
Utilities
UTI Country
UTI Sector
Nov-96 Aug-97 May-98 Feb-99 Nov-99 Aug-00 May-01 Feb-02

APPENDIX 2. BIASES OF ALTERNATIVE APPROACHES

Assume the same set up as in equation 1, but instead of sectors consider individual firms. The continuously compounded return on, in this case, firm k in country C at time t is denoted $R^C_{k,t}$ and is explained by two sources of risk, the sector risk sensitivity, $\beta^S_{k,t}$, and the country risk sensitivity $\beta^C_{k,t}$

$$R^C_{k,t} = \alpha_i + \gamma^S_{k,t} f^{S,*}_{k,t} + \gamma^C_{k,t} f^{C,*}_{k,t} + \varepsilon_{i,t} \qquad \text{(B.1.)}$$

However, the returns on the sector index and the country index include the dependent variable (weighted by w^S in the case of the sector index and w^C in the case of the country index). Therefore, $f^{S,*}_{k,t}$ and $f^{C,*}_{k,t}$ can be rewritten as,

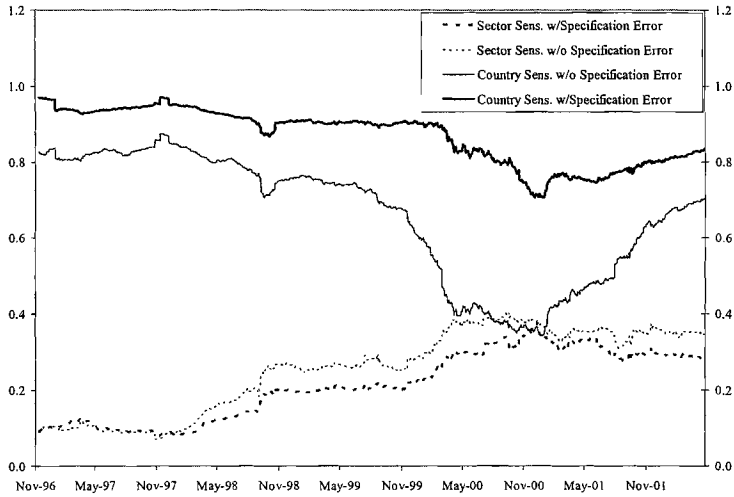
$$f^{S,*}_{k,t} = w^S R^C_{k,t} + (1 - w^S) f^S_{k,t}$$
$$f^{C,*}_{k,t} = w^C R^C_{k,t} + (1 - w^C) f^C_{k,t}$$

Plugging these expressions into B.1. and reordering such that the dependent variable is moved to the left hand side and the independent variables on the right hand results in the following expression, which reflects the actual model estimated:

$$R^C_{k,t} = \frac{\alpha_i}{(1 - w^S \gamma^S_{k,t} - w^C \gamma^C_{k,t})} + \frac{\gamma^S_{k,t}}{(1 - w^S \gamma^S_{k,t} - w^C \gamma^C_{k,t})} f^S_{k,t} + \\ + \frac{\gamma^C_{k,t}}{(1 - w^S \gamma^S_{k,t} - w^C \gamma^C_{k,t})} f^C_{k,t} + \frac{\varepsilon_{i,t}}{(1 - w^S \gamma^S_{k,t} - w^C \gamma^C_{k,t})} \qquad \text{(B.2)}$$

It is therefore clear that the sector and country sensitivities are measured with a positive bias relative to the "true" coefficient estimates if the specification errors are not adjusted for, i.e. sensitivities would be higher than actually suggested by the data. In addition, the error term and the sensitivities estimated would be correlated and hence the coefficient estimates would be inconsistent. The size of the bias and the inconsistency hinges on the weight of the individual firm in the sector and country indices. It can be argued that the problem is not that large in the case of Urias *et al* (1998) and Ametisova *et al* (2002), since they use individual firm data. Using individual country's sector indices as the dependent variables, the weights are generally at least an order of magnitude larger and hence the upward bias it significant (see figure B.1 for an example). Even in the case of the previously mentioned studies, there are cases, such as Nokia in Finland, where its share of the country index is very large (over 50 percent sometimes) and its share in the European telecom index is also non-trivial. This chapter corrects for the specification problem by using customized indices (discussed in the main body of the chapter). This is another advantage of avoiding individual firm level data, since generating customized indices for every firm is clearly extremely time consuming and computationally potentially very difficult.

Figure B.1. Before and After Error Correction



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