



**IBM Institute for Business Value
and Economist Intelligence Unit
global forecasting model methodology**

*Predicting the growth of investable assets across the world's 35
largest economies through 2025*

Contents	
<i>Introduction</i>	3
<i>Forecasting model overview</i>	3
<i>Historical data collection, collation and estimation</i>	4
<i>Building the forecasting models</i>	7
<i>Summary of findings</i>	12
<i>Conclusion</i>	13
<i>Appendix</i>	14
<i>Related publications</i>	15
<i>References</i>	16
<i>Sources</i>	16

Introduction

The IBM Institute for Business Value, in collaboration with the Economist Intelligence Unit (EIU), has built a forecasting model to determine both the size and shifts in asset growth across the world’s largest 35 economies. The output of the model has been incorporated into the Institute’s broader study on globalization entitled, “Get global. Get specialized. Or get out: Unexpected lessons in global financial markets.” This more detailed methodology paper provides an overview of the forecasting model and how it was developed.

Forecasting model overview

For the forecasting model, we define investable assets as any holdings in equities, bonds and money market instruments by both institutions and households. We were interested in showing how the U.S. dollar value of these assets may change over time and how the relative shares of total investable assets may shift between the industrialized countries and the emerging markets by 2025.

Forecasting returns for investment instruments is fraught with difficulty. Some forecasters favor the use of past market performance in terms of growth rates to estimate future performance, but we believe that such an approach is inappropriate for this study. Our hypothesis is based on two main assumptions:

- In the long term, returns from and growth of the value of investment instruments must be tied to some measure of overall economic activity, such as gross domestic product (GDP).
- The relative size of an economy on its own is not necessarily the determinant of financial assets in aggregate. Some measure of the relative sophistication and regulatory environment of a country’s financial sector is also required and can serve as a potential catch-up factor to the leading economies.

Highlights

Data availability for countries varied significantly. Measures of monetary aggregates were used for countries that do not systematically report data.

Historical data collection, collation and estimation

Data availability for the required countries in the study varied significantly (see Figure 1). It ranged from obtainable historical data for the larger Organisation for Economic Co-operation and Development (OECD) countries to little or insufficient historical data for less-developed emerging markets.

Figure 1. The projected 35 largest economies in 2025.

Argentina	China	Iran	Netherlands	Switzerland
Australia	Denmark	Ireland	Norway	Taiwan
Austria	France	Italy	Poland	Thailand
Belgium	Germany	Japan	Russia	Turkey
Brazil	Greece	Korea	Saudi Arabia	Ukraine
Canada	India	Malaysia	Spain	United Kingdom
Chile	Indonesia	Mexico	Sweden	United States

Source: Economist Intelligence Unit forecasts

To address these challenges, we used a standard reference system for the OECD countries.¹ This set of comparable data was built from OECD sources, Eurostat and national statistical offices and was based on a system of financial account concepts.

Additionally, we used measures of monetary aggregates, such as M2 and domestic credit, and domestic stock and bond market capitalization as proxies for countries that do not systematically report financial data based on international standards.² Data for these proxy variables was collected and collated from national statistical offices, the International Monetary Fund’s (IMF) “International Financial Statistics” and from the Bank of International Settlements. Stock market capitalization data was taken primarily, and where available, from the World Federation of Exchanges.

Highlights

A composite index was created based on ten specific component measures to assess the relative sophistication of each nation's financial sector.

In order to arrive at a robust and comparable data set across all countries, the relationship between each asset class (such as stock market capitalization) and the financial account concept (e.g., equities, which also include non-quoted shares and financial derivatives) was established. Where available, flow data was used where stock data was unavailable to supplement our estimates.

Based on data collected, we created a composite index, consisting of ten component measures, for the relative sophistication of each country's financial sector (see description below and Figure 2 for overview of country sophistication rankings). Eight of these were qualitative in nature, and two were quantitative. Definitions for each variable are provided below (see Appendix for a full explanation of the scoring criteria for each variable).

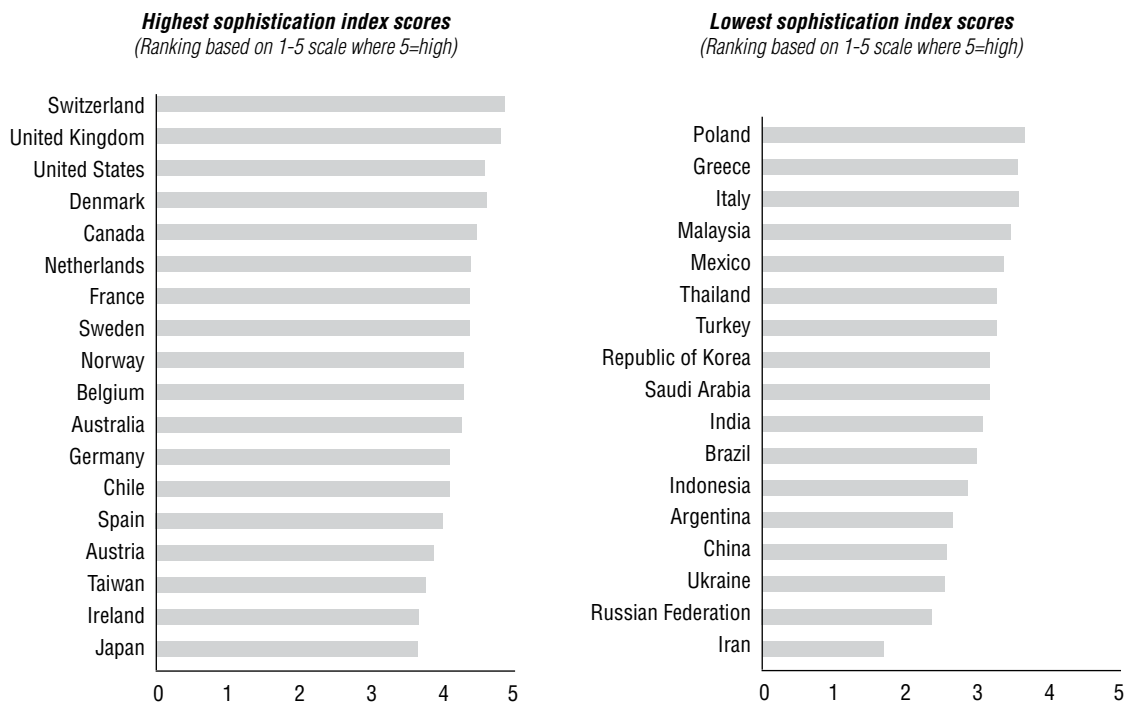
1 Economic policy and structure

- 1.1 Monetary stability – MSTB (5=good)
- 1.2 Use of indirect instruments – IIUS (5=good)
- 1.3 Financial liberalization – FILI (5=good)

2 Financing

- 2.1 Banking system openness – BSO (5=good)
- 2.2 Financial regulatory system – FRS (5=high quality)
- 2.3 Financial market distortions – FMD (5=low)
- 2.4 Access of foreigners to local market – FALM (5=good)
- 2.5 Access to medium-term financing – MTAF (5=good)
- 2.6 Relative importance of stock market – STM (normalized scoring 0-5)
- 2.7 Interest rate spread (lending minus deposit rate) – IRSP (normalize scoring 0-5)

Figure 2. Country sophistication rankings as of 2007.



Source: IBM/EIU Global Forecasting Model 2007; IBM Institute for Business Value analysis.

The qualitative variables were scored by EIU senior country analysts for their countries of expertise. Equal weights were applied to the ten variables to arrive at the composite index for any given country for each year through 2025.

Highlights

We tested the composite sophistication index relative to market capitalization as a percentage of gross domestic product.

The composite sophistication index was tested against the size of market capitalization as a percentage of GDP. This assumes equities represents one of the most sophisticated investment assets and suggests, at least on this measure, that sophistication plays a significant role in the development of a country's financial sector.

Thus, the correlation coefficients of the composite index scores to market capitalization were calculated for each year between 1997 and 2004 across all countries. Generally, the coefficients were above +0.5 and sometimes greater than +0.7, suggesting sophistication is worthy of further investigation.

Building the forecasting models

Our investigations with the data led us to test the following formula for forecasting total financial assets.

Function (1) : Total financial assets

$$dTLIBav_{i,t} = a_0 + a_1 TLIBGDPsop_{i,t} + a_2 SOPH_{i,t} + a_3 GDPD_{i,t} + a_4 DUM_{i,t} + e_{1,t}$$

where:

$dTLIBav_{i,t}$ = The dependent variable defined as annual growth in total financial assets in country i at time t

$TLIBGDPsop_{i,0}$ = A convergence term, measuring the gap between country i and the United States in terms of total financial assets as a percentage of GDP at the start of the estimation period

$SOPH_{i,0}$ = The score for the sophistication index for country i at the start of the estimation period

$GDPD_{i,t}$ = The annual change in nominal US\$GDP in country i at time t

$DUM_{i,t}$ = A dummy variable for data-poor countries, such as Iran, Saudi Arabia and Ukraine

e_t = The error or residual term of the function at time t.

Highlights

The growth in a country's financial assets can be explained by a number of independent variables.

These forecasts for long-term GDP growth are based on a well-established Economist Intelligence Unit model. This approach was used to arrive at our GDP forecasts for 2025 for each of the 35 countries.

Statistical test results for function (1) are shown in Figures 3 and 4.

Figure 3. Coefficients and test results for function (1).³

	Independent variables			
	<i>GDPD</i>	<i>SOPH</i>	<i>DUM</i>	<i>TLIBGDPsop</i>
Correlation coefficients	0.869	0.0174	0.0831	-0.0297
Standard error of the coefficients	0.098	0.0048	0.0181	0.0045
Tscores	8.853	3.5898	4.5959	-6.5431
Probability (p-value)	0.000	0.0011	0.0001	0.0000

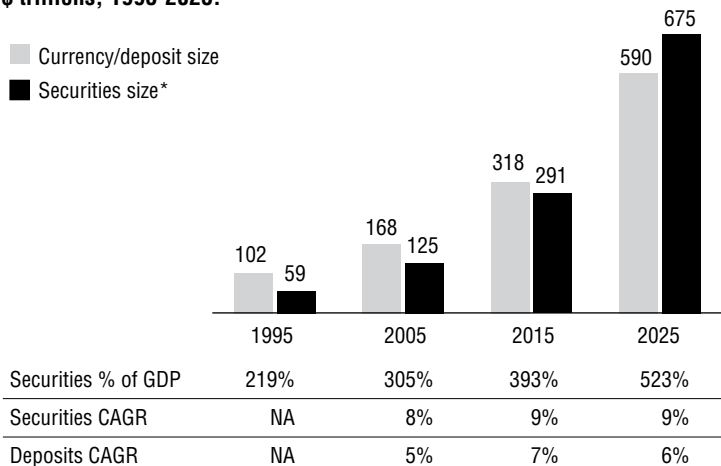
Summary statistics	
R ² (coefficient of determination)	0.973
Standard error	0.0224
F-statistic (F-stat)	275.231
Degrees of freedom	31.0000
Sum of squares - regression(SS) _{reg}	0.552
Sum of squares – residual SS _{resid}	0.0155

In general, the data suggests the growth of a country's financial assets can be highly explained by the independent variables (R-Squared = 0.973), with GDPD, the annual change in nominal GDP showing the greatest significance on the model. This is coupled with the fact that the residual sum of squares (the variability in the model not defined by the independent variables) is relatively small. The F-stat (275) suggests the relationship between the independent and dependent variables does not occur by chance, while the t-scores and p-values suggest the null hypothesis can be rejected with some level of certainty and, thus, the model is representative of reality. Finally, the standard error provides some measure of certainty by testing the error, or standard deviation, of the sampling distribution.

Highlights

We established a methodology for measuring the interdependency of global financial markets by exploring the evolution of global financial linkages.

Figure 4. Total financial assets and total stock of inward portfolio investment, US\$ trillions, 1995-2025.



Note: *Securities includes equity and fixed income securities;
Source: IBM/EIU Global Forecasting Model 2007; IBM Institute for Business Value analysis.

	1995	2005	2015	2025
Total	160,238	293,051	609,152	1,265,087
Industrialized countries	149,643	263,223	507,452	981,305
Emerging markets	10,595	29,829	101,700	283,782
Industrialized countries (% of total)	93.4	89.8	83.3	77.6
Emerging markets (% of total)	6.6	10.2	16.7	22.4

We were also interested in measuring how interdependent global financial markets may become through cross-country financial flows. We approached this by exploring how global financial linkages have evolved over time, and how they may continue to evolve. As our proxy measure of cross-border financial investment, we analyzed total portfolio investment stocks in one country selected from the rest of the world, outside the set of 35 countries with the largest economies.⁴ Our investigations with the data led us to test the following formula for forecasting total portfolio investment flows.

Highlights

Statistical results for the total stock of inward portfolio flows.

Function (2) : Total stock of inward portfolio flows

$$d\ln\text{PortStock}_{i,t} = a_1 d\text{DomCap}_{i,t} + a_2 \text{Open}_{i,t} + a_3 \text{DUM}_{i,t} + e_{1,t}$$

where:

$d\ln\text{PortStock}_{i,t}$ = The dependent variable defined as the measure of the change in the stock of portfolio investment in country i at time t

$d\text{DomCap}_{i,t}$ = A measure of the change in the depth of the domestic financial markets (equities and bond markets) in country i at time t

$\text{OPEN}_{i,t}$ = The average score for a subset of our sophistication variables that focus on international openness and accessibility for foreign investors FILI , BSO and FALM in country i at time t (see Appendix for the definition and scoring criteria for FILI , BSO and FALM)

$\text{DUM}_{i,t}$ = A dummy variable for data poor countries, such as Argentina, Russia and Ukraine.

e_t = The error or residual term of the function at time t .

Statistical test results for function (2) are shown in Figures 5 and 6.

Figure 5. Coefficients and test results for function (2).

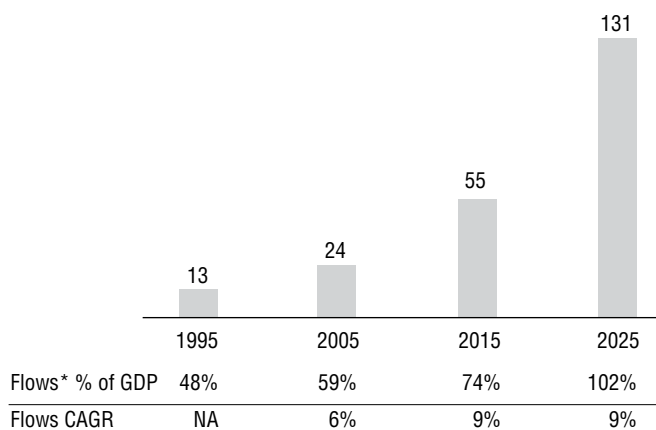
	Independent variables		
	<i>Open</i>	<i>dDomCap</i>	<i>DUM</i>
Correlation coefficients	0.048	0.7896	-0.1274
Standard error of the coefficients	0.019	0.1736	0.0419
Tscores	2.480	4.5493	-3.0412
Probs (p-value)	0.019	0.0001	0.0049
	Summary statistics		
R ² (coefficient of determination)	0.842		
Standard error	0.0716		
F-statistic (F-stat)	49.734		
Degrees of freedom	28.0000		
Sum of squares - regression(SS) _{reg}	0.764		
Sum of squares - residual SS _{resid}	0.1435		

Highlights

Growth in inward stock portfolios can be explained by financial sector depth and key financial sophistication factors.

Similarly, the data for the second function suggests the growth in inward stock portfolio can be explained by the change in financial sector depth, as well as key sophistication factors ($R^2 = 0.842$), the relationship between the variables does not occur by chance, and the model is representative of the broader population and reality.

Figure 6. Total inward portfolio investment stocks, US\$ trillions, 1995 - 2025.



**Flow CAGR is estimated from 1995-2005 and includes equity and fixed income securities, GDP is nominal GDP.*

Source: IBM/EIU Global Forecasting Model 2007; IBM Institute for Business Value analysis.

	2005	2015	2025
Total	23,787	55,341	131,155
Industrialized countries	22,759	52,434	122,730
Emerging markets	1,028	2,907	8,425
Industrialized countries (% of total)	95.7	94.7	93.6
Emerging markets (% of total)	4.3	5.3	6.4

Highlights

The total size of financial assets is expected to quadruple by 2025, with securities expected to double by 2015 and quintuple by 2025.

Summary of findings

Within the confines of the data, we were able to establish relationships among our measure of total financial assets, the growth in economic activity, our measure of sophistication of a country's financial sector, and a catch-up measure from a starting year that defined the gap between the lead country (the United States) and a given country (i).

As a result, we were able to establish that the total size of financial assets will quadruple to US\$1,265 trillion by 2025. Of this amount, the size of securities assets (both equities and bonds) is expected to double to US\$291 trillion by 2015 and quintuple to US\$675 trillion by 2025.

The growth in the value of securities will be 9 percent per annum, far outpacing our nominal GDP growth forecasts of 6 percent. However, this overall percentage disguises large variations across countries, with the group of emerging market countries growing at almost twice the rate of the OECD countries. Our model assumes that those countries with the largest forecast nominal GDP growth and the biggest potential for catch-up through improvements in financial sector sophistication will grow at the highest rate in terms of total financial assets (specifically, Russia, Ukraine, China, India and Indonesia). In absolute terms, however, the larger OECD countries will continue to dominate, with China and India as the only emerging markets in the top ten countries even in 2025.

Regarding the stock of portfolio investments (our proxy measure of a country's financial interaction with the rest of the world), we were able to find a potential causal model related to the change in the value of the domestic financial markets (equity and bond assets), and a refined set of the variables used in our composite measure of financial sophistication that focused on the relative openness of a country to overseas investors.

Highlights

The size of portfolio investment is expected to grow about 9 percent per year through 2025.

We established that the total size of portfolio investment (measured by inward portfolio flows) will quintuple to US\$131 trillion by 2025. Our forecasts predict that the growth rates will be around 9 percent per year through 2025, outpacing significantly our forecast growth of total nominal GDP (US\$) of around 6 percent. This suggests that global financial interaction and cross-border flows will be much deeper by 2025 than what currently exists among these 35 countries and with the rest of the world.

Conclusion

Our objective for this study was to project the size of financial assets and degree of global financial integration over the next two decades – a challenging task for any organization to undertake. As part of this process, we needed to determine a viable and robust methodology. As such, our unique approach not only builds upon existing academic pursuits, but also contributes to the debate about how to accurately estimate the future impact of emerging markets on worldwide financial assets and the interdependency of global financial markets.

We would like to thank the Economist Intelligence Unit for its collaboration in this significant piece of research regarding an ongoing academic debate.

For more information please contact iibv@us.ibm.com.

Appendix

Our composite index of the sophistication of a country’s financial sector includes the following variables:

		Score					
	Definition and variable scoring methodology	Notes	5.0	4.0	3.0	2.0	1.0
MSTB	Are there institutional/ structural factors in place to attain or sustain a low inflationary environment?	Consider: a highly independent central bank, strong commitment to an IMF program, strong commitment to attaining Maastricht treaty inflation criteria.	Very strong institutional/ structural factors in place	Strong institutional/ structural factors in place	Moderate institutional/ structural factors in place	Weak institutional/ structural factors in place	Very weak institutional/ structural factors in place
IIUS	How advanced is the adoption of indirect instruments of monetary policy?	Direct instruments may include: interest rate controls, credit ceilings, directed credits; indirect instruments may include: reserve requirements, rediscount facilities, open market operations and repo market operations.	Almost exclusive reliance on indirect instruments	Predominant use of indirect instruments	An even mix of indirect and direct instruments	Predominant use of direct instruments	Almost exclusive reliance on direct instruments
FILI	Has the country undergone substantial financial liberalization in the recent past and, if so, is bank supervision adequate?	Note: if country underwent liberalization over ten years ago, answer question for degree of bank supervision. If country has not undergone liberalization, answer question for degree of bank supervision, but score no better than 2.	Yes, and bank supervision is extremely vigilant	Yes, and bank supervision is more than adequate	Yes, and bank supervision is adequate	Yes; the lack of adequate bank supervision is a concern	Yes; the lack of adequate bank supervision is a major concern
BSO	Assess the degree of openness of the banking sector.	Assess the freedom of banks to operate and provide a range of financial services.	Very high (Few or no restrictions on foreign banks; government controls some banks.)	High (Few limits on foreign banks; some limits on financial services)	Moderate (Barriers to new bank formation, significant government influence)	Low (Banks tightly controlled by government)	Very low (Financial institutions in chaos)
FRS	The quality of the financial regulatory system		Very good	Good	Fair	Poor	Very poor

FMD	Assess the degree of distortion in the financial markets.	Consider: interest rate controls, negative interest rates; differential between deposit and lending rates; credit market disruptions.	Real rates consistently low and positive; low differential between deposit and lending rates	Positive real rates, but differential between deposit and lending rates is at least 5%	Single-digit negative real interest rates	Double-digit negative real rates and large deposit-lending rate differentials	Severe disruptions in credit market
FALM	Access of foreigners to the local capital market.		Very good	Good	Fair	Poor	Very poor
MTAF	Companies' access to medium-term finance for investment		Very good (Easy access for the entire range of financial instruments)	Good (Reasonable access, but impaired in at least one category, usually equity finance)	Fair (Access to foreign markets mainly for foreign firms; can tap domestic bank finance)	Poor (Investment mainly self-financed; limited bank finance)	Very poor (Acute shortage of investment finance)
STM	Population set normalized, based on variance from minimum X5	Local stock market capitalization as a percent of GDP (2000-2004)					
IRSP	Population set normalized, based on variance from maximum X5	Average spread between EIU's preferred measure of lending rate and deposit rate.					

Related publications

Dence, Suzanne L., Wendy E. Feller and Daniel W. Latimore. "Get global. Get specialized. Or get out. Unexpected lessons in global financial markets." IBM Institute for Business Value, July 2007.

Dence, Suzanne L., Daniel W. Latimore and John M. White. "The trader is dead, long live the trader: A financial markets renaissance." IBM Institute for Business Value. March 2006.

Dence, Suzanne L., Daniel W. Latimore, Mukund Prasad and John M. White. "Asset managers turning up the heat: Creating differentiated value under uncertainty." IBM Institute for Business Value. August 2005.

Dence, Suzanne L., Daniel W. Latimore, Mukund Prasad and John M. White. "Capturing the sell-side upside: Three steps to focused execution." IBM Institute for Business Value. April 2005.



References

- ¹ Data as defined in a country's financial accounts for a given year based on System of National Accounts methodology and framework. Financial accounts are defined as financial transactions between resident sectors and rest of world. The stocks are measured as currency and deposits, lending, bonds, equities and other. We use financial liabilities as our preferred measure of assets held by others.
- ² For comparability, we used data as defined by: "International Financial Statistics." International Monetary Fund, Statistics Department. March 1, 2001.
- ³ In converting this relationship into a 20-year forecast, we have allowed the two start-of-period terms to vary in two panels, for 2006-2015 and for 2016-2025, to reflect the 10-year sample used for the cross-section and the changing relative position of each economy as its nominal GDP grows and financial sophistication evolves at different rates. Therefore, for 2006-2015, we use 2005's SOPH and TLIBGDPD, and for 2016-2025, we use 2015 values.
- ⁴ Portfolio investment stocks in US\$ as defined in: "International Financial Statistics." International Monetary Fund, Statistics Department. March 1, 2001.

Sources

- Alexander, Craig. "Rates of Return for the Long Haul." TD Financial Group. January 26, 2006. http://www.td.com/economics/special/ca0106_returns.pdf
- Alexander, Craig. "Long-Run Returns for Investment Portfolios." TD Financial Group. April 2002. http://www.td.com/economics/special/ca0106_returns.pdf
- Poterba, James. "The Impact of Population Aging on Financial Markets." National Bureau of Economic Research. October, 2004. <http://www.nber.org/papers/w10851.pdf>
- Reinker, Kenneth S., and Edward Tower. "Predicting Equity Returns for 37 Countries: Tweaking the Gordon Formula." Duke University. July 12, 2002. http://www.econ.duke.edu/Papers/Other/Tower/Equity_Returns.pdf
- Diamond, Peter A. "What Stock Market Returns to Expect for the Future?" Center for Retirement Research. Boston College. September 1999. http://econ-www.mit.edu/faculty/download_pdf.php?id=190
- Neal, Craig R. "Macrofinancial Indicators for 117 Developing and Industrialised Countries." World Bank. March 1990. http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1990/03/01/000009265_3960928221533/Rendered/PDF/multi_page.pdf
- Pain, Nigel. "Financial Liberalization and Foreign Portfolio Investment in the United Kingdom." Oxford Economic Papers. January 1993.
- United Nations National System of Accounts. <http://unstats.un.org/unsd/sna1993/tocLev8.asp?L1=13&L2=2>

© Copyright IBM Corporation 2008

IBM Global Services
Route 100
Somers, NY 10589
U.S.A.

Produced in the United States of America
01-08
All Rights Reserved

IBM and the IBM logo are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both.

Other company, products and service names may be trademarks or service marks of others.

References in this publication to IBM products and services do not imply that IBM intends to make them available in all countries in which IBM operates.