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Transitory or permanent exchange
rate changes - an important
distinction in risk management

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Förord

I Bohlins Revisionsbyrås uppläggning av revision tas utgångspunkten för revisionen i en utvärdering av väsentliga riskområden för företaget. Det gäller för revisorn att skaffa sig en helhetsbild av koncernen och/eller företagets risksituation. Granskningen inriktas sedan på de områden som bedöms som väsentliga och/eller särskilt riskfyllda.

Riskanalys är således inte ett nytt instrument, vare sig för revisorer eller företagsledningar. En av de risker som tidigt blev föremål för en allmän uppmärksamhet var valutarisken. I samband med devalveringen av den svenska kronan i mitten av 70-talet drabbades många företag av förluster. Detta ledde fram till en rad åtgärder för att minimera förluster p g a ogynnsamma valutakursförändringar. Problemet är emellertid att en ensidig fokusering på valutarisker kan vara oekonomisk. Ett företag påverkas på flera olika sätt av ändrade valutakurser. Det är därför viktigt att vara medvetan om nödvändigheten av att se på ett företags riskexponering på ett mer övergripande sätt.

Två forskare som rönt internationell uppmärksamhet för sina arbeten om hur sådana övergripande analyser kan göras är professorerna Lars Oxelheim och Clas Wihlborg, numera vid Göteborgs Universitet. På uppdrag av Bohlins Revisionsbyrå har de skrivit denna forskningsrapport.

Rapporten kan framstå som något teknisk, även om den främst riktar sig emot praktikerna. För att underlätta förståelsen har därför författarna skrivit en längre sammanfattning på svenska, där problemen skissas. Bohlins anser det angeläget att rapporten får en så stor spridning som möjligt och har därför låtit publicera den. De som är intresserade av ytterligare information om hur vi på Bohlins ser på riskbedömning i allmänhet och valutarisker i synnerhet kan kontakta Sven Andrén på Bohlins Finansgrupp eller Rolf Rundfelt på Bohlins Affärsanalytiker.

Stockholm i mars 1989

**TRANSITORY OR PERMANENT EXCHANGE RATE CHANGES -
AN IMPORTANT DISTINCTION IN RISK MANAGEMENT**

by

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EXECUTIVE'S SUMMARY

Ökad integration - finansiell såväl som handelsmässig - har medfört att reala och monetära störningar och chocker snabbt fortplantar sig från land till land. För en liten och öppen ekonomi som den svenska innebär integrationen små möjligheter att utestänga effekterna av exempelvis ändrad penningpolitik i USA, kartellbildning mellan oljeproducerande länder med åtföljande oljeprishöjningar m fl policy- eller icke policyåtgärder på internationella marknader. På företagsnivå kan denna utveckling te sig bekymmersam med tanke på att fluktuationer i marknadspriserna - räntor och valutakurser - i ett historiskt perspektiv varit mycket stora under 1980-talet, men utvecklingen innebär också nya vinstmöjligheter.

Trots den ökade risken har inte praktiker och akademiker nått fram till någon samstämmighet i hur företaget bör hantera sina valutarisker. En förklaring till att konsensus inte nåtts ligger i förhållandet att forskningen kring växelkursens bestämningsfaktorer och förloppet kring deras inverkan inte lett till entydiga resultat. Oenighet råder sålunda bland forskare om relevansen av exempelvis den internationella köpkraftspariteten som jämviktsrelation för växelkursen. Denna relation, som säger att den långsiktiga jämviktskursen bestäms av utvecklingen av den relativa inflationen mellan de nationer vars valutor relateras i en växelkurs har sedan den första gången utformades på 1500-talet haft rollen som den mest betydelsefulla enskilda förklaringsfaktorn. Enligt denna relation ses avvikelser, dvs reala växelkursändringar, som temporära. Från slutet av 1970-talet och framåt har det publicerats ett antal forskningsrapporter som ifrågasätter det

korrekta i resonemanget genom att hävda att varje avvikelse måste ses som permanent. Mellan dessa skolor finns de som hävdar att återgång till jämvikt förr eller senare kommer att ske men att tidsmönstret skiljer sig åt beroende på vilken typ av chock eller störning det handlar om samt beroende på det specifika landets öppenhet för internationell handel med beaktan av elasticiteten i denna handel.

Utvecklingen för det engelska pundet, schweizerfrancen och dollarn efter 1973 och sammanbrottet för Bretton Woods-överenskommelsen kan användas för att illustrera resonemanget kring temporär respektive permanent avvikelse. Enligt Oxelheim (1985) var US-dollar - utifrån en analys av köpkraftsparitet - undervärderad under andra halvan av 1970-talet. I samband med att den ekonomiska politiken i USA gavs en ny inriktning i oktober 1979 steg den reala växelkursen snabbt och från att ha varit undervärderad med 10-20 procent under 1970-talets andra hälft var dollarn i början av 1985 övervärderad med ca 30 procent. Olika former av multinationella överenskommelser bidrog sedan till att dollarn i slutet av 1986 åter befann sig på sin långsiktiga jämviktsnivå, dvs den nivå som står i överensstämmelse med att avvikelser från internationell köpkraftsparitet är att betrakta som temporära.

Utvecklingen för schweizerfrancen kan användas för att illustrera att varaktigheten i de temporära avvikelserna kan skilja sig kraftigt åt mellan valutor. För schweizerfrancen inträffade ett kraftigt omslag i den reala växelkursen 1977/78 då den steg med 30 procent och blev övervärderad med ca 20 procent jämfört med en korg av valutorna i de för landets handel viktigaste länderna. I en liten, öppen och valutakänslig ekonomi som den

schweiziska kunde denna övervärdering inte bestå särskilt länge utan i början av 1980 var schweizerfrancen åter på sin långsiktiga jämviktsnivå enligt köpkraftsparitet. Övervärderingen hävdades i detta fall genom att den schweiziska centralbanken införde negativ förräntning på de placeringar i landets banker som gjordes av valutautlåningar. Denna åtgärd minskade snabbt efterfrågan på schweizerfranc för finansiella placeringar och bidrog till att "priset" på valutan sjönk och att den temporära avvikelserna från köpkraftsparitet eliminerades.

För US-dollarn och schweizerfrancen kan sålunda avvikelserna karakteriseras som temporära, om än med olika varaktighet. De som hävdar att avvikelserna i vissa fall skall betraktas som permanenta använder ofta det engelska pundet som exempel. Denna valuta blev i samband med upptäckten av Nordsjöoljan - och i viss mån omläggning av den ekonomiska politiken - kraftigt övervärderad jämfört med den kurs som motiverades av den långsiktiga köpkraftsparitetsutvecklingen. Många hävdar att just reala inkomstförändringar av det slag som upptäckten och exploateringen av oljan utgjorde för England medför att den reala växelkursen inte återvänder till sin gamla jämviktsnivå utan antar en ny långsiktig nivå. Den uppkomna avvikelserna - från den gamla till den nya nivån - skall sålunda ses som permanent.

Ovanstående exempel och den empiriska analysen i stort tyder på att avvikelserna från köpkraftsparitet i allmänhet kan ses som temporära. Detta synsätt överensstämmer med vårt. Begreppet permanent är dock inte oväsentligt, eftersom en ändring bör ses som "permanent" ur företagets synvinkel om den antas bestå under hela den period för vilken företaget planerar och kalkylerar. Temporära är

sådana förändringar som kan väntas jämna ut sig under företagets planeringshorisont. Med denna distinktion blir det sålunda av stor vikt att i riskhanteringen på företagsnivå ta ställning till om en real valutakursändring är att betrakta som "permanent" eller temporär. Valet av "bästa" exponeringsmått med åtföljande ändamålsenlig hantering är avhängigt detta ställningstagande. Föreliggande rapport utvärderar olika exponeringsmått under antagande om att en real valutakursändring är permanent resp temporär. Utvärderingen innehåller också en bedömning av exponeringsmåttens användbarhet för framgångsrik riskhantering, vilken kan uttryckas i reducerad variabilitet i företagets kassaflöde eller värde till följd av oväntade valutakursändringar.

En nyckelkomponent i hanteringen av företagets exponering blir att bedöma sannolikheten för att en avvikelse från internationell köpkraftsparitet skall bestå efter en viss tid. Härvid får man beakta att reallt betingade avvikelser synes ha längre varaktighet än avvikelser som härrör från en monetär chock eller störning. I utvärderingen måste också beaktas att en chock på världsmarknaden kan ta sig många uttryck på prisvariablerna i det enskilda landet beroende på den policymix som valts för att dämpa effekterna från chocken. I ett övergripande synsätt bör sålunda växelkursen kopplas samman med andra makroekonomiska variabler med inflytande på företagets resultat och ställning såsom räntor, inflationstakter och politiska risker.

Det stora flertalet företag, internationellt sett, tillämnar (1987) ett partiellt synsätt jämfört med ovan nämnda övergripande sätt att skatta företagets exponering för växelkursändringar. Det stora flertalet har valt traditionella angreppssätt som

är baserade på den information som kan erhållas förhållandevis lätt i företagets redovisning. Till de traditionella exponeringsmått räknas transaktionsexponering, balansräkningsexponering (translation exposure) samt enkla approximationer av ekonomisk exponering utifrån dessa båda exponeringsbegrepp. Det är helt klart att i allmänhet ger dessa begrepp en mycket ofullständig bild av företagets verkliga exponering. Det är emellertid viktigt att företaget har en uppfattning om dessa exponeringsmått förhållande till ekonomisk exponering.

Transaktionsexponeringen avser nettoflödet vid given framtida tidpunkt under det att balansräkningsexponeringen avser nettovärden som ofta refererar till en konsoliderad balansräkning för en multinationell koncern. Under vissa antaganden kan dessa mått approximera företagets ekonomiska värde. Från en ekonomisk synvinkel blir valet av omräkningsmetod för bestämning av ekonomiskt värde en funktion av valet av växelkurs för värdering av utländska tillgångar och skulder på ett ekonomiskt korrekt sätt samt en funktion av hur vinster och förluster bör fördelas över tiden i företagets balansräkning. När det handlar om en bedömning av det ekonomiska värdet av tillgångar och skulder i utländsk valuta samt förändringar i värdet till följd av en oförutsedd valutakursändring, så gäller det allmänt att ta ställning till : (1) kassaflödets karaktär i varje period, (2) karaktären på växelkursändringen, (3) tidsmönstret för hemtagning av kassa samt (4) den förväntade graden av varaktighet i en växelkursändring.

Alla de traditionella omräkningsmetoderna kan ses som approximationer av den ekonomiska exponeringen. Förhållandet att approximationerna inte fångar förväntningarna hos marknadsaktörerna är en allmän

invändning för alla mått baserade på företagets redovisningshandlingar. De kan dock ofta utgöra underlag till marknadsdeltagarna och därvid utgöra utgångspunkten för deras förväntningar om växelkursändringens påverkan på företagets ekonomiska värde.

Vi har tidigare nämnt relationen mellan flödesexponering och värdeexponering. I en jämförelse uppkommer ofta frågan hur man skall se på kopplingen mellan transaktionsexponering och balansräkningsexponering. Är de substitut eller komplement? Om balansräkningsexponeringen kan ses som nuvärdet av framtida kassaflöden och den reala växelkursändringen är permanent, så är de substitut. I detta fall kan den ekonomiska exponeringen reduceras till noll antingen genom att säkra värdet av alla framtida transaktioner i hemlandets valuta eller genom att successivt eliminera balansräkningsexponeringen en period i taget. Om däremot den reala växelkursändringen är temporär kommer elimineringen av balansräkningsexponeringen att skapa ekonomisk exponering. En partiell reduktion av balansräkningsexponeringen skall här till för att eliminera den ekonomiska exponeringen.

Oxelheim och Wihlborg (1987) visar med hjälp av en regressionsmodell hur man på ett övergripande sätt kan beräkna företagets känslighet för förändringar i för företaget relevanta makroekonomiska variabler. Med en sådan modell kan inflytandet från en växelkursändring på exempelvis företagets ekonomiska värde på ett korrekt sätt isoleras från inflytandet av ändringar i övriga makroekonomiska variabler. I själva verket är det företagets känslighet för inhemska och utländska policyförändringar som bör beräknas. Dessa har olika effekter på företaget beroende på vilken policystörning som

inträffar. Ändringar i penningpolitiken tenderar att ge reala växelkursavvikelser och ränteförändringar med ett annat mönster än de som genererats av ändringar i finanspolitiken. Ändringar i teknologi och produktivitet tenderar att ge ett tredje mönster. Det är därför möjligt, som ett alternativ till att mäta företagets känslighet för förändringar i marknadsvariabler, att mäta känsligheten för policyförändringar och andra makroekonomiska störningar såsom oljeprisförändringar.

Regressionsanalysen lämpar sig väl om man bedömer mönstret för chockernas inverkan i uppkomna avvikelser som stabilt. Man kan då använda de skattade koefficienterna som underlag för beslut om säkring med syfte att reducera variansen i exempelvis företagets ekonomiska värde eller kassaflöde.

Om reala växelkursändringar eller andra störningar är temporära, som så ofta är fallet, så kan säkring av det ekonomiska värdet verkställas genom säkring av serier av relativt oberoende kassaflöden för olika tidsperioder. Däremot kan bokföringsvärden av tillgångar och skulder inte användas som mått på exponeringen.

Antager vi å andra sidan att reala växelkursändringar är permanenta så är den bästa gissningen på en framtida kurs den gällande reala växelkursen. Om en icke förväntad ändring inträffar, så kan sålunda kursen förväntas ligga kvar på den nya nivån. I detta fall kan hela det ekonomiska värdet av tillgångar och skulder säkras gentemot t ex växelkurs - och ränteosäkerhet.

Svårigheten att erhålla ett operationellt mått på exponeringen ökar när förändringen är att betrakta som varken temporär eller permanent. Här får man då

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arbeta med sannolikheter för att en viss förändring skall vara permanent. När denna sannolikhet varierar över tiden kommer företagets känslighet för olika störningar att variera över tiden, dvs känslighetsmåtteten blir instabila.

Tror man inte att mönstret för chockerna samt varaktigheten i de effekter de ger upphov till är stabila så kan regressionsmodellen för att skatta exponeringen kompletteras med scenarioanalys. Med detta hjälpmedel kan man identifiera vilken typ av chock eller störning som det enskilda företaget skall lägga störst tonvikt på. Export/importföretaget kan sålunda konstatera att känsligheten är störst för kortfristiga fluktuationer i penningpolitiken och lägga sina ansträngningar på att försöka skatta dessa ändringar som underlag för beslut om exploatering eller säkring. Tillverkaren av tung industriell utrustning kan å andra sidan finna denna typ av chock av mindre intresse och koncentrera sig på ändringar i finanspolitiken. Fördelen med scenarioanalysen är att den hjälper företagsledningen att förstå hur företagets kassaflöde i kommande perioder - och därigenom också företagets ekonomiska värde - är influerat av olika typer av chocker. Nackdelen jämfört med regressionsanalysen är att användaren behöver relativt detaljerad kunskap om relationer mellan olika makroekonomiska variabler efter att störningar eller chocker inträffat. Finns inte denna kunskap är det svårt för användaren att skilja mellan mer eller mindre trovärdiga scenarier. Ekonomisk teori indikerar att olika störningar ger olika anpassningsvägar för växelkursen och andra relevanta variabler - en insikt som är värdefull för den som baserar sin exponeringskalkyl på scenarioanalys.

Till skillnad från scenarioanalysen kräver en exponeringsanalys baserad på regressionsmodellen inte särskilt detaljerad kunskap om makroekonomiska relationer utan har sin svaghet i att vara baserad på analys av historiska data och där det sålunda kan inträffa att exponeringskoefficienterna visar sig vara föråldrade när de skall användas.

Bristerna hos olika exponeringsmått bör inte leda till pessimism hos den som önskar ett tillförlitligt underlag för sin riskhantering. Visserligen är alla mått är mer eller mindre känsliga för antagandet om graden av varaktighet i den reala valutakursändringen och andra störningar. Det faktum att måtten inte är perfekta får dock inte tolkas som om de saknar värde. En kombination av analys av företagets känslighet för störningar baserad på exponeringskoefficienter som skattats med en regressionsmodell och scenarioanalys baserad på viss insikt om makroekonomiska störningar ger företaget möjlighet att både minska sin exponering och öka sina vinstmöjligheter.

De traditionella exponeringsmåtten skall användas med stor försiktighet. De är ofta partiella i den bemärkelsen att de inte beaktar kopplingen mellan växelkursen och övriga makroekonomiska variabler. De är alla känsliga för antagandet om graden av varaktighet i en valutakursändring. Utan en jämförelse mellan dessa mått och önskade exponeringsmått kan säkring av exponering mätt på traditionellt sätt leda till slumpmässiga resultat för företaget.

I Introduction

After the breakdown of the fixed exchange rate system in the early 1970 the debate about the appropriate measurement and management of exchange rate risk has been nearly continuous. Increased turbulence in the world economy during the same period made the issue more urgent. It may seem surprising that a consensus about exchange risk management has not developed. However, disagreement about this issue can be explained by the absence of a consensus about exchange rate determination and the functioning of world financial markets.

In most of the traditional literature exchange risk was viewed in isolation and changes in nominal exchange rates were viewed as completely independent of other economic disturbances. Against this view stands one which presumes that goods, financial, and foreign exchange markets in the world are highly efficient. In this view exchange risk disappears when interest rate differentials always adjust to exchange rate expectations (International Fisher Parity), and goods prices are always equalized across countries (Purchasing Power Parity).¹ Furthermore, with perfectly efficient domestic financial markets, the existence of exchange risk need not worry firms since shareholders would be able to develop their own optimately diversified portfolios to offset risk.

A number of empirical studies early in the floating rate period did find results consistent with

¹Firms and individuals would face inflation risk in the currency of denomination of assets and liabilities with future payments contracted in nominal terms. This inflation risk is independent of whether the currency of denomination is domestic or foreign. See Wihlborg (1980) and Sharp (1985).

exchange market efficiency and the monetary models based on Purchasing Power Parity (PPP), which would imply that exchange risk does not matter.¹ However, these results did not hold up to further experience and testing.² In this paper we adopt the latter view, which implies that all the conditions necessary for exchange risk to be trivial are not met in the real world. Nevertheless, we also regard the view that exchange rate changes can be seen as independent events as invalid. Rational exchange risk management must take into consideration the interdependence of the exchange rate with other variables such as inflation rates, and interest rates.

Currently there are two competing views of exchange rate determination. In one view, PPP is still a reasonably accurate guide to long run exchange rate determination but that in the short run the exchange rate is determined primarily by financial market considerations leading to frequent short run deviations from PPP. In this view deviations from PPP, i.e., changes in real exchange rates, will tend to be self-reversing.

A different view has developed based on recent empirical studies which have failed to find any strong systematic tendency for deviations from PPP to reverse themselves at least in monthly and quarterly data.³ These studies suggest instead that

¹ Purchasing Power Parity holds (in relative terms) when exchange rate changes offset differences in national inflation rates. Thus, under PPP the change in the purchasing power of a dollar in the U.S. is equal to the change in the purchasing power of the same dollar in other countries.

² For recent evidence on these issues and references to other studies see Arndt, Sweeney and Willett (1985).

³ See, for example, Adler and Lehman (1983), Darby, et al. (1983), Frenkel (1983), Pigott and Sweeney (1985), and Roll (1979).

changes in real exchange rates (deviations from PPP) are typically permanent in the sense that further changes seem to be roughly equally likely to be upwards as downwards, i.e., the real exchange rate follows a random walk. These research results may not be conclusive, however, because of such factors as differences in view about the best measures for PPP calculations, the number and frequency of economic disturbances, the still relatively short time period of experience with floating rates, and difficulties of distinguishing between slow adjustment versus no tendency for reversal. If we accept the view that real exchange rate changes around PPP are self-reversing, the difficulties of showing this statistically highlight the problem of forecasting the time-horizon over which PPP can be expected to hold. We consider here the implications of this problem for accounting and economic measures of exposure to exchange rates and other macro economic variables and for strategies for managing these exposures.

An important aspect of recent exchange rate theory is that exchange rate changes are to a considerable extent induced by underlying economic and financial developments, and the relationship between central bank behavior and exchange rate changes is very complex. Exchange rate uncertainty may be caused by central banks but central banks may also contribute to a more stable exchange rate by appropriate intervention or by preannouncing and following specific targets for monetary variables.

II A Brief Preview of Alternative Exposure Measures

We begin by discussing traditional measures of exchange rate exposure emphasizing the importance of attempting to evaluate ex ante the likelihood that a disturbance is temporary as opposed to permanent. We argue, for example, that whether the recent change in U.S. accounting standards from FASB 8 to FASB 52 was an improvement or not from the standard point of capturing relevant economic developments depends critically on whether exchange rate changes and monetary policy changes tend to be temporary or permanent.

In discussing economic exposure we adopt the perspective suggested by Lessard (1979) that this concept should reflect the sensitivity of the firm's economic value to changes in exchange rates. A number of authors have argued in the last few years that we should thus think of exposure as a regression coefficient.¹ Oxelheim and Wihlborg (1987) extend the regression approach to take into account that the exchange rate is one of several variables which adjust simultaneously to macroeconomic disturbances. Therefore, exchange rate exposure and exposures to related macroeconomic variables such as inflation rates and interest rates must be measured simultaneously. Thereby, measures of different kinds of exposures can be isolated and instability in measures of exposure based on historical data can be reduced.

¹ See, for example, Adler and Dumas (1983), Hodder (1982), Garner and Shapiro (1985), and Oxelheim and Wihlborg (1987).

Oxelheim and Wihlborg argue further that sometimes stable exposure coefficients cannot be identified by means of regression analysis. For example, changes in the degree to which exchange rate movements can be expected to be temporary or permanent create uncertainty about the applicability of historically estimated exposure coefficients for future unanticipated disturbances. For example, modern exchange rate analysis suggests that whether interest rate and exchange rate changes are positively or negatively correlated depends on whether the change in interest rates is caused by changes in inflationary expectations or in liquidity conditions.¹ An unanticipated monetary expansion will cause a temporary real interest rate decrease and temporary fall in the real exchange rate. These real effects would be expected to be reversed fairly quickly. A large budget deficit on the other hand would cause a higher domestic interest rate and a temporary appreciation of the currency. Again we would expect the real interest rate and exchange rate effects to be at least partially reversed but the adjustment period might be much longer than with a monetary policy change. Changes in technology and productivity, on the other hand, are more likely to give rise to nonreversing changes in real exchange rates. Thus, the probability that changes in the real exchange rate and the real interest rate will be permanent depends on the kind of disturbance causing changes in these variables as well as the expected degree of permanence of the disturbance itself.

¹ This is an example of the general point raised by Robert Lucas in his famous econometric policy critique. For references to this literature and an application to the relationships between exchange rate changes and inflation in the U.S., see Pigott, Rutledge, and Willett (1985).

Simple historical statistical analysis of exposure coefficients will typically be quite sensitive to the pattern of such shocks as well as the structure of the firm. Unless one has considerable confidence that the pattern of shocks and their degree of permanence will be relatively stable, then one needs to develop estimates of the sensitivity of the firm to different types of shocks by other means than regression analysis. Oxelheim and Wihlborg (1987) discuss the use of scenario analysis in this situation. This kind of analysis can yield important information about the firm's sensitivity to disturbances of different kinds as well as about exposure management strategies in an uncertain world. It can also suggest what types of shocks the particular firm should put the greatest effort into attempting to forecast. For example, an export/import firm might find itself to be very sensitive to short term variations in monetary policy while a manufacturer of heavy equipment might not. Thus, we think that the scenario approach offers the possibilities of important advances in the efficiency of exposure management policies.

We will now analyze in more detail the role of temporary and permanent disturbances in the different exposure measures.

III Traditional Exchange Rate Exposure Measures

Three common measures of exchange rate exposure are (a) transaction exposure, (b) translation exposure and (c) approximations of economic exposure. After describing each of these measures we discuss the relationship among them and their relevance when exchange rate changes are temporary and permanent, respectively.

a. Transaction exposure

This type of exposure refers to uncertainty about the domestic currency value of a specific future cash flow in a foreign currency. For example, the exposure of a strictly home-based company that contracts a loan on the international capital market has transaction exposures in the loan currency for dates at which the loan and interest are to be paid. Similarly, the importing company is facing transaction exposure when it is invoiced in the supplier's currency, and an exporter is exposed when exports will be paid for at a later date in a currency other than the domestic currency. In all three cases we know which party is exposed to exchange rate uncertainty, and the strength and duration of the exposure can be measured fairly easily.

It is more difficult to determine the exposure to exchange rate risk of a company which has extensive international operations, or one which, over and above its export and import activities, possesses overseas assets not normally intended to be transferred, as well as debts in a number of currencies. Thus, the multinational company has additional risk to consider apart from the risk facing domestic companies whose international activities are limited to exporting and importing.

Most often the concept of transaction exposure is reserved for contracted flows in foreign currencies. This limitation is obviously not necessary, but taking non-contracted cash flows into account demands a substantially larger information base. A consequence of this limitation is that transaction exposure usually does not take exposure of a firm's commercial operations - up to the date of delivery - into account but emphasizes financial

commitments in foreign currencies. Certain future commercial cash flows can naturally be contracted for in monetary terms in advance of delivery of goods, and it is possible that financial flows are not definitely contracted for in monetary terms at the time a loan is taken. Often, an expected cash flow is initially a non-contracted expected sale or purchase, which at the date of delivery becomes a contracted financial flow in the form of accounts payable or receivable.

Transaction exposure for contracted flows alone can be covered nearly exactly by entering forward contracts when the exact day on which each cash flow will occur is known. (There is always a credit risk associated with accounts receivable.) If more extended definitions of transaction exposure are used, including non-contracted commercial flows, then exact covers cannot be obtained but the cover decision must be based on expectations of cash flows.

b. Translation exposure

Translation exposure is most often an accounting concept, though one could theoretically define a corresponding economic concept. Accounting translation exposure in a particular currency (often called simply accounting exposure), may be defined as the net balance sheet position in a foreign currency. Since translation gains are estimated over reporting periods, exposure is often measured as a period average. Furthermore, a firm's translation exposure in a particular currency refers usually to the consolidated balance sheet of a

multinational corporation in quarterly or annual reports to stockholders.

Under the accounting rules established in FASB 8 for the United States, monetary assets and liabilities were translated at the current rate while non-monetary items (plant, equipment, inventories) were translated at historical rates in effect at the time of acquisition. Thus, translation gains (losses) were equal to the average position in monetary items times the appreciation of the foreign currency. Because of the short run variability in measured profits caused by exchange rate fluctuations under the rules of FASB 8 considerable opposition to these rules was generated, culminating in the adoption of a new set of standards. Under this "all-current" method of translation all assets and liabilities are translated at the current rate. Thus, all assets and liabilities are exposed. However, translation gains and losses do not appear, as the main rule, in the income statement under FASB 52. Instead, translation gains and losses appear in a reserve account which is included in the firm's net worth. Exchange gains and losses appear on the income statement only when they are realized. Under Canadian standards, on the other hand, exchange gains and losses can be amortized over the life-time of a loan.

It is not easy to evaluate the different methods of calculating translation exposure since many conflicting elements enter the analysis as we shall see below. It is possible that exposure cannot be determined satisfactorily by any one method; a combination of methods may be needed, or at least a method may have to be adapted to a particular firm and industry. Furthermore, we note below that the economic relevance of different translation methods depends on the expected time path of exchange rate changes and monetary policy.

c. Economic exposure and translation methods; the issues

The idea of economic exchange rate exposure is to obtain an estimate of the sensitivity of a firm's economic value to unexpected changes in exchange rates. The economic value depends on the expected ability of the firm to produce cash flows in the future. The final effect of an exchange rate change obviously cannot be known until time has elapsed, but at the time a disturbance occurs, managers, shareholders, and other stakeholders should have some more or less explicit judgment of its impact on the firm.

Ideally exchange rate exposure should be evaluated in terms of exchange rate effects on the present value of future cash flows.¹ We can illustrate the economic relevance or irrelevance of accounting based concepts of exchange rate exposure by a few simple examples. In the process, we note that there is a common pitfall in exposure analysis in equating the search for an economically relevant translation rate (i.e., current, historical or another rate) with the search for a method to evaluate exposure. The choice of a translation rate could be, for example, to obtain a measure of the (accounting) value of foreign assets that is comparable to the (accounting) value of domestic

¹ Lessard (1979), Wihlborg (1980), Oxelheim (1981), and Glick (1986) as well as major textbooks on International Financial Management agree on this point but operationalize the concept in different ways. Many firms seem to have developed a measure of economic exposure as an accounting translation exposure adjusted by the addition of, for example, inventories to exposure under FASB 8, or by deducting plant and equipment from exposure under FASB 52.

assets. The dollar value so estimated may or may not be a good exposure measure and the value may not correctly reflect the economic value of foreign assets unless domestic assets also have been correctly evaluated in economic terms.

One aspect of our choice between FASB 8 and FASB 52 is whether translation gains and losses should be included on the consolidated income statement as well as on the balance sheet. The alternative is to refer such gains and losses to a reserve account.

Oxelheim (1983) and Levi (1983) compare the income statement effects of exchange rate changes under different accounting methods for translation of specific foreign currency items. Oxelheim's and Levi's criterion for evaluating the methods is comparability - from an economic point of view - of income or cost on a translated income statement with income or cost from a comparable domestic asset or liability. For example, assume that a firm has the choice between borrowing in domestic and foreign currency. The interest cost in domestic currency is 10 percent while the interest cost in foreign currency is 20 percent, and the expected depreciation of the foreign currency is 10 percent. Over the year, if the exchange rate behaves as expected, the income statement under FASB 8 will include the outright interest cost as well as the exchange rate gain. However, if the loan is not paid back within the year, then under FASB 52 a translation gain will appear in owners' equity but not on the income statement.

Which method is superior from an economic point of view? This depends on whether the exchange rate change is expected to be permanent or temporary. If the change is expected to be permanent then under

FASB 8 the income statement reflects an actual economic cost, while if the change is expected to be reversed before payment of the loan, then the income statement under FASB 52 provides a better effective cost comparison.

Assume next that plant and equipment with similar capabilities are located in different countries and that the firm uses historical cost accounting at home. In this case an exchange rate change has no effect on the income statement regardless of whether FASB 8 or FASB 52 is used. Under the former method, the historical exchange rate is used for translation, so no translation gains or losses occur. Under FASB 52 translation effects occur, but they appear only in a reserve account and in owners' equity. Does the relative dollar value of the equipment located in different countries change with the exchange rate? Assume first that the exchange rate change corresponds to domestic inflation. Historical cost accounting will then lead to a false (underestimated) dollar value of the plant and equipment when it is located at home. A comparable underestimation of the dollar value of the foreign equipment occurs if translation is done with the historical exchange rate (as under FASB 8).

If, however, the exchange rate corresponds to foreign inflation, then the dollar value of foreign equipment is underestimated. If PPP holds, whether the equipment is over or underestimated relative to domestic equipment depends on whether foreign inflation is less than or greater than domestic inflation.

On the other hand, if there is a real exchange rate change so that the purchasing power of foreign

currency increases, then there may be a real gain in having the equipment earning cash flows in the foreign currency. Specifically, if the exchange rate change is expected to be permanent, the relative value of foreign equipment changes with the exchange rate. Accordingly, the balance sheet under FASB 52 provides a better estimate of the relative dollar values even with historical cost accounting, though the income statement will not reflect the value changes.

The above discussion indicates that there are two issues related to the choice of translation method from an economic point of view. One aspect is the choice of exchange rate in order to value foreign assets and liabilities in an economically correct manner. The second aspect is to determine how gains and losses should be allocated over time on the income statement.

d. Valuing foreign assets and liabilities

When analyzing economic value and changes therein it is convenient to use a present value formula:

$$PV_0^{US} = E_0 \left[\frac{x_1^{US}}{(1+d) \cdot p_1^{US}} + \dots + \frac{x_n^{US}}{(1+d)^n \cdot p_n^{US}} \right] \quad (1.)$$

where:

E = expectations operator; subscripts refer to time-period; superscripts refer to country (currency in which valuation occurs)

x^{US} = U.S. value of a cash flow originating in dollars or foreign currency

d = the (real) discount rate

P = the price level

US = shareholders' country of residence.

The effect on the present value in dollars (PV_0^{US}) of exchange rate changes will now depend on: (i) the type of cash flows, (ii) the nature of exchange rate changes, (iii) the timing of cash flow remittances, and (iv) the expected degree of permanence of exchange rate changes. We will discuss these factors one by one in order to better understand economic exposure, which can be defined as $\Delta PV_0^{US} / \Delta e_0$, i.e., the change in the U.S. value of the firm of an (unanticipated) exchange rate change.

i. The type of cash flows in any period

For monetary assets or liabilities such as accounts receivable and long term debt payable in foreign currency there is a fixed foreign currency cash flow (\bar{x}^{FC}) each period. On the other hand, production from given plant and equipment and the value of inventories tend to increase in value with foreign inflation, so that in any period t the foreign currency cash flow is $x_0^{FC} \cdot p_t^{FC}$, that is, the initial cash flow in foreign currency multiplied by the price level in period t (assuming the initial price level is one). In order to analyze further the exposure of different kinds of assets and liabilities we must consider whether exchange rate movements are changes in real rates or correspond to changes in a country's price level.

ii. The nature of exchange rate changes

In general, an exchange rate can be written as

$$e_t \equiv \frac{p_t^{US}}{p_t^{FC}} \cdot u_t \text{ for the period } t \text{ where } u_t \text{ is the real}$$

exchange rate or deviation from Purchasing Power Parity (PPP).

Using this expression and equation (1.), the value of an asset or liability with fixed contracted payment $PV(C)$ in a foreign currency can be written as:

$$PV_0^{US}(C) = E_0 \left(\frac{\bar{X}^{FC} \cdot e_1}{(1+d) \cdot P_1^{US}} + \dots + \frac{\bar{X}^{FC} \cdot e_n}{(1+d)^n \cdot P_n^{US}} \right) \quad (2.)$$

or

$$PV_0^{US}(C) = \bar{X}^{FC} \cdot E_0 \left(\frac{u_1}{(1+d) \cdot P_1^{FC}} + \dots + \frac{u_n}{(1+d)^n \cdot P_n^{FC}} \right) \quad (3.)$$

Contracted payments in foreign currency are exposed to real exchange rate changes (u) and changes in the price level in the currency of denomination (P^{FC}). Their values are, as shown in equation (3.), independent of domestic inflation, unless real exchange rates and price levels are correlated. The reason is that domestic inflation is offset by an appreciation of the foreign currency leaving the domestic real value of the foreign currency payments unchanged.

The value of foreign assets and liabilities with foreign currency payments linked to foreign inflation, $PV(NC)$ can be written as:

$$PV_0^{US}(NC) = E_0 \left(\frac{X_0^{FC} \cdot P_1^{FC} \cdot e_1}{(1+d) \cdot P_1^{US}} + \dots + \frac{X_0^{FC} \cdot P_n^{FC} \cdot e_n}{(1+d)^n \cdot P_n^{US}} \right) \quad (4.)$$

or

$$PV_0^{US}(NC) = X_0^{FC} \cdot E_0 \left(\frac{u_1}{(1+d)} + \dots + \frac{u_n}{(1+d)^n} \right) \quad (5.)$$

Examples of assets with future payments linked to inflation are plant and equipment used to produce goods or sales in future periods and inventories. The price on future sales are typically not contracted far in advance and can be expected to follow inflation. In equation (5.) it is shown that the domestic value of such payments is exposed only to real exchange rate changes, assuming that the volume of sales produced by the asset is known.

A domestic firm borrowing in foreign currency would have foreign currency liabilities with future payments contracted in foreign currency as in equation (3.). A multinational corporation would typically have assets producing noncontracted future payments in foreign currency as well as liabilities with contracted payments.

In order to correctly measure economic exposure, we need to consider the effects on cash flows (X^{FC}) of real exchange rate changes. In general, the response of the foreign currency cash flow, X^{FC} , depends on the type of production processes undertaken. For example, if a firm sells non-tradeables as outputs and purchases non-tradeables as inputs, then real exchange rate changes will not have a large impact on the firm's local currency cash flows. However, if the firm sells tradeable goods as outputs, and purchases non-tradeables as inputs, cash flows will vary inversely to real changes in the value of the foreign currency. If the firm produces non-tradeables as outputs, but has substantially tradeable inputs, then the foreign currency cash flows will vary positively with real changes in the exchange rate. In these

last two cases, the foreign currency payments are not linked to foreign inflation, since X^{FC} is a function of the real exchange rate, u . Other exposure measures discussed below incorporate these cash flow effects explicitly.¹

iii. The timing of cash flow remittances

The above expressions are written as if foreign currency cash flows were exchanged into U.S. dollars every period. Assume instead that there is great flexibility in the timing of remittances and that the firm will be able to evaluate whether it is a good or bad time to remit, i.e., that the firm has some ability to forecast exchange rate changes. It is not able to forecast at time 0 the exact dates and rates at which remittances will occur, however. Exposure to unanticipated exchange rate changes would clearly be smaller in this case than when remittances are fixed in time.

A more general approach to expressing the present value of a foreign subsidiary would be to multiply the present value of the subsidiary in foreign currency with an estimated translation rate ($e_{T,0}$) which represents a weighted discounted sum of future expected exchange rates at times remittances actually take place. For assets with contracted (C) and noncontracted (NC) future payments we have the following expressions for their domestic currency values:

$$PV_0^{US}(C) = e_{T,0} \bar{X}^{FC} \cdot E_0 \left[\frac{1}{(1+d) \cdot P_1^{FC}} + \dots + \frac{1}{(1+d)^n \cdot P_n^{FC}} \right] \quad (6.)$$

¹ For other analyses which relax this assumption, see Hodder (1982) and Wihlborg (1980).

and

$$PV_0^{US} (NC) = e_{T,0} X^{FC} \cdot E_0 \left[\frac{1}{(1+d)} + \dots + \frac{1}{(1+d)^n} \right] \quad (7.)$$

The translation rate $e_{T,0}$ is evaluated at time zero and depends on the expected timing of remittances, and on the ability of the firm to forecast and avoid periods of unfavorable exchange rates. Using expressions (6.) and (7.) it becomes clear that a foreign subsidiary's exposure depends on two factors. First, it depends on the exposure of the subsidiary evaluated as any foreign company, i.e., $\Delta X^{FC} / \Delta e_0$. (The foreign company's assets and liabilities are evaluated in foreign currency within the brackets after E_0 .) Second, it depends on the sensitivity of the rate $e_{T,0}$, the average translation rate, to changes in the current exchange rate e_0 . In other words, exposure to current exchange rate changes depends on $\Delta e_{T,0} / \Delta e_0$. To analyze this sensitivity further, we must examine the expected degree of permanence of exchange rate changes.

iv. The expected degree of permanence of exchange rate changes

First, assume that the foreign subsidiary is to be sold in the near future. Then clearly, the proper translation rate $\Delta e_{T,0}$ approximately equal to the current exchange rate e_0 (i.e., $\Delta e_{T,0} / \Delta e_0 = 1$). In other words, the dollar value of the firm changes in proportion to the current exchange rate. The exposure based on current-rate accounting as under FASB 52 is essentially a "liquidation value exposure" in this sense.

Even if the subsidiary is not going to be sold, but there is an expected permanent exchange rate change (or at least a change expected to remain for the lifetime of the asset), then $E_0(\Delta e_1)/\Delta e_0 = \dots = E_0(\Delta e_n)/\Delta e_0 = \Delta e_{T,0}/\Delta e = 1$. This would be the case if, as some studies suggest, the real exchange rate follows a random walk.

On the other hand, if there is an expected temporary exchange rate change so that $E_0(\Delta e_1)/\Delta e_0 = 1$, but $E_0(\Delta e_2)/\Delta e_0 = \dots = E_0(\Delta e_n)/\Delta e_0 = 0$, and remittances will occur over all future periods, then there is little reason to change the translation rate (i.e., $\Delta e_{T,0}/\Delta e_0 \approx 0$), since only a small part of remittances are expected at the rate existing on the valuation date.

Since price levels rarely decline in the modern era, real exchange rate changes are generally much more likely to be reversed over time than are changes in price levels. Even if deviations from PPP were always temporary, the extent to which shareholders in foreign subsidiaries should be considered seriously exposed to exchange rate changes, would vary depending on the length of time needed to restore PPP, the forecastability of deviations from PPP, and the degree of flexibility of remittances.

If the purpose of translation is to express the economic value of the firm, then the choice of an exchange rate at which to translate is equivalent to the search for $e_{T,0}$ above. Oxelheim (1981) and Wihlborg (1980) argue that if the exchange rate tends to fluctuate around Purchasing Power Parity, an estimated exchange rate consistent with PPP could be a convenient translation rate for assets and liabilities held by foreign subsidiaries. An estimate of a long run average rate different from

the PPP rate could be used if a long run trend in the Purchasing Power Parity relationship is expected. Such a trend may occur, for example, if two countries have different rates of change of the relative price between traded and non-traded goods.

A particular advantage of translating at a long run average exchange rate would be that most permanent exchange rate changes would cause translation gains and losses corresponding to changes in economic value while temporary real exchange rate changes would not affect the valuation of the foreign subsidiary. FASB 52 recognizes that exchange rate changes may cause temporary translation gains or losses by referring these gains and losses to a reserve account, which does not influence the firm's income statement. This procedure is obviously misleading, however, when exchange rate changes are expected to be permanent. Only in the case when the non-integrated subsidiary's host country suffers hyperinflation does FASB 52 recognize the permanent nature of exchange rate changes by requiring that financial statements of the foreign subsidiary must be translated using the monetary/non-monetary method while the subsidiary is required to use the dollar as its "functional" currency for translation purposes. In effect, the firm is required to use a method identical to FASB 8 in this case.

e. Translation methods and the allocation of gains and losses over time

Even if a translation rate has been chosen in such a way that the economic value of foreign assets and liabilities are captured in domestic currency, it is not always desirable to include the total gain or loss on the income statement. Under FASB 52 no

gains or losses are, as the main rule, included in income. Therefore, exchange gains and losses appear on the income statement only when realized cash flows occur. The disadvantage of this method is that very large gains and losses appear at irregular intervals, when, for example, foreign currency loans are repaid.

Under FASB 8 all gains and losses are included in income. Since under FASB 8, monetary assets and liabilities are translated at the current rate, income in domestic currency fluctuate with exchange rate changes even when gains and losses are not realized.

Oxelheim (1981) suggests that a PPP rate or a rate based on the interest rate differential may be used to allocate exchange gains and losses over time. With a PPP rate, gains and losses corresponding to the inflation differential during a period would be included in income. If exchange rates over time follow PPP, this method would smooth out the income statement effects of exchange rate changes.

With a rate based on the interest rate differential, gains and losses from anticipated changes during a period would be included in income. The method would be implemented by assuming that the exchange rate change for translation purposes would be equal to the interest rate differential. In general, the translation rate at the end of the period would equal the forward rate at the beginning of the period. Translation gains and losses due to actual exchange rate changes in excess of the interest rate differential would be largely unanticipated and referred to a reserve account. Such gains and losses would tend to cancel over time in efficient foreign exchange markets.

f. The purpose of accounting rules and the relationship among exposure measures

In the preceding above analysis of economic exposure we argue that translation exposure based on any of the existing accounting rules cannot capture economic exposure consistently. It may be unfair, however, to ask this of an accounting rule. Such a rule should be designed to inform managers, stockholders and financial markets about the impact of exchange rate changes on the firm's value. Since economic value depends on expectations, which may be quite uncertain and differ considerably among individuals, the purpose of an accounting rule could simply be to provide the best possible information to market participants. Different individuals may then form their own judgements and expectations about the impact of exchange rate changes on a firm. This paper cannot go into all the facts on how to provide financial markets with information, but obviously any rule must be clearly understood and its objective clearly defined. The rule that correctly captures value changes from the point of view of all shareholders does not exist, since they may reside in different countries. Furthermore, changes in the real value of the firm depends on individual shareholders' consumption bundles, which may differ among individuals.

Another possible objective of accounting rules may be to make changes in income and/or changes in owners' equity comparable among subsidiaries in different countries. In this case, translation rules should perhaps not capture economic value, since accounting principles used for each subsidi-

ary in their respective currencies do not. Instead, translation rules should be made consistent with other accounting principles, and it should allocate gains and losses over time in a reasonable way as discussed above.

From the point of view of information signalling an all-current method for balance sheet translation could be superior to other methods since it is very simple and market participants can more easily infer from the income statement and the balance sheet in domestic currency what the firm's position is in foreign currencies. With the temporal method such as FASB 8 on the other hand, the information content of the translated balance sheet is less since different items are translated at different rates. If an all-current method is used it is still possible to allocate gains and losses over time by means of exchange rate changes implied by PPP or the interest rate differentials.

Ultimately, the actual choice of a translation rule may not be very important for market valuation when market participants learn to understand it and to extract information from it. Then market participants can reinterpret the accounting data themselves and form their own valuation. Views differ on this point, however.¹

In addition to the relationship between accounting (translation) and economic value, it is important to understand the relationship between transaction exposure on the one hand, and economic and transla-

¹ Dukes' study (1978) of the stock-market effect of the introduction of FASB 8 indicates that the stock market valuation of a firm is independent of the translation rule. The results of the study are hard to interpret, however, since it is not known how firms responded by hedging exposure under the new rule.

tion exposures on the other. Are, for example, transaction and translation exposures complementary or substitutes? Can they be added together to obtain a measure of economic exposure? These issues can be discussed by considering the differences between locking in dollar values of transactions, accounting values, and economic values, respectively.

To an important extent the answers to the above questions depend on whether or not translation exposure is viewed as a measure of the expected value of the foreign currency position. Equation (2.) shows that economic value consists of the present value of a number of cash flows through time. Economic exposure is more properly a sensitivity measure for economic value. Transaction exposure is conventionally defined as the cash flows in foreign currency in each period.

To an important extent transaction and translation exposures can be viewed as substitutes if the latter is seen as the foreign currency present value of cash flows. The firm that knows fully its future pattern of payments and receipts in foreign currency and uses forward contracts to lock in the dollar value of all these future transactions ($X_1 - X_n$) is obviously not economically exposed to exchange rate changes at all. However, reducing translation exposure to zero for one period by locking in the dollar value in one period of the foreign currency value of the firm may overprotect against economic exposure. The reason is that exchange rate changes are sometimes perceived to be temporary in which case the present value in dollars of all future cash flows does not change in proportion to the exchange rate. However, if all

exchange rate changes are expected to be permanent (this is consistent with a random walk), then reducing translation exposure to zero is equivalent to reducing economic exposure to zero. In this case, economic exposure can be reduced to zero either by locking in the dollar value of all future transactions ($X_1 - X_n$) or by consecutively eliminating translation exposure one period at a time.

On the other hand, if exchange rate changes are expected to be temporary, then elimination of translation exposure (PV_0^{EC}) would in fact cause economic exposure. Partial reduction of translation exposure would instead eliminate economic exposure and serve as a substitute for the elimination of transaction exposure.

g. Exposure, hedging, and the firm's time perspective

Modern finance theory suggests that firm managers should be concerned primarily with the maximization of shareholder wealth. However, many firms seem to be concerned with cash flows in the near future and their variability. The previous section demonstrated that the time path of expected exchange rate changes - i.e., the intertemporal covariances among exchange rate changes - determines the relationship between exposure of near-term cash flows (transaction exposure) and the exposure of economic value and shareholder wealth.

Another factor of importance for the relationship between cash flow exposure and value exposure is the firm's discount rate. The time perspective of the firm and the weight of near term cash flows and more distant cash flows in the economic value is reflected in the discount rate or the cost of capital of the firm. The importance of the in-

ter-temporal pattern of exchange rate changes and cash flows increases with a decreasing discount rate, i.e., with the length of the firm's perspective.¹ As an illustration of the role of the discount rate for the firm's exposure management strategy, we may consider a firm with quarterly cash flows of X units of foreign currency. Assume that the firm has the choice of always leaving these X units uncovered, or of covering in every quarter next quarter's cash flow by selling X units of foreign currency in the three-month forward market. Under what conditions for the discount rate is it meaningful to always cover cash flows in the next quarter? It has been noted by a number of writers that the forward rate tends to change with changes in the spot rate, and that the variances of the two rates are equal.² Then, the gain from consecutive covering depends only on the discount rate, d. It is shown in Oxelheim and Wihlborg (1987) that the variance of the firm's value without cover relative to the firm's value when it covers each quarter the cash flows in the following quarter is $1/(1+d/4)^2$. For most firms this ratio is likely to be close to one. The "ineffectiveness" in terms of variance reduction of consecutive covering noted also by Clark (1973) arises as a result of the discrepancy between the firm's long time perspective as reflected in the discount rate and its short "action horizon".

Naturally, if the firm's planning horizon is only say one year, and cash flows beyond one year are not considered, then the variance of cash flows

¹ See, e.g., Lessard (1979), and Oxelheim and Wihlborg (1987).

² See, for example, Levich (1979), Mussa (1982), Shapiro (1983a) and Oxelheim (1985).

within this year can be reduced by covering in forward markets all flows within the year. (Remaining uncertainty would depend on the credit risk and payment discipline of customers.) It does not seem to be a rational objective of the firm, however, to give zero weight to flows beyond a specific cutoff date unless this date is quite distant.

This discussion indicates that a large diversified MNC or an export/import firm with a large number of foreign currency transactions into the indefinite future would not be able to reduce their value variances by consecutively covering near term accounts payable and receivable. If instead the firms attempt to cover expected cash flows in the more distant future, they would reduce exchange rate risk but by locking in the domestic currency value of future cash flows the firm exposes itself to domestic inflation. Such inflation risk may be considerable over long time horizons. On the other hand, a small firm with a few relatively large foreign currency transactions in the near future would be able to reduce the exchange rate exposure of its value by covering near term foreign currency cash flows.

IV Regression Approaches to Measuring Exchange Rate and Related Macroeconomic Exposures

Oxelheim and Wihlborg (1987) suggest that the exposure to exchange rate changes could be measured by the coefficient in a regression equation that regresses the value of real cash flows on a number of simultaneously determined macroeconomic variables such as the exchange rate, domestic and

foreign price levels, domestic and foreign interest rates, and a relative price of particular importance for the firm. The regression coefficient for the exchange rate is an expression for the sensitivity of real cash flows to changes in the exchange rate holding other explanatory variables constant. The exposure of the economic value could similarly be measured by regressing the economic value on the same variables.

By regressing cash flow or value on a number of interdependent macroeconomic variables simultaneously the analyst recognizes that exposures to these variables may emanate in macroeconomic disturbances that influence exchange rates, price levels, interest rates and exchange rates simultaneously. On the other hand, if exchange rate exposure, interest rate exposure, etc. were estimated by simple regressions of cash flows on these variables separately (see footnote 5), then exposure measures would be overlapping and poor guides for hedging. As suggested by recent exchange rate theory overviewed in the introduction, exchange rate exposure is just one reflection of more general macroeconomic exposures to unanticipated changes in money supplies, budget deficits, oil price changes and other macroeconomic disturbances.

Oxelheim and Wihlborg (1987) also argue that in many circumstances one should attempt to estimate macroeconomic exposure of cash flow or value to money supply shifts, fiscal policy changes, and other underlying macroeconomic events by regressing cash flow or value on the specific macroeconomic disturbances rather than on exchange rates, price levels and interest rates. In this paper we shall not attempt to discuss the particular circumstances

under which one multiple regression approach is superior to another. All have the advantage of taking into account interdependence among variables and thereby they help the firm measure true economic exposure to changes in the macroeconomic environment. Likewise all may at times suffer from the disadvantage of instability in estimates of exposure-coefficients. We return to this issue below.

With such approaches it is necessary to decide whether the regression should be applied on the real value of cash flows on, say, a quarterly basis or on the economic value of the firm. It is, no doubt, easier to implement the regression approaches on cash flow data since economic value is an exclusive concept. The stock market value of a firm could naturally be used as an easily available measure of value but its drawback is that it is not independent of the information provided to the public by the firm. Stock market value, therefore, may be subject to some manipulation in the short run and it may be sensitive to revelation of irrelevant accounting information unless the firm also makes public information required to interpret accounting data.

Suppose that the firm has measured its macroeconomic exposure by estimating how quarterly cash flows depend on changes in different macroeconomic price variables or disturbances. Then we must ask how the cash flow exposure coefficients can be applied for hedging purposes. We assume that hedging has the objective of reducing the variance of the firm's economic value. Once again it is necessary to form an opinion about whether disturbances in exchange rates and other price variables, or in macroeconomic disturbances, are temporary or permanent.

When cash flow exposure on a quarterly basis has been estimated, but the concern of the firm is value exposure, it is necessary to translate cash flow-exposure coefficients into value-exposure coefficients. One possibility is that the real exchange rate (or any other variables) is expected to remain at the current level or to return to it even if unanticipated changes occur. Then real exchange rate changes are expected to be temporary. In this case the cash flow exposure in dollar terms to near term real exchange rate changes is equal to the exposure of economic value to these changes. It follows then that cash flow exposures for different time horizons are independent. Hedging of value can then be accomplished by hedging a series of cash flow exposures, as represented by coefficients for the sensitivity of cash flows to changes in macroeconomic variables.

If real exchange rate changes instead are expected to be permanent, then real exchange rates are serially uncorrelated and the best guess of the future rate is the current real exchange rate. If an unanticipated change occurs, then the best guess is that the rate will remain at the new level.¹ In such a case, the exposure coefficients for the impact on the real value of cash flows of a real exchange rate change is a fraction of the coefficient for the impact on value. However, if exposure is measured by regressing the percentage change in cash flows on percentage changes in macroeconomic variables, then the coefficients reveal value exposure as well, since the percentage change in the value of an unanticipated change must

¹ Note, however, that even with a given mean, the degree of dispersion of the probability function of expected exchange rate changes may influence the incentives for resource allocation. See Willett and Flacco (1985).

be equal to the percentage change in cash flows during the same period. The reason is that expected cash flows in all periods would be influenced to the same degree as cash flows in the period the permanent real exchange rate change occurred.

The difficulty in obtaining an operational measure of value exposure increases when changes in variables are neither temporary nor permanent. It is then necessary to form an opinion about the probability that a certain change will be permanent. This probability may vary over time, however. In the latter case, there is no fixed rule for translating between cash flow and value exposure and the usefulness of the regression approach to measuring exposure is reduced.

V Conclusions - Towards a Scenario Approach for Measuring Exposure

The probability that a certain change in the real exchange rate is permanent may vary over time. In this case, the relative economic validity of accounting measures of exposure varies over time, as well. Furthermore, exposure coefficients for the sensitivity of firm value to changes in exchange rates, price levels, and interest rates are unstable, when the probability that a change in any of these variables is permanent fluctuates over time. Similarly, the sensitivity of a firm's value to fundamental macroeconomic disturbances tends to be unstable.

As was noted in the introduction, some empirical evidence indicates that real exchange rate changes are best described as permanent, but this evidence contradicts a large body of theoretical literature

on exchange rate determination and may be explained by the inability of tests to distinguish between different kinds of disturbances to which the economy was subjected during the test period. Price level and interest rate changes may be permanent to varying degrees. Economic theory indicates that different disturbances induce different adjustment paths of exchange rates and other variables. Therefore, the frequency with which different macroeconomic disturbances occur as well as their magnitude would determine the probability that a certain change is permanent.

These conclusions seem to lead to some pessimism about the validity of specific accounting measures, like regression exposure coefficients, as guides for exchange rate exposure management. However, the fact that measures of exposure are not perfect does not imply that they are worthless. With some knowledge of the nature of disturbances during the period when exposures were estimated, it is possible to use the measures as a point of reference. The measures can be adjusted for current exposure management by adding current information and expectations about the macroeconomic environment. For example, if the probability of permanent disturbances is seen as increasing, then current estimates of exposure to exchange rate changes can be increased as well.

One additional and helpful tool for exposure analysis should be mentioned in this context: Scenario-analysis of the impact on a firm of macroeconomic disturbances with different degrees of permanence helps the firm adjust its "old" exposure measures to new information about the nature of macroeconomic disturbances.

The advantage of scenario analysis is that it can help the firm understand how its cash flows in future periods and, therefore, its economic value would be influenced by different kinds of disturbances (money supply shocks, fiscal policy changes, oil price shocks, etc.) under different assumptions about the functioning of the economic environment. For example, economic theory and statistical analysis can be used as input to simulate the magnitudes and time paths of the exchange rate changes in response to macroeconomic disturbances. Furthermore, the impact on cash flows of the firm in any one period can be analyzed in detail under different assumptions about the relationship between exchange rates, inflation rates, interest rates, etc. given the particular economic and financial structure of the firm in question.¹ Such scenario analysis can be a valuable tool for complementing other types of exposure analysis as well as a method in itself for analyzing exposure. Oxelheim and Wihlborg (1987), and Oxelheim, Wihlborg and Willett (1987), contain detailed examples of scenario analyses of monetary and fiscal policy disturbances under different assumptions about the probability that disturbances are permanent.

The "cost" of scenario analysis is that its implementation requires relatively detailed knowledge of macroeconomic relationships among different variables after specific disturbances. Otherwise it is impossible to distinguish between more or less reasonable scenarios. Regression approaches to estimating exposure require less detailed knowledge about macroeconomic structure

¹ For a recent example of the development of a simulation model which could be adapted for this purpose, see Hekman (1985).

but their reliance on historical data analysis can make exposure estimates out of date by the time they can be estimated. Thus, a combined regression and scenario approach to exposure measurement may be the best strategy.

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